SITE-SPECIFIC STORMWATER MANAGEMENT PLAN (SMP)

WHENUAPAI GREEN

98-100 & 102 Totara Road, Whenuapai

For Private Plan Change

Ver 4 – Rev F – December 24

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Ver. 4	Revised for Private Plan Change application. Rev A – for lodgement 04 April 2024 Rev B – for lodgement 05 August 2024 Rev C – for lodgement 12 August 2024 Rev D – for lodgement 29 October 2024 Rev E – for lodgement 12 November 2024 Rec F – for notification 20 December 2024

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1. CONTENTS

TABLES

FIGURES

EXECUTIVE SUMMARY

This stormwater management plan has been prepared in support of Neil Construction Limited's private plan change application for the proposed Whenuapai Green development. The Plan Change Area (PCA) will be located on existing properties situated at 98-100 and 102 Totara Road, Whenuapai, covering a total area of 16.36 hectares. Currently a lifestyle property, the site comprises primarily pasture and is bordered by McCaw Avenue to the south, Totara Road to the west and northwest, and the NZDF Whenuapai Air Force Base to the east. There are recent housing developments to the south which was developed as part of the Special Housing Area (SHA) programme.

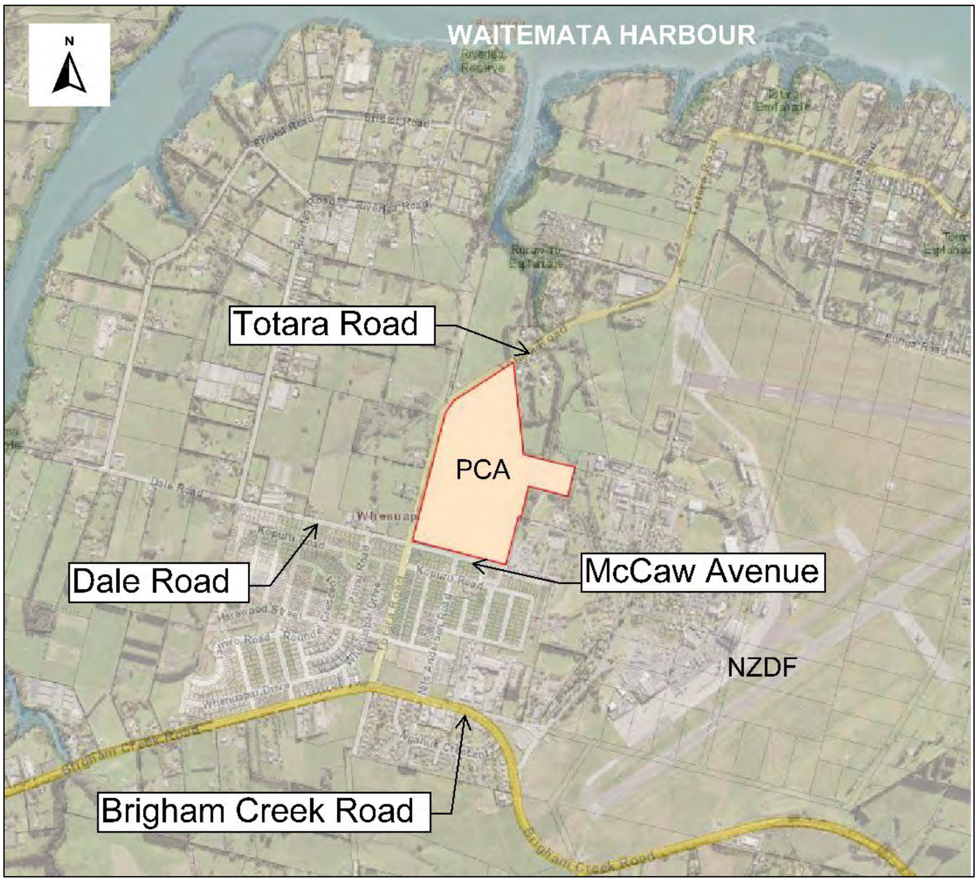

Figure 1: Site Location (Auckland Council GeoMaps)

The site is currently zoned "future urban". The proposed Private Plan Change will provide a change of zoning to "Residential - Mixed Housing – Urban". This will allow for a future development which will allow for an estimated 430 residential dwellings.

The existing and proposed stormwater catchments for the PCA flow into the Ratara Stream to the west of Totara Road and into the Rarawaru Creek to the east. The two streams discharge into the upper reaches of the Waitemata Harbour.

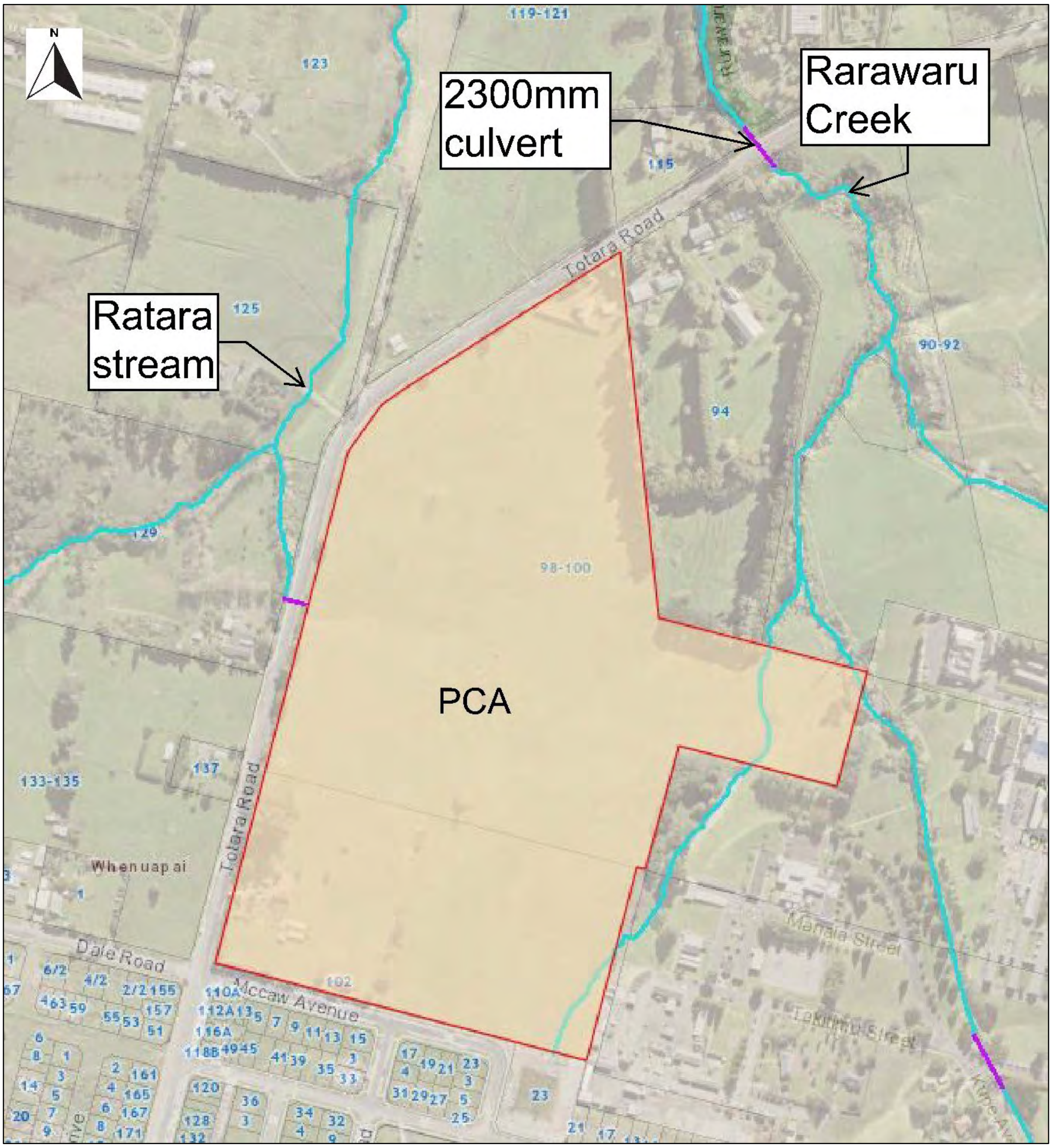

Figure 2: Aerial Photography (2017) and surrounding watercourses (AC GeoMaps)

Diversions and discharges of stormwater through the public network are permitted by the NDC provided that the discharges and network are authorised by a Stormwater Management Plan (SMP). For greenfield development, it is a requirement of the NDC that an SMP is notified with the plan change documents and meets the NDC requirements. The SMP is consistent with NDC Schedule 2 (which set out the NDC's strategic objectives, outcomes, and targets) and Schedule 4 (the performance requirements). This SMP has been prepared to support the private plan change and the plan change is consistent with the SMP. The proposed precinct provisions implement the management and mitigation measures set out on the SMP.

The stormwater management principles and objectives of this PCA will meet the requirements of the Auckland Unitary Plan (AUP) and the Auckland NDC as follows:

- Stormwater Management Area Flow SMAF 1 requirements for those areas which will discharge to streams (unless it can be shown that stream erosion is not increased), including:
    - Retention / internal reuse of the first 5mm of runoff from new impervious areas.
    - Detention of runoff from the 95th percentile rainfall event with controlled release over 24 hours to prevent stream erosion.
- Water quality treatment of runoff for the 90th percentile rainfall event from all new impervious areas (excluding inert roofing and pervious pavement), but including impervious pavement and high contaminate generating activities, namely high use roads and carparks.
- A piped stormwater network with capacity to convey the 10% AEP[1] rainfall event.
- Attenuation of stormwater flood flows for the 10% AEP rainfall event to pre-development flows.
- Full or partial attenuation of stormwater flood flows for the 1% AEP rainfall event to prevent flooding of downstream habitable floors of houses and minimise flooding of properties.

It is intended that once approved, this Stormwater Management Plan will be adopted under Schedule 10 of the NDC.

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[1] The probability of exceeding a given threshold within a period of one year. For example, in relation to flooding, 1% AEP flood plain is the area that would be inundated in a storm event of a scale that has a 1% or greater probability of occurring in 1 year. **Auckland Unitary Plan – J1. Definitions.**

1 EXISTING SITE APPRAISAL

1.1 Summary of data sources and dates

Table 1 - Summary of Data Source

Existing site appraisal item	Source and date of data used
Topography	• Neil Construction Ltd Topographical Survey. • Auckland Council GIS LIDAR (2016-2018)
Geotechnical / soil conditions	• CMW Preliminary Geotechnical Assessments 18 May 2018 & 16 August 2019 • CMW Geotechnical Investigation Report AKL2018-0085AF rev 1- 7 Dec 2022 • CMW – Geotechnical RFI 24 June 2024
Existing stormwater network	• Auckland Council GeoMaps Data • Neil Construction Ltd Topographical Survey.
Existing hydrological features	• Auckland Council GeoMaps Data • Bioresearches – Watercourse Classification, 9 Nov 2020 • Bioresearches – 98, & 100-102 Totara Road, Whenuapai – Wetland Assessment,17 Nov 2021 • Cato Bolam – Survey of Stream Beds 1 July 2022. • Viridis – Ecological Impact Assessment February 2024
Stream, river, coastal erosion	• Auckland Council GeoMaps Data
Flooding and flowpaths	• Bioresearches – Watercourse Classification 9 Nov 2020 • Auckland Council GeoMaps Data • AECOM Memorandum Whenuapai Rapid Flood Hazard Assessment 03 Jun 2016 and Auckland Council Whenuapai RFHA Model Update Memo 01 Sept 2023 (Model ID 1399). • Whenuapai 2 Stormwater Management Plan, March 2016.
Coastal Inundation	• Auckland Council GeoMaps Data

Existing site appraisal item	Source and date of data used
Ecological / environmental areas	• Geosciences Ltd Environmental Due Diligence Investigation 24 Sept 2019 • Viridis – Ecological Impact Assessment February 2024 • Viridis – RFI Response, Ecology 3 July 2024
Cultural and heritage sites	• Clough & Associates Ltd Archaeological Assessment October 2023. • Te Kawarau Iwi Tiaki Trust - Cultural Impact Assessment Sept 2021
Contaminated land	• Geosciences Ltd Preliminary Site Investigation of 98-100 Totara Road, Whenuapai (Revised 10 Nov 2021). • Geosciences Ltd Preliminary Site Investigation of 102 Totara Road, Whenuapai (Revised 10 Nov 2021).

1.2 Location and general information

The PCA is located on existing properties at 98-100 and 102 Totara Road, Whenuapai and occupies a total area of 16.36 hectares. It is currently predominantly in pasture, contains three residential dwellings and is used as a lifestyle property. McCaw Avenue is on the southern boundary of the site, Totara Road to the west and northwest and the NZDF Whenuapai Air Force Base is to the east. There are recent new housing developments to the south of the site and a private residence (94 Totara Road) to the north-east.

Table 2 – Summary of Property Information

Existing site element	
Site address	• 98-100 & 102 Totara Road, Whenuapai
Legal description	• Lot 2 DP81411, Lot 1 DP53062
Current Land Use	• Rural lifestyle
Current building coverage	• 3 dwellings with garages, outbuildings. Total area is approximately 800m2.
Historical Land Use	• Farming

1.3 Topography

The PCA is of irregular shape and currently consists of relatively flat undeveloped farmlands which generally slopes from south to north, falling from RL25m to RL16m over a 600m distance. The overall slope is 1.5 percent, although it increases where the land slopes towards the western boundary in the middle of the site. In the eastern “panhandle” there are steeper slopes that fall to tributaries of the Rarawaru Creek which run through this area.

1.4 Geotechnical

CMW Geosciences have prepared a Geotechnical Investigation Report[2] which confirms that the PCA will be generally suitable for residential development and provides parameters for the design of site works.

Based on the investigation results, the site is underlain by Puketoka Formation alluvial deposits, with Waitemata Group deposits encountered beneath the alluvium. Groundwater was encountered across the site between 0.7m and 4.0m depth below existing ground level.

A geotechnical assessment of the site in respect of the proposed development is summarised as follows:

- The site is located in a low seismicity region with the nearest active fault (Wairoa North Fault) located approximately 42 kilometres south-east of the site. The risk of fault rupture induced damage is considered ‘low’.
- Due to the geological age and soil fabric of the soils encountered, liquefaction is low risk for the proposed works.
- The Puketoka Formation soils underlying the site are generally of a stiff to very stiff consistency and unlikely to undergo large static settlements when subject to typical residential development loads.

  Notwithstanding this, any localised soft spots and/ or isolated pockets of weak alluvial deposits that may be encountered during earthworks can be over excavated and replaced with engineered fill or reworked to minimise the risk of potential differential settlements and reduced bearing capacities.
- With reference to AS2870 and BRANZ Report SR120A, the preliminary expansive site class for this development has been assessed as M (moderately reactive soils).
- Generally, the site is near flat with discrete areas of sloping ground near stream banks. As such global stability has been classified as low risk.
- With reference to NZS1170.5:2004, the subject site has been assessed as Class C – Shallow Soils.
- The subsoils encountered beneath the site are considered suitable to be able to support up to 300kPa geotechnical ultimate bearing pressures from conventional NZS 3604 type structures.

A copy of the CMW Geotechnical Investigation Report is included in Appendix C

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[2] CMW Geosciences. (2022, December 07). Whenuapai Green Development 98-102 Totara Road, Whenuapai Geotechnical Investigation Report. AKL2018-0085AF Rev 1. Auckland: CWM Geosciences.

1.5 Existing drainage features and stormwater infrastructure

There is no existing public stormwater network within the plan change area, but there are several small culverts under Totara Road plus an existing 2300mm diameter road culvert to the northeast. The recent SHA development to the south of the site has a public stormwater network, including a detention pond, which discharges into the south-eastern corner of the PCA.

1.6 Receiving environment

Downstream of the 2300mm diameter culvert under Totara Road, the Rarawaru Creek connects to the upper tidal reaches of the Waitemata Harbour. This area is shown in the Auckland Unitary Plan as a Significant Ecological Area – Marine 2. Auckland Council GeoMaps Data shows this area to include an Ecosystem Code of SA1.2 and 'being mangrove forest and scrub in an estuarine hydrosystem'.

The Ratara Stream to the west of the site also connects with the upper tidal reaches of the Waitemata Harbour approximately 400m downstream of the Totara Road culvert.

1.7 Existing hydrological features

Auckland Council GeoMaps Data and the (Viridis Environmental Consultants, Ecological Impact Assessment 2024) provide information on the existing drainage features and stormwater infrastructure. Rarawaru Creek is located on the eastern side of the PCA and Ratara Stream on the western side, although tributaries are unnamed, along with overland flow paths and flood plains within and adjacent to the PCA. Note that the overland flow paths and flood plains from GeoMaps are based on modelled flows from the Maximum Probable Development (MPD – 80% impervious) of the entire catchment with allowance for climate change. The climate change allowance was updated to 3.8° Celsius in September 2023.

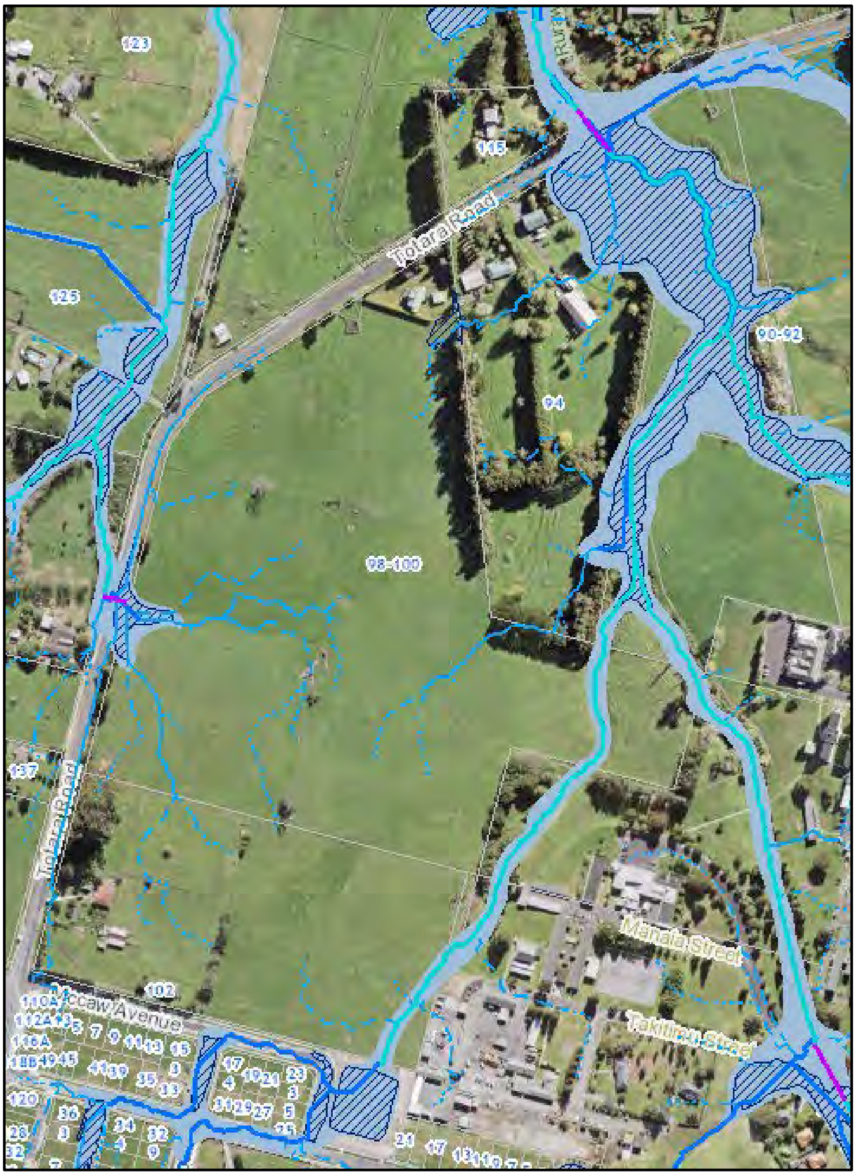


Figure 3: Overland Flow Paths and Flood Plains (Auckland Council GeoMaps 3.8°C increase due to climate change)

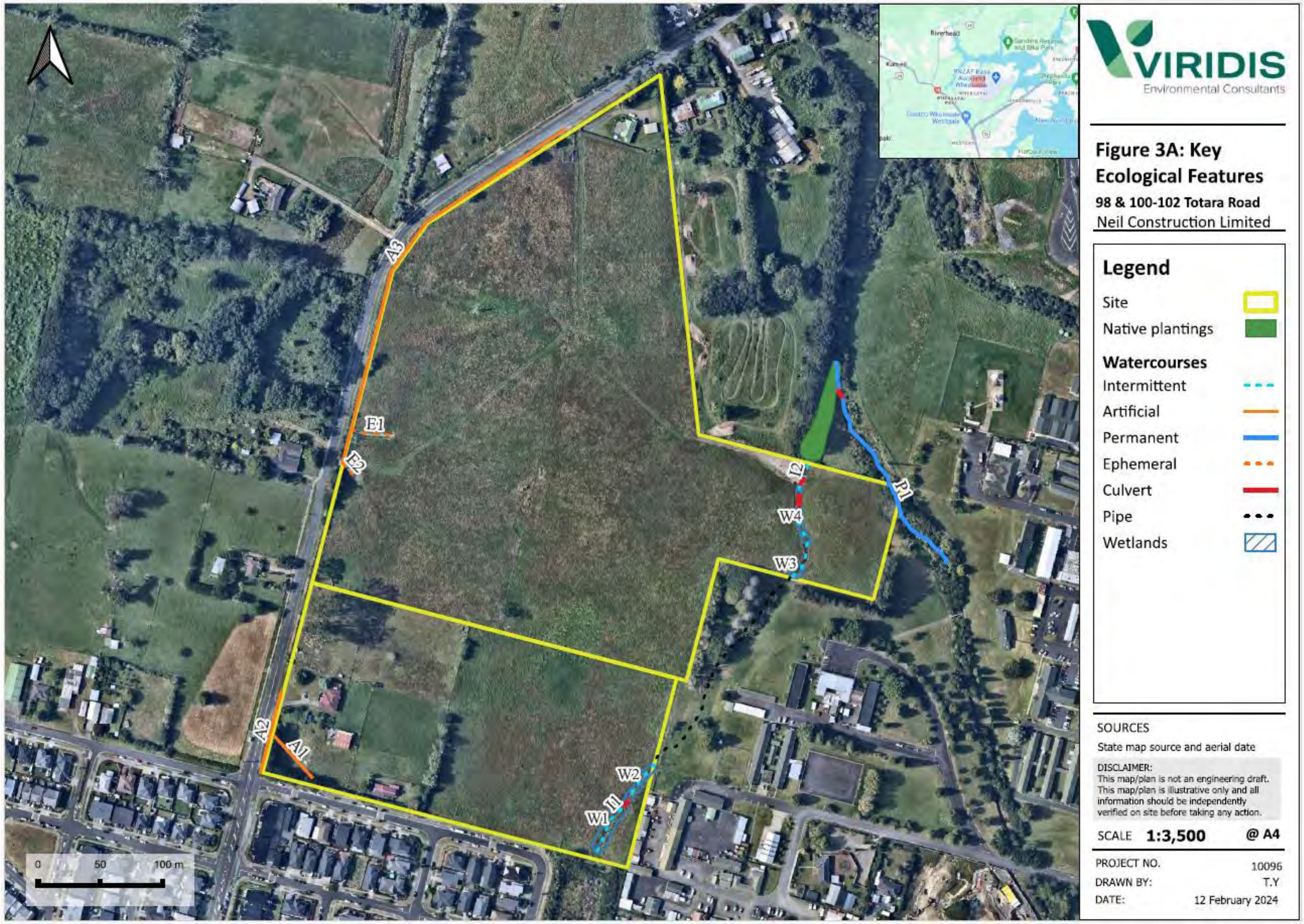


Figure 4: Viridis Figure 3A: Key Ecological Features 98 and 100-102 Totara Road

Drainage on the existing site is primarily by way of overland flow paths conforming to the natural contours of the PCA. The western side of the PCA flows are by way of several minor overland flow paths, including ephemeral overland flow paths (labelled “E.1 and E.2 on Figure 4) and the table drains beside Totara Road. These combine at a low point adjacent to the western boundary which is beside a sag point in Totara Road. There is an existing 450mm diameter stormwater culvert beneath the road carriageway. The culvert discharges into a stream / overland flow path on the western side of Totara Road which is a tributary of the Ratara Stream.

On the eastern side of the PCA there is an intermittent stream (labelled ‘I1’ on Figure 4) which originates from a stormwater detention basin at the end of McCaw Road that serves a housing development immediately to the south of the site. This flows through the south-eastern corner of the PCA before going into the neighbouring NZDF airbase where it is piped. It emerges again (labelled ‘B’ on Figure 4) to flow through the eastern “panhandle” of the PCA, before again re-entering NZDF land.

Several smaller overland flow paths from the eastern part of the PCA also flow to this stream, some by way of the neighbouring property at 94 Totara Road.

All these overland flow paths and streams discharge into the Rarawaru Creek that then flows through a 2300mm diameter culvert under Totara Road approximately 140m from the north-eastern corner of the PCA. The culvert outlet has been surveyed as having an invert level of RL1.41m. This level is similar to the existing Mean High Water Springs (MHWS) tide level of RL 1.39 and below the predicted constant tidal boundary condition of RL 2.89m used by the updated (Auckland Council RFHA model ID 1399, 2023).

The (Viridis Environmental Consultants Ecological Impact Statement, 2024) report shows the nature of watercourses on the property and the report includes the following summary:

> “The existing terrestrial and freshwater ecological values of the site have been identified and assessed. It is considered the PPC is appropriate for the area from an ecological perspective and can protect and enhance the indigenous biodiversity values of the site in accordance with the outcomes of relevant plans and policy documents while providing for efficient development.
> Overall, it is considered that the proposed PPC can effectively manage any adverse effects of residential development on the natural environment through the existing planning provisions and policy framework within the AUP-OP. Any potential adverse effects can be adequately mitigated through appropriate stormwater design, fauna management plans, restoration and riparian planting, and detailed design.”

Included in the Ecological Impact Assessment, Viridis have also addressed the Freshwater Ecology to provide a more detailed assessment of potential wetlands within the site.

In summary, Intermittent Watercourses I1 and I2 contained wetlands W1, W2, W3 and W4 (See Figure 4) and were considered “natural wetlands” as per the NPS-FM.

Cato Bolam Consultants Ltd were engaged to survey the existing streams and investigate their Esplanade Qualifying status (Ref 46739 7 July 2022).

Therefore, the watercourses are not qualifying in terms of the requirements for the vesting of Esplanade Reserve under section 230 of the Resource Management Act 1991.

Watercourses I1, I2 and P1 will have riparian margins of 10m each side as required by the Auckland Council Unitary Plan – E3 Lakes, rivers, streams and wetlands. These will be planted using native species.

The following reports are included in the full plan change application package:

- Viridis, Ecological Impact Assessment: Key Ecological Features 98 and 100-102 Totara Road
- Viridis – RFI Response, Ecology 3 July 2024
- Cato Bolam Consultants report on existing stream beds (Ref 46739 7 July 2022).

1.8 Flooding and flowpaths

Auckland Council GeoMaps does not show the *existing* areas of flooding but does show predicted future flood plains and flood prone areas, along with overland flow paths for the site. These areas have been established by modelling the 1% AEP rainfall event (Maximum Probable Development (MPD) - 80% impervious) and 3.8 degrees climate change scenario using 2016 LiDAR data. Refer to AECOM Memorandum Whenuapai Rapid Flood Hazard Assessment 03 Jun 2016 and Auckland Council Memo Whenuapai RFHA Model Update 1 September 2023 for details.

Existing overland flow paths on the western side of the PCA combine to discharge from the site through a 450mm diameter culvert under Totara Road which in turn discharges into the upper end of a tributary of the Ratara Stream. On the eastern side of the PCA, several small overland flow paths discharge to the Rarawaru Creek or tributaries.

The extent of flooding is confined to areas adjacent to the existing streams and overland flow paths through the PCA. This is primarily a small area on the western side of the PCA where flows leave the site by way of the existing culvert.

GeoMaps also shows flooding of Totara Road itself on the western side of the site adjacent to 129 Totara Road, where there is a sag in the road, along with flooded areas on the properties at 125 & 129 Totara Road where driveways and farm tracks cross the stream.

To the northeast of the site there is a larger area of flooding behind the Totara Road embankment across the Rarawaru Creek where there is an existing 2300mm diameter culvert. The culvert would be assumed to be fully blocked.

Additional modelling by NCL using HEC-RAS software has confirmed the flooding extents for the MPD flows with climate change as shown on GeoMaps and considers various scenarios to establish the impact of development of the PCA on flood levels, including on-site attenuation in the SW basins. Based on the flood modelling outcomes, it is reasonable to conclude that there is no potential increase in flood hazard to existing buildings downstream of the Whenuapai Green development.

For full details of the NCL analysis see Appendix B for the "Hydraulic Modelling Report – Whenuapai Green (revision 2) 24/06/2024".

1.9 Coastal inundation

While the AUP OIP Coastal Inundation 1 percent AEP plus 1m Control applies to the downstream receiving environment, it does not extend to the PCA which is well above coastal inundation levels. The minimum proposed site level varies between RL16m and RL25m, meaning the site itself is not at risk from coastal inundation.

The Whenuapai RFHA Model Update has assumed a constant tidal boundary condition of 2.89mRL (Auckland Vertical Datum).

1.10 Biodiversity

The Auckland Unitary Plan Geomaps Significant Ecological Area (SEA) overlay shows there are no SEA's within the site, however there is a 'Marine 2' overlay applied to the downstream receiving environment of the Rarawaru Creek to the north of Totara Road.

The site itself is mainly covered in pasture that has been used for cattle grazing and has low biodiversity value.

The Ecological Impact Assessment prepared by Viridis addresses the ecology in the vicinity of the streams and overland flow paths and states that the riparian yard and channel banks are dominated by terrestrial exotic pasture grass. This also included an assessment of wetlands, identifying wetlands W1 and W2 on intermittent stream I1 and W2 and W4 on intermittent stream I2.

1.11 Cultural and heritage sites

Te Kawerau ā Maki was engaged to prepare a Cultural Impact Assessment for a residential fast track housing development within the PCA in 2021. The Cultural Impact Assessment (September 2021) provided a map which depicted some of the key cultural sites within the area:

Figure 5: Surrounding cultural and heritage sites.

The map indicates that the Rarawaru Creek is a key cultural area. For Te Kawerau ā Maki the entire Whenuapai and Upper Harbour area is a cultural landscape, embedded with identity, meaning, and significance. The character and integrity of the whole is made up of its constituent parts, such as the harbour, the various awa/river and streams, and the historic pā and kāinga (and their gardens) located along the coastline.

The Conclusion of the report dated September 2021 states:

> *'The proposal is to develop 16.36ha into several hundred residential lots, roading and other infrastructure, amenities, and potentially a school catering for up to 1200 children. The site sits on relatively productive soils within a cultural landscape focused on coastal settlements and resource extraction around the upper Waitematā harbour. The site is in very close proximity to Te Rarawaru historic kāinga site and the Rarawaru, Waionoke, and Ratara streams. A total of five impacts are noted in relation to the development (not including individual potential animal impacts which are not covered in this report), most of which could be minor to moderate beneficial (one would be negligible adverse) if mitigations discussed are incorporated, which would be a net benefit from a cultural perspective. Without mitigation minor (but not less than minor) adverse cultural effects would occur. Mitigations include a mixture of stream restoration, native planting, stormwater treatment, and place-naming/interpretation.'*

Consultation with all mana whenua groups has been undertaken for this PPC. Of the Mana Whenua groups, responses from Ngāti Manuhiri (deferred to Te Kawerau ā Maki) and Te Kawerau ā Maki were received. .Te Kawerau ā Maki indicated that it would not propose a new CIA report as the content for the resource consent can be repurposed to the PPC, however Te Kawerau ā Maki would like to engage in the precinct provisions and context section to ensure the precinct includes a robust and agreed cultural context. No response has been received from any other Mana Whenua. The applicant is committed to ongoing collaboration with Mana Whenua and will continue to engage through the PPC process.

The archaeological assessment provided by Clough & Associates Ltd 2023 show that there are no recorded archaeological sites within 1km of the proposed PCA.

There are three recorded historic heritage structures on the Auckland Council CHI within 500m of the PCA, two of which are scheduled on the AUP OP. These are the RNZAF Bristol Block Barracks (AUP OP Schedule 14.1 ID 00231, CHI 12878); the RNZAF Officers' Mess (AUP OP Schedule 14.1 ID 00232, CHI 12879) and a historic dwelling (CHI 3431). However, the latter has been demolished.

The Cultural and Heritage layer on Auckland Council GeoMaps shows that the scheduled extent of place of the RNZAF Officers' Mess (ID 00232) extends marginally into the proposed plan change area. Future development enabled by the proposed plan change will not affect any physical remains relating to the RNZAF Officers' Mess, which would all be contained within the Ministry of Defence property.

The Conclusions to the report include the following statement:

> *'no archaeological sites have been identified within the property boundaries and the potential for any unidentified subsurface remains to be exposed during development is very low.'*

1.12 Contaminated land

Refer to the following reports included separately with the PPC application:

Geosciences Ltd has conducted preliminary site investigations (PSI) of the sites for the proposed development and two reports have been prepared by as follows:

Geosciences Ltd – Preliminary Site Investigation of 98-100 Totara Road, Whenuapai – 9 May 2018 (revised 10 November 2021).

The following is a summary of the report findings:

> This investigation has identified potential sources of contamination on site to be the discrete area surrounding the existing residential dwelling in the northern portion of the site. Due to the age of the dwelling which was relocated onto the site in the 1990s, GSL considers that the following potential sources of contamination will require further investigation should any change in landuse, subdivision, or development works be proposed in that area:
>
> · Historical use of lead based paints; and
>
> · Potentially asbestos containing building materials utilised in the residential dwelling and garage on site.
>
> Additionally, plans held within the property file identify the location of the onsite domestic waste water treatment systems (septic tank and effluent disposal field), which Auckland Council have considered to be encompassed by Items G.5 and G.6 on the MfE HAIL. GSL concludes that should any change in landuse, subdivision, or development of that portion of the land be proposed, then these small scale, localised points will require further investigation and likely require localised remedial works.
>
> With regards to the wider site area, GSL did not identify any evidence for any potentially contaminating activity included on the MfE Hazardous Activities and Industries List having been undertaken on the site. GSL therefore concludes that the risk for actual or potential contamination on the site to be low, and concludes that with

respect to the wider site area that any future change in land use, subdivision, or development would be highly unlikely to result in a risk to human health or the environment.

Geosciences Ltd – Environmental Due Diligence Investigation of 102 Totara Road, Whenuapai – 24 September 2019.

The following is a summary of the report findings:

> This investigation has identified potential sources of contamination on site to be the discrete area surrounding the original 1960's residential dwelling and former shed locations along the northern site boundary. Due to the age of the original dwelling, which was constructed in 1969, GSL considers that the following potential sources of contamination will require further investigation should any change in landuse, subdivision, or development works be proposed in that area:
>
> - Historical use of lead based paints; and
> - Potentially asbestos containing building materials utilised in the residential dwellings and sheds on site.
>
> Additionally, plans held within the property file identify the location of the onsite domestic wastewater treatment systems (septic tank and effluent disposal field) associated with the two residential dwellings, which Auckland Council have considered to be encompassed by Items G.5 and G.6 on the MfE HAIL. GSL concludes that should any change in land use, subdivision, or development of that portion of the land be proposed, then these small scale, localised points will require further investigation and likely require localised remedial works.
>
> With regards to the wider site area, outside of the commentary above, GSL did not identify any evidence for any potentially contaminating activity included on the MfE Hazardous Activities and Industries List having been undertaken on the site. GSL therefore concludes that the risk for actual or potential contamination on the site to be low and concludes that with respect to the wider site area that any future change in landuse, subdivision, or development would be highly unlikely to result in a risk to human health or the environment.

Geosciences Ltd – Site Management Plan (SMP) 98-102 Totara Road, Whenuapai, 29 November 2021

Geosciences Ltd have also prepared a Site Management Plan, which is also included with the plan change application, for dealing with any contaminants.

The following is a summary of the SMP:

> This site-specific management plan (SMP) provides procedures for the handling of potentially contaminated excavated soil material because of the proposed development at 98-102 Totara Road, Whenuapai (Figure 1). It is to be submitted to Auckland Council for approval before works commence on site.
>
> The practices and procedures in this plan are intended to ensure that health, safety, and environmental risks associated with the proposed earthworks activities at 98-102 Totara Road are managed to an acceptably low level. It is not intended that this SMP should replace the contractor's site-specific health and safety plan or earthworks and sediment control plan but should be enacted in conjunction with these documents.

Copies of the Geosciences reports are included in the Appendix C

2 DEVELOPMENT SUMMARY AND PLANNING CONTEXT

2.1 Regulatory and design requirements

Table 3: Regulatory and design requirements

Requirement	Relevant regulatory / design to follow
Unitary Plan – SMAF hydrology mitigation	• The PCA is not currently within a SMAF zone in the AUP Controls; however, SMAF 1 requirements will be applied where applicable. • The SMAF 1 hydrological mitigation requirements given in AUP Table 10.6.3.1.1 for discharge to streams are as follows: - Retention (volume reduction) of at least 5 mm of runoff depth from new impervious surfaces. - Detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff from impervious surfaces in the 95th percentile 24-hour rainfall event minus retention volume.
High Contaminant Generating Areas	• AUP E9 – High contaminant generating car parks and high use roads.
Natural Hazards	• Overland flow paths, with flooding occurring in identified flood prone areas.
Auckland Unitary Plan Precinct	• Currently not applicable, but a new Precinct will be applied when the Plan Change is approved.
Existing Catchment Management Plan	• Whenuapai 2 Stormwater Management Plan 2016, which was prepared for the development immediately to the south of the site. Part of the proposed Whenuapai Green development site is downstream but included within the same overall catchment. • Healthy Waters have previously accepted that the Whenuapai 2 SMP requirements can be applied to Whenuapai Green.
Auckland Council Regionwide Network Discharge Consent	• Although it is currently outside the area covered by the NDC, using the same requirements the PCA would be classified as a "Greenfields" site (future urban). • SMAF 1 requirements to be applied where applicable. • Schedule 4 requires water quality treatment of the stormwater runoff for the 90th percentile rainfall event for all new impervious areas. • It is intended that this SMP once approved be adopted under Schedule 10 of the NDC.

This SMP has been prepared in accordance with the Auckland Council Regional Stormwater Network Discharge Consent. However, if this approach is not accepted by Council, the alternative approach would be to apply for a private stormwater discharge consent instead. Similar stormwater management requirements would apply to this situation as for the NDC SMP approach. Hence, the design principles adopted here apply to both situations. Stormwater management requirements are listed in section 6.2.

3 MANA WHENUA MATTERS

3.1 Identification and incorporation of mana whenua values

The applicant has contacted the following mana whenua groups that are identified as Mana Whenua in the area where the PPC land is located:

- Te Kawerau ā Maki
- Ngāti Manuhiri
- Ngāti Maru
- •Ngāti Te Ata
- Ngāti Whātua o Kaipara
- Ngāti Whātua o Ōrākei Trust Board
- Te Rūnanga o Ngāti Whātua
- Te Ākitai Waiohua
- Ngāti Paoa

Of the above Mana Whenua groups, responses from Ngāti Manuhiri (deferred to Te Kawerau ā Maki) and Te Kawerau ā Maki were received. Te Kawerau ā Maki indicated that it would not propose a new CIA report as the content for the resource consent can be repurposed to the PPC, however Te Kawerau ā Maki would like to engage in the precinct provisions and context section to ensure the precinct includes a robust and agreed cultural context. No response has been received from any other Mana Whenua.. The applicant will continue to engage with mana whenua throughout the PPC process.

The proposed design is formulated in compliance with the recommendations in Auckland Council Guidance Documents GD01 and GD04 to incorporate mana whenua values. *The revival and enhancement of mauri will be a focus during the design and construction phases through:*

- Providing hydrologic mitigation to reduce run off from extensive impervious areas.

- A riparian margin will be created with a 10m set back from the top bank of the stream and restored with native riparian planting 10m wide either side of stream.
- Provide treatment to the runoff from the roads.
- Restoring a buffer of native vegetation along the waterways

As part of the Whenuapai Green Fast-track application for this site, Te Kawerau ā Maki provided a CIA for the residential development on land that now forms the PCA. Whilst the CIA was prepared for a resource consent, NCL acknowledges the knowledge shared in relation to potential cultural impacts and Te Kawerau ā Maki has confirmed that this is also relevant for the PPC. The mitigation proposed through the fast-track process has been upheld and incorporated, as far as practicable, through precinct provisions. This is summarised below:

Name	**Summary of Impact**	**Proposed Mitigation**
Waitematā Harbour	Direct adverse from stormwater discharge carrying sediments and contaminants; indirect adverse from extra vehicles on impervious surfaces; cumulative adverse from net contaminant loading of the harbour; potential combined beneficial impact if stream restoration works undertaken and robust stormwater systems in place	Undertaking stream and wetland protection and restoration works within the property footprint, employ a 100% native vegetation palate for all street planting/public spaces, and will install a mixture of tree pits, vegetated swales, rain gardens, and retention/ detention tanks, all to GD01 requirements, for stormwater treatment
Te Rawawaru / Waionoke Stream	Direct adverse from stormwater discharge carrying sediments and contaminants; indirect adverse from extra vehicles on impervious surfaces; potential combined beneficial impact if stream restoration works undertaken and robust stormwater systems in place	Stream restoration works within the property footprint, employ a 100% native vegetation palate for all street planting/public spaces, and will install a mixture of tree pits, vegetated swales, rain gardens, and retention/ detention tanks, all to GD01 requirements, for stormwater treatment
Ratara Stream	direct adverse from stormwater discharge carrying sediments and contaminants; indirect adverse from extra vehicles on	Stream restoration works within the property footprint, employ a 100% native vegetation palate

Name	Summary of Impact	Proposed Mitigation
Ratara Stream	impervious surfaces; potential combined beneficial impact if stream restoration works undertaken and robust stormwater systems in place	for all street planting/public spaces, and will install a mixture of tree pits, vegetated swales, rain gardens, and retention/ detention tanks, all to GD01 requirements, for stormwater treatment

A copy of the Cultural Impact Assessment is included with the plan change application.

4 STAKEHOLDER ENGAGEMENT AND CONSULTATION

Table 4: Stakeholder Engagement and Consultation

Stakeholders	What is the reason for interest?	What engagement has been completed?	Feedback and response
New Zealand Defence Force	Neighbour to east of PCA.	Previous Covid 19 Recovery Act (FTCA) application: Memorandum provided to NZDF outlining the proposed stormwater management on the site. 9 Oct 23 Private Plan Change Consultation letter sent to NZDF. 21/12/23 Request for meeting. Included Draft Precinct Plan 22.12.23, Draft NZDF Precinct provisions. 30/01/24 Meeting held with NZDF. 31/01/24 Summary of meeting sent to NZDF.	NZDF provided draft conditions in relation to stormwater: ● No standing water ● Dry ponds to empty within 48 hours of end of 2% AEP storm event. ● No platforms which may allow perching sites for birds. ● 22/02/24 NZDF response noting that some feedback to come.
Healthy Waters	Stormwater management.	An initial draft stormwater management plan was submitted with the application for consideration of the development under for Covid-19 Recovery Act. Oct 22 Draft SMP was sent to Healthy Waters for comment. Comments received from Danny Curtis 19 Oct 22. Meeting held 3 Nov. and further comments received email of 7 Nov 22. SMP Ver2 submitted for consent under FTCA.	Initial feedback from Katja Huls, Healthy Waters dated 08/12/21: The stormwater management proposed is generally aligned with the requirements of Schedules 2 and 4 of the Region-wide NDC. The site is downstream of the Whenuapai 2 SHA area which has a draft Stormwater Management Plan (SMP). The applicant should develop in accordance with this SMP. Healthy Waters (Danny Curtis) have accepted that the Whenuapai 2 SMP requirements can be applied. Response from Healthy Waters (Hillary Johnston) 15/05/23.

Stakeholders	What is the reason for interest?	What engagement has been completed?	Feedback and response
		FTCA Consent refused. NCL to apply for Private Plan Change. Commenced preparation of draft SMP Version 4. Emails 31/11, 08/11 and 20/11/23 to Healthy Waters requesting clarification of 3.8ºCC and water quality treatment of minor roads. Email 19/12 to HW (Susan Andrews) again requesting clarification of the above items. Letter 10 June 2024 Further information requested under clause 23 schedule 1 of the RMA	Response received from HW (Susan Andrews) email 27/11/23 requesting NCL send a draft SMP for review. No clarification received from HW concerning 3.8ºCC and water quality treatment of minor roads. Again, no response received from HW. NCL proceeding with draft SMP Ver 4. NCL reply to HW Cl 23 request July 2024. Draft SMP Ver 4 Rev B July 2024.
Auckland Transport	Upgrading on Totara Road. New road connections with Totara Road	Previous FTCA application: Various correspondence with Auckland Transport by consultants Dave Smith of Abley Transportation and Eric Hebner of Team Traffic. 09/10/23 Private Plan Change Consultation letter sent to AT, incl. meeting request. 30/10/23 Email from Abley requesting further discussion with Auckland Forecasting Centre (AFC) On-going correspondence with AFC.	Integrated Traffic Assessment prepared by Abley. Upgrade requirements for Totara Road confirmed, including use of raingardens for water quality treatment. New road connections confirmed. Intersection layouts and controls confirmed. 13/11/23 AT busy, appointing a traffic consultant.
Supporting Growth Auckland (SGA)	Various	09/10/23 Private Plan Change Consultation letter sent to SGA, incl. meeting request.	No response.
Watercare Services Ltd	Wastewater network including pump station.	Previous FTCA application: Several meetings have been held with Lars Fog, Program Lead, Major Projects, Watercare.	Wastewater is to be drained northwards by gravity to a proposed pump station at the end of McKean Road which will ultimately also serve other future development sites in the area. Wastewater will be pumped southwards along Totara Road to Brigham Creek

Stakeholders	What is the reason for interest?	What engagement has been completed?	Feedback and response
		09/10/23 Private Plan Change Consultation letter sent to WSL, incl. meeting request.	Road, where a new gravity main will be constructed down to the proposed Watercare "Slaughterhouse" pump station.
Auckland Council Parks and Open Space.	Reserves, etc.	09/10/23 Private Plan Change Consultation letter sent, incl. meeting request.	10/10/23 Will make contact on Roja's return from leave. No subsequent response.
Te Kawarau a Maki	Manu Whenua	10/02/23 Private Plan Change introduction letter sent. 22/12/23 Consultation request follow-up – provided draft Precinct Plan 27/3/23 Consultation follow up	27/3/23 Response received from Edward Ashby. The CIA can be repurposed for the PPC. TKaM wish to engage on the precinct provisions to ensure they achieve a robust and agreed cultural context
Ngati Manuhiri	Manu Whenua	10/02/23 Private Plan Change introduction letter sent. 22/12/23 Consultation request follow-up – provided draft Precinct Plan	10/03/24 Response - In this instance we would tautoko our whananga hapu with interests in this area. Due to resourcing constraints we tautoko our whananga and their mahi on this Kaupapa.
Ngati Maru	Manu Whenua	10/02/23 Private Plan Change introduction letter sent. 22/12/23 Consultation request follow-up – provided draft Precinct Plan	. No response.
Ngati Paoa Iwi Trust and Trust Board	Manu Whenua	10/02/23 Private Plan Change introduction letter sent. 22/12/23 Consultation request follow-up – provided draft Precinct Plan.	No response.
Ngati Te Ata	Manu Whenua	10/02/23 Private Plan Change introduction letter sent. 22/12/23 Consultation request follow-up – provided draft Precinct Plan.	No response.
Ngati Whatua o Kaipara	Manu Whenua	10/02/23 Private Plan Change introduction letter sent. 22/12/23 Consultation request follow-up – provided draft Precinct Plan.	No response.
Ngati Whatua Orakei Trust Board	Manu Whenua	10/02/23 Private Plan Change introduction letter sent. 22/12/23 Consultation request follow-up – provided draft Precinct Plan.	No response.
Te Runanga o Ngati Whatua	Manu Whenua	10/02/23 Private Plan Change introduction letter sent. 22/12/23 Consultation request follow-up – provided draft Precinct Plan.	No response.

Stakeholders	What is the reason for interest?	What engagement has been completed?	Feedback and response
Te Akitai Waiohua	Manu Whenua	10/02/23 Private Plan Change introduction letter sent. 22/12/23 Consultation request follow-up – provided draft Precinct Plan.	No response.
Neighbours 1 McCaw Avenue 3 McCaw Avenue 5 McCaw Avenue 7 McCaw Avenue 9 McCaw Avenue 11 McCaw Avenue 13 McCaw Avenue 15 McCaw Avenue 17 McCaw Avenue 19 McCaw Avenue 21 McCaw Avenue 23 McCaw Avenue 110A Totara Road 137 Totara Road 125-127 Totara Road 123 Totara Road 119-121 Totara Road 115-117 Totara Road 94-96 Totara Road 113 Totara Road		Neighbour Consultation Letters sent as part of FTCA application. Some responses received. Private Plan Change initiated - consent now to be notified.	

5 PROPOSED DEVELOPMENT

5.1 General development information

The proposal for the PCA will change the current zoning from “Future Urban” to “Residential – Mixed Housing Urban”. This will allow resource consents to be submitted for the subdivision and development of the land.

5.2 Location and area

The PCA is located on existing properties at 98-100 and 102 Totara Road, Whenuapai and occupies a total area of 16.37 hectares. McCaw Avenue is on the southern boundary of the site, Totara Road to the west and northwest and the NZDF Whenuapai Air Force Base to the east. Refer to Figure 1: Site Location Plan.

5.3 Purpose of the development

The plan change application seeks to rezone 16.37 hectares of land from Future Urban to Residential – Mixed Housing Urban. The plan change further seeks to apply precinct provisions to facilitate the transition from semi-rural land uses to the development of residential housing in an integrated and comprehensive manner.

The PCA is expected to yield approximately 430 residential houses including terrace units, duplex units, and standalone houses. The total developable area is approximately 15.87 hectares.

This SMP has been developed in support of the Private Plan Change application. Information presented in this section will, therefore, be generalised at best and have a limited impact on the proposed stormwater management at this stage. Detailed design must be based on the principles outlined in this SMP.

Totara Road will be upgraded with two traffic lanes, plus a cycleway and footpath on the side of the proposed development.

There will be limited road access into the site and no direct vehicle access from Totara Road to any lots.

5.4 Site layout and urban form

Urban Acumen Ltd have prepared an Urban Design Statement to support the PPC application which includes an urban design analysis and recommendations to inform the development of the proposed Precinct Plan and associated provisions. The precinct plan and associated provisions will enable comprehensive residential development that provides connectivity between dwellings, reserves and the surrounding neighbourhood. Resource Consent will be required, along with detailed design of the layout, streetscape and infrastructure.

A copy of the Urban Design Statement is included in the full Plan Change application.

A copy of the precinct plans is included in Appendix A.

5.5 Earthworks

The existing site is gently sloping from the south to north with an average slope of 1.5 percent, although there is a low point on the western boundary adjacent to Totara Road to which the larger part of the site drains. Earthworks would be required over most of the site area to create roads, general building platforms and stormwater detention basins. A balanced cut / fill approach would be taken if possible.

Sediment and erosion controls to mitigate the effects of stormwater runoff on the adjacent streams and downstream receiving environment will be implemented during earthworks operations. These works will be in accordance with Auckland Council document GD05 “Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region”.

6 STORMWATER MANAGEMENT

6.1 Principles of stormwater management

6.1.1 Original principles

The stormwater principals to be used on the PCA are based on the requirements of Auckland Council document GD04 “Water Sensitive Design for Stormwater”. This provides guidance for the application of water sensitive design (WSD) to land use planning and land development, with a specific focus on stormwater and freshwater management.

WSD applies a set of principles to land development to reduce or minimise negative effects on the environment. The emphasis is on the appropriate location, layout and design of development, including its context within the broader catchment and region. WSD can be applied at multiple scales, for structure planning, subdivision and site development, and is appropriate for both greenfield sites and brownfield redevelopment.

A WSD approach considers the multiple objectives influencing project outcomes, including urban design, landscape amenity, and community issues and aspirations. In this way, stormwater management is targeted to where the greatest benefit can be achieved, both for the community and the land developer, and is an integral component of good urban design.

This will include:

- Promoting inter-disciplinary planning and design with consideration of a WSD approach in the early stages of design. This requires the input of a range of disciplines such as engineering, landscape architecture, urban design, community engagement, planning and ecology, and is normal best practice in this regard.
- Protect and enhance the values and functions of natural ecosystem such as mature vegetation, aquifers, watercourses and wetlands for their stormwater management function.
- Address stormwater effects as close to source as possible. This involves treating and mitigating the effects of runoff prior to it leaving the site.
- Mimic natural systems and processes for stormwater management.

6.1.2 Updated principles

Following an application for referral of the development proposal under the COVID-19 Recovery (Fast Track Consenting) Act 2020, initial comments were received from Katja Huls of Healthy Waters, Auckland Council. The comments included pointing out that the site is downstream of the Whenuapai SHA which has a draft Stormwater Management Plan and that the proposed development should develop in accordance with this SMP. The SMP also required stormwater quality treatment to the requirements of the Auckland Unitary Plan.

However, to comply with Schedule 4 (Greenfields) of the regionwide Network Discharge Consent (which is more stringent than the AUP), stormwater quality treatment of all new impervious surfaces is now proposed. This will facilitate the adoption of the SMP into the NDC.

6.2 Proposed stormwater management

6.2.1 General

The stormwater management for the proposed plan change area (PCA) will generally comply with the requirements Schedule 4 of the Auckland Region-wide Network Discharge Consent (NDC) and the Auckland Unitary Plan (AUP).

- The primary stormwater network shall accommodate the runoff from the 10% AEP storm event for the proposed Maximum Probable Development scenario for the site with climate change accounted for.
- Stream hydrology: AUP SMAF 1 mitigation of the 95th percentile rainfall event will be required for all areas discharging to applicable streams to limit stream erosion by:
    - providing retention (volume reduction) of at least 5mm runoff depth for all new impervious areas for which hydrology mitigation is required.
    - providing detention (temporary storage) and a drain down period of 24 hours for the difference between the predevelopment and post-development runoff volumes from the 95th percentile, 24-hour rainfall event minus the 5 mm retention volume.

  SMAF mitigation will not be required for coastal discharges (from SW Basin B) or where it is shown there is no increase in stream erosion due to development (catchment C).
- Stormwater quality treatment to remove contaminants shall be provided to the runoff from all new impervious surfaces (excluding inert roofing) for the 90th percentile rainfall event in accordance with the methods of GD01, unless otherwise mitigated or impracticable.
- Full or partial peak flow attenuation, as required, for the 10% and 1% AEP runoff in accordance with the AUP and SWCoP to manage overland flow paths and existing streams to prevent flooding of buildings.
- Management of overland flow paths on roads to meet Auckland Transport TDM requirements.

6.2.2 Stormwater Basins

Created Wetland ponds are not appropriate to provide treatment for the PCA due to the potential of bird- strike issues at the Whenuapai Airbase. Open water or new bird habitats (within stormwater management devices) are to be prohibited to limit an increase in bird life in the area. Large detention/wetland basins, if selected, shall be constructed as “dry basins”.

A major component of the stormwater management for the proposed PCA will therefore be the provision of two stormwater 'dry' basins which will be designed to the requirements of Auckland Council Guidance Document GD01, Chapter 9 Technical Guidance: Ponds. The stormwater basins will help provide detention and attenuation for stormwater runoff for the 95th percentile, 10% AEP and 1% AEP rainfall events. Indicative contributing catchments to each basin are shown on drawing 4520-PC-SW-433 for piped flows up to the 10% AEP and SW-431 for overland flows up to the 1% AEP rain event.

The catchment shown for Area "C" cannot be piped or flow to either SW basin because of the typography of the site so runoff from the 10% AEP and 1% AEP events will be discharged direct to the adjacent stream. Overall post- development peak discharges into the stream will not, however, exceed pre-development flows as the existing catchment is larger than the developed catchment.

It should be noted that the catchments shown on drawings SW-433 and SW-431 are indicative only having been based on those determined for the FTCA consent lodgement. This has been done to show that it is possible to provide a subdivision complying with this SMP. The final catchments may differ as the subdivision layouts for the PCA have yet to be determined.

Further design of the stormwater basins, along with flood analysis, will be required as part of a resource consent application for development of the PCA.

6.2.3 Water quality

The receiving environment for runoff from the site is to the upper reaches of the Waitemata Harbour by way of the Ratara Stream to the west and the Rarawaru Creek to the east. This is shown in the Auckland Unitary Plan as a Significant Ecological Area – Marine 2 which has an Ecosystem Code of SA1.2 and being "mangrove forest and scrub in an estuarine hydro-system". This type of environment is sensitive to sediments, heavy metals and other contaminants. To improve the water quality of the runoff from the development a water sensitive design approach will be adopted to maintain or enhance the quality of water discharged to the receiving environment.

Regionwide Network Discharge Consent Requirements

Under the water quality requirements of the NDC, the proposed PCA would be covered by Schedule 4 (Greenfields) which requires:

- Treatment of all impervious areas by a water quality device designed in accordance with GD01/TP 10 for the relevant contaminants.

Or An alternative level of mitigation determined through a SMP that:

- applies an Integrated Stormwater Management Approach (as per above);
- meets the NDC Objectives and Outcomes in Schedule 2; and
- is the BPO.

Stormwater Management Device Toolbox

The following table provides a guide to the utilisation of various stormwater management devices when applied to the Whenuapai Green PCA. The information is based on GD01 Table 15.

Table 5: Stormwater Management Device Toolbox

	Quantity Control				Quality Control			
Device	Flood Attenuation	95th %ile detention	5mm retention		Gross pollutants	Sediment	Other pollutants	Suitability for Whenuapai Green
			Infiltration	Retention				
Catchpit (std AT)	-	-	-	-	●	●	×	●
Catchpit (private)	-	-	-	-	●	●	○	●
Pervious pavement (to GD01)	-	●	○(1)	●	○	○	○	○
Living roof	-	●	-	●	-	○	○	×(3)
Rainwater tank	-	●	-	●	-	●	○	●
Infiltration device	-	●	●(1)	●(1)	-	-	-	○(1)
Bioretention Swale	-	●	●(1)	●(1)	●	●	●	●
Raingarden (to GD01)	-	-	●(1)	●(1)	●	●	●	●(2)
Dry Pond (planted base)	●	●	x	●	●	●	●	●

Notes:

NB All devices assume sizing, construction, and maintenance to GD01.

● Very suitable ○ Somewhat suitable x Not suitable - Not applicable

(1) Subject to confirmation by geotechnical testing of infiltration rates.
(2) Subject to AT or Healthy Waters approval as applicable.
(3) NZDF bird strike restrictions.

Water Quality Train

The effective water quality train to be used on the PCA will vary depending on the location of the three main sub-catchments.

See below for outline diagrams and tables showing the Water Quality Train for the three main catchment. As water quality flows will be conveyed by the piped stormwater network, refer to drawing PC-SW-433 for the three main catchment areas (A, B & C).

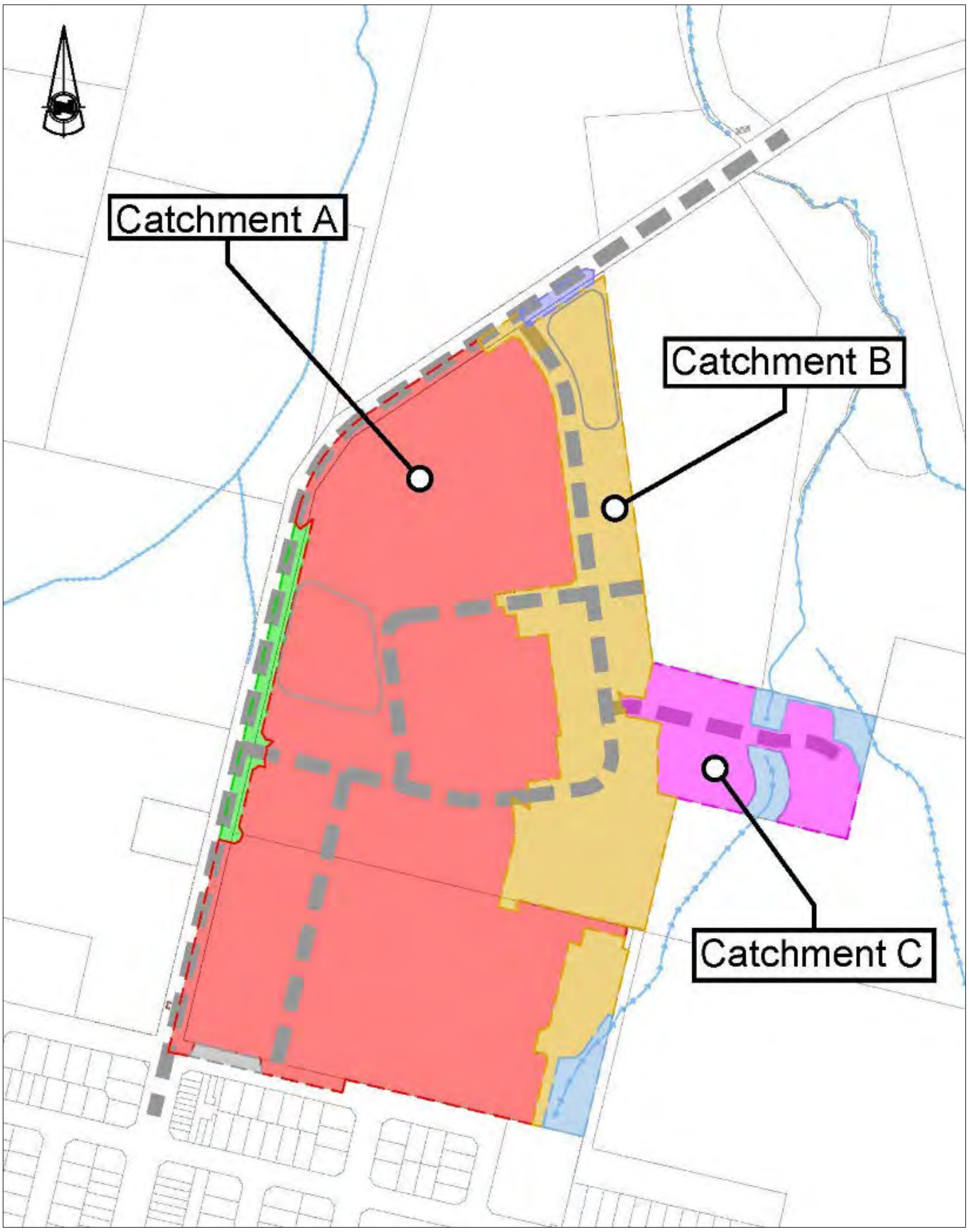


Figure 6: PCA Developed Piped Stormwater Network Catchments.

For SW Catchment A, a low flow diversion manhole will divert the water quality flow into planted swales to provide wate quality treatment. These will form a separate part of the planted base of the SW basin.

For SW Basin B a low flow diversion manhole will divert water quality flows to a separate bioretention device (raingarden to GD01) located before SW Basin B.

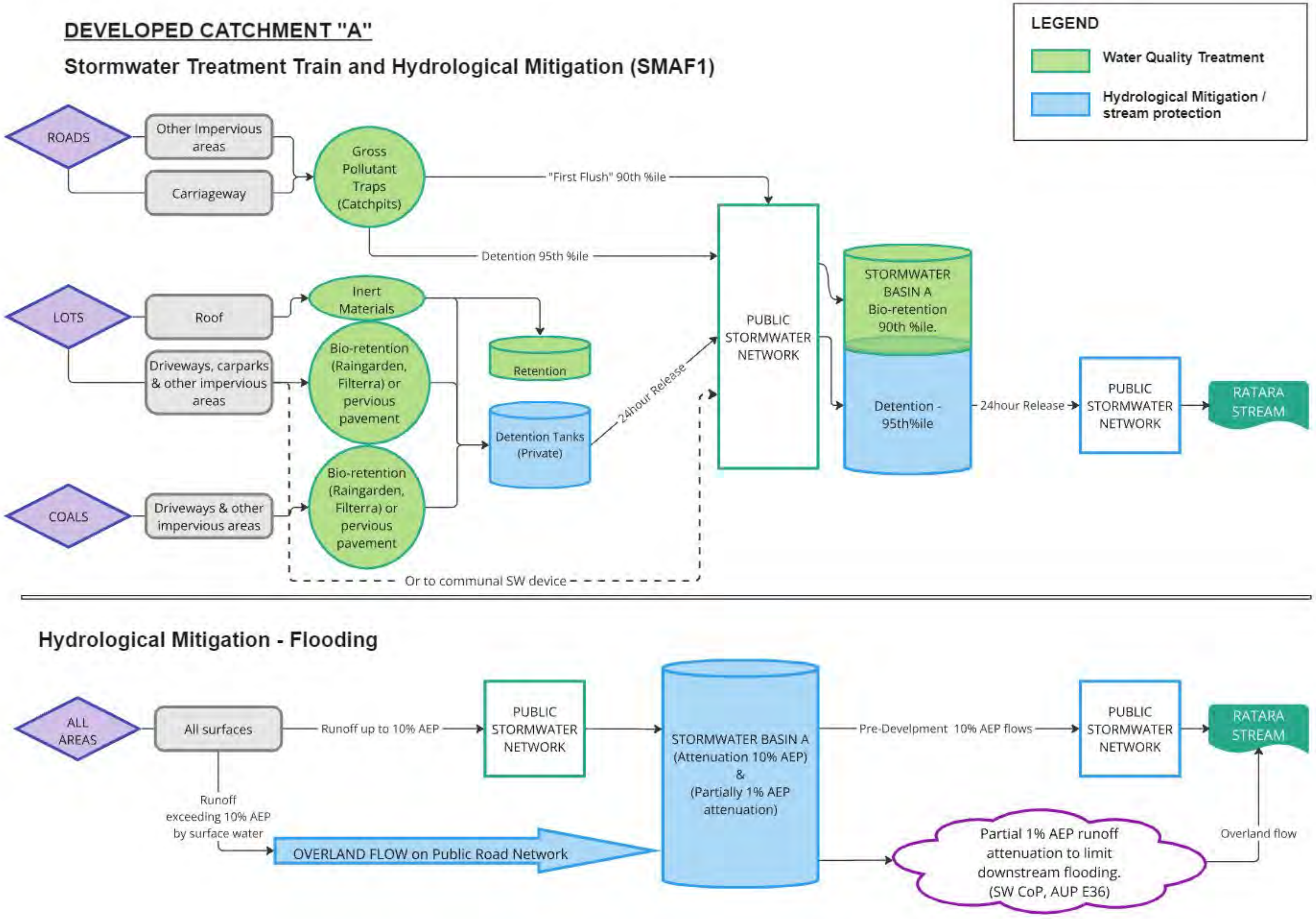
SW runoff from the upgrade to Totara Road will be treated in rain gardens located in the road reserve to provide the required stormwater quality treatment. These can also be used to meet the retention and detention requirements. The use of rain gardens will be subject to the approval of Auckland Transport. Where this cannot be obtained, the SW from the roads will be piped to the adjacent SW basins for treatment along with the internal roads. For the sag point on Totara Road, it may be necessary to incorporate a raingarden within the drainage reserve, between the road boundary and SW Basin A. Sizing of all raingardens will be in accordance with Auckland Council document GD01 Stormwater Management Devices in the Auckland Region.

See below for outline sketches (Figs 5, 6 & 7) and tables (6, 7 & 8) showing the Water Quality Train for the main catchment areas of the PCA.

Water Temperatures

Water temperatures reaching the receiving environment will not be significantly increased due to runoff from new impervious surfaces.

- Impervious areas on lots will be limited to 60%.
- On nearly all occasions rainfall is preceded by and/or accompanied by cloud cover.
- Rainfall up to the 95th percentile event will be piped directly to retention / detention tanks with 24-hour release allowing water temperatures to reduce.
- The SW dry basins will be planted, thus providing shade.


DEVELOPED CATCHMENT "A"

Stormwater Treatment Train and Hydrological Mitigation (SMAF1)

Hydrological Mitigation - Flooding

Figure 7: Developed Catchment "A". Stormwater Treatment Train and Hydrological Mitigation.

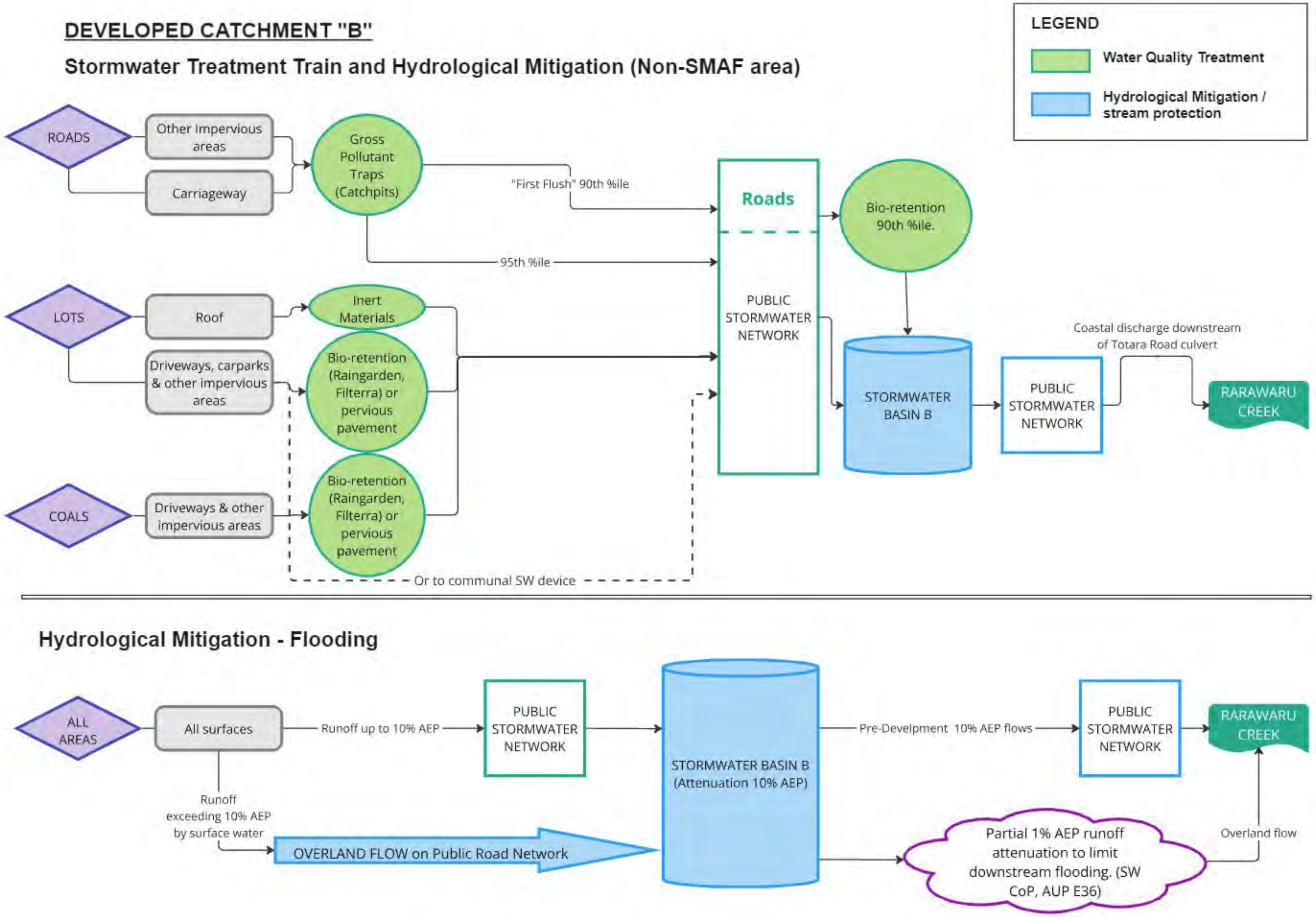


Figure 8: Developed Catchment "B". Stormwater Treatment Train and Hydrological Mitigation.

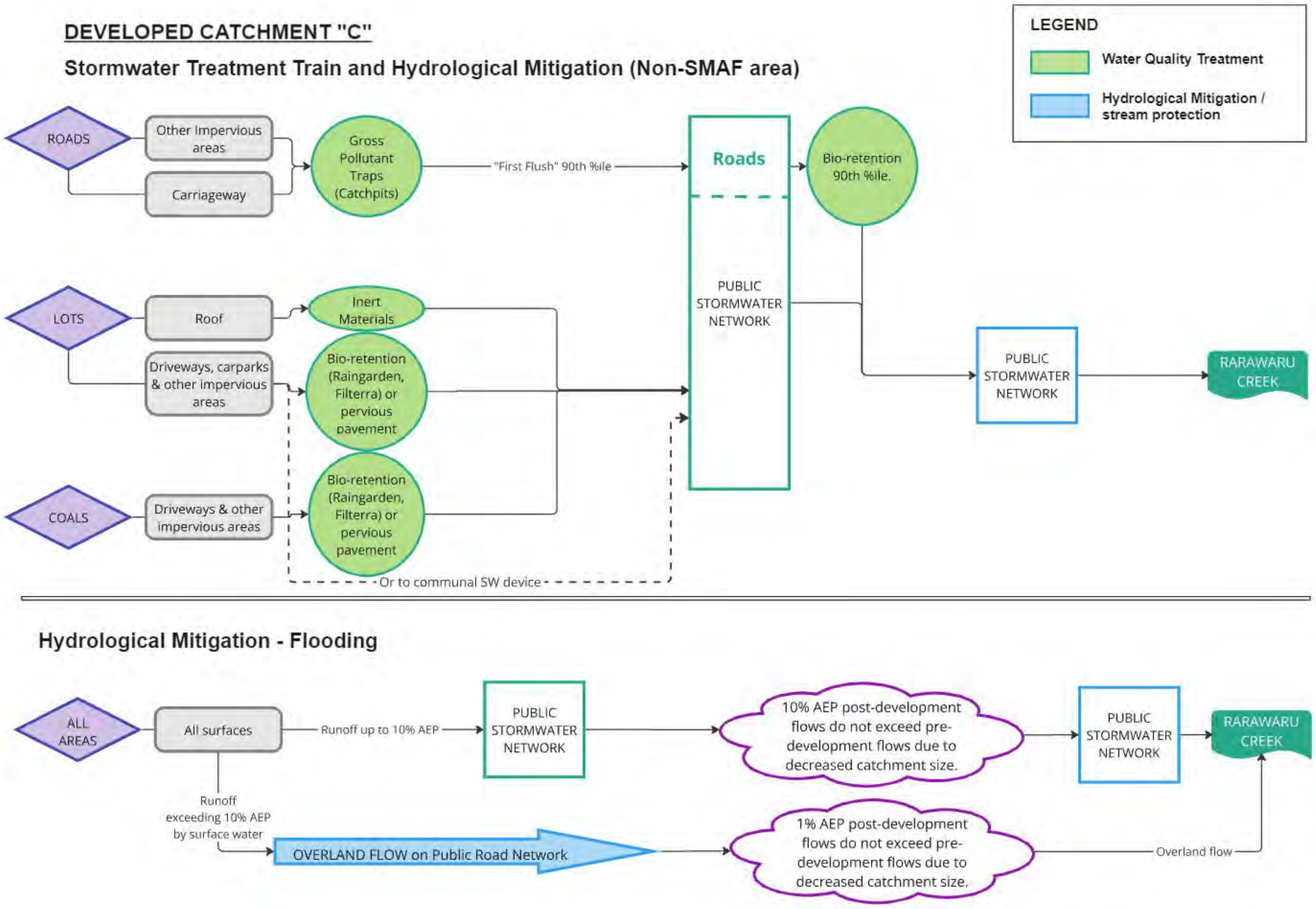


Figure 9: Developed Catchment "C". Stormwater Treatment Train and Hydrological Mitigation.

Table 6 : Water Quality Treatment Train Provided - AREA 'A' – SMAF 1 (Refer to Developed Catchment Plan 4520-PC-SW-433)

Item	Details	SW Quality Treatment Train Provided
Residential Lots (private)	60% impervious area	• Inert Roofing Materials • 5.0mm retention for on-site internal reuse or ground soakage if infiltration rates allow. • For driveways: Pervious pavement, a site specific or communal GD01 device or approved proprietary device. • Further mitigation by on-site detention tanks.
COALs (private)	85% impervious area	• Gross pollutant traps (catchpits). • Pervious pavement or on-site rain gardens designed to GD01 or approved proprietary device to provide water quality treatment or piped to a communal GD01 device. • Further mitigation by on-site detention tanks.
Internal Roads	85% impervious area	• Gross pollutant traps (catchpits) • Further water quality treatment at SW basin A -see below.
Totara Road (high use road)	85% impervious area	• Gross pollutant traps (catchpits) • Bioretention (eg rain gardens), subject to AT approval, designed to GD01 to provide water quality treatment and retention or piped to a communal GD01 device. • Bioretention devices also discharge to SW Basin A where possible.
SW Basin 'A'	Dry pond provides treatment, detention, and attenuation of SW. Base and side slopes fully planted.	• Low flow diversion of 90%-ile water quality flows through planted swale to provide water quality treatment. • Hydraulic residence time of minimum 9 minutes in swales. • At inlets, energy dissipation measures will be provided to meet Auckland Council SW CoP and TR2013/018. • Planting to GD01 C1.0 Technical Guidance: plants and soil.
Ratara Stream	Slow flowing stream	• Additional treatment provided by vegetation on stream banks and in channel.
Discharge to CMA	Upper reaches of Waitemata Harbour	

Table 7: Water Quality Treatment Train Provided - AREA 'B' – Non-SMAF (Refer to Developed Catchment Plan 4520-PC-SW-433)

Item	Details	SW Quality Treatment Train Provided
Residential Lots (private)	60% impervious area	• Inert Roofing Materials • 5.0mm retention for on-site internal reuse or ground soakage if infiltration rates allow. • For driveways: Pervious pavement, a site specific or communal GD01 device or approved proprietary device.
COALs (private)	85% impervious area	• Gross pollutant traps (catchpits). • Pervious pavement or on-site rain gardens designed to GD01 or approved proprietary device to provide water quality treatment or piped to a communal GD01 device.
Internal Roads (low use roads - less than 5000 vpd)	85% impervious area	• Gross pollutant traps (catchpits) • Further treatment in raingarden at SW basin B -see below.
SW Basin 'B'	Initial SW quality treatment device. Dry pond provides attenuation of SW. (Detention volumes piped direct to coastal discharge) Base and side slopes fully planted.	• Diversion manhole directs water quality flows to treatment device. • Rain garden or alternative designed to GD01 to provide water quality treatment. • At inlets, energy dissipation measures will be provided to meet Auckland Council SW CoP and TR2013/018 • Stormwater flows through planted base of stormwater basin to provide additional water quality treatment.
Rarawaru Creek	Discharge to tidal area.	
Discharge to CMA	Upper reaches of Waitemata Harbour.	

- Note: Area B is non-SMAF as discharges are to tidal areas of the Rarawaru Creek downstream of the Totara Road culvert.

Table 8: Water Quality Treatment Train Provided - AREA 'C' - Non-SMAF (Refer to Developed Catchment Plan 4520-PC-SW-433).

Item	Details	SW Quality Treatment Train Provided
Residential Lots (private)	60% impervious area	• Inert Roofing Materials • 5.0mm retention for on-site internal reuse or ground soakage if infiltration rates allow. • For driveways: Pervious pavement, a site specific or communal GD01 device or approved proprietary device. • Further mitigation by on-site detention tanks.
COALs (private)	85% impervious area	• Gross pollutant traps (catchpits). • Pervious pavement or on-site rain gardens designed to GD01 or approved proprietary device to provide water quality treatment or piped to a communal GD01 device. • Further mitigation by on-site detention tanks.
Internal Roads	85% impervious area	• Gross pollutant traps (catchpits). • Rain gardens designed to GD01 to provide water quality treatment. • Discharge into tributary of Rarawaru Creek.
Rarawaru Creek	Slow flowing stream becoming tidal downstream of Totara Road.	• Additional treatment provided by vegetation in channel and on banks.
Discharge to CMA	Upper reaches of Waitemata Harbour.	

- Note: Area C is non-SMAF as discharges to the Rarawaru Creek do not increase stream erosion risk – refer Appendix B Technical Memo – Stream Erosion Risk Assessment.

6.2.4 Stream hydrology

Existing Streams

Riparian Planting

The existing streams on the PCA (I1, I2 and P1 – see Figure 4 Viridis Fig3A) will be enhanced by removing the existing culverted farm crossings and reinstating the stream to match adjacent reaches. Riparian planting, with appropriate species, will also be undertaken to at least 10m each side of all existing streams. This planting will help provide removal of sediment and water quality treatment of direct stormwater runoff from adjacent areas, both during the construction phase and at completion.

Stream Erosion

Preliminary assessments of stream erosion potential have been made using the Auckland Council “Erosion Screening Tool” (EST). Initial results showed that there is no significant risk of increased stream erosion if appropriate mitigation is adopted - e.g. SMAF 1 control. See Appendix B for Technical Memo – Stream Erosion Risk Assessment.

A geomorphological assessment of the stream will be conducted during the detailed design phase. This assessment will inform the development of targeted mitigation strategies, including riparian planting, bank stabilization measures, and other ecological enhancements, to reduce erosion risk and support the improvement of stream health.

Proposed site ‘Panhandle’ Culvert

As part of the development a road will need to cross existing stream ‘I2’ which will require culverting. While a fish habitat assessment has not been done, the Viridis report suggest that intermittent streams I1 and I2 will most likely provide habitat to some fish species, therefore the fish passage requirements of the National Environmental Standards – Freshwater (NES-F) will be applied. The culvert will need to meet the permitted activity requirements of Section 70 of the NES-F. This has conditions so that the culvert will provide for the same passage of fish upstream and downstream as would exist without the culvert.

Initial concept design options have been considered which will meet the requirements of the NES-F. The most suitable option would be an arch culvert spanning across the stream which will allow the natural stream largely to remain. Alternatives would be a circular or box culvert laid at the gradient of the existing stream base and embedded below the stream bed which will allow the natural stream to re-establish.

Concept design will be presented at resource consent stage with detailed design at Engineering Plan Approval. The culvert design will meet the requirements of the Auckland Council SW Code of practice and/or Auckland Transport TDM.

A Fish Re-location Plan and a Stream-works Construction Management Plan will be prepared prior to construction works commencing.

Site Development Requirements

Stream Hydrological:

The requirements for the proposed PCA to meet stream hydrology requirements are as follows:

- The SMAF 1 hydrological mitigation requirements given in AUP Table 10.6.3.1.1 apply to catchments discharging to streams as follows:
    - Retention (volume reduction) of at least 5 mm (per m2) of runoff depth from new impervious surfaces.
    - Where re-use of the retention volume is not possible, this will be included in the detention volume. An alternative is disposal by way of in-ground soakage if soil perviousness exceeds 2mm/hr. The CMW Geotechnical Investigation Report shows that soakage is available in test locations of natural ground, however, because of compaction during earthworks, the use of soakage would have to be confirmed by testing of individual lots at building consent stage.
- Detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff from new impervious surfaces in the 95th percentile 24-hour rainfall event minus retention volume. Runoff for detention has been calculated as 23mm (per m2) of impervious area.
- NOTE: For catchment B which discharges into stormwater basin B, detention is not required as flows can be piped downstream of the 2300m Totara Road culvert to discharge to a coastal outfall. For catchment C, a preliminary stream erosion risk assessment was conducted, confirming that there is no increase in potential erosion risk. Therefore, the SMAF 1 hydrological mitigation provisions are not required for the catchment.

The above requirements will be achieved as follows:

Residential lots

For residential lots, retention will require private stormwater tanks plumbed for internal water reuse to be used for toilet flushing and similar uses where non-potable water is permitted. Alternatively, retention can be achieved by providing ground soakage if available. Detention of the 95th percentile rainfall event with release over 24-hours will require private stormwater tanks. Above ground, inground or in-slab tanks are required and will be subject to being able to connect to the public stormwater pipe network. Alternatively, the detention component can be conveyed via the stormwater network to a communal (public) stormwater device or system sized and designed in accordance with GD01.

Design of the retention, detention tanks and the plumbing of non-potable water for internal reuse will be to the requirements of GD01 and be part of the Building Consent approval. The requirements will be enforced by a Consent Notice entered on the title.

Internal Roads

All internal roads will require storage for the retention and detention volumes. Infiltration may be possible if the soakage capacity of the ground is more than 2.0mm/hr, but this would need to be confirmed on a site-specific basis and would require AT approval. Where possible runoff from the internal roads will be piped to the stormwater basins. In stormwater basin A, the detention volume will be stored and released over 24 hours.

Due to the topography, roads within the easternmost part of catchment C may not be able to be piped to a SW basin. Detention volumes will be discharged directly into the tributary of the Rarawaru Creek. SW quality treatment of road runoff will be provided in rain gardens, subject to AT approval. At completion, ownership of rain gardens will be vested in Auckland Council as a roading asset.

Totara Road

The eastern side of Totara Road which is adjacent to the development will be widened to allow for a cycle path and footpath. As Totara Road has a daily traffic volume exceeding 5,000 vpd, stormwater runoff from the carriageway will require treatment for stormwater quality. Additionally, stormwater runoff for the difference between pre and post development impervious areas will also need to meet the detention requirements as above.

To meet the stormwater detention and treatment requirements, raingardens are proposed to be provided within the Totara Road berm. These will discharge to the stormwater basins where site levels make this possible, otherwise to the basin discharge point.

Design of the raingardens will be to the requirements of GD01 and finalised at resource consent stage.

Stream Baseflows

With reference to Figures 3 & 4 (see Section 1.7 Existing hydrological features), the Rarawaru Creek is located to the east of the PCA and the Ratara Stream to the west of the PCA. While both streams are outside the PCA there are unnamed tributaries which extend into the PCA. These tributaries have been identified by Viridis as intermittent or artificial watercourses. The only permanent stream within the PCA is P1 which runs a very short distance through a corner in the east of the PCA. The main streams to the east and west of the PCA are permanent streams and have catchments considerably larger than that contributed by the PCA. The intermittent stream I1 (W1, W2) in the southeast corner of the PCA also is largely fed by the already developed Whenuapai 2 catchment to the south.

The existing pre-development catchment within the PCA is shown on drawing PC-SW-432(A). The indicative developed catchment is shown on PC-SW-433(A). Both drawings are attached in Appendix A.

Baseflows are to be maintained in all streams. Further details regarding the stream baseflows are to be provided at Resource Consent Stage. This could include the following:

- Details of both the pre-development and post-development catchments as they apply to baseflows, including the wider catchments external to the PCA which contribute the majority of the existing baseflow.
- A further report from an ecologist including specific consideration of the existing streams, internal and external to the PCA, with an assessment of the potential effects from any changes in baseflow.

Baseflow can be increased in a particular catchment, if necessary, by considering the following:

- Changing the post-development land contours as, typically, the water table and hence subsoil baseflows follow the ground contour. This will need to be done while still achieving the necessary pipe and overland flow directions.
- Changing the piped discharge points of parts of the western catchments to the upper stream reaches. This will provide more low-level stream flows which will help maintain stream health in dryer periods.
- Increasing the pervious area of catchments. Options available to increase the pervious area would be to incorporate roadside swales or to use pervious paving for lot driveways and COALs.

6.2.5 Flooding

The primary stormwater network shall accommodate the runoff from the 10% AEP storm event for the Maximum Probable Development scenario with climate change accounted for. The maximum probable development for the proposed Residential –Mixed Housing Urban zoning is assessed as being an average of 70% imperviousness, based on 60% impervious lot areas (AUP H5.6.9) and 85% impervious area for roads and COALs.

An analysis of the flooding potential of the Whenuapai Stormwater Catchment has previously been undertaken for Auckland Council. The Whenuapai Catchment Rapid Flood Hazard Assessment (RFHA) Model was completed by AECOM in 2016 being model ID 136 as registered on Auckland Council's model register. Details of the model build can be found in the Whenuapai Rapid Food Hazard Assessment Memorandum (2016). The model was updated in 2020 to LIDAR 2016 by WatRes Consulting Limited.

The following updates were made by Auckland Council in 2022:

- ICM software version 9.5
- Constant tidal boundary condition of 2.89mRL (Auckland Vertical Datum 1946)
- Rainfall to account for 3.8 degrees climate change

The updated model has been used for mapping flood plains for the Whenuapai catchment and has been registered as model ID 1399.

The results of the RFHA are presented in the Auckland Council GeoMaps system showing overland flow paths and flood plains. It is also included in the Auckland Council Open Data.

An extract from Auckland Council GeoMaps shows overland flow paths and the extent of the potential flooding on the PCA and the surrounding area – see Figure 3.

Neil Group (NGL) have also completed a Hydraulic Modelling Report (HMR) incorporating more detail relating to the proposed development and the downstream receiving environment. This has been done using the HEC-HMS and HEC-RAS flood computational analysis programs. The report shows that the proposed development will not be subject to flooding. It also shows that the additional SW runoff resulting from increased impervious areas can be managed to minimise the effects on streams and downstream areas. Any increases in flood volumes will be attenuated sufficiently to prevent any significant increase in the potential flooding of neighbouring properties and hence complies with the Auckland Council Stormwater Code of Practice.

Note: Catchments and impervious areas are based on the lots, road layouts, contours and SW basins used for Version 2 dated 15 Dec 2022 of this SMP as submitted with the previous fast-track (FTCA) application. After the PCA is rezoned, these will be updated at Resource Consent stage once a final development layout has been determined.

See Appendix B for a copy of the 4520 Memo – Hydraulic Modelling Report (Revision 1).

6.2.6 Overland flowpath and floodplain management

As detailed above, the Auckland Council GeoMaps shows the overland flow paths and flooding that would occur in the catchment for the 1% AEP rainfall event. These are based on the maximum probable development (80% impervious) of the entire catchment and include allowance for 3.8° climate change.

Floodplain - Western Side

There are several small overland flow paths shown across the existing PCA, with those on the western side concentrating in an existing low area beside Totara Road where a 450mm diameter concrete pipe culvert conveys stormwater under the road to the west to discharge into a tributary of the Ratara Stream. GeoMaps, as shown in Figure 10 below, indicates the low area as a flood plain and flood prone area.

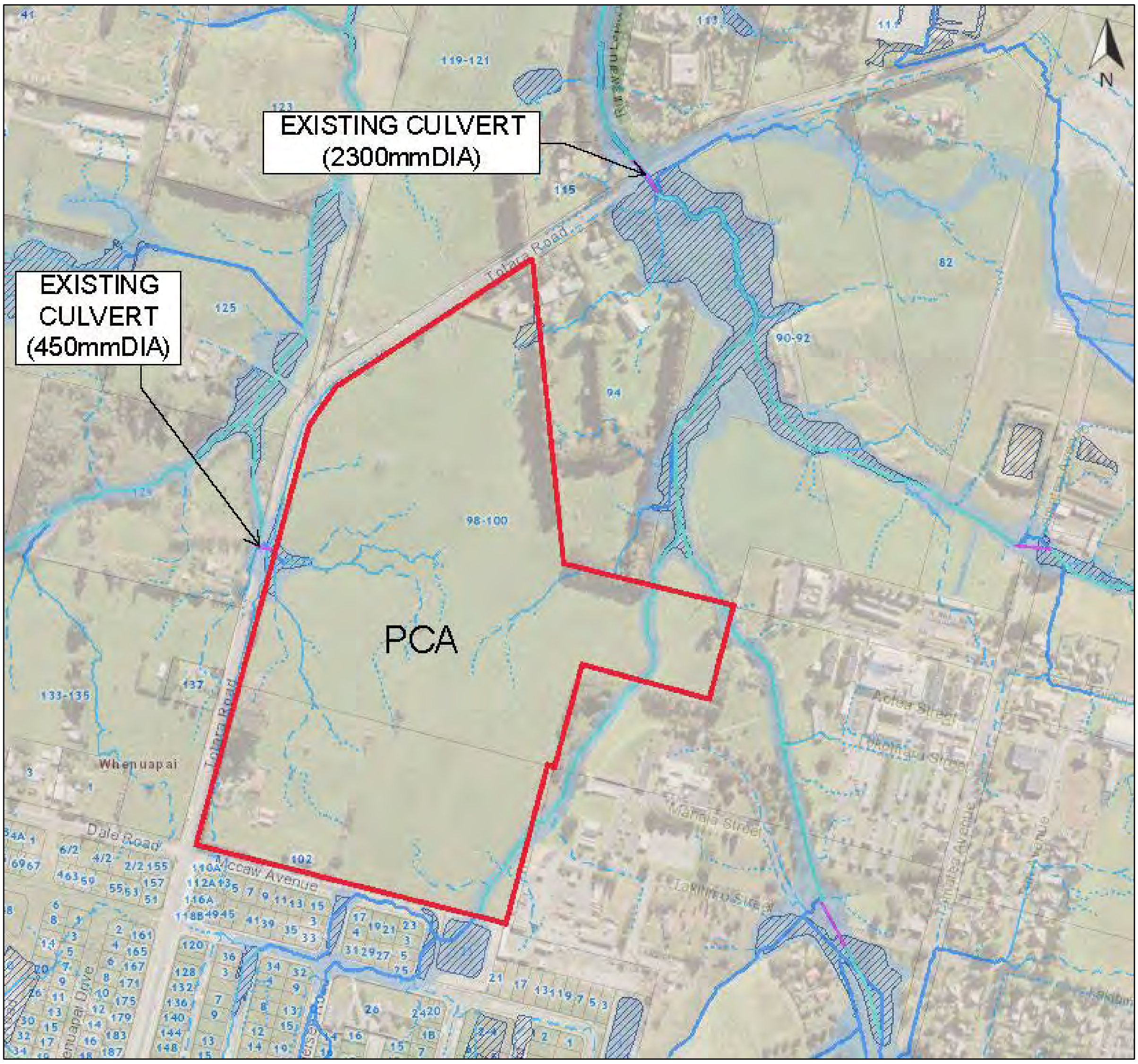


Figure 10: Flood plains and overland flow paths. Assumed maximum probable development (80% impervious) and rainfall depth increased by 32.68% due to climate change (3.8 degrees). Sourced from Auckland Council GeoMaps, 12/03/2024

Figure 12 shows the flood extent during a 1% AEP storm event in the pre-development scenario. Refer to Appendix B (Hydraulic Modelling Report) for model parameters and water surface elevation results.

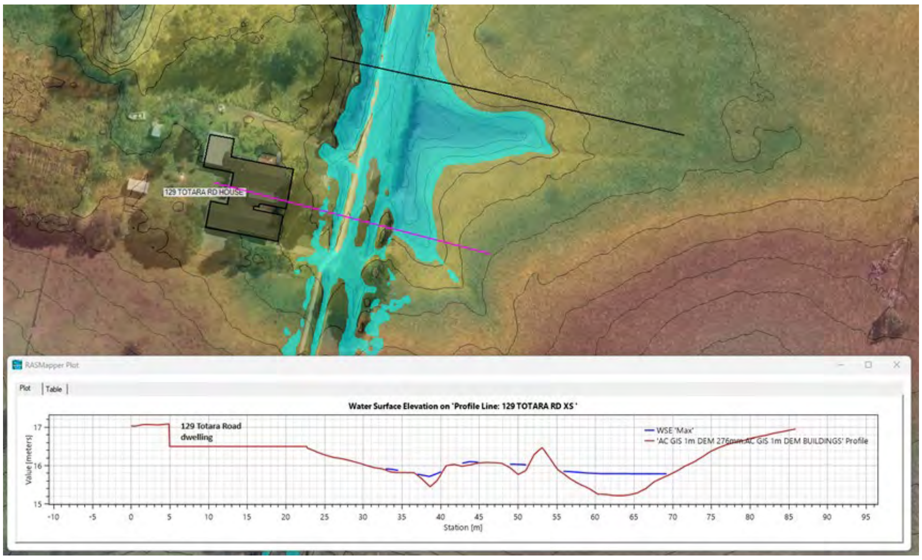


Figure 11: Catchment A - Pre-Development flood extent (Refer to Hydraulic Modelling Report for model parameters and water surface elevation results).

As part of the proposed development there will be a stormwater dry basin (Basin A) located in the existing flood plain. This will be designed to provide detention and 24-hour release of the runoff for the 95th percentile detention volume, plus attenuation of the runoff from the 10% AEP and partial attenuation of the 1% AEP rainfall events. Figure 12 illustrates the flood extent during a 1% AEP storm event in the post-development scenario. Refer to Appendix B (Hydraulic Model Report) for model parameters and water surface elevation results.

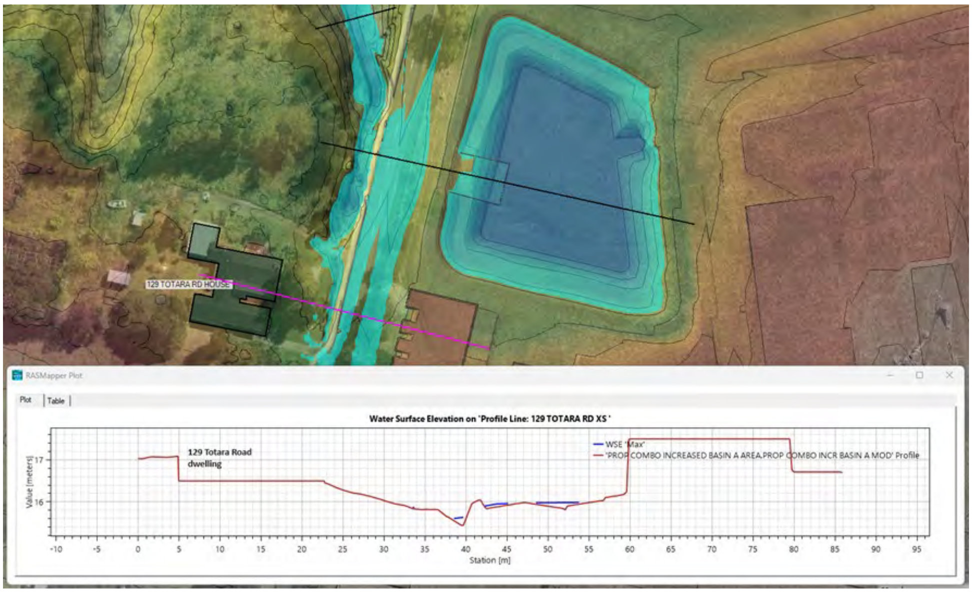


Figure 12: Catchment A - Post-Development flood extent (Refer to Hydraulic Modelling Report for model parameters and water surface elevation results).

An outlet pipe(s) from the SW basin will be provided under Totara Road which will discharge through a stabilised outlet to the Ratara stream.

<u>Floodplain - Eastern Side</u>

On the eastern side of the PCA GeoMaps (Figure 10) shows a minor flood plain in the south-eastern corner associated with stream reach I1 (Figure 4 Viridis Fig 3A). This stream will be untouched by development works and will have a planted riparian margin.

A minor flood prone area in the north-east will be filled as part of the required earthworks. Outside the PCA, GeoMaps (Figure 10) shows a large floodplain associated with the Rarawaru Creek where it flows over Totara Road as the 2300mm diameter culvert which is assumed to be fully blocked. This is a very conservative assumption, and a more realistic assessment would be a 50% blockage. The flood plain includes part of the adjacent property at 94 Totara Road.

Figure 13 depicts the flood extent during a 1% AEP storm event in the pre-development scenario. Refer to Appendix B (Hydraulic Modelling Report) for model parameters and water surface elevation results.

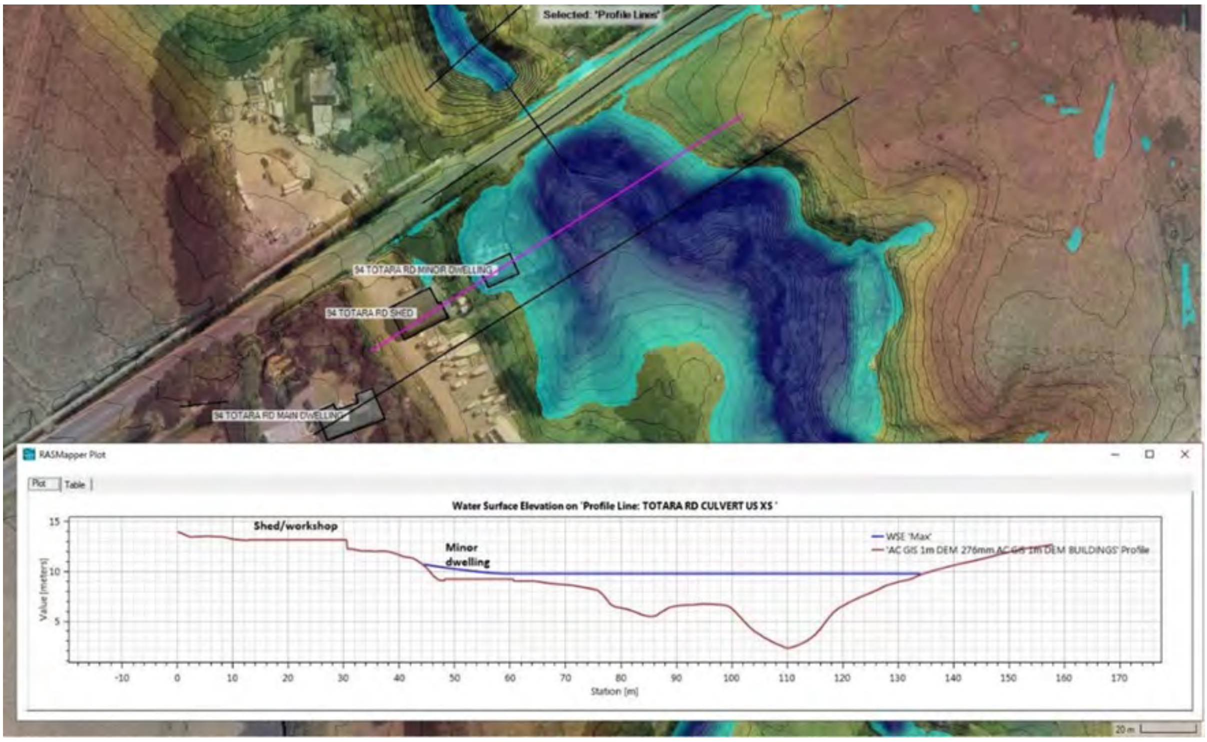


Figure 13: Totara Road 2300mmDN culvert. Pre-development scenario (assuming culvert blockage of 50%).

The NGL Hydraulic Modelling Report (HMR) (Appendix B) includes consideration of flows from catchments B & C which discharge into the Rarawaru Creek. The modelling shows (Figure 14) a post-development flood level of RL 9.69m (Scenario WGD_[CC](50%) at the Totara Road culvert) which is a reduction of 80mm in flood water elevation when compared to the pre-development simulation RL 9.77m (Scenario Pre_[CC](50%)). The reduction in flood water elevation can be attributed to the proposed Basin B, which attenuates the stormwater runoff generated from its catchment. 94 Totara Road has an outbuilding used as a shed/workshop (approx. floor level RL 13.15m) which still has a freeboard of 3.46m. The main dwelling (floor level is approx. RL16.0m) is well above flood levels. Flooding of a small minor dwelling closer to the culvert, which has a floor level of RL 9.22m, will occur due to climate change considerations irrespective of whether the PCA is developed or not.

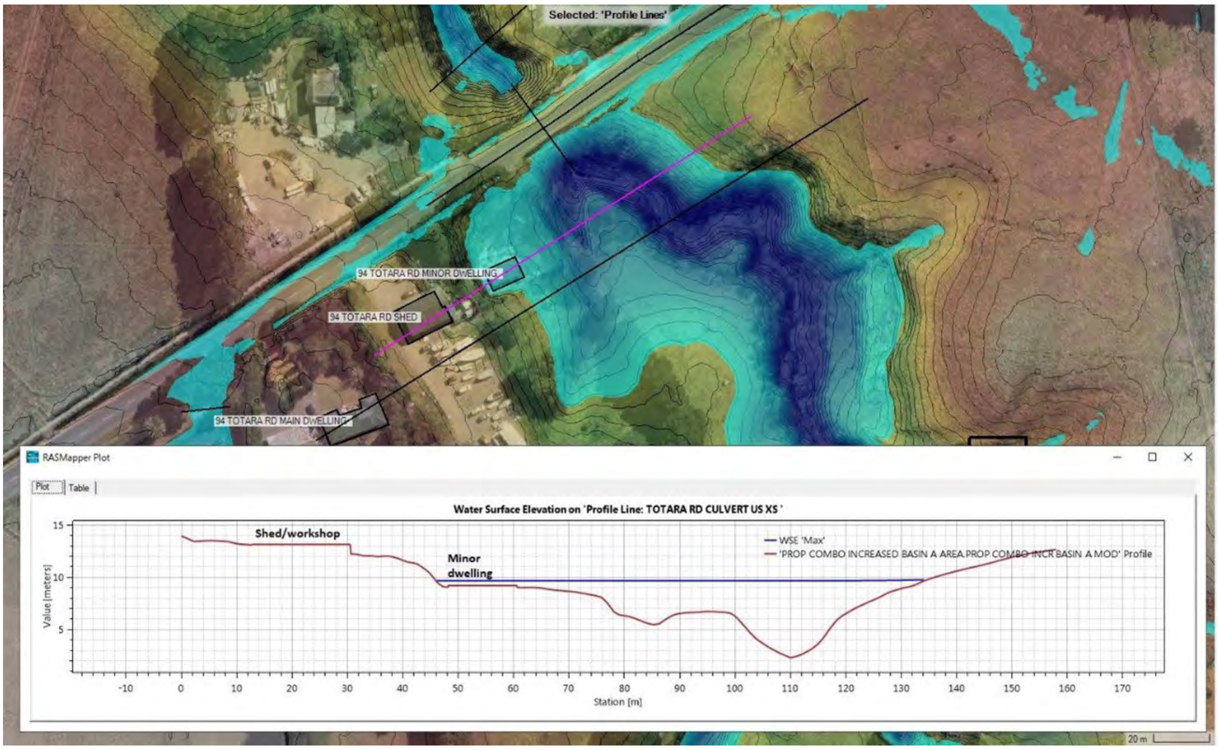


Figure 14: Totara Road 2300mmDN culvert. Post-development scenario (assuming culvert blockage of 50%).

Overland Flow Paths

For the developed PCA overland flow paths will convey secondary stormwater flows along the public roads to discharge into either stormwater basin A or B, apart from the small area in catchment C. The road cross sections will be designed so that the overland flows meet Auckland Transport requirements.

Auckland Transport requirements for stormwater flows on roads are provided in the Transport Design Manual – Engineering Design Code – Road Drainage and Surface Water Control (version 1.2).

Serviceability requirements for the 10% AEP storm event are provided in TDM Table 2. The proposed design will meet these requirements by providing suitably placed road catchpits connected into the public stormwater system.

Requirements for overland flow during a major event (1% AEP) are provided in TDM Table 3: Mayor Event – Roadway Flow Limitations. Where possible the total flow will be contained within the road reserve.

Floor levels of adjacent buildings will meet all requirements of the TDM, AC SWCoP & GD13, AUP E36 and the Building Code E1.

Further consideration of overland flows will be undertaken at resource consent stage when the site layout is finalised.

6.2.7 NZDF Conditions

Following initial consultation, the New Zealand Defence Force, draft precinct provisions have been prepared that relate to NZDF interests and the RNZAF Base Auckland. The draft provisions address matters relevant to this SMP relating to Bird Strike and stormwater management as follows:

Stormwater quality

(a) All land use development shall be managed in accordance with an approved Network Discharge Consent and/or a Stormwater Management Plan approved by the stormwater network utility operator.

(b) Stormwater runoff from all impervious areas other than roofs and pervious pavers must be either:

  i. treated at-source by a stormwater management device or system that is sized and designed in accordance with 'Guidance Document 2017/001 Stormwater Management Devices in the Auckland Region (GD01)' or 'Stormwater treatment Devices Design Guideline Manual (TP10)'; or

  ii. treated by a communal stormwater management device or system that is sized and designed in accordance with 'Guidance Document 2017/001

Stormwater Management Devices in the Auckland Region (GD01)' that is designed and authorised to accommodate and treat stormwater from the site.

(c) Roofs must be constructed of inert building materials. Roofs must be constructed of inert building material with runoff directed to a tank sized for the minimum of 5mm retention volume for non-potable internal reuse within the property.

Dry detention basins or stormwater ponds

(a) In the event that dry detention basins or stormwater ponds are proposed, these shall be designed by a suitably qualified and experienced person to:

  i. Minimise bird settling or roosting (including planting with species unlikely to be attractive to large and/or flocking bird species); and

  ii. Fully drain down within 48 hours of a 2 percent Annual Exceedance Probability (AEP) storm event; and

  iii. Have side slopes at least as steep as 1 vertical to 4 horizontal (1:4) except for:

    1. Any side slope treated with rock armouring; or

    2. Any area required for vehicle access, provided that such vehicle access has a gradient of at least 1 vertical to 8 horizontal (1:8).

Bird strike

(a) If roof gradients are less than 15 degrees, measures to discourage bird roosting on the roof of the structure are required where building design may be conducive to potential bird roosting.

(b) Any measures to discourage bird roosting on the roof of the structure shall be maintained thereafter to the satisfaction of Auckland Council in consultation with NZDF.

The proposed stormwater basins to be utilised within the PCA will be "dry" basins which will be able to fully drain after rainfall events. These will be designed so that they will empty within the required 48 hours after the 2% AEP rainfall event.

A "scruffy dome" grated screen is normally used over the top of the control manholes, but the standard dome may provide a perch for certain birds. In this case a modified screen of conical shape will be used, which with sloping sides should deter larger birds from roosting on the screen. Also, because of the requirement to avoid standing water in the SW basin, it will not be possible to incorporate a sediment forebay. Energy dissipation measures will be provided at inlets to meet Auckland Council SW CoP and TR2013/018.

6.3 Hydraulic connectivity

Stormwater runoff from private property, including Lots and COALS, will be collected from all impervious and pervious surfaces by private drainage pipelines. These will then connect to the proposed public stormwater network along with runoff from roads and other public areas. The public stormwater network will be designed to provide capacity for the 10% AEP rainfall event, including climate change, in accordance with the design requirements of the Auckland Council Stormwater Code of Practice.

6.4 Asset ownership

On completion of the subdivision within the PCA and on the issue of titles, the ownership of all stormwater assets, including Local Reserves – Stormwater, will vest in Auckland Council. Discharge consents will be transferred to Auckland Council after satisfactory completion of the works.

Cesspits, raingardens, and bioretention treatment devices in road reserves are to be vested in Auckland Transport.

Devices within the future lots will be privately owned and maintained by the respective owners enforced by consent notices.

It is intended that this SMP once approved will be adopted under Schedule 10 of the NDC in accordance with Schedule 5 of the NDC or Schedule 8 if applicable.

6.5 Ongoing maintenance requirements

<u>Design Requirements</u>

Stormwater management devices are to be designed to the required of Auckland Council Guidance Document GD 01 – Stormwater Management Devices in the Auckland Region.

When designing stormwater management devices, the matters below will be addressed as part of the design:

- Lifecycle operation and maintenance cost

- Easy access to the site for ongoing operations and maintenance
- Safety for staff and public during ongoing operations and maintenance
- Least traffic management plan requirements
- A parking bay.

Safe Access to Stream Outfalls

The design must also consider how safe access to stream outfalls will be provided. The following should be considered and installed where appropriate.

- Parking area
- Fencing with lockable gate
- Pathway from road or footpath down to pipe outlet
- Safe platform to enable an operator to easily remove vegetation or debris from grates.

Ongoing Maintenance

After completion of construction, Neil Construction Ltd (NCL) will be responsible for the maintenance requirements as required by the approved resource consent, including payment of a maintenance bond. Auckland Council - Parks maintenance requirements are likely to include street trees plus planting within the stormwater reserves, raingardens, stream and riparian planting. At completion of the maintenance periods and after a final inspection, the responsibility for the ongoing maintenance of the stormwater assets will transfer to Auckland Council.

Stormwater Operation and Maintenance Plan

A Stormwater Operation and Maintenance Plan (SWO&M) will be submitted with the Resource Consent application The SWO&M plan will include information on the following:

- Location Plan
- Stormwater Device
- Device maintenance
- Health and safety
- A summary of maintenance activities and frequency
- Responsibilities

6.6 Implementation of stormwater network

Site works will commence with bulk earthworks to establish the overall contour of the proposed PCA. During the bulk earthworks operations stormwater runoff will be controlled to the requirements of GD05 using diversion channels, sediment ponds and decanting earth bunds. Works will be staged with areas topsoiled, grassed and mulched as they are completed. The bulk earthworks will include the general shaping of the stormwater basins which may also be used in part as temporary sediment ponds.

Stream and riparian planting will occur before or in conjunction with bulk earthworks to allow early establishment and to help with sediment control. This will depend on being able to meet seasonal planting requirements.

Construction of the public stormwater pipe network will follow the overall staging plans for subdivision. Piped outfalls to the adjacent streams will be constructed in the initial stages to ensure that overland flows are minimised. Implementation of the stormwater network will be discussed during the resource consent process.

The staging of the development will be such that the stormwater management devices will be in place before any construction of new impervious surfaces, including roads, which will drain to those devices. For future private lots and COALs, stormwater management devices will require resource and/or building consent approval. A staging plan will be submitted with the future resource consent application.

6.7 Dependencies

There are no dependencies relating to stormwater issues involved with this PCA.

The stormwater management will only need to cater for the proposed PCA as upstream properties have been developed in recent years with stormwater management provided in accordance with the Whenuapai 2 Stormwater Management Plan which has been adopted under Schedule 10 of the NDC.

Similarly, attenuation of flood flows from the PCA will be provided in the stormwater basins so that downstream properties will not be subjected to flooding due to increased runoff.

6.8 Risks

Table 9: Risk Assessment

What is the risk to the proposed stormwater management?	How can this be mitigated / managed?	What other management / mitigation could be used?	When does this risk need to be addressed?	What is the resultant level of risk?
Inaccuracies in the base information including that obtained from GeoMaps.	Full topographical survey of the site. Modelling and calculations to assess site and downstream flooding.		During the design phase.	Low.
Errors made during the design process.	Thorough review of all design elements.		During the design phase.	Low
Errors made during the construction phase.	Construction monitoring. Preparation of “as-built” drawings.		During the construction phase.	Low.
Stormwater management devices on lots not installed or maintained correctly.	Provision of consent notices on titles with installation and maintenance requirements.		During the consenting and 224c processes.	Low.

7 DEPARTURES FROM REGULATORY OR DESIGN CODES

There are no departures from regulatory or design codes.

8 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

8.1 Conclusions

The proposal for the Whenuapai Green Plan Change will provide a zoning to allow an estimated 430 residential dwellings. The total site area is 16.36 hectares. The new zoning will allow for a residential subdivision which will provide all the required infrastructure to serve the development, including roading, water supply, wastewater, stormwater drainage and other private utility services such as power and telecoms.

The stormwater management principles proposed for this PCA will provide for effective control of the increased runoff arising from the change in impervious areas. This will include on-site retention providing for the re-use of rainwater, along with detention to limit downstream stream erosion.

Following the issue of resource consents, two stormwater dry basins will be constructed to provide the detention and attenuation of larger flood flows thus minimising increases in downstream flooding. SW basins will not have standing water to avoid encouragement of bird roosting in the area, as this is not compatible with flight operations on the adjacent NZDF airbase. Treatment of runoff from high contaminant generation activities will be provided in SW basins and raingardens where required. The stormwater basins will also provide amenity with extensive planting as well as paths for passive recreation.

All the existing permanent or intermittent streams will be retained within the proposed drainage reserves which will vest to Auckland Council on issue of titles. Riparian margins of at least 10m will be replanted. These works will further contribute to the long-term water quality of the streams and their riparian habitat.

In summary, the proposal to discharge stormwater to the streams on site would have no appreciable adverse effects on the water quality of the streams and the physical integrity of the stream beds and riparian margins.

See below for a summary of the stormwater management requirements:

Table 10: Summary of Site SW Management Requirements

Location	Retention 5.0mm (/m2 impervious area)	Detention 23mm 24 hr release (/m2 impervious area)	Attenuation (10% AEP and partial 1% AEP)	Treatment
Lots:				
SMAF1	Yes (re-use)	Yes (at source)	Yes (in SW basins)	Yes
Non-SMAF	No	No	Yes (in SW basins)	Yes
COALs:				
SMAF 1	Add to detention	Yes (at source)	Yes (in SW basins)	Yes
Non-SMAF	No	No	Yes (in SW basins)	Yes
Roads:				
SMAF 1	Add to detention	Yes (SW Basin)	Yes (in SW basins)	Yes
Non-SMAF	No	No	Yes (in SW basins)	Yes

Notes:

1. SMAF 1 areas discharge to Ratara Stream - See Whenuapai Green Overlay Plans

This SMP has been prepared to support the private plan change and the plan change is consistent with the SMP. The proposed precinct provisions implement the management and mitigation measures set out on the SMP.

8.2 Recommendations

- It is recommended that this SMP be approved under the proposed Plan Change.
- The detailed design for Engineering Plan Approval is to be in accordance with the principles as outlined in this Stormwater Management Plan and in accordance with the AC SWCoP.
- On-site stormwater management requirements to be implemented by way of Auckland Council consent notices on titles, requiring the recommended stormwater mitigation measures be applied during the design of the proposed dwellings.
- Construction works to be monitored to ensure that the stormwater management requirements in proposed public areas are implemented to the design requirements.

9 REFERENCES

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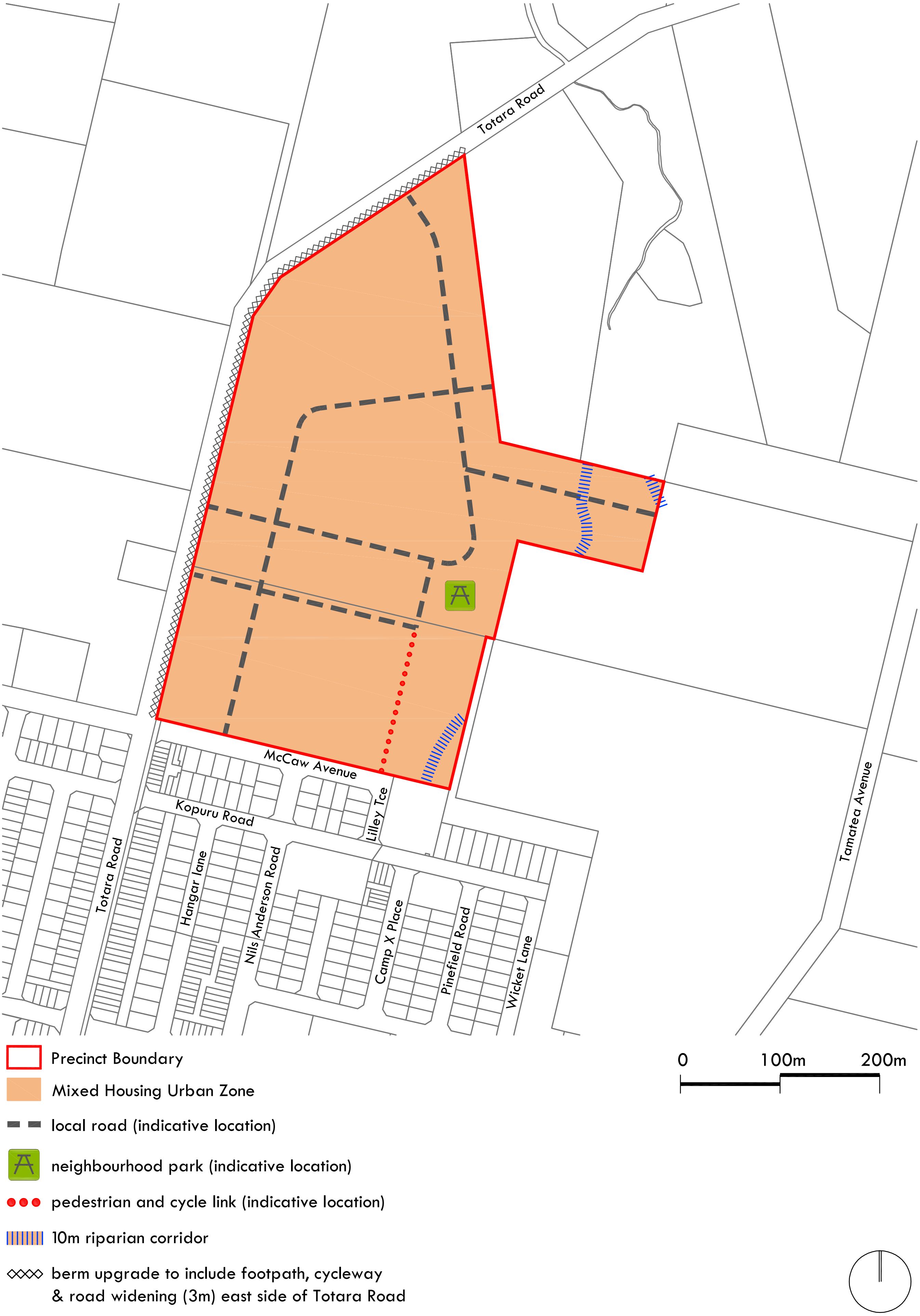
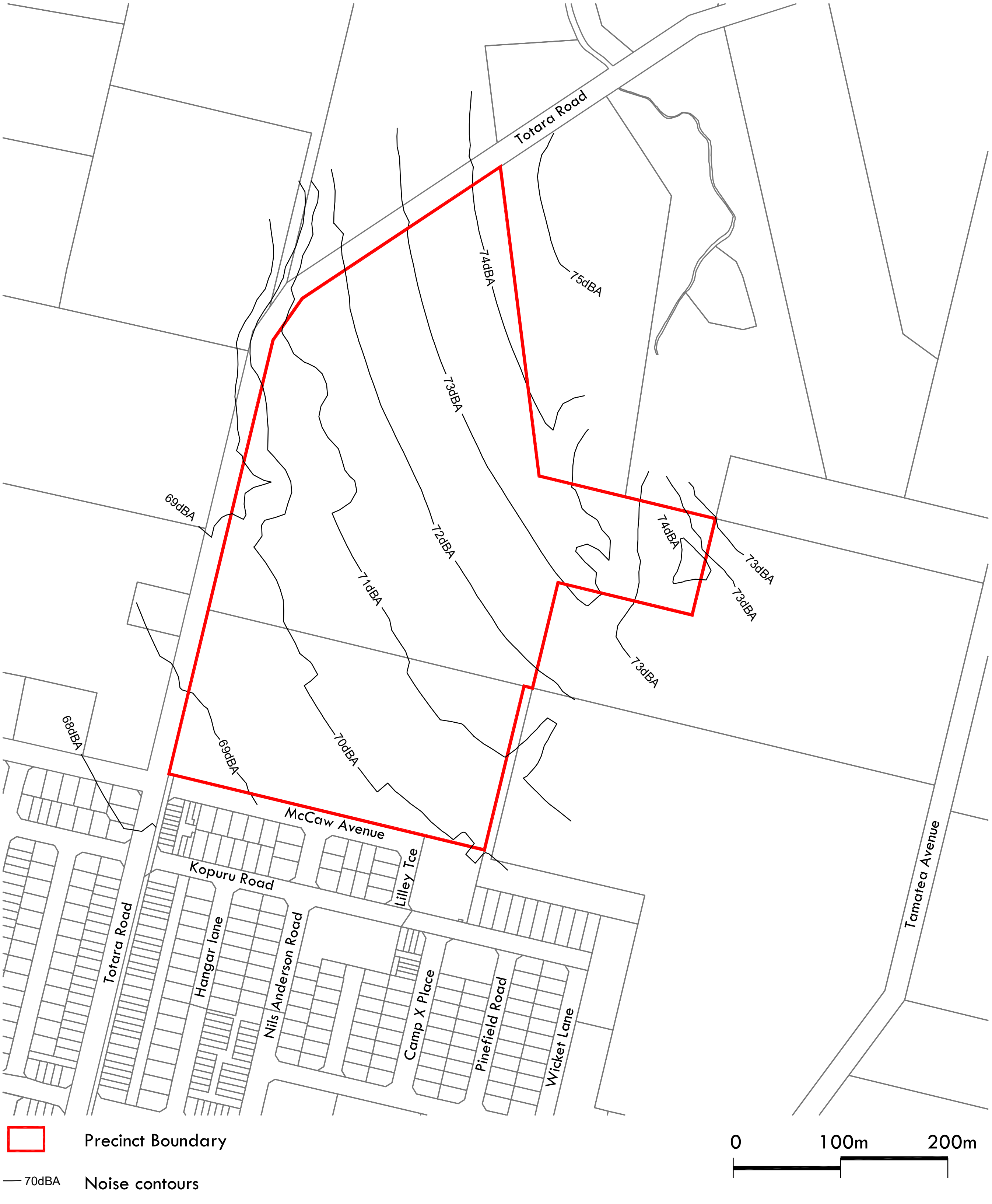
APPENDIX A

- Whenuapai Green Precinct Plan and Zoning Plans.

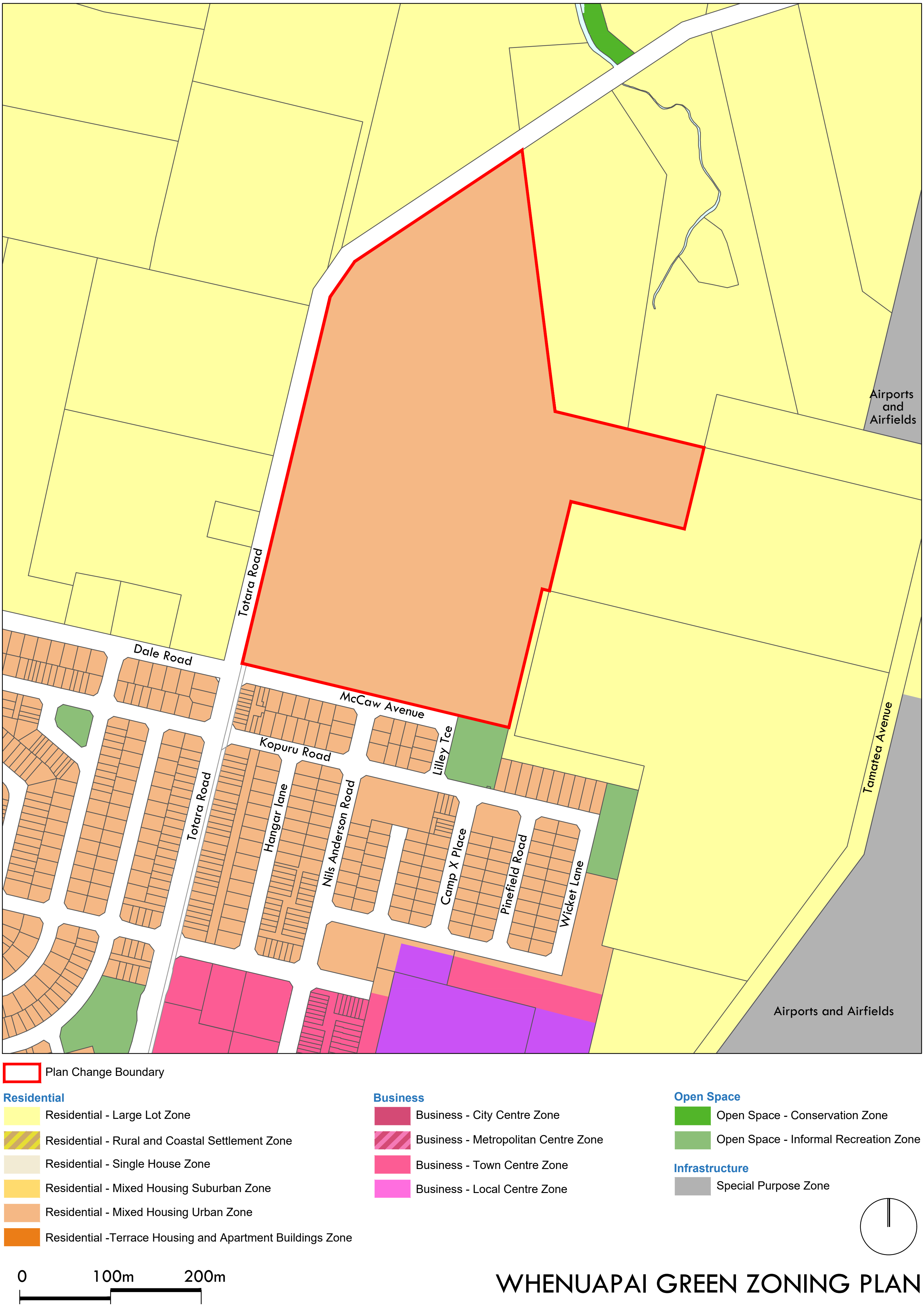
- Catchment Plans 4520-PC-SW-430(A), 431(A), 432(A) & 433(A)



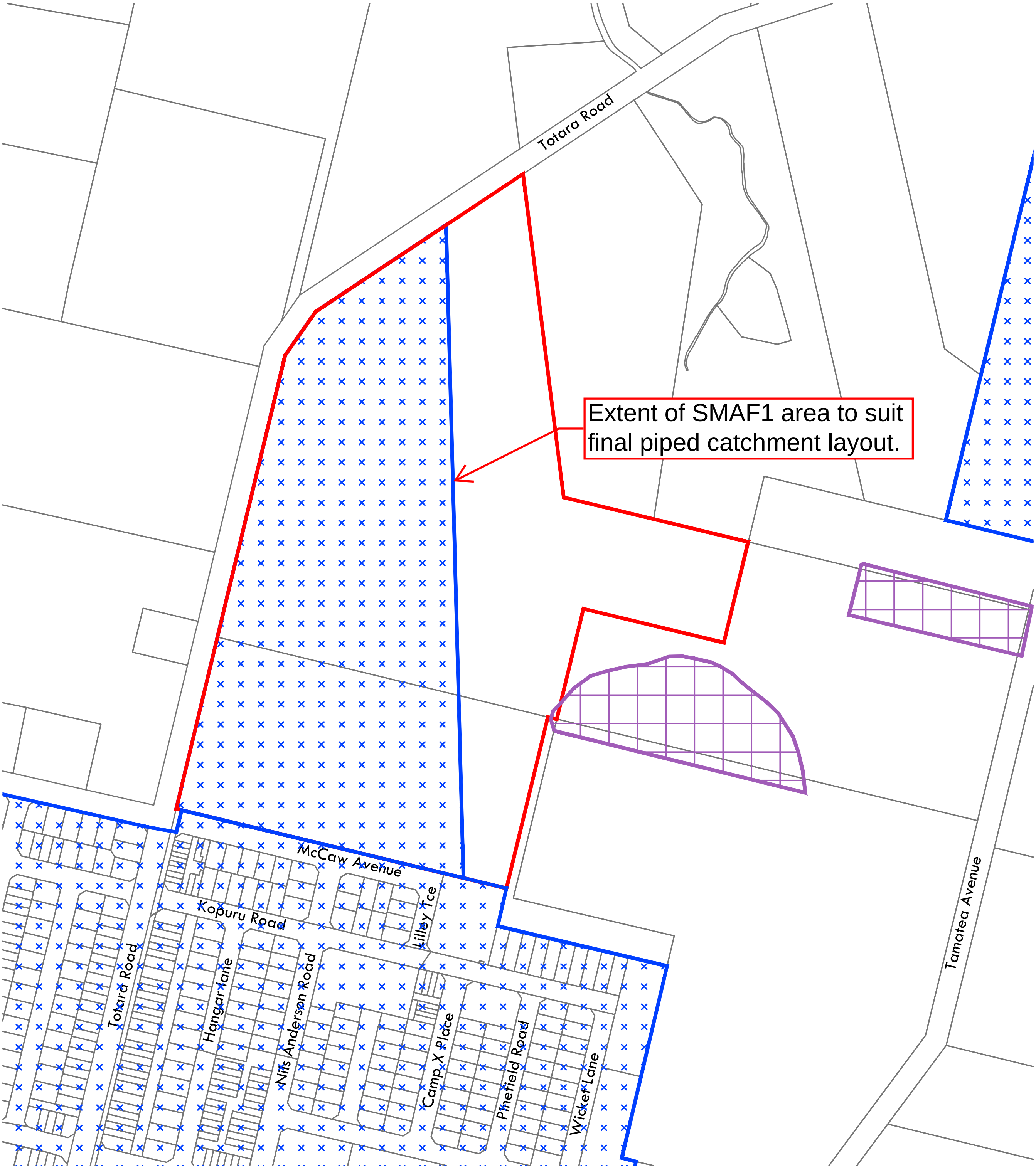
WHENUAPAI GREEN PRECINCT PLAN 1



WHENUAPAI GREEN PRECINCT PLAN 2 - NOISE MITIGATION AREAS



WHENUAPAI GREEN ZONING PLAN



Extent of SMAF1 area to suit final piped catchment layout.

🟥 Precinct Boundary

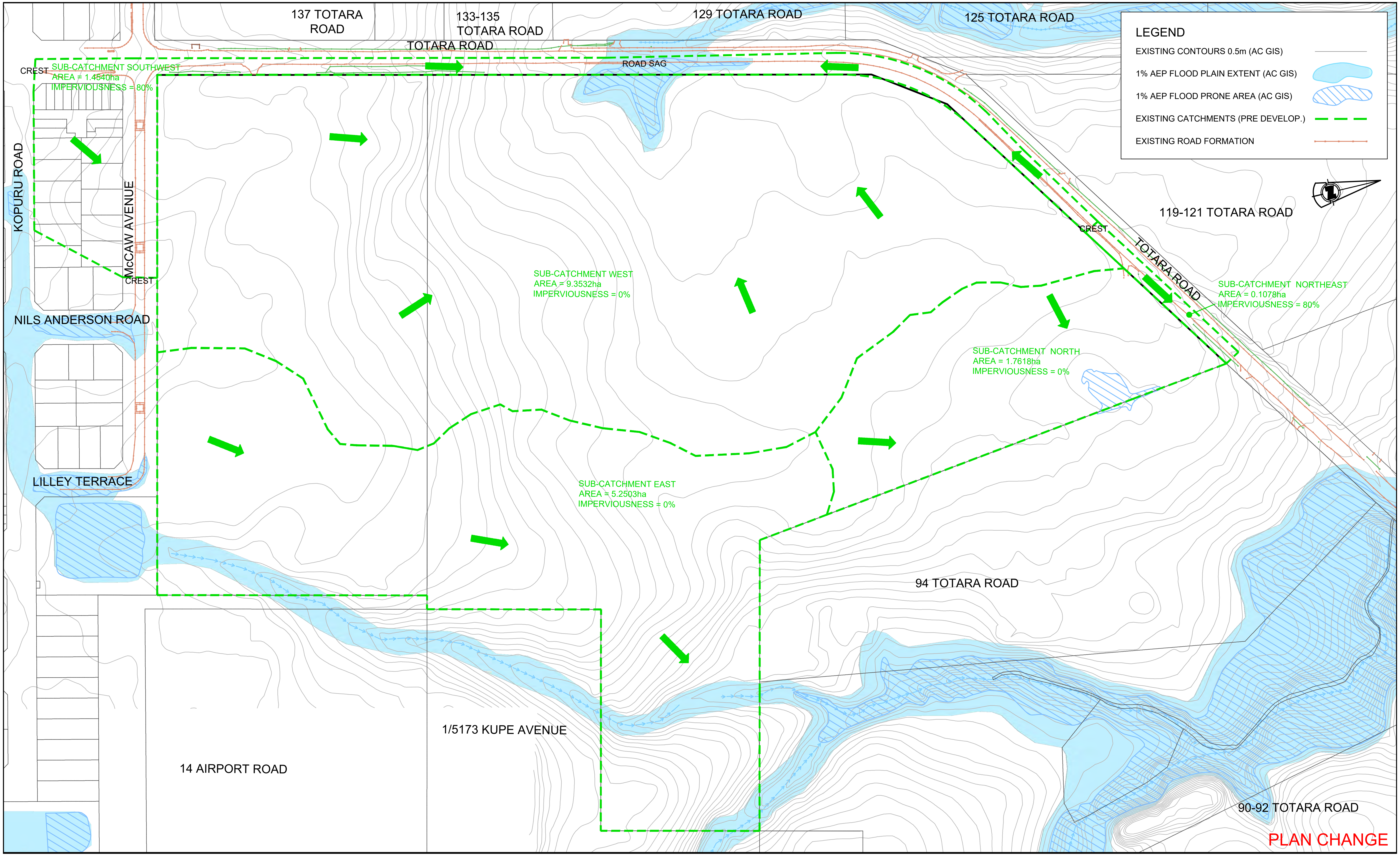
Historical Heritage & Special Character

▦ Historical Heritage Overlay Extent of Place [rcp/dp]

× Flow 1 [rp]
▤ Flow 2 [rp]
Stormwater Management Area Control

0 100m 200m

WHENUAPAI GREEN OVERLAY PLANS



Rev	Description	By	Date
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Job Title
WHENUAPAI GREEN
98–102 TOTARA ROAD
WHENUAPAI

Drawing Title
STORMWATER DRAINAGE
1% AEP EXISTING (PRE–DEVELOP.)
CATCHMENT AREAS

	By	Date
Surveyed:	CP / MS	
Designed:	KLP	
Drawn:	KLP	02/2024
Approved:	BJ	

Scale
1:2000@A3

Job No. 4520

Drawing No.
4520–PC–SW–430

Rev
A

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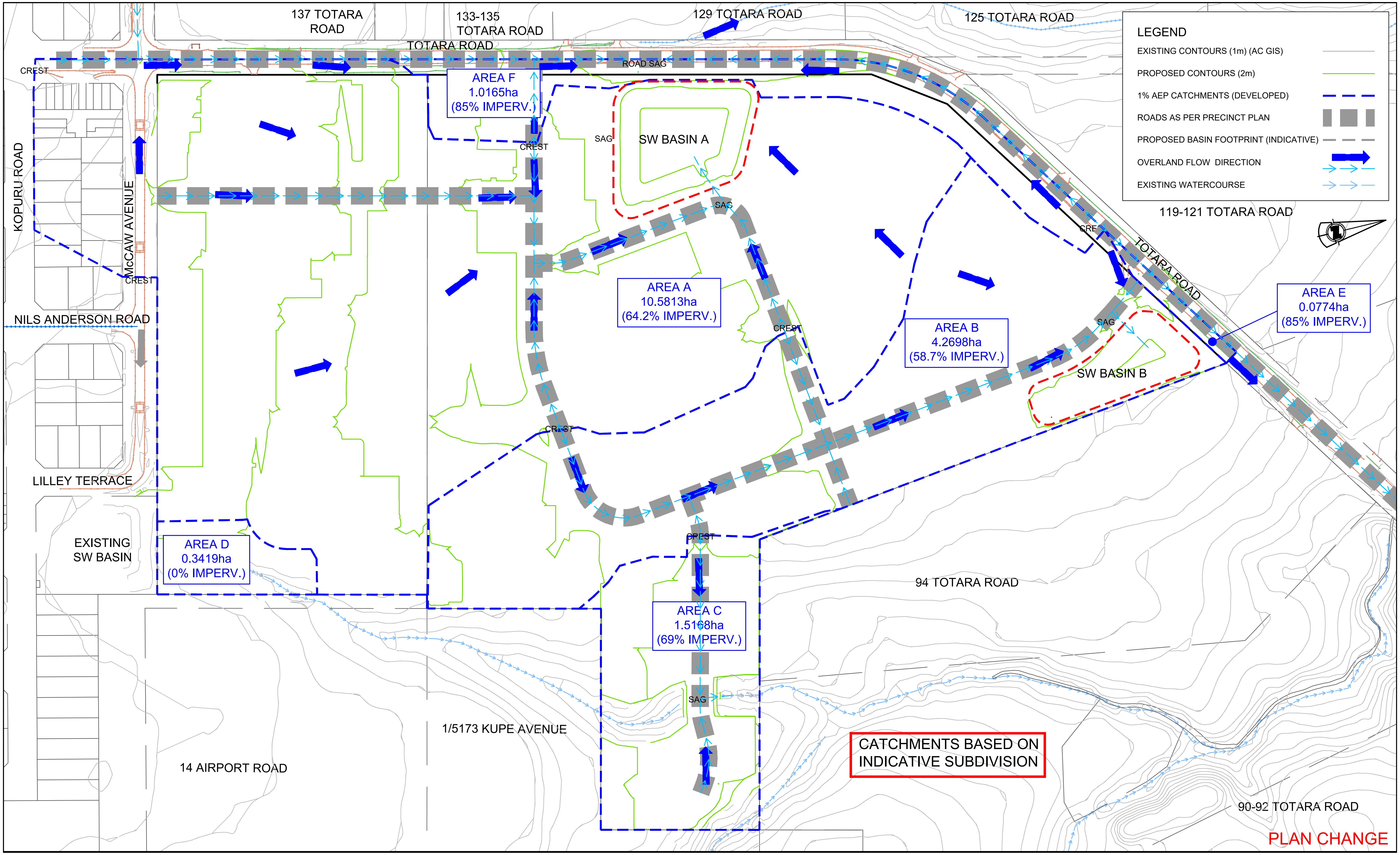

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Job Title
WHENUAPAI GREEN
98-102 TOTARA ROAD
WHENUAPAI

Drawing Title
STORMWATER DRAINAGE
1% AEP DEVELOPED
CATCHMENT AREAS

	By	Date	Scale	Job No. 4520
Surveyed:	CP / MS		1: 2000@A3	Drawing No. 4520-PC-SW-431
Designed:	KLP			Rev A
Drawn:	KLP	02/2024		
Approved:	BJ			

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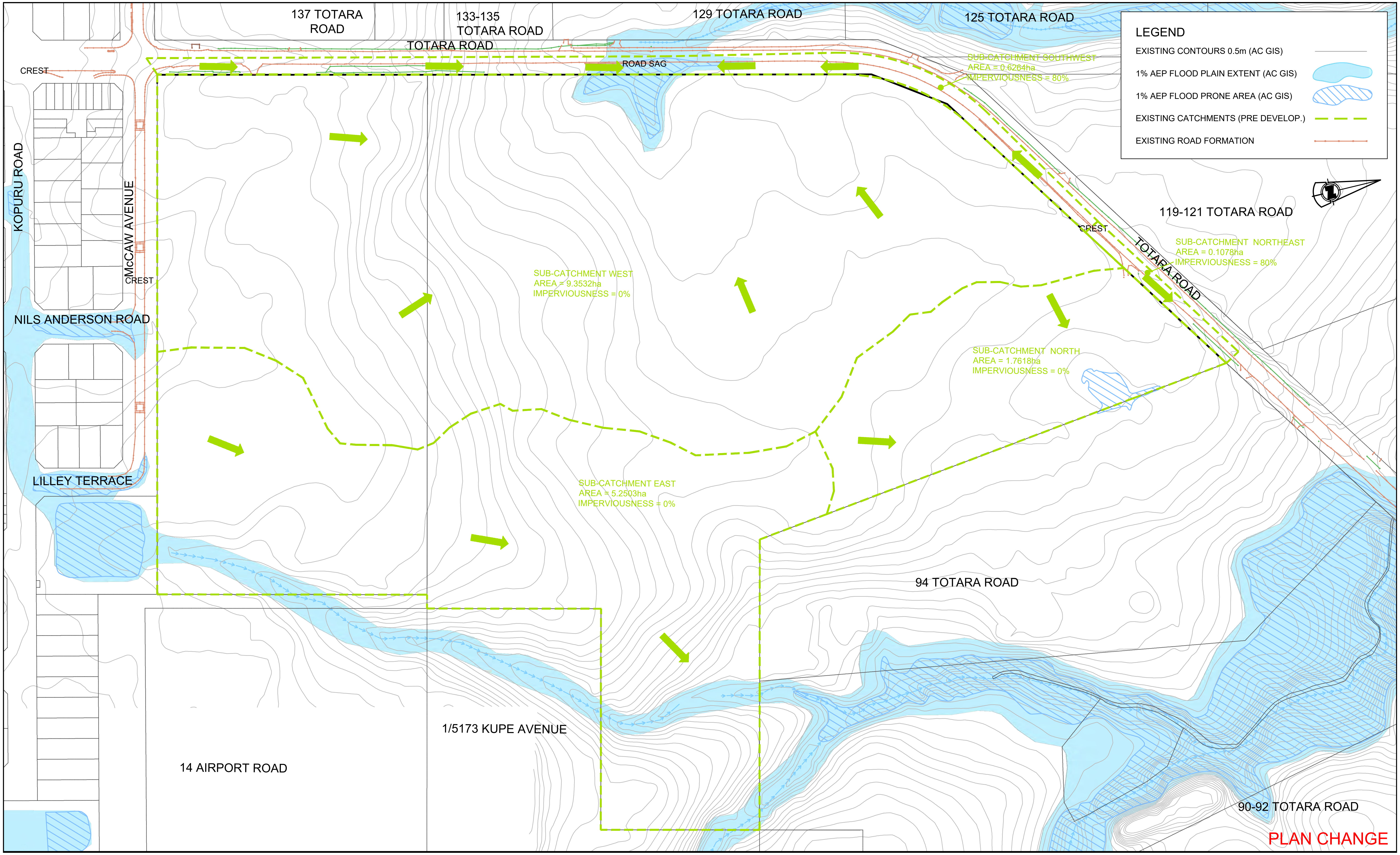

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Job Title
WHENUAPAI GREEN
98–102 TOTARA ROAD
WHENUAPAI

Drawing Title
STORMWATER DRAINAGE
10% AEP EXISTING (PRE–DEVELOP.)
CATCHMENT AREAS

	By	Date	Scale
Surveyed:	CP / MS		1:2000@A3
Designed:	KLP		
Drawn:	KLP	02/2024	
Approved:	BJ		

Job No. 4520
Drawing No. 4520–PC–SW–432
Rev A

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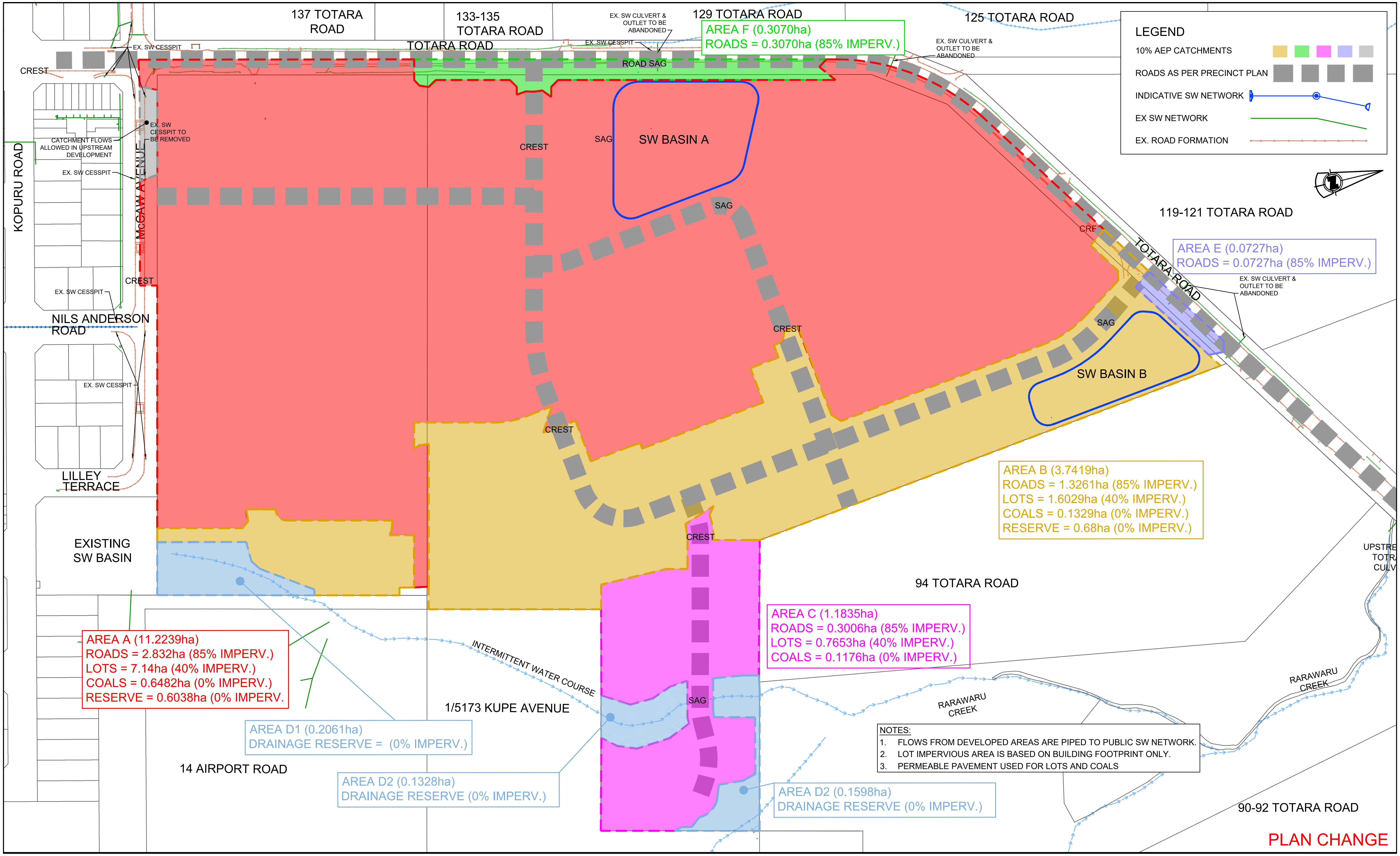

AREA F (0.3070ha)
ROADS = 0.3070ha (85% IMPERV.)

AREA E (0.0727ha)
ROADS = 0.0727ha (85% IMPERV.)

AREA B (3.7419ha)
ROADS = 1.3261ha (85% IMPERV.)
LOTS = 1.6029ha (40% IMPERV.)
COALS = 0.1329ha (0% IMPERV.)
RESERVE = 0.68ha (0% IMPERV.)

AREA C (1.1835ha)
ROADS = 0.3006ha (85% IMPERV.)
LOTS = 0.7653ha (40% IMPERV.)
COALS = 0.1176ha (0% IMPERV.)

AREA A (11.2239ha)
ROADS = 2.832ha (85% IMPERV.)
LOTS = 7.14ha (40% IMPERV.)
COALS = 0.6482ha (0% IMPERV.)
RESERVE = 0.6038ha (0% IMPERV.

AREA D1 (0.2061ha)
DRAINAGE RESERVE = (0% IMPERV.)

AREA D2 (0.1328ha)
DRAINAGE RESERVE (0% IMPERV.)

AREA D2 (0.1598ha)
DRAINAGE RESERVE (0% IMPERV.)

NOTES:
1. FLOWS FROM DEVELOPED AREAS ARE PIPED TO PUBLIC SW NETWORK.
2. LOT IMPERVIOUS AREA IS BASED ON BUILDING FOOTPRINT ONLY.
3. PERMEABLE PAVEMENT USED FOR LOTS AND COALS

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B	MINOR CHANGE TO LABELS	BJ	10/2024
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Job Title
WHENUAPAI GREEN
98–102 TOTARA ROAD
WHENUAPAI

Drawing Title
STORMWATER DRAINAGE
10% AEP DEVELOPED
CATCHMENT AREAS

	By	Date	Scale
Surveyed:	CP / MS		1:2000@A3
Designed:	KLP		
Drawn:	KLP	02/2024	
Approved:	BJ		

Job No. 4520
Drawing No. 4520–PC–SW–433
Rev B

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APPENDIX B

- Hydraulic Modelling Report (HMR), Whenuapai Green.
- Technical Memo – Stream Erosion Risk Assessment

Memo – Hydraulic Modelling Report (HMR)

WHENUAPAI GREEN

98-102 Totara Road - Whenuapai

25/10/2024

Revision 3

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Contents

List of Tables

List of Figures

Memo – Hydraulic Modelling Report (HMR)

WHENUAPAI GREEN

1. Scope

The primary aim of this report is to provide support to Whenuapai Green Development (WGD) application for a Plan Change (PC) and evaluate the potential changes in surface water elevations immediately downstream of the Plan Change Area (PCA). This report examines two distinct scenarios:

a. Pre-development: Assumes existing conditions for the entire catchment area.
b. Post-development: Assumes WGD area developed to 70% impervious and the rest of the catchment to be unchanged (existing conditions).

In both scenarios, the assessment considers an extreme rainfall event with a 1% Annual Exceedance Probability (AEP[1]), incorporating a 3.8°C of warming factor. This comparison is essential for understanding the impact of the proposed development on surface water levels and ensuring that WGD does not increase flooding to existing buildings/dwellings.

2. Site Overview

The proposed Whenuapai Green development encompasses existing properties located at 98-100 and 102 Totara Road, Whenuapai, covering a total area of 16.36 hectares. The site predominantly serves as pastureland and has been utilized for cattle farming.

McCaw Avenue forms the southern boundary of the site, while Totara Road defines the western and northwest boundaries. To the east lies the NZDF Whenuapai Air Force Base. Additionally, recent housing developments have taken place to the south of the site.

3. Existing Flood Model

Recently, Auckland Council (AC) has issued an update to the Whenuapai Rapid Flood Hazard Assessment (RFHA), referred as model ID 1399. This update incorporates a temperature increase of 3.8°C, reflecting climate change effects, along with coastal tidal conditions reaching RL 2.89m. The primary objective of the RFHA is to delineate areas susceptible to flooding in the absence of adequate pipework infrastructure. Notably, the RFHA operates under the assumption of maximum probable development (MPD) across the entire catchment, with 80% impervious surface coverage and a 1% Annual Exceedance Probability (AEP) threshold.

However, it's imperative to acknowledge that AC's GEOMAPS flood extent, while informative, is not directly applicable to the WGD PC application. Unlike the RFHA, which assumes full catchment development, the WGD PC application presents a unique development scenario that differs in impervious surface coverage and other key parameters. Therefore, careful consideration and contextualization of these assessments are essential for informed flood risk management and mitigation strategies within the Whenuapai area.

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[1] The probability of exceeding a given threshold within a period of one year. For example, in relation to flooding, 1% AEP flood plain is the area that would be inundated in a storm event of a scale that has a 1% or greater probability of occurring in 1 year. (Auckland Council)

4. Objective

This report aims to provide support for WGD PC application by refining existing flood modelling (Auckland Council RFHA model ID 1399, 2023) to represent the actual effects of WGD PC application, acknowledging the limitations and differences from AC RFHA model.

It is important to note future developments upstream or downstream from this PCA should undertake hydraulic modelling to assess their effects on the existing environment and provide necessary mitigation measures.

5. Hydraulic Model

A hydrological and hydraulic model was built using HEC-HMS v4.1 and HEC_RAS v6.1 software. The following parameters were used:

Terrain:

- Existing terrain: Auckland LiDAR 1m DEM (2016/2018).
    - Vertical Accuracy Specification is +/- 0.2m (95%).
    - Horizontal Accuracy Specification is +/- 0.6m (95%).
    - Vertical Datum Auck46 translated to NZVD2016 (+276mm).
- Proposed terrain: Combined Existing terrain LiDAR, recently surveyed data and proposed Whenuapai Green Development terrain.

2D Surface and Mesh zones

A flexible mesh was created for the entire site (contributing catchment) using a combined surface:

- For areas of less or no concern, cell size used was 100m^2 (10 x10m)
- For areas of overland flow path, cell size used was 1m^2 (1 x 1m)
- Break lines were included along road centrelines to align mesh perpendicular to flow direction.
- Weir coefficient used (Totara Rd and future panhandle road crossing) was 1.66.

Roughness

For 1D elements, such as culverts, the friction factor assigned was 0.013 (Manning’s, n value).

Existing culverts of less than 1,500DN were assumed to be 100% blocked. Existing culverts of 1,500DN or greater were assumed 50% blocked.

The proposed Basin A outlet pipes (double barrel 750mmDN) were assumed to be 50% blocked and sized for 2 x 1% AEP storm event.

For 2D roughness values a land cover polygon layer was created using the parameters listed in Table 5-1:

Table 5-1: Roughness values over 2D domain

Land use ID	Description	Manning's
1	Grass	0.1
2	Road / COAL	0.05
3	Watercourse	0.04
4	Buildings	0.5

6. Hydrological Model

The hydrological model was developed as per TP108 (Auckland Regional Council, 1999) considering two separate catchments: Ratara Stream Catchment and Rarawaru Creek Catchment. Each sub-catchment was split into pervious/impervious components, and its respective lag time (Tp) was calculated. Both catchments outfall to the Waitemata Harbour.

The flows generated from the HEC HMS project were introduced to the HEC RAS 2D model as inflow boundary conditions. Refer to Appendix B for HEC HMS model details.

Curve Number

Based on Geotechnical site investigation (CMW Geosciences, 2022) carried out between August 2019 and October 2022, it is assumed the geology in the Whenuapai area to be the following:

> *"Published Geological Maps1 suggest the site is underlain by alluvial deposits of Puketoka Formation (Tauranga Group) overlying alternating sandstone and siltstone (with variable volcanic content and interbedded volcaniclastic grits) of the Waitemata Group."*

The soil layer were created based on the soil type classification used in AC RFHA report (Auckland Council - Ewater NewZealand Ltd, 2023) and the Ministry for the Environment data portal (Ministry for the Environment, 2016).

Therefore, the CN values assumed for the Hydrological model were:

- 74 for all pervious areas (assuming soil type group C)
- 98 for all impervious areas.

Rainfall

Rainfall was derived from TP108 (Auckland Regional Council, 1999) figure A.6 100-year ARI Daily Rainfall Depth (195mm) and then increased by 32.68% to account for 3.8 degrees Celsius of climate change factor (259mm).

Tidal Boundary

Downstream water level boundary condition of RL 2.89m (Assuming 1 metre sea level rise) as per (Auckland Council Stormwater Flood Modelling Specifications, 2011) Section 7.1.3.

Flood Model Parameters

Following the construction of the flood model, a series of sensitivity tests were carried out to evaluate its accuracy. To validate the model, the flood results were compared with Auckland Council's GEOMAPS flood plains layer. It's important to highlight that this comparison specifically focused on the Future Development (MPD) scenario, which is the only publicly available layer on the council's GEOMAPS website.

In the MPD scenario, the flood model's results closely approximated Auckland Council's GEOMAPS flood plains layer within acceptable tolerance levels. The consistency observed between the flood model results and the GEOMAPS layer for the MPD scenario provides assurance regarding the overall reliability of the model.

<u>Totara Road Culvert (DN2300mm)</u>

The existing DN2300mm culvert is situated outside the proposed Plan Change Area at Totara Road (road sag), as shown in Figure: 6-1 below, providing flow continuity to the existing Rarawaru Creek. Table 6-1 provides a summary of the parameters used in the hydraulic model:

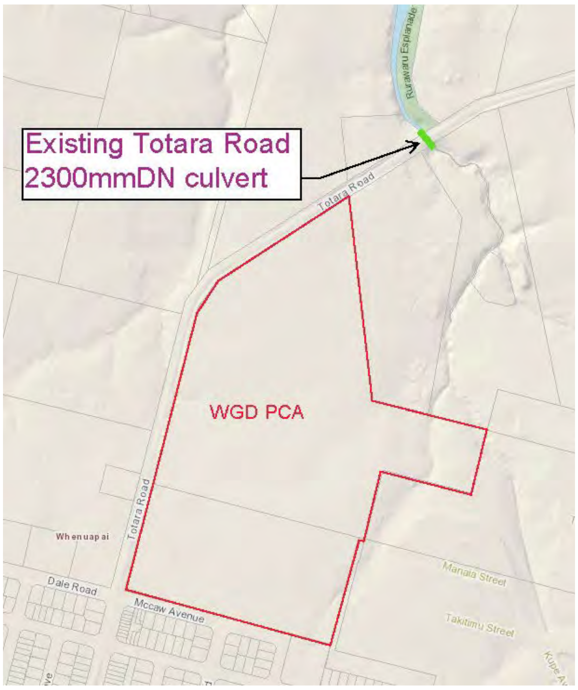

Figure: 6-1 Existing Totara Road DN2300mm culvert location.

Figure: 6-2: Existing Totara Road DN2300mm culvert (view from downstream end)

Table 6-1: Existing Totara Road DN2300mm culvert

Parameter	Value
Culvert size	**2,300mm**
Culvert length	35m (approx.)
Culvert material	Concrete
Inlet configuration	Projecting from fill
Upstream invert level	1.8m (approx.)
Downstream invert level	1.41m (surveyed)
Culvert grade	1.11%
Road chainage	1,304m (approx.)
Road lowest RL (at sag)	10.1m (surveyed)

The properties surrounding Totara Road culvert are predominantly rural. Auckland Council's GEOMAPS indicates no potential flood hazard to property dwellings downstream to Totara Road Culvert, based on its RFHA which assumes 80% of maximum probable development. However, it is noted that upstream property, 94 Totara Road, partially falls within the 1% Annual Exceedance Probability (AEP) flood extent. An aerial survey analysis reveals several building structures on this property, with only one structure situated within the AC GEOMAPS 1% AEP flood extent, assumed to be a minor dwelling. Notably, the main dwelling stands at an elevation of at least 5m above the AC GEOMAPS 1% AEP flood level (approx. RL:11m). Table 7.2 below provides the assumed floor levels of the potentially affected structures on 94 Totara Road:

Table 6-2: 94 Totara Road existing structures elevations (RL)

Structure	Elevation (RL)
Main dwelling	16m
Shed/workshop	13.15m
Minor dwelling	9.22m

Rarawaru Creek Flood Model Assessment Scenarios and Results

The hydraulic model presented in this report was subjected to a series of scenarios to evaluate the potential impact of the proposed development (WGD PC) on flood flows, extents, depth and velocities downstream.

This report primarily focuses on comparing flood parameters between existing conditions (pre-development) and the proposed development scenario (WGD PC area developed while the rest of the catchment remains unchanged). Additionally, the analysis incorporates three distinct blockage conditions for the existing Totara Road culvert (DN2300mm): 100%, 50% and 0%. A scenario matrix detailing these variations is presented in Table 6-3 below.

Table 6-3: Flood Model Scenarios Matrix

Scenarios	Pre-Development [TP108]	WGD [TP108]	Pre-Development [with CC]	WGD [with CC]
0% culvert blockage	Pre_[TP108] (0%)	WGD_[TP108] (0%)	Pre_[CC] (0%)	WGD_[CC] (0%)
50% culvert blockage	Pre_[TP108] (50%)	WGD_[TP108] (50%)	Pre_[CC] (50%)	WGD_[CC] (50%)
100% culvert blockage	Pre_[TP108] (100%)	WGD_[TP108] (100%)	Pre_[CC] (100%)	WGD_[CC] (100%)

Scenario Pre_[TP108](0%)

Pre-development [no Climate Change allowance] and (0% culvert blockage).

This scenario represents the pre-development conditions of the entire catchment with no culvert blockage. The assessment considers existing impervious surfaces based on Auckland Council's GEOMAPS impervious surfaces layer, which includes roads, buildings, and other impervious areas. The Totara Road culvert (DN2300mm) is assumed to be completely unobstructed (0% blockage), allowing for unrestricted stormwater flow. The rainfall depth adopted in this scenario is 195mm, as per Auckland Council document TP108 contour maps (Figure A6). This scenario helps in understanding the baseline flood extents, depths, and velocities without any developmental changes or culvert blockages.

Results:

The 1% AEP hydraulic analysis results are summarised in the Table 6-4 and represented in Figure 6-3. These results will be used as baseline parameters when comparing with post-development scenario WGD_[TP108](0%).

Table 6-4: Totara Road DN2300mm culvert Scenario Pre_[TP108](0%) results.

Parameter	Value
Culvert blockage	0%
Whenuapai Green Developed	No
Headwater elevation (RL)	5.55m
94 Totara Road minor dwelling freeboard	3.67m
94 Totara Road shed/workshop freeboard	7.60m
94 Totara Road main dwelling freeboard	10.45m
Totara Road freeboard (or flood depth)	4.55m
Upstream headwater depth	3.75m
Downstream tailwater depth	2.48m
Downstream 1% AEP peak flow rate	17.11m^3/s
Downstream velocity	1.22m/s

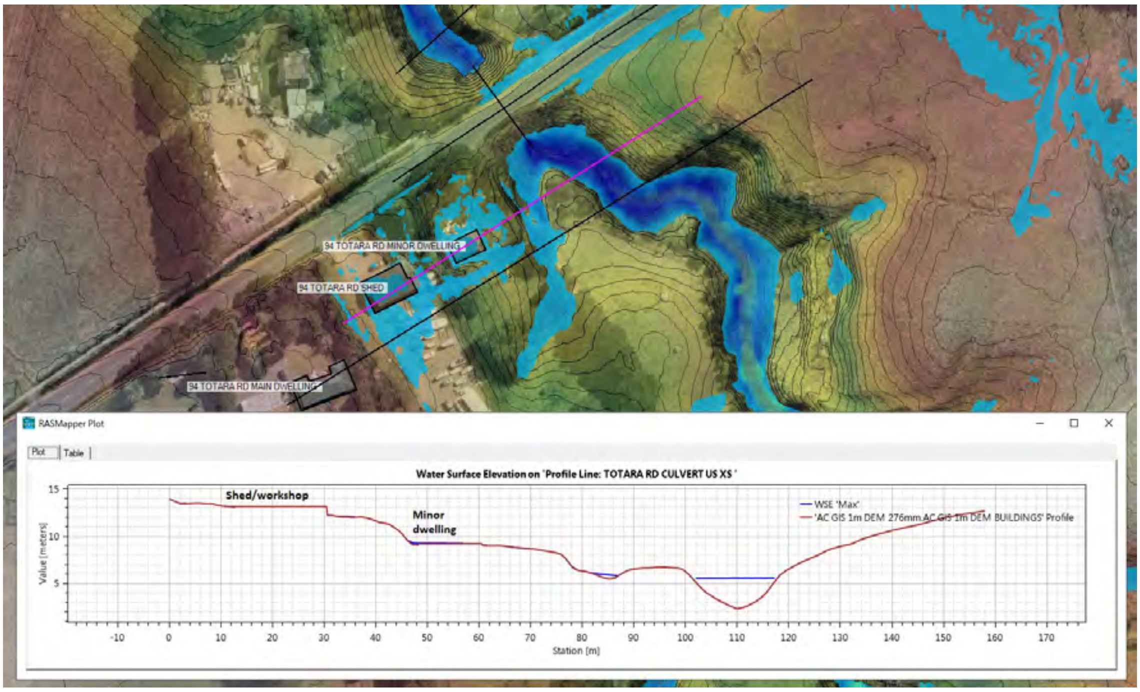

Figure 6-3: Totara Road DN2300mm culvert Scenario Pre_[TP108](0%) results.

Scenario Pre_[TP108](50%)

Pre-development [no Climate Change allowance] and (50% culvert blockage).

In this scenario, the pre-development conditions of the entire catchment are evaluated while considering a 50% blockage of the existing Totara Road culvert (DN2300mm). Partial blockage (50%) of the culvert is introduced in the model to comply with AC Code of Practice Chapter 4, Section 4.3.9.8. This scenario is critical for understanding the potential flood risk under current conditions with a moderate blockage in the culvert. The rainfall depth, assuming no climate change effects, remains consistent with Scenario Pre_[TP108](0%) at 195mm.

Results:

Table 6-5: Totara Road DN2300mm culvert Scenario Pre_[TP108](50%) results. Table 6-5 results and Figure 6-4 illustrates the flood extent at 94 Totara Road, upstream of the DN2300mm culvert, assuming a 50% culvert blockage. Based on this simulation scenario, there are no buildings located within the 1% AEP floodplain.

Table 6-5: Totara Road DN2300mm culvert Scenario Pre_[TP108](50%) results.

Parameter	Value
Culvert blockage	50%
Whenuapai Green Developed	No
Headwater elevation (RL)	7.82m
94 Totara Road minor dwelling freeboard	1.40m
94 Totara Road shed/workshop freeboard	5.33m
94 Totara Road main dwelling freeboard	8.18m
Totara Road freeboard (or flood depth)	2.28m
Upstream headwater depth	6.02m

Parameter	Value
Downstream tailwater depth	2.26m
Downstream 1% AEP peak flow rate	11.67m^3/s
Downstream velocity	0.97m/s

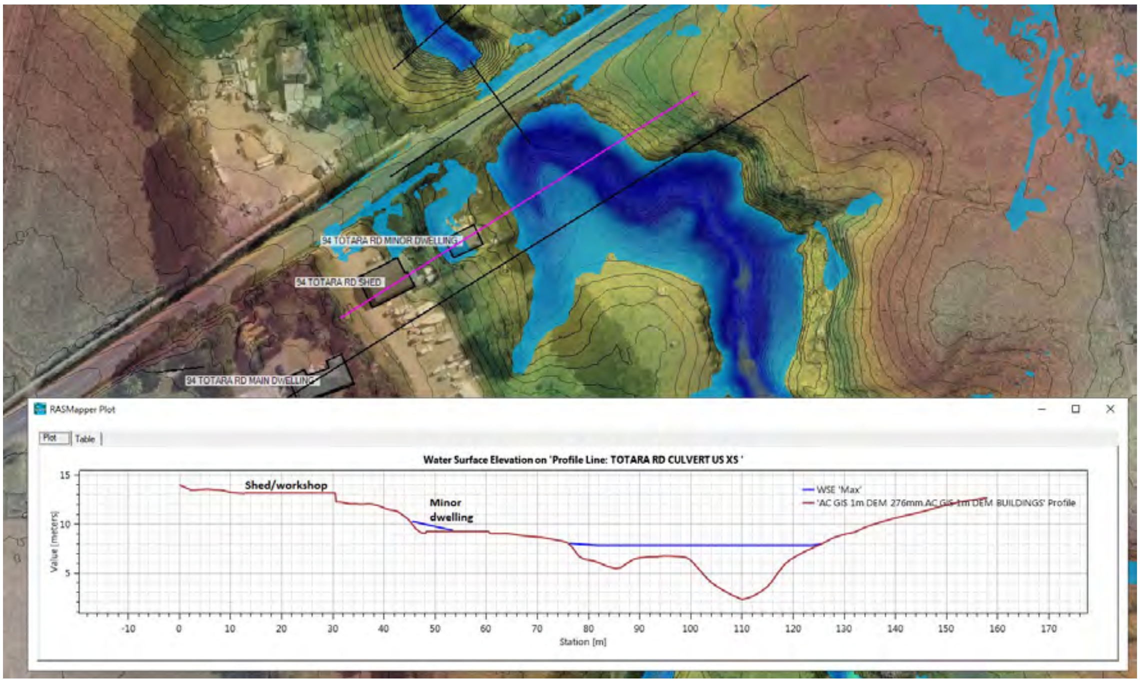

Figure 6-4: Totara Road DN2300mm culvert Scenario Pre_[TP108](50%) results.

Scenario Pre_[TP108](100%)

Pre-development [no Climate Change allowance] and (100% culvert blockage).

This scenario assesses the pre-development conditions assuming a full blockage (100%) of the Totara Road culvert (DN2300mm). A complete culvert blockage simulation is helpful to ascertain the secondary flow path (road overtopping) parameters such as extents, depths, and velocities. This scenario helps in evaluating the worst-case flood risk under current rainfall conditions (195mm).

Results:

In a worst-case scenario where the existing culverts is fully blocked and assuming current rainfall parameters (depth and intensities), the minor dwelling at 94 Totara Road is at risk of flooding. It is estimated the water level will be 1.28m above the minor dwelling floor level (assumed to be at RL 9.22m).

Table 6-6: Totara Road DN2300mm culvert Scenario Pre_[TP108](100%) results.

Parameter	Value
Culvert blockage	100%
Whenuapai Green Developed	No
Headwater elevation (RL)	10.50m
94 Totara Road minor dwelling freeboard	-1.28m

Parameter	Value
94 Totara Road shed/workshop freeboard	2.65m
94 Totara Road main dwelling freeboard	5.50m
Totara Road freeboard (or flood depth)	-0.34m
Upstream headwater depth	8.70m
Downstream tailwater depth	2.23m
Downstream 1% AEP peak flow rate	10.91m^3/s
Downstream velocity	0.99m/s

Similarly, the water depth at Totara Road lowest point (road sag) is approximately a 340mm. Figure 6-6 demonstrate that at this flood depth, the average flood flow velocity is 0.93m/s, which gives a depth x velocity product of 0.32m^2/s, categorizing it as an H2 event (unsafe for small vehicles) according to the Australian Rainfall & Runoff (AR&R) flood hazard vulnerability curve, refer to Figure 7-1 of this report.

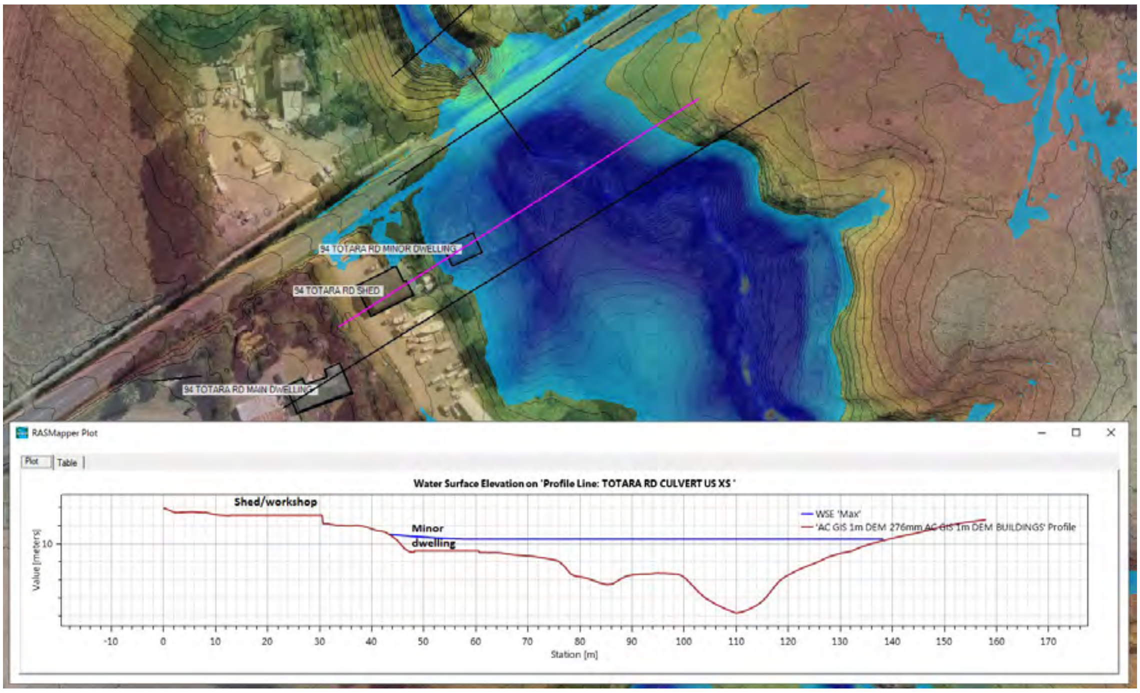

Figure 6-5: Totara Road DN2300mm culvert Scenario Pre_[TP108](100%) results.

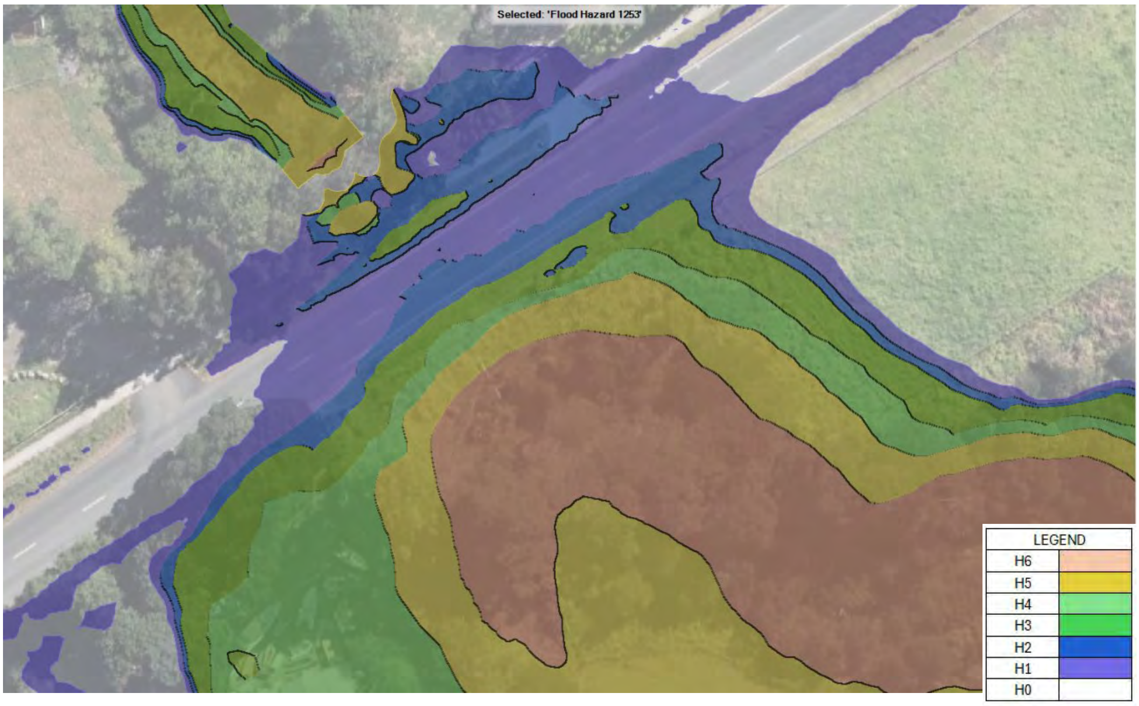

Figure 6-6: Totara Road Flood Hazard - Pre_[TP108](100%).

Scenario WGD_[TP108](0%)

PCA developed and rest of catchment unchanged [no Climate Change allowance] and (0% culvert blockage).

This scenario evaluates the impact of the proposed Whenuapai Green development (WGD) while the rest of the catchment remains unchanged (existing conditions). It assumes no blockage (0%) of the existing Totara Road culvert (DN2300mm). This setup allows for an assessment of how the new development affects flood extents, depths, and velocities, comparing the results to the baseline simulation, scenario Pre_[TP108](0%). Climate Change is not considered in this scenario and the rainfall depth used is 195mm for a 1% AEP storm event.

Results:

The results shown in Table 6-7 and Figure 6-7 confirm that even after development of the proposed Plan Change Area (PCA), under current rainfall parameters, there is no increase in headwater elevation upstream to Totara Road culvert. In fact, due to slight change in the catchment delineation within the PCA, there is a reduction in headwater elevation by 200mm. This reduction could also be attributed to the fact that the runoff generated from catchment B is diverted to downstream of the existing Totara Road culvert through basin B’s outlet.

Table 6-7: Totara Road DN2300mm culvert Scenario WGD_[TP108](0%) results.

Parameter	Value
Culvert blockage	0%
Whenuapai Green Developed	Yes
Headwater elevation (RL)	5.34m
94 Totara Road minor dwelling freeboard	3.88m
94 Totara Road shed/workshop freeboard	7.81m

Parameter	Value
94 Totara Road main dwelling freeboard	10.66m
Totara Road freeboard (or flood depth)	4.76m
Upstream headwater depth	3.54m
Downstream tailwater depth	2.52m
Downstream 1% AEP peak flow rate	17.18m^3/s
Downstream velocity	1.16m/s

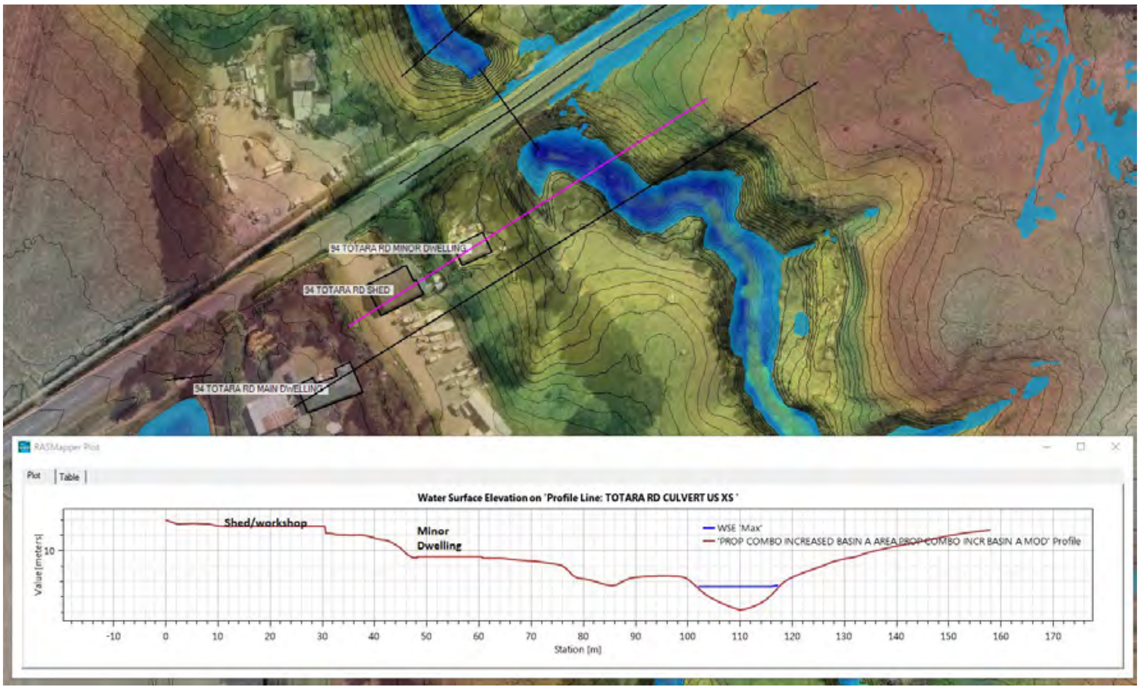

Figure 6-7: Totara Road DN2300mm culvert Scenario WGD_[TP108](0%).

Scenario WGD_TP108(50%)

PCA developed and rest of catchment unchanged [no Climate Change allowance] and (50% culvert blockage).

In this scenario, the impact of the proposed Whenuapai Green development is assessed with a 50% blockage of the existing Totara Road culvert (DN2300mm). The scenario considers full development of the PCA while keeping the rest of the catchment unchanged. The results are compared to the pre-development scenario with a similar 50% culvert blockage to determine the development's impact on flood risk. Climate Change is also not considered in this scenario.

Results:

Similarly to unobstructed culvert scenario, the results shown in Table 6-8 confirm a slight reduction in the headwater elevation at 94 Totara Road. This reduction, while marginal (182mm), reassures that the proposed plan change development imposes no risk of increasing flooding to existing buildings at 94 Totara Road.

Table 6-8: Totara Road DN2300mm culvert Scenario WGD_[TP108](50%) results.

Parameter	Value
Culvert blockage	50%
Whenuapai Green Developed	Yes
Headwater elevation (RL)	7.70m
94 Totara Road minor dwelling freeboard	1.52m
94 Totara Road shed/workshop freeboard	5.45m
94 Totara Road main dwelling freeboard	8.30m
Totara Road freeboard (or flood depth)	2.40m
Upstream headwater depth	5.90m
Downstream tailwater depth	2.28m
Downstream 1% AEP peak flow rate	11.52m^3/s
Downstream velocity	0.92m/s

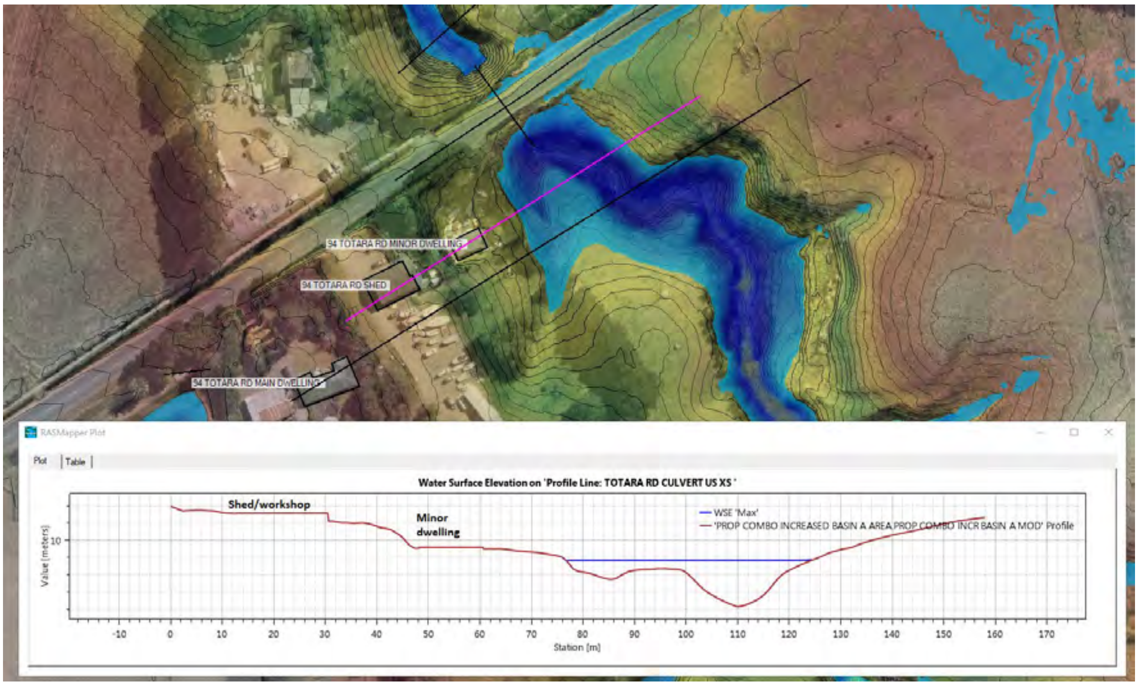

Figure 6-8: Totara Road DN2300mm culvert Scenario WGD_[TP108](50%) results.

Scenario WGD_[TP108](100%)

PCA developed and rest of catchment unchanged [no Climate Change allowance] and (100% culvert blockage).

This scenario examines the impact of the proposed WG development and assuming existing Totara Road culvert (DN2300mm) to be fully blocked (100%). By comparing the outcomes of this scenario to the pre-development conditions, Pre_[TP108](100%), the effects of the WG development on flood risk to the downstream properties can be evaluated. Climate Change is also not considered in this scenario and 24-hour 1% AEP rainfall adopted is 195mm.

Results:

Similar to the 50% culvert blockage scenario, the results shown in Table 6-9 confirm a slight reduction in the headwater elevation at 94 Totara Road, with a decrease of 20mm. This reduction, though minor, confirms that the proposed plan change development does not increase the flood hazard to existing buildings at 94 Totara Road.

Table 6-9: Totara Road DN2300mm culvert Scenario WGD_[TP108](100%) results.

Parameter	Value
Culvert blockage	100%
Whenuapai Green Developed	Yes
Headwater elevation (RL)	10.48m
94 Totara Road minor dwelling freeboard	-1.26m
94 Totara Road shed/workshop freeboard	2.67m
94 Totara Road main dwelling freeboard	5.52m
Totara Road freeboard (or flood depth)	-0.36m
Upstream headwater depth	8.68m
Downstream tailwater depth	2.19m
Downstream 1% AEP peak flow rate	9.58m^3/s
Downstream velocity	0.87m/s

Similarly to scenario Pre_[TP108](100%), the water depth at Totara Road lowest point (road sag) is approximately a 360mm. At this flood depth, the average flood flow velocity is 0.73m/s, which gives a depth x velocity product of 0.26m^2/s, categorizing it as an H1 event (generally safe for people, vehicles and buildings) according to the Australian Rainfall & Runoff (AR&R) flood hazard vulnerability curve, refer to Figure 7-1 of this report. Therefore, in a fully blocked culvert scenario, no increase in flood hazard due to WGD is observed.

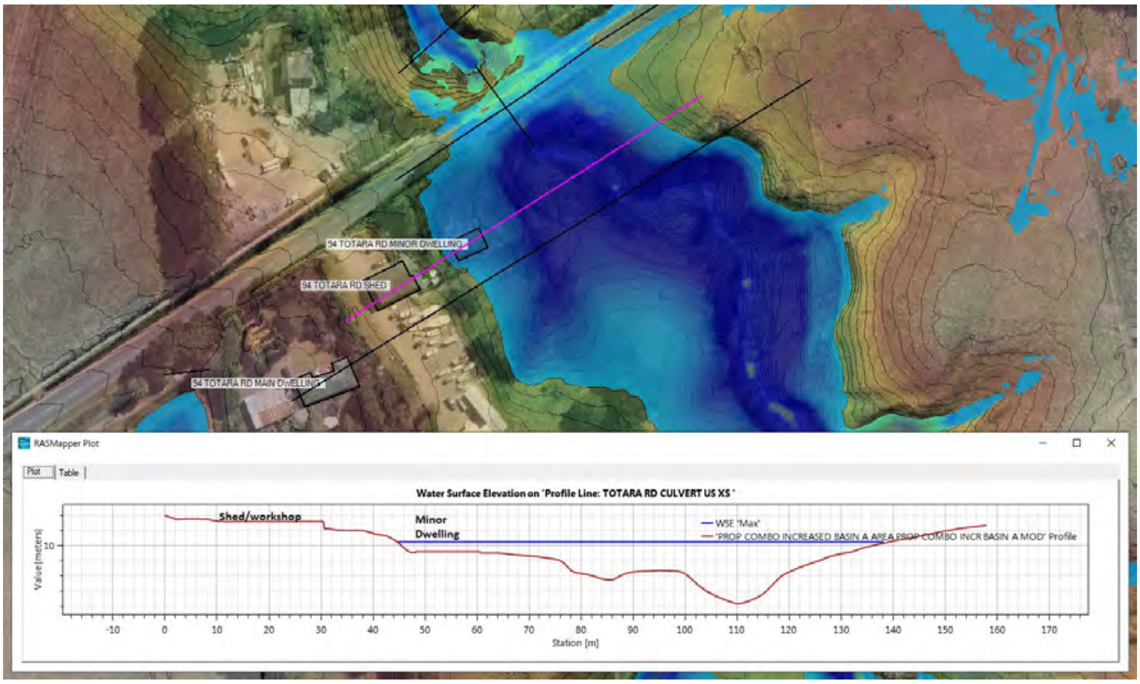

Figure 6-9: Totara Road DN2300mm culvert Scenario WGD_[TP108](100%) results.

Scenario Pre_[CC] (0%)

Pre-development (with Climate Change allowance) and 0% culvert blockage.

This scenario represents the pre-development conditions of the entire catchment, incorporating the effects of climate change. It accounts for existing impervious surfaces based on Auckland Council's GEOMAPS impervious surfaces layer, encompassing roads, buildings, and other impervious areas. The simulation evaluates flood extent under the assumption of no further development within the catchment. Additionally, it considers the Totara Road culvert (DN2300mm) to be unobstructed, with a 0% blockage condition. Rainfall depth utilized in this scenario amounts to 259mm, reflecting the impact of climate change with a temperature increase of 3.8 degrees Celsius.

Results:

Table 6-10 demonstrates how the adoption of climate change increase factor (3.8 degrees Celsius) to rainfall parameter impacts the flood results when compared to scenario Pre_[TP108](0%). The headwater elevation is increases by 1.57m; however, a 2.11m freeboard is still maintained for the existing minor dwelling. In this scenario, the increase in peak flow rate and average velocity downstream of the culvert is 5.26m^3/s and 0.23m/s respectively.

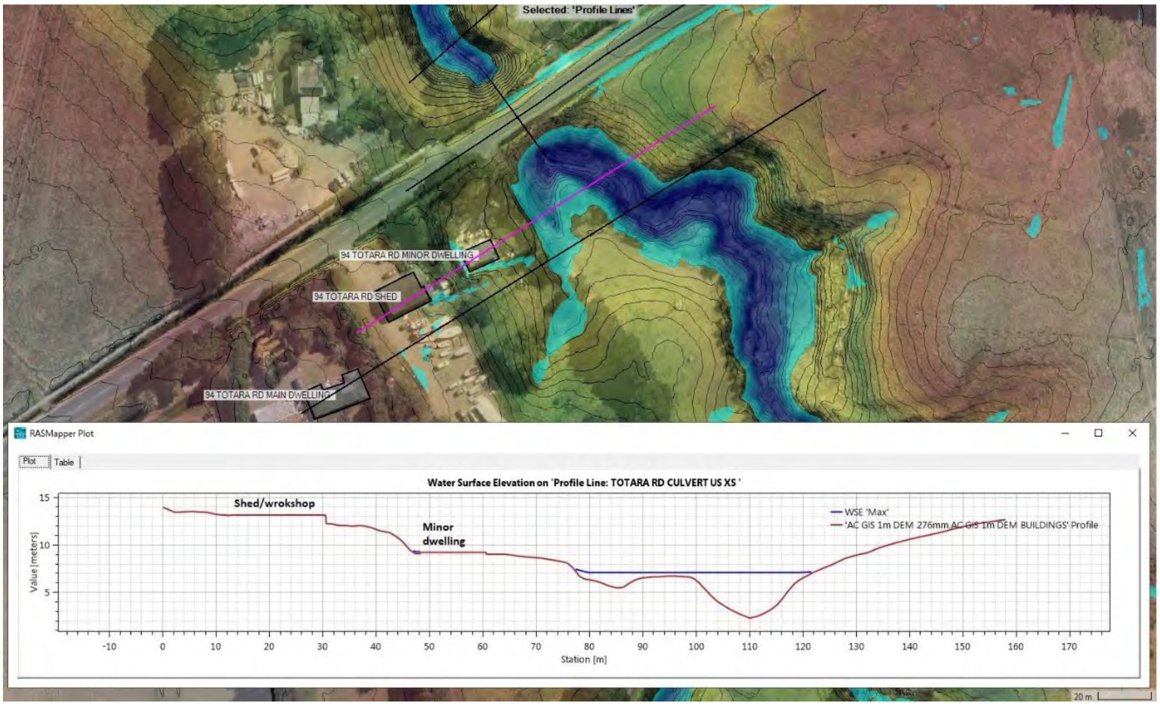

Figure 6-10: Totara Road DN2300mm culvert Scenario Pre_[CC] (0%) result.

The 1% AEP hydraulic analysis results are summarised in the Table 6-10 below:

Table 6-10: Totara Road DN2300mm culvert - Scenario Pre_[CC] (0%) results.

Parameter	Value
Culvert blockage	0%
Whenuapai Green Developed	No
Headwater elevation (RL)	7.1m
94 Totara Road minor dwelling freeboard	2.11m
94 Totara Road shed/workshop freeboard	6.04m
94 Totara Road main dwelling freeboard	8.89m
Totara Road freeboard (or flood depth)	2.99m
Upstream headwater depth	5.31m
Downstream tailwater depth	2.68m
Downstream 1% AEP peak flow rate	22.36m^3/s
Downstream velocity	1.43m/s

These results set the baseline parameters to be use in comparison with scenario WGD_[CC] (0%).

Scenario Pre_[CC](50%)

Pre-development [with Climate Change allowance] and (50% culvert blockage).

In this scenario, the pre-development conditions of the catchment are assessed while considering a 50% blockage of the existing Totara Road culvert (DN2300mm). Similar to Scenario Pre_CC (0%), existing impervious surfaces are factored in, along with the effects of climate change. However, the presence of a 50% blockage in the culvert introduces constraints on the flow of stormwater, impacting flood extents and velocities downstream. The rainfall depth, inclusive of climate change effects, remains consistent with Scenario Pre_CC (0%) at 259mm.

Results:

In this scenario, as shown in Table 6-11 there is a significant increase in headwater elevation by 1.95m. Consequently, the assumed floor level of the existing minor dwelling is 550mm below the flood water elevation. Despite the substantial rise in headwater, the increase in peak flow rate and average velocity downstream of the culvert is marginal.

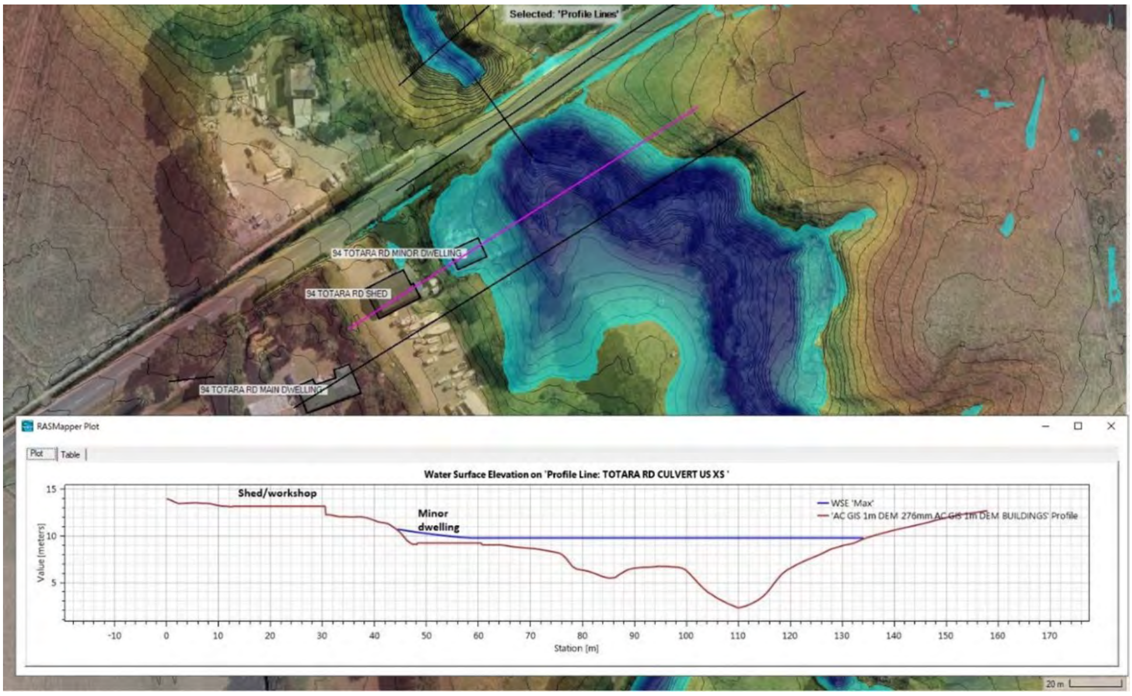

Figure 6-11: Totara Road DN2300mm culvert Scenario Pre_CC (50%) result.

The 1% AEP hydraulic analysis results are summarised in the Table 6-11 below:

Table 6-11: Totara Road DN2300mm culvert - Scenario Pre_[CC](50%) results.

Parameter	Value
Culvert blockage	50%
Whenuapai Green Developed	No
Headwater elevation (RL)	9.77m
94 Totara Road minor dwelling freeboard	-0.55m
94 Totara Road shed/workshop freeboard	3.38m
94 Totara Road main dwelling freeboard	6.23m
Totara Road freeboard (or flood depth)	0.33m
Upstream headwater depth	7.97m
Downstream tailwater depth	2.28m
Downstream 1% AEP peak flow rate	11.86m^3/s
Downstream velocity	0.99m/s

Scenario Pre_[CC](100%)

Pre-development [with Climate Change allowance] and (100% culvert blockage).
This scenario assesses the pre-development conditions of the catchment while assuming a complete blockage of the Totara Road culvert (DN2300mm). With no flow passage through the culvert, this scenario represents the worst-case scenario, potentially leading to roadway overtopping. In this context, it provides insights into the extent of secondary overland flow paths. Similar to previous scenarios, existing impervious surfaces and climate change effects are considered. Rainfall depth, incorporating climate change impacts, remains consistent at 259mm.

Results:
In the scenario Pre_[CC](100%), the adoption of a climate change increase factor (3.8 degrees Celsius) results in an increase in headwater elevation by 180mm when compared to historical (TP108) rainfall parameters. Similarly, downstream of the culvert, the peak flow rate and average velocity increase significantly, by 13.21m³/s and 0.62m/s respectively, as shown in Table 6-12.

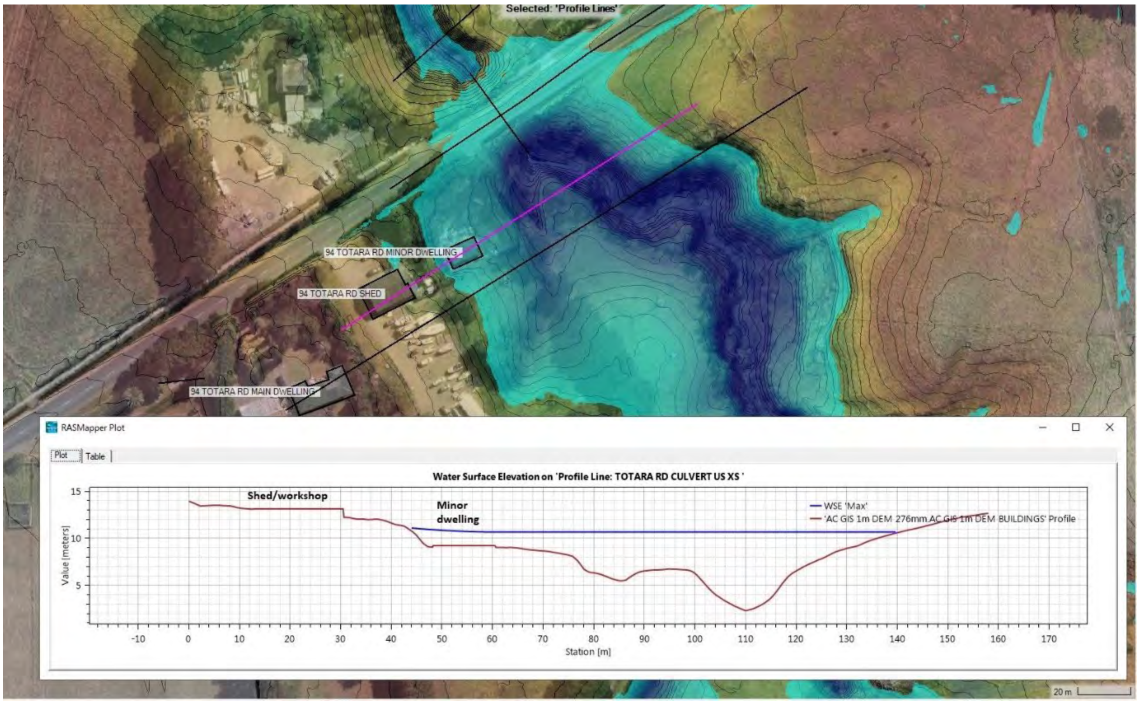

Figure 6-12: Totara Road DN2300mm culver Scenario Pre_[CC] (100%) result.

The hydraulic analysis results for Scenario Pre_[CC](100%) are summarized in Table 6-12:

Table 6-12: Totara Road DN2300mm culvert - Scenario Pre_[CC](100%) results.

Parameter	Value
Culvert blockage	100%
Whenuapai Green Developed	No
Headwater elevation (RL)	10.68m

94 Totara Road minor dwelling freeboard	-1.46m
94 Totara Road shed/workshop freeboard	2.47m
94 Totara Road main dwelling freeboard	5.32m
Totara Road freeboard (or flood depth)	-0.47m
Upstream headwater depth	8.88m
Downstream tailwater depth	2.72m
1% AEP peak flow rate	24.12m^3/s
Downstream velocity	1.61m/s

The results demonstrate a significant increase in headwater elevation as a consequence of the assumed complete blockage of the culvert, leading to the overtopping of the road. At the lowest point of Totara Road (road centreline), the depth of the flow reaches approximately 470mm. The average velocity at this juncture registers at approximately 1.14m/s. This combination yields a depth-velocity product of 0.54, categorizing it as an H2 event (unsafe for small vehicles) in the Australian Rainfall & Runoff (AR&R) flood hazard vulnerability curve, Figure 7-1.

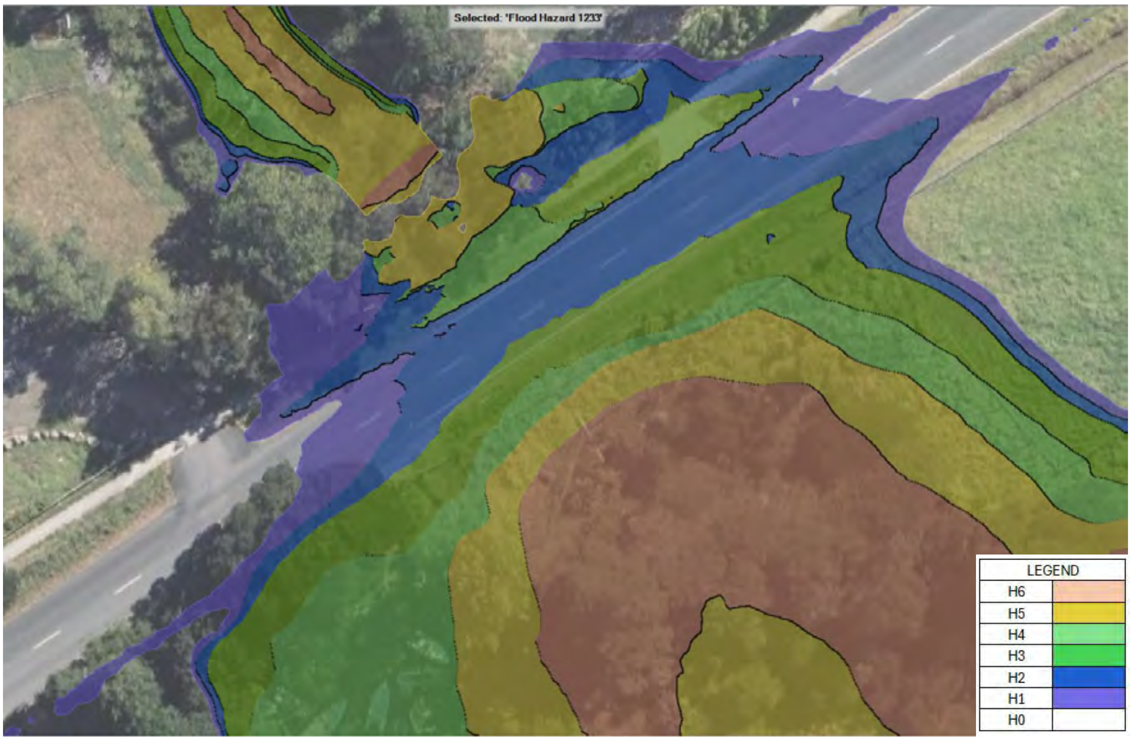

Figure 6-13: Totara Road Flood Hazard - Scenario Pre_[CC](100%).

Scenario WGD_[CC](0%)

PCA developed and rest of catchment unchanged [with Climate Change allowance] and (0% culvert blockage).

This scenario evaluates the impact of the proposed Whenuapai Green development (WGD) while considering the effects of climate change. It assumes the full development of the WGD area, while the remainder of the catchment remains unchanged. Operating under the assumption of a 0% blockage for the existing Totara Road culvert

(DN2300mm), the simulation analyses flood extents, flows, and velocities downstream of the culvert. By comparing the outcomes of this simulation to Scenario Pre_CC (0%), which represents pre-development conditions, the impact of WGD on flood risk to existing dwellings can be ascertained. Rainfall depth, incorporating climate change effects, remains consistent at 259mm.

Results:

In this scenario, as shown in Table 6-13, the development of the PCA under climate change conditions (3.8 degrees Celsius increase) and no culvert blockage results in a headwater elevation reduction of 190mm compared to the pre-development scenario using the same parameters. This reduction is due to the fact that the runoff generated from catchment B is diverted to downstream of the existing Totara Road culvert through Basin B's outlet, as discussed in previous scenario WGD[TP108](0%). Additionally, the peak flow rate downstream of the culvert increases marginally (1.32m3/s, or 6%), indicating that the proposed development, even under future climate conditions, does not significantly exacerbate downstream flood risk.

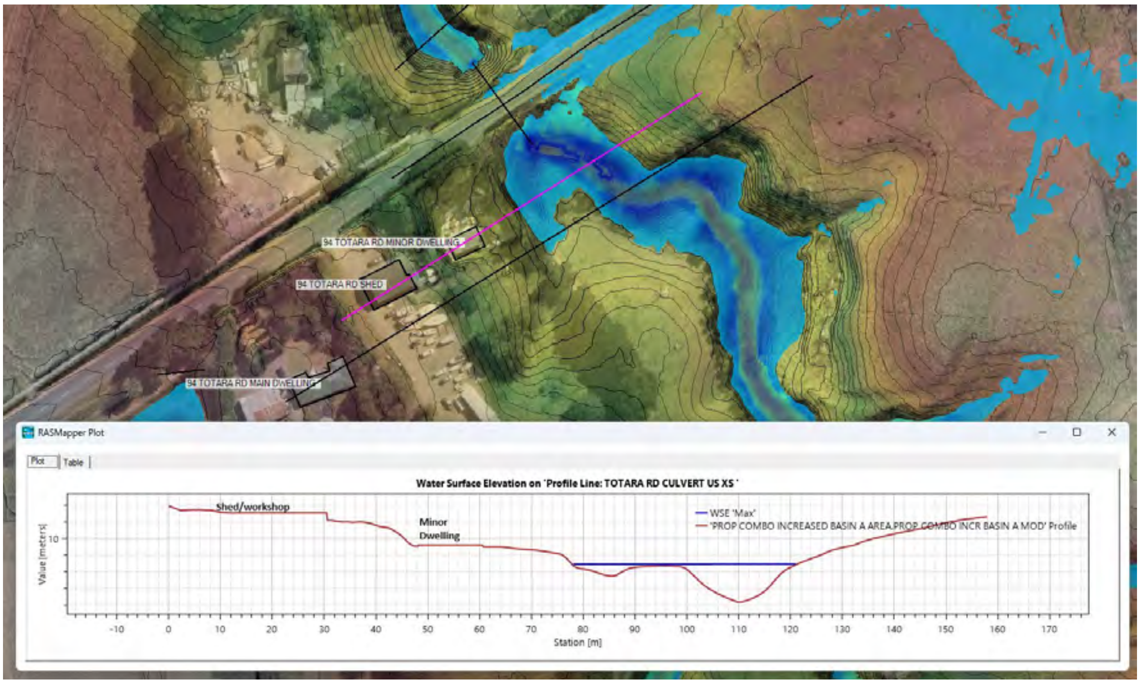

Figure 6-14: Totara Road DN2300mm culver Scenario WGD_[CC](0%) result.

The hydraulic analysis results for Scenario Pre_[CC](0%) are summarized in Table 6-13 below.

Table 6-13: Totara Road DN2300mm culvert - Scenario WGD_[CC](0%)

Parameter	Value
Culvert blockage	0%
Whenuapai Green Developed	No
Headwater elevation (RL)	6.92m
94 Totara Road minor dwelling freeboard	2.30m
94 Totara Road shed/workshop freeboard	6.23m
94 Totara Road main dwelling freeboard	9.08m

Totara Road freeboard (or flood depth)	3.18m
Upstream headwater depth	5.12m
Downstream tailwater depth	2.77m
1% AEP peak flow rate	23.68m^3/s
Downstream velocity	1.38m/s

Scenario WGD_[CC](50%)

PCA developed and rest of catchment unchanged [with Climate Change allowance] and (50% culvert blockage).

In this scenario, the impact of the proposed Whenuapai Green development (WGD) is assessed while considering the effects of climate change. It assumes full development of the WGD area while keeping the rest of the catchment unchanged. Operating under the assumption of a 50% blockage for the existing Totara Road culvert (DN2300mm), the simulation analyses flood extents, flows, and velocities downstream of the culvert. By comparing the outcomes of this scenario results from scenario Pre_CC (50%), which represents pre-development conditions with a 50% culvert blockage, the effects/impacts of the WGD development on flood risk can be evaluated. Rainfall depth, incorporating climate change effects, remains consistent at 259mm.

Results:

The results shown in Table 6-14 suggest a decrease in headwater elevation by 130mm. However, the peak flow rate downstream of the culvert increases by 2.54m³/s. These changes in flow dynamics are likely due to the diversion of flows from Basin B to downstream of the culvert. Although there are concentrated flows downstream of the culvert, the discharge from Catchment Area B is attenuated in Basin B to approximately pre-development levels.

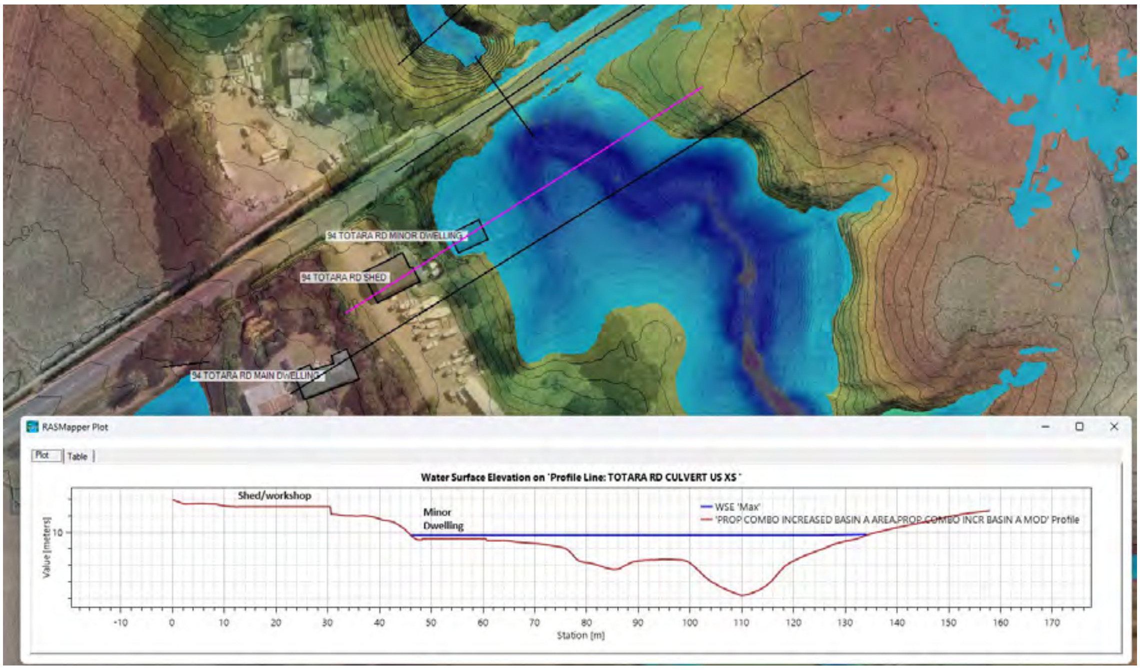

Figure 6-15: Totara Road DN2300mm culver Scenario WGD_[CC](50%) result.

The hydraulic analysis results for Scenario WGD_[CC](50%) are summarized in Table 6-14:

Table 6-14: Totara Road DN2300mm culvert - Scenario WGD_CC (50%) results.

Parameter	Value
Culvert blockage	50%
Whenuapai Green Developed	Yes
Headwater elevation (RL)	9.64m
94 Totara Road minor dwelling freeboard	-0.42m
94 Totara Road shed/workshop freeboard	3.51m
94 Totara Road main dwelling freeboard	6.36m
Totara Road freeboard (or flood depth)	0.46m
Upstream headwater depth	7.84m
Downstream tailwater depth	2.42m
1% AEP peak flow rate	14.40m^3/s
Downstream velocity	1.03m/s

Similarly to Scenario Pre_[CC](50%), the existing minor dwelling at 94 Totara Road remains within the flood extent, with the water surface elevation estimated to be 460mm above its assumed floor level.

Scenario WGD_[CC](100%)

PCA developed and rest of catchment unchanged [with Climate Change allowance]and (100% culvert blockage).

This scenario evaluates the impact of the proposed Whenuapai Green development (WGD). It assumes full development of the WGD area while maintaining the rest of the catchment unchanged. Operating under the assumption of a complete blockage (100%) for the existing Totara Road culvert (DN2300mm), the simulation examines flood extents, flows, and velocities downstream of the culvert. By comparing the outcomes of this scenario to Scenario Pre_[CC](100%), which represents pre-development conditions with a 100% culvert blockage, the effects / impact of the WGD project on flood risk can be determined. Rainfall depth, incorporating climate change effects, remains consistent at 259mm.

Results:

In this scenario, there is no increase in a headwater elevation when compared to scenario Pre_[CC](100%). Downstream of the culvert, the water depth increases by 120mm, and the peak flow rate increases by 0.62m^3/s when compared to pre-development scenario using the same parameters. These changes are attributed to the diversion of catchment AREA B flows to downstream to the culvert, as explained in scenario WGD_CC](50%).

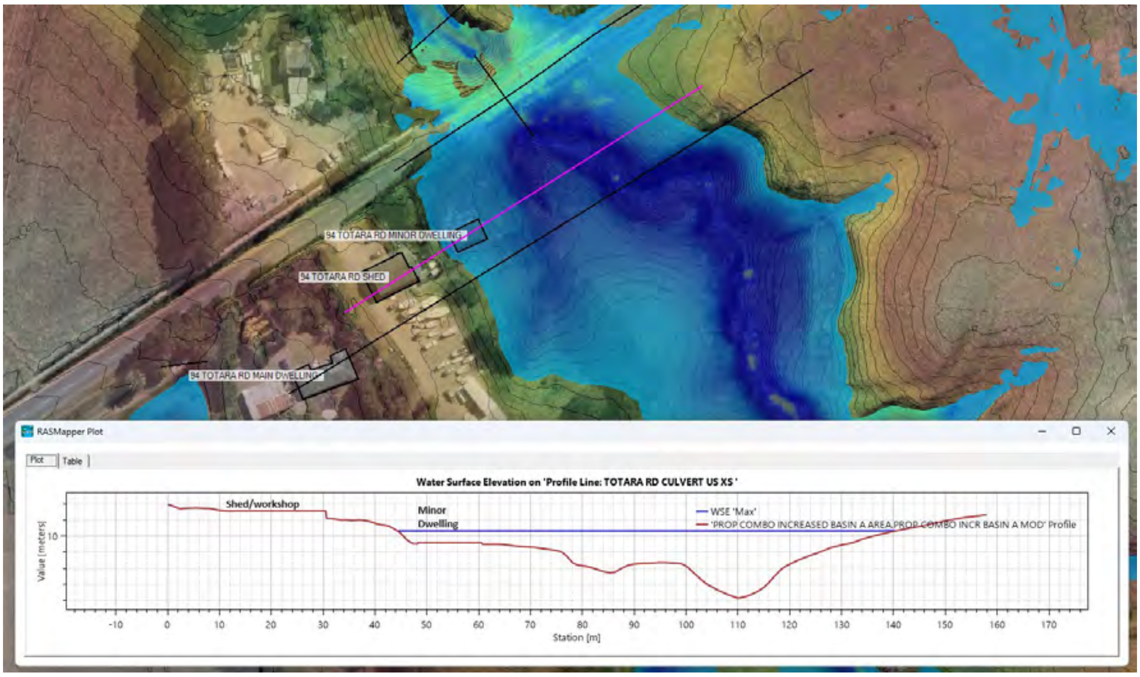

Figure 6-16: Totara Road DN2300mm culver Scenario WGD_[CC](100%) result.

The hydraulic analysis results for Scenario WGD_[CC](100%) are summarized in Table 6-14:

Table 6-15: Totara Road DN2300mm culvert - Scenario WGD_[CC](100%) results.

Parameter	Value
Culvert blockage	100%
Whenuapai Green Developed	Yes
Headwater elevation (RL)	10.68m
94 Totara Road minor dwelling freeboard	-1.46m
94 Totara Road shed/workshop freeboard	2.47m
94 Totara Road main dwelling freeboard	5.32m
Totara Road freeboard (or flood depth)	-0.53m
Upstream headwater depth	8.88m
Downstream tailwater depth	2.84m
1% AEP peak flow rate	24.74m^3/s
Downstream velocity	1.39m/s

Similarly to Scenario Pre_[CC](50%), the existing minor dwelling at 94 Totara Road remains within the flood extent, with the water surface elevation estimated to be 1.46m above its assumed floor level.

The results shown in Figure 6-16 indicate a significant increase in headwater elevation due to the assumed complete blockage of the culvert, leading to the overtopping of the road. Figure 6-17 shows that at the lowest point of Totara Road (road centreline), the depth of the flow reaches approximately 530mm. The average velocity at this juncture registers at approximately 1.04m/s. This combination yields a depth-velocity product of

0.55, categorizing it as an H3 event (unsafe for vehicles, children, and the elderly) in the Australian Rainfall & Runoff (AR&R) flood hazard vulnerability curve, Figure 7-1. The flood hazard classification increases in this simulation due to the flood depth is higher than the threshold for an H2 event (0.5m). However, the increase in the depth-velocity product is marginal (0.01) when compared to the pre-development scenario.

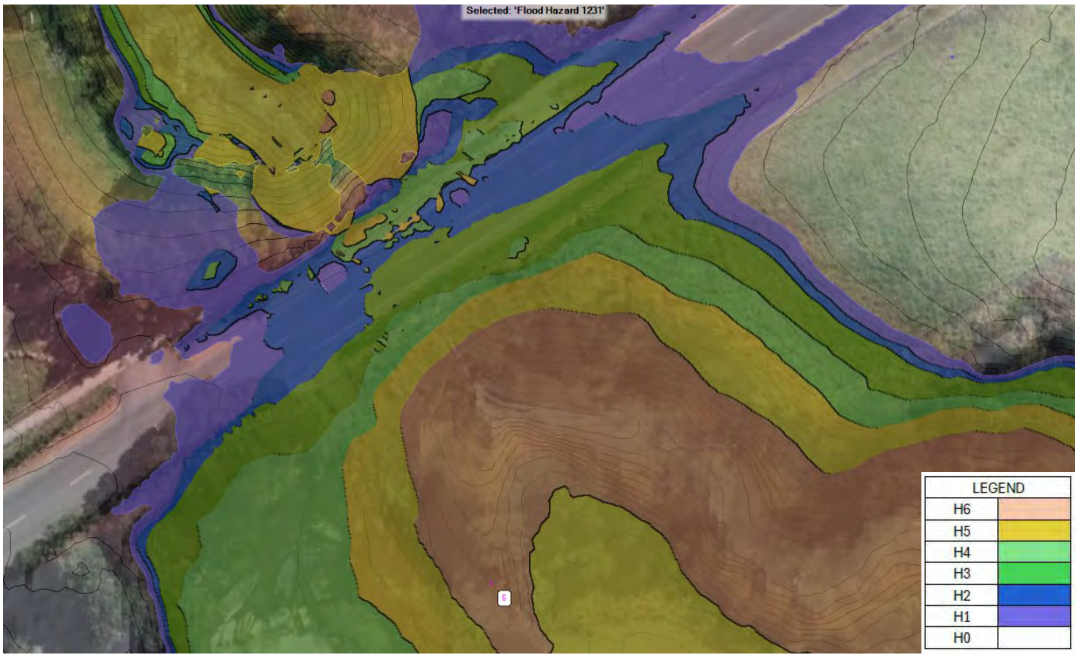

Figure 6-17: Totara Road Flood Hazard - Scenario WGD_CC (100%).

Ratara Stream Flood Model Assessment Scenarios and Results

The flood model analysis for Ratara Stream primarily focused on the existing Totara Road low point (sag) at approximately chainage 765m. This assessment aimed to evaluate the potential impacts of the Whenuapai Green Development (WGD) on downstream properties, particularly 125-129 Totara Road. According to Auckland GEOMAPS flood plain extents derived from the 2023 Rapid Flood Hazard Assessment model, no existing structures (dwellings) are identified to be at risk of flooding.

The existing dwellings at 125-129 Totara Road have not been surveyed, however it can be estimated based on existing terrain data (AC GEOMAPS) and pictures from the site. Table 6-16 shown the floor levels used in the hydraulic model.

Table 6-16: Assumed floor level

Property address	Assumed floor level (m)
125 Totara Road	**17.0m**
129 Totara Road	**16.5m**

Currently, a DN450mm stormwater culvert is situated at approximately the road's low point, facilitating drainage from the existing ephemeral watercourse at 98-100 Totara Road and directing it into Ratara Stream at 129 Totara Road. As part of the Whenuapai Green Development (WGD), it is proposed to upgrade the existing DN450mm culvert to a twin barrel DN750mm culvert. The design parameters used in the flood simulation are shown in Table 6-16 below: Table 6-17 below:

Table 6-17: Proposed Basin A outlet culvert

Parameter	Value
Culvert size	**2 x DN750mm**
Culvert length	44m
Culvert material	Concrete
Inlet configuration	Drop inlet
Upstream invert level	13.9m
Downstream invert level	13.33m
Culvert grade	1.32%
Road chainage	783m (approx.)
Road lowest RL (at sag)	15.46m (surveyed)
Basin spillway invert level	15.75m

For the flood analysis, culverts with diameters less than 1.5m are assumed to be 100% blocked and are therefore not included in the flood model. However, the proposed Basin A outlet pipe (twin barrel DN750mm) totals 1.5m in diameter and is included in the simulations. The Ratara Stream flood model considered six scenarios, as shown in Table 6-18 below.

Table 6-18: Ratara Stream Flood Model Scenarios Matrix

Scenarios	**Pre-Development [TP108]**	**WGD [TP108]**	**Pre-Development [with CC]**	**WGD [with CC]**
0% Design culvert blockage	--	WGD_[TP108] (0%)	--	WGD_[CC] (0%)
50% Design culvert blockage	--	WGD_[TP108] (50%)	--	WGD_[CC] (50%)
100% ex. culvert blockage[2]	Pre_[TP108] (100%)	--	Pre_[CC] (100%)	--

The proposed Whenuapai Green Development (WGD) Private Plan Change (PC) aims to ensure that there is no increase, and ideally a reduction, in flooding to the existing dwellings downstream of its development.

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[2] In a 1%AEP simulations pre-development scenario the existing DN450mm Totara Road culvert is assumed to be fully blocked.

Pre_[TP108](100%)

Pre-development [no Climate Change allowance] and (100% existing culvert blockage).

This scenario represents the pre-development conditions of the entire Ratara Stream catchment, assuming current rainfall depth and intensity based on TP108 (Auckland Regional Council, 1999). It accounts for existing impervious surfaces delineated by Auckland Council's GEOMAPS impervious surfaces layer, encompassing roads, buildings, and other impervious areas. The simulation assumes the existing DN450mm culvert to be fully blocked and evaluates flood extent under the assumption of no further development within the catchment. The results of this simulation set the flood dynamics baseline for comparison with the proposed post-development scenarios.

129 Totara Road Results:

In this scenario, the anticipated water surface elevation is estimated to be 15.7m. Consequently, the existing dwelling at 125 Totara Road is expected to have an approximate 800mm freeboard. Therefore, the existing dwelling faces no flooding risk as shown in **Error! Reference source not found.**.

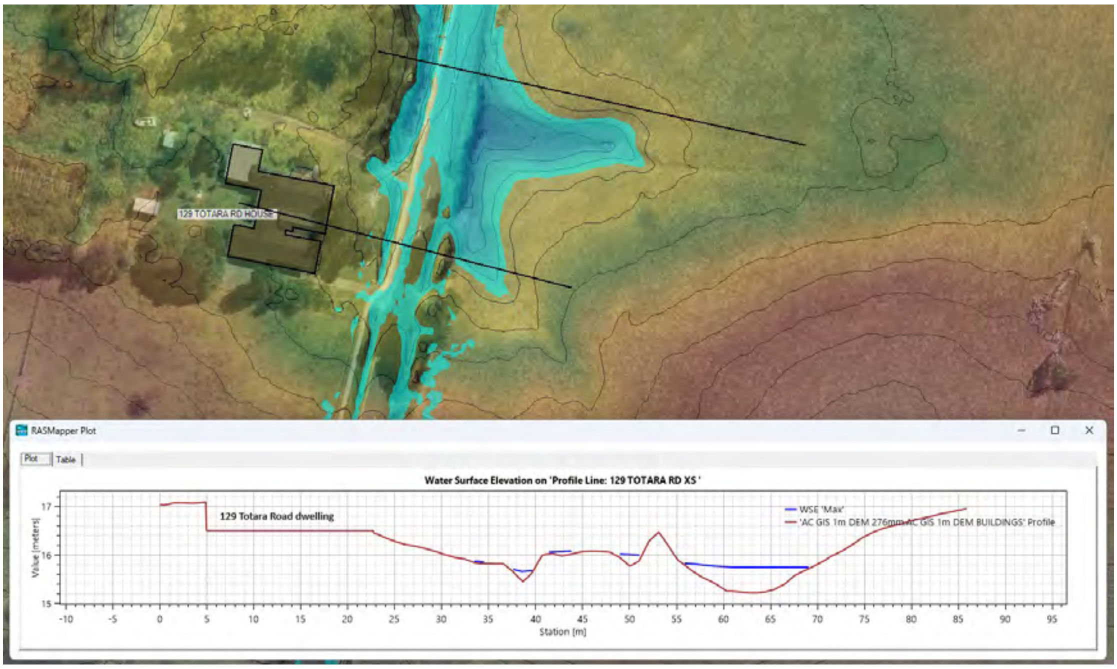

Figure 6-18: 129 Totara Road Scenario Pre_[TP108](100%).

125 Totara Road Results

In this pre-development scenario, the maximum water surface level is projected to reach RL: 12.7m, providing a substantial freeboard of approximately 4.3 meters as shown in Figure 6-19.**Error! Reference source not found.**

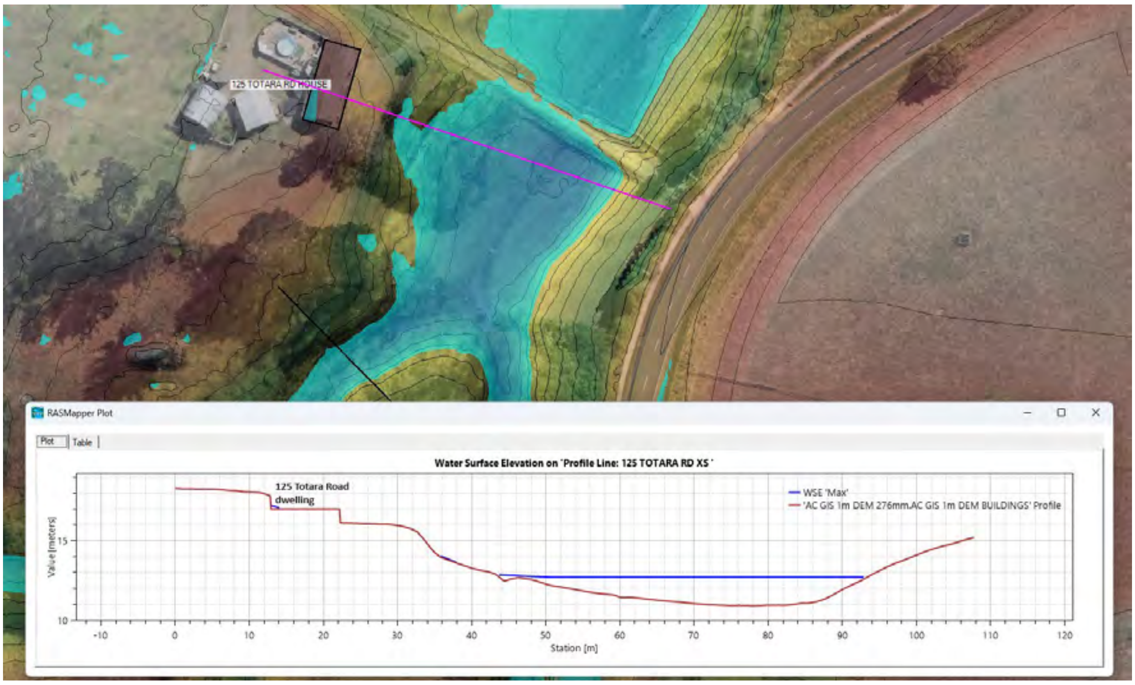

Figure 6-19: 125 Totara Road Scenario Pre_[TP108](100%).

WGD_[TP108](0%)

Post-development [no Climate Change allowance] and (0% design culvert blockage).

In this scenario, the impact of the proposed Whenuapai Green Development (WGD) is assessed and compared to Scenario Pre_[TP108](100%). It assumes full development of the WGD area while keeping the rest of the catchment unchanged. This assessment operates under the assumption that the proposed Basin A outlet culvert remains unobstructed. The rainfall depth, assuming no climate change effects, remains consistent with Scenario Pre_[TP108](100%) at 195mm.

129 Totara Road Results:

In the post-development scenario, the water surface elevation at 129 Totara Road is estimated to be approximately RL: 15.6m, which gives the existing dwelling 900mm freeboard, as shown in

Figure 6-20. The simulation confirms the flood water elevation reduces by 100mm when compared to Pre-Development scenario. Downstream of Basin A outlet culvert, the peak flow rate is attenuated by 0.42m^3/s.

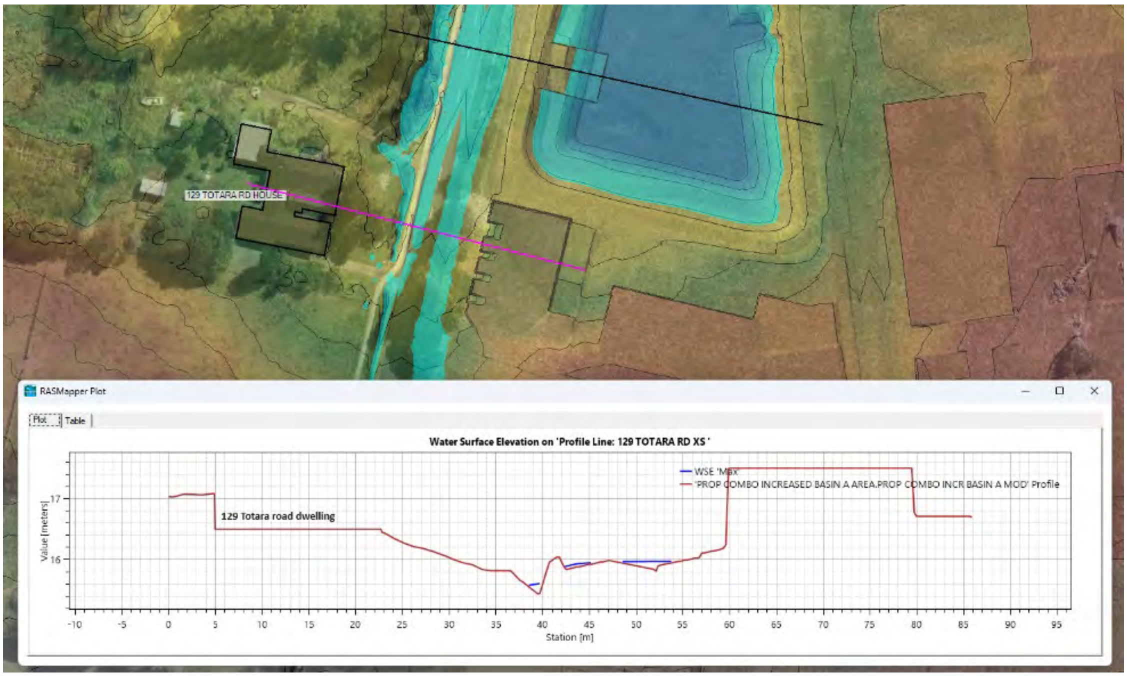

Figure 6-20: 129 Totara Road scenario WGD[TP108](0%).

125 Totara Road

In this scenario, the expected water surface elevation at 125 Totara Road is approximately RL: 12.70m, same as Pre-Development scenario. As illustrated in Figure 6-21, there is no increase in headwater elevation and the existing dwelling maintains a significant distance from any flood risk (4.3m freeboard).

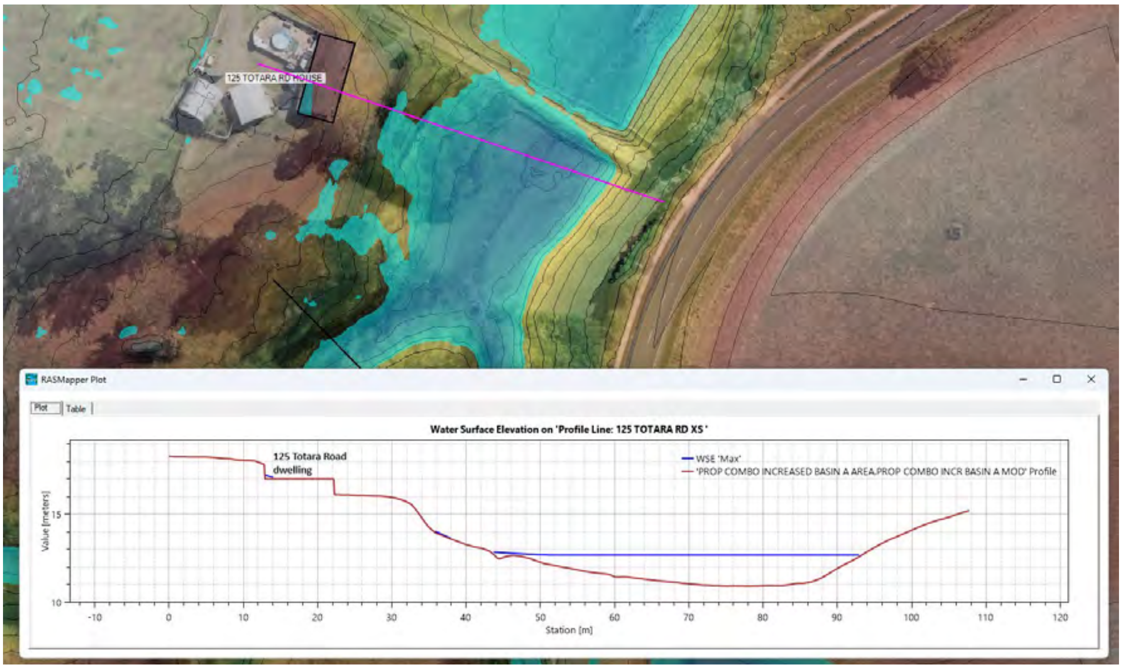

Figure 6-21: 125 Totara Road scenario WGD[TP108](0%).

<u>WGD_[TP108](50%)</u>

Post-development [no Climate Change allowance] and (0% design culvert blockage).

In this post-development scenario, 50% culvert blockage is adopted for the proposed Basin A outlet. The model assumes one of the twin barrel DN750mm culverts to be fully blocked and the other to be unobstructed. This assumption is to ascertain the impact of WGD in the downstream properties in the case of partial failure of the stormwater attenuation device. The rainfall depth, assuming no climate change effects, remains consistent with Scenario WGD_[TP108](100%) at 195mm.

129 Totara Road Results:

In this scenario, as shown in Figure 6-22, the partial blockage (50%) of Basin A outlet does not impact the surface water elevation at 129 Totara Road. This is because the existing dwelling at 129 Totara Road is significantly upstream of the Basin A discharge point.

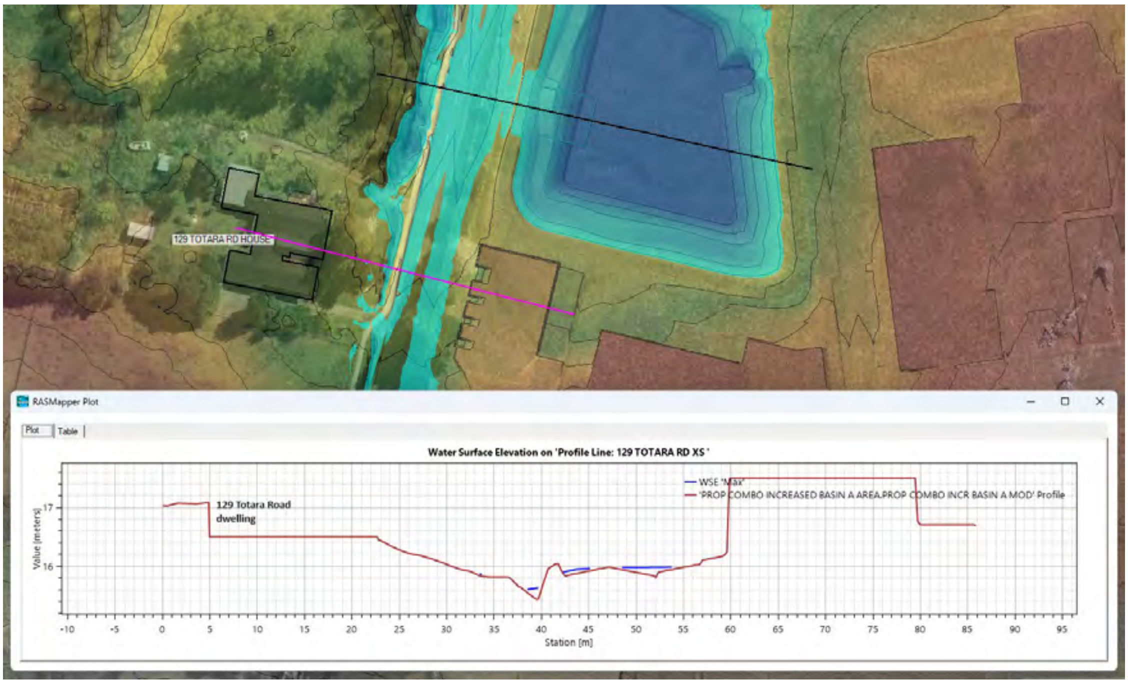

Figure 6-22: 129 Totara Road scenario WGD[TP108](50%).

125 Totara Road

In this scenario, the expected water surface elevation at 125 Totara Road is maintained at RL: 12.70m, as occurs in the Pre-Development scenario. As illustrated inFigure 6-23, there is no increase in headwater elevation and the existing dwelling maintains a significant distance from any flood risk (4.23m freeboard).

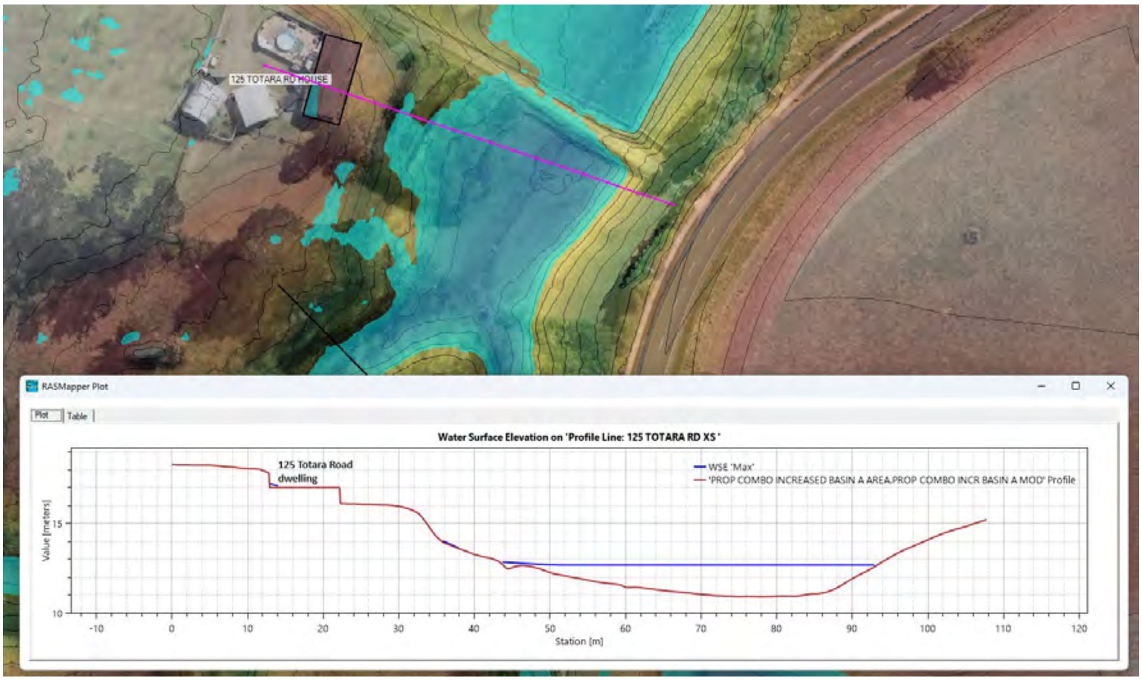

Figure 6-23: 125 Totara Road scenario WGD[TP108](50%).

Pre_[CC](100%)

Pre-development [with Climate Change allowance] and (100% existing culvert blockage).

This scenario represents the pre-development conditions of the entire Ratara Stream catchment, assuming rainfall depth of 259mm, reflecting the impact of climate change with a temperature increase of 3.8 degrees Celsius. It accounts for existing impervious surfaces delineated by Auckland Council's GEOMAPS impervious surfaces layer, encompassing roads, buildings, and other impervious areas. The simulation assumes the existing DN450mm culvert to be fully blocked and evaluates flood extent under the assumption of no further development within the catchment. The results of this simulation set the flood dynamics baseline for comparison with the proposed post-development scenarios.

129 Totara Road Results:

In this scenario, the anticipated water surface elevation is estimated to be 15.75m. Consequently, the existing dwelling at 125 Totara Road is expected to have an approximate 750mm freeboard. Therefore, the existing dwelling faces no flooding risk as shown in Figure 6-24.

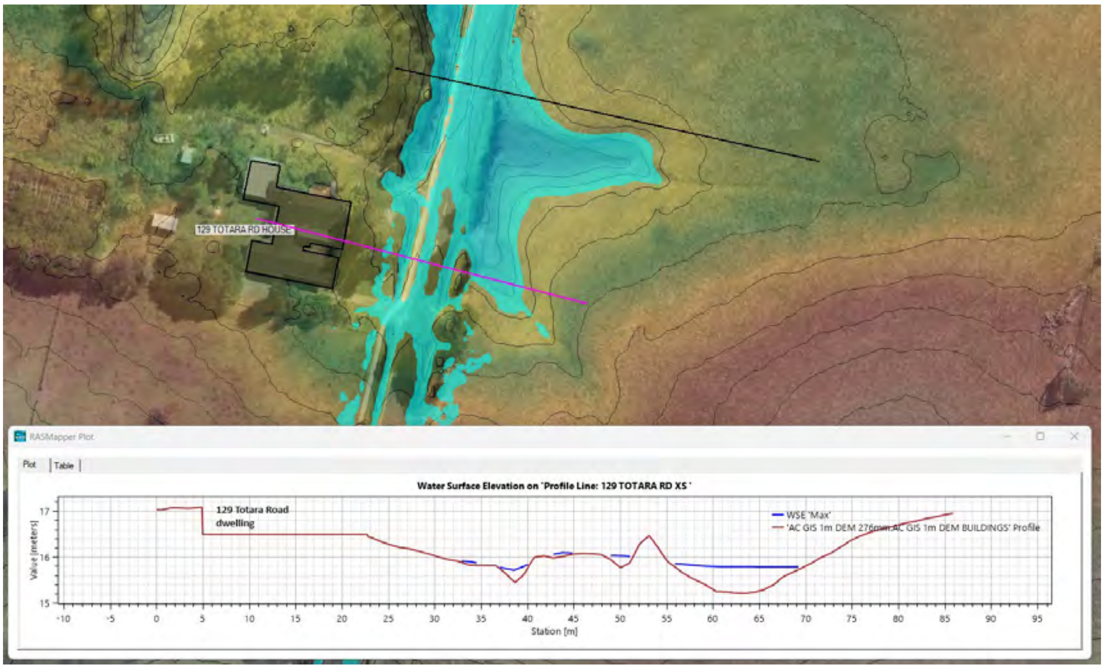

Figure 6-24: 129 Totara Road Scenario Pre_[CC](100%).

125 Totara Road Results

In this pre-development scenario, the maximum water surface level is projected to reach RL: 12.76m, providing a substantial freeboard of approximately 4.24 meters as shown in Figure 6-25.**Error! Reference source not found.**

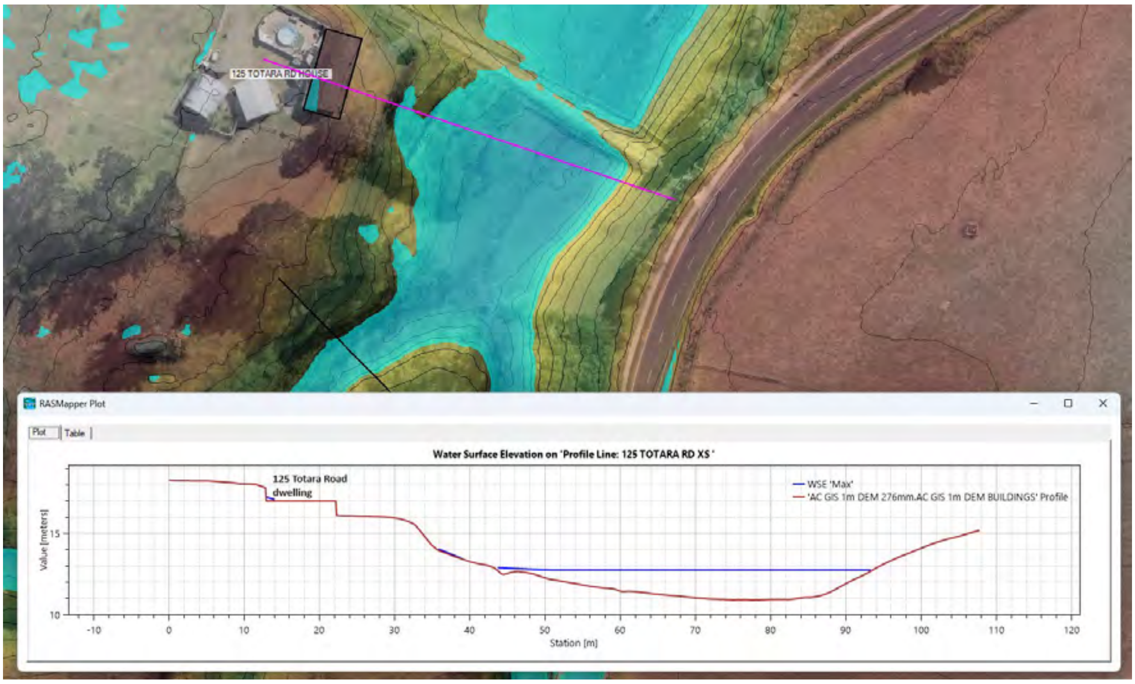

Figure 6-25: 125 Totara Road Scenario Pre_[CC](100%).

WGD_[CC](0%)

Post-development [with Climate Change allowance] and (0% design culvert blockage).

In this scenario, the impact of the proposed Whenuapai Green Development (WGD) is assessed and compared to Scenario Pre_[CC](100%). It assumes full development of the WGD area while keeping the rest of the catchment unchanged. This assessment operates under the assumption that the proposed Basin A outlet culvert remains unobstructed. Similar to the scenario Pre_[CC](100%), it assumes a rainfall depth of

295mm, taking into account the effects of climate change due to a 3.8°C increase in temperature.

129 Totara Road Results:

In the post-development scenario, the water surface elevation at 129 Totara Road is estimated to be approximately RL: 15.6m, which gives the existing dwelling 900mm freeboard, as shown in

Figure 6-20. The simulation confirms a reduction in WSL of 300mm when compared to Pre-Development scenario. The reduction in water surface elevation is due to proposed stormwater basin providing volume reduction and peak flow attenuation.

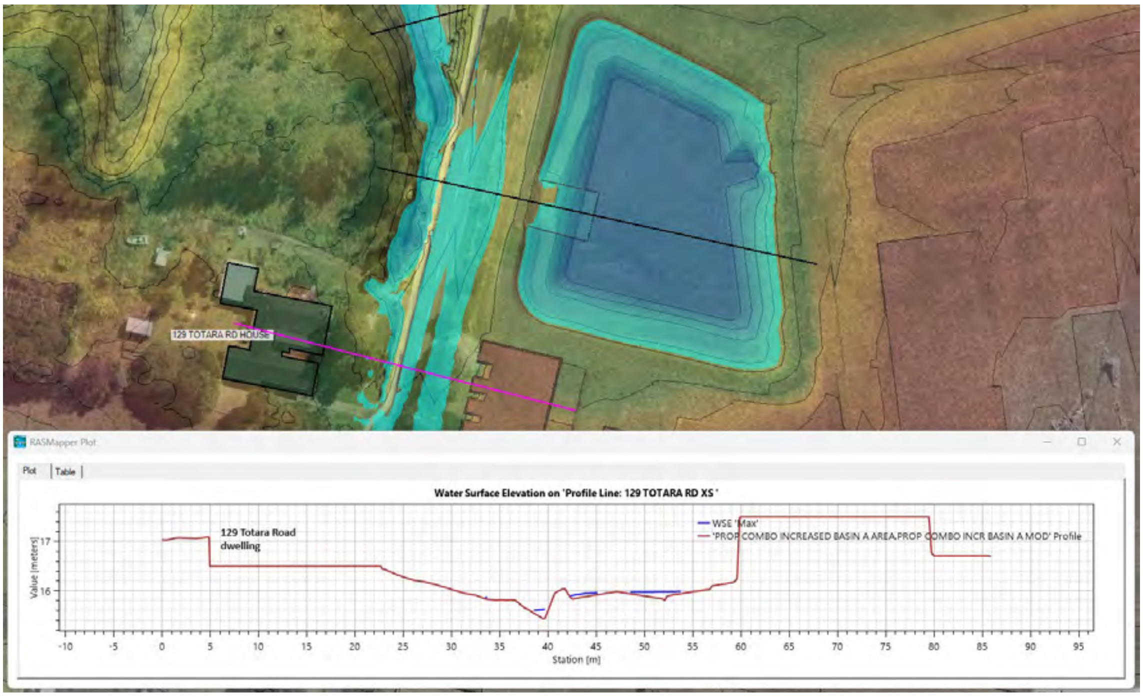

Figure 6-26: 129 Totara Road scenario WGD[CC](0%).

125 Totara Road

In this scenario, the expected water surface elevation at 125 Totara Road is approximately RL: 12.75m, similar to the Pre-Development scenario. As illustrated in Figure 6-27, there is no increase in headwater elevation and the existing dwelling maintains a significant distance from any flood risk (4.25m freeboard).

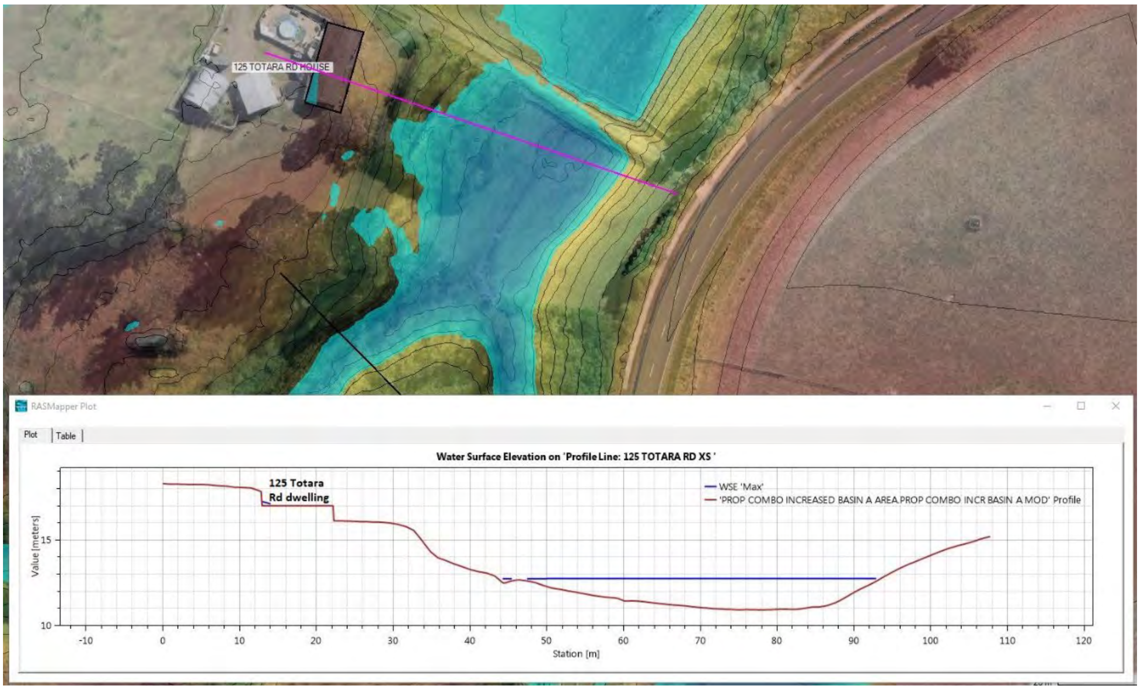

Figure 6-27: 125 Totara Road scenario WGD[CC](0%).

WGD_[CC](50%)

Post-development [with Climate Change allowance] and (0% design culvert blockage). In this post-development scenario, 50% culvert blockage is adopted for the proposed Basin A outlet. The model assumes one of the twin barrel DN750mm culverts to be fully blocked and the other to be unobstructed. This assumption is to ascertain the impact of WGD on the downstream properties in the case of partial failure of the stormwater attenuation device. The rainfall depth, accounting for the effects of climate change (3.8°C increase in temperature), is set at 259mm.

129 Totara Road Results:

In the post-development scenario, the water surface elevation at 129 Totara Road is estimated to be approximately RL: 15.6m, which gives the existing dwelling 900mm freeboard, as shown in

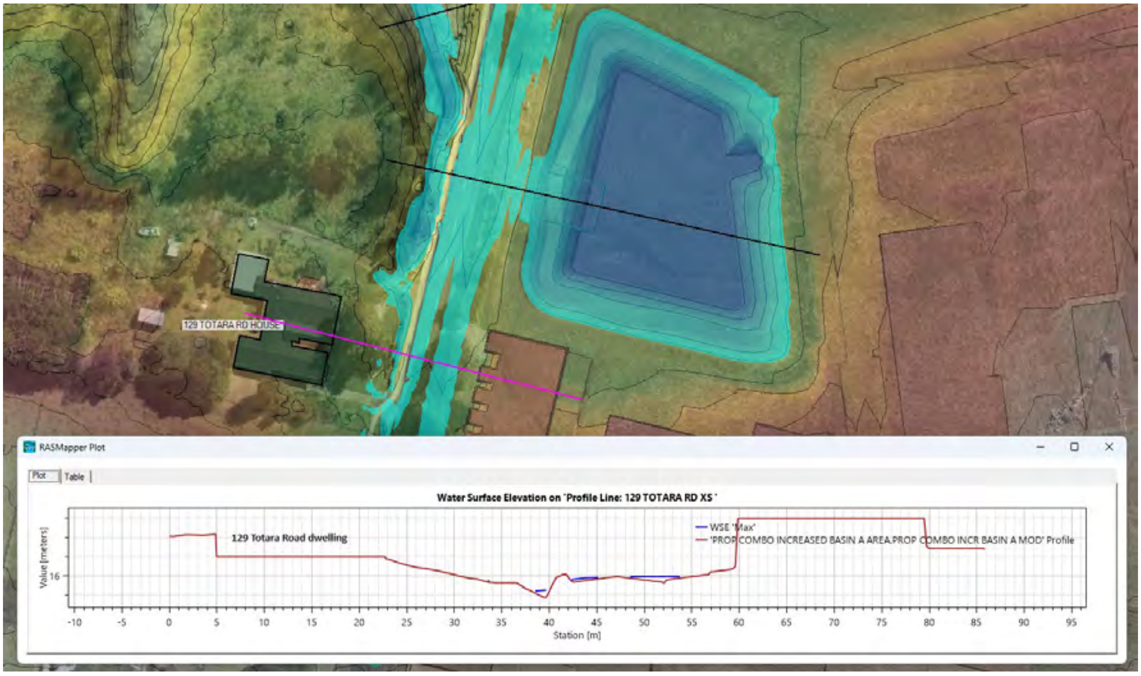

Figure 6-28. The simulation confirms a reduction in WSL of 300mm when compared to Pre-Development scenario. The reduction in water surface elevation is due to proposed stormwater basin providing volume reduction and peak flow attenuation.

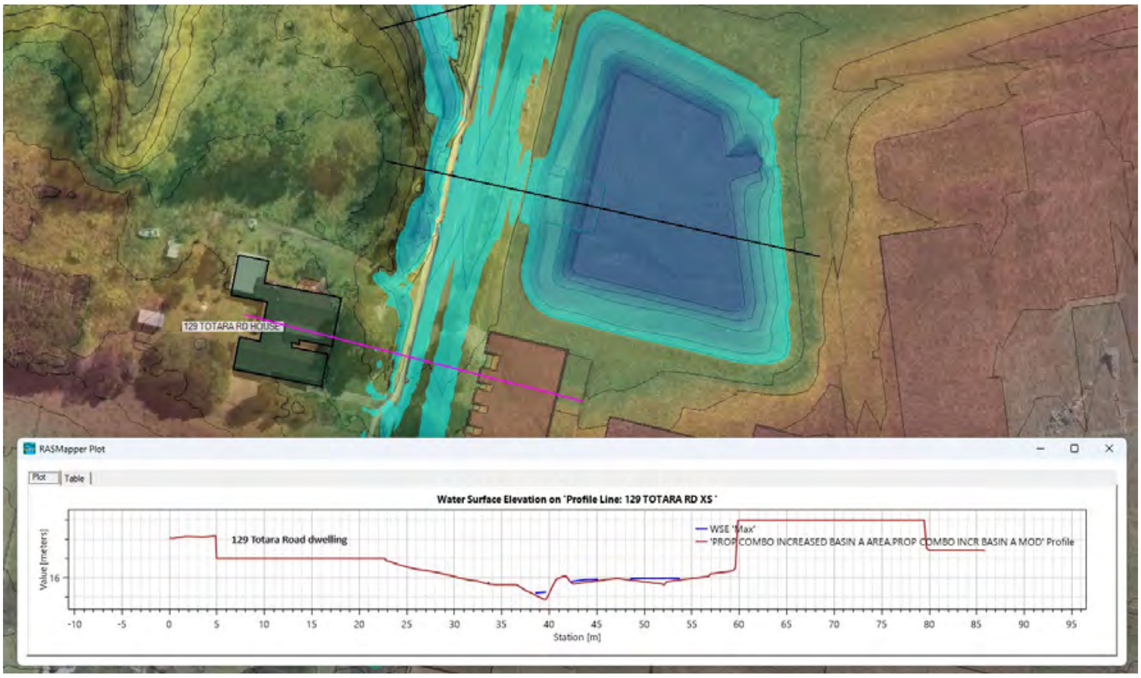

Figure 6-28: 129 Totara Road scenario WGD[CC](50%).

125 Totara Road

In this scenario, the expected water surface elevation at 125 Totara Road is approximately RL: 12.74m, similar to the Pre-Development scenario. As illustrated inFigure 6-29, there is no increase in headwater elevation and the existing dwelling maintains a significant distance from any flood risk (4.26m freeboard).

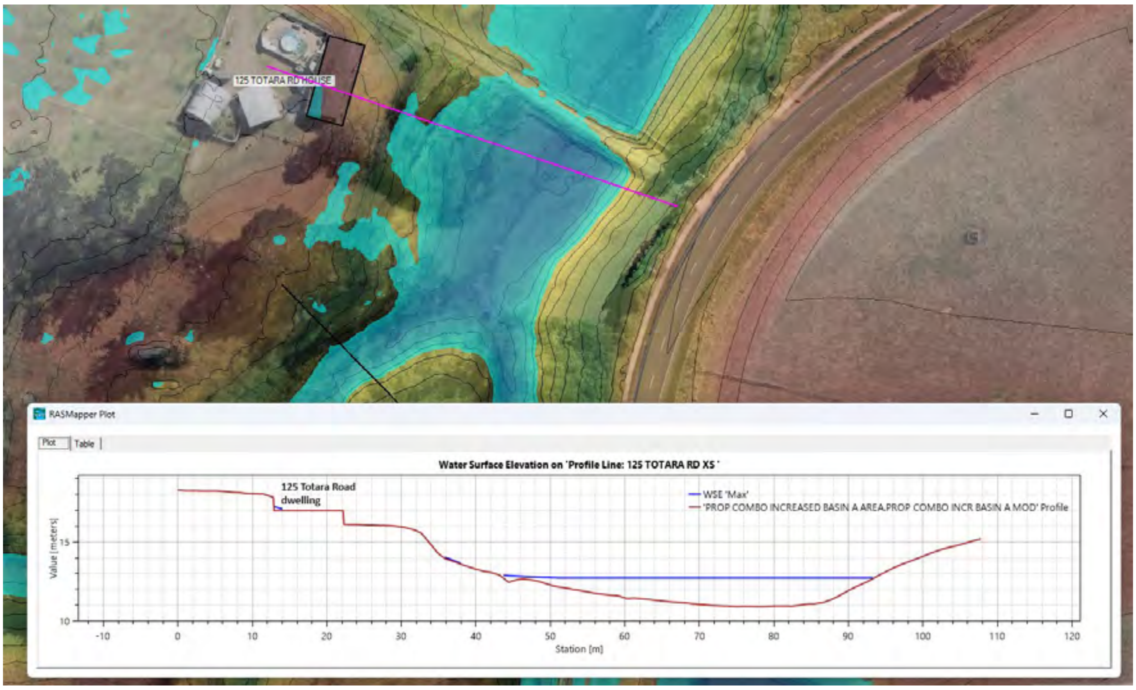

Figure 6-29: 125 Totara Road scenario WGD[CC](50%).

7. Flood Hazard Definition

The term 'Flood Hazard' is defined differently across regions and countries. Definitions often encompass factors such as depth (D), extent, velocity (V), and a combination of depth and velocity (D x V). In New Zealand, the common practice among councils is to use the D x V method to evaluate the safety of individuals and vehicles.

Flood Fragility Curves

Flood fragility curves are tools used to assess the vulnerability of structures and infrastructures to flood hazards. They represent the probability of failure or damage as a function of flood intensity parameters, such as water depth and velocity. These curves are essential in flood risk management, helping to estimate potential damages, design flood protection measures, inform emergency response plans, and communicate risks to stakeholders.

The National Stormwater Modelling Guide (Water New Zealand, 2024) recommends:

> *"If no local guidance is available, the 2019 Australian Rainfall and Runoff (ARR) guidelines recommend using a formulation developed by the Australian Emergency Management Institute (AEMI)…"*

This method refines the outputs by categorizing them into six hazard bands, making it easier for non-technical users to interpret:

- **H1**: Generally safe for people, vehicles, and buildings.
- **H2**: Unsafe for small vehicles.
- **H3**: Unsafe for vehicles, children, and the elderly.
- **H4**: Unsafe for vehicles and people.
- **H5**: Unsafe for vehicles and people. All buildings are vulnerable to structural damage. Some less robust buildings are subject to failure.
- **H6**: Unsafe for vehicles and people. All building types are considered vulnerable to failure.

Visual Representation

Flood fragility curves are often visualized through graphs that plot the likelihood of damage against flood parameters. Figure 7-1 and Table 7-1 sTable 7-1: Combined Hazard Curves - Vulnerability Thresholds Classification Limits (Smith et al., 2014)hown below are extracts of ARR Chapter 7- Safety Design Criteria (Figure 6.7.9).

These tools were used in this report to classify the flood hazard when the simulation flood water overtops the road embankment.

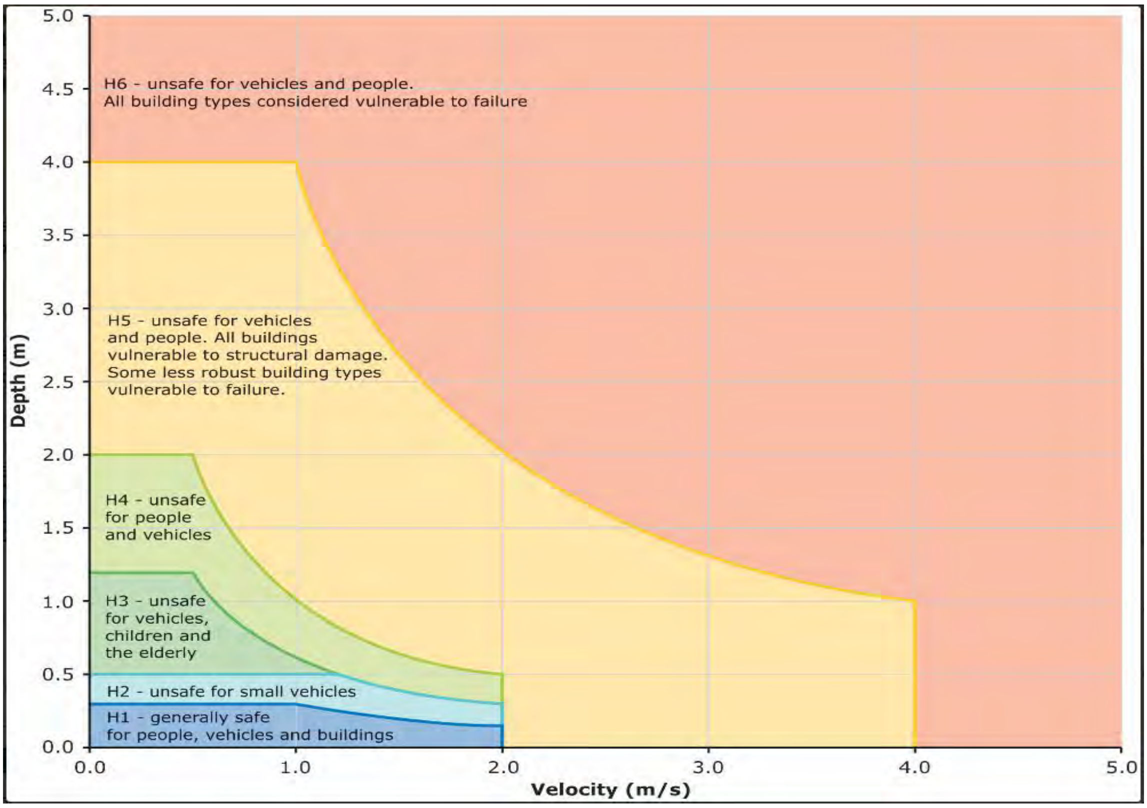

Figure 7-1: Combined Flood Hazard Fragility Curves (Smith et al., 2014)

Table 7-1: Combined Hazard Curves - Vulnerability Thresholds Classification Limits (Smith et al., 2014)

Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)
H1	D*V ≤ 0.3	0.3	2
H2	D*V ≤ 0.6	0.5	2
H3	D*V ≤ 0.6	1.2	2
H4	D*V ≤ 1.0	2	2
H5	D*V ≤ 4.0	4	4
H6	D*V > 4.0	-	-

8. Limitations of this report

Hydrological Model

This flood model utilizes the Auckland Council TP108 Method to convert rainfall data into stormwater runoff estimations. It's important to acknowledge that the TP108 rainfall contour maps were generated in 1999 and are based on a limited historical dataset. As such, these maps may not fully capture recent changes in climate patterns, which can affect rainfall-runoff relationships. Additionally, the standard 24-hour temporal rainfall pattern employed in the TP108 method represents an idealized depiction of Auckland Region rainfall, potentially overlooking the nuances and variability inherent in actual rainfall events.

Limited Data for Calibration

The availability of limited data for calibration poses challenges in refining model parameters to accurately represent real-world conditions. Site of interest walkover provided post-major storm event (January 2023) provided insight at potential flood extents.

Hydraulic Modelling

While the hydraulic modelling in this report provides valuable insights into flood risk to the properties downstream of the WGD, it is important to acknowledge certain limitations inherent in the modelling process. These limitations may affect the accuracy and precision of the results and should be considered when interpreting the findings.

Software Limitations: The hydraulic modelling was primarily performed using HEC-RAS software (version 6.1), which is widely utilized for river and floodplain analysis. However, it is essential to recognize that HEC-RAS, like any modelling software, has inherent limitations. These may include simplifications in flow calculations, inaccuracies in channel bathymetry, and constraints in handling complex hydraulic scenarios, such as very steep slopes.

2D Simulation: While 2D hydraulic modelling offers advantages over traditional 1D modelling by capturing spatial variability, it also has its limitations. In 2D simulations, certain simplifications are made, such as assuming average velocities within cells and representing water depth with a single value per cell. These simplifications may not fully capture the intricacies of flow dynamics, especially in highly complex or urbanized areas.

Assumptions in Manning's Values: In this study, Manning's values were assumed based on available literature, field observations, and engineering judgment. However, it is important to acknowledge that these values may vary spatially and with flow depth, leading to uncertainties in the modelling results.

9. Conclusion

The flood results presented in this report are intended for guidance and not for establishing final flood levels outside the Whenuapai Green development area. Based on the flood modelling outcomes, it is reasonable to conclude that there is no potential increase in flood hazard to existing buildings downstream of the Whenuapai Green development.

10. References

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APPENDIX A: Catchments Delineation and Parameters

Table 10-1 - Ratara Stream Catchment Parameters (Existing conditions)

Catchment ID	Total Area (ha)	Imperviousness (%)	Tc Imperv. (min)	Tc Perv. (min)
WEST	9.353	0.83	11.1	10.9
SOUTHWEST	1.454	80%	10.0	10.0
RATARA 1	3.9700	1.3%	10.0	10.0
RATARA 2	5.5900	6.2%	10.0	10.0
RATARA 3	5.9500	3.8%	10.0	10.0
RATARA 4	6.2797	7.0%	14.5	14.3
RATARA 5	2.2200	8.0%	10.0	10.0
RATARA 6	22.140	11.1%	24.5	24.0
RATARA 7	2.4752	17.8%	10.7	10.5

Figure 10-1 Ratara Stream Catchment delineation.

Table 10-2 – Ratara Stream Catchment Parameters (Whenuapai Green Developed)

Catchment ID	Total Area (ha)	Imperviousness (%)	Tc Imperv. (min)	Tc Perv. (min)
AREA A	10.581	64.2%	11.1	10.9
AREA F	1.017	85%	10.0	10.0
RATARA 1	3.9700	1.3%	10.0	10.0
RATARA 2	5.5900	6.2%	10.0	10.0
RATARA 3	5.9500	3.8%	10.0	10.0
RATARA 4	6.2797	7.0%	14.5	14.3
RATARA 5	2.2200	8.0%	10.0	10.0
RATARA 6	22.1400	11.1%	24.5	24.0
RATARA 7	0.0248	17.8%	10.7	10.5

Figure 10-2: Ratara Stream Catchment delineation (Whenuapai Green developed).

Table 10-3: Rarawaru Creek Catchment Parameters (Existing conditions)

Catchment ID	Total Area (ha)	Imperviousness (%)	Tc Imperv. (min)	Tc Perv. (min)
RARAWARU 1	2.4000	0.8%	10.0	10.0
RARAWARU 2	7.2599	13.4%	10.0	10.5
RARAWARU 3	4.2258	9.4%	10.0	10.0
RARAWARU 4	11.0830	6.0%	10.4	18.1
RARAWARU 5	3.1060	16.1%	10.4	18.3
RARAWARU 6	3.4990	0.1%	10.0	17.4
RARAWARU 7	8.6010	40.7%	10.2	17.9
RARAWARU 8	6.3454	40.4%	10.0	10.0
RARAWARU 9	19.1311	52.8%	15.4	27.0
RARAWARU 10	43.3620	45.1%	19.1	33.4
RARAWARU 11	2.5600	20.0%	10.0	10.0
TAKITIMU	2.8010	22.4%	10.0	16.1
WHENUAPAI 2	17.1620	68.0%	13.0	22.7
ITM	2.8000	23.7%	10.0	12.7
NORTH	1.7620	0.0%	10.0	10.8
EAST	5.2500	0.0%	10.0	10.0

Figure 10-3: Rarawaru Creek Catchment delineation (Existing conditions).

Table 10-4: Rarawaru Creek Catchment Parameters (Whenuapai Green Developed)

Catchment ID	Total Area (ha)	Imperviousness (%)	TC Imperv. (min)	TC Perv. (min)
RARAWARU 1	2.4000	0.8%	10.0	10.0
RARAWARU 2	7.2599	13.4%	10.0	10.5
RARAWARU 3	4.2258	9.4%	10.0	10.0
RARAWARU 4	11.0833	6.0%	10.4	18.1
RARAWARU 5	3.1060	16.1%	10.4	18.3
RARAWARU 6	3.4994	0.1%	10.0	12.9
RARAWARU 7	8.6010	40.7%	10.2	17.9
RARAWARU 8	6.3454	40.4%	10.0	10.0
RARAWARU 9	19.1311	52.8%	15.4	27.0
RARAWARU 10	43.3620	45.1%	19.1	33.4
RARAWARU 11	2.5600	20.0%	10.0	10.0
TAKITIMU	2.8010	22.4%	10.0	16.1
WHENUAPAI 2	17.1620	68.0%	13.0	22.7
ITM	2.8000	23.7%	10.0	12.7
AREA B	4.2700	58.7%	10.0	10.8
AREA C	1.5170	69.0%	10.0	10.0

Figure 10-4: Rarawaru Creek Catchment delineation (Whenuapai Green developed).

APPENDIX B: Hydrologic Model results (HEC HMS)

RATARA PRE_[TP108]					RATARA PRE_[CC]				
Hydrologic Element	**Drainage Area (km^2)**	**Peak Discharge (m^3/s)**	**Time to Peak**	**Volume (mm)**	**Hydrologic Element**	**Drainage Area (km^2)**	**Peak Discharge (m^3/s)**	**Time to Peak**	**Volume (mm)**
RATARA 1 JUNC	0.0397	0.97	12:13	130	**RATARA 1 JUNC**	0.0397	1.44	12:13	188
RATARA 2 JUNC	0.0559	1.39	12:13	133	**RATARA 2 JUNC**	0.0559	2.05	12:13	191
RATARA 3 JUNC	0.0595	1.47	12:13	131	**RATARA 3 JUNC**	0.0595	2.17	12:13	190
RATARA 4 JUNC	0.0628	1.42	12:15	133	**RATARA 4 JUNC**	0.0628	2.09	12:15	192
RATARA 5 JUNC	0.0222	0.56	12:13	134	**RATARA 5 JUNC**	0.0222	0.82	12:13	193
RATARA 6 JUNC	0.2214	4.15	12:21	135	**RATARA 6 JUNC**	0.2214	6.09	12:21	194
RATARA 7 JUNC	0.0248	0.63	12:13	140	**RATARA 7 JUNC**	0.0248	0.92	12:13	199
SOUTHWEST JUNC	0.0145	0.45	12:12	177	**SOUTHWEST JUNC**	0.0145	0.62	12:12	240
WEST JUNC	0.0935	2.24	12:13	129	**WEST JUNC**	0.0935	3.33	12:13	188

RATARA WGD_[TP108]					RATARA WGD_[CC]				
Hydrologic Element	**Drainage Area (km^2)**	**Peak Discharge (m^3/s)**	**Time to Peak**	**Volume (mm)**	**Hydrologic Element**	**Drainage Area (km^2)**	**Peak Discharge (m^3/s)**	**Time to Peak**	**Volume (mm)**
AREA A JUNC	0.1058	3.05	12:13	168	**AREA A JUNC**	0.1058	4.27	12:13	230
AREA F JUNC	0.0102	0.32	12:12	180	**AREA F JUNC**	0.0102	0.44	12:12	243
RATARA 1 JUNC	0.0397	0.97	12:13	130	**RATARA 1 JUNC**	0.0397	1.44	12:13	188
RATARA 2 JUNC	0.0559	1.39	12:13	133	**RATARA 2 JUNC**	0.0559	2.05	12:13	191
RATARA 3 JUNC	0.0595	1.47	12:13	131	**RATARA 3 JUNC**	0.0595	2.17	12:13	190
RATARA 4 JUNC	0.0628	1.42	12:15	133	**RATARA 4 JUNC**	0.0628	2.09	12:15	192
RATARA 5 JUNC	0.0222	0.56	12:13	134	**RATARA 5 JUNC**	0.0222	0.82	12:13	193
RATARA 6 JUNC	0.2214	4.15	12:21	135	**RATARA 6 JUNC**	0.2214	6.09	12:21	194
RATARA 7 JUNC	0.0248	0.63	12:13	140	**RATARA 7 JUNC**	0.0248	0.92	12:13	199

RARAWARU PRE_[TP108]					RARAWARU PRE_[CC]				
Hydrologic Element	**Drainage Area (km^2)**	**Peak Discharge (m^3/s)**	**Time to Peak**	**Volume (mm)**	**Hydrologic Element**	**Drainage Area (km^2)**	**Peak Discharge (m^3/s)**	**Time to Peak**	**Volume (mm)**
RARAWARU 1 JUNC	0.0240	0.59	12:13	129	**RARAWARU 1 JUNC**	0.0240	0.87	12:13	188
RARAWARU 2 JUNC	0.0726	1.83	12:13	137	**RARAWARU 2 JUNC**	0.0726	2.68	12:13	196
RARAWARU 3 JUNC	0.0423	1.06	12:13	135	**RARAWARU 3 JUNC**	0.0423	1.56	12:13	194
RARAWARU 4 JUNC	0.1108	2.28	12:17	132	**RARAWARU 4 JUNC**	0.1108	3.37	12:17	191
RARAWARU 5 JUNC	0.0311	0.66	12:16	138	**RARAWARU 5 JUNC**	0.0311	0.97	12:16	198
RARAWARU 6 JUNC	0.0350	0.80	12:14	129	**RARAWARU 6 JUNC**	0.0350	1.19	12:14	187
RARAWARU 7 JUNC	0.0860	2.07	12:14	153	**RARAWARU 7 JUNC**	0.0860	2.96	12:14	214
RARAWARU 8 JUNC	0.0635	1.75	12:13	153	**RARAWARU 8 JUNC**	0.0635	2.50	12:13	214
RARAWARU 9 JUNC	0.1913	4.24	12:17	160	**RARAWARU 9 JUNC**	0.1913	5.96	12:17	222
RARAWARU 10 JUNC	0.4336	8.38	12:20	155	**RARAWARU 10 JUNC**	0.4336	11.85	12:20	216
RARAWARU 11 JUNC	0.0256	0.66	12:13	141	**RARAWARU 11 JUNC**	0.0256	0.97	12:13	201
EAST JUNC	0.0525	1.28	12:13	129	**EAST JUNC**	0.0525	1.90	12:13	187
ITM JUNC	0.0280	0.70	12:14	143	**ITM JUNC**	0.0280	1.01	12:14	203
NORTH JUNC	0.0176	0.42	12:13	129	**NORTH JUNC**	0.0176	0.63	12:13	187
TAKITIMU JUNC	0.0280	0.80	12:15	189	**TAKITIMU JUNC**	0.0280	1.09	12:15	253
WHENUAPAI 2 JUNC	0.1716	4.41	12:15	170	**WHENUAPAI 2 JUNC**	0.1716	6.14	12:15	232

RARAWARU WGD_[TP108]					RARAWARU WGD_[CC]				
Hydrologic Element	**Drainage Area (km^2)**	**Peak Discharge (m^3/s)**	**Time to Peak**	**Volume (mm)**	**Hydrologic Element**	**Drainage Area (km^2)**	**Peak Discharge (m^3/s)**	**Time to Peak**	**Volume (mm)**
RARAWARU 1 JUNC	0.0240	0.59	12:13	129	**RARAWARU 1 JUNC**	0.0240	0.87	12:13	188
RARAWARU 2 JUNC	0.0726	1.83	12:13	137	**RARAWARU 2 JUNC**	0.0726	2.68	12:13	196
RARAWARU 3 JUNC	0.0423	1.06	12:13	135	**RARAWARU 3 JUNC**	0.0423	1.56	12:13	194
RARAWARU 4 JUNC	0.1108	2.28	12:17	132	**RARAWARU 4 JUNC**	0.1108	3.37	12:17	191
RARAWARU 5 JUNC	0.0311	0.66	12:16	138	**RARAWARU 5 JUNC**	0.0311	0.97	12:16	198
RARAWARU 6 JUNC	0.0350	0.80	12:14	129	**RARAWARU 6 JUNC**	0.0350	1.19	12:14	187
RARAWARU 7 JUNC	0.0860	2.07	12:14	153	**RARAWARU 7 JUNC**	0.0860	2.96	12:14	214
RARAWARU 8 JUNC	0.0635	1.75	12:13	153	**RARAWARU 8 JUNC**	0.0635	2.50	12:13	214
RARAWARU 9 JUNC	0.1913	4.24	12:17	160	**RARAWARU 9 JUNC**	0.1913	5.96	12:17	222
RARAWARU 10 JUNC	0.4336	8.38	12:20	155	**RARAWARU 10 JUNC**	0.4336	11.85	12:20	216
RARAWARU 11 JUNC	0.0256	0.66	12:13	141	**RARAWARU 11 JUNC**	0.0256	0.97	12:13	201
AREA B JUNC	0.0427	1.23	12:13	164	**AREA B JUNC**	0.0427	1.73	12:13	226
AREA C JUNC	0.0152	0.45	12:12	171	**AREA C JUNC**	0.0152	0.63	12:12	233
ITM JUNC	0.0280	0.70	12:14	143	**ITM JUNC**	0.0280	1.01	12:14	203
TAKITIMU JUNC	0.0280	0.80	12:15	189	**TAKITIMU JUNC**	0.0280	1.09	12:15	253
WHENUAPAI 2 JUNC	0.1716	4.41	12:15	170	**WHENUAPAI 2 JUNC**	0.1716	6.14	12:15	232

APPENDIX C: Totara Road Culvert (2300DIA) Flood Model Results Summary

Scenarios (No Climate Change)	Pre-Development_[TP108](Blockage)			WGD_[TP108](Blockage)		
Parameter	**Pre_[TP108](0%)**	**Pre_[TP108](50%)**	**Pre_[TP108](100%)**	**WGD_[TP108](0%)**	**WGD_[TP108](50%)**	**WGD_[TP108](100%)**
Culvert blockage	0%	50%	100%	0%	50%	100%
Whenuapai Green Developed	No	No	No	Yes	Yes	Yes
Headwater elevation (RL)	5.54m	7.82m	10.50m	5.38m	7.76m	10.48m
94 Totara Road minor dwelling freeboard	3.68m	1.40m	-1.28m	3.84m	1.46m	-1.26m
94 Totara Road shed/workshop freeboard	7.61m	5.33m	2.65m	7.77m	5.39m	2.67m
94 Totara Road main dwelling freeboard	10.46m	8.18m	5.50m	10.62m	8.24m	5.52m
Totara Road freeboard (to top of embankment)	4.56m	2.28m	-0.40m	4.72m	2.34m	-0.38m
Upstream headwater depth	3.74m	6.02m	8.70m	3.58m	5.96m	8.68m
Downstream tailwater depth	4.13m	6.41m	9.09m	3.97m	6.35m	9.07m
Downstream 1% AEP peak flow rate	17.1m3/s	11.7m3/s	10.9m3/s	17.8m3/s	11.8m3/s	10.0m3/s
Downstream velocity	1.2m3/s	1.0m3/s	1.0m3/s	1.2m3/s	0.9m3/s	1.0m3/s

*Values in red to highlight breach of freeboard

Scenarios (with Cliamte Change)	Pre-Development_[with CC](Blockage)			WGD_[with CC](Blockage)		
Parameter	**Pre_[CC](0%)**	**Pre_[CC](50%)**	**Pre_[CC](100%)**	**WGD_[CC](0%)**	**WGD_[CC](50%)**	**WGD_[CC](100%)**
Culvert blockage	0%	50%	100%	0%	50%	100%
Whenuapai Green Developed	No	No	No	Yes	Yes	Yes
Headwater elevation (RL)	7.11m	9.77m	10.68m	7.56m	9.69m	10.72m
94 Totara Road minor dwelling freeboard	2.11m	-0.55m	-1.46m	1.66m	-0.47m	-1.50m
94 Totara Road shed/workshop freeboard	6.04m	3.38m	2.47m	5.59m	3.46m	2.43m
94 Totara Road main dwelling freeboard	8.89m	6.23m	5.32m	8.44m	6.31m	5.28m
Totara Road freeboard (to top of embankment)	2.99m	0.33m	-0.58m	2.54m	0.41m	-0.62m
Upstream headwater depth	5.31m	7.97m	8.88m	5.76m	7.89m	8.92m
Downstream tailwater depth	5.70m	8.36m	9.27m	6.15m	8.28m	9.31m
Downstream 1% AEP peak flow rate	22.36m3/s	11.86m3/s	24.12m3/s	24.13m3/s	14.68m3/s	27.94m3/s
Downstream velocity	1.43m/s	0.99m/s	1.61m/s	1.40m/s	1.03m/s	1.48m/s

*Values in red to highlight breach of freeboard

Technical Memo

To:	Auckland Council	**Job no:**	4520
From:	Kleber Lessa do Prado (Design Engineer) and Brian Jones (Group Manager Engineer) – The Neil Group	**Data:**	25/10/2024
Subject:	Stream Erosion Risk Assessment		
Site Address:	98-102 Totara Road, Whenuapai (Whenuapai Green Development Plan Change)		

1 Introduction

This memo addresses queries raised under Clause 23 of the Resource Management Act (RMA), specifically concerning the additional information requested about stormwater management (Item SW1). Neil Construction Limited aims to provide Auckland Council Healthy Waters (HW) with a high level (desktop) assessment of the potential stream erosion risks associated with the proposed land-use changes within and downstream of the Whenuapai Green Plan Change Area (PCA).

2 Background

Neil Construction Limited has submitted a Private Plan Change application to Auckland Council, seeking to rezone land at 98-102 Totara Road, Whenuapai. Currently zoned as 'Future Urban' under the Auckland Unitary Plan (AUP), the proposed change would allow for residential development, with the zoning shifting to 'Residential – Mixed Housing – Urban'.

Given that the PCA is a greenfield development, the recommended stormwater management approach is to implement a minimum Stormwater Management Area Control - Flow 1 (SMAF 1) hydrological mitigation, involving both detention and retention measures, for impervious surfaces where the receiving environment includes streams. It should be noted that SMAF 1 does not apply to areas discharging directly into the coastal environment. Note, the post-development flows discharged to Basin B are directed to coastal environment.

2.1 Stream Conditions and Ecological Considerations

The site's freshwater and terrestrial ecology have been assessed (Viridis, 2024), and the proposed private plan change has been deemed ecologically appropriate. The plan aims to promote the enhancement of indigenous biodiversity while ensuring efficient development. According to the Bioresearches Watercourse Classification (2020), the existing watercourse channel banks have been degraded by livestock.

The Plan Change Area (PCA) contributes to two major watercourse catchments: Rarawaru Creek to the east and Ratara Stream to the west. Within the PCA, two tributaries of Rarawaru Creek intersect the site. One is an intermittent watercourse (referred as Watercourse W2 in VIRIDIS Ecological Impact Assessment, crossing the site at two points: the southeast corner (downstream of the existing Whenuapai 2 basin) and through the panhandle (referred as Watercourse W4). The second tributary (referred as Watercourse P1) is a permanent reach of the Rarawaru Creek that crosses the northeast end of the panhandle. However, the contribution of the PCA to the Watercourse E catchment is minimal, representing only 0.54% of the total upstream catchment area.

Given these factors, the stream erosion risk assessment will focus primarily on the **Rarawaru Creek tributary (Watercourse W2 & W4)** and **Ratara Stream**, as shown in Figure 1 (shown below), which illustrates the relevant cross-section locations for analysis.

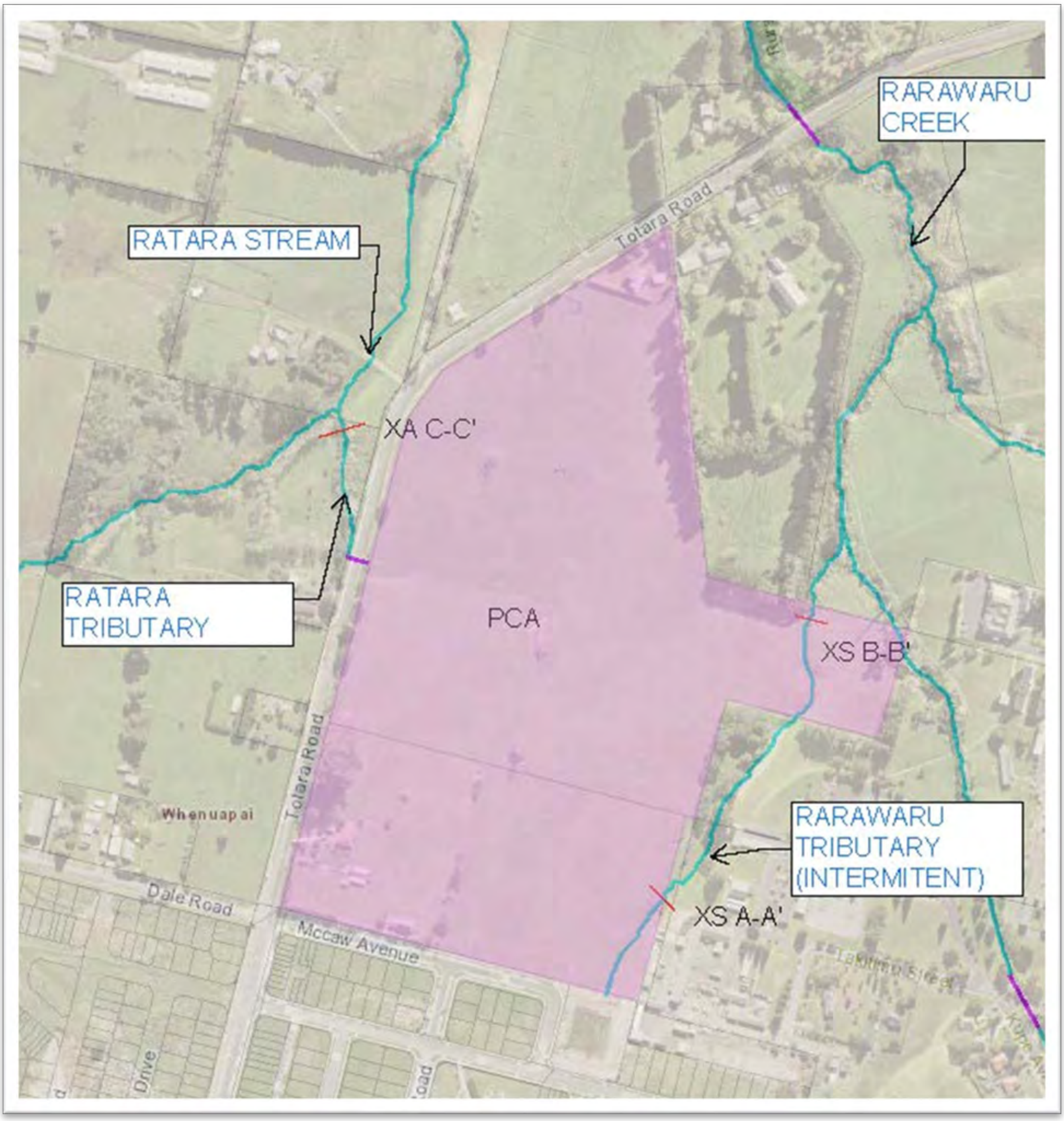


Figure 1 - Stream erosion assessment cross-section locations.

2.2 Geological Context

The geotechnical investigation conducted by CMW Geosciences (2022) at 98-102 Totara Road revealed that the site is predominantly underlain by Puketoka Formation Alluvials, consisting of firm to very stiff clayey silts and silty clays.

Considering the site's existing geological conditions, it can be inferred that the hydrological soil group type for the calculations corresponds to Group B, with a Curve Number (CN) of 61, as specified in Auckland Council TP108-1999, Tables 3.2 and 3.3.

3 Methodology

Auckland Council Healthy Waters (HW) has recommended the use of the Erosion Screening Tool HW .v2024 (EST) to assess the potential risk of stream erosion resulting from the proposed Plan Change Area (PCA) development. The EST tool employs the TP108 method to model hydrological conditions (hydrographs for various scenarios) and estimate bank and stream bed shear stress based on hydraulic forces. By comparing pre- and post-development scenarios, the tool calculates the potential stream erosion risk driven by increased surface runoff due to land use changes. It is important to note that this assessment does not quantify the actual erosion volume or sediment load entering the receiving environment but focuses on the potential for erosion risk.

3.1 Modifications to the EST:

Given known limitations of the standard EST, several modifications were made for this assessment:

- **Integration of Stormwater Mitigation and Attenuation:** The impact of Stormwater Management Area Flow 1 (SMAF1) controls was incorporated. This was achieved by modelling the stormwater network using third-party software (HEC HMS), which allows for the inclusion of detention and attenuation devices, such as stormwater basins. The modified EST provides a more accurate representation of flow attenuation and reduction in runoff velocity due to these mitigation devices.

- **Critical Shear Stress Estimation:** Due to the limited availability of geotechnical consultants with equipment capable of performing in-situ testing for critical shear stress, no on-site testing was conducted for this project. Therefore, an **estimated critical shear stress value of 32.6 Pa** was adopted based on the 50th percentile median value derived from Auckland-specific data compiled by Cardno for Auckland Council. This value aligns with the recommendations in the Auckland Council Technical Report 038 / 2009 (Erosion Parameters for Cohesive Sediment in Auckland Streams), which suggests adopting a median critical shear stress of approximately 33 Pa when site-specific data is unavailable.

The TR2009-038 report provides detailed testing of critical shear stress through jet tests in eleven streams across the wider Auckland region, and these values were considered appropriate for use in this assessment (see Figure 2 for reference).

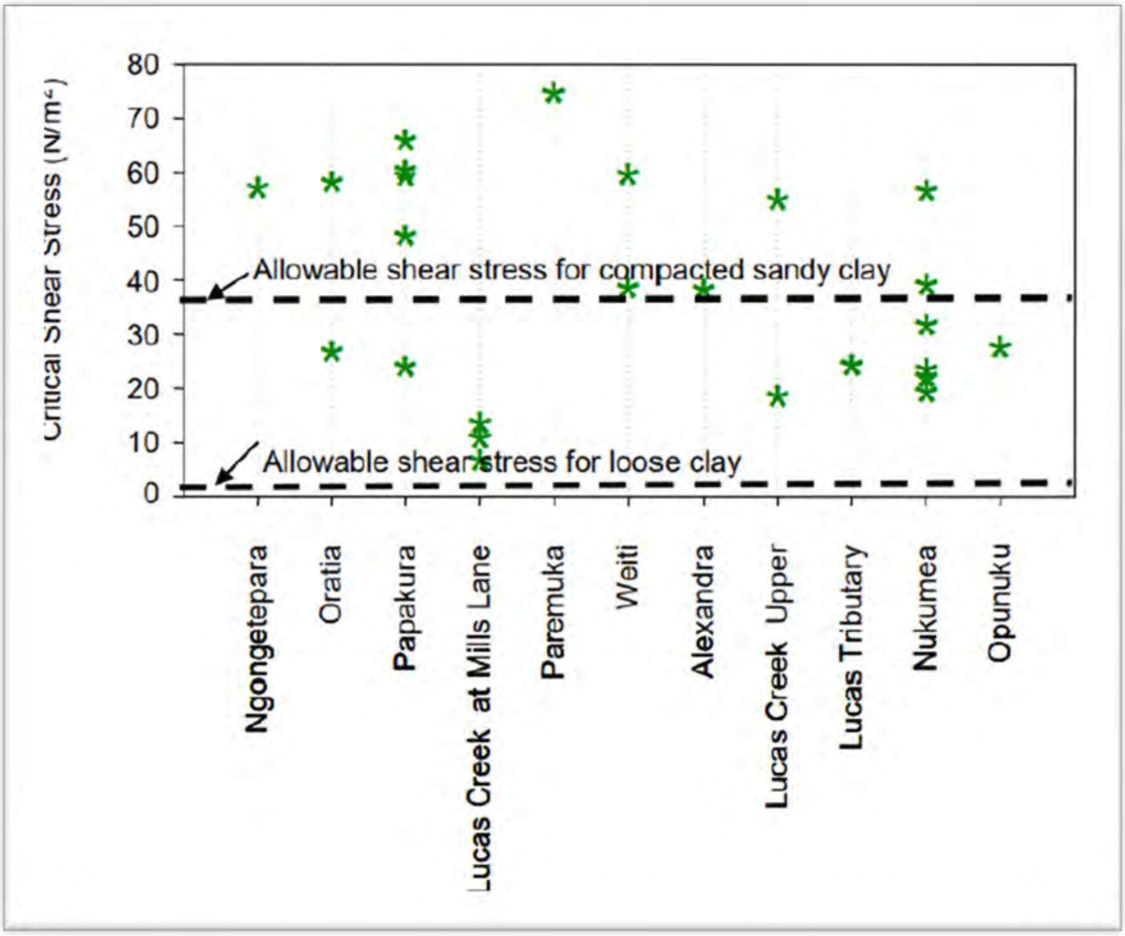
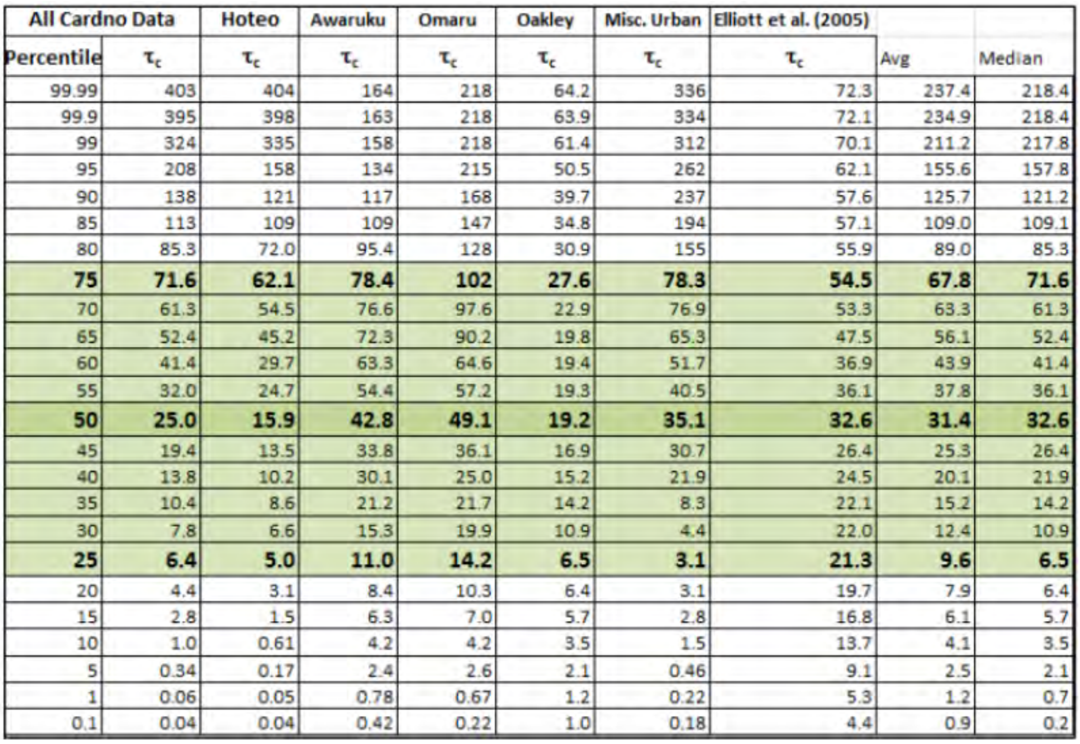


Figure 2 - Critical shear stress measured by jet tests in Auckland streams/locations, (Taken from AC TR2009-038)

Table 1 Critical shear stress in the bank materials at various locations around the Auckland region. (from Auckland-specific data compiled by Cardno for Auckland Council and included in the Stream Erosion Tool).



All Cardno Data		Hoteo	Awaruku	Omaru	Oakley	Misc. Urban	Elliott et al. (2005)		
Percentile	τ_c	τ_c	τ_c	τ_c	τ_c	τ_c	τ_c	Avg	Median
99.99	403	404	164	218	64.2	336	72.3	237.4	218.4
99.9	395	398	163	218	63.9	334	72.1	234.9	218.4
99	324	335	158	218	61.4	312	70.1	211.2	217.8
95	208	158	134	215	50.5	262	62.1	155.6	157.8
90	138	121	117	168	39.7	237	57.6	125.7	121.2
85	113	109	109	147	34.8	194	57.1	109.0	109.1
80	85.3	72.0	95.4	128	30.9	155	55.9	89.0	85.3
75	**71.6**	**62.1**	**78.4**	**102**	**27.6**	**78.3**	**54.5**	**67.8**	**71.6**
70	61.3	54.5	76.6	97.6	22.9	76.9	53.3	63.3	61.3
65	52.4	45.2	72.3	90.2	19.8	65.3	47.5	56.1	52.4
60	41.4	29.7	63.3	64.6	19.4	51.7	36.9	43.9	41.4
55	32.0	24.7	54.4	57.2	19.3	40.5	36.1	37.8	36.1
50	**25.0**	**15.9**	**42.8**	**49.1**	**19.2**	**35.1**	**32.6**	**31.4**	**32.6**
45	19.4	13.5	33.8	36.1	16.9	30.7	26.4	25.3	26.4
40	13.8	10.2	30.1	25.0	15.2	21.9	24.5	20.1	21.9
35	10.4	8.6	21.2	21.7	14.2	8.3	22.1	15.2	14.2
30	7.8	6.6	15.3	19.9	10.9	4.4	22.0	12.4	10.9
25	**6.4**	**5.0**	**11.0**	**14.2**	**6.5**	**3.1**	**21.3**	**9.6**	**6.5**
20	4.4	3.1	8.4	10.3	6.4	3.1	19.7	7.9	6.4
15	2.8	1.5	6.3	7.0	5.7	2.8	16.8	6.1	5.7
10	1.0	0.61	4.2	4.2	3.5	1.5	13.7	4.1	3.5
5	0.34	0.17	2.4	2.6	2.1	0.46	9.1	2.5	2.1
1	0.06	0.05	0.78	0.67	1.2	0.22	5.3	1.2	0.7
0.1	0.04	0.04	0.42	0.22	1.0	0.18	4.4	0.9	0.2

3.2 Erosion Thresholds

The Erosion Screening Tool (EST) categorizes potential stream bed and bank erosion risk into four bands based on excess shear stress. These bands, along with their corresponding erosion risks, are outlined in Table 2 below:

Table 2 - Auckland Council Erosion Risk Thresholds (from EST HW v.2024)

Threshold	**Excess Shear**	**Description**
Green	<1.0	Indicates no erosion predicted to occur
Yellow	>1.0 <2.0	Indicates the potential for some erosion of the channel
Orange	>2.0 <10.0	Indicates the potential for channel to be mobile, (likely active erosion)
Red	>10.0	Indicates potential rapid rates of erosion and incision of channel

These thresholds serve as benchmarks for evaluating the risk of stream erosion under various stormwater event scenarios.

3.3 Stormwater Event Scenarios

The Erosion Screening Tool (EST) evaluates several scenarios, including pre-development, post-development, and considers both current and future rainfall depths (adjusted for climate change factors). A broad range of Annual Exceedance Probabilities (AEPs), from 400% AEP (3 months ARI) to 1% AEP (100 years ARI), are also modelled to assess the potential erosion risks under different storm conditions.

Key Input Parameters:

- **Rainfall Depths**: The table below summarizes the rainfall depths used in the EST tool, incorporating climate change (CC) factors:

Table 3 Rainfall depth (in mm)

Rainfall Event	TP108	Applied CC	CC factor[1]
3 month (400% AEP)	29	31	7.1%[2]
6 month (200% AEP)	48	57	16.3%[2]
1 YEAR (100% AEP)	67	84	19.7%[2]
2 YEAR (50% AEP)	85	98	15.1%
2.3 YEAR (43.49% AEP)	91	105	15.1%
5 YEAR (20% AEP)	112	130	16.4%
10 YEAR (10% AEP)	135	158	17.0%
100 YEAR (1% ARI)	195	259	32.7%

1. Climate Change factors (CC) based on Auckland Council SW CoP Chapter 4 version 4 – Table 1.
2. The rainfall depths for AEPs greater than 50% were calculated using EST regression curves. There is no public data available to verify these results.

- **Curve Numbers (CNs)**: The table below presents the values used in the TP108 calculations for different soil types and scenarios:

Table 4 – Curve Number used in the TP108 calculations

Soil Type	CN	Land Cover Type	Scenarios
B	61	Pervious	ED+C & ED+CC
C	74	Pervious	PD+C & PD+CC
Sealed roads, roofs	98	Impervious	All

- **Channel Roughness Coefficient**: The watercourses assessed are characterized as straight, smooth, and uniform, with long grass or tree roots in the bed. Accordingly, a **Manning's roughness coefficient of 0.035** has been deemed appropriate for the calculations.

- **Catchment Composition**: The catchment composition, including pervious and impervious surfaces, was based on existing conditions and indicative proposed development. For more detailed information, refer to plans 4520-PC-SW-430 and SW-431.

4 Stream Erosion Potential Risk Assessment Results

The excess shear stress at each cross-section has been calculated using the Erosion Screening Tool (EST) for all scenarios and storm events mentioned above. The detailed results for each scenario are provided in Appendix A.

The potential stream erosion risk was evaluated by analysing the duration during which excess shear stress exceeded each of the predefined erosion thresholds. The section below summarizes the percentage of time each erosion threshold was exceeded at each cross-section, comparing pre-development (ED+C) and post-development (PD+C) scenarios under varies rainfall events:

4.1 Cross-section A-A (Watercourse W2)

The contributing catchment for cross-section A-A is approximately 14 hectares, with the majority of the area already developed as part of the Whenuapai 2 development (circa 2017). The profile for cross-section A-A used in the EST calculations is shown in Figure 3 below.

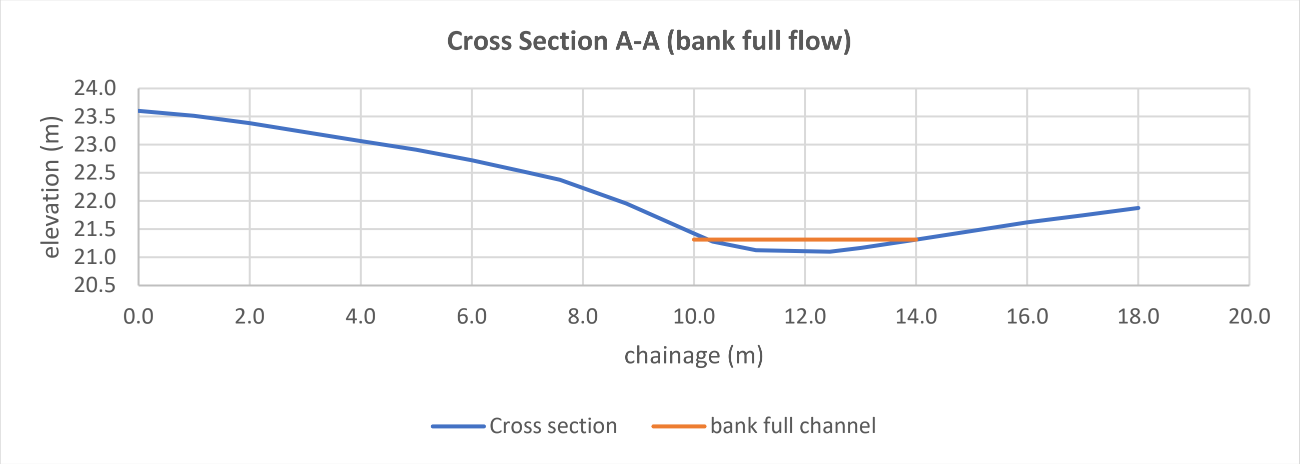


Figure 3 - Cross-section A-A (Watercourse W2) & Bank full flow

The results for the erosion risk assessment at cross-section A-A are summarized in Table 5:

Table 5 - Cross-section A-A (Watercourse W2) EST results summary

	Threshold	Pre-Development (Scenario 1 ED+C)	Post-Development (Scenario 3 PD+C)	% of time of exceedance difference	Pre-Development (Scenario 2 ED+CC)	Post-Development (Scenario 4 PD+CC)	% of time of exceedance difference
3 month ARI	<1 (min)	100.0%	100.0%	0.0%	100.0%	100.0%	0.0%
	>1 & <2 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
6 month ARI	<1 (min)	100.0%	100.0%	0.0%	100.0%	99.3%	-0.7%
	>1 & <2 (min)	0.0%	0.0%	0.0%	0.0%	0.7%	0.7%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1 year ARI	<1 (min)	100.0%	97.9%	-2.1%	97.2%	97.2%	0.0%
	>1 & <2 (min)	0.0%	2.1%	2.1%	2.8%	2.8%	0.0%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2 year ARI	<1 (min)	97.2%	97.2%	0.0%	96.5%	95.8%	-0.7%
	>1 & <2 (min)	2.8%	2.8%	0.0%	3.5%	4.2%	0.7%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2.3 year ARI	<1 (min)	97.2%	97.2%	0.0%	95.1%	95.1%	0.0%
	>1 & <2 (min)	2.8%	2.8%	0.0%	4.9%	4.9%	0.0%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5 year ARI	<1 (min)	95.1%	95.8%	0.7%	94.4%	93.8%	-0.7%
	>1 & <2 (min)	4.9%	4.2%	-0.7%	5.6%	6.3%	0.7%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10 year ARI	<1 (min)	94.4%	93.8%	-0.7%	93.1%	93.1%	0.0%
	>1 & <2 (min)	5.6%	6.3%	0.7%	6.9%	6.9%	0.0%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
100 year ARI	<1 (min)	91.0%	91.7%	0.7%	87.5%	87.5%	0.0%
	>1 & <2 (min)	9.0%	8.3%	-0.7%	10.4%	10.4%	0.0%
	>2 & <10 (min)	0.0%	0.0%	0.0%	2.1%	2.1%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

As anticipated, the difference in the percentage of exceedance for cross-section A-A is negligible. This is due to the small portion of the catchment contributing from the PCA, which minimizes the impact of the proposed development on potential stream erosion risk.

4.2 Cross-section B-B (Watercourse W4).

Similar to cross-section A-A, the majority of the contributing catchment for cross-section B-B is already developed, covering an area of approximately 18 hectares. The proposed Whenuapai Green Development (WGD) results in a modest increase of approximately 7% in imperviousness. The profile for cross-section B-B used in the EST calculations is shown in Figure 4:

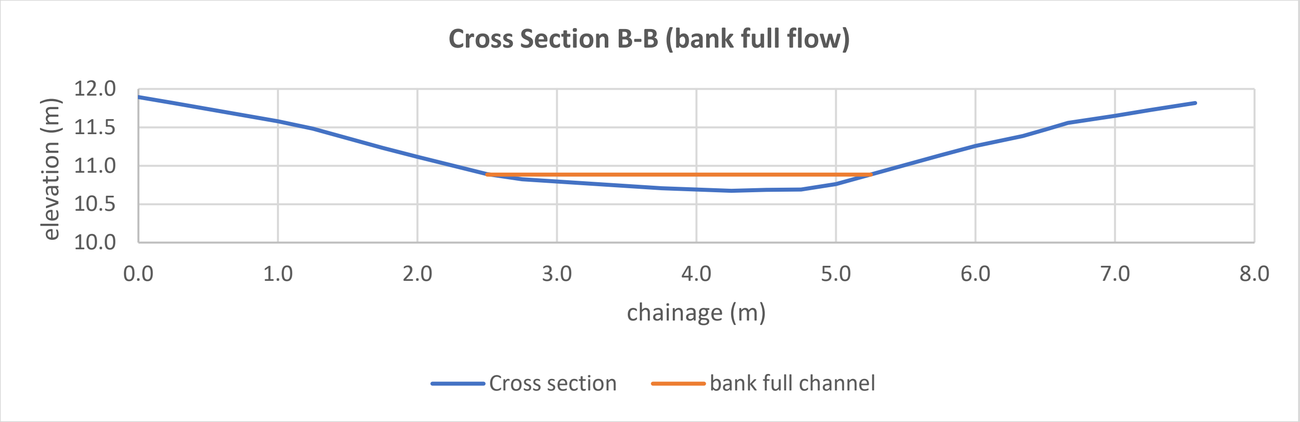


Figure 4 - Cross-section B-B (Watercourse W4) & Bank full flow

The results for the erosion risk assessment at cross-section B-B are summarized in Table 6 below:

Table 6 - Cross-section B-B (Watercourse W4) EST results summary

	Threshold	Pre-Development (Scenario 1 ED+C)	Post-Development (Scenario 3 PD+C)	% of time of exceedance difference	Pre-Development (Scenario 2 ED+CC)	Post-Development (Scenario 4 PD+CC)	% of time of exceedance difference
3 month ARI	<1 (min)	100.0%	97.2%	-2.8%	97.9%	96.5%	-1.4%
	>1 & <2 (min)	0.0%	2.8%	2.8%	2.1%	3.5%	1.4%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
6 month ARI	<1 (min)	93.8%	93.8%	0.0%	97.9%	90.3%	-7.6%
	>1 & <2 (min)	6.3%	6.3%	0.0%	2.1%	9.7%	7.6%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1 year ARI	<1 (min)	89.6%	88.2%	-1.4%	84.0%	83.3%	-0.7%
	>1 & <2 (min)	10.4%	10.4%	0.0%	13.2%	13.2%	0.0%
	>2 & <10 (min)	0.0%	1.4%	1.4%	2.8%	3.5%	0.7%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2 year ARI	<1 (min)	84.7%	83.3%	-1.4%	83.3%	81.9%	-1.4%
	>1 & <2 (min)	13.2%	13.9%	0.7%	12.5%	13.2%	0.7%
	>2 & <10 (min)	2.1%	2.8%	0.7%	4.2%	4.9%	0.7%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2.3 year ARI	<1 (min)	82.6%	81.3%	-1.4%	81.3%	79.2%	-2.1%
	>1 & <2 (min)	14.6%	16.0%	1.4%	14.6%	16.0%	1.4%
	>2 & <10 (min)	2.8%	2.8%	0.0%	4.2%	4.9%	0.7%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5 year ARI	<1 (min)	76.4%	74.3%	-2.1%	67.4%	66.7%	-0.7%
	>1 & <2 (min)	19.4%	20.8%	1.4%	27.1%	27.1%	0.0%
	>2 & <10 (min)	4.2%	4.9%	0.7%	5.6%	6.3%	0.7%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10 year ARI	<1 (min)	66.0%	63.9%	-2.1%	65.3%	62.5%	-2.8%
	>1 & <2 (min)	28.5%	30.6%	2.1%	27.1%	30.6%	3.5%
	>2 & <10 (min)	5.6%	5.6%	0.0%	7.6%	6.9%	-0.7%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
100 year ARI	<1 (min)	35.4%	49.3%	13.9%	29.9%	27.1%	-2.8%
	>1 & <2 (min)	55.6%	41.7%	-13.9%	56.3%	60.4%	4.2%
	>2 & <10 (min)	9.0%	9.0%	0.0%	13.9%	12.5%	-1.4%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

The table demonstrates that the difference in percentage of exceedance at cross-section B-B is minimal, with less than a 3% increase for most storm events.

It should be noted that for the 100-year ARI storm event (without considering climate change), while the excess shear peak is higher, the percentage of exceedance below 2 increases by 13.9%. This is largely due to part of the catchment discharging to the coastal environment downstream of the existing 2300DIA Totara Road culvert. Therefore, the proposed development in this scenario, reduces the potential risk of stream bank erosion.

4.3 Cross-section C-C (Ratara Stream).

Unlike cross-sections A-A and B-B, the majority of the contributing catchment for the Ratara Stream tributary is covered by the PCA. As a result, the increase in stormwater runoff from impervious areas, if not properly managed and mitigated, could significantly elevate the risk of stream bank erosion.

To mitigate the impacts of the proposed development, the PCA includes provisions to attenuate peak flows generated from its catchments to pre-existing conditions. The flow hydrograph discharge from Basin A and the upstream catchments was modelled using HEC HMS, with the model results then input into the EST to provide an accurate shear stress boundary.

The profile for cross-section C-C used in the EST calculations is shown in Figure 5 below:

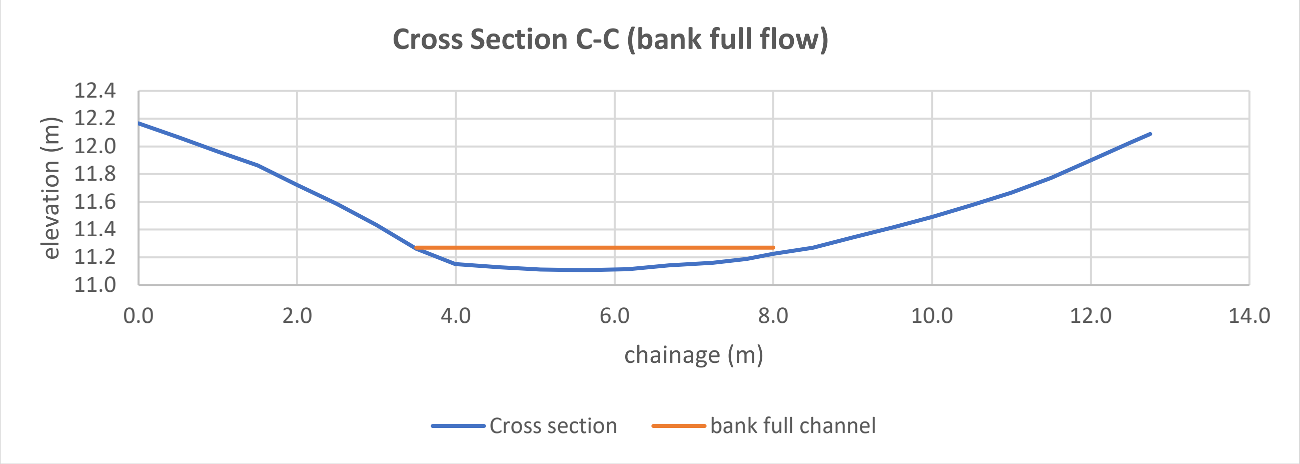


Figure 5 - Cross-section C-C (Ratara Stream) & Bank full flow

The results for the erosion risk assessment at cross-section C-C are summarized in Table 7 below:

Table 7- Cross-section C-C (Ratara Strem) EST results summary

	Threshold	Pre-Development (Scenario 1 ED+C)	Post-Development (Scenario 3 PD+C)	% of time of exceedance difference	Pre-Development (Scenario 2 ED+CC)	Post-Development (Scenario 4 PD+CC)	% of time of exceedance difference
3 month ARI	<1 (min)	100.0%	100.0%	0.0%	100.0%	100.0%	0.0%
	>1 & <2 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
6 month ARI	<1 (min)	100.0%	100.0%	0.0%	100.0%	100.0%	0.0%
	>1 & <2 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1 year ARI	<1 (min)	100.0%	100.0%	0.0%	100.0%	100.0%	0.0%
	>1 & <2 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

	Threshold	Pre-Development (Scenario 1 ED+C)	Post-Development (Scenario 3 PD+C)	% of time of exceedance difference	Pre-Development (Scenario 2 ED+CC)	Post-Development (Scenario 4 PD+CC)	% of time of exceedance difference
2 year ARI	<1 (min)	100.0%	100.0%	0.0%	100.0%	100.0%	0.0%
	>1 & <2 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2.3 year ARI	<1 (min)	100.0%	100.0%	0.0%	100.0%	98.6%	-1.4%
	>1 & <2 (min)	0.0%	0.0%	0.0%	0.0%	1.4%	1.4%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5 year ARI	<1 (min)	100.0%	98.6%	-1.4%	97.9%	96.5%	-1.4%
	>1 & <2 (min)	0.0%	1.4%	1.4%	2.1%	3.5%	1.4%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10 year ARI	<1 (min)	98.6%	96.5%	-2.1%	97.2%	95.1%	-2.1%
	>1 & <2 (min)	1.4%	3.5%	2.1%	2.8%	4.9%	2.1%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
100 year ARI	<1 (min)	96.5%	93.8%	-2.8%	93.8%	91.7%	-2.1%
	>1 & <2 (min)	3.5%	6.3%	2.8%	6.3%	7.6%	1.4%
	>2 & <10 (min)	0.0%	0.0%	0.0%	0.0%	0.7%	0.7%
	>10 (min)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 7 above demonstrates that the difference in percentage of exceedance in cross-section C-C (Ratara Stream) is minor, less than 3%.

5 Results

The assessment of stream bank erosion risk in the Plan Change Area (PCA) has revealed the following key insights regarding the two primary watercourses of interest: the Rarawaru Creek tributary and the Ratara Stream.

5.1 Rarawaru Creek Tributary:

In the areas of the PCA that discharge into the Rarawaru Creek tributary, there is an observed increase in peak flows due to the proposed increase in impervious surfaces. However, despite these increases, the potential risk to stream bank erosion is negligible, especially for the most frequent storm events, ranging from 3 months to 2 years ARI. The slight rise in runoff does not significantly exceed critical erosion thresholds during these events, indicating that the stream's natural resilience and the existing mitigation measures are sufficient to prevent notable erosion in the tributary. As such, the risk of stream bank erosion in this portion of the catchment remains low.

5.2 Ratara Stream:

For the areas discharging into the Ratara Stream, the implementation of Stormwater Management Area Flow 1 (SMAF1) provisions has proven effective in mitigating the potential risks associated with increased stormwater runoff. The SMAF requirements adopted for this catchment, particularly through detention and retention measures, successfully attenuate peak flows to levels similar to pre-development conditions. This has been confirmed through the modelled results, which show that the potential for stream bank erosion is minimized across various storm events, including more severe and less frequent events. The hydrological attenuation provided by the proposed stormwater basins ensures that the stream is protected from significant increases in erosive forces.

These results confirm that the stormwater management provisions incorporated into the development plan are effective at mitigating potential stream bank erosion risks, both in the Rarawaru Creek tributary and the Ratara Stream. While there is an increase in impervious areas due to the PCA, the mitigation measures, particularly those associated with SMAF1, successfully manage peak flows and erosion risk, ensuring the long-term stability of the watercourses.

6 Stream Erosion Risk Assessment Limitations

While the Erosion Screening Tool (EST) provides a framework for evaluating the potential risk of stream bank erosion due to land use changes, there are certain limitations associated with the current assessment. These limitations should be considered when interpreting the results:

6.1 Simplified Hydrological Modelling:

The EST tool uses a simplified hydrological model to represent complex catchment dynamics. Although the tool incorporates rainfall depths, runoff volumes, and shear stress calculations, it may not fully capture the variability in localized stormwater flows that can impact stream erosion. Additionally, assumptions made in the model, such as uniform roughness coefficients and generalized curve numbers, may not reflect the full complexity of real-world conditions.

6.2 Absence of Site-Specific Geotechnical Data:

Due to the lack of site-specific in-situ testing for critical shear stress, the assessment relied on default values derived from Auckland-specific datasets (e.g., median critical shear stress of 32.6 Pa). While this approach aligns with Auckland Council's TR2009-038 recommendations, it introduces some uncertainty, particularly in stream sections that may have unique geotechnical characteristics not captured by the generalized data. Additionally, if field testing were performed, the actual critical shear stress values could potentially be higher than the default values used, which would suggest a a lower risk of stream bank erosion than currently estimated in the assessment.

6.3 Climate Change Assumptions:

The model incorporated future rainfall scenarios based on factors of temperature increase to account for climate change impacts. However, climate change projections remain inherently uncertain, particularly regarding the intensity and frequency of extreme weather events. Any deviations from the projected climate scenarios used in this assessment may alter the actual erosion risks.

6.4 Sediment Load Not Considered:

The current assessment focuses on stream bank erosion risk but does not quantify the additional sediment load that may enter the stream system due to increased runoff. Sediment transport dynamics, which can also contribute to degradation of stream channels and downstream ecosystems, have not been explicitly modelled in this study.

6.5 Effects of Vegetation:

The EST tool does not account for the stabilizing effects of vegetation type, root density, or other natural factors that could reduce the risk of stream bank erosion. Well-established vegetation, particularly with deep root systems, can play a significant role in reinforcing stream banks and mitigating erosion. However, these natural factors are not captured within the model. Additionally, any proposed riparian margin planting or other ecological enhancements planned as part of the PCA cannot be included in the tool’s calculations. As such, the positive impact of vegetation in reducing erosion risk may be underrepresented in this assessment, suggesting that actual erosion potential may be lower than predicted, especially in areas where riparian planting is proposed.

6.6 Topographic Data Sources:

The cross-sections for A-A and B-B were developed using detailed topographic survey data from within the PCA, ensuring a higher level of accuracy for these locations. However, for the Ratara Stream cross-section, being outside the PCA, the assessment relied on Auckland Council GIS LiDAR data (0.25m contours, NZVD2016) to establish the cross-sectional profile. While LiDAR provides a valuable approximation of terrain, it is limited by its inability to penetrate water, meaning it cannot capture the bathymetry of the channel. As a result, the LiDAR-based cross-section was slightly modified to include a channel bed to approximate actual stream conditions. This introduces some level of uncertainty, as the adjustments are based on assumptions rather than precise measurements.

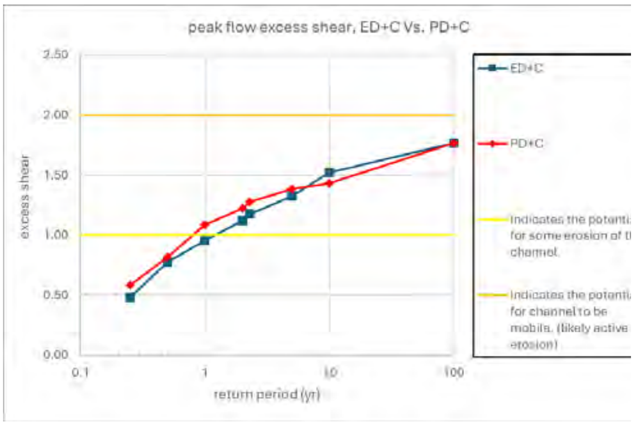
APPENDIX A

The appendix contains all detailed Erosion Screening Tool (EST) results, including tables and graphs, from the stream erosion risk assessment for all scenarios.

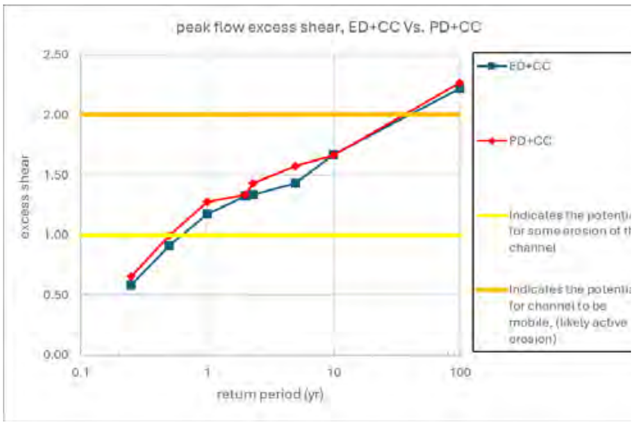
Cross-Section A-A EST output results

return period (yr)	0.25	0.5	1	2	2.30	5	10	100
Scenario 1 ED+C								
boundary shear stress at peak (N/m2)	15.70	25.15	31.07	36.54	38.20	43.09	49.55	57.66
excess shear at peak	0.48	0.77	0.95	1.12	1.17	1.32	1.52	1.77
excess shear excedence (min)								
<1 (min)	1440	1440	1440	1400	1400	1370	1360	1310
>1 & <2 (min)	0	0	0	40	40	70	80	130
>2 & <10 (min)	0	0	0	0	0	0	0	0
>10 (min)	0	0	0	0	0	0	0	0
Scenario 2 ED+CC								
boundary shear stress at peak (N/m2)	19.02	29.64	38.20	43.17	43.56	46.71	54.36	72.28
excess shear at peak	0.58	0.91	1.17	1.32	1.34	1.43	1.67	2.22
excess shear excedence (min)								
<1 (min)	1440	1440	1400	1390	1370	1360	1340	1260
>1 & <2 (min)	0	0	40	50	70	80	100	150
>2 & <10 (min)	0	0	0	0	0	0	0	30
>10 (min)	0	0	0	0	0	0	0	0
Scenario 3 PD+C								
boundary shear stress at peak (N/m2)	19.02	26.57	35.34	39.86	41.52	45.06	46.71	57.66
excess shear at peak	0.58	0.81	1.08	1.22	1.27	1.38	1.43	1.77
excess shear excedence (min)								
<1 (min)	1440	1440	1410	1400	1400	1380	1350	1320
>1 & <2 (min)	0	0	30	40	40	60	90	120
>2 & <10 (min)	0	0	0	0	0	0	0	0
>10 (min)	0	0	0	0	0	0	0	0
Scenario 4 PD+CC								
boundary shear stress at peak (N/m2)	21.38	32.50	41.52	43.56	46.56	51.30	54.22	73.88
excess shear at peak	0.66	1.00	1.27	1.34	1.43	1.57	1.66	2.27
excess shear excedence (min)								
<1 (min)	1440	1430	1400	1380	1370	1350	1340	1260
>1 & <2 (min)	0	10	40	60	70	90	100	150
>2 & <10 (min)	0	0	0	0	0	0	0	30
>10 (min)	0	0	0	0	0	0	0	0

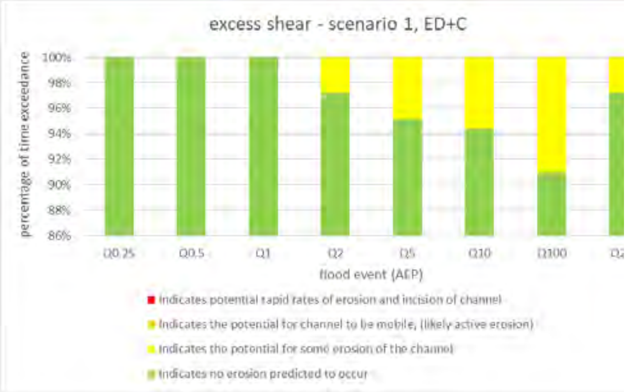
Cross-section A-A Pre vs Post (Existing rainfall depth)

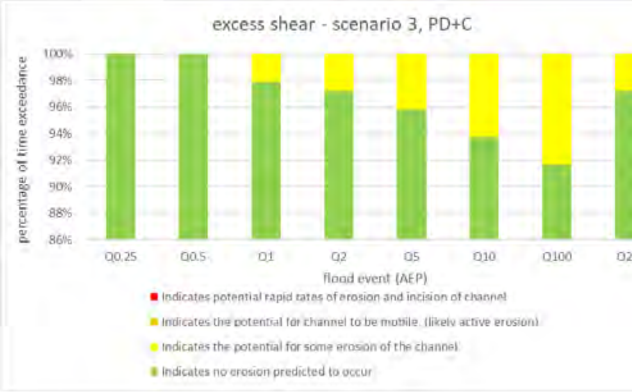


Cross-section A-A Pre vs Post (Future rainfall depth)

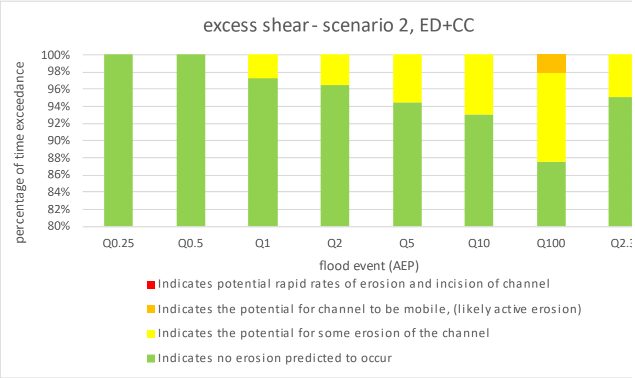


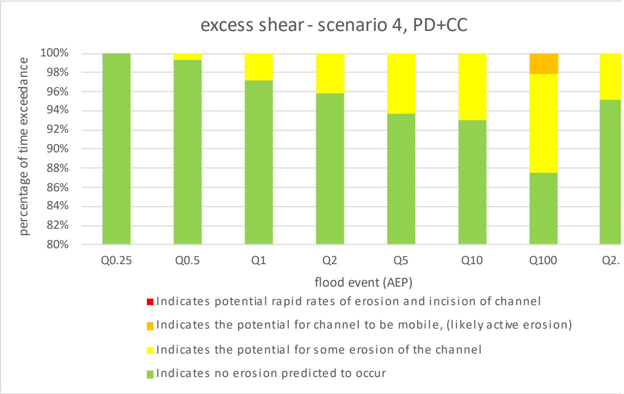
Cross-section A-A – Pre vs Post excess shear stress time of exceedance (Existing rainfall depth)





Cross-section A-A – Pre vs Post excess shear stress time of exceedance (Future rainfall depth)

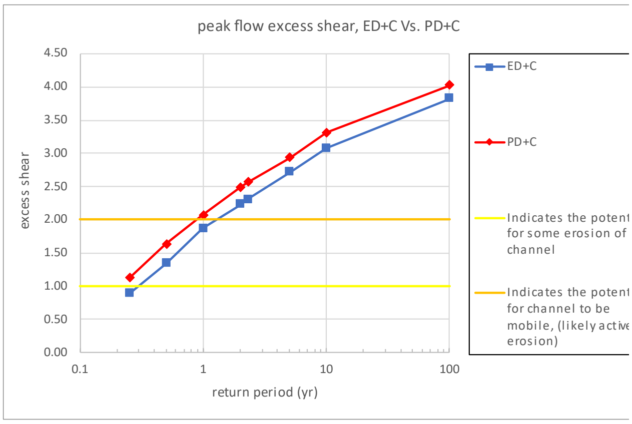




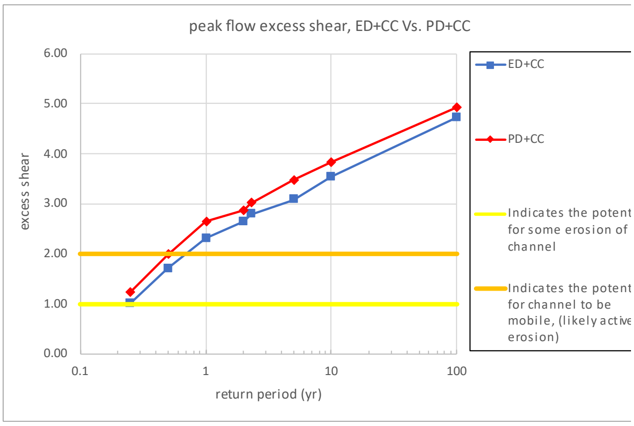
Cross-Section B-B EST output results

return period (yr)	0.25	0.5	1	2	2.30	5	10	100
Scenario 1 ED+C								
boundary shear stress at peak (N/m2)	28.84	43.72	60.93	72.69	75.28	88.56	100.37	124.73
excess shear at peak	0.88	1.34	1.87	2.23	2.31	2.72	3.08	3.83
excess shear excedence (min)								
<1 (min)	1440	1350	1290	1220	1190	1100	950	510
>1 & <2 (min)	0	90	150	190	210	280	410	800
>2 & <10 (min)	0	0	0	30	40	60	80	130
>10 (min)	0	0	0	0	0	0	0	0
Scenario 2 ED+CC								
boundary shear stress at peak (N/m2)	32.73	55.59	75.28	86.14	90.96	100.31	115.40	154.00
excess shear at peak	1.00	1.71	2.31	2.64	2.79	3.08	3.54	4.72
excess shear excedence (min)								
<1 (min)	1410	1330	1210	1200	1170	970	940	430
>1 & <2 (min)	30	110	190	180	210	390	390	810
>2 & <10 (min)	0	0	40	60	60	80	110	200
>10 (min)	0	0	0	0	0	0	0	0
Scenario 3 PD+C								
boundary shear stress at peak (N/m2)	36.55	53.17	67.44	81.22	83.69	95.80	108.08	131.32
excess shear at peak	1.12	1.63	2.07	2.49	2.57	2.94	3.32	4.03
excess shear excedence (min)								
<1 (min)	1400	1350	1270	1200	1170	1070	920	710
>1 & <2 (min)	40	90	150	200	230	300	440	600
>2 & <10 (min)	0	0	20	40	40	70	80	130
>10 (min)	0	0	0	0	0	0	0	0
Scenario 4 PD+CC								
boundary shear stress at peak (N/m2)	40.12	64.78	86.14	93.48	98.10	113.04	124.73	160.47
excess shear at peak	1.23	1.99	2.64	2.87	3.01	3.47	3.83	4.92
excess shear excedence (min)								
<1 (min)	1390	1300	1200	1180	1140	960	900	390
>1 & <2 (min)	50	140	190	190	230	390	440	870
>2 & <10 (min)	0	0	50	70	70	90	100	180
>10 (min)	0	0	0	0	0	0	0	0

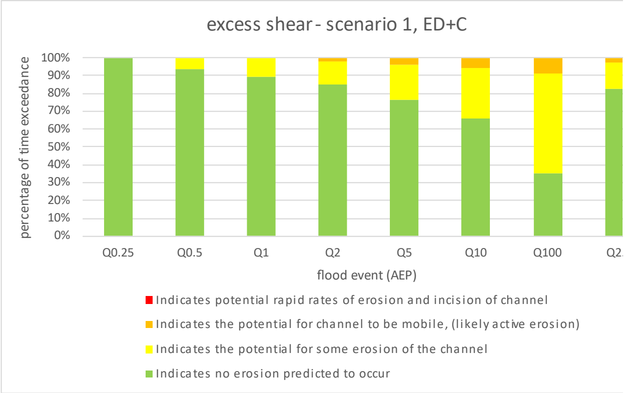
Cross-section B-B Pre vs Post (Existing rainfall depth)

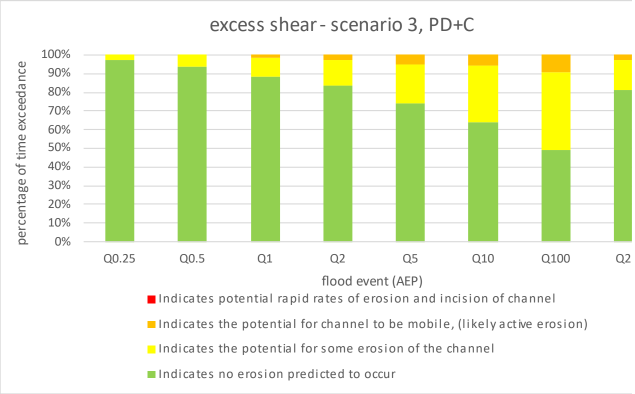


Cross-section B-B Pre vs Post (Future rainfall depth)

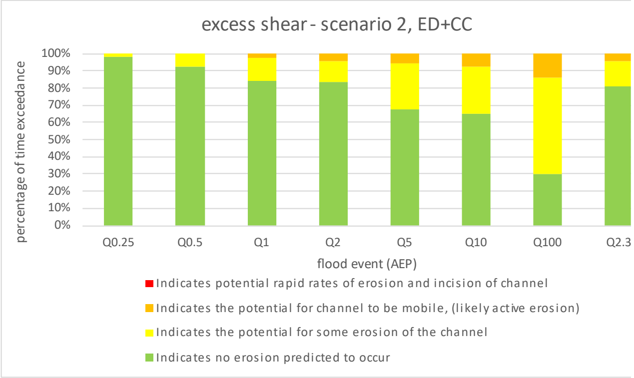


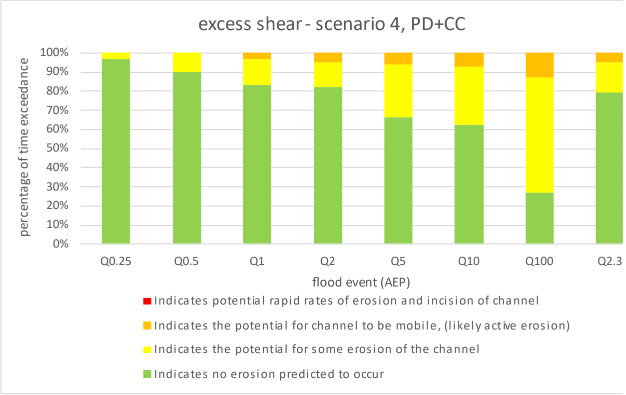
Cross-section B-B - Pre vs Post excess shear stress time of exceedance (Existing rainfall depth)





Cross-section B-B – Pre vs Post excess shear stress time of exceedance (Future rainfall depth)

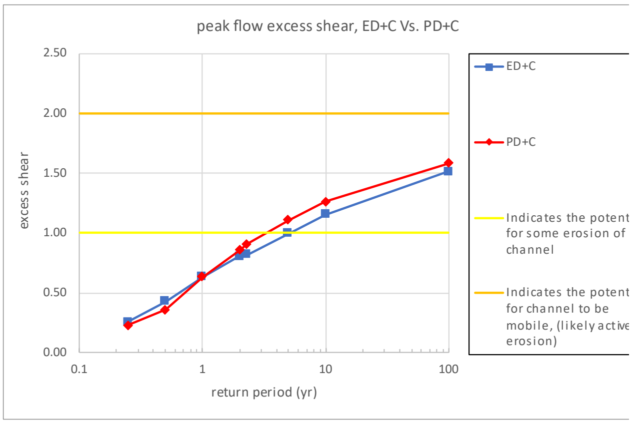




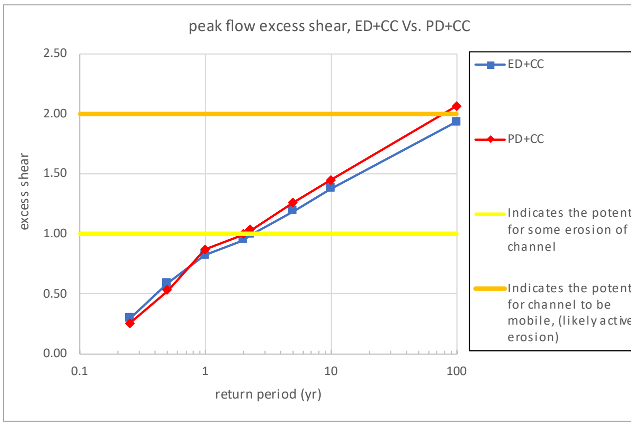
Cross-Section C-C EST output results

return period (yr)	0.25	0.5	1	2	2.30	5	10	100
Scenario 1 ED+C								
boundary shear stress at peak (N/m2)	8.31	13.97	20.67	26.21	26.73	32.44	37.58	49.33
excess shear at peak	0.25	0.43	0.63	0.80	0.82	0.99	1.15	1.51
excess shear excedence (min)								
<1 (min)	1440	1440	1440	1440	1440	1440	1420	1390
>1 & <2 (min)	0	0	0	0	0	0	20	50
>2 & <10 (min)	0	0	0	0	0	0	0	0
>10 (min)	0	0	0	0	0	0	0	0
Scenario 2 ED+CC								
boundary shear stress at peak (N/m2)	9.61	19.12	26.73	30.90	32.44	38.75	44.79	62.90
excess shear at peak	0.29	0.59	0.82	0.95	0.99	1.19	1.37	1.93
excess shear excedence (min)								
<1 (min)	1440	1440	1440	1440	1440	1410	1400	1350
>1 & <2 (min)	0	0	0	0	0	30	40	90
>2 & <10 (min)	0	0	0	0	0	0	0	0
>10 (min)	0	0	0	0	0	0	0	0
Scenario 3 PD+C								
boundary shear stress at peak (N/m2)	7.44	11.73	20.67	27.93	29.62	36.14	41.09	51.61
excess shear at peak	0.23	0.36	0.63	0.86	0.91	1.11	1.26	1.58
excess shear excedence (min)								
<1 (min)	1440	1440	1440	1440	1440	1420	1390	1350
>1 & <2 (min)	0	0	0	0	0	20	50	90
>2 & <10 (min)	0	0	0	0	0	0	0	0
>10 (min)	0	0	0	0	0	0	0	0
Scenario 4 PD+CC								
boundary shear stress at peak (N/m2)	8.31	17.22	28.34	32.44	33.67	41.09	47.11	67.18
excess shear at peak	0.25	0.53	0.87	0.99	1.03	1.26	1.45	2.06
excess shear excedence (min)								
<1 (min)	1440	1440	1440	1440	1420	1390	1370	1320
>1 & <2 (min)	0	0	0	0	20	50	70	110
>2 & <10 (min)	0	0	0	0	0	0	0	10
>10 (min)	0	0	0	0	0	0	0	0

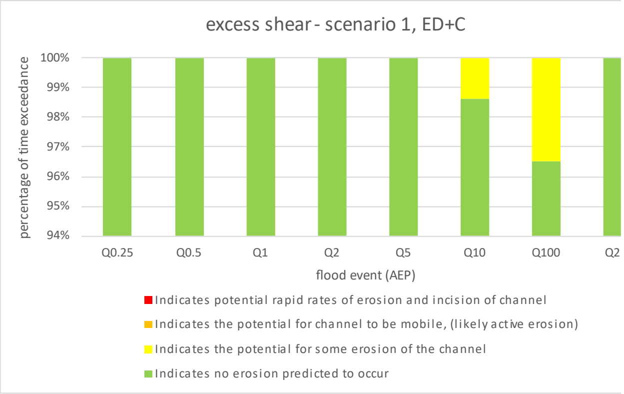
Cross-section B-B Pre vs Post (Existing rainfall depth)

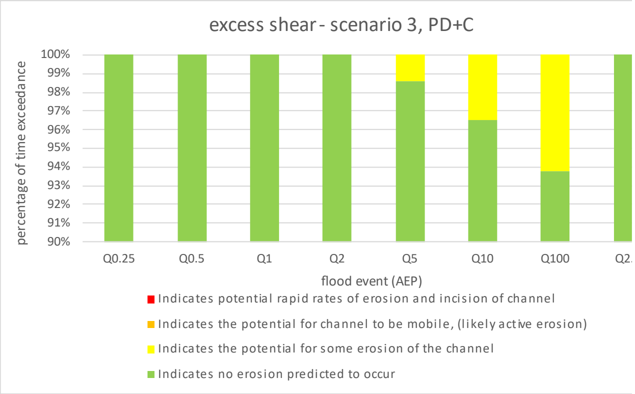


Cross-section B-B Pre vs Post (Future rainfall depth)

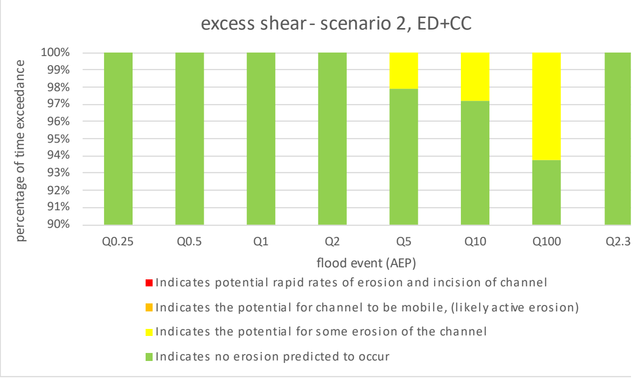


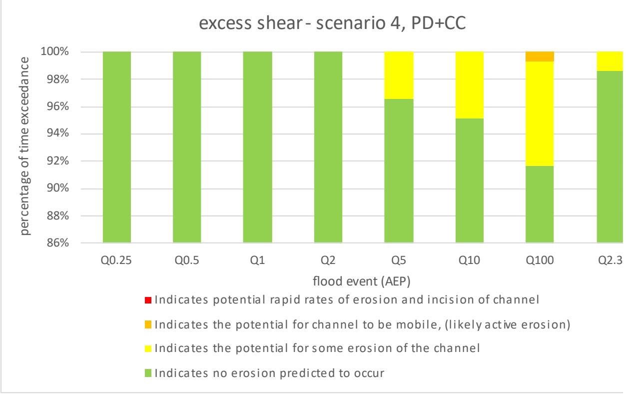
Cross-section B-B - Pre vs Post excess shear stress time of exceedance (Existing rainfall depth)





Cross-section B-B – Pre vs Post excess shear stress time of exceedance (Future rainfall depth)





APPENDIX C – ASSSOCIATED REPORTS

- CMW - Whenuapai Green 98-102 Totara Road, Whenuapai – Preliminary Geotechnical Investigation Report (12 March 2024)
- Viridis – Ecological Impact Assessment February 2024
- Viridis – RFI Response, Ecology 3 July 2024
- Geosciences – Site Investigation report 9 May 2018 (Revised 10 November 2021)

12 March 2024

WHENUAPAI GREEN

98-102 TOTARA ROAD, WHENUAPAI

PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT

Neil Construction Limited

AKL2018-0085AG Rev 0

AKL2018-0085AG		
Date	**Revision**	**Comments**
11 March 2024	A	Initial draft for internal review
12 March 2023	0	Issue to Support Plan Change Application

	Name	**Signature**	**Position**
Prepared by	Chris Ritchie		Principal Engineering Geologist CMEngNZ, PEngGeol
Reviewed and Authorised by	Richard Knowles	RJ Knowles	Principal Geotechnical Engineer CMEngNZ, CPEng

EXECUTIVE SUMMARY

This report presents the results of a geotechnical investigation and geohazards assessment to support of a Private Plan Change request ('PPC') to make changes to the Auckland Unitary Plan – Operative in Part ('AUP') to enable the rezoning of 98-100 and 102 Totara Road, collectively referred to as Whenuapai Green ('WG') or the 'PPC land'. WG comprises an approximate land area of 16.36 ha over two properties. The zone change request seeks to rezone the PPC land from Future Urban Zone ('**FUZ**') to Residential – Mixed Housing Urban ('**MHU**') zone.

The site comprises two individual lot parcels (LOT 2 DP 81411 and LOT 1 DP 53062) with a collective land area of approximately 16.4 hectares. Ground contours grade gently from approximately mRL 25.0 at the southern boundary to mRL 15.0 across the bulk of the site.

Based on the investigation results, the site is underlain by Puketoka Formation alluvial deposits, with Waitemata Group deposits encountered beneath the alluvium. Groundwater was encountered across the site between 0.7m and 4.0m depth below existing ground level.

A geotechnical assessment of the site in respect of the proposed development is summarised as follows:

- The site is located in a low seismicity region with the nearest active fault (Wairoa North Fault) located approximately 42 kilometres south-east of the site. The risk of fault rupture induced damage is considered 'low'.
- Due to the geological age and soil fabric of the soils encountered, liquefaction is low risk for the proposed works.
- The Puketoka Formation soils underlying the site are generally of a stiff to very stiff consistency and unlikely to undergo large static settlements when subject to typical residential development loads Notwithstanding this, any localised soft spots and/ or isolated pockets of weak alluvial deposits that may be encountered during earthworks can be over excavated and replaced with engineered fill or reworked to minimise the risk of potential differential settlements and reduced bearing capacities.
- With reference to AS2870 and BRANZ Report SR120A, the preliminary expansive site class for this development has been assessed as M (moderately reactive soils).
- Generally the site is near flat with discrete areas of sloping ground near stream banks. As such global stability has been classified as low risk.
- With reference to NZS1170.5:2004, the subject site has been assessed as Class C – Shallow Soils.
- The subsoils encountered beneath the site are considered suitable to be able to support up to 300kPa geotechnical ultimate bearing pressures from conventional NZS 3604 type structures.

TABLE OF CONTENTS

Appendices

1 INTRODUCTION

1.1 Project Brief

CMW Geosciences (CMW) was engaged by Neil Construction Limited to carry out a geotechnical investigation of a site located at 98-102 Totara Road, Whenuapai to support a Private Plan Change application to Auckland Council. The request seeks to rezone the PPC land from Future Urban Zone ('**FUZ**') to Residential – Mixed Housing Urban ('**MHU**') zone.

The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced 2018-0085AF, Rev.0 dated 3 June 2022.

1.2 Scope of Work

As detailed in our proposal letter (referenced above), the agreed scope of work to be conducted by CMW was defined as follows:

- Desk top study of available information relevant to the proposed development.
- Arrange and execute a geotechnical site investigation (SI).
- Evaluate and develop an appropriate geological and geotechnical model, including seasonal groundwater variations.
- Identify any geohazards to the proposed development, including liquefaction, static settlements, sensitive soils, groundwater issues.
- Compile all of the above detail into a concise geotechnical investigation report, incorporating relevant plans, field investigation data, laboratory test data to support a private plan change application.

2 SITE DESCRIPTION

2.1 Site Location

The site is located at 98-102 Totara Road, Whenuapai, and consists of two individual lot parcels (Lot2 2 DP 81411 and Lot 1 DP 53062) with a collective land area of approximately 16.4 hectares. The overall site location is shown on Figure 1 below.

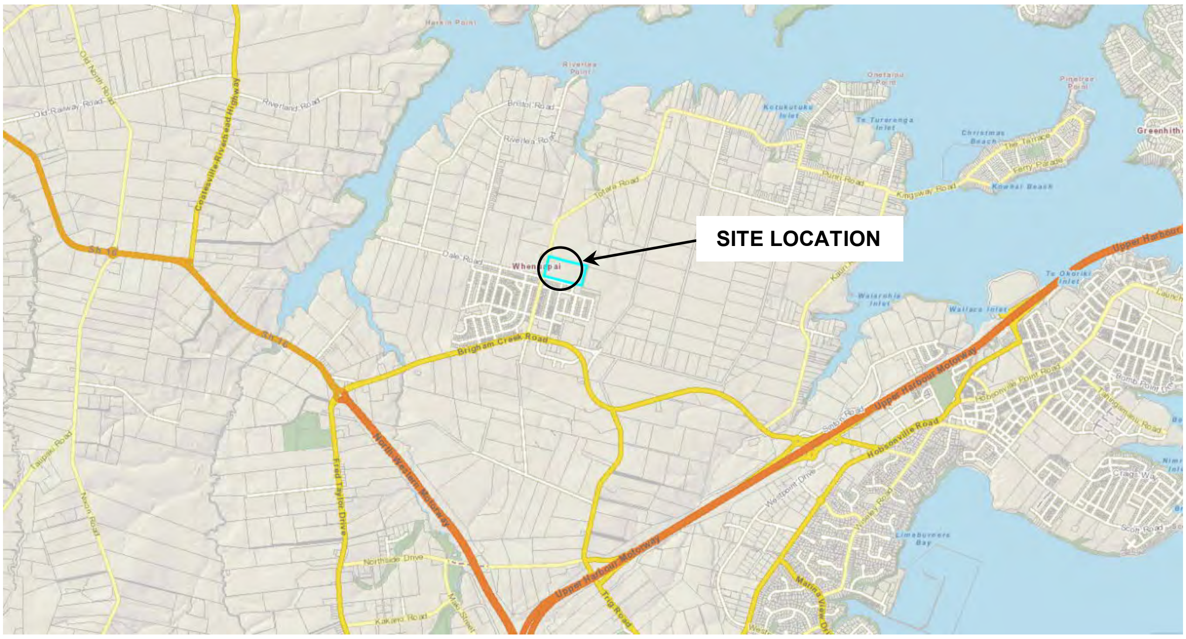


Figure 1: Site Location Plan (Source: Auckland council Geomaps)

2.2 Landform

The current general landform, together with associated features located within and adjacent to the site is presented on Geotechnical Site Plan, attached (***Drawing 02***).

The ground contours grade gently from approximately mRL 25.0 at the southern boundary to mRL 15.0 across the bulk of the site.

A south to north flowing tributary with approximately 2m deep invert is located in the eastern part of 98-100 Totara Road and collects the stormwater runoffs from the site and adjacent properties to the south. This tributary discharges north of the site boundary, into a permanent stream which flows from southeast to northwest and crosses the site at the north-eastern corner.

Part way up the western boundary there appears to be a field drain feeding a shallow over land flow path with flowing water. No signs of the drain could be found anywhere else. We presume that it is shallowly buried and only a short distance from where it is seen to discharge.

The site is bound to the north and west by Totara Road, to the south by McCaw Avenue and to the east by Whenuapai Airforce Base. Currently there are three dwellings (and associated ancillary structures) located on site. A single dwelling with a detached garage is located in the northern tip with access off Totara Road and two dwellings (102 and 102A Totara Road) with detached sheds are located in the south-western corner. Both these dwellings are accessed off Totara Road near the intersection with Dale Road and McCaw Avenue. The remainder of the site exists in pasture.

Historic aerial photography viewed on the Auckland GIS viewer and from the Retrolens website indicates the current dwelling located near the northern tip of 98-100 Totara Road was constructed between 1988 and 1996. The two dwellings located adjacent to the south western and southern boundaries of 102 Totara Road were constructed circa 1968 and 1996, respectively.

The historic photos show an area in the east of the site was used to grow a plantation of trees from around 1950 to around 1980. Other large single trees are visible in the historic photos over time that are no longer present.

Our review of the publicly available historic aerial photos found no signs of major slope instability.

3 INVESTIGATION SCOPE

3.1 Desktop Study

As part of this geotechnical assessment, CMW completed a desktop review of available geotechnical information pertaining to this site. The following information was reviewed as part of our desktop study:

- Published geological map[1]
- New Zealand Geotechnical Database;
- Topographical information available from Auckland Council GIS database;
- Aerial imagery (current and historic) available from Auckland Council GIS database;
- Currently proposed scheme plans provided by Neil Construction Ltd;
- Preliminary geotechnical Investigation Reports for 98-100 Totara Road (Ref: AKL2018-0085AB Rev. 0, dated 18 May 2018), and 102 Totara Road (Ref: AKL2019-0136AB Rev. 0) prepared by CMW Geosciences.

3.2 Field Investigation

Recent field investigations were carried out between 14 October 2022 and 15 October 2022. All fieldwork was carried out under the direction of CMW Geosciences in general accordance with the NZGS specifications[2] and logged in accordance with NZGS guidance[3]. The scope of fieldwork completed was as follows:

- Undertook a walkover survey of the site to assess the general landform and site conditions;
- Twenty-five hand auger boreholes, denoted HA01-22 to HA25-22, were drilled using a 50mm diameter auger to target depths of between 4.0m and 5.0m below existing ground levels to visually observe the near surface soil profile and to facilitate in-situ permeability / vane shear strength testing. HA09-22, HA11-22, HA13-22, HA19-22, HA20-22, HA21-22, and HA25-22 were terminated between 1.5m and 3.7m depth due to refusal. Engineering logs of the hand auger boreholes, together with peak and remoulded vane shear strengths are presented in ***Appendix B.***
- Dynamic cone (Scala) penetrometer (DCP) tests were carried out within auger boreholes that were refused early to a maximum depth of 2m below the base of the borehole to provide soil density profiles and investigate interface with rock material. Graphical results of the DCP testing are presented on respective borehole logs in ***Appendix B.***

The approximate locations of the respective investigation sites referred to above are shown on the Site Plan (***Drawing 01***). Test locations were measured using a hand-held GPS device.

3.3 Laboratory Testing

Laboratory testing was carried out generally in accordance with the requirements of NZS4402[4] (where applicable). Two soil samples were taken from site (HA04-18 and HA11-18) during our 2018 investigation. Both these samples were collected near ground surface (between 0.4m and 0.8m depth) and sent to a IANZ accredited soil testing laboratory to determine the expansiveness of the soils (test 2.2 and 2.6).

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[1] Edbrooke, S. W. (compiler) 2001: Geology of the Auckland area. Institute of Geological & Nuclear Sciences 1:250 000 geological map 3. 1 sheet +74 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences.

[2] NZ Geotechnical Society (2017) NZ Ground Investigation Specification, Volume 1 – Master Specification

[3] NZ Geotechnical Society (2005), Field Description of Soil and Rock, Guideline for the field classification and description of soil and rock for engineering purposes.

[4] New Zealand Standard NZS4402 (1986), Methods of testing soils for civil engineering purposes.

Results from the expansive soil testing are appended (***Appendix C***) and discussed below. Further expansive soil testing will be carried out on site following site development earthworks to assist with geotechnical completion reporting (GCR).

4 GROUND MODEL

4.1 Published Geology

Published geological maps[5] for the area depict the regional geology as comprising Late Pliocene to Mid Pleistocene alluvial deposits of the Puketoka Formation as illustrated in below.

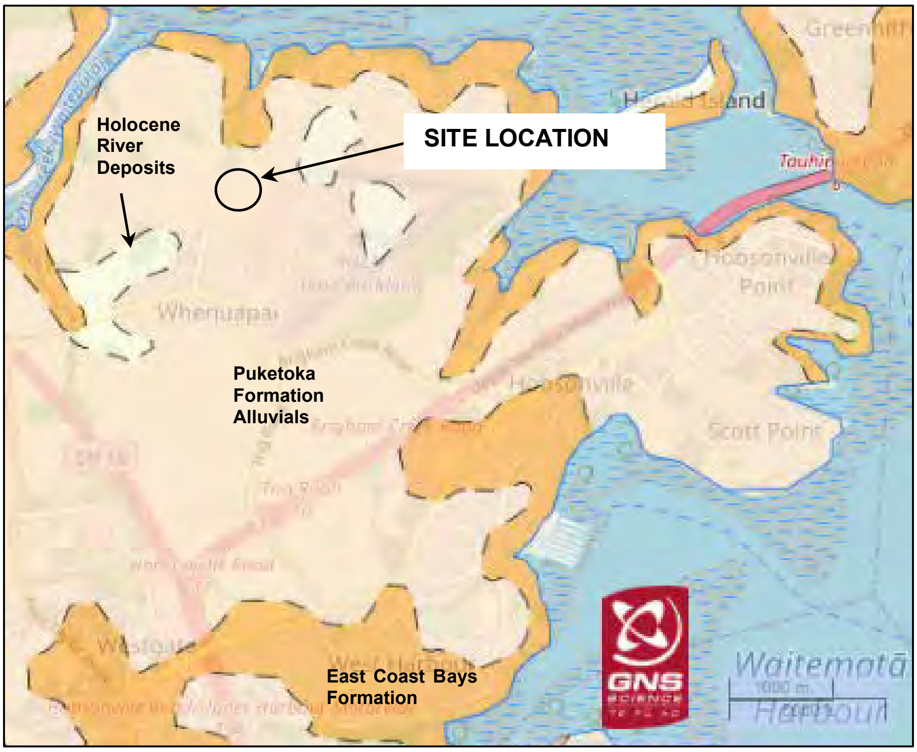

Figure 2: Regional Geology (GNS Science – Geology Web Map 1:250 000)

These alluvial deposits predominantly consist of inorganic clays and silts with occasional inclusions of sand and gravel with muddy peat and lignite, rhyolitic pumice (including non-welded ignimbrite, tephra and alluvial pumice deposits) and massive micaceous sand beds. Below these upper soil layers, the deeper geological formation is reported to comprise, interbedded muddy sandstones and siltstones of the East Cast Bays Formation within the Waitemata Group.

The main geotechnical hazards likely to be encountered within Puketoka Formation are low bearing capacity and settlement of soft/organic soils.

4.2 Stratigraphic Units

The ground conditions encountered and inferred from the investigation were considered to be generally consistent with the published geology for the area and our previous site investigations. These can be generalised according to the following subsurface sequences.

The distribution of the various units encountered is presented in the appended Geological Sections on ***Drawings 02 and 03***.

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[5] Edbrooke, S. W. (compiler) 2001: Geology of the Auckland area. Institute of Geological & Nuclear Sciences 1:250 000 geological map 3. 1 sheet +74 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences.

4.2.1 Topsoil / Fill

Topsoil generally consisting of dark brown silt was encountered in the majority of the hand augers up to 400mm depth.

Isolated lenses of uncontrolled fill were encountered in HA04-22, HA05-22, and HA19-22 to a depth of up to 600mm below ground level.

4.2.2 Puketoka Formation

Residually weathered Puketoka Formation soils were encountered underlying the topsoil and fill in all boreholes across the site and comprised brown to grey streaked orange, stiff to very stiff clays, from 0.2m up to approximately 4.8m depth, overlying grey stiff to hard silt and silty to sandy clays from 0.9m to 5.0m depth.

Thin lenses of organic silt were found to be embedded within these soils in discrete locations across the site.

4.2.3 Recent Alluvium

Recent alluvial deposits comprising, brown and grey, low plasticity silt with minor organic inclusions were encountered in HA11-22 to 1.2m depth below ground surface.

4.2.4 Waitemata Group Transition Zone

Transitional Waitemata Group materials were encountered in several hand augers at depths from approximately 3m to 5m below ground surface, and typically comprised completely to highly weathered ECBF sandstone and mudstone deposits. These deposits were generally recovered as hard and saturated soils.

4.3 Groundwater

Standing groundwater was encountered in several hand auger boreholes drilled during the past and most recent site investigations. Groundwater levels were generally recorded between 0.7m and 4.0m depth below the existing ground level. A summary of the groundwater levels encountered across the site during our most recent site investigation undertaken on 14 October 2022 is presented in Table 1 below.

Table 1: Summary of Groundwater Levels across site

Borehole ID	Groundwater Depth (m bgl)	Borehole ID	Groundwater Depth (m bgl)
HA01-22	4.0	HA15-22	2.9
HA02-22	3.5	HA16-22	1.5
HA03-22	2.5	HA17-22	0.9
HA04-22	3.3	HA18-22	3.2
HA05-22	2.5	HA19-22	1.6
HA07-22	2.9	HA20-22	1.4
HA08-22	2.0	HA21-22	1.5
HA10-22	1.6	HA22-22	2.2
HA11-22	0.7	HA23-22	3.9

HA12-22	2.1	HA24-22	2.8
HA14-22	1.1		

It should be appreciated that the groundwater levels measured during the site investigations may not be representative of the worst-case groundwater conditions given the time of the year these investigations were undertaken. The actual worst-case groundwater levels may be higher following times of heavy or prolonged rainfall and/ or wetter winter conditions.

5 GEOHAZARDS ASSESSMENT

5.1 Context

Section 106 of the Resource Management Act[6] (RMA) requires an assessment of the risk from natural hazards to be carried out when considering the granting of a subdivision consent. S106 RMA specifically states that the assessment must consider the combined effect of the natural hazard likelihood and material damage to land or structures (consequence).

The following sections of this report provide an preliminary assessment of the geohazards relevant to this site and provide the basis for the Natural Hazards Risk Assessment presented in ***Appendix D*** to support a Private Plan Change Application.

5.2 Seismicity

A seismic assessment has been carried out in general accordance with NZGS guidance[7] to calculate the peak horizontal ground acceleration or PGA (a_{max}) as follows:

$$a_{max} = C_{0,1000}\frac{R}{1.3} x\ f\ x\ g$$

Where: $C_{0,1000}$ = unweighted PGA coefficient (for subsoil class C)

R = return period factor given in NZS1170.5, Table 3.5 (for importance level IL2)

f = site response factor subject to subsoil class (for subsoil class C)

g = acceleration due to gravity

The ULS PGA was calculated based on a 50-year design life in accordance with the New Zealand Building Code[8] and importance level (IL) 2 structures. The PGA for the serviceability limit state (SLS) and ultimate limit state (ULS) earthquake scenarios is as follows:

Table 2: Design Peak Ground Acceleration (PGA) for Various Limit States

Limit State	AEP	R	PGA(g)	$\text{Magnitude}_{\text{eff}}$
SLS	1/25	0.25	0.04	5.9
ULS	1/500	1.0	0.19	6.5
ACCOPS	1/150	0.58	0.10	5.75

Note: SLS = serviceability limit state; ULS = ultimate limit state; ACCOPS = Auckland Council seismic stability case[9], AEP = annual exceedance probability

5.3 Fault Rupture

The site is located in a low seismicity region with the nearest active fault (Wairoa North Fault) located approximately 42 kilometres south-east of the site. The updated National Seismic Hazard Model (NZSM) estimates up to 4% chance of damage resulting from fault rupture to sites in Auckland located up to a distance of 40 kilometres from the source. We therefore consider fault rupture to be low risk.

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[6] Resource Management Act (1991), as at 29 October 2019

[7] NZ Geotechnical Society publication “Earthquake geotechnical engineering practice, Module 1: Overview of the standards”, (March 2016)

[8] Ministry of Business, Innovation and Employment (1992) NZ Building Code Handbook, Third Edition, Amendment 13 (effective from 14 February 2014)

[9] Auckland Council Code of Practice for Land Development and Subdivision, version 1.6, 24 September 2013, Table 2.C.1

5.4 Liquefaction and Lateral Spreading

In accordance with NZGS guidance[10] the liquefaction susceptibility of the soils at this site has been considered with respect to geological age, soil fabric and soil consistency / density.

The vast majority of case history data compiled in empirical charts for liquefaction evaluation come from Holocene deposits or man-made fills[11,12]. Pleistocene aged alluvium (>12,000 years) is also considered to have a very low to low risk of liquefaction[11].

Soils are also classified with respect to their grain size and plasticity to assess liquefaction susceptibility. Based on more recent case histories, there is general agreement that sands, non-plastic silts, gravels and their mixtures form soils that are susceptible to liquefaction. Clays, although they may significantly soften under cyclic loading, do not exhibit liquefaction features, and therefore are not considered liquefiable.

Given the majority of soils across the site are >12,000 years old and are plastic, we consider the liquefaction (and lateral spreading) susceptibility of the site is '**low**'.

In addition, the liquefaction vulnerability assessment (Level A Basic Assessment) present on the Auckland Council Geomaps shows the liquefaction potential for this site to be unlikely.

5.5 Slope Stability

The landform is generally near flat with discrete areas of steep slopes near watercourses. As such, the site is considered at low risk of slope instability.

5.6 Load Induced Settlement

The residual Puketoka soils encountered on site generally conform to the definition of 'good ground' provided in NZS 3604 and should be able to sufficiently withstand up to 300kPa ultimate bearing pressures from shallow foundations and roads without undergoing settlement. Notwithstanding this, the presence of localised soft spots and pockets of compressible alluvial soils embedded within the residual soils can affect the overall mechanics of the bearing soils and introduce the risk of differential settlement within structures. The presence of such materials should be confirmed during construction and where possible excavated and replaced with engineered fill. Alternatively, where proposed roads and structures are expected to span over these materials (located at depth), remediation in the form of specifically designed foundation systems and/ or ground improvement techniques (e.g., lime stabilisation of surface soils) may be utilised.

5.7 Pumice Soil Exposure

Trace pumiceous silts were observed in some boreholes and can be commonly associated with other soft and sensitive soils.

Depending on the final development plans, undercutting portions of soft and sensitive soils may be required. The majority of this undercut material can generally be suitable for use as engineered fill once conditioned and blended with more plastic soils (clays).

5.8 Expansive Soils

Seasonal shrinking and swelling results in vertical surface ground movement which can cause significant cracking of floor slabs and walls. There have been instances of concrete floors and/ or foundations that have been poured on dry, desiccated subgrades in summer months on expansive soils and have undergone heaving and cracking requiring extensive repairs or re-building once the soil moisture contents have

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[10] Earthquake Geotechnical Engineering Practice, Module 3: Identification, assessment and mitigation of liquefaction hazards", (May 2016)

[11] Seed, H.B. and Idriss, I.M. (1971) *A simplified procedure for evaluating soil liquefaction potential*, Earthquake Engineering Research Centre, Report No. EERC 70-9, University of California

[12] Youd, T.L. and Perkins, D.M. (1978) Mapping liquefaction-induced ground failure potential, *Journal of the Geotechnical Engineering Division,* ASCE, Vol. 104, No. GT4, Proc Paper 13659, p. 433-446

returned to higher levels. This hazard is addressed by a combination of careful foundation design and site preparation.

NZS 3604:2011[13] excludes from the definition of ‘good ground’, soils with a liquid limit of more than 50% and a linear shrinkage of more than 15% due to their potential to shrink and swell as a result of seasonal fluctuations in water content. For soils exceeding these limits, NZS 3604 references AS 2870[14]. for foundation design advice. However, the November 2019 update of Acceptable Solution B1/AS1[15] provides amendments to NZS 3604 that define a method for testing and classifying the soils and provides foundation designs for specific, simple house configurations across the range of expansive soil conditions.

Nevertheless, there is evidence[16] indicating that the use of the B1/AS1 method of assessment of expansiveness may be inaccurate. Accordingly, our assessments herein have been made in line with our experience, BRANZ Report SR120A[17] and AS2870.

The soil samples collected from the site were tested in a laboratory for linear shrinkage, natural water content, and cone penetration limit (the latter two tests can be correlated to the liquid limit of the soil) and have been used for the classification of the expansive soil class in addition to the visual-tactile method. The laboratory test results are attached in ***Appendix C***, and classification of expansive site class is provided in Section 8**.**

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[13] Standards New Zealand (2011) Timber-framed buildings, NZS 3604:2011, NZ Standard

[14] Standards Australia Limited (2011) *Residential slabs and footings*, AS 2870-2011, Australian Standard, NSW

[15] Ministry of Business, Innovation and Employment (2019) *Acceptable Solutions and Verification Methods for NZ Building Code Clause B1 Structure,* B1/AS1, Amendment 19

[16] Rogers, N., McDougall, N., Twose, G., Teal, J. & Smith, T. (2020) The Shrink Swell Test: A Critical Analysis, *NZ Geomechanics News,* Issue 99, pages 66-80.

[17] Fraser Thomas Limited (2008) - Addendum Study Report (BRANZ SR120A), Soil Expansivity in the Auckland Region – Final Report

6 CONCLUSION

Based on our hazard assessment, we consider that the land is suitable for future urban development including infrastructure, having acceptable levels of post-development residual risk from natural hazards.

Any proposed earthworks are to be undertaken in accordance with all relevant standards and documents. The engineering controls required to control existing, latent risks are commonplace works in this terrain that are consistent with those being adopted on adjacent land. Further site investigation and design will need to be undertaken to quantify the geotechnical controls prior to resource consent application and the commencement of any works.

7 CLOSURE

Additional important information regarding the use of your CMW report is provided in the '*Using your CMW Report*' document attached to this report.

This report has been prepared for use by Neil Construction Limited in relation to the Whenuapai Green 98-102 Totara Road, Whenuapai project in accordance with the scope, proposed uses and limitations described in the report. Should you have further questions relating to the use of your report please do not hesitate to contact us.

Where a party other than Neil Construction Limited seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

USING YOUR CMW GEOTECHNICAL REPORT

Geotechnical reporting relies on interpretation of facts and collected information using experience, professional judgement, and opinion. As such it generally has a level of uncertainty attached to it, which is often far less exact than other engineering design disciplines. The notes below provide general advice on what can be reasonably expected from your report and the inherent limitations of a geotechnical report.

Preparation of your report

Your geotechnical report has been written for your use on your project. The contents of your report may not meet the needs of others who may have different objectives or requirements. The report has been prepared using generally accepted Geotechnical Engineering and Engineering Geology practices and procedures. The opinions and conclusions reached in your report are made in accordance with these accepted principles. Specific items of geotechnical or geological importance are highlighted in the report.

In producing your report, we have relied on the information which is referenced or summarised in the report. If further information becomes available or the nature of your project changes, then the findings in this report may no longer be appropriate. In such cases the report must be reviewed, and any necessary changes must be made by us.

Your geotechnical report is based on your project's requirements

Your geotechnical report has been developed based on your specific project requirements and only applies to the site in this report. Project requirements could include the type of works being undertaken; project locality, size and configuration; the location of any structures on or around the site; the presence of underground utilities; proposed design methodology; the duration or design life of the works; and construction method and/or sequencing.

The information or advice in your geotechnical report should not be applied to any other project given the intrinsic differences between different projects and site locations. Similarly geotechnical information, data and conclusions from other sites and projects may not be relevant or appropriate for your project.

Interpretation of geotechnical data

Site investigations identify subsurface conditions at discrete locations. Additional geotechnical information (e.g. literature and external data source review, laboratory testing etc) are interpreted by Geologists or Engineers to provide an opinion about a site specific ground models, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist due to the variability of geological environments. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. Interpretation of factual data can be influenced by design and/or construction methods. Where these methods change review of the interpretation in the report may be required.

Subsurface conditions can change

Subsurface conditions are created by natural processes and then can be altered anthropically or over time. For example, groundwater levels can vary with time or activities adjacent to your site, fill may be placed on a site, or the consistency of near surface conditions might be susceptible to seasonal changes. The report is based on conditions which existed at the time of investigation. It is important to confirm whether conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

Interpretation and use by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. To help avoid misinterpretations, it is important to retain the assistance of CMW to work with other project design professionals who are affected by the contents of your report. CMW staff can explain the report implications to design professionals and then review design plans and specifications to see that they have correctly incorporated the findings of this report.

Your report's recommendations require confirmation during construction

Your report is based on site conditions as revealed through selective point sampling. Engineering judgement is then applied to assess how indicative of actual conditions throughout an area the point sampling might be. Any assumptions made cannot be substantiated until construction is complete. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances from previous assumption, conduct additional tests if required and recommend solutions to problems encountered on site.

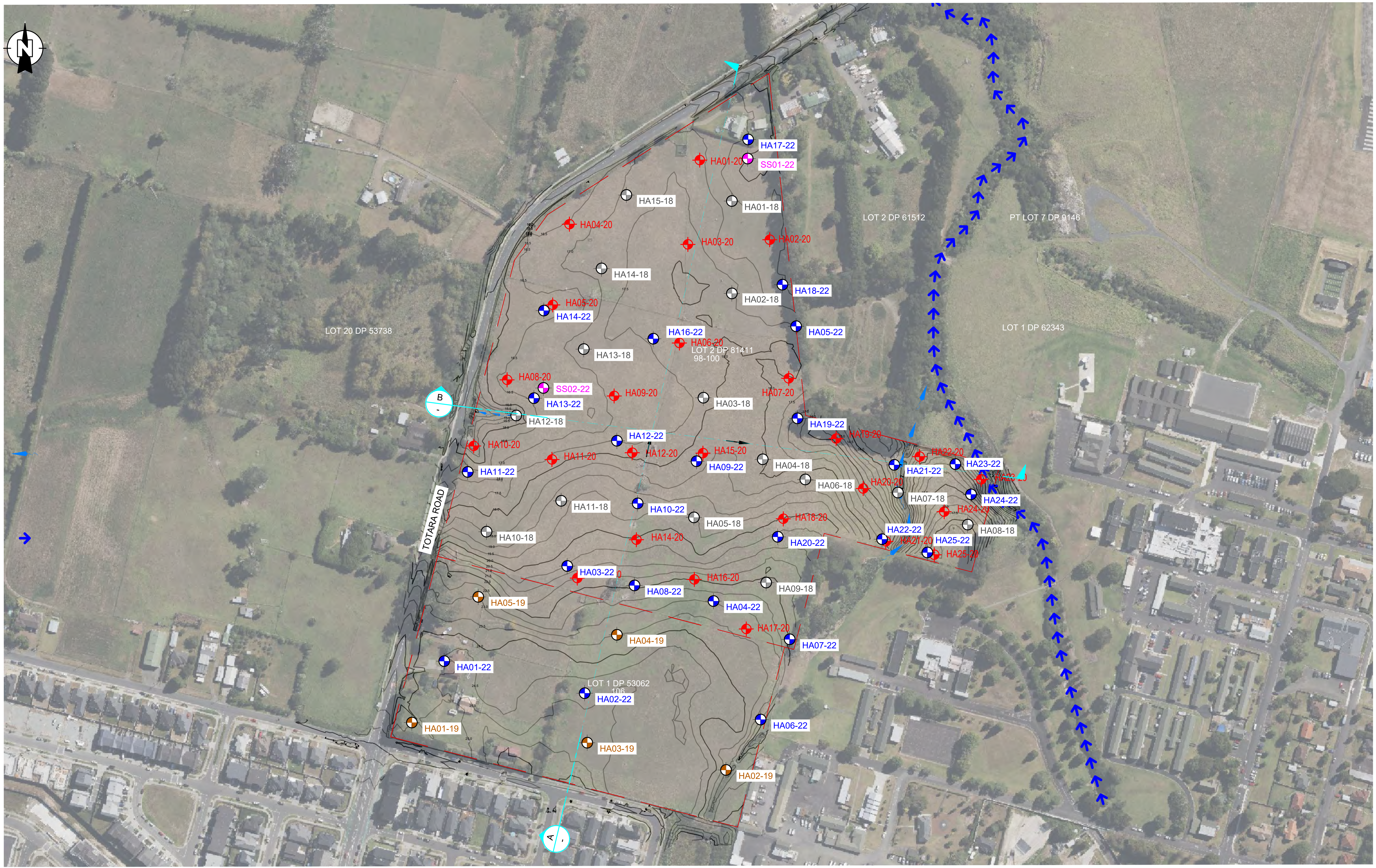
A Geotechnical Engineer, who is fully familiar with the site and the background information, can assess whether the report's recommendations remain valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

Environmental Matters Are Not Covered

Unless specifically discussed in your report environmental matters are not covered by a CMW Geotechnical Report. Environmental matters might include the level of contaminants present of the site covered by this report, potential uses or treatment of contaminated materials or the disposal of contaminated materials. These matters can be complex and are often governed by specific legislation.

The personnel, equipment, and techniques used to perform an environmental study can differ significantly from those used in this report. For that reason, our report does not provide environmental recommendations. Unanticipated subsurface environmental problems can have large consequences for your site. If you have not obtained your own environmental information about the project site, ask your CMW contact about how to find environmental risk-management guidance.

Appendix A: Drawings



LEGEND:

HA01-22	HAND AUGER (HA) LOCATION
HA01-19	HAND AUGER (HA) LOCATION
HA01-18	HAND AUGER (HA) LOCATION
HA20-20	HAND AUGER (HA) LOCATION
SS01-22	SOAKAGE TEST LOCATION
— —	SITE BOUNDARY
→→→	STREAM LINE
	OVERLAND FLOW

NOTES:

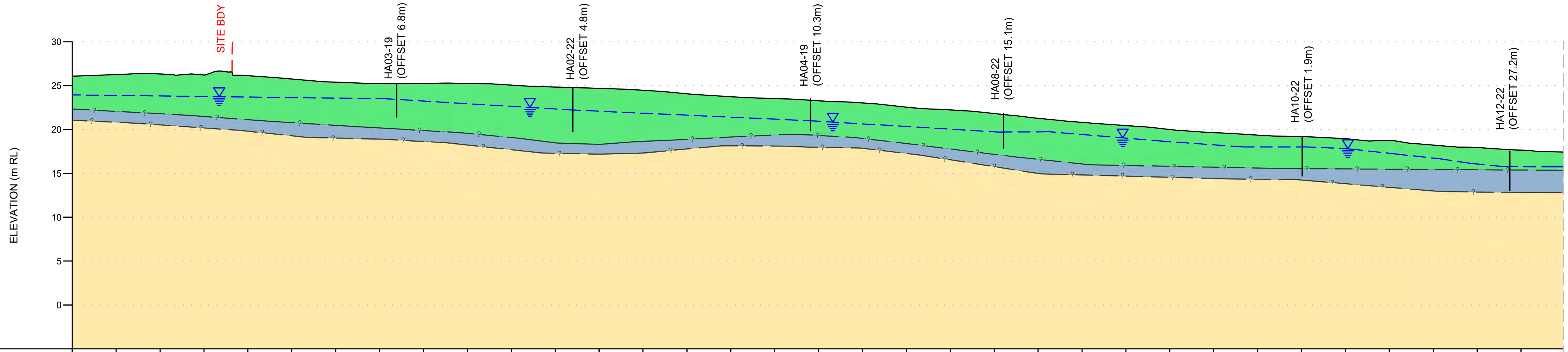
1. BASE PLAN ADAPTED FROM AUCKLAND COUNCIL'S GIS MAP.
2. EXISTING SURVEY DATA RECEIVED FROM NEIL CONSTRUCTION LIMITED.

1:3000 — 0 30 60 90 120 160 m

CMW Geosciences

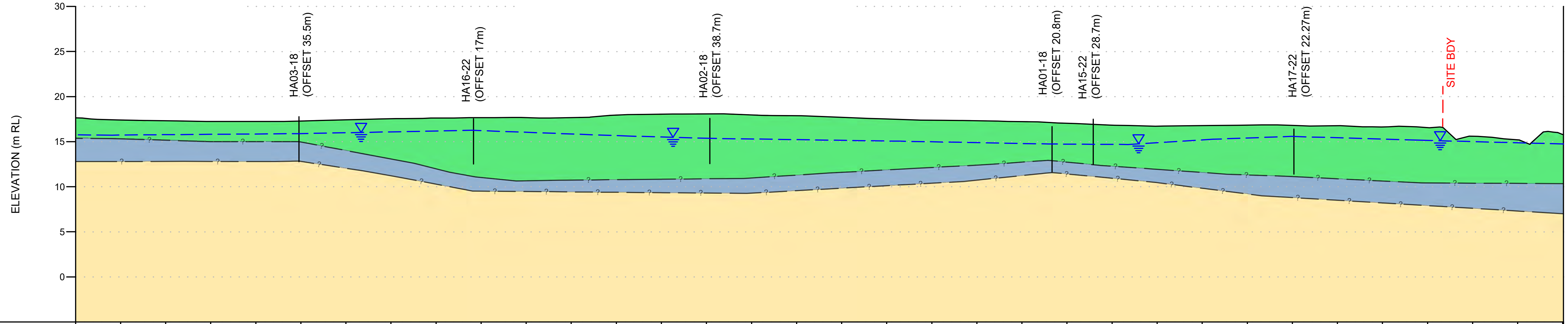
CLIENT: **NEIL CONSTRUCTION LIMITED**		DRAWN: JS	PROJECT No: AKL2018-0085
PROJECT: **98-100 TOTARA ROAD, WHENUAPAI**		CHECKED: HP	FIGURE: 01
		REVISION: 1	SCALE: 1:3000
TITLE: **SITE INVESTIGATION PLAN**		DATE: 11/03/2024	SHEET: A3

\\CMWGEOSCIENCES.SHAREPOINT.COM@SSL\DAVWWWROOT\SITES\AUCKLANDTEAM\SHARED DOCUMENTS\AUCKLAND PROJECT DOCUMENTS\2018\AKL2018-0085 98-100 TOTARA ROAD, WHENUAPAI\07 DRAWINGS\CAD\2022\AKL2018-0085-SITE INVESTIGATION PLAN.DWG



DESIGN SURFACE (m RL)				26.67	26.70	26.60	24.70	24.70	24.51	24.33	23.70	23.70	22.74	22.74	21.99	22.00	22.00
EXISTING GROUND (m RL)		26.32	26.20	26.13	25.76	25.40	25.25	25.25	25.25	25.05	24.84	24.69	24.47	24.08	23.74	23.53	23.28
DISTANCE (m)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170

DESIGN SURFACE (m RL)	20.66	20.57	20.40	20.40	20.22	20.31	20.30	19.13	18.89	19.30	19.40	19.38	19.39	19.02	19.00	19.00	19.00
EXISTING GROUND (m RL)	23.03	22.56	22.23	21.83	21.28	20.81	20.44	20.00	19.64	19.36	19.20	18.96	18.74	18.23	17.94	17.64	17.42
DISTANCE (m)	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340



DESIGN SURFACE (m RL)	19.00	18.40	18.55	18.32	17.89	17.79	17.96	18.13	17.65	17.61	17.61	17.61	17.61	17.61	17.61	17.61	17.61
EXISTING GROUND (m RL)	17.42	17.33	17.25	17.25	17.30	17.42	17.55	17.63	17.66	17.67	17.68	17.95	18.05	18.08	17.97	17.88	17.70
DISTANCE (m)	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500

DESIGN SURFACE (m RL)	17.61	17.61	17.61	17.61	17.61	17.48	16.81	16.31	15.96	15.79	15.63	15.80	15.87	15.55	15.23	
EXISTING GROUND (m RL)	17.52	17.39	17.33	17.23	17.05	16.84	16.73	16.80	16.84	16.82	16.78	16.64	16.57	15.61	15.21	
DISTANCE (m)	510	520	530	540	550	560	570	580	590	600	610	620	630	640	650	**660**

LEGEND:

──	EXISTING SURFACE
─ ▽ ─	STANDING GROUNDWATER LEVEL
🟩	PUKETOKA FORMATION SOILS / ALLUVIUM
🟦	WAITEMATA GROUP RESIDUAL SOILS
🟨	WAITEMATA GROUP BEDROCK

1:500 — 0 5 10 15 20 25 m

1:1000 — 0 10 20 30 40 50 m

CMW Geosciences

CLIENT: **NEIL CONSTRUCTION LIMITED**

PROJECT: **98-100 TOTARA ROAD, WHENUAPAI**

TITLE: **GEOLOGICAL SECTION-A**

DRAWN: JS

CHECKED: HP

REVISION: 1

DATE: 11/03/2024

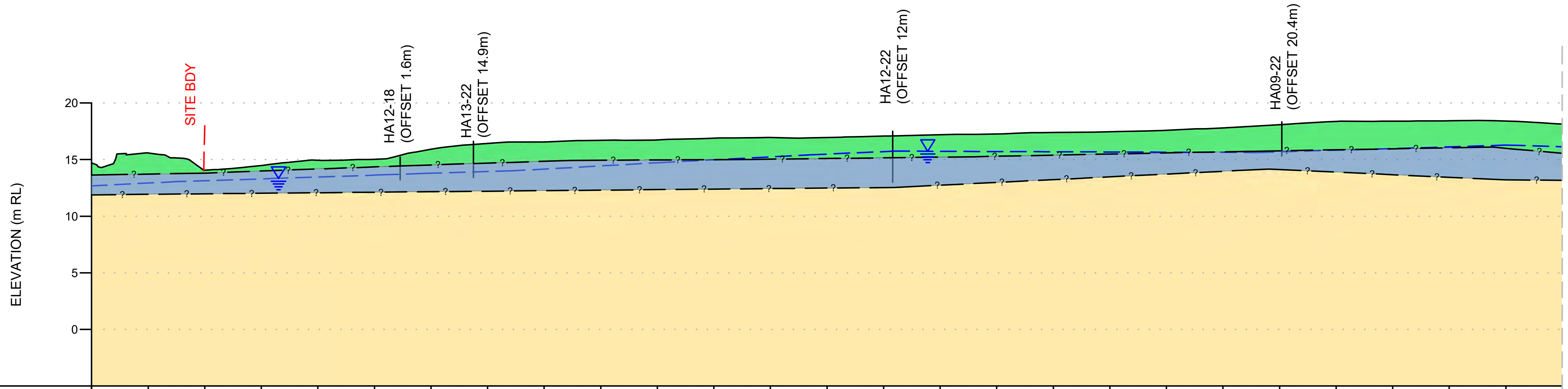
PROJECT No: AKL2018-0085

FIGURE: 02

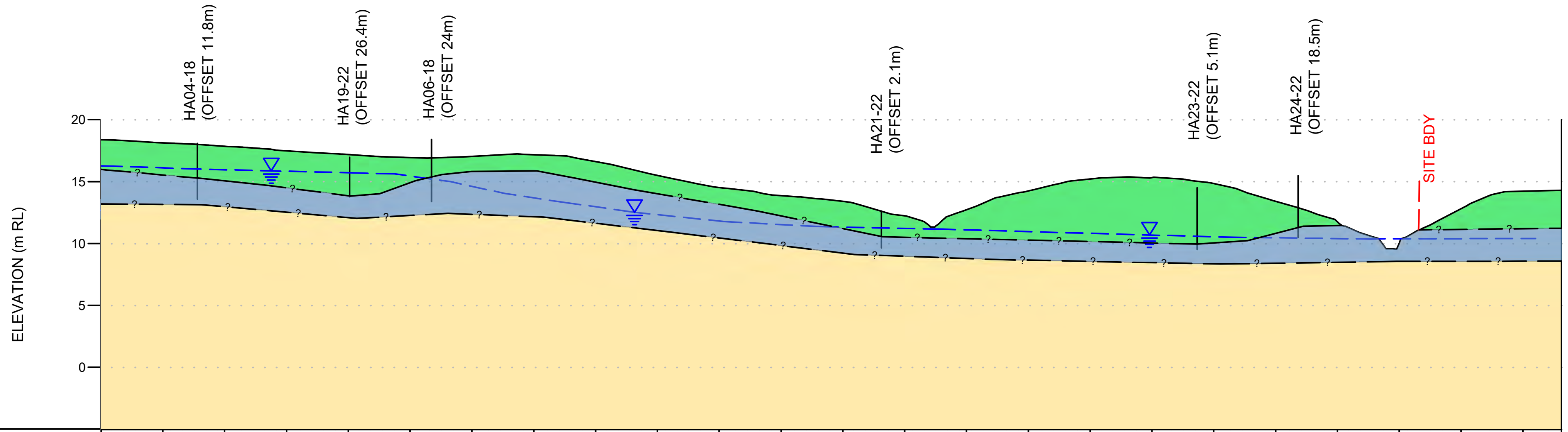
SCALE: H 1:1000 V 1:500

SHEET: A3

\\CMWGEOSCIENCES.SHAREPOINT.COM@SSL\DAVWWWROOT\SITES\AUCKLANDTEAM\SHARED DOCUMENTS\AUCKLAND PROJECT DOCUMENTS\2018\AKL2018-0085 98-100 TOTARA ROAD, WHENUAPAI\07 DRAWINGS\CAD\2022\AKL2018-0085-SITE INVESTIGATION PLAN.DWG



DESIGN SURFACE (m RL)	15.58	14.05	14.48	14.94	15.03	15.92	16.43	16.56	16.70	16.75	16.90	16.95	16.95	17.08	17.20	17.27	17.39	17.46	17.59	17.79	18.08	18.38	18.39	18.43	18.40	18.15
EXISTING GROUND (m RL)	15.58	14.05	14.48	14.94	15.03	15.92	16.43	16.56	16.70	16.75	16.90	16.95	16.95	17.08	17.20	17.27	17.39	17.46	17.59	17.79	18.08	18.38	18.39	18.43	18.40	18.15
DISTANCE (m)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260



DESIGN SURFACE (m RL)	18.15	17.87	17.50	17.20	16.95	17.04	17.19	16.64	15.51	14.53	13.88	13.43	12.25	12.74	14.26	15.22	15.35	14.86	13.42	11.77	10.02	12.83		
EXISTING GROUND (m RL)	18.15	17.87	17.50	17.20	16.95	17.04	17.19	16.64	15.51	14.53	13.88	13.43	12.25	12.74	14.26	15.22	15.35	14.86	13.42	11.77	10.02	12.83		
DISTANCE (m)	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	486

LEGEND:

——— EXISTING SURFACE

—▽— STANDING GROUNDWATER LEVEL

🟩 PUKETOKA FORMATION SOILS / ALLUVIUM

▨ WAITEMATA GROUP RESIDUAL SOILS

▨ WAITEMATA GROUP BEDROCK

1:1000 — 0 10 20 30 40 50 m

1:500 — 0 5 10 15 20 25 m

CMW Geosciences

CLIENT: **NEIL CONSTRUCTION LIMITED**

PROJECT: **98-100 TOTARA ROAD, WHENUAPAI**

TITLE: **GEOLOGICAL SECTION-B**

DRAWN: JS

CHECKED: HP

REVISION: 0

DATE: 11/03/2024

PROJECT No: AKL2018-0085

FIGURE: 03

SCALE: H 1:1000
V 1:500

SHEET: A3

\\CMWGEOSCIENCES.SHAREPOINT.COM@SSL\DAVWWWROOT\SITES\AUCKLANDTEAM\SHARED DOCUMENTS\AUCKLAND PROJECT DOCUMENTS\2018\AKL2018-0085 98-100 TOTARA ROAD, WHENUAPAI\07 DRAWINGS\CAD\2022\AKL2018-0085-SITE INVESTIGATION PLAN.DWG

Appendix B: Hand Auger Borehole Logs

HAND AUGER BOREHOLE LOG - HA01-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan   Logged by: OP   Checked by: JW   Scale: 1:25   Sheet 1 of 1

Position: 1744061.4mE; 5927382.1mN Projection: NZTM
Datum: AUCKHT1946   Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15
	Depth	Type & Results						
					OL: Organic SILT : dark brown. Low plasticity. (Topsoil)			
	0.3	Peak = 106kPa Residual = 20kPa			ML: Clayey SILT: orange brown mottled orange. Low plasticity. (Puketoka Formation)			
	0.6	Peak = 176kPa Residual = 86kPa						
					CH: Silty CLAY: brownish white mottled orange. High plasticity. (Puketoka Formation)			
	1.0	Peak = 149kPa Residual = 133kPa		1				
	1.2	Peak = 156kPa Residual = 76kPa						
	1.6	Peak = 183kPa Residual = 96kPa						
					... at 1.70m, Becoming purpleish grey			
	2.0	Peak = 179kPa Residual = 116kPa		2				
	2.5	Peak = UTP			*... at 2.50m, Becoming light pinkish grey*		VSt	
	3.0	Peak = 123kPa Residual = 93kPa		3				
					... at 3.10m, Iron ataining			
					ML: Clayey SILT: light pinkish grey. Low plasticity. (Puketoka Formation)			
	3.5	Peak = 106kPa Residual = 73kPa						
▼ 13-10-2022	4.0	Peak = 66kPa Residual = 50kPa		4				
	4.5	Peak = 159kPa Residual = 56kPa						
	5.0	Peak = 140kPa ~~Residual = 50kPa~~		5	Borehole terminated at 5.0 m			

Termination Reason: Target depth

Shear Vane No: 2087   DCP No:

Remarks: Groundwater encountered 4.0m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA02-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan Logged by: OP Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744206.2mE; 5927367.7mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater | Samples & Insitu Tests | RL (m) | Depth (m) | Graphic Log | Material Description | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) 5 10 15

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Depth	Type & Results
0.3	Peak = 199kPa Residual = 100kPa
0.6	Peak = 196kPa Residual = 103kPa
0.9	Peak = 199kPa Residual = 113kPa
1.2	Peak = UTP
1.6	Peak = 186kPa Residual = 120kPa
2.0	Peak = 219kPa Residual = 125kPa
2.5	Peak = UTP
3.0	Peak = UTP
3.5	Peak = 189kPa Residual = 40kPa
4.0	Peak = 140kPa Residual = 43kPa
4.5	Peak = 149kPa Residual = 90kPa
5.0	Peak = 93kPa ~~Residual = 66kPa~~

Depth (m): 1, 2, 3, 4, 5

Groundwater: 13-10-2022 (at 3.5 m)

OL: Organic SILT
: dark brown. Low plasticity.
(Topsoil)

ML: Clayey SILT: orange brown mottled orange. Low plasticity.
(Puketoka Formation)

CH: Silty CLAY: brownish white mottled orange. High plasticity.
(Puketoka Formation)

ML: Clayey SILT: light brownish white mottled orange. Low plasticity.
(Puketoka Formation)

CH: Silty CLAY: dark pinkish grey mottled orange. High plasticity.
(Puketoka Formation)

... at 2.40m, Becoming white.

ML: Clayey SILT: with some fine peat; bluish grey. Low plasticity.
(Puketoka Formation)

Borehole terminated at 5.0 m

Consistency/Relative Density: VSt to H; VSt

Termination Reason: Target depth
Shear Vane No: 2087 DCP No:
Remarks: Groundwater encountered 3.5m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

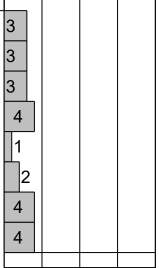
HAND AUGER BOREHOLE LOG - HA03-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan   Logged by: EM   Checked by: JW   Scale: 1:25   Sheet 1 of 1

Position: 1744323.5mE; 5927326.2mN   Projection: NZTM
Datum: AUCKHT1946   Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests Depth	Type & Results	RL (m)	Depth (m)	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density
					OL: Organic SILT: black. (Topsoil)		
	0.3	Peak = >189kPa			CL: Silty CLAY: light brown mottled orange. Low plasticity. (Puketoka Formation)	D to M	
	0.6	Peak = >189kPa					
	0.9	Peak = >189kPa			... *at 0.80m, becoming light grey mottled orange.*		
	1.2	Peak = >189kPa		1			VSt to H
	1.6	Peak = 143kPa Residual = 78kPa				M	
	2.0	Peak = 97kPa Residual = 57kPa		2			
13-10-2022 ▼	2.4	Peak = 70kPa Residual = 35kPa			... *at 2.40m, becoming light grey, orange mottling absent.*		
	2.8	Peak = 62kPa Residual = 19kPa			... *at 2.80m, contains some small rootlets and black organic silt.* ML: Sandy SILT: light greyish brown. Low plasticity; sand, fine grained. (Puketoka Formation) ... *at 2.80m, contains some small rootlets and black organic silt.*		
	3.2	Peak = 46kPa Residual = 27kPa		3		S	St to VSt
	3.6	Peak = 95kPa Residual = 32kPa			... *at 3.40m, becoming light grey.*		
	4.0	Peak = UTP		4	... *at 3.80m, becoming light bluish grey.*		H
					Borehole terminated at 4.2 m		
				5			

Dynamic Cone Penetrometer (Blows/100mm)



Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3239   DCP No: 22
Remarks: Groundwater encountered at 2.4m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA04-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan

Logged by: EM Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744229.2mE; 5927449.3mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater: 14-10-2022 ▼

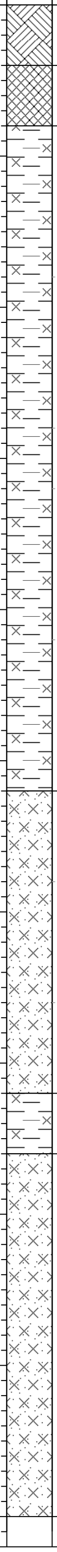
Samples & Insitu Tests

Depth	Type & Results
0.3	Peak = 127kPa Residual = 35kPa
0.6	Peak = >189kPa
0.9	Peak = 135kPa Residual = 60kPa
1.2	Peak = UTP
1.6	Peak = UTP
2.0	Peak = UTP
2.4	Peak = UTP
2.8	Peak = 141kPa Residual = 43kPa
3.2	Peak = 95kPa Residual = 41kPa
3.6	Peak = 60kPa Residual = 30kPa
4.0	Peak = 46kPa Residual = 24kPa
4.4	Peak = 62kPa Residual = 27kPa
4.8	Peak = 60kPa Residual = 35kPa

RL (m)

Depth (m): 1, 2, 3, 4, 5

Graphic Log



Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

OL: Organic SILT: black.
(Topsoil)

ML: SILT: brown. Non-plastic.
(Fill)

CL: Silty CLAY: light yellowish brown. Low plasticity.
(Puketoka Formation)

... at 0.90m, becoming orange brown.

... at 1.40m, becoming grey mottled orange, contains some sand, fine to medium.

... at 1.60m, sand absent.

... at 2.10m, contains minor fine sand.

ML: Sandy SILT: light grey mottled orange. Low plasticity; sand, fine to medium.
(Puketoka Formation)

... from 2.90m to 3.00m, contains organic silt lens.

... at 3.30m, becoming orange mottled grey.

CL: Silty CLAY: light grey mottled orange. Low plasticity.
(Puketoka Formation)

ML: Sandy SILT: light brownish grey. Low plasticity; sand, fine.
(Puketoka Formation)

Borehole terminated at 5.0 m

Moisture Condition: D to M; M; W; S

Consistency/ Relative Density: VSt to H; St to VSt; F to St

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Termination Reason: Target depth
Shear Vane No: 3239 DCP No:
Remarks: Groundwater encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

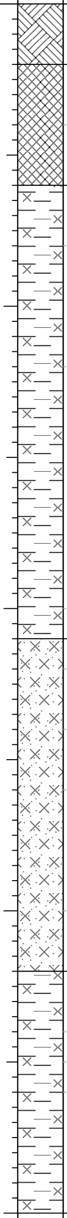
HAND AUGER BOREHOLE LOG - HA05-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan
Logged by: EM Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744117.6mE; 5927450.8mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

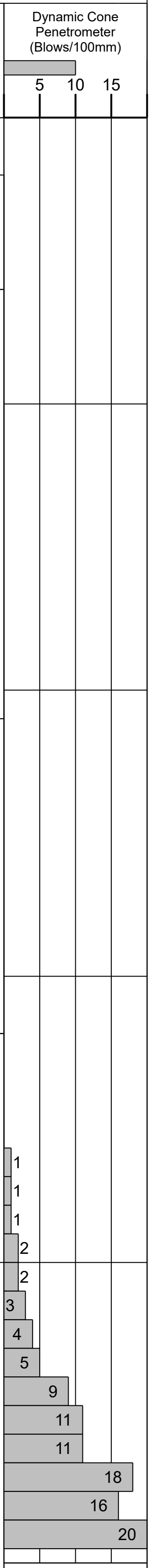
Groundwater: 14-10-2022

Samples & Insitu Tests	
Depth	Type & Results
0.3	Peak = 81kPa Residual = 14kPa
0.6	Peak = >189kPa
0.9	Peak = >189kPa
1.2	Peak = UTP
1.6	Peak = UTP
2.0	Peak = >189kPa
2.4	Peak = 135kPa Residual = 81kPa
2.8	Peak = 87kPa Residual = 30kPa
3.2	Peak = UTP
3.6	Peak = UTP



Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density
OL: Organic SILT: black. (Topsoil)	D to M	
ML: SILT: brown. Non-plastic. (Fill) ... *at 0.40m, becoming brown mottled orange, contains minor clay.*		St
CL: Silty CLAY: light yellowish brown. Low plasticity. (Puketoka Formation) ... *at 0.80m, becoming light orange-brown with some bluish grey streaks.* ... *at 1.20m, becoming light bluish grey with orange mottling.* ... *at 2.00m, contains some sand, fine to medium.*	M	H
ML: Sandy SILT: light grey mottled orange. Low plasticity; sand, fine to medium. (Puketoka Formation) ... *at 2.20m, contains fine black organic silt lens.* ... *at 2.40m, contains minor clay, sand becoming fine, orange mottling absent.* ... *at 2.60m, becoming orange, sand is now fine to medium.* ... *at 3.00m, becoming grey mottled orange, sand is fine.*	M to W S	St to VSt
CL: Silty CLAY: light bluish grey. Low plasticity. (Puketoka Formation) ... *at 3.40m, becoming dark orange.* ... *at 3.50m, becoming dark purplish brown, contains fine black organic silt lens.* ... *at 3.60m, material is extremely difficult to pull out of auger head.*		H

Borehole terminated at 4.0 m



Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3239 DCP No: 22
Remarks: Groundwater encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA06-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan   Logged by: OP   Checked by: JW   Scale: 1:25   Sheet 1 of 1

Position: 1744358.2mE; 5927384.5mN Projection: NZTM
Datum: AUCKHT1946   Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log
	Depth	Type & Results			
	0.3	Peak = 115kPa Residual = 29kPa			
	0.6	Peak = 208kPa Residual = 48kPa			
	0.9	Peak = 208kPa Residual = 83kPa		1	
	1.2	Peak = 208kPa Residual = 112kPa			
	1.5	Peak = 224kPa Residual = 109kPa			
	1.8	Peak = 208kPa Residual = 112kPa		2	
	2.1	Peak = 183kPa Residual = 131kPa			
	2.4	Peak = 208kPa Residual = 112kPa			
	2.7	Peak = 160kPa Residual = 99kPa		3	
	3.0	Peak = 176kPa Residual = 102kPa			
	3.3	Peak = 160kPa Residual = 112kPa			
	3.6	Peak = 160kPa Residual = 144kPa			
	3.9	Peak = 130kPa Residual = 49kPa		4	
	4.5	Peak = 208kPa Residual = 160kPa		5	

Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15
OL: Organic SILT: dark brown. Low plasticity. (Topsoil)	D to M		
CL: Silty CLAY: greyish brown mottled orange. Low plasticity. (Puketoka Formation)		VSt to H	
CL: Sandy SILT: light greyish white. Low plasticity. (Puketoka Formation)	M to W		
Borehole terminated at 4.5 m			

Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3434   DCP No:
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA07-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan
Logged by: PT
Checked by: JW
Scale: 1:25
Sheet 1 of 1

Position: 1744382.7mE; 5927452.2mN Projection: NZTM
Datum: AUCKHT1946
Survey Source: pLog Tablet

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Groundwater	Samples & Insitu Tests Depth	Samples & Insitu Tests Type & Results
	0.3	Peak = 213kPa Residual = 93kPa
	0.6	Peak = 193kPa Residual = 100kPa
	0.9	Peak = 216kPa Residual = 100kPa
	1.2	Peak = UTP
	1.6	Peak = 206kPa Residual = 130kPa
	2.0	Peak = 216kPa Residual = 106kPa
	2.5	Peak = 203kPa Residual = 66kPa
14-10-2022		
	3.0	Peak = >230kPa
	3.5	Peak = 133kPa Residual = 43kPa
	4.0	Peak = 70kPa Residual = 47kPa
	4.5	Peak = UTP
	5.0	Peak = UTP

OL: Organic SILT: dark brown.
(Topsoil)

CL: Clayey SILT: brownish grey mottled orange. Low plasticity.
(Puketoka Formation)

CL: Silty CLAY: light grey mottled orange. Low plasticity, moderately sensitive.
(Puketoka Formation)

ML: Clayey SILT: with minor fine sand; light greyish brown mottled orange. Low plasticity, Iron stained.
(Puketoka Formation)

CL: Gravelly SILT: dark pinkish grey light. Low plasticity.
(Puketoka Formation)
... from 2.90m to 3.00m, Dark pinkish grey CLAY
... from 3.30m to 3.40m, Organic/peat layer

ML: Silty Fine to medium SAND: light grey mottled orange. Low plasticity, moderately sensitive.
(Puketoka Formation)
... at 4.50m, Becoming blueish grey.

Borehole terminated at 5.0 m

Consistency/Relative Density: H; VSt; St; H

Termination Reason: Target depth
Shear Vane No: 2087
DCP No:
Remarks: Groundwater encountered at 2.9m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA08-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan | Logged by: EM | Checked by: JW | Scale: 1:25 | Sheet 1 of 1

Position: 1744251.8mE; 5927497.6mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15
						OL: Organic SILT: black. (Topsoil)			
	0.3	Peak = 141kPa Residual = 54kPa				CL: Silty CLAY: light brown mottled dark orange. Low plasticity. (Puketoka Formation)			
	0.6	Peak = >189kPa				... *at 0.60m, becoming light grey mottled orange.*	M		
	0.9	Peak = >189kPa		1				VSt to H	
	1.2	Peak = UTP							
	1.6	Peak = 119kPa Residual = 68kPa				... *at 1.60m, becoming light grey.*	M to W		
						... *at 1.80m, becoming light brown.*			
▼ 13-10-2022	2.0	Peak = 100kPa Residual = 70kPa		2					
	2.4	Peak = 65kPa Residual = 30kPa							
	2.8	Peak = 41kPa Residual = 22kPa				... *at 2.80m, contains fine black organic silt lens.*			
				3		ML: Sandy SILT: light greyish brown. Low plasticity; sand, fine. (Puketoka Formation)	S	F to St	
	3.2	Peak = 60kPa Residual = 35kPa							
						... *at 3.50m, becoming light greyish brown, contains a fine black organic silt lens.*			
	3.6	Peak = 84kPa Residual = 32kPa							
						... *at 3.80m, contains some small rootlets and a fine black organic silt lens.*			
						... *at 3.90m, becoming light bluish grey.*		H	
	4.0	Peak = UTP		4		Borehole terminated at 4.0 m			1 1 2 2 2 3 4 5 6 4
				5					

Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3239 DCP No: 22
Remarks: Groundwater encountered at 2m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA09-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan | Logged by: PT | Checked by: JW | Scale: 1:25 | Sheet 1 of 1

Position: 1744304.2mE; 5927602.4mN Projection: NZTM
Datum: AUCKHT1946 | Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density
				0.0	OL: Organic SILT: dark brown. (Topsoil)	M	
	0.3	Peak = 224kPa Residual = 48kPa		0.3	CL: CLAY: brownish grey. Low plasticity. (Puketoka Formation)		VSt to H
	0.6	Peak = 176kPa Residual = 48kPa					
	0.9	Peak = 141kPa Residual = 48kPa					
				1.0	CH: Silty CLAY: light greyish brown. High plasticity, moderately sensitive. (Puketoka Formation)		
	1.2	Peak = 176kPa Residual = 64kPa					
	1.5	Peak = 163kPa Residual = 90kPa					
	1.8	Peak = 144kPa Residual = 61kPa					
	2.1	Peak = 160kPa Residual = 74kPa					
	2.4	Peak = UTP		2.4	ML: Sandy SILT: light grey. Low plasticity, moderately sensitive. (Puketoka Formation)		
	2.7	Peak = UTP					
	3.0	Peak = UTP		3.0	Borehole terminated at 3.0 m		D to VD

Dynamic Cone Penetrometer (Blows/100mm)

Depth (m)	Blows/100mm
3.0	9
3.1	13
3.2	9
3.3	7
3.4	9
3.5	10
3.6	14
3.7	17
3.8	19
3.9	20

Termination Reason: Equipment refusal due to hard ground

Shear Vane No: 3434 DCP No: 22

Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA10-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan   Logged by: PT   Checked by: JW   Scale: 1:25   Sheet 1 of 1

Position: 1744254.5mE; 5927566.9mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater: 13-10-2022

Samples & Insitu Tests

Depth	Type & Results
0.3	Peak = 150kPa Residual = 35kPa
0.6	Peak = 109kPa Residual = 32kPa
0.9	Peak = 150kPa Residual = 35kPa
1.2	Peak = 160kPa Residual = 64kPa
1.5	Peak = 141kPa Residual = 54kPa
1.8	Peak = 128kPa Residual = 42kPa
2.1	Peak = 112kPa Residual = 51kPa
2.4	Peak = 96kPa Residual = 51kPa
2.7	Peak = 224kPa Residual = 48kPa
3.0	Peak = 141kPa Residual = 54kPa
3.3	Peak = 138kPa Residual = 64kPa
3.6	Peak = 144kPa Residual = 112kPa
3.9	Peak = 125kPa Residual = 80kPa
4.2	Peak = 224kPa Residual = 160kPa
4.5	

RL (m)

Depth (m): 1, 2, 3, 4, 5

Graphic Log

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

OL: Organic SILT: dark brown.
(Topsoil)

CL: Silty CLAY: brownish grey. Low plasticity.
(Puketoka Formation)

... at 2.40m, Poor recovery

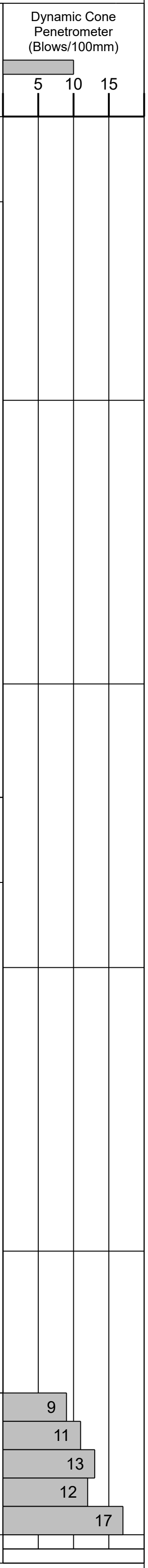
ML: Sandy SILT: light grey. Low plasticity.
(Puketoka Formation)

Borehole terminated at 4.5 m

Moisture Condition: M to W; S

Consistency/ Relative Density: VSt; St; VSt to H; D

Dynamic Cone Penetrometer (Blows/100mm)



Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3434   DCP No: 22
Remarks: Groundwater encountered at 1.6m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA11-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan Logged by: EM Checked by: JW Scale: 1:25 Sheet 1 of 1

CMW Geosciences

Position: 1744111.1mE; 5927593.4mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15
	Depth	Type & Results							
						OL: Organic SILT: brownish black. (Topsoil)			
	0.3	Peak = 54kPa Residual = 14kPa				ML: SILT: with some clay; brown. Low plasticity. (Puketoka Formation)	M to W	F to St	
						... at 0.40m, becoming silty clay.			
	0.6	Peak = 41kPa Residual = 5kPa							
▼ 13-10-2022							W to S		
	0.9	Peak = 49kPa Residual = 5kPa							
				1					
	1.2	Peak = 97kPa Residual = 19kPa							
						... from 1.40m to 1.60m, contains some black organic silt.			
	1.6	Peak = UTP				*... at 1.60m, becoming greyish brown with orange spots.*	S	H	
						ML: Sandy SILT: bluish grey. Non-plastic; sand, fine. (Puketoka Formation)			
	2.0	Peak = UTP		2					
						... at 2.20m, contains small rootlets and green fibrous plant material.			
	2.4	Peak = UTP				*... at 2.40m, low recovery.*			
						Borehole terminated at 2.5 m			
				3					
				4					
				5					

Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3239 DCP No:
Remarks: Groundwater encountered at 0.8m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

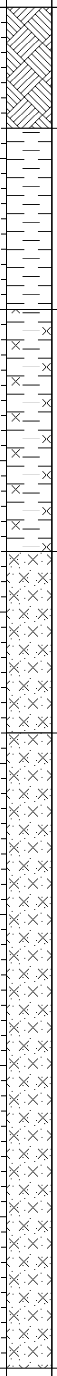
HAND AUGER BOREHOLE LOG - HA12-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan
Logged by: PT Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744237.0mE; 5927619.6mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater: 13-10-2022 at 2.1 m

Depth	Type & Results
0.3	Peak = 141kPa Residual = 19kPa
0.6	Peak = 144kPa Residual = 64kPa
0.9	Peak = 141kPa Residual = 48kPa
1.2	Peak = 125kPa Residual = 67kPa
1.5	Peak = 144kPa Residual = 48kPa
1.8	Peak = 138kPa Residual = 51kPa
2.1	Peak = 176kPa Residual = 61kPa
2.4	Peak = UTP
2.7	Peak = UTP
3.0	Peak = UTP
3.3	Peak = UTP
3.6	Peak = UTP
3.9	Peak = UTP
4.2	Peak = UTP
4.5	Peak = UTP

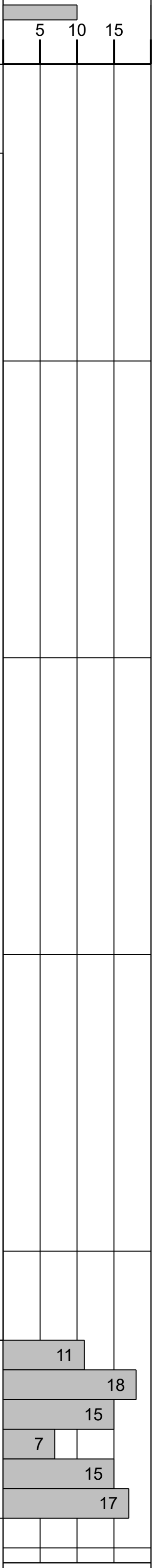


Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Material Description	Moisture Condition	Consistency/ Relative Density
OL: Organic SILT: dark brown. (Topsoil)	M	
CL: CLAY: brownish grey. Low plasticity. (Puketoka Formation)	M	VSt to H
CH: Silty CLAY: light greyish brown. High plasticity, moderately sensitive. (Puketoka Formation)	M	VSt to H
CH: Sandy CLAY: light brown. High plasticity, moderately sensitive. (Puketoka Formation)	M / W	VSt to H
ML: Sandy SILT: light grey. Low plasticity. (Puketoka Formation)	W	VSt to H / D

Borehole terminated at 4.5 m

Dynamic Cone Penetrometer (Blows/100mm)



Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3434 DCP No: 22
Remarks: Groundwater encountered at 2.1m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA13-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan   Logged by: PT   Checked by: JW   Scale: 1:25   Sheet 1 of 1

Position: 1744167.0mE; 5927655.6mN Projection: NZTM
Datum: AUCKHT1946   Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
					OL: Organic SILT: dark brown. (Topsoil)			
	0.3	Peak = 115kPa Residual = 32kPa			CL: CLAY: brownish grey. Low plasticity. (Puketoka Formation)			
	0.6	Peak = 128kPa Residual = 32kPa					VSt	
	0.9	Peak = 93kPa Residual = 29kPa						
				1				
	1.2	Peak = 96kPa Residual = 32kPa						
	1.5	Peak = 80kPa Residual = 35kPa				M to W	St	
	1.8	Peak = 80kPa Residual = 32kPa						
				2				
	2.1	Peak = UTP			ML: Sandy SILT: with minor siltstone; light grey. Low plasticity, moderately sensitive. (Puketoka Formation)			
	2.4	Peak = UTP						
	2.7	Peak = UTP					H	
	3.0	Peak = UTP		3				
					Borehole terminated at 3.2 m			3 4 4 6 8 7 10 10 11 12 13 20
							MD to D	
				4				
				5				

Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3434   DCP No: 906
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA14-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan Logged by: PT Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744176.4mE; 5927729.1mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater: 13-10-2022 (at 1.1 m)

Depth	Type & Results
0.3	Peak = 144kPa Residual = 45kPa
0.6	Peak = 192kPa Residual = 77kPa
0.9	Peak = 160kPa Residual = 74kPa
1.2	Peak = 102kPa Residual = 45kPa
1.5	Peak = 128kPa Residual = 48kPa
1.8	Peak = 99kPa Residual = 51kPa
2.1	Peak = 96kPa Residual = 32kPa
2.4	Peak = 128kPa Residual = 51kPa
2.7	Peak = 157kPa Residual = 58kPa
3.0	Peak = 192kPa Residual = 48kPa
3.3	Peak = 205kPa Residual = 45kPa
3.6	Peak = 224kPa Residual = 54kPa
3.9	Peak = 224kPa Residual = 48kPa
4.2	Peak = UTP
4.5	Peak = UTP
4.8	Peak = UTP

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

OL: Organic SILT: dark brown.
(Topsoil)

CL: Silty CLAY: light grey. Low plasticity, moderately sensitive.
(Puketoka Formation)

ML: Sandy SILT: light grey. Low plasticity, moderately sensitive.
(Puketoka Formation)

... from 2.70m to 3.00m, Poor recovery

CL: Silty CLAY: light grey mottled light brown. Low plasticity, moderately sensitive.
(Puketoka Formation)

ML: Sandy SILT: light grey. Low plasticity, moderately sensitive.
(Puketoka Formation)

Borehole terminated at 5.0 m

Moisture Condition: M; W

Consistency/ Relative Density: VSt; St to VSt; H

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Depth (m): 1 2 3 4 5

Termination Reason: Target depth
Shear Vane No: 3434 DCP No:
Remarks: Groundwater encountered at 1.1m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA15-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan   Logged by: OP   Checked by: JW   Scale: 1:25   Sheet 1 of 1

Position: 1744287.9mE; 5927842.2mN   Projection: NZTM
Datum: AUCKHT1946   Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15
					OL: Organic SILT : dark brown. Low plasticity. (Topsoil)	M		
	0.3	Peak = 179kPa Residual = 76kPa			ML: Clayey SILT: orange brown mottled orange. Low plasticity. (Puketoka Formation)		VSt to H	
	0.6	Peak = >230kPa Residual = 90kPa						
					... at 0.70m, Becoming light yellowish brown.			
	0.9	Peak = 203kPa Residual = 106kPa						
				1	CH: Silty CLAY: brownish white mottled orange. High plasticity. (Puketoka Formation)			
	1.2	Peak = 169kPa Residual = 96kPa						
	1.6	Peak = 159kPa Residual = 66kPa						
	2.0	Peak = 159kPa Residual = 83kPa		2	*... from 2.00m to 2.30m, Minor fine to coarse sand.*			
	2.5	Peak = 130kPa Residual = 75kPa			*... from 2.50m to 2.70m, Becoming orangeish brown.*			
						M to W		
13-10-2022						S		
	3.0	Peak = 100kPa Residual = 53kPa		3				
	3.5	Peak = 146kPa Residual = 83kPa			*... at 3.50m, Becoming grey.*			
	4.0	Peak = 206kPa Residual = 33kPa		4				
					ML: Clayey SILT: grey. Low plasticity. (Puketoka Formation)			
	4.5	Peak = 226kPa Residual = 75kPa						
					ML: SILT: grey. Low plasticity. (Puketoka Formation)			
	5.0	Peak = UTP		5	Borehole terminated at 5.0 m			

Termination Reason: Target depth
Shear Vane No: 2087   DCP No:
Remarks: Groundwater encountered at 2.9m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA16-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan

Logged by: OP Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744267.7mE; 5927705.7mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests Depth	Samples & Insitu Tests Type & Results	RL (m)	Depth (m)	Consistency/ Relative Density
	0.3	Peak = >230kPa Residual = 63kPa			
	0.6	Peak = 216kPa Residual = 96kPa			H
	0.9	Peak = 153kPa Residual = 63kPa		1	
	1.2	Peak = 120kPa Residual = 28kPa			VSt
13-10-2022 ▼	1.6	Peak = 66kPa Residual = 25kPa			
	2.0	Peak = 83kPa Residual = 43kPa		2	
	2.5	Peak = 100kPa			
	3.0	Peak = 133kPa Residual = 40kPa		3	St to VSt
	3.5	Peak = 159kPa Residual = 76kPa			
	4.0	Peak = 183kPa Residual = 40kPa		4	
	4.5	Peak = UTP			VSt to H
	5.0	Peak = 174kPa		5	

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

OL: Organic SILT
: dark brown. Low plasticity.
(Topsoil)

ML: SILT: brown orange. Low plasticity.
(Puketoka Formation)

... *at 0.50m, Becoming greyish brown mottled orange.*

ML: Clayey SILT: light greyish brown. Low plasticity.
(Puketoka Formation)

... *at 1.50m, Becoming iron stained.*

ML: Sandy SILT: light greyish brown. Low plasticity, Iron stained.
(Puketoka Formation)

ML: SILT: grey. Low plasticity.
(Puketoka Formation)

... *at 4.70m, Trace fine sand,*

Borehole terminated at 5.0 m

Moisture Condition

Dynamic Cone Penetrometer (Blows/100mm)
5 10 15

Termination Reason: Target depth
Shear Vane No: 2087 DCP No:
Remarks: Groundwater encountered at 1.5m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA17-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan

Logged by: PT Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744347.7mE; 5927873.9mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests Depth	Samples & Insitu Tests Type & Results
	0.3	Peak = 160kPa Residual = 74kPa
	0.6	Peak = 176kPa Residual = 80kPa
▼ 14-10-2022	0.9	Peak = 176kPa Residual = 29kPa
	1.2	Peak = 160kPa Residual = 26kPa
	1.5	Peak = 176kPa Residual = 80kPa
	1.8	Peak = 160kPa Residual = 96kPa
	2.1	Peak = 144kPa Residual = 99kPa
	2.4	Peak = 128kPa Residual = 67kPa
	2.7	Peak = 96kPa Residual = 61kPa
	3.0	Peak = 112kPa Residual = 64kPa
	3.3	Peak = 125kPa Residual = 48kPa
	3.6	Peak = 128kPa Residual = 67kPa
	3.9	Peak = 144kPa Residual = 80kPa
	4.2	Peak = 160kPa Residual = 99kPa
	4.5	Peak = 176kPa Residual = 131kPa
	4.8	Peak = UTP

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Depth (m)	Material Description
0.0	OL: Organic SILT: dark brown. Low plasticity. (Topsoil)
0.3	CH: Silty CLAY: greyish brown mottled orange. High plasticity. (Puketoka Formation)
3.0	ML: Sandy SILT: light greyish white. Low plasticity. (Puketoka Formation)
3.9	ML: Sandy SILT: light grey. Low plasticity, Iron stained. (Puketoka Formation)
5.0	Borehole terminated at 5.0 m

Depth (m)	Moisture Condition
0.0 – 1.0	M to W
1.0 – 5.0	W

Depth (m)	Consistency/ Relative Density
0.3 – 2.7	VSt
2.7 – 3.0	St
3.0 – 5.0	VSt to H

Dynamic Cone Penetrometer (Blows/100mm) 5 10 15

Termination Reason: Target depth
Shear Vane No: 3434 DCP No:
Remarks: Groundwater encountered at 0.9m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA18-22

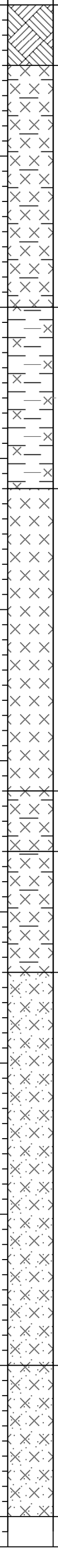
Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan Logged by: OP Checked by: JW Scale: 1:25 Sheet 1 of 1

CMW Geosciences

Position: 1744376.6mE; 5927751.3mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater: 14-10-2022

Samples & Insitu Tests Depth	Type & Results
0.3	Peak = 60kPa Residual = 23kPa
0.6	Peak = 143kPa Residual = 13kPa
0.9	Peak = 146kPa Residual = 70kPa
1.2	Peak = UTP
1.6	Peak = 163kPa Residual = 70kPa
2.0	Peak = 209kPa Residual = 123kPa
2.5	Peak = 209kPa Residual = 116kPa
3.0	Peak = 189kPa Residual = 103kPa
3.5	Peak = 169kPa Residual = 90kPa
4.0	Peak = 169kPa Residual = 56kPa
4.5	Peak = 130kPa Residual = 83kPa
5.0	Peak = UTP



Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

OL: Organic SILT: dark brown.
(Topsoil)

CL: Clayey SILT: with trace fine to coarse sand; orange brown. Low plasticity.
(Puketoka Formation)

CL: Silty CLAY: light brownish grey mottled orange. Low plasticity, moderately sensitive.
(Puketoka Formation)

... at 1.30m, Becoming light brownish white mottled orange.

ML: SILT: with some clay; light brownish white mottled orange. Low plasticity.
(Puketoka Formation)

CL: CLAY: sandy silt; greyish brown mottled orange. Low plasticity, Some pink mottles.
(Puketoka Formation)

ML: Clayey SILT: greyish brown. Low plasticity, Iron stained.
(Puketoka Formation)

ML: Sandy SILT: light grey mottled orange. Low plasticity, moderately sensitive.
(Puketoka Formation)

ML: Sandy SILT: bluish grey. Low plasticity.
(Waitemata Group)

Borehole terminated at 5.0 m

Moisture Condition: D to M; M to W; W; S

Consistency/ Relative Density: St; VSt to H

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Depth (m): 1 2 3 4 5

Termination Reason: Target depth
Shear Vane No: 2087 DCP No:
Remarks: Groundwater encountered at 3.2

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA19-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan
Logged by: EM
Checked by: JW
Scale: 1:25
Sheet 1 of 1

Position: 1744389.3mE; 5927638.6mN
Projection: NZTM
Datum: AUCKHT1946
Survey Source: pLog Tablet

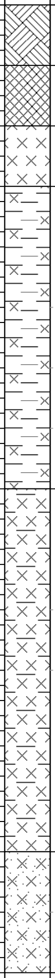
Groundwater: 13-10-2022 (at 1.6)

Samples & Insitu Tests	
Depth	Type & Results
0.3	Peak = UTP
0.6	Peak = 138kPa Residual = 54kPa
0.9	Peak = 92kPa Residual = 32kPa
1.2	Peak = >189kPa
1.6	Peak = >189kPa
2.0	Peak = UTP
2.4	Peak = 78kPa Residual = 14kPa
2.8	Peak = 154kPa Residual = 35kPa
3.2	Peak = UTP

RL (m)

Depth (m): 1, 2, 3, 4, 5

Graphic Log

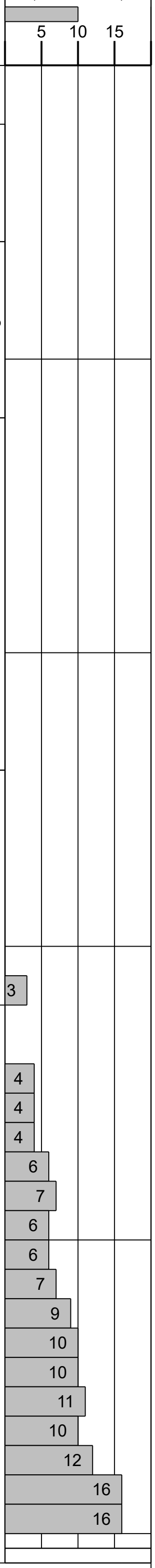


Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)
OL: Organic SILT: black. (Topsoil)
ML: SILT: brown. Non-plastic. (Fill)
ML: SILT: with minor clay; orange brown. Low plasticity. (Puketoka Formation)
CL: Silty CLAY: orange brown. Low plasticity. (Puketoka Formation)
... at 1.00m, becoming lighter yellow-orange brown.
... at 1.20m, becoming light greyish brown mottled orange.
... at 1.40m, contains some sand, fine.
ML: Sandy SILT: light greyish brown mottled orange. Low plasticity; sand, fine to medium. (Puketoka Formation)
... at 2.00m, still sandy silt, sand becoming fine to coarse.
... at 2.20m, contains minor siltstone fine.
ML: Sandy SILT: with minor fine gravel; light grey mottled orange. Low plasticity; sand, fine. (Puketoka Formation)
... at 3.00m, becoming grey with white mottling. Contains some fine to medium gravel.
Borehole terminated at 3.2 m

Moisture Condition
D to M
M
S

Consistency/ Relative Density
H
VSt to St
H
St to VSt

Dynamic Cone Penetrometer (Blows/100mm)



Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3239
DCP No: 22
Remarks: Groundwater encountered at 1.6m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA20-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan Logged by: EM Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744372.8mE; 5927538.7mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater: 14-10-2022 ▼ (at 1.4 m)

Samples & Insitu Tests	
Depth	Type & Results
0.3	Peak = >189kPa
0.6	Peak = >189kPa
0.9	Peak = 122kPa Residual = 43kPa
1.2	Peak = UTP
1.6	Peak = 68kPa Residual = 22kPa
2.0	Peak = 106kPa Residual = 51kPa
2.4	Peak = UTP
2.8	Peak = >189kPa
3.2	Peak = UTP
3.6	Peak = UTP

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

OL: Organic SILT: black.
(Topsoil)

CL: Silty CLAY: with some fine sand; brown mottled orange. Low plasticity.
(Puketoka Formation)

... *at 0.40m, becoming light brownish grey mottled orange, sand absent.*

... *at 0.90m, becoming light grey mottled orange.*

ML: Sandy SILT: light grey mottled orange. Non-plastic, sand, fine.
(Puketoka Formation)

... *at 2.40m, becoming light bluish grey mottled orange.*

CL: Silty CLAY: with minor fine sand; bluish grey mottled orange. Low plasticity.
(Puketoka Formation)

... *at 3.00m, orange mottling absent.*

ML: Sandy SILT: bluish grey. Non-plastic, sand, fine.
(Puketoka Formation)

Borehole terminated at 3.7 m

Moisture Condition: M; W; S

Consistency/Relative Density: H; St to VSt; H

Dynamic Cone Penetrometer (Blows/100mm)

3	
5	
4	
5	
10	
11	
14	
15	
15	
15	

Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3239 DCP No: 22
Remarks: Groundwater encountered at 1.4m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA21-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan

Logged by: EM Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744471.0mE; 5927599.3mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater: 14-10-2022

Samples & Insitu Tests

Depth	Type & Results
0.3	Peak = >189kPa
0.6	Peak = >189kPa
0.9	Peak = >189kPa
1.2	Peak = UTP
1.6	Peak = 116kPa Residual = 43kPa
2.0	Peak = UTP
2.4	Peak = UTP
2.8	Peak = UTP

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

OL: Organic SILT: black.
(Topsoil)

CL: Silty CLAY: brown mottled orange. Low plasticity.
(Puketoka Formation)

... at 0.80m, becoming grey mottled orange.

ML: Sandy SILT: light grey mottled orange. Low plasticity; sand, fine.
(Puketoka Formation)

CL: Silty CLAY: light bluish grey mottled orange. Low plasticity.
(Puketoka Formation)

ML: Sandy SILT: light grey mottled orange. Low plasticity; sand, fine.
(Puketoka Formation)

... at 2.20m, becoming bluish grey mottled orange.

CL: Silty CLAY: bluish grey mottled orange. Low plasticity.
(Puketoka Formation)

ML: Sandy SILT: bluish grey mottled orange. Low plasticity; sand, fine.
(Puketoka Formation)

... at 2.90m, becoming bluish grey, orange mottling absent.

Borehole terminated at 3.0 m

Moisture Condition: M; S

Dynamic Cone Penetrometer (Blows/100mm)

Depth (m)	Blows/100mm
2.9	3
3.0	6
3.1	7
3.2	6
3.3	8
3.4	9
3.5	8
3.6	12
3.7	13
3.8	16
3.9	15
4.0	15

Termination Reason: Equipment refusal due to hard ground
Shear Vane No: 3239 DCP No: 22
Remarks: Groundwater encountered at 1.5

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA22-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 13/10/2022
Borehole Location: See site plan Logged by: OP Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744460.7mE; 5927536.6mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests Depth	Samples & Insitu Tests Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15
						OL: Organic SILT : dark brown. Low plasticity. (Topsoil)	M		
	0.3	Peak = UTP				ML: Sandy SILT: orange brown orange. Low plasticity. (Puketoka Formation)		H	
						... at 0.50m, Becoming blueish grey, iron stained			
	0.6	Peak = >230kPa Residual = 116kPa							
	0.9	Peak = UTP							
				1					
						... at 1.10m, Becoming lighter grey.			
	1.6	Peak = 126kPa Residual = 66kPa						VSt to H	
	2.0	Peak = 126kPa Residual = 47kPa		2		ML: Clayey SILT: with minor fine sand; light greyish brown mottled orange. Low plasticity. (Waitemata Group)			
13-10-2022 ▼							S		
	2.5	Peak = 149kPa Residual = 83kPa							
	3.0	Peak = UTP		3		ML: Sandy SILT: grey. Low plasticity. (Waitemata Group)			
	3.5	Peak = UTP							
	4.0	Peak = UTP		4					
	4.5	Peak = UTP							
	5.0	Peak = UTP		5		Borehole terminated at 5.0 m			

Termination Reason: Target depth
Shear Vane No: 2087 DCP No:
Remarks: Groundwater encountered at 2.2m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA23-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan Logged by: PT Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744522.6mE; 5927600.0mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests Depth	Samples & Insitu Tests Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15
						OL: Organic SILT: dark brown. Low plasticity. (Topsoil)			
	0.3	Peak = 189kPa Residual = 48kPa				CL: CLAY: brown. Low plasticity. (Puketoka Formation)			
	0.6	Peak = 224kPa Residual = 128kPa				ML: SILT: with some fine sand; grey. Low plasticity. (Puketoka Formation)			
	0.9	Peak = 192kPa Residual = 112kPa		1					
	1.2	Peak = 224kPa Residual = 128kPa							
	1.5	Peak = 224kPa Residual = 128kPa							
	1.8	Peak = 208kPa Residual = 80kPa					M to W		
	2.1	Peak = 176kPa Residual = 64kPa		2		ML: Sandy SILT: light greyish white. Low plasticity. (Puketoka Formation)			
	2.4	Peak = 192kPa Residual = 32kPa							
	2.7	Peak = 208kPa Residual = 61kPa						VSt to H	
	3.0	Peak = 208kPa Residual = 61kPa		3					
	3.3	Peak = 224kPa Residual = 80kPa							
	3.6	Peak = 224kPa Residual = 112kPa							
▼ 14-10-2022	3.9	Peak = 224kPa Residual = 96kPa		4					
	4.2	Peak = 224kPa Residual = 64kPa							
	4.5	Peak = UTP					W		
				5		Borehole terminated at 5.0 m			

Termination Reason: Target depth
Shear Vane No: 3434 DCP No:
Remarks: Groundwater encountered at 3.9m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA24-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan

Logged by: OP Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744535.8mE; 5927574.5mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests Depth	Samples & Insitu Tests Type & Results	RL (m)	Depth (m)	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15
					OL: Organic SILT: dark brown. (Topsoil)	D to M		
					ML: Clayey SILT: with trace fine to coarse sand; orange brown. Low plasticity. (Puketoka Formation)			
	0.3	Peak = >230kPa					H	
					CL: Silty CLAY: light brownish grey mottled orange. Low plasticity, moderately sensitive. (Puketoka Formation)			
	0.6	Peak = 153kPa Residual = 33kPa						
	0.9	Peak = 176kPa Residual = 47kPa						
				1	CL: Clayey SILT: with minor fine sand; light brownish grey. Low plasticity, Iron staining between 1m and 1.5m. (Puketoka Formation)			
	1.2	Peak = 216kPa Residual = 73kPa						
	1.6	Peak = 216kPa Residual = 90kPa				M to W		
	2.0	Peak = 173kPa Residual = 66kPa		2				
					... at 2.20m, Becoming iron stained			
	2.5	Peak = 179kPa Residual = 53kPa						
14-10-2022 ▼							VSt to H	
	3.0	Peak = 166kPa Residual = 73kPa		3				
	3.5	Peak = 173kPa Residual = 63kPa			ML: Sandy SILT: light orange grey. Low plasticity. (Puketoka Formation)			
					ML: Clayey SILT: greyish brown. Low plasticity, Iron stained. (Puketoka Formation)	S		
	4.0	Peak = 209kPa		4	ML: Sandy SILT: bluish grey. Low plasticity. (Waitemata Group)			
	4.5	Peak = UTP						
	5.0	Peak = UTP		5	Borehole terminated at 5.0 m			

Termination Reason: Target depth
Shear Vane No: 2087 DCP No:
Remarks: Groundwater encountered 2.8m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA25-22

Client: Neil Construction Limited
Project: 98-100 Totara Road, Whenuapai
Site Location: Whenuapai
Project No.: AKL2018-0085
Date: 14/10/2022
Borehole Location: See site plan Logged by: PT Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744499.0mE; 5927525.5mN Projection: NZTM
Datum: AUCKHT1946 Survey Source: pLog Tablet

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density
						OL: Organic SILT: dark brown. Low plasticity. (Topsoil)		
	0.3	Peak = 173kPa Residual = 48kPa				CL: Silty CLAY: greyish brown mottled orange. Low plasticity. (Puketoka Formation)		VSt to H
	0.6	Peak = 192kPa Residual = 64kPa						
	0.9	Peak = 179kPa Residual = 61kPa		1				
	1.2	Peak = 192kPa Residual = 83kPa				ML: Sandy SILT: grey. Low plasticity. (Waitemata Group)		
	1.5	Peak = 224kPa Residual = 83kPa						
				2		Borehole terminated at 1.7 m		D to VD
				3				
				4				
				5				

Dynamic Cone Penetrometer (Blows/100mm)

5 10 15

6
9
9
9
11
7
9
10
11
15
12
20

Termination Reason: Equipment refusal due to hard ground

Shear Vane No: 3434 DCP No: 22

Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

Appendix C: Laboratory Test Results

DETERMINATION OF THE LIQUID LIMIT & LINEAR SHRINKAGE
TEST METHOD NZS 4402 : 1986 TEST 2.2 & 2.6

Project Name : **98-100 Totara Ave**

Project No : 18 0160 00

Client : CMW Geosciences Ltd

Page : 1 of 1

Address : 9 Piermark Drive
Albany

Date of Order : 15/05/2018

Sample Method : Handauger

Attention : J.Walden

Sample Date : 14/05/2018

Sampled By : JW

Sample No.	Location	Depth (m)	Liquid Limit	Linear Shrinkage	Natural Water Content (%)
803G	HA04-18	0.4-0.8m	67	18	35.4
804G	HA11-18	0.4-0.8m	58	16	34.5

Comments :

Tested By: SN Date : 17.05.18
Calculated By : EC Date : 19.05.18
Checked By : EC Date : 21.05.18

Appendix D: Natural Hazards Risk Assessment

NATURAL HAZARDS RISK ASSESSMENT FOR LAND SUBDIVISION WHENUAPAI GREEN, 98-102 TOTARA ROAD, WHENUAPAI

A. CONTEXT

Section 106 of the Resource Management Act (RMA) requires an assessment of the risk from natural hazards to be carried out when considering the granting of a subdivision consent. S106 RMA specifically states that the assessment must consider the combined effect of the natural hazard likelihood and material damage to land, other land or structures (consequence).

Section 2 of the RMA defines natural hazards as any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.

This appendix to CMW report reference AKL2018-0085AF Rev 1 sets out the criteria for and presents the results of an assessment of the geotechnical-related natural hazards associated with this proposed subdivision development. The remaining hazards, i.e. tsunami, wind, drought, fire and flooding hazards are not covered by this assessment.

B. BASIS OF ASSESSMENT

B.1. Risk Classification

The occurrence of natural hazards and their potential impacts on the proposed subdivision development is assessed in terms of risk significance, which is based on likelihood and consequence factors. A risk table is used to help assess the likelihood and consequence factors, the form of which used by CMW for this project is presented in Table B1.

Table B1: Natural Hazard Risk Classification

Risk Matrix		**Consequence**				
		Insignificant 1	**Minor 2**	**Moderate 3**	**Major 4**	**Catastrophic 5**
Likelihood	**Almost Certain 5**	Medium 5	High 10	Very high 15	Extreme 20	Extreme 25
	Likely 4	Low 4	Medium 8	High 12	Very high 16	Extreme 20
	Moderate 3	Low 3	Medium 6	Medium 9	High 12	Very high 15
	Unlikely 2	Very low 2	Low 4	Medium 6	Medium 8	High 10
	Rare 1	Very low 1	Very low 2	Low 3	Low 4	Medium 5

B.2. Likelihood

With respect to assessing the likelihood or chance of the risk occurring, the qualitative definitions used by CMW for this project are provided in Table B2 for each likelihood classification.

Table B2: Qualitative Natural Hazard Likelihood Definitions

1	Rare	The natural hazard is not expected to occur during the design life of the project
2	Unlikely	The natural hazard is unlikely, but may occur during the design life
3	Moderate	The natural hazard will probably occur at some time during the life of the project
4	Likely	The natural hazard is expected to occur during the design life of the project
5	Almost Certain	The natural hazard will almost definitely occur during the design life of the project

B.3. Consequence

In terms of determining the consequence or severity of the natural hazard occurring, the qualitative definitions used by CMW for this project are provided in Table B3 for each consequence classification.

Table B3: Qualitative Natural Hazard Consequence Definitions

1	Insignificant	Very minor to no damage, not requiring any repair, no people at risk, no economic effect to landowners.
2	Minor	Minor damage to land only, any repairs can be considered normal property maintenance no people at risk, very minor economic effect.
3	Moderate	Some damage to land requiring repair to reinstate within few months, minor cosmetic damage to buildings being within relevant code tolerances, does not require immediate repair, no people at risk, minor economic effect.
4	Major	Significant damage to land requiring immediate repair, damage to buildings beyond serviceable limits requiring repair, no collapse of structures, perceptible effect to people, no risk to life, considerable economic effect.
5	Catastrophic	Major damage to land and buildings, possible structure collapse requiring replacement, risk to life, major economic effect, or possible site abandonment.

B.4. Risk Acceptance

It is recognised that the natural hazard risk assessment provided herein is qualitative and, due to the wide range of possible geohazards that could occur, is somewhat subjective. Other methods are available to quantitatively assess an acceptable level of geotechnical related natural hazard risk, such as defining an acceptable factor of safety with respect to slope stability or acceptable differential ground settlements with respect to recommended building code limits.

Therefore, to give this qualitative natural hazard risk assessment some relevance to more commonly adopted numerical or quantitative geotechnical assessment techniques, a residual risk rating of very low to medium (risk value = 1 to 9 inclusive) is considered an acceptable result for the proposed subdivision development.

A risk rating of high to extreme (risk value ≥ 10) is considered an unacceptable result for the proposed subdivision development.

C. RISK ASSESSMENT

The natural hazards relevant to this proposed subdivision development and adjacent, potentially affected land have been assessed with respect to the criteria outlined above.

Assessment is based on proposed post development ground conditions with and without any geotechnical controls. The latent risk was first assessed with the site in its proposed developed state to consider the risks to the development and surrounding land, including assessment of land modifications from the pre-existing natural state, without any implemented geotechnical controls. The specific geotechnical mitigation measures and engineering design solutions outlined in the table below and CMW report, where relevant, were then considered to determine the natural hazard residual risk remaining after the proposed controls have been implemented.

Results of this assessment are presented in Table C1 below.

Table C1: Natural Hazard Risk Assessment Results

RMA S2 Hazard	**Description**	**Proposed Site Latent Risk of Damage to Land / Structures**			**Comments and Geotechnical Control**	**Proposed Site Residual Risk of Damage to Land / Structures OR Acceleration/ Worsening of Hazard with Geotechnical Controls Implemented**		
		Likelihood	**Consequence**	**Risk Rating**		**Likelihood**	**Consequence**	**Risk Rating**
Earthquake	Fault Rupture	1	5	Medium 5	Nearest active fault is approximately 80km away. Located in a low seismicity region	1	5	Medium 5
	Liquefaction Induced Flooding and/ or Subsidence	1	4	Low 4	Liquefaction risk assessed as not significant based on age and soil fabric criteria	1	4	Low 4
	Lateral Spread	1	4	Low 4	Risk of liquefaction induced lateral displacement is considered low due to absence of potentially liquifiable zone below ground surface	1	4	Low 4
Volcanic Activity	Ash & Pyroclastic Falls	1	5	Medium 5	No volcanoes in the area	1	5	Medium 5
	Lava flows & Lahars	1	5	Medium 5	No volcanoes in the area	1	5	Medium 5

Geothermal Activity	Formation of geysers, hot springs, fumaroles, mud pools	1	5	Medium 5	No geothermal activity in the area	1	5	Medium 5
Erosion	Cut Batters	5	2	High 10	Max 1V:3H gradient	2	2	Low 4
	Fill Batters	4	2	Medium 8	Appropriate drainage and stormwater flow, max gradient 1V:2.5H	2	2	Low 4
	Coastal (cliff top)	1	4	Low 4	No coastal cliffs located within the site	1	4	Low 4
Landslip	Global Slope Instability	5	4	Extreme 20	Appropriate drainage and control of groundwater levels, stability improvement works as recommended in the report	1	4	Low 4
	Soil Creep	5	4	Extreme 20	Appropriate design of footings, regrading of locally oversteepened slopes	1	4	Low 4
	Bearing Capacity Failure	2	4	Medium 8	Undercut and replace any unsuitable material, appropriate site gradients	1	4	Low 4
	Cut & Fill Batter Instability	4	4	Very High 16	Gradients of less than 1V:3H, engineered fill placed appropriately, use of specifically designed retaining walls with sufficient toe drainage	1	4	Low 4
Subsidence	Expansive Soils	5	3	Very High 15	Foundation design to account for expansive soils	1	3	Low 3
	Cut Batters	5	2	High 10	Max 1V:3H gradient	2	2	Low 4
	Fill Batters	4	2	Medium 8	Appropriate drainage and stormwater flow, max gradient 1V:2.5H	2	2	Low 4
	Effects of dewatering	2	4	Medium 8	Risk of dewatering induced ground settlement beyond site boundary is considered low due to adequate setback from proposed excavation	1	4	Low 4

Notes:

- Assessments include the impact of the proposed subdivision works on adjacent properties.

- The following reference(s) contain information on the hazards contained in this assessment and the non-geotechnical hazards that have not been included:
    - **Auckland**
      https://aucklandcouncil.maps.arcgis.com/apps/MapSeries/index.html?appid=81aa3de13b114be9b529018ee3c649c8

VIRIDIS
Environmental Consultants

Whenuapai Green Plan Change

Ecological Impact Assessment

Prepared for: Neil Construction Limited

February 2024

DOCUMENT CONTROL AND REVISION HISTORY

Document title	Whenuapai Green Plan Change Ecological Impact Assessment
Prepared for	Neil Construction Limited
Version	Draft A
Date	19 February 2024
Document number	10096-001-1

Version	Issue Date	Document number
Draft A	19 February 2024	10096-001-A (Project-Doc-Rev)

Author(s)	Timothy Yang Ecologist	
Reviewer(s)	Annabelle Coates Senior Ecologist	Mark Delaney Director | Ecology Lead

Reference: Viridis 2024. Whenuapai Green Plan Change Ecological Impact Assessment. A report prepared for Neil Construction Limited by Viridis Limited. February 2024.

Cover photo: View of Whenuapai Green plan change area looking north from the centre of the site (taken by Viridis Limited, January 2023).

TABLE OF CONTENTS

List of Tables

List of Figures

1 INTRODUCTION

Neil Construction Limited (NCL) is applying to Auckland Council for a Private Plan Change (PPC) to rezone the land at 98, 100 and 102 Totara Road, Whenuapai ('the site'; Figure 1).

The PPC seeks to rezone approximately 16.4 ha of land from a Future Urban Zone (FUZ) to a Mixed Housing Urban Zone (MHU) in an integrated and comprehensive manner. The plan change will incorporate residential areas with associated infrastructure and open space.

The site is bordered by Totara Road on the northern and western sides, McCaw Avenue to the south, and the Royal New Zealand Airforce (RNZAF) Base Auckland to the east.

This report describes the existing ecological values of the site, including terrestrial and freshwater features, and assesses the potential effects of the proposed PPC on those values.

An ecological assessment of the site and neighbouring environment identified the presence of permanent and intermittent watercourses, natural inland wetlands, and one small area of indigenous vegetation along the reach of the permanent watercourse and an area of planted native vegetation just immediately outside of the site boundaries. The plan change will enable the transition of land within the site from semi-rural land use to a Mixed Housing Urban Zone. Precinct provisions will be provided with the plan change. The precinct will facilitate the establishment of infrastructure to support development and ensure it is integrated into and enables future urban development of the wider area.

The overarching approach of this Ecological Impact Assessment (EcIA) is to ascertain the existing terrestrial and freshwater ecological values on the site and determine the impact of the proposed land use change and associated activities on those values. Recommended measures to avoid, remedy or mitigate adverse effects on terrestrial and freshwater ecology are provided as required. Recommendations for addressing anticipated residual adverse effects on the ecological values of the site through enhancement are also made where applicable.

Figure 1: Boundaries of plan change area in context of wider Whenuapai area.

2 METHODOLOGY

2.1 Overview

The assessment included a desktop review and site visit undertaken by a suitably qualified ecologist. The desktop review involved an examination of current and historical aerial imagery of the site, during which factors such as changes in vegetation and surface water were noted. A review of data on Auckland Council's Geomaps (such as current biodiversity layers, predicted watercourses and site topography) was also undertaken. Watercourse and wetland memorandums prepared by Bioresearches prepared for a Covid-19 Fast Track application were also reviewed (Bioresearches 2020 & 2021).

A site assessment was undertaken on 24th of January 2024, during which the presence and extent of freshwater and terrestrial features within the property and surrounding area were recorded, and the quality of associated habitat (if any) was visually assessed in accordance with the methodology detailed in Sections 2.2 through 2.3, below.

2.2 Terrestrial Ecology

The vegetation within the property was assessed during the site visit. The botanical value of both exotic and native vegetation was recorded, and the quality, extent and connectivity of vegetation were considered. Terrestrial fauna habitat was assessed qualitatively, in conjunction with database reviews (e.g., Department of Conservation's ARDs, Bioweb, eBird and iNaturalist) and considered indigenous lizards, birds, and bats. A desktop review of local bat and herpetofauna records from specific databases was undertaken. Opportunistic sightings of avifauna were recorded, and the conservation status of the species, as defined by Robertson et al. (2021), was noted.

The ecological value of terrestrial features was determined in accordance with the methodology prescribed in the Environment Institute of Australia and New Zealand (EIANZ) guidelines (refer to Section 2.4).

2.3 Freshwater Ecology

During the site assessment, the presence and extent of streams and wetlands on site (if any) were noted, and the quality of any freshwater habitat was visually assessed. Watercourses were classified as per the Auckland Unitary Plan Operative in Part (AUP-OP) definitions to determine, in accordance with the definitions in this plan, the ephemeral, intermittent or permanent status of the watercourse. Freshwater habitat was assessed, noting ecological aspects such as channel modification, hydrological heterogeneity, riparian vegetation extent, substrate type and any fish or macroinvertebrate habitat observed. Riparian and catchment information was also reviewed, and the NIWA New Zealand Freshwater Fish Database (NZFFD) was examined for fish species potentially present within the site.

Where appropriate, potential wetland areas were assessed in accordance with wetland delineation protocols (MfE, 2022a; Clarkson, 2014) and pasture exclusion methodology (MfE, 2022b) to determine if an area met the regulatory definition of 'natural inland wetland' (NPS-FM 2020). Potential wetland areas were assessed based on the prevalence of certain vegetation species and their indicator status ratings, as defined by Clarkson et al. (2021):

- Obligate wetland (OBL) vegetation, which almost always is a hydrophyte (a plant that only grows in wet environments), rarely found in uplands (non-wetland areas).

- Facultative wetland (FACW) vegetation, which usually is a hydrophyte but can occasionally be found in uplands.
- Facultative (FAC) vegetation, which is commonly either a hydrophyte or non-hydrophyte.
- Facultative upland (FACU) vegetation, which is occasionally a hydrophyte but is usually found in uplands.
- Upland (UPL) vegetation, which is rarely a hydrophyte and is almost always found in uplands.

Where the dominance or prevalence tests showed unclear results, hydric soils and hydrology tests were undertaken in accordance with the methodology outlined in MfE (2022a) and Clarkson (2014). Wetland assessments also included identifying native and exotic vegetation species, examining the structural tiers within wetland areas and assessing the quality and abundance of aquatic habitats. Signs of wetland degradation, such as pugging and grazing from stock access, structures such as culverts impeding hydrological function, and weed infestation were also noted.

The ecological value of freshwater features was determined in accordance with the methodology prescribed in the EIANZ guidelines (refer to Section 2.4).

2.4 Ecological Impact Assessment

The overarching approach of this analysis and reporting is to ascertain the existing ecological values on the site and determine the impact of the proposed plan change on those values.

The ecological value of the site, relating to species, communities and systems, was determined as per the EIANZ Ecological Impact Assessment guidelines (EcIAG) for use in New Zealand (Roper-Lindsay et al., 2018). This report also identifies statutory guidelines and regulations with respect to ecology (such as watercourses, wetlands, high-value vegetation and habitats) where relevant to the proposed development. Using this framework, the EcIAG describes a simple ranking system to assign value to species as well as other matters of ecological importance, such as species assemblages and levels of organisation. The overall ecological value is then determined on a scale from '*Negligible*' to '*Very High*'.

Criteria for describing the magnitude of effects are given in Chapter 6 of the EcIAG. The level of effect can then be determined by combining the value of the ecological feature/attribute with the score or rating for the magnitude of effect to create a criterion for describing the level of effects (Table 1). A moderate level of effect requires careful assessment and analysis of the individual case. For moderate levels of effects or above, measures need to be introduced to avoid through design, or appropriate mitigation needs to be addressed (Roper-Lindsay et al., 2018).

Table 1. Criteria for describing the level of effects (from Roper-Lindsay et al. 2018).

Magnitude of Effect	**Ecological Value**				
	Very High	**High**	**Moderate**	**Low**	**Negligible**
Very High	*Very High*	*Very High*	*High*	*Moderate*	Low
High	*Very High*	*Very High*	*Moderate*	Low	Very Low
Moderate	*High*	*High*	*Moderate*	Low	Very Low
Low	*Moderate*	Low	Low	Very Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low	Very Low
Positive	Net Gain	Net Gain	Net Gain	Net Gain	Net Gain

Notes: Where text is italicised, it indicates 'significant effects' where mitigation is typically required.

3 SITE DESCRIPTION

3.1 Site Context

3.1.1 Ecological District

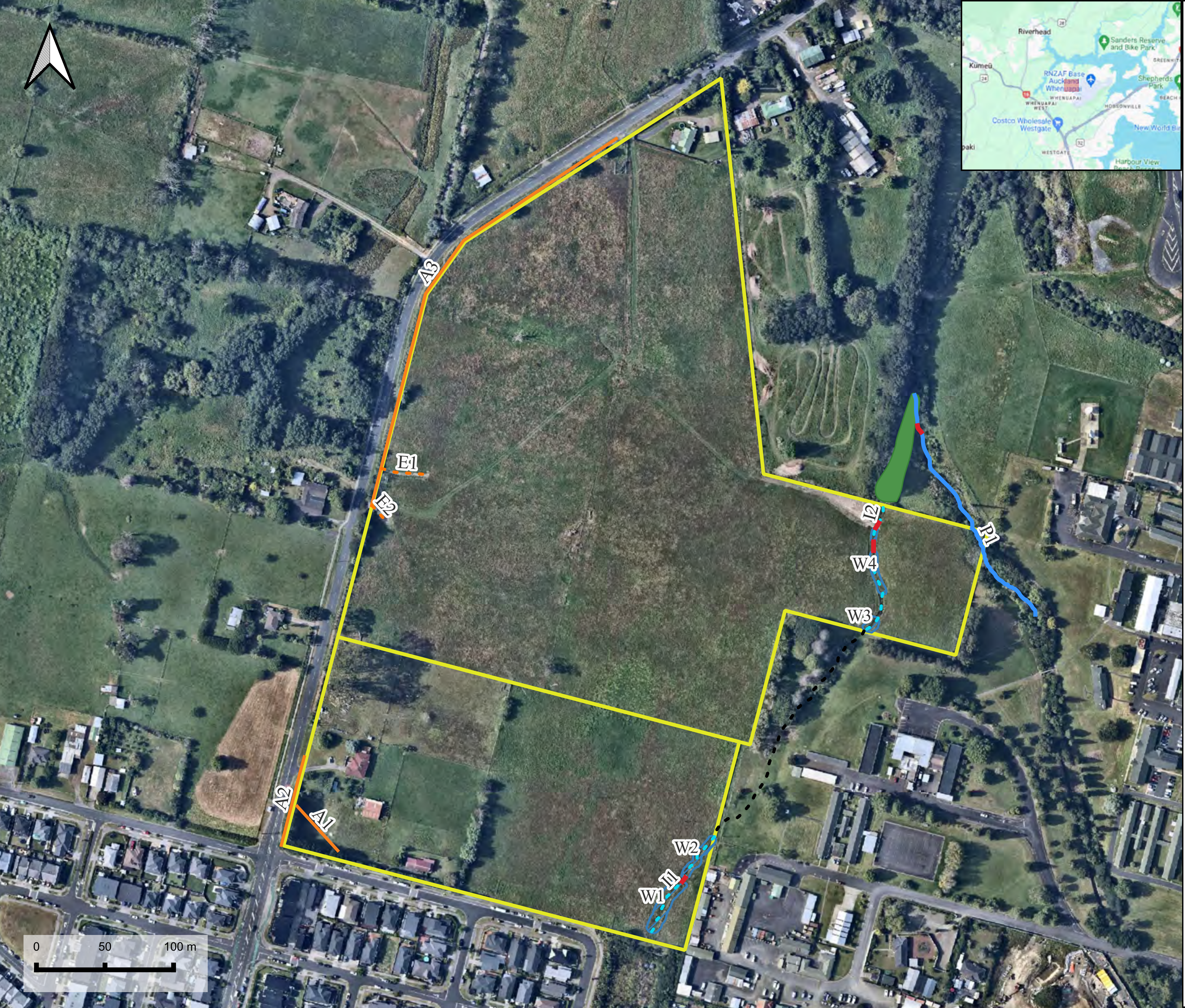
The site is located in the Tāmaki Ecological District. The district is characterised by harbours and coastal areas with a strong influence from historic volcanic activity. Significant vegetation clearance has occurred, and the district is now dominated by urban areas. The Tāmaki Ecological District would have historically been heavily forested.

Historically (pre-human), the site would have likely contained the ecosystem type 'Pūriri forest' (WF7). Native flora characteristic of this ecosystem type would have included pūriri (*Vitex lucens*) with occasional kahikatea (*Dacrycarpus dacrydioides*), kohekohe (*Didymocheton spectabilis*) and karaka (*Corynocarpus laevigatus*), which could support a diverse community of invertebrates, amphibians, reptiles, birds and bats (Singers et al., 2017). However, a review of historical aerial imagery indicates that the site, and much of the surrounding landscape, was cleared over 80 years ago for agricultural purposes (Figure 2).

3.1.2 Local Context

Currently, the site contains a small number of residential dwellings, associated outbuildings, and large areas of field/pasture. Land use within the site is now dominated by agricultural activities.
The wider area is largely rural, with the RNZAF Base Auckland bordering the site on the east and an area of residential development on the southern boundary. It is expected residential development will continue to occur around the site. There are no Significant Ecological Areas (SEA) within the site. The closest terrestrial SEA is located approximately 1,300 m to the southwest of the site, while the closest SEA is a marine SEA that acts as the receiving environment for the streams on site and located approximately 165 m North of the site. The key ecological features on-site and the surrounding landscape are presented in Figure 3.

Figure 2: Historical aerial imagery of the site, dated 1940 (source: Retrolens).



VIRIDIS
Environmental Consultants

Figure 3A: Key Ecological Features

98 & 100-102 Totara Road

Neil Construction Limited

Legend

Site ▭

Native plantings 🟩

Watercourses

Intermittent - - -

Artificial —

Permanent —

Ephemeral - - -

Culvert —

Pipe - - -

Wetlands ▨

SOURCES

State map source and aerial date

SCALE **1:3,500** @ A4

PROJECT NO.	10096
DRAWN BY:	T.Y
DATE:	12 February 2024

4 TERRESTRIAL ECOLOGY

4.1 Vegetation

Vegetation within the site can be characterised as garden and amenity planting, shelterbelts, and riparian vegetation. Managed pasture was the dominant vegetation type.

Vegetation other than grass/pasture was not common throughout the site and was generally concentrated around the riparian yard of the intermittent streams (Figure 4) and the residential dwellings on the site.

Indigenous vegetation on site was limited to a small area of the permanent stream (P1) riparian margin that crosses through the eastern corner of the site and scattered species elsewhere. Native species identified within the site included cabbage tree (*Cordyline australis*), mamaku (*Cyathea medullaris),* karamu (*Coprosma robusta*), kiokio (*Parablechnum novae-zelandiae*), cabbage tree (*Cordyline australis*), mānuka (*Leptospermum scoparium*), mahoe (*Melicytus ramiflorus*) and flax (*Phormium tenax*). The freshwater values of this area are discussed in section 2.3

Most of the site was dominated by exotic species such as red clover (*Trifolium pratense*), white clover (*Trifolium repens*), kikuyu grass (*Pennisetum clandestinum*), Yorkshire fog (*Holcus lanatus*), creeping buttercup (*Ranunculus repens*), scattered soft rush (*Juncus effusus*), and bindweed (*Convolvulus sp.*).

In addition, the site had many listed pest plants[1] established such as woolly nightshade (*Solanum mauritianum*), Chinese privet (*Ligustrum sinense*), montbretia (Crocosmia × crocosmiiflora), gorse (*Ulex sp.*), brushwattle (*Paraserianthes lophantha*), and Japanese honeysuckle (*Lonicera japonica*).

Just outside the site but within the surrounding area was a small pocket of native planting (1000 m^2) past the northeast corner of the site (Figure 3).

The ecological and botanical value of the vegetation within the site was assessed as **low** due to the large proportion of non-natives and weeds.

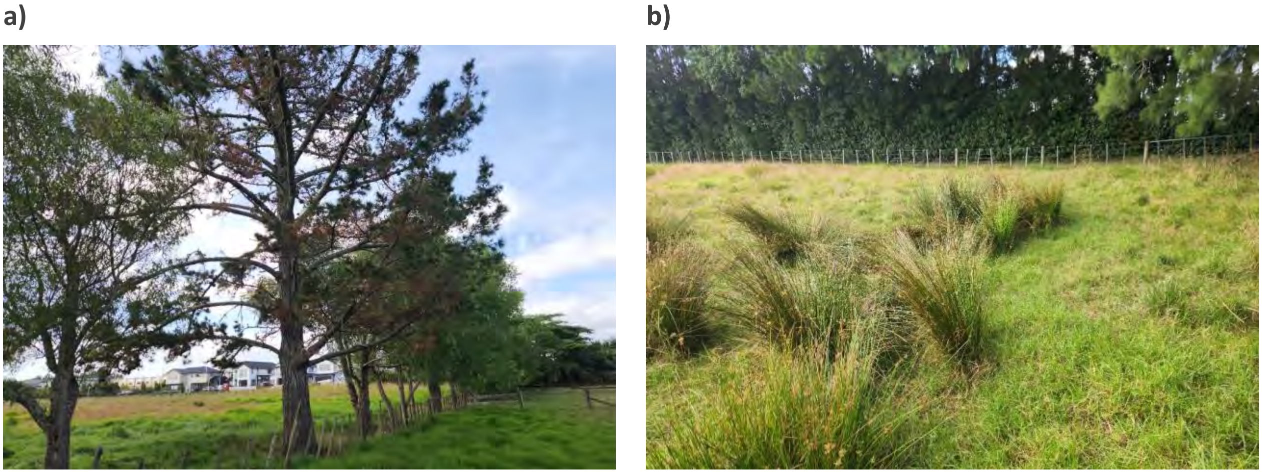


Figure 4: a) Stand of exotic trees and b) Soft rush established on banks of intermittent stream/wetland margin.

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[1] As listed in the Auckland Regional Pest Management Plan 2020-2030.

Figure 5: a) View overlooking vegetated permanent stream from site and b) Example image of the vegetation around stream.

4.1.1 Connectivity and Ecological Function

Connectivity between areas of vegetation is important to facilitate ecological function. Edge communities are heavily influenced by increased exposure to light, drying winds, and competitive weeds. This 'edge effect' restricts some native flora and fauna to forest interiors. Patch fragmentation increases the edge effect and decreases the availability of habitat for interior species. Loss of ecological connectivity can also impair reproductive function for both flora and fauna.

There were only small areas of vegetation other than pasture. Small amounts of exotic and native vegetation were present within the site, and these were isolated or generally long and narrow, such as the vegetation along the permanent watercourse. As a result, all vegetation within the site was subject to very high edge effects, and as such, the functioning of the vegetated area and its ability to persist and buffer the effects of adverse weather and weed invasion were significantly reduced. The more mature areas were likely to provide some level of connectivity for highly mobile fauna, such as birds, as they move between other small, vegetated areas in the wider vicinity of the site. However, the vegetation present does not present significant connectivity opportunities.

The connectivity and ecological functioning values of the site were considered to be **low**.

4.2 Terrestrial Fauna Habitat

4.2.1 Avifauna (Birds)

No formal bird survey was undertaken on the site. Opportunistic observations, with records retrieved from ebird.org, provided a list of species likely to be present in the wider area (Table 2). The avifauna community is expected to be dominated by common native and exotic species. There is a possibility the At Risk – Declining NZ pipit is present within the site, or wider area. New Zealand pipits can be found in farmland and around wetlands and have been recorded in the rural areas around west Auckland. New Zealand pipits are protected under the Wildlife Act 1953, irrespective of whether the PPC proceeds or not.

The existing vegetation provides nesting, roosting, and foraging habitat for native birds within the site; however, the value is limited due to the low botanical values of the site. The lack of complex, diverse vegetation significantly limits the ability of the site to provide high-value habitat.

The ecological value of the site for avifauna was considered to be **moderate** due to the potential presence of an At-Risk – Declining species but a lack of quality habitat.

Table 2: Bird species potentially present within the site.

Common name	Species name	Conservation status
Pūkeko	*Porphyrio melanotus melanotus*	Not Threatened
Spur-winged plover	*Vanellus miles novaehollandiae*	Not Threatened
Kingfisher	*Todiramphus sanctus vagans*	Not Threatened
Eastern rosella	*Platycercus eximius*	Introduced and Naturalised
Tui	*Prosthemadera novaeseelandiae novaeseelandiae*	Not Threatened
Magpie	*Gymnorhina tibicen*	Introduced and Naturalised
Fantail	*Rhipidura fuliginosa placabilis*	Not Threatened
Skylark	*Alauda arvensis*	Introduced and Naturalised
Welcome swallow	*Hirundo neoxena neoxena*	Not Threatened
Silvereye	*Zosterops lateralis lateralis*	Not Threatened
Common myna	*Acridotheres tristis*	Introduced and Naturalised
Thrush	*Turdus philomelos*	Introduced and Naturalised
Blackbird	*Turdus merula*	Introduced and Naturalised
Sparrow	*Passer domesticus*	Introduced and Naturalised
Paradise shelduck	*Tadorna variegata*	Introduced and Naturalised
Grey warbler	*Gerygone igata*	Not Threatened
Kereru	*Hemiphaga novaeseelandiae*	Not Threatened
Pheasant	*Phasianus colchicus*	Introduced and Naturalised
Australasian harrier	*Circus approximans*	Not Threatened
NZ pipit	*Anthus novaeseelandiae novaeseelandiae*	At Risk - Declining

4.2.2 Herpetofauna (Lizards)

Herpetofauna (reptiles and amphibians) comprise a significant component of New Zealand's terrestrial fauna. There are currently 104 endemic herpetofauna taxa recognised in New Zealand (Hitchmough et al., 2021) and more than 80% are considered 'Threatened' or 'At Risk'. All indigenous reptiles and amphibians are legally protected under the Wildlife Act 1953, and vegetation and landscape features that provide significant habitat for native herpetofauna are protected by the Resource Management Act 1991 (RMA). Statutory obligations require the management of resident reptile and amphibian populations where they or their habitats are threatened by disturbances such as land development.

No formal lizard survey was undertaken. A review of records from the wider Whenuapai area shows that five species have been recorded in the wider area (Table 3). The habitat present within the site was generally too highly modified to support native lizards, with the exception of copper skink. The stands of mixed vegetation were too open to provide any significant arboreal lizard habitat, and the lack of connection to existing stands of native vegetation means geckos are unlikely to be able to colonise the site even if the habitat is suitable. Copper skinks are known to inhabit areas of long pasture and rank grass. Ornate skinks are unlikely to be present as they are generally found in forested areas and shrubland, amongst dense leaf litter, low foliage, thick rank grass and under rocks or logs. Habitat such as this was not present on site.

The ecological value of the site for herpetofauna was considered to be **moderate** due to the possible presence of At Risk – Declining copper skink.

Table 3: Lizards present in the wider Whenuapai area.

Common name	Species name	Conservation status	Likelihood of presence
Pacific gecko	*Dactylocnemis pacificus*	Not Threatened	Unlikely
Elegant gecko	*Naultinus elegans*	At Risk - Declining	Unlikely
Forest gecko	*Mokopirirakau granulatus*	At Risk - Declining	Unlikely
Copper skink	*Oligosoma aeneum*	At Risk - Declining	Likely
Ornate skink	*Oligosoma ornatum*	At Risk - Declining	Unlikely

4.2.3 Chiroptera (Bats)

Long-tailed bats (LTBs; *Chalinolobus tuberculatus*) are classified as ‘Nationally Vulnerable’ in the North Island (O’Donnell et al., 2023). This classification is given the qualifier “Data Poor”, which indicates that there is low confidence in the rating due to poor data available on the species populations and distribution (Townsend et al., 2008). LTBs have large home ranges.

No formal survey for LTBs was completed as part of the investigations for this report. However, LTBs are known to occur throughout the Auckland area, including around Whenuapai and west Auckland. Therefore, the site is within the flight range of known LTB habitat.

Few trees on site had suitable roosting or nesting habitat for bats due to the lack of cavities or large sections of flaking bark; the only notable tree was a large dead tree with branches removed, as shown in Figure 5. The site and surrounding area were not considered to be optimal for bats due to the dominance of agriculture with scattered suitable areas of vegetation, and increasing urban areas in the adjacent areas. However, bats are known to utilise waterways as forage and commuting corridors, and the proximity of the site to the Rawawaru Creek and Ratara Stream catchments means there is a possibility of bats foraging in the area. It is therefore considered that LTBs may periodically be present in the area and potentially within the site. However, the habitat is not expected to support regular visits or communal roosts.

The ecological value of the site for bats has conservatively been considered to be **high**.

5 FRESHWATER ECOLOGY

5.1 Watercourses

All waterways within the site were classified and mapped according to definitions within the AUP-OP as either permanent, intermittent, ephemeral, or artificial channels (Figure 3). Watercourses that have been modified for farm drainage but were once natural, upon review of historical aerials, have been mapped as natural streams.

The freshwater assessments were undertaken from December 2023 to January 2024. Despite some areas being outside of the optimal season for classifying watercourses, a conservative approach has been taken for all watercourses, and there was confidence in the classification of intermittent streams due to the areas meeting more than three of the intermittent stream criteria, excluding the presence of surface water more than 48 hours after a rainfall event. Regardless, all watercourses within the site would be required to be reassessed at the resource consent stage prior to future development.

The watercourse classification types are described in this section.

5.1.1 Permanent streams (P1)

One permanent stream was identified within the PPC site, as shown in Figure 3. The permanent stream was classified based on the clear presence of permanent flowing water, stream width and catchment size.

The permanent watercourse was an unnamed tributary of the Rawawaru Creek (P1). It flowed through the eastern part of the site in a northwestern direction to join the Rawawaru Creek.

The stream reach of this unnamed tributary (P1) within the site was well-shaded by the riparian vegetation described in section 4.1 and had a good amount of organic matter input. The stream provided moderate habitat for fauna with a good mix of pools and runs, and the substrate was comprised of a mix of bedrock, soft sediment and cobble.

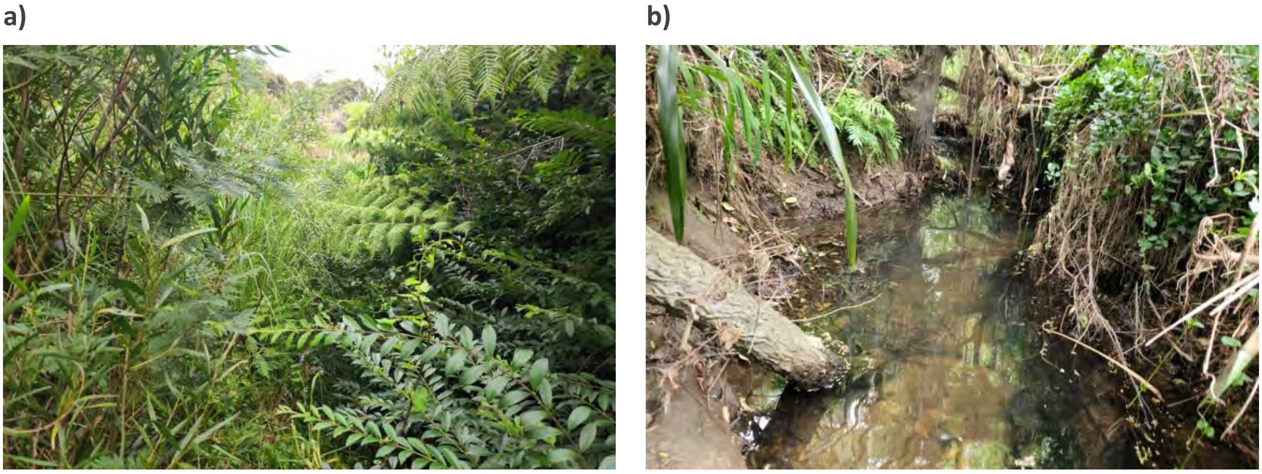

Figure 6: a) Vegetation around the unnamed tributary P1 and b) Organic input and bank stream P1.

A review of the NZFFD for the Waitematā harbour catchment showed eight fish species that have been previously identified in the catchment (Table 4).

The permanent stream reaches of the Waitematā harbour and Rawawaru Creek may provide spawning habitat for īnanga.

Due to the agricultural land uses within the catchments, it is expected that the benthic invertebrate community would be dominated by taxa that are tolerant to high nutrient and sediment loading.

The site is upstream of the Waitematā harbour. There is an SEA located north of the site and downstream at the start of the Rawawaru Creek. All activities occurring upgradient of this have the potential to influence the sensitive receiving environment.

Based on the significance of the location directly upstream of a marine SEA and the likely presence of 'At-Risk' species, the permanent stream was conservatively assessed as being of **moderate** ecological value.

Table 4. Fish species potentially present within the site (records retrieved from the NZFFD, conservation status from Dunn et al., 2018).

Common name	Species name	Conservation status
Īnanga	*Galaxias maculatus*	At Risk – Declining
Longfin eel	*Anguilla dieffenbachii*	At Risk – Declining
Shortfin eel	*Anguilla australis*	Not Threatened
Banded kōkopu	*Galaxias fasciatus*	Not Threatened
Redfin bully	*Gobiomorphus huttoni*	Not Threatened
Common bully	*Gobiomorphus cotidianus*	Not Threatened
Mosquitofish	*Gambusia affinis*	Listed Unwanted Organism
Grass carp	*Ctenopharyngodon idella*	Introduced

5.1.2 Intermittent streams (I1 – I2)

Two watercourses within the site have been identified as intermittent streams (Figure 7). These intermittent streams drained to the Rawawaru Creek and the greater Waitematā harbour. The intermittent stream reaches within the site had little riparian vegetation present, and the riparian margin consisted of managed pasture with very limited shading, organic matter input, and filtration functions. The streams are full of mercer grass and banks with soft rush (Figure 7).

Within the intermittent reaches of the site, a number of culverts were present, including at least one that was perched, which likely acts as a partial barrier to fish passage. However, species with climbing ability, such as eels and banded kōkopu, may be able to navigate them.

The intermittent waterways were considered to currently have **low** ecological values. When water is present, they have the potential to support some of the fish species listed in Table 4, including At Risk – Declining fish species, specifically longfin eels. However, observations on site suggest water is not regularly present or present for long periods of time. Therefore, the likelihood of fish other than the tolerant shortfin eel being present is low.

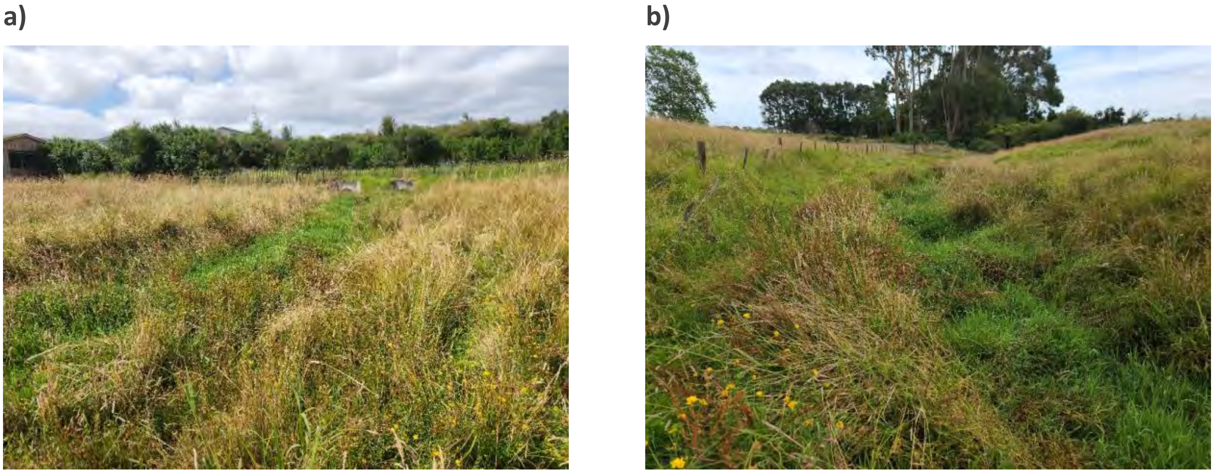

Figure 7. Mercer grass, soft rush, shallow channel and lack of shading along a) I1 and b) I2.

5.1.3 Ephemeral streams (E1-E2)

There were two ephemeral streams on site. The ephemeral channels contained rooted terrestrial vegetation within them, showed no evidence of substrate sorting and did not contain natural pools or easily identifiable channels/banks. They contained no significant riparian vegetation and no instream freshwater habitat.

The ecological value of the ephemeral watercourses within the site was considered to be **negligible**.

5.1.4 Artificial channels (A1, A2, A3)

There were three artificial channels on site. These watercourses have been classified as artificial based on a number of criteria, including alignment with the natural topography, absence of a historical natural channel, catchment size and artificial characteristics such as unnaturally deep and straight channels.

Artificial channels also run along some site boundaries as roadside drains (Figure 8). The channel labelled A3 flowed along the northwestern boundary of the site and appeared to be dry. Another roadside drain, A2, which connects to an artificial drain A1 for farm purposes on the southwestern boundary of the site, also appeared dry.

The ecological value of the artificial drains was considered to be **negligible** due to their artificial nature and the channels being dry and considered likely to be dry for the majority of the time.

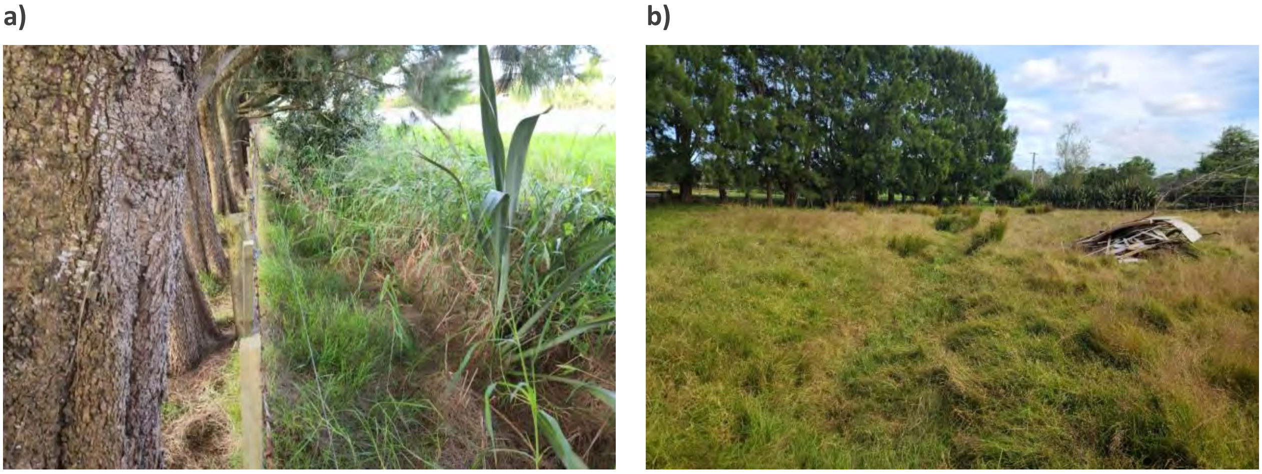

Figure 8: a) Example of artificial channel along the road on the southwestern corner of the site and b) artificial channel that cuts through the corner of the site.

5.2 Wetlands (W1-W4)

Four wetland areas were identified within the site. All of the wetlands were located along the margins of the intermittent stream reaches. Natural inland wetlands within the site have been mapped as per Figure 3. All of the wetlands within the site met the rapid vegetation test for wetland delineation and contained permanent hydrological indicators such as saturated ground and surface water. All wetlands within the site were considered 'natural inland wetlands' as per the NPS-FM definitions. Wetland extent was delineated based on contours and/or a clear change in vegetation community from OBL/FACW dominant to FACU/UPL dominant.

All other pasture areas within the site were considered non-wetlands, using the rapid pasture test (i.e., >50% dominance of pasture species) (MfE, 2022b). Regardless, it is acknowledged that wetlands can be dynamic features that fluctuate regularly/seasonally, and wetlands within the sites would be required to be classified and reassessed at the resource consent stage prior to future development.

The wetlands were vegetated with soft rush (*Juncus effusus* – FACW), water pepper (*Persicaria hydropiper* – FACW), lotus (*Lotus pedunculatus* – FAC), mercer grass (*Paspalum distichum* – FACW), kiokio (*Parablechnum novae-zelandiae* – FAC), redshank (*Persicaria maculosa* – FACW), creeping buttercup (*Ranunculus repens* – FAC) and Yorkshire fog (*Holcus lanatus* – FAC) (Figure 7). *Paspalum* (*dilatatum* and *urveilli*; both FAC) was observed on edges of wetland and other pasture species like kikuyu and clover were noted past the wetland boundary.

The stream margin wetlands met the definition of a natural inland wetland as per the NPS-FM.

The ecological value of these stream-margin wetlands was assessed as **low**. The vegetation community around the wetlands was dominated by exotic/invasive species.

5.3 Summary of Ecological Values

The values of the site are summarised in Table 5. The terrestrial ecological value of the site was generally low. Exotic trees (i.e., planted stands and shelterbelts) within the site were considered to provide **low** ecological values. Very little native vegetation remains across the site to provide any significant habitat for indigenous fauna, aside from some small regenerating patches consisting of common species. Rank grasses around the site possibly provide some suitable habitat for 'At-Risk' indigenous herpetofauna. The remainder of the site itself is largely comprised of low-value managed pasture. Features on site were considered to provide **moderate** ecological for birds and lizards and was conservatively assessed to have **high** ecological value for bats.

The freshwater values of the site are linked to the presence of moderate-value permanent watercourses, which may provide habitat for 'At-Risk' īnanga spawning. Low-value freshwater features included intermittent streams and stream margin wetlands that have been degraded due to the agricultural practices.

Table 5: Summary of the ground-truthed terrestrial and freshwater ecological values within the site

Ecological Feature	Ecological Value
Vegetation	Low
Connectivity and Ecological Function	Low
Avifauna (Birds)	Moderate
Herpetofauna (Lizards)	Moderate
Chiroptera (Bats)	High
Permanent streams	Moderate
Intermittent streams	Low
Ephemeral streams	Negligible
Artificial channels	Negligible
Stream margin wetlands	Low

6 ASSESSMENT OF ECOLOGICAL EFFECTS

6.1 Overview

The proposed PPC seeks to rezone approximately 16.4 ha of land from FUZ to a MHU under the AUP-OP. Additional provisions will likely be proposed for the area as part of the precinct plans. All Auckland-wide and zone provisions within the AUP-OP will apply to the re-zoned land and will enable the Auckland Council to regulate and manage future subdivision development.

This section assesses the potential effects of the proposed urbanisation of the site on the current and potential ecological values within the sites and the associated wider landscape.

6.2 Terrestrial Ecology

6.2.1 Vegetation and terrestrial ecological connectivity and function

Vegetation values within the site were significantly limited due to the dominance of exotic vegetation. No SEAs were present within the site. The most significant amount of vegetation within the site was located within the riparian yard of the permanent stream. Any alteration to the riparian vegetation will require resource consent, and therefore, effects will be assessed during future consenting phases if alteration is proposed.

Rezoning the site will result in low adverse effects on the existing vegetation. It is expected vegetation beyond the riparian yard will be removed, namely the shelterbelts; however, this can already be removed as a permitted activity. It is expected that as a part of future development works, landscaping and riparian planting will be undertaken throughout the site which will provide an increase in plant diversity and ecological connectivity.

Incorporate info from the landscape report when available

6.2.2 Terrestrial indigenous fauna

The protection and enhancement of the ecological features within the site and the creation of areas of new habitat through revegetation planting in relation to open space areas and riparian margins will increase and improve the quality of the terrestrial habitat for indigenous fauna across the site over time.

Any potential direct adverse effects on native terrestrial fauna as a result of future development works (e.g., earthworks, vegetation clearance) will be assessed at the resource consenting phase. It is considered that adverse ecological effects on fauna can be appropriately mitigated through the implementation of fauna management plans.

Specific provisions to manage the effects on LTBs are not required in the PPC because they are already legally protected by the Wildlife Act 1953.

6.2.3 Pest mammals

The rezoning of the site from rural to urban land uses will ultimately lead to an increase in the human population density within the area. An increase in human population density has been found to decrease possum and rodent numbers and, expectedly, increase domestic cats in residential areas (Miller, 2020). With the close proximity of the existing Whenuapai development, roaming domestic cats are likely already present within the site. However, increased numbers are inevitable as a result of the rezoning.

In turn, the number of mustelids can become very limited, where cats are in abundance. Hedgehogs are often abundant in urban areas due to the abundance of anthropogenic food and shelter (Miller, 2020).

The current site is not known to have pest control measures, and most pests are likely at carrying capacity. Pest control is likely to be implemented on-site once the number of residents increases. Additionally, it is likely that the landscape plans will propose native vegetation protection and enhancement requiring pest control, which will aim to decrease possum, mustelid, hedgehog and rodent densities within the proposed ecological spaces.

The reduction in agricultural land with a re-zone to urban will likely result in an overall decrease in the possum, mustelid, and rodent abundance and an overall increase in hedgehog and cat numbers in urban areas. Overall, urbanisation of the PPC areas is expected to provide positive outcomes for reducing pest mammal populations within the sites and the wider Structure Plan area.

6.3 Freshwater Ecology

6.3.1 Watercourses

The permanent watercourse within the site was considered to be of moderate ecological value, while the intermittent watercourses were considered to be of low ecological value. The watercourses are already subject to existing Auckland-wide AUP-OP rules and policies.

The main threats to freshwater ecology as a result of a change to Mixed Housing Urban Zone are:

- The decrease in riparian yard setback
- The potential for increased impervious surfaces as a result of development.
- The potential increase in contaminant runoff as a result of development

All threats can be effectively managed during development with appropriate controls such as erosion and sediment control plans, appropriate design and riparian planting and management. It is expected that any specific potential adverse effects resulting from future development will be addressed and managed during future consenting processes, including through detailed design (e.g. for culverts and outfalls) and through mitigation such as planting.

Activities in relation to development near intermittent and permanent streams (e.g., riparian yard infringements, riparian vegetation clearance, stream reclamation) will require assessment at the resource consent stage. It is considered that the effects management hierarchy will be appropriate for managing the adverse effects of future proposals and mitigating/offsetting where required. As such, the proposed rezoning is not anticipated to result in residual adverse effects on the site's freshwater values.

It is expected the artificial drains will be reclaimed during future works or incorporated into on-site stormwater management. Artificial channels are not subject to protection or management rules under either FUZ or MHU zones, and therefore, no change in effects is anticipated.

Urban activities are often associated with elevated road-derived contaminants such as heavy metals and hydrocarbons caused by the increased traffic due to a significantly denser population. Contaminants can have detrimental effects on aquatic flora and fauna. Additionally, there are often issues of increased litter and nutrients (from garden fertiliser) entering the watercourses of urban land use areas. Changing from rural land use is also likely to result in a decrease in certain contaminants, such as those associated with stock effluent runoff.

Activities in relation to development near intermittent and permanent streams (e.g., riparian yard infringements, riparian vegetation clearance, stream reclamation) will require assessment at the resource consent stage. It is considered that the effects management hierarchy will be appropriate for managing the adverse effects of future proposals and mitigating/offsetting where required. As such, the proposed rezoning is not anticipated to result in residual adverse effects on the site's freshwater values. Significant enhancement of freshwater ecological values within the PPC sites are expected through the planting of riparian yards and the reduction of stock effluent and fertiliser run-off to waterways, in conjunction with appropriate stormwater management practices to improve water quality to receiving environments.

6.3.2 Riparian margins

The proposed change from FUZ to MHU will decrease the riparian yards setback from 20 m to 10 m. However, as the site is zoned Future Urban, it is already anticipated that this reduction will occur at some stage.

One of the main purposes of riparian yard setbacks is to provide a buffer to the stream to increase ecological values through filtration of overland flow, provision of shade and organic matter, and contribution to fish and invertebrate habitat. Currently, the riparian yards are of limited ecological value and comprise narrow strips of vegetation and pasture. Subdivision and development of areas adjacent to waterways will likely include planting of the full 10 m riparian yard which will be a significant improvement from what is currently present. There is limited proven scientific evidence as to what width of the riparian yard is most effective, with the general consensus being any yard is better than none, and wider yards tend to be more self-sustaining and require less intervention to manage weeds. While greater setback distances allow more space for riparian planting and, therefore, a corresponding increase in the ecological benefit derived from such planting, 10 m is consistent with the zoning provision and a 10 m riparian yard is considered to be appropriate.

The rezoning is expected to result in an increase in the riparian vegetation quality of the plan change area overall, provided riparian planting is undertaken.

6.3.3 Wetlands

There are four wetlands within the site boundaries. The location of all wetlands is shown in Figure 3. There is the potential for wetlands to be affected by future land use changes in the same manner as waterways. Wetlands are also protected from development by the AUP-OP (Chapter E3) and the NES-F, and any future earthworks, diversions and discharges within 100 m of any wetland or works, discharges or vegetation removal within or within 10 m of a wetland will be subject to a resource consent application. Identification of the wetlands at this stage allows future development to be designed around the wetlands and their catchments to ensure no complete or partial drainage occurs.

It should be noted that as the zoning is currently FUZ, it is a prohibited activity to reclaim natural inland wetlands under the NES-F. The urban rezoning will provide a consenting pathway for wetland reclamation under Regulation 45C of the NES-F. Compliance with relevant NES-F regulations in relation to natural inland wetlands will be required for subsequent development following rezoning, and it is considered that any adverse effects on natural inland wetlands will be able to be assessed and managed appropriately at the future resource consent stage.

6.3.4 Stormwater

If not appropriately managed, a land use change from rural to urban land uses may threaten freshwater ecological values through the potential increase in impervious surfaces and pollutant runoff due to subsequent development. Increases in impervious surfaces can amplify the adverse stormwater effects on the receiving environment by resulting in scouring, erosion or high levels of contaminant input if not designed and mitigated appropriately. However, changing from a rural land use is likely to result in a decrease in certain contaminants such as those associated with fertilisers and pesticides and sediment runoff.

Incorporate info from the stormwater management report when available

6.4 Relevant Plans and Policies

6.4.1 National Policy Statement for Indigenous Biodiversity 2023

The National Policy Statement for Indigenous Biodiversity (NPS-IB) sets out objectives, policies and implementation requirements to manage natural and physical resources to maintain indigenous biodiversity under the RMA. It outlines a system for the management of biodiversity outside of public conservation land.

There is no significant indigenous biodiversity within the site and no areas that meet the definition of a Significant Natural Area as per the NPS-IB. The effects management hierarchy will be applied to manage residual ecological effects. The PPC will provide opportunities to increase indigenous cover through planting and enhancements of riparian areas and wetlands.

It is assumed that a 10-metre riparian margin will be provided around all permanent and intermittent waterways as well as the wetlands. And that this margin will be planted with appropriate native species. It is considered that the plan change is in accordance with the NPS–IB.

6.4.2 National Policy Statement for Freshwater Management 2020

The NPS-FM provides national direction for decisions regarding water quality and quantity and the integrated management of land, freshwater and coastal environments under the RMA. The NPS-FM contains national objectives for protecting ecosystems, indigenous species and the values of outstanding water bodies and wetlands.

All streams and wetlands will remain and be enhanced through the provision of a 10-metre planted riparian buffer around all features.

Future resource consents required for the development of the site will require compliance with relevant NES-F regulations in relation to natural inland wetlands, noting that a consenting pathway is provided for urban development (refer to Regulation 45C).

6.4.3 Auckland Unitary Plan – Operative in Part 2016

The AUP-OP sets out a number of policies and objectives that give effect to the RMA to promote the sustainable management of natural and physical resources. This section addresses the objectives and policies set out in the AUP-OP pertaining to ecology.

Chapter B7 – Natural Resources

In line with the objectives and policies in this chapter, areas of significant indigenous biodiversity value and freshwater environments have been identified. Freshwater habitat will be protected from inappropriate adverse effects of subdivision use and development, or otherwise, the effects management hierarchy applied to manage ecological effects. A 10 metre planted riparian margin will be provided around all freshwater environments which will provide significant benefit to both terrestrial ecological values and stream and wetland functioning.

Chapter E1 – Water Quality and Integrated Management

Consistent with Chapter E1, the development of the site will provide opportunities for the appropriate integrated management of water discharges, subdivision and greenfield development to maintain and/or enhance water quality, flows, intermittent/permanent streams and associated riparian margins.

A stormwater management plan is being prepared by Neil Construction Limited. The plan details methods to be put in place to manage both the quality and quantity of stormwater generated within the site.

Chapter E3 – Lakes, Rivers, Streams and Wetlands

All potential streams, rivers and wetlands have been identified within the sites in line with Chapter E3. Additionally, significant adverse effects can be avoided by retaining all intermittent and permanent streams where practicable and where avoidance cannot be achieved through the implementation of the effects management hierarchy.

Chapter E15 – Vegetation Management and Biodiversity

Consistent with Chapter E15, the vegetation and biodiversity values of the site have been identified. Development of the site will provide opportunities to maintain and enhance ecosystem services and indigenous biodiversity values, particularly in sensitive environments and areas of contiguous indigenous vegetation cover while providing for appropriate subdivision, use and development.

4.3.3 Auckland Plan 2050

The Auckland Plan is a long-term spatial plan that aims to ensure Auckland grows in a sustainable way that supports people and the local environment and ecosystems. When considering environmental outcomes, the plan seeks to preserve, protect, and care for the natural environment and use development as an opportunity to do so, as well as future-proof Auckland's infrastructure.

The precinct plan aligns with the Auckland Plan through the incorporation of ecological and active mode/green corridors into the design to connect Aucklanders to their environment. It will also incorporate sustainable infrastructure while providing for appropriate development.

Consistent with the Auckland Plan 2050, the PPC provides an opportunity to restore degraded ecosystems where appropriate while providing for appropriate development.

6.4.4 Parks and Open Spaces Strategic Action Plan 2013

Auckland Council's Parks and Open Spaces Strategic Action Plan 2013 seeks to conserve Auckland's rich natural heritage through parks and open spaces. The Plan further states that parks and open spaces can protect ecosystems that make Auckland unique, such as our streams.

Consistent with the Parks and Open Spaces Strategic Action Plan, the PPC provides an opportunity to create an open space that protects the streams and site.

4.3.4 Auckland’s Urban Ngahere (Forest) Strategy 2018

Auckland’s Urban Ngahere (Forest) Strategy aims to promote the protection, expansion, management, and education around the network of vegetation within current and future urban Auckland. The includes remaining forest fragments, native trees, natural stormwater assets, community gardens and parks, and private gardens.

The vegetation within the PPC sites has been identified and classified, and the development of the site provides opportunities that align with the strategy’s nine principles: Right tree in the right place; Preference for native species; Ensure urban forest diversity; Protect nature, healthy trees; Create ecological corridors and connections; Access for all residents; Management urban forest on public and private land; and deploy regulatory and non-regulatory tools.

The Precinct Plan proposes increased canopy cover through stream and wetland riparian revegetation, improved ecological linkages and corridors, a dominance of indigenous planting in landscaped areas, incorporation of plants for ecological revegetation areas that suit the ecological district and environmental conditions.

7 SUMMARY AND RECOMMENDATIONS

Neil Construction Limited are applying to Auckland Council for a PPC to rezone the land at 98 and 100-102 Totara Road, Whenuapai, from a FUZ to a MHU under the AUP OP.

The existing terrestrial and freshwater ecological values of the site have been identified and assessed. It is considered the PPC is appropriate for the area from an ecological perspective and can protect and enhance the indigenous biodiversity values of the site in accordance with the outcomes of relevant plans and policy documents while providing for efficient development.

Overall, it is considered that the proposed PPC can effectively manage any adverse effects of residential development on the natural environment through the existing planning provisions and policy framework within the AUP-OP. Any potential adverse effects can be adequately mitigated through appropriate stormwater design, fauna management plans, restoration and riparian planting, and detailed design.

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TO:	Auckland Council	Date:	3 July 2024
COPY TO:	Michelle Kemp (Campbell Brown)	Document No:	10096-003-1
FROM:	Annabelle Coates		

WHENUAPAI GREEN PPC – RFI RESPONSE, ECOLOGY

Neil Construction Limited (NCL) is applying to Auckland Council for a Private Plan Change (PPC) to rezone the land at 98, 100 and 102 Totara Road, Whenuapai ('the site'). The PPC seeks to rezone approximately 16.4 ha of land from a Future Urban Zone (FUZ) to Residential - Mixed Housing Urban (MHU) zone.

Auckland Council, through a consultant ecologist (Wildlands Consultants Limited) have requested further information to assess the potential ecological effects of the proposed plan change. The contents of this memo are intended to respond to the requests where necessary.

1. Please clarify whether any areas of the site meet the RMA definition of 'wetland', but have not been identified and mapped as natural inland wetland due to the use of the pasture exclusion.

No. The only wetlands present on the site were those that were identified in Figure 3, and section 5.2 of the ecological impact assessment.

We understand that our methodology or reasoning for non-wetlands areas may not have been clear in the EcIA. As such, to clarify, wetlands and non-wetlands in pastoral settings typically consist of relatively simple plant communities and exist along a hydrological continuum. At one end of continuum are sites that are clearly wetlands, with the plant community dominated by OBL or FACW species. At the other end are areas that are clearly dryland, with the plant community dominated by FACU or UPL species.

In the field, rapid tests are often utilised when assessing these relatively simple plant communities, where a qualitative visual assessment of dominant species is generally adequate and more efficient than intensive transect/plot sampling.

The rapid assessment methodology in the MfE wetland delineation protocols focus on if an area is a wetland, rather than if an area is not a wetland. We believe this is an oversight of the wetland delineation protocols. However, in contrast the MfE pasture exclusion assessment methodology does set out a rapid assessment methodology for areas that are very clearly drylands.

In the case of the PPC site, outside of the identified wetlands, the pasture plant community consisted of simple, nearly uniform stands of FACU and UPL species. These areas had low species diversity, low spatial heterogeneity, and abrupt boundaries between different vegetation communities. As such, we have used the rapid assessment methodology outlined in the pasture exclusion protocols as a proxy in the absence of dryland rapid test within the wetland delineation protocols.

Additionally, no hydrological indicators were present within the site, other than within the wetlands already identified.

Regardless of this, as this application concerns a plan change only, any future resource consents would require the site to be reassessed for wetland presence. As wetlands are dynamic features that fluctuate regularly/seasonally, the wetlands that were present during the site assessment for the plan change, may be larger/smaller/different shape/not present, in the future. Up to date information will be collected at the time of future development in order to accurately determine effects of that development, and provide appropriate mitigation and management if necessary.

2. Please justify the inclusion of a road (indicative) extending eastward from the site into the neighbouring NZDF land.

The location of a road has wider considerations than just ecological values. I cannot provide justification for the siting on the road. However, I make the following comments as they relate to ecological values.

Crossing a stream is not considered to be reclamation and as such there will be no loss of extent. The stream will still be present, and will still function as a natural stream, providing the crossing is appropriately designed. There is no reference to reclamation in the NPS-FM. In the NES-F, the rules which stem from the NPS-FM, culverts are permitted activities, provided they can meet the conditions set out in clause 70(2). If the stream crossing does go ahead, noting detailed design will not be completed until any plan change processes have been completed, an appropriate crossing will be installed. If the crossing is a culvert, and cannot meet the permitted activity conditions, resource consent will be applied for with any mitigation or management recommended as appropriate.

The intent of a plan change is show that the change is achievable and that there would be not significant constraints/adverse effects, and that the plan change is in line with national and regional policies. If stream crossings were considered reclamation, requiring functional need to be considered, stream crossings would almost be unachievable/impossible for urban development unless it was for specified infrastructure that would will provide significant national or regional benefits.

In regard to standard I1.6.5 of the proposed precinct provisions, it is recommended the wording of the precinct plan be updated to state "*At the time of subdivision or development, land within 10m of the streams and wetlands identified on Precinct Plan 1 must be planted with native vegetation from the top of the bank of the stream or the wetland's edge, with the exception of any locations where road or pedestrian crossings are proposed.*" This would allow for appropriate urban development to occur allowing pedestrian and road access across the streams.

I also cannot comment on the appropriateness of locating a neighbourhood park in this location as that should be determined by an appropriately qualified urban designer or similar. I do note though that the statement in the EcIA "*Consistent with the Parks and Open Spaces Strategic Action Plan, the PPC provides an opportunity to create an open space that protects the streams and site*," is correct. Providing stream crossings and protecting streams within the site are not mutually exclusive, providing the crossing is appropriately desgined. As mentioned, detailed designs are not required and plan change stage, rather it must be demonstrated the the proposed plan change will not create significant adverse effects, and is consistent with relevant policies. From an ecological perspective, the plan change meets these requirements.

3. Please clarify if wetland reclamations are intended to occur as a result of the rezoning and associated development.

No wetland reclamation is anticipated as a result of proposed future works within the site. Nevertheless, the purpose of a plan change application is not to determine detailed design or the specific effects of the detailed design , rather the purpose is to assess the potential effects associated with the plan change and whether the plan change is consistent with relevant policies. The EcIA is factually correct. Changing the zoning from rural (Future Urban Zone) to any urban zone does provide a consenting pathway for wetland reclamation. This change needs to be considered when considering potential effects of the change in zoning. However, just because there will be a consenting pathway does not automatically mean wetlands can and will be reclaimed. Consenting pathways are not permitted activities. Any future works to reclaim a wetland, noting that no such works are anticipated, would still require full assessment and application of the effects management hierarchy, with appropriate mitigation provided at the time. It is irrelevant to state the site provides limited opportunities for on site offsetting or compensation as the effects of such future works have not been established, and therefore the ability of the site to provide the appropriate offsetting or compensation cannot be assessed. Additionally, offsite mitigation may be appropriate, if such works are required, but again, this will be determined once the effects management hierarchy has been applied to any real, or imagined future works. Lastly, if appropriate mitigation for any theoretical wetland reclamation cannot be achieved, then the resource application for those specific works should be rejected.

4. Please justify the reduction of the riparian yard from 20 metres to 10 metres.

The change from a rural zone (Future Urban Zone) to an urban zone allows the riparian yard to be decreased from 20 m to 10 m. The land has already been rezoned from a rural zone, to Future Urban Zone, which implies it has been considered suitable for urban development. Auckland Council's own guidance, as provided in TP148 states a 10 m wide buffer "*allow[s] for indigenous vegetation succession and should result in a relatively low-maintenance riparian zone. Edge effects mean that the outer 1-2 metres of the buffer is likely to suffer weed infestations, and these weeds would spread to the interior of the riparian zone wherever canopy gaps occurred.*" The guidance further states that buffers of 15 to 20 m should be required on 'large waterways' though it does not define what a large waterway is. For these purposes, we consider a large waterway would be more than 3 m in width, and therefore subject to esplanade provisions, thus requiring a minimum of 20 m from the stream to remain undeveloped. We also note the streams within the site have very small catchments, and flow into the sea approximately 500 m downstream of the site, further supporting their consideration as not 'large waterways.' The intermittent streams within the site were much smaller than 3 m in width. The permanent stream that flows for a very short distance (approx. 15 m) through a corner of the site was also much smaller than 3 m in width (approx. 1.5m).

Based on the size of the streams, and councils own guidance, we consider a 10 m riparian yard is perfectly adequate to enhance and protect riparian and stream functions.

5. Please;

a) clarify the "riparian corridor" areas on the proposed precinct plan.

b) Provide a plan identifying indicative riparian planting areas.

The Precinct Plan does not clearly show where riparian corridors will be located. For clarity, the 'green link' indicated in the plan is also a riparian corridor. An updated plan will be provided.

6. Please clarify the intended size and location of the neighbourhood park.

Size and location of any proposed parks or recreation grounds are beyond the expertise of an ecologist. They should be assessed by an appropriately qualified urban designer or similar expert. Any riparian planting associated with the streams and wetlands would occur regardless of the location or size of the park.

geosciences LTD

9 May 2018 (Revised 10 November 2021)

Maraetai Land Development
C/- Neil Construction Limited
PO Box 8751
Symonds Street
Auckland 1150

Ref: Ltr-1173/PSI/May18(Rev1)

Attention: David Page
Land Manager

Dear David,

RE: PRELIMINARY SITE INVESTIGATION OF 98-100 TOTARA ROAD, WHENUAPAI

Geosciences Ltd (GSL), has conducted a preliminary site investigation (PSI) of the property located at 98-100 Totara Road, Whenuapai in accordance with GSL proposal ref: *Pro 1489/Apr18* dated 24 April 2018. The property is legally described as Lot 2 DP 81411, comprises an area of 11.61 Ha and is hereafter referred to as 'the site' in this report.

The primary purpose of this investigation is to assess the likelihood of any potential contamination issues being present on site, and the resulting applicability of the National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health (NES).

1 BACKGROUND

The site is currently a rural residential lot comprising of a residential dwelling in the northern corner of the site, while the remaining area of the site is vacant pasture utilised for the grazing of cattle. The landuse is consistent with the surrounding area, which has a mixture of rural and rural-residential properties nestled in and around the Whenuapai NZ Air Force base located approximately 1 km to the east of the site. GSL understands that the site has been identified for future residential development.

The *National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health (NES)* (Ministry for the Environment (MfE), 2012) ensures that land affected by contaminants in soil is appropriately identified and assessed. When soil disturbance, change in landuse, or subdivision activities take place it should be, if necessary remediated or the contaminants contained to make the land safe for the intended landuse.

Under the NES, land is considered to be actually or potentially contaminated if an activity or industry on the MfE Hazardous Activities and Industries List (HAIL) has been, is, or is more likely than not to have been undertaken on the land under investigation. Consequently, any change in landuse, subdivision or development required a preliminary site investigation (PSI) of the land to determine whether or not any risk to human health exists as a result of any current or former activities that are occurring, or may have occurred, on that land.

GSL understands that the site has been secured by Maraetai Land Development with the intention of developing the land at some stage in the future. Maraetai Land Development engaged GSL to undertake a preliminary site investigation of the site to comment on the likely contamination risks associated with the property and determine whether or not the provisions of the NES are likely to apply to the site, or portions thereof.

2 SCOPE OF WORKS

This preliminary site investigation, undertaken in general accordance with the MfE Contaminated Land Management Guidelines (CLMG) No. 1 - *"Reporting on Contaminated Sites in New Zealand"* and No 5 - *"Site Investigation and Analysis of Soils"* included:

- an historical appraisal of the site by a study of historic aerial photographs;
- a review of the current and historic certificates of title;
- a review of the property file held by Council;
- a visual site inspection and walkover of the property; and
- the preparation of this letter report to comment on the liabilities applicable under the National Environmental Standards (NES) regulations, and Auckland Unitary Plan (Operative in Part) (AUP(OP)) rules for the development of the site.

3 SITE HISTORY

In order to establish the sites history, GSL conducted a desktop study of publicly available information, the findings of the study are detailed in the following sections.

3.1 RECORDS OF TITLE

GSL has reviewed copies of the current and historic Records of Title for the aforementioned property, including any instruments on the title which detail relevant property information such as: current ownership, registered interests, easements, covenants, lease restrictions and transmissions, to determine if pre-existing consent notices or other restrictions / notifications which may be relevant to historic uses of or potential soil contamination are held against the property. No notes of interest were recorded on the titles. Copies of the certificates are attached in Appendix A.

3.2 HISTORIC AERIAL PHOTOGRAPHS

Historic aerial photographs from 1940, 1950, 1963, 1972, 1980, and 1988 are available from the Retrolens website while images from 1996, 2006, 2008, 2010, 2015, and 2017 are available on the Auckland Council GEOMaps website (GIS). The findings of the historic aerial photograph review are summarised below, while copies of the aerial photographs have been attached in Appendix B.

1940-1950	The 1940 image is the first available image of the site and shows the full extent of the site as vacant pasture. The site is divided into paddocks with a narrow shelter belt along the western, southern, and eastern boundaries. The only discernible structure on the site is

	a small shed to the north of the site's centre, the use of the shed is not apparent from the image. There is little discernible development to the site in the 1950 image, aside from the shed in the centre having been removed.
1963-1972	The 1963 image shows the site remaining vacant with no discernible structures noted on the area of the site. A portion of the site along the eastern boundary has been planted with trees which appear to be well established and mature by this time. There are no discernible changes to the site in the 1972 image.
1980-1988	The 1980 and 1988 images show the only development to the site being the removal of the trees noted in the eastern portion of the site, with the full area having been returned to pasture.
1996-2017	The 1996 image is the first available colour image of the site and shows the only development to the site as being the construction of a residential dwelling and garage in the northernmost portion of the site. The remaining site area remains under pasture. There are no discernible developments to the site through the remaining images up to the 2017 plate. A small pen is present to the south of the dwelling, the proximity of the pen / race to the site boundary with Totara Road implies that the pen is a holding pen and loading race for livestock, the lay out of the race does not appear to be consistent with a spray race.

3.2.1 Summary of Aerial Photographs

GSL has reviewed the available historic aerial images of the site and conclude that the site has remained predominantly vacant pasture for its discernible history. For a period between the 1950's and 1980s, the eastern portion of the site was densely vegetated before being cleared again for pasture use.

The current residential dwelling was constructed by 1996 in the northern most portion of the site. The aerial photographs show no distinct evidence for any activity or industry included on the MfE HAIL having been undertaken on the site. There are no structures present on the site which could be spray races, nor is there any evidence for horticultural activities having been undertaken on the site.

3.3 PROPERTY FILE

GSL requested a copy of the property file from Auckland Council for review of historic activities. The property file contained plans and resource consent application documentation relating to the development of the site in 1994. The plans indicate that a house was relocated onto the property, a consent checklist indicated that the house was "at least 45 years old" cladded with weatherboard and tiles onto timber joinery. Due to the age of the dwelling, GSL notes that the potential exists for lead based paints to have been used on the exterior of the building. While not explicitly included on the MfE HAIL, lead based paint can infiltrate the soil directly surrounding the dwelling at times when the exterior paint is in deteriorated condition, or when routine maintenance is undertaken, such as scraping or sanding. In addition, GSL considers that there is potential for asbestos containing materials

(ACM) to have been used in its construction which will require consideration under the Health and Safety at Work (Asbestos) Regulations 2016 should the house be identified for demolition.

Plans dated 1995, for the garage associated with the dwelling are also contained in the property file, these indicates that the garage is constructed using a timber frame, blockwork and clad in galvanised steel, with corrugated steel roofing. The plans indicate that the garage sits on a 100 mm thick concrete slab foundation.

Plans dated 1994 were also contained in the property file relating to the onsite effluent disposal systems. As Auckland Council have generally considered domestic effluent disposal systems and septic tanks to be encompassed by Items G.5 and G.6 of the MfE HAIL as waste disposal to land, consideration will be required with respect to their presence. A pump out report is held on file which identified a concrete tank of 4,500 l capacity and a drainage field trench in place, the location of the tank is shown on Figure 2.

3.4 SUMMARY OF DESKTOP INVESTIGATION

GSL conducted a desktop study of publicly available information including a review of current and historic certificates of title, a review of historic aerial photographs, and a review of the property file held by Council. The desktop study has identified the following potential issues associated with the existing residential dwelling on site:

- Historic use of lead based paints;
- Potential presence of asbestos containing materials; and
- Presence of an onsite effluent disposal system.

No issues were identified that would encompass the wider areas of site beyond the house curtilage.

4 SITE INSPECTION AND WALKOVER

GSL undertook a site inspection on 8 May 2018 at which time the weather was fine and clear, at the time of the inspection the site appears exactly as it does in the most recent aerial photographs, that is; largely vacant pasture laid out in paddocks for the grazing of cattle. The only structures on the full extent of the site are the dwelling noted in the aerial photographs and its associated garage.

The site is accessed by a sealed driveway off Totara Road in the northern corner of the site, the driveway leads to the dwelling from which point access to the paddocks is gained through a standard timber farm gate. Adjacent to the gate is a timber loading race as identified in the aerial imagery. GSL notes that the layout of the race is consistent with a loading bay only and there is no evidence present for the race having been utilised for spraying of livestock. Similarly, its position adjacent to the road suggests that is has solely been utilised for loading / unloading stock for transport.

The dwelling and garage are confirmed to be as described in the property file plans; that is the dwelling is primarily being constructed of timber frame and weatherboard construction, with tiled roofing while the garage is timber framed and clad in metal weatherboards. No visually obvious potential ACM products were identified from an inspection of the exterior surfaces of these structures.

The area south of the dwelling curtilage is entirely vacant and separated into paddocks by standard post and batten wire farm fencing in aged condition. With respect to the portion of the site identified as being vegetated during the 1960s and 1970s, a number of tree stumps remain within this portion of the site showing relatively uniform distribution. The size and density of the stumps still present on site when assessed against that portion of the site suggest that marginal land may have been converted to forestry for a time as a mechanism for making better use of that land.

In the eastern portion of the site a small creek runs in a northerly direction across the site. While GSL notes that the creek's genesis is within the Royal NZ Air Force Whenuapai Air Force Base, it is only a very small portion of the headwater above the site and appears to originate from a portion of the Air Force Base occupied by landscaped gardens adjacent to recreational centres / barracks / mess hall type buildings on site well removed from the high risk portions of the site associated with aircraft.

No evidence for any activity or industry included on the MfE HAIL having been, or currently being undertaken on the site was noted during the site inspection. Site photographs are included as Appendix D.

5 POTENTIAL FOR CONTAMINATION

Following the completion of this investigation, GSL has identified the following source of potential contamination on site:

- Historic use of lead based paints on the residential house - encompassed under HAIL Item I where a risk to human or environmental health is present only;
- Possible utilisation of Asbestos Containing Materials within the construction of the house - HAIL Item E.1 only when in broken or degraded condition; and
- Presence of a septic tank and effluent disposal system associated with the residential house - HAIL Item G.5 / G.6.

An assessment of the likely extents and issues associated with each of these items is discussed in turn below based on GSL' extensive experience in similar situations.

5.1 LEAD BASED PAINT

While the use of lead based paint was becoming more and more reduced in the 1950's, its use continued until the 1970's and as such could be present on the villa relocated to site despite its construction in 1955. GSL considers that soil immediately surrounding the dwelling could potentially have been impacted by lead based paints if the exterior paint on the dwelling had been in deteriorated condition, or at times when routine maintenance such as sanding, or scraping were undertaken without adequate ground protection in place.

The potential effects of lead based paint on the surrounding soil would be expected to be concentrated in the area surrounding the dwelling where paint chips, flakes, or dust had infiltrated the soil, lead can then leach out of the paint into the soil resulting in high concentrations in the soil. Those concentrations are generally limited to the immediate curtilage and rapidly attenuate with distance from the source (the dwelling), only impacting the surficial soils within that curtilage.

5.2 ASBESTOS CONTAINING MATERIALS IN BUILDINGS

ACM has been widely used in an array of building materials for an extensive period of New Zealand's building materials history. While its use was widely concluded by 1990, New Zealand legislation notes that its use cannot be ruled out on buildings constructed prior to 1 January 2000. As a result, the presence of asbestos within the building and garage cannot be ruled out.

With regards to ACM, the potential for soil contamination is only present if ACM is in deteriorated or broken condition. No broken or degraded ACM was identified during the site inspection suggesting that if ACM is present within the building, it is most likely in good condition.

As with lead based paint, ACM is only likely to impact soil immediately adjacent to the dwelling and as such are not considered to present a potential for gross soil contamination across the site as a whole.

With respect to the demolition of any building constructed prior to 1999 the *Health and Safety at Work (Asbestos) Regulations 2016, demands* a fully intrusive pre-demolition hazardous building materials survey to be undertaken before demolition works can commence. The survey must be conducted by a suitably WorkSafe NZ licensed asbestos assessor and will identify the location and extent of any hazardous building materials, specifically ACM. Should ACM be identified in the survey then asbestos removal works will be required prior to the demolition of the dwelling, the removal must be completed by an appropriately licensed asbestos removal contractor and under the controls of an asbestos removal control plan (to be provided by the appointed contractor. The hazardous building materials survey will form the basis of any asbestos removal control plan.

5.3 EFFLUENT DISPOSAL INFRASTRUCTURE

Domestic effluent disposal infrastructure is considered by Auckland Council to be encompassed under Items G.5 and G.6 of the MfE HAIL as waste disposal to land. Should the existing septic tank and disposal field require decommissioning and removal as part of the proposed future development, works in this area will need to address the requirement of the NES and Auckland Unitary Plan (Operative in Part) with respect to contamination regulations.

Effluent disposal fields are likely to result in small scale impacts limited to the topsoil horizon where the effluent liquor is dispersed. In GSL's experience, impacts are unlikely to extend beyond the boundaries of the disposal field and generally do not exceed 400 mm in depth meaning that a small, localised area will likely require remedial earthworks during decommissioning. Impacts are considered unlikely to be pervasive across a large area.

6 CONCLUSIONS

GSL has undertaken a preliminary site investigation, in general accordance with the MfE Contaminated Land Management Guidelines, of the property located at 98-100 Totara Road, Whenuapai. The primary purpose of this investigation is to assess the likelihood of any potential contamination issues being present on site, and if so, comment on their likely implications for future residential development.

This investigation has identified potential sources of contamination on site to be the discrete area surrounding the existing residential dwelling in the northern portion of the site. Due to the age of the dwelling which was relocated onto the site in the 1990s, GSL considers that the following potential sources of contamination will require further investigation should any change in landuse, subdivision, or development works be proposed in that area:

- Historical use of lead based paints; and
- Potentially asbestos containing building materials utilised in the residential dwelling and garage on site.

Additionally, plans held within the property file identify the location of the onsite domestic waste water treatment systems (septic tank and effluent disposal field), which Auckland Council have considered to be encompassed by Items G.5 and G.6 on the MfE HAIL. GSL concludes that should any change in landuse, subdivision, or development of that portion of the land be proposed, then these small scale, localised points will require further investigation and likely require localised remedial works.

With regards to the wider site area, GSL did not identify any evidence for any potentially contaminating activity included on the MfE Hazardous Activities and Industries List having been undertaken on the site. GSL therefore concludes that the risk for actual or potential contamination on the site to be low, and concludes that with respect to the wider site area that any future change in landuse, subdivision, or development would be highly unlikely to result in a risk to human health or the environment.

6.1 NATIONAL ENVIRONMENTAL STANDARDS

As a result of the identification of potentially contaminating landuses within he residential footprint on site, any change in landuse, subdivision, or development of that area will be required to address the regulations of the NES. As there is no distinct evidence for any activity included on the MfE HAIL having occurred or being more likely than not to have occurred on the wider site area, the wider site area does not meet the definition of *"Land Covered"* under Regulation 5(7), as a result, the regulations of the NES are not applicable to the change in landuse, subdivision, or development of those areas.

With respect to the immediate area of the original dwelling, while the NES is applicable to the development of that portion of the site, GSL notes that the area and volume of impacted soils is likely to be extremely limited in the scale of the overall development. The disturbance of potentially lead impacted soil within the dwelling curtilage and the effluent disposal systems are likely to be well within the remit of a Permitted Activity under Regulation 8(3) of the NES. Regulation 8(3) allows for the disturbance and offsite disposal of soil on actually or potentially contaminated sites as a permitted activity while the following conditions are met:

a) "Controls to minimise the exposure of humans to mobilised contaminants must -
  i. Be in place when the activity begins;
  ii. Be effective while the activity is done;
  iii. Be effective until the soil is reinstated to an erosion resistant state;
b) The soil must be reinstated to an erosion resistant state within 1 month after serving the purpose for which the activity was done
c) The volume of disturbance on soil must not be more than 25 m^3 per 500 m^2;
d) Soil must not be taken away in the course of the activity except that -
  i. For the purpose of laboratory analysis, any amount of soil may be taken away as soil samples;
  ii. For all other purposes combined, a maximum of 5 m^3 per 500 m^2may be taken away per year.

e) *Soil taken away in the course of the activity must be disposed of at a facility licensed to receive soil of that kind;*
f) *The duration of the activity must be no longer than two months;*
g) *The integrity of a structure designed to contain contaminated soil must not be compromised."*

For a site of this size (11.61 Ha) Regulation 8(3) allows for the disturbance of up to 5,805 m^3 and the offsite disposal of up to 1,161 m^3 of soil, per year, as a permitted activity. It is likely that the required soil disturbance and offsite disposal of any actually or potentially impacted soil will fall within those volumes. The remediation of the effluent field and any actually or potentially impacted soil in the dwelling curtilage are considered highly likely to be encompassed by the above volumes, noting that Regulation 8(3) allows for the works to be encompassed by consecutive years, i.e. that should works extent over two days, that those days can be considered consecutive years and the volumes can be doubled.

A site management plan will likely be required to document the controls to be in place for the protection of human and environmental health for the duration of soil disturbance in those areas in order to meet the requirements of Regulation 8(3).

6.2 AUCKLAND UNITARY PLAN (OPERATIVE IN PART)

For the same reasons as the NES above, the majority of the site does not meet the Auckland Council definition of *"land containing elevated levels of contaminants"* and as such, the contaminated land rules of Chapter E.30 of the AUP(OP) will not apply to the proposed change in landuse, subdivision, and development of the site.

That said, the area of the residential dwelling and disposal field may meet that definition, and technically, the contaminated land rules of the Chapter E.30 may be applicable to soil disturbance in that area. That said, the AUP(OP) allows for the small scale disturbance of soil on actually or potentially contaminated land as a permitted activity under Rule E.30.6.1.2, which provides for small scale disturbance while the following conditions are met:

1. *"The volume of soil disturbed must not exceed:*
    a. *200 m^3 per site; or*
    b. *200 m^3 per project for sites or roads with multiple concurrent land disturbance projects, where the cumulative total volume of soil disturbance associated with each given project will be used when determining activity status; or*
    c. *an average depth and width of 1 m for linear trenching by network utilities in the road or rail corridor. For the purposes of this rule the rail corridor does not include land more than 10 m from the rail tracks.*
2. *Prior to the activity commencing:*
    a. *the Council must be advised of the activity in writing if the volumes of soil disturbed on land containing elevated levels of contaminants exceeds 25 m^3, including details of the measures and controls to be implemented to minimise discharges of contaminants to the environment, and such controls are to be effective for duration of the activity and until the soil is reinstated to an erosion-resistant state; and*
    b. *control on linear trenching must be implemented to manage discharges to the environment from trenches acting as migration pathways for contaminants;*
3. *Any discharge from land containing elevated levels of contaminants must not contain separate phase liquid contaminants including separate phase hydrocarbons.*
4. *The duration of the soil disturbance on a site must not exceed two months.*

> 5. *Any contaminated material removed from the site must be disposed of at a facility or site authorised to accept such materials."*

Where the disturbance of soil required to address the above potentially impacted areas can comply with the above conditions, GSL considers that the remediation of those areas can be undertaken as a permitted activity. Following the completion of those remedial works, the contaminated land rules of Chapter E.30 will no longer be applicable to the proposed development.

7 RECOMMENDATIONS

In order to address the requirements of the NES and Chapter E.30 of the AUP(OP) a site management plan will be required to document the controls to be in place for the protection of human and environmental health from the potential mobilisation of contaminants in soil during soil disturbance works.

Thank you for the opportunity to carry out this investigation. Should you have any queries regarding this report please do not hesitate to contact us on 09 475 0222.

Report prepared on behalf of GSL by:	Report reviewed on behalf of GSL by:	Report authorised on behalf of GSL by:
David Wilkinson Environmental Scientist Geosciences Ltd	Carl O'Brien General Manager Geosciences Ltd	Johan Faurie Principal Geosciences Ltd

Disclaimer

This report is provided on the condition that Geosciences Ltd disclaims all liability to any person or entity other than the client and Auckland Council in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Geosciences Ltd disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in our proposal and according to our general terms and conditions and special terms and conditions for contaminated sites.

Statement

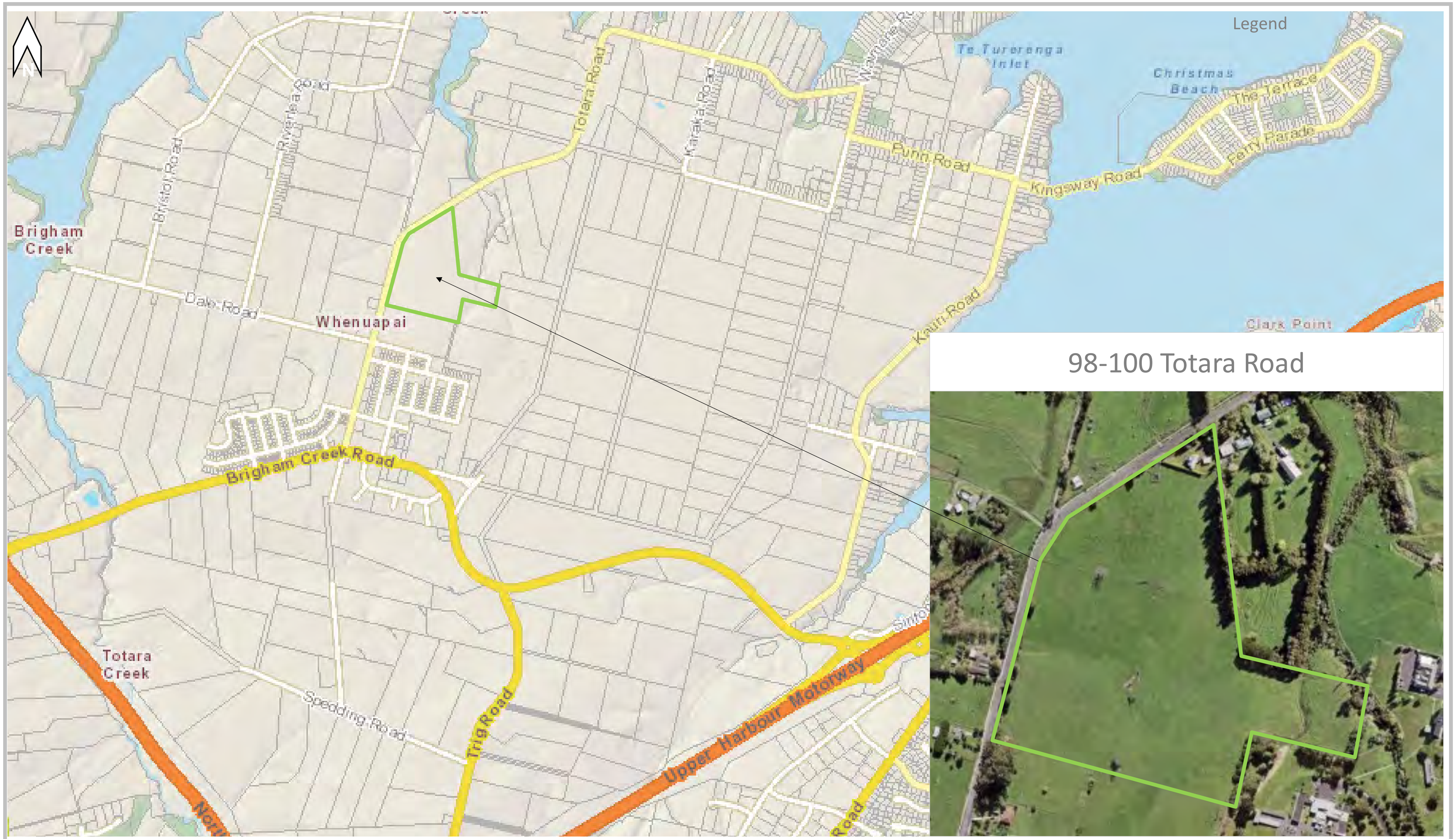
This site investigation has been prepared in accordance with the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011. It has been managed by a suitably qualified and experienced practitioner (SQEP); and reported on in accordance with the current edition of the Ministry for the Environment's *Contaminated Land Management Guidelines No.1 – Reporting on Contaminated Sites in New Zealand.*

8 LIMITATIONS

The conclusions and all information in this Report are given strictly in accordance with and subject to the following limitations and recommendations:

1. The assessment undertaken to form this conclusion is limited to the scope of work agreed between GSL and the client, or the client's agent as outlined in this Report. This report has been prepared for the sole benefit of the client and neither the whole nor any part of this report may be used or relied upon by any other party.
2. The investigations carried out for the purposes of the report have been undertaken, and the report has been prepared, in accordance with normal prudent practice and by reference to applicable environmental regulatory authority and industry standards, guidelines and assessment criteria in existence at the date of this report.
3. This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by GSL for use of any part of this report in any other context.
4. This Report was prepared on the dates and times as referenced in the report and is based on the conditions encountered on the site and information reviewed during the time of preparation. GSL accepts no responsibility for any changes in site conditions or in the information reviewed that have occurred after this period of time.
5. Where this report indicates that information has been provided to GSL by third parties, GSL has made no independent verification of this information except as expressly stated in the report. GSL assumes no liability for any inaccuracies in or omissions to that information.
6. Given the limited Scope of Works, GSL has only assessed the potential for contamination resulting from past and current known uses of the site.
7. Environmental studies identify actual sub-surface conditions only at those points where samples are taken and when they are taken. Actual conditions between sampling locations may differ from those inferred. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated and GSL does not guarantee that contamination does not exist at the site.
8. Except as otherwise specifically stated in this report, GSL makes no warranty or representation as to the presence or otherwise of asbestos and/or asbestos containing materials ("ACM") on the site. If fill has been imported on to the site at any time, or if any buildings constructed prior to 1970 have been demolished on the site or materials from such buildings disposed of on the site, the site may contain asbestos or ACM .
9. Except as specifically stated in this report, no investigations have been undertaken into any off-site conditions, or whether any adjoining sites may have been impacted by contamination or other conditions originating from this site. The conclusion set out above is based solely on the information and findings contained in this report.
10. Except as specifically stated above, GSL makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.
11. The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.
12. Use, development or re-development of the site for any purpose may require planning and other approvals and, in some cases, environmental regulatory authority and accredited site auditor approvals. GSL offers no opinion as to whether the current or proposed use has any or all approvals required, is operating in accordance with any approvals, the likelihood of obtaining any approvals, or the conditions and obligations which such approvals may impose, which may include the requirement for additional environmental works.
13. GSL makes no determination or recommendation regarding a decision to provide or not to provide financing with respect to the site. The on-going use of the site and/or planned use of the site for any different purpose may require the owner/user to manage and/or remediate site conditions, such as contamination and other conditions, including but not limited to conditions referred to in this report.
14. Except as required by law, no third party may use or rely on, this report unless otherwise agreed by GSL in writing. Where such agreement is provided, GSL will provide a letter of reliance to the agreed third party in the form required by GSL.
15. To the extent permitted by law, GSL expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this Report. GSL does not admit that any action, liability, or claim may exist or be available to any third party.
16. Except as specifically stated in this section, GSL does not authorise the use of this report by any third party.

FIGURES



geosciences ltd **ENVIRONMENTAL**	Title:	**Figure 1 - Site Locality**	**Reference:** J1173 **Date:** 07/05/2018
Level 1, 47 Clyde Road, Browns Bay, 0630 Tel: (09) 475 0222	Project name:	90-100 Totara Road, Whenuapai	**Drawn:** DW **Approved:** COB

Aerial photograph courtesy of Auckland Council GIS

geosciences ltd ENVIRONMENTAL	**Title:**	**Figure 2 - Septic Tank and Disposal Field Location**	**Reference:** J1173 **Date:** 09/05/2018
Level 1, 47 Clyde Road, Browns Bay, 0630 Tel: (09) 475 0222	Project name:	98-100 Totara Road, Whenuapai	**Drawn:** DW **Approved:** COB

APPENDIX A CERTIFICATE OF TITLE

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952
Limited as to Parcels

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **NA38B/84**
Land Registration District **North Auckland**
Date Issued 24 August 1977

Prior References
NA767/239

Estate	Fee Simple
Area	11.6100 hectares more or less
Legal Description	Lot 2 Deposited Plan 81411

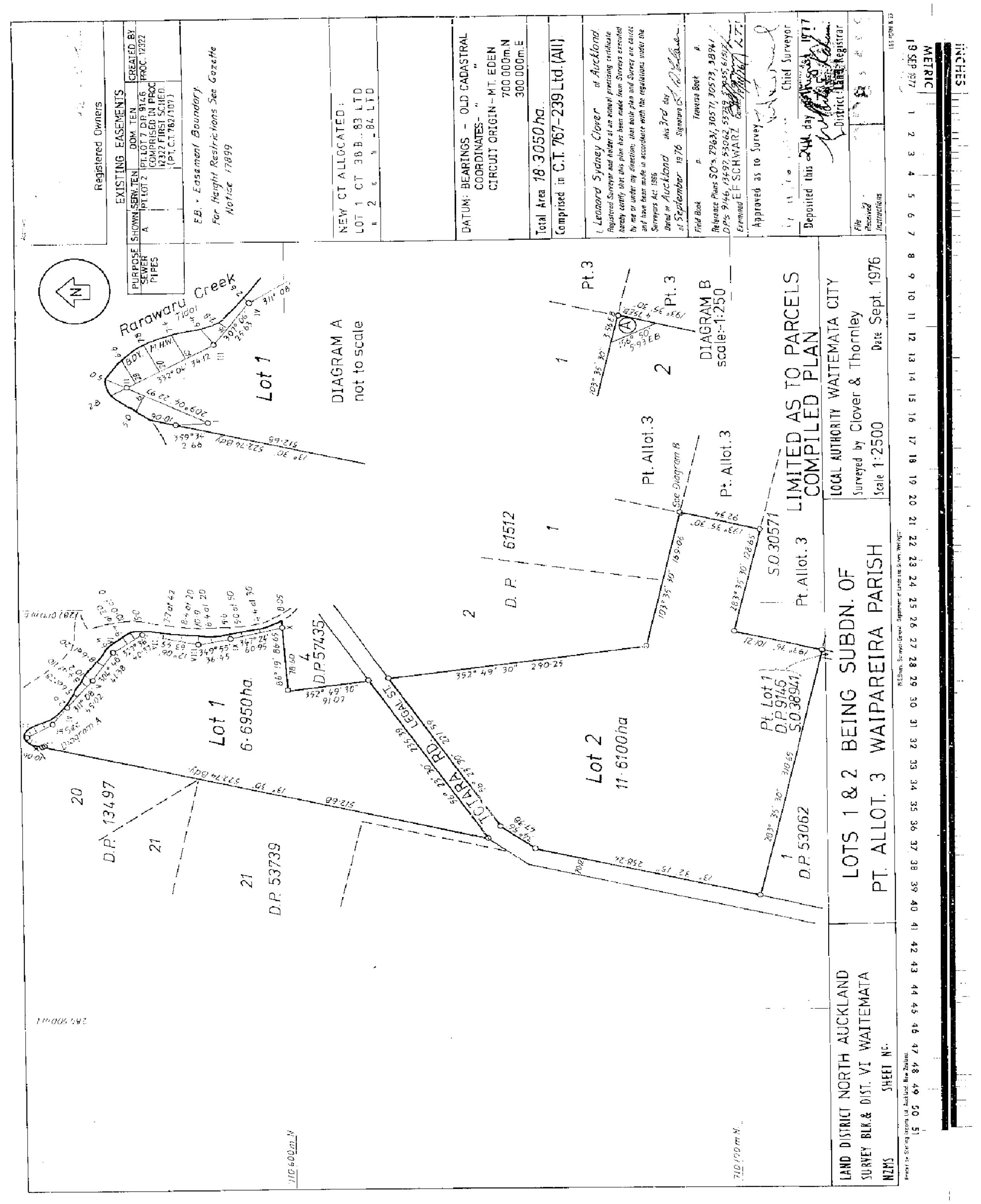
Proprietors
Lois Violet Harre and Roderick McCrae Harre

Interests

Subject to a drainage right over part marked A created by Proclamation 12322

K72265 Compensation Certificate by The Minister of Works - 26.8.1959 at 1.57 pm

17899 Gazette Notice declaring the within land subject to restrictions imposed by the within notice - 26.11.1960 at 2.54 pm


LOTS 1 & 2 BEING SUBDN. OF
PT. ALLOT. 3 WAIPAREIRA PARISH
LIMITED AS TO PARCELS
COMPILED PLAN
LOCAL AUTHORITY WAITEMATA CITY
Surveyed by Clover & Thornley
Scale 1:2500
Date Sept. 1976
LAND DISTRICT NORTH AUCKLAND
SURVEY BLK.& DIST. VI WAITEMATA
NZMS
SHEET No.
DATUM: BEARINGS - OLD CADASTRAL
COORDINATES - "
CIRCUIT ORIGIN - MT. EDEN
700 000m.N
300 000m.E
Total Area 18.3050 ha.
Comprised in C.T. 767-239 Ltd.(All)
NEW CT ALLOCATED:
LOT 1 CT 38B/83 LTD
" 2 " " 84 LTD
Registered Owners
EXISTING EASEMENTS
PURPOSE
SHOWN
SERV. TEN
DOM. TEN
CREATED BY
SEWER PIPES
A
PT. LOT 2
PT. LOT 7 DP 9146 COMPRISED IN PROC. 12322 FIRST SCHED. (PT. C.T. 762/107)
PROC. 12322
E.B. - Easement Boundary
For Height Restrictions See Gazette Notice 17899
I, Leonard Sydney Clover of Auckland
Registered Surveyor
Dated at Auckland this 3rd day of September 1976
Examined E F SCHWARZ
Approved as to Survey
Chief Surveyor
Deposited this 24th day of 1977
District Land Registrar
Lot 1
6.6950ha
Lot 2
11.6100ha
DIAGRAM A
not to scale
DIAGRAM B
scale:-1:250
Rarawaru Creek
TOTARA RD.
LEGAL ST.
D.P. 61512
D.P. 13497
D.P. 53739
D.P. 57435
D.P. 53062
D.P. 9146
S.O. 30571
S.O. 38941
Pt. Allot. 3
Pt. Lot 1
Pt. 3
352° 49' 30" 290.25
352° 49' 30" 91.07
103° 35' 30" 169.08
283° 35' 30" 128.85
203° 35' 30" 310.65
193° 55' 30"
INCHES
METRIC

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952
Limited as to Parcels

Historical Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA38B/84**
Land Registration District	**North Auckland**
Date Issued	24 August 1977

Prior References
NA767/239

Estate	Fee Simple
Area	11.6100 hectares more or less
Legal Description	Lot 2 Deposited Plan 81411

Original Proprietors
Barrie Frederick Connell and Lloyd McCrae Harre

Interests

Subject to a drainage right over part marked A created by Proclamation 12322

K72265 Compensation Certificate by The Minister of Works - 26.8.1959 at 1.57 pm

17899 Gazette Notice declaring the within land subject to restrictions imposed by the within notice - 26.11.1960 at 2.54 pm

7282097.1 Transmission to Lloyd McCrae Harre - 19.3.2007 at 9:00 am

7282097.2 Transfer to Lloyd McCrae Harre, Lynnette Joy Clark and Colin James Lucas - 19.3.2007 at 9:00 am

9569425.1 CAVEAT BY PAUL MAYNARD - 16.12.2014 at 3:40 pm

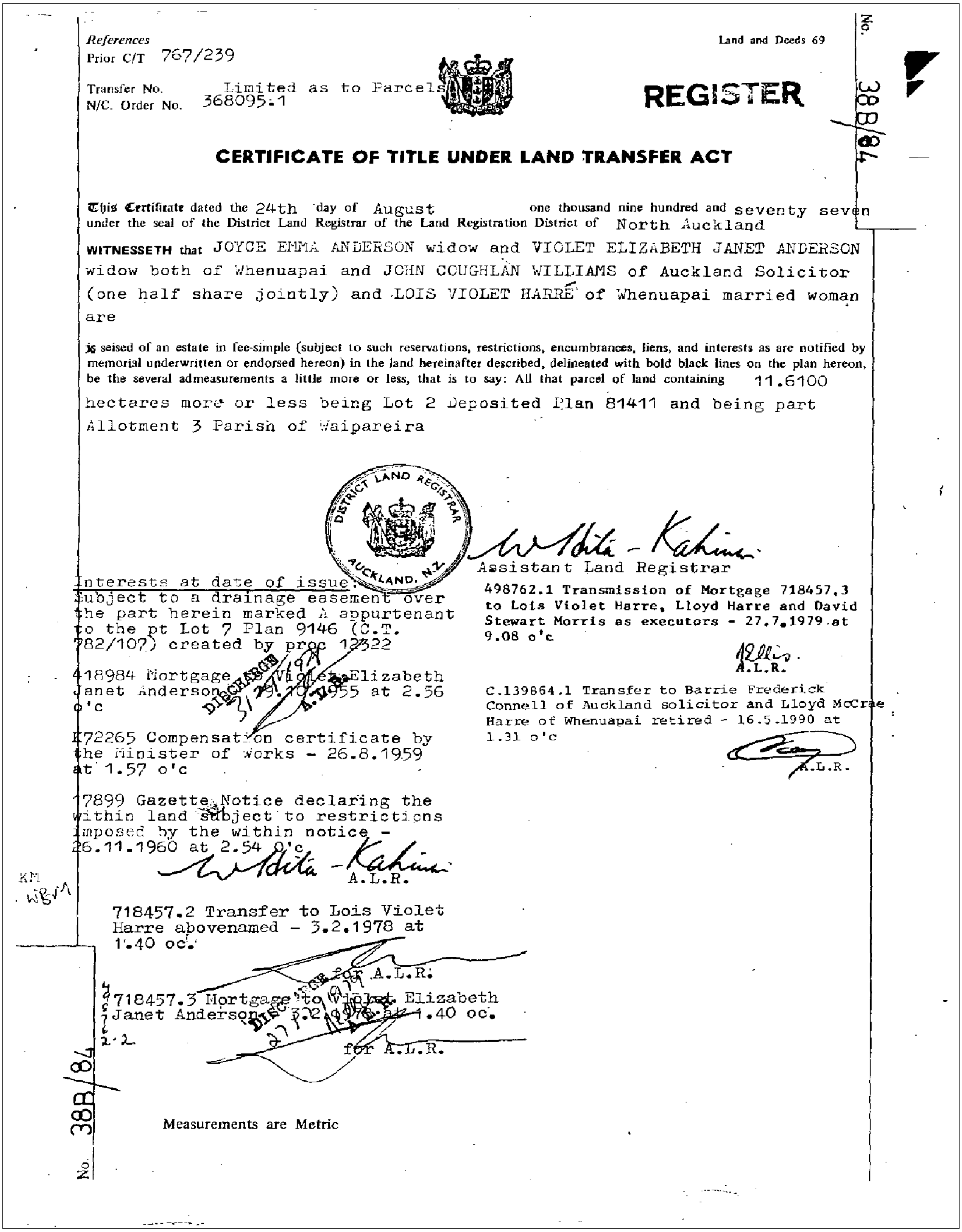
9395603.1 Transmission to Lynnette Joy Clark and Colin James Lucas as survivor(s) - 25.3.2015 at 3:32 pm

9395603.2 Transfer to Lois Violet Harre and Roderick McCrae Harre - 25.3.2015 at 3:32 pm

10023492.1 Lapse of Caveat 9569425.1 pursuant to Section 145A Land Transfer Act 1952 - produced 7.4.2015 at 3.25 pm and entered 28.4.2015 at 7.00 am

9936639.1 CAVEAT BY LYNNETTE JOY CLARK AND COLIN JAMES LUCAS - 15.4.2015 at 9:20 am

10423337.1 Withdrawal of Caveat 9936639.1 - 25.8.2016 at 9:54 am



References
Prior C/T 767/239

Transfer No. Limited as to Parcels
N/C. Order No. 368095.1

Land and Deeds 69

No. 38B/84

REGISTER

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT

This Certificate dated the 24th day of August one thousand nine hundred and seventy seven under the seal of the District Land Registrar of the Land Registration District of North Auckland

WITNESSETH that JOYCE EMMA ANDERSON widow and VIOLET ELIZABETH JANET ANDERSON widow both of Whenuapai and JOHN COUGHLAN WILLIAMS of Auckland Solicitor (one half share jointly) and LOIS VIOLET HARRE of Whenuapai married woman are

~~is~~ seised of an estate in fee-simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial underwritten or endorsed hereon) in the land hereinafter described, delineated with bold black lines on the plan hereon, be the several admeasurements a little more or less, that is to say: All that parcel of land containing 11.6100 hectares more or less being Lot 2 Deposited Plan 81411 and being part Allotment 3 Parish of Waipareira

DISTRICT LAND REGISTRAR AUCKLAND, N.Z.

Assistant Land Registrar

Interests at date of issue:

Subject to a drainage easement over the part herein marked A appurtenant to the pt Lot 7 Plan 9146 (C.T. 782/107) created by proc 12322

418984 Mortgage to Violet Elizabeth Janet Anderson - 19.10.1955 at 2.56 o'c

DISCHARGE 31/7/1979 A.L.R.

K72265 Compensation certificate by the Minister of Works - 26.8.1959 at 1.57 o'c

17899 Gazette Notice declaring the within land subject to restrictions imposed by the within notice - 26.11.1960 at 2.54 o'c

A.L.R.

KM

718457.2 Transfer to Lois Violet Harre abovenamed - 3.2.1978 at 1.40 oc.

for A.L.R.

~~718457.3 Mortgage to Violet Elizabeth Janet Anderson - 3.2.1978 at 1.40 oc.~~

DISCHARGE

for A.L.R.

498762.1 Transmission of Mortgage 718457.3 to Lois Violet Harre, Lloyd Harre and David Stewart Morris as executors - 27.7.1979 at 9.08 o'c

Ellis.
A.L.R.

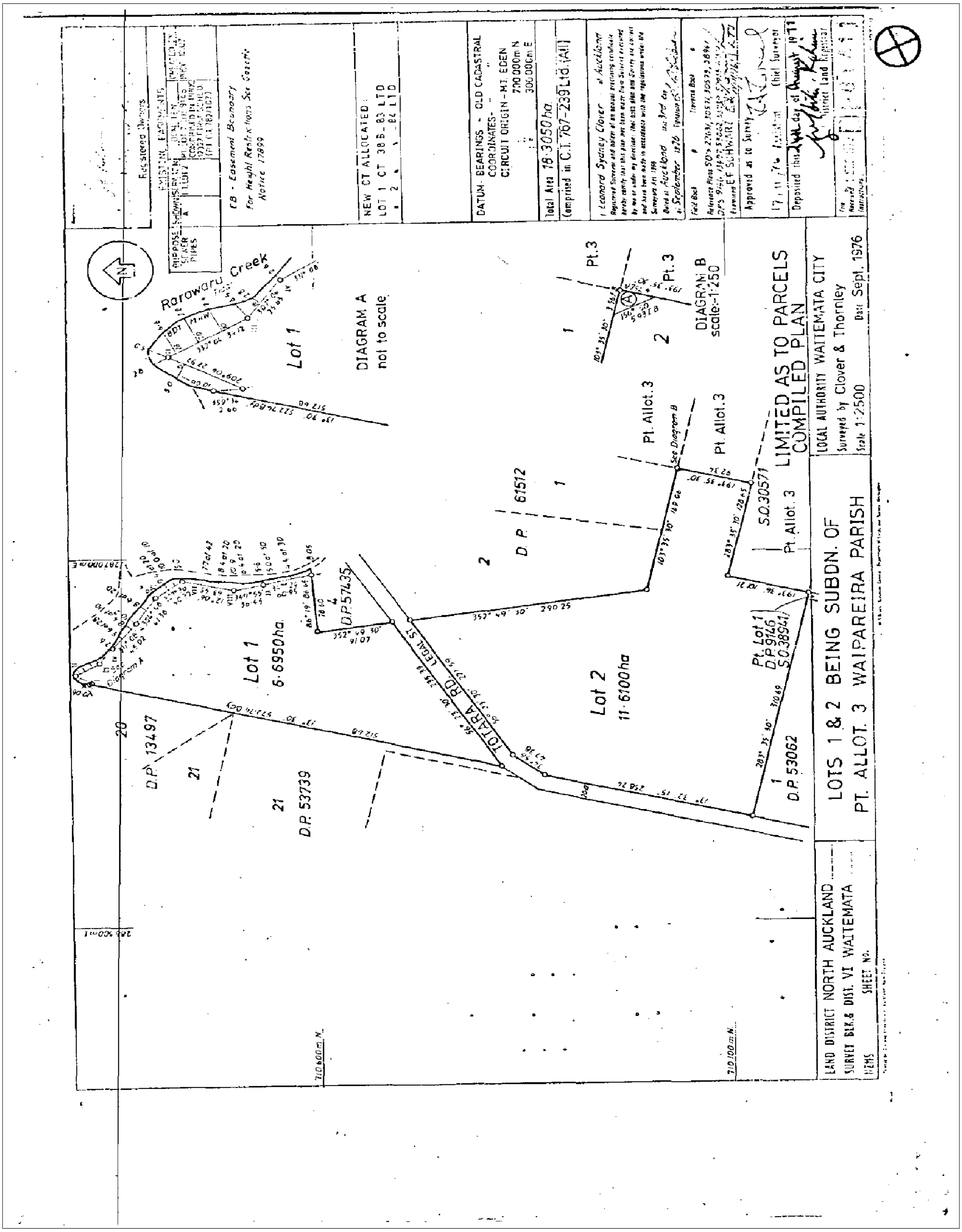
C.139864.1 Transfer to Barrie Frederick Connell of Auckland solicitor and Lloyd McCrae Harre of Whenuapai retired - 16.5.1990 at 1.31 o'c

A.L.R.

Measurements are Metric

No. 38B/84

Identifier **NA38B/84**



APPENDIX B HISTORICAL AERIAL PHOTOGRAPHS

Title:	**Historic Aerial Photographs**	**Reference:**	J1173
Project name:	98-100 Totara Road, Whenuapai	**Date:**	30/04/2018
geosciences	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Drawn:**	DW
		Approved:	COB

Title:	**Historic Aerial Photographs**	**Reference:**	J1173
		Date:	30/04/2018
Project name:	98-100 Totara Road, Whenuapai	**Drawn:**	DW
geosciences ltd ENVIRONMENTAL	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Approved:**	COB

Title:	**Historic Aerial Photographs**	**Reference:**	J1173
		Date:	30/04/2018
Project name:	98-100 Totara Road, Whenuapai	**Drawn:**	DW
geosciences	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Approved:**	COB

Aerial photograph courtesy of Auckland Council GIS

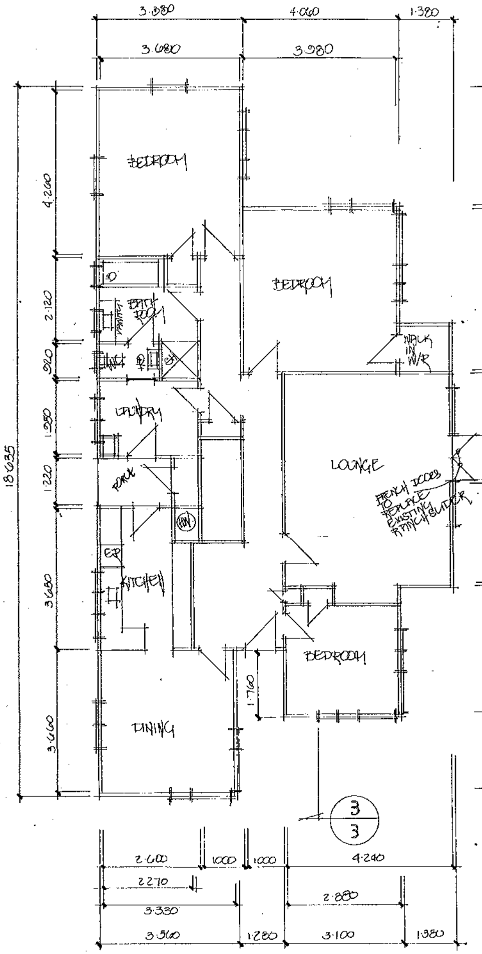
Aerial photograph courtesy of Auckland Council GIS

Title:	**Historic Aerial Photographs**	**Reference:**	J1173
Project name:	98-100 Totara Road, Whenuapai	**Date:**	30/04/2018
		Drawn:	DW
geosciences ltd ENVIRONMENTAL	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Approved:**	COB

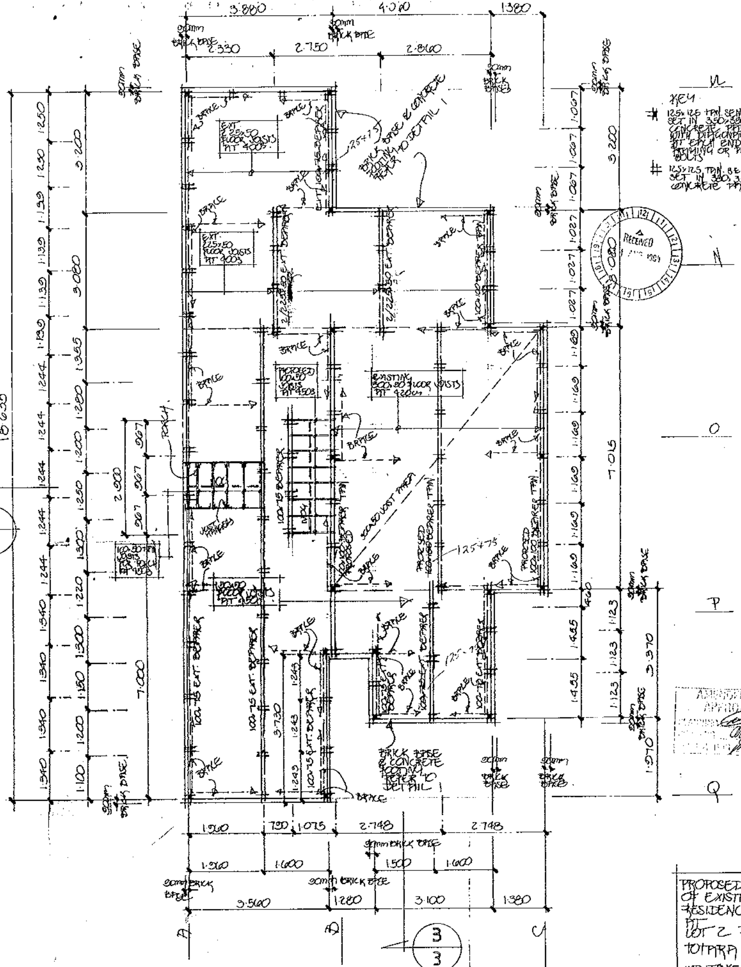
Title:	**Historic Aerial Photographs**	**Reference:**	J1173
Project name:	98-100 Totara Road, Whenuapai	**Date:**	30/04/2018
geosciences ltd ENVIRONMENTAL	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Drawn:**	DW
		Approved:	COB

Title:	**Historic Aerial Photographs**	**Reference:**	J1173
Project name:	98-100 Totara Road, Whenuapai	**Date:**	30/04/2018
geosciences ltd ENVIRONMENTAL	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Drawn:**	DW
		Approved:	COB

APPENDIX C PROPERTY FILE EXTRACTS



FLOOR PLAN



FOUNDATION PLAN

KEY

12.5×12.5 TAN. SENTON PILES SET IN 350×350×450 DEEP CONCRETE PAD WITH DIAGONAL BRACES FIXED AT EACH END TO SUBFLOOR FRAMING OR PILES WITH H.R. BOLTS

12.5×12.5 TAN. BEATON PILES SET IN 350×350×450 DEEP CONCRETE PAD

RECEIVED

AMENDED PLANS APPROVED BY
6 SEP 1994
02 SEP 1994

PROPOSED RELOCATION OF EXISTING RESIDENCE
AT
LOT 2 DP 81411
TOITARA ROAD
WAITAKERE CITY

DATE	8/94
SCALE	1:50
SHEET	2 OF 3

No native trees and bush are to be cleared without prior approval of Council. Contact Council's Environmental Protection Officer for advice.

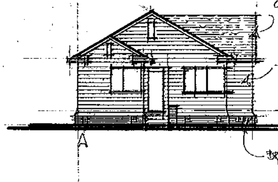
The property owner is required to submit to this Town Authority on completion of the construction of the septic tank and effluent disposal system, a certificate from the Consulting Engineer/Geologist certifying that the septic tank and the effluent disposal system has been constructed in accordance with the design that has been submitted with the building permit application.

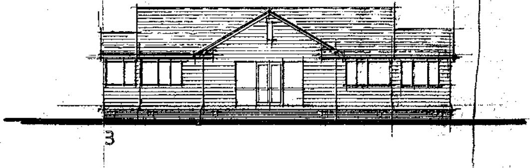
Sanitary plumbing to be carried out by a registered plumber in compliance with the NZ Building Code or an alternative solution approved by Council and shall be inspected by Waitakere City Council Plumbing & Drainage Surveyor prior to enclosing in walls, cavities and under floor.

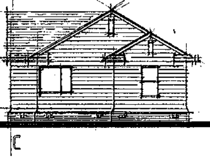
Drainage shall be inspected and tested by Waitakere City Council Plumbing & Drainage Surveyor prior to backfilling.

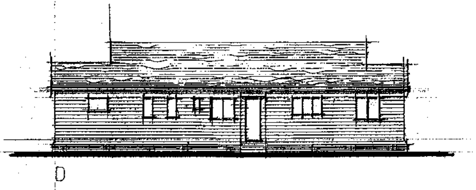
Stormwater / sanitary drainage shall be carried out by a registered drainlayer in compliance with the NZ Building Code or an alternative solution approved by Council

APPROVED
PLUMBING & DRAINAGE
INSPECTOR
DATE: 2 3 AUG 1994

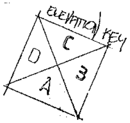


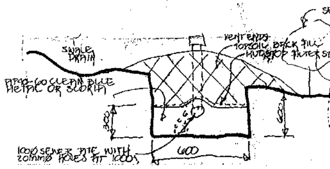




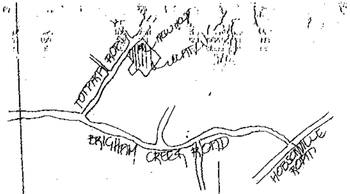


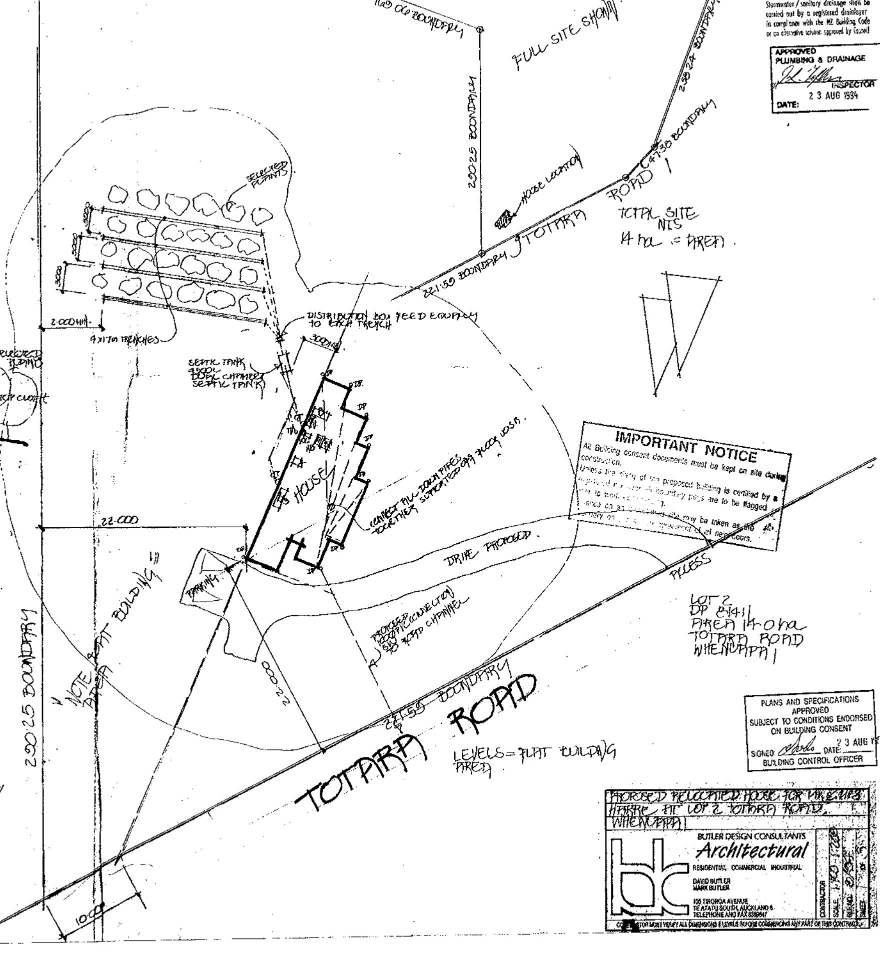
ELEVATIONS





SECTION THROUGH TRENCHES





LEVELS = FLAT BUILDING AREA

LOT 2
DP 8?411
AREA 14.0ha
TOTARA ROAD
WHENUAPAI

IMPORTANT NOTICE

All Building consent documents must be kept on site during construction.
Unless the siting of the proposed building is certified by a [illegible] boundary pegs are to be flagged [illegible]
[illegible] may be taken as the [illegible] agreement of all neighbours.

PLANS AND SPECIFICATIONS
APPROVED
SUBJECT TO CONDITIONS ENDORSED
ON BUILDING CONSENT
SIGNED: DATE: 2 3 AUG
BUILDING CONTROL OFFICER

PROPOSED RELOCATED HOUSE FOR MR & MRS
HARRE AT LOT 2 TOTARA ROAD,
WHENUAPAI

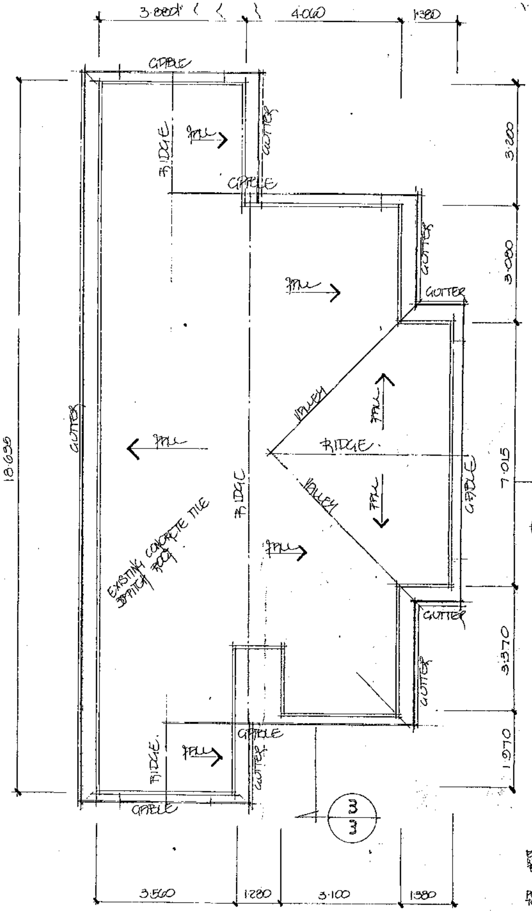
BUTLER DESIGN CONSULTANTS
Architectural
RESIDENTIAL COMMERCIAL INDUSTRIAL

DAVID BUTLER
MARK BUTLER

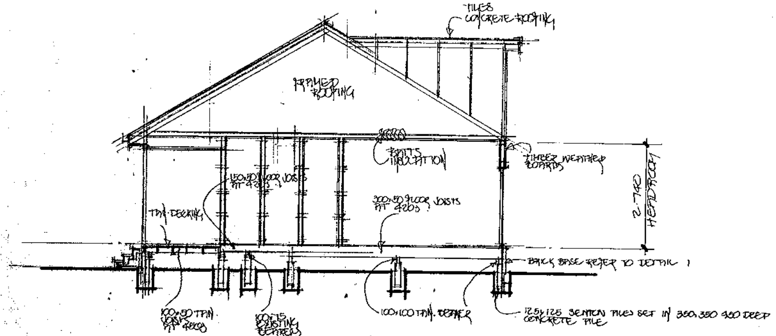
105 TIROROA AVENUE
TE ATATU SOUTH, AUCKLAND 8
TELEPHONE AND FAX 8389847

CONTRACTOR
SCALE 1/100 [illegible]
REF. NO.
SHEET

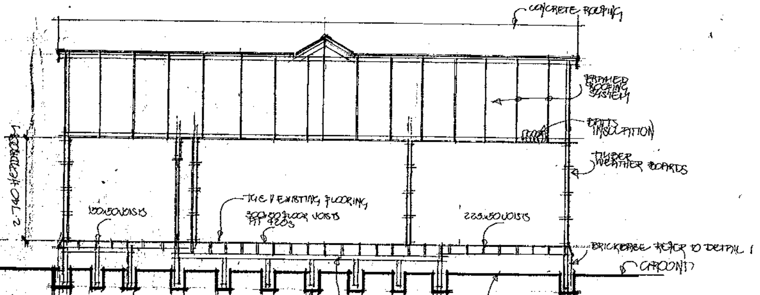
CONTRACTOR MUST VERIFY ALL DIMENSIONS & LEVELS BEFORE COMMENCING ANY PART OF THIS CONTRACT



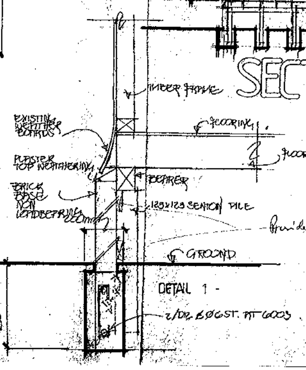
ROOF PLAN



SECTION A



SECTION 3



DETAIL 1 -

PROPOSED RELOCATION OF EXISTING RESIDENCE
PT
LOT 2 DP 8441
TOIPAKA ROAD
WAITAKERE CITY

PLANS AND SPECIFICATIONS
APPROVED
SUBJECT TO CONDITIONS ENDORSED
ON BUILDING CONSENT
SIGNED DATE 2 3 AUG 1994
BUILDING CONTROL OFFICER

DATE	8/94
SCALE	1:50
SHEET	3 OF 3

HAWTHORN-GEDDES
Civil & Structural
Registered Civil & Structural Engineers

138 Bank Street
P.O. Box 1575
Whangarei

Wangarei Ph (09)438·
Fax (09)438·
Warkworth Ph (09)425·
Kaikohe Ph (09)401·

JOB No: B0709 DATE: AUG 94
CLIENT: ROD HAREE
STRUCTURE: RELOCATED HOUSE
STRUCTURAL COMPONENTS: ON SITE EFFLUENT DISPOSAL DESIGN
N.Z.S.: ARWB TB58
DESIGNER: BJ KOSE CHECKED:

1. SITE LOT 2
DP 81411
14.00 ha
TOTARA RD
WHENUAPAI

2 ASSUMPTIONS : 3 BEDROOM HOUSE ⇒ 5 PEOPLE
WATER TANK WATER SUPPLY ⇒ 140ℓ/P/DAY

BOREHOLE REVEALED GOOD TOPSOIL
LAYER OVER A SANDY SILTY CLAY
(CAT 4 SUBSOILS)
ALLOW 10mm/DAY LONG TERM
SOAKAGE.
DESIGN FOR SHALLOW TRENCHES

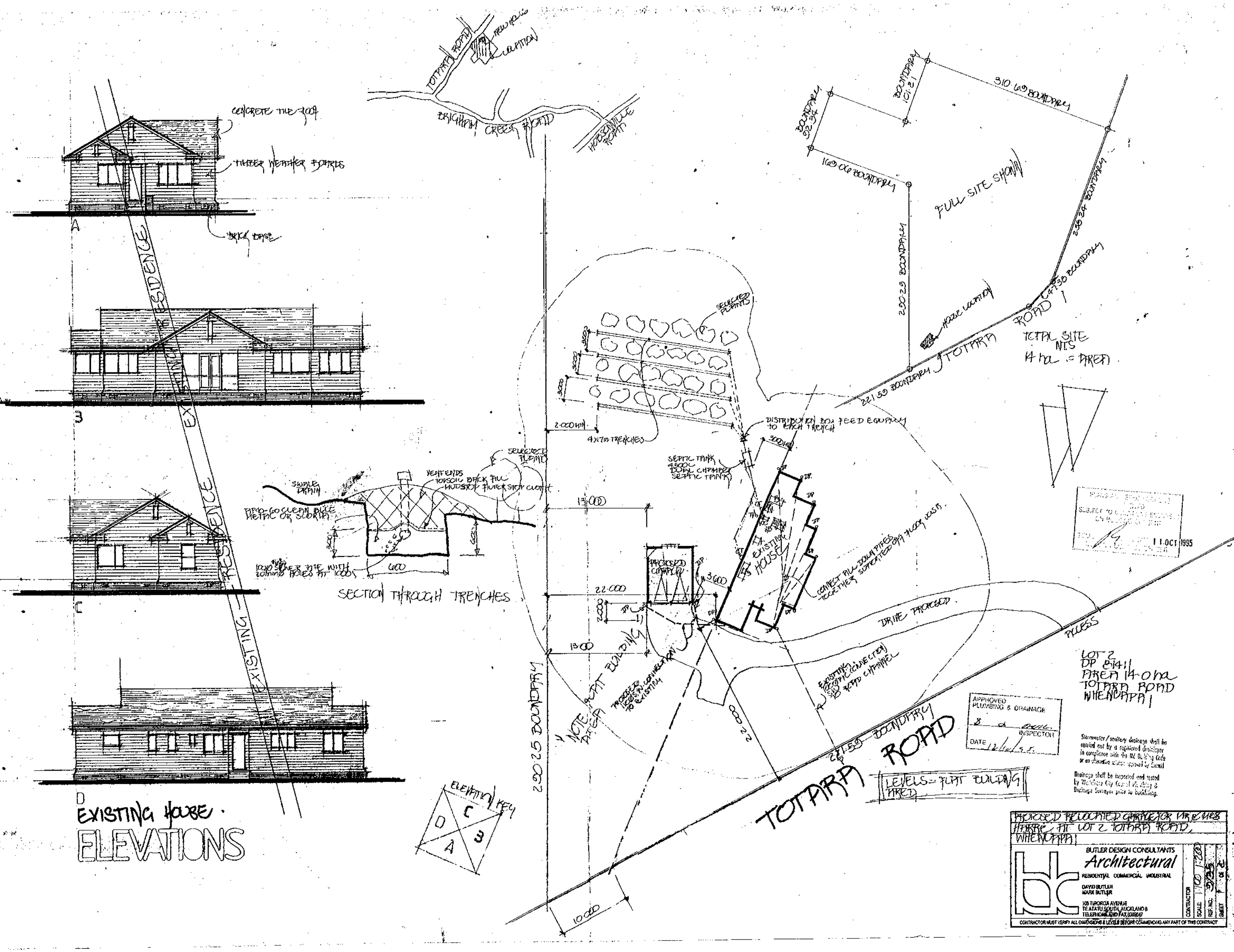
3. DESIGN : TOTAL EFFLUENT LOADING ⇒ 5×140
= 700ℓ/DAY

TOTAL SOAKAGE AREA REQ'D $= \frac{700}{10}$
$= 70m^2$

TOTAL WETTED AREA $= 0.25+0.25+0.6$
$= 1.1m^2$

∴ TOTAL LENGTH OF TRENCH REQ'D
= 64m

∴ CONSTRUCT 4 × 17m LONG TRENCHES



LOT 2
DP 81411
AREA 14.0 ha
TOTARA ROAD
WHENUAPAI

PLANS ... SUBJECT TO ... [illegible]
11 OCT 1995

APPROVED
PLUMBING & DRAINAGE
INSPECTOR
DATE 12/10/95

Stormwater / sanitary drainage shall be carried out by a registered drainlayer in compliance with the NZ Building Code or an alternative scheme approved by Council

Drainage shall be inspected and tested by Waitakere City Council Plumbing & Drainage Surveyor prior to backfilling.

PROPOSED RELOCATED CARPORT FOR MR & MRS HARRE, AT LOT 2 TOTARA ROAD, WHENUAPAI

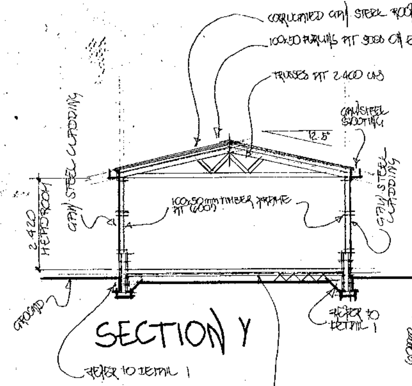
BUTLER DESIGN CONSULTANTS
Architectural
RESIDENTIAL COMMERCIAL INDUSTRIAL

DAVID BUTLER
MARK BUTLER

105 TUROROA AVENUE
TE ATATU SOUTH, AUCKLAND 8
TELEPHONE AND FAX 8388647

CONTRACTOR
SCALE 1/100 1:200
REF. NO. 9525
SHEET 1 OF 2

CONTRACTOR MUST VERIFY ALL DIMENSIONS & LEVELS BEFORE COMMENCING ANY PART OF THIS CONTRACT



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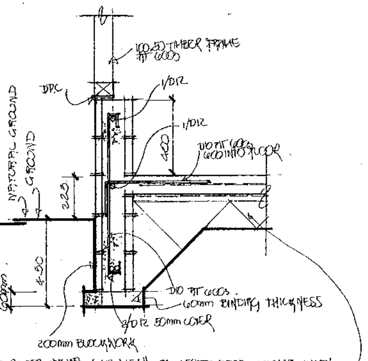
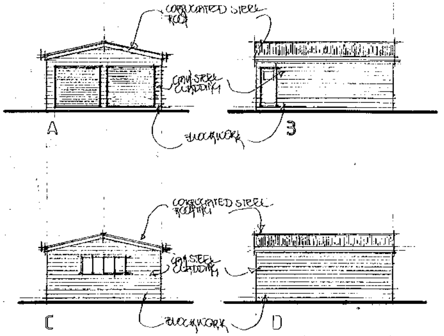
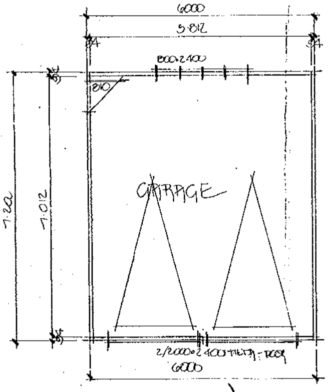
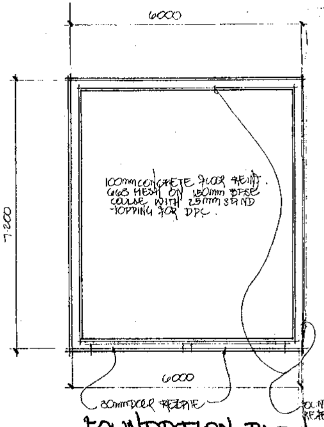


DETAIL 1

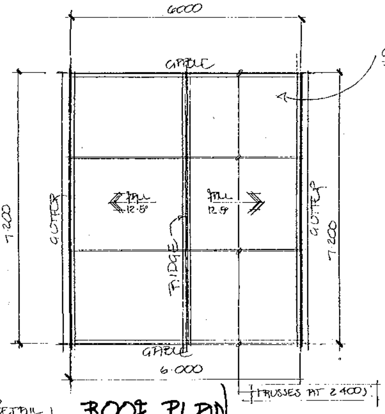




FLOOR PLAN



FOUNDATION PLAN



ROOF PLAN

SUBJECT TO CONDITIONS ON BUILDING CONSENT
SIGNED
BUILDING CONTROL OFFICER
11 OCT 1995

PROPOSED =
EXISTING GARAGE TO BE RELOCATED
TO LOT 2
TOTARA ROAD
WHENUAPAI

SCALE	1:50, 1:10, 1:100
DATE	9/95
SHEET	2 OF 2

Andrea 0223551608 2days

sset Management

Sewer Miscellaneous Work Order

eport Date	05/07/2017 10:23 AM	Submitted By		Page 1

ork Order #	411811	Activity	SSTPO3	SEWER SEPTIC TANK PUMP OUT 3YR

isc ID 19994367

ddress 98 TOTARA RD
WHENUAPAI 0618

Description

osition
rea
ub-area
ap #

District
Location

isc Type	UKNOW STANDARD SEPTIC TANK	Colour				
sage Unit						
urface		Condition				
aterial						
odel #		Length	15.000	Height	0	
erial #	4050	Width	0	Diameter	0	
Weigh	0.00	Depth	0.000	Avg Monthly Usage	0.00	
levation	0.00			Total Usage	0.00	
wner	PRV PRIVATE	Service Status	PVIN	PRIVATE LIVE		
arcel						
Coord						
Coord		Plan #				
Coord		Date Installed				
udget #						

itiated By			Initiated Date	05/07/2017	Scheduled	01/08/2017 09:00
ssigned To	STC	SEPTIC TANK CONTRACT	Service #		Due	29/08/2017 09:00

uthorisation
udget #
rew
aint Type
riority
roblem
roject
ource
ast A y SSTPO3 SEWER SEPTIC TANK PUMP OUT 3YR

Group Proj # 6819
Out of Service ☐
Potential Service Request ☐
Last Activity Completed 01/08/2014

Gate.

Onsite Wastewater Management
Effluent Disposal System Data Sheet

Auckland Council

PROPERTY INFORMATION

Property Address:

98 TOTARA RD WHENUAPAI

UNIT ID

Work Order: **411811**

Pumpout Date: 14/8/09

Property Type:

☐ Residential (small) ☒ Residential (large) ☐ Bach ☐ Public Facility

☐ Other (Specify) ...

PUMP OUT INFORMATION

☒ Routine ☐ Early ☐ Rescheduled ☐ Emergency

☐ To Be Rescheduled Date Required ...

Comments

ASSET DATA

Type ☒ Standard ☐ Pre Treatment ☐ Grey Water ☐ Grease Trap
☐ Long Drop ☐ Chamber ☐ Hi Tech
☐ Other (Specify) ...

Size (litres) ☐ 2700 ☐ 4050 ☒ 4500
☐ Other (Specify) ... litres

Material ☒ Concrete ☐ Fibreglass ☐ Plastic(PE)

Lid Depth ☐ Not Applicable ☐ Above Ground ☐ Ground Level
☒ Below Ground (Specify Depth) ... 100 mm

Risers Required ☐ Yes ☒ No

Details ...

Effluent Filter ☐ Yes ☒ No *Baffles* ☒ Yes ~~☐ No~~

Sludge/Scum Depth ☐ Not Applicable Measured With Sludgeometer ☐ Yes ☒ No

Scum Depth (mm) ... 150 *Sludge Depth (mm) ...* 200

Hose Length ☒ ≤ 50m ☐ > 50m and ≤ 100 m ☐ > 100m

TANK CONDITION AND DEFECTS

Condition Good ☒ Yes ☐ No

Details ...

Defects Identified ☒ None ☐ Root Intrusion ☐ Broken Lid ☐ Other

Details ...

COMPLETION

Lid Sealed ☐ Not Applicable ☒ Yes ☐ No

Comments ...

Cleanup Completed ☒ Yes ☐ No

Details ...

GENERAL PUMPOUT COMMENTS *(Notes on any other related issues).*

Comments:

Onsite Wastewater Management
Effluent Disposal System Data Sheet

Auckland Council

DRAINAGE FIELD DATA

Field Found ☐ Not Applicable *(Skip to **General Inspection Comments** below)* ☒ Yes ☐ No

Comments ...

Drainage Field Type ☐ Evapo Beds ☐ Dripper Line ☒ Trench
☐ Raam Light ☐ Bore Holes ☐ Unknown
☐ Other (Specify) ...

Separate Grey Water System ☐ Yes ☒ No ☐ Unknown

All Pipes Into Gulley Traps ☒ Yes ☐ No ☐ Unknown

DRAINAGE FIELD CONDITION

Drainage Field Suitable ☐ Yes ☐ No

Details ...

All Components Accessible For Maintenance (incl. risers, monitoring ports, distribution box) ☒ Yes ☐ No

Comments ...

All Components in Good Condition ☒ Yes ☐ No

Details ...

Distribution Box ☒ Water Tight ☐ Ground Water Entry ☐ Visual Leakage Out

Details ...

DRAINAGE FIELD DEFECTS

Defects Identified ☒ None ☐ Effluent Surfacing ☐ Strong Odour ☐ Ponding
☐ Evidence Of Vehicle Traffic or Livestock On Drainage Field ☐ Other

Details ...

GENERAL INSPECTION COMMENTS *(Notes on location of drainage field, soil type if known) ie in bush, paddock.*

Comments
Soil type: Sand Loam [✓ Clay]
Nature of site (is it pasture, bush, paddock or other – please describe): Lawn
Is it boggy or overland flow: NO

SITE INCIDENT *(Note: Requires notification to Auckland Council Call Centre)*

OSH Incident ☐ Yes ☒ No

Details ...

Contractor Damage ☒ None ☐ Property ☐ Truck ☐ Mushroom ☐ Lid ☐ Other

Details ...

Reinstatement Complete ☐ Not Applicable ☒ Yes ☐ No

Comments ...

DAY WORKS *(Note: Requires Engineer's Prior Approval)*

Day Works Hr ... Min ...

Details ...

SIGNOFF

Pump Out and Inspection Undertaken By [Name] ... Igor, Victor, Eloni, Bene

Map

☒ Task Location Confirmed

☐ Task Location Correction Required

Septic Tank Locations

Aerial Imagery 2015-2016 Urban

19994367 **98 TOTARA RD WHENUAPAI**

▭ Parcel Boundaries

Ⓢ Private, Other

Ⓢ Septic Tank of Interest (Private, Other)

0 3.5 7 10.5
Meters

Scale @ A4
= 1:500

Date Printed:
6/07/2017

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Document Path: [illegible]\WSW O&P\IT\GIS\GIS BAU\WCC Septic Tank Map Series\3. Workspace\2017\SepticTankMapBook_July17.mxd

APPENDIX D SITE PHOTOGRAPHS

PLATE 1: LOADING BAY ADJACENT TO SITE ACCESS

PLATE 2: PASTURE AREA LOOKING SOUTH

PLATE 3: DWELLING AND GARAGE ON NORTHERN PORTION OF SITE

PLATE 4: EASTERN PORTION OF SITE, FORMERLY PLANTED WITH TREES

PLATE 5: CREEK RUNNING ACROSS EASTERN PORTION OF SITE

PLATE 6: CREEK RUNNING FROM AIRBASE ACROSS EASTERN PORTION OF SITE

PLATE 7: SOUTHERN PORTION OF SITE

PLATE 8: SITE VIEWED FROM THE SOUTHERN BOUNDARY LOOKING NORTH

24 September 2019 (Revised 10 November 2021)

Maraetai Land Development
C/- Neil Construction Limited
PO Box 8751
Symonds Street
Auckland 1150

Ref: Ltr-1394/PSI/Sep17(Rev1)

Attention: David Page
Land Manager

Dear David,

RE: PRELIMINARY SITE INVESTIGATION OF 102 TOTARA ROAD, WHENUAPAI

Geosciences Ltd (GSL), has conducted preliminary site investigation (PSI) of the property located at 102 Totara Road, Whenuapai in accordance with GSL proposal ref: *Pro 1855/Aug19* dated 06 August 2019. The property is legally described as Lot 1 DP 53062, comprises an area of 4.7551 Ha and is hereafter referred to as 'the site' in this report.

The primary purpose of this investigation is to assess the likelihood of any potential contamination issues being present on site, and the resulting applicability of the National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health (NES).

1 BACKGROUND

The site is currently a rural residential lot comprising of two residential dwellings; one located midway along the western boundary of the site and the other located on the southern boundary of the site. The landuse is consistent with the surrounding area, which has a mixture of rural and rural-residential properties nestled in and around the Whenuapai NZ Air Force directly the east of the site. GSL understands that the site has been identified for future residential development.

The *National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health (NES)* (Ministry for the Environment (MfE), 2012) requires that land affected by contaminants in soil is appropriately identified and assessed. When soil disturbance, change in landuse, or subdivision activities take place it should be, if necessary remediated or the contaminants contained to make the land safe for the intended landuse.

Under the NES, land is considered to be actually or potentially contaminated if an activity or industry on the MfE Hazardous Activities and Industries List (HAIL) has been, is, or is more likely than not to have been undertaken on the land under investigation. Consequently, any change in landuse, subdivision or development required a preliminary site investigation (PSI) of the land to determine whether or not any risk to human health exists as a result of any current or former activities that are occurring, or may have occurred, on that land.

GSL understands that the site has been secured by Maraetai Land Development, with the intention of developing the land for residential landuse. Maraetai Land Development engaged GSL to undertake an investigation of the site to comment on the likely contamination risks associated with the property and determine whether or not the provisions of the NES are likely to apply to the site, or portions thereof.

2 SCOPE OF WORKS

This preliminary site investigation, undertaken in general accordance with the MfE Contaminated Land Management Guidelines (CLMG) No. 1 - "*Reporting on Contaminated Sites in New Zealand*" and No 5 - *"Site Investigation and Analysis of Soils"* included:

- an historical appraisal of the site by a study of historic aerial photographs;
- a review of the current and historic certificates of title;
- a review of the property file held by Council;
- a visual site inspection and walkover of the property; and
- the preparation of this letter report to comment on the liabilities applicable under the National Environmental Standards (NES) regulations, and Auckland Unitary Plan (Operative in Part) (AUP(OP)) rules for the development of the site.

3 SITE HISTORY

In order to establish the site history, GSL conducted a desktop study of publicly available information, the findings of the study are detailed in the following sections.

3.1 RECORDS OF TITLE

GSL has reviewed copies of the current and historic Records of Title for the aforementioned property, including any instruments on the title which detail relevant property information such as: current ownership, registered interests, easements, covenants, lease restrictions and transmissions, to determine if pre-existing consent notices or other restrictions / notifications which may be relevant to historic uses of or potential soil contamination are held against the property. The titles indicate that the property was formed in 1964 under the Joint Family Homes Act 1964 and settled to Lois Violet Harre and Lloyd McCrae Harre, noting Mr McCrae occupation as a farmer. There are no other notes of interest on the titles. Copies of the certificates are attached in Appendix A.

3.2 HISTORIC AERIAL PHOTOGRAPHS

Historic aerial photographs from 1940, 1950, 1963, 1972, 1980, and 1988 are available from the Retrolens website while images from 1996, 1999, 2000, 2003, 2006, 2008, 2010, 2015, and 2017 are available on the Auckland Council GEOMaps website (GIS). The most recent available image is held on Google Earth from April 2019. The findings of the historic aerial photograph review are summarised below, while copies of the aerial photographs have been attached in Appendix B.

1940 This is the first available image of the site. Currently the site is vacant apart from trees lining the north, east and western boundaries of the site.

1950-1963 The site is currently segregated down the centre by a thick shelter belt running approximately north-south across the site. In 1950 trees from the northwest corner of the site have been removed, by 1963 the remainder of trees on the norther boundary have also been removed. There are no other significant developments on site.

1972 By 1972 a residential dwelling has been erected on site, as well as a paved driveway accessing the site from Totara Road to the west. An area of domestic garden has been established to the south of the dwelling with some planting evident. The remainder of the site remains vacant pasture with no other significant developments.

1980-1988 The shelter belt previously segregating the site down the middle has been removed. To the south of the residential dwelling a shed has been erected, a second small shed with a small, fenced enclosure is noted in the approximate centre of the site adjacent to the remnants of the former shelter belt.

Other than the construction of a second small shed in the approximate centre of the site's northern boundary, there is little discernible development to the site in the 1988 image.

1996 The 1996 image is the first available colour image of the site and while the image is of poor quality the colour confirms the site pastoral landuse. To the south of the residential dwelling the existing barn / shed has been extended to the south, while a small shed has been constructed in the southwest paddock, adjacent to the domestic gardens. In the southeast corner of the site, a stormwater culvert and channel is evident.

1999-2003 By 1999 a new residential dwelling has been erected along the southern boundary of the site. The small shed in the southwest paddock, noted in the previous image, has been removed. There are no other discernible developments to the site through the images from 2000, and 2003.

2006 The 2006 image is of much higher quality making the sites features easily discernible, the sites use remains predominantly pastoral with the two residential dwellings and barn in the southwest quadrant of the site. The small shed appears to be an animal shelter and pen first noted in the 1980 image appears to be a small animal enclosure or run. To the south of the main dwelling and barn a small apparent portacom type shed has been placed on the paddock, this is assumed to be a portable structure as it has been removed again by the 2008 image. A small domestic sized shadehouse has been constructed in the gardens to the southwest of the original dwelling.

Other than the removal of the portacom there are no discernible developments to the site in the 2008 image.

2010-2019 The shed in the centre of the northern boundary appears to be undergoing demolition / removal at the time of the 2010 image, some building materials are piled to the south of the shed and only remnants of the structure remain along with a timber animal loading race. A small shed has been constructed in the garden of the recent residential dwelling; this is assumed to be a temporary structure as it is removed by the 2015 image.

Aside from the demolition and removal of the shelter and animal run north of the site centre there is little discernible development noted on site in the 2015 image. The 2017 image shows a port-a-com style shed located off the southwest corner of the barn to the south of the original dwelling. The stormwater flowpath appears to have been replanted between culverts on the southern boundary and the eastern boundary where it crosses into the adjacent airbase. The 2019 Google Earth image shows little discernible development to the site.

3.2.1 Summary of Aerial Photographs

GSL has reviewed the available historic aerial images of the site and concluded that the site remained predominantly vacant pasture since at least 1940. Residential landuse is established by 1972, with a second residential dwelling being constructed by 1999. The aerial photographs show no distinct evidence for any activity or industry included on the MfE HAIL having been undertaken on the site. There are no structures present on the site which could be spray races, nor is there any evidence for horticultural activities or major earthworks having been undertaken on the site.

3.3 PROPERTY FILE

GSL requested a copy of the property file from Auckland Council for review of historic activities. Copies of relevant historic plans, correspondence, permits, and consents have been attached in Appendix C. The following items of note were on the supplied file:

1963 A building permit application for the construction of a residential dwelling is held on file specifying “decromastic tiles” under roofing material, the bituminous glue utilised in some decromastic tiles has been known to contain asbestos fibres. Fibrous plaster ceilings are also noted in the specifications. Also specified in the building plans is the use of “white and red lead” paints and primers on exterior woodworking.

1979 Building application and permit for tractor shed.

1998 An application for the construction of minor dwelling located more than 20m from the existing dwelling is held on file. Plans included on the property file indicate the location of a domestic septic tank and effluent disposal trench and soakage system associated with the minor dwelling.

3.3.1 Summary of Property File

GSL reviewed the property file held by Auckland Council for the site, noted on the specifications for the original dwelling are potentially asbestos containing materials (ACM) and lead based paints. When in broken or degraded condition, asbestos containing material is included on the MfE HAIL under Item E.1, similarly the impacts of lead based paints can be encompassed by Item I of the HAIL where a potential risk to human health or the environment is noted.

Drainage plans and pump-out-reports held in the property file indicate the presence of two onsite septic tanks and effluent disposal systems on the site. Auckland Council consider that domestic effluent disposal systems are encompassed by Item G.5 and G.6 of the MfE HAIL as waste disposal to land.

3.4 SUMMARY OF DESKTOP INVESTIGATION

GSL conducted a desktop study of publicly available information including a review of current and historic certificates of title, a review of historic aerial photographs, and a review of the property file held by Council. The desktop study has identified the following potential issues associated with the existing residential dwelling on site:

- Historic use of lead based paints on the original dwelling and older sheds on site;
- Potential presence of asbestos containing materials within the original dwelling and sheds in the paddocks; and
- Presence of onsite effluent disposal systems.

4 SITE INSPECTION AND WALKOVER

GSL undertook a site inspection on 19 September 2019 at which time the weather was fine and clear, at the time of the inspection the site appears exactly as it does in the most recent aerial photographs, that is; largely vacant pasture laid out in paddocks for the grazing of cattle. The only structures on the full extent of the site are the dwellings and barn noted in the aerial photographs.

The main dwelling on site is the original 1960s house, which is accessed directly off Totara Road along a concrete driveway in the southwest quadrant of the site, a second driveway is cut along the southern boundary of the site providing access to the more recent minor dwelling.

The dwelling itself is confirmed to be as described in the plans in the property file, being a timber framed brick clad dwelling on concrete blockwork foundations, with tiled roofing, the lower storey of the dwelling appears to be utilised as a second dwelling / granny flat under the main house. Between the Totara Road and the main dwelling is a large manicured lawn with a vegetable garden, fruit trees, and a small shadehouse housing grapevines to the south of the dwelling. North of the dwelling and ornamental gardens are three chicken houses with attached runs sited under a stand of large mature Australian Swamp Gum trees. The chicken sheds are constructed out of timber frames and clad with longrun iron roofing materials.

Off the southeast corner of the main dwelling is a large timber barn with various stockpiles of timber, including some treated decking timbers, and roofing materials to the west and north of the barn. The barn itself is utilised for storage of firewood, kindling and other timber products, all of which are situated on a concrete floor slab. A timber loading race and pen is constructed on the east end of the barn which provides gated access to the adjacent paddocks and remainder of the site. In the northwest corner of a small paddock north of the barn and east of the main dwelling the breather valve for the septic tank system was noted, no distinct visually obvious indication was noted for the tank overflow or soakage trenches was noted during the inspection.

The second, more recent dwelling is located on the southern site boundary and accessed along a separate driveway off Totara Road, the dwelling is maintained in excellent condition and clad with modern weatherboards, and corrugated iron roofing material. In the paddock to the west of the dwelling the septic tank system associated with the dwelling is noted, the system is an Oasis Clearwater system which appears to be a modern, high tech, multi chamber system.

The remaining site area is vacant pasture and laid out in paddocks, separated by electrified cattle fences, the paddocks are utilised for raising drystock. The only structures noted on the pastoral areas of the site are the remnants of the loading race associated with the former shed on the northern boundary. Residual tree stumps from the former large shelter belt are noted across the central portion of the site running in a north-south direction. There are no structures present on the eastern half of the site, the full extent of that portion of the site is vacant pasture, the only item of note is the stormwater channel in the southeast corner of the site which directs culverted stormwater from the adjacent subdivision across a small portion of the site and onto the airbase to the east, where it is re-culverted. There is minimal risk for any potential run off from the airbase impacting soil on the site, as the stormwater channel would intercept any potential runoff. Additionally, the portion of the airbase appears to be predominantly residential barracks, mess halls, and office type buildings, no high-risk activities associated with airports or airfields appear to be undertaken on that portion of the base.

With the exception of the identification of two effluent disposal systems onsite, no evidence for any activity or industry included on the MfE HAIL having been, or currently being undertaken on the site was noted during the site inspection. Site photographs are included as Appendix D.

5 POTENTIAL FOR CONTAMINATION

Following the completion of this investigation, GSL has identified the following source of potential contamination on site:

- Historic use of lead based paints on the original 1960s residential dwelling and sheds adjacent to the northern site boundary;
- Possible utilisation of Asbestos Containing Materials within the construction of the original dwelling and sheds adjacent to the northern boundary; and
- Presence of two septic tanks and effluent disposal systems associated with the residential dwellings.

An assessment of the likely extents and issues associated with each of these items is discussed in turn below based on GSL' extensive experience in similar situations.

5.1 LEAD BASED PAINT

While the use of lead based paint was becoming more and more reduced in the 1950's, its use continued until the 1970's. As lead paints are noted in the specification for the construction of the dwelling, noting the use of lead primers on exterior woodwork, GSL considers that the curtilage of the original dwelling has the potential to be impacted by the historic use of lead based paints.

GSL considers that soil immediately surrounding the original 1960's dwelling could potentially have been impacted by lead based paints if the exterior paint on the dwelling had been in deteriorated condition, or at times when routine maintenance such as sanding, or scraping were undertaken without adequate ground protection in place.

The potential effects of lead based paint on the surrounding soil would be expected to be concentrated in the area surrounding the dwelling where paint chips, flakes, or dust had infiltrated the soil, lead can then leach out of the paint into the soil resulting in elevated concentrations in the soil. Those concentrations are generally limited to the immediate curtilage and rapidly attenuate with distance and depth from the source (the dwelling), only impacting the surficial soils within that curtilage. As the dwelling in question is primarily brick clad, and lead primers were noted for use on external woodwork only, and the lead content in 160s paints was significantly lower than pre-1940 paints, the potential for impacts to present a risk to human or environmental health is considered to be low.

5.2 ASBESTOS CONTAINING MATERIALS IN BUILDINGS

ACM has been widely used in an array of building materials for an extensive period of New Zealand's building materials history. While its use was widely concluded by 1990, New Zealand legislation notes that its use cannot be ruled out on buildings constructed prior to 1 January 2000. As a result, the presence of asbestos within the buildings cannot be ruled out.

With regards to ACM, the potential for soil contamination is only present if ACM is in deteriorated or broken condition. No broken or degraded ACM was identified during the site inspection suggesting that if ACM is present within the building, it is most likely in good condition.

As with lead based paint, ACM is only likely to impact soil immediately adjacent to the original dwelling, and small sheds along the northern site boundary and as such are not considered to present a potential for gross soil contamination across the site as a whole.

With respect to the demolition of any building constructed prior to 1 January 2000 the *Health and Safety at Work (Asbestos) Regulations 2016, demands* a fully intrusive pre-demolition hazardous building materials survey to be undertaken before demolition works can commence. The survey must be conducted by a suitably WorkSafe NZ licensed asbestos assessor and will identify the location and extent of any hazardous building materials, specifically ACM. Should ACM be identified in the survey then asbestos removal works will be required prior to the demolition of the dwelling, the removal must be completed by an appropriately licensed asbestos removal contractor and under the controls of an asbestos removal control plan (to be provided by the appointed contractor. The hazardous building materials survey will form the basis of any asbestos removal control plan.

5.3 EFFLUENT DISPOSAL INFRASTRUCTURE

Domestic effluent disposal infrastructure is considered by Auckland Council to be encompassed under Items G.5 and G.6 of the MfE HAIL as waste disposal to land. Should the existing septic tank and disposal field require decommissioning and removal as part of the proposed future development, works in this area will need to address the requirement of the NES and Auckland Unitary Plan (Operative in Part) with respect to contamination regulations.

Effluent disposal fields are likely to result in small scale impacts limited to the topsoil horizon where the effluent liquor is dispersed. In GSL's experience, impacts are unlikely to extend beyond the boundaries of the disposal field and generally do not exceed 400 mm in depth meaning that a small localised area will likely require remedial earthworks during decommissioning. Impacts are considered unlikely to be pervasive across a large area.

6 CONCLUSIONS

GSL has undertaken a preliminary site investigation, in general accordance with the MfE Contaminated Land Management Guidelines, of the property located at 102 Totara Road, Whenuapai. The primary purpose of this investigation is to assess the likelihood of any potential contamination issues being present on site, and if so, comment on the applicability of the regulations of the NES and Chapter E.30 of the AUP(OP).

This investigation has identified potential sources of contamination on site to be the discrete area surrounding the original 1960's residential dwelling and former shed locations along the norther site boundary. Due to the age of the original dwelling, which was constructed in 1969, GSL considers that the following potential sources of contamination will require further investigation should any change in landuse, subdivision, or development works be proposed in that area:

- Historical use of lead based paints; and
- Potentially asbestos containing building materials utilised in the residential dwellings and sheds on site.

Additionally, plans held within the property file identify the location of the onsite domestic wastewater treatment systems (septic tank and effluent disposal field) associated with the two residential dwellings, which Auckland Council have considered to be encompassed by Items G.5 and G.6 on the MfE HAIL. GSL concludes that should any change in landuse, subdivision, or development of that portion of the land be proposed, then these small scale, localised points will require further investigation and likely require localised remedial works.

With regards to the wider site area, outside of the commentary above, GSL did not identify any evidence for any potentially contaminating activity included on the MfE Hazardous Activities and Industries List having been undertaken on the site. GSL therefore concludes that the risk for actual or potential contamination on the site to be low and concludes that with respect to the wider site area that any future change in landuse, subdivision, or development would be highly unlikely to result in a risk to human health or the environment.

6.1 NATIONAL ENVIRONMENTAL STANDARDS

As a result of the identification of potentially contaminating landuses within the residential footprint on site, any change in landuse, subdivision, or development of that area will be required to address the regulations of the NES. As there is no distinct evidence for any activity included on the MfE HAIL having occurred or being more likely than not to have occurred on the wider site area, the wider site area does not meet the definition of *"Land Covered"* under Regulation 5(7), as a result, the regulations of the NES are not applicable to the change in landuse, subdivision, or development of those areas.

With respect to the immediate area of the original dwelling, while the NES is applicable to the development of that portion of the site, GSL notes that the area and volume of impacted soils is likely to be extremely limited in the scale of the overall development. The disturbance of potentially lead impacted soil within the dwelling curtilage and the effluent disposal systems are likely to be well within the remit of a Permitted Activity under Regulation 8(3) of the NES. Regulation 8(3) allows for the disturbance and offsite disposal of soil on actually or potentially contaminated sites as a permitted activity while the following conditions are met:

a) *"Controls to minimise the exposure of humans to mobilised contaminants must -*
   i. *Be in place when the activity begins;*
   ii. *Be effective while the activity is done;*
   iii. *Be effective until the soil is reinstated to an erosion resistant state;*

b) *The soil must be reinstated to an erosion resistant state within 1 month after serving the purpose for which the activity was done*

c) *The volume of disturbance on soil must not be more than 25 m^3 per 500 m^2;*

d) *Soil must not be taken away in the course of the activity except that -*
   i. *For the purpose of laboratory analysis, any amount of soil may be taken away as soil samples;*
   ii. *For all other purposes combined, a maximum of 5 m^3 per 500 m^{2}may be taken away per year.*

e) *Soil taken away in the course of the activity must be disposed of at a facility licensed to receive soil of that kind;*

f) *The duration of the activity must be no longer than two months;*

g) *The integrity of a structure designed to contain contaminated soil must not be compromised."*

For a site of this size (4.7551 Ha) Regulation 8(3) allows for the disturbance of up to 2,377.55 m^3 and the offsite disposal of up to 475.51 m^3 of soil, per year, as a permitted activity. It is likely that the required soil disturbance and offsite disposal of any actually or potentially impacted soil will fall within those volumes.

A site management plan will likely be required to document the controls to be in place for the protection of human and environmental health for the duration of soil disturbance in those areas in order to meet the requirements of Regulation 8(3).

6.2 AUCKLAND UNITARY PLAN (OPERATIVE IN PART)

For the same reasons as the NES above, the majority of the site does not meet the Auckland Council definition of *"land containing elevated levels of contaminants"* and as such, the contaminated land rules of Chapter E.30 of the AUP(OP) will not apply to the proposed change in landuse, subdivision, and development of the site.

That said, the area of the residential dwelling and disposal field may meet that definition, and technically, the contaminated land rules of the Chapter E.30 may be applicable to soil disturbance in that area. That said, the AUP(OP) allows for the small scale disturbance of soil on actually or potentially contaminated land as a permitted activity under Rule E.30.6.1.2, which provides for small scale disturbance while the following conditions are met:

1. *"The volume of soil disturbed must not exceed:*
   a. *200 m^3 per site; or*
   b. *200 m^3 per project for sites or roads with multiple concurrent land disturbance projects, where the cumulative total volume of soil disturbance associated with each given project will be used when determining activity status; or*
   c. *an average depth and width of 1 m for linear trenching by network utilities in the road or rail corridor. For the purposes of this rule the rail corridor does not include land more than 10 m from the rail tracks.*
2. *Prior to the activity commencing:*
   a. *the Council must be advised of the activity in writing if the volumes of soil disturbed on land containing elevated levels of contaminants exceeds 25 m^3, including details of the*

measures and controls to be implemented to minimise discharges of contaminants to the environment, and such controls are to be effective for duration of the activity and until the soil is reinstated to an erosion-resistant state; and

- b. *control on linear trenching must be implemented to manage discharges to the environment from trenches acting as migration pathways for contaminants;*

3. *Any discharge from land containing elevated levels of contaminants must not contain separate phase liquid contaminants including separate phase hydrocarbons.*
4. *The duration of the soil disturbance on a site must not exceed two months.*
5. *Any contaminated material removed from the site must be disposed of at a facility or site authorised to accept such materials."*

Where the disturbance of soil required to address the above potentially impacted areas can comply with the above conditions, GSL considers that the remediation of those areas can be undertaken as a permitted activity. Following the completion of those remedial works, the contaminated land rules of Chapter E.30 will no longer be applicable to the proposed development.

7 RECOMMENDATIONS

In order to address the requirements of the NES and Chapter E.30 of the AUP(OP) a site management plan will be required to document the controls to be in place for the protection of human and environmental health from the potential mobilisation of contaminants in soil during soil disturbance works.

Thank you for the opportunity to carry out this investigation. Should you have any queries regarding this report please do not hesitate to contact us on 09 475 0222.

Report prepared on behalf of GSL by:	Report authorised on behalf of GSL by:
David Wilkinson Environmental Scientist Geosciences Ltd	Carl O'Brien General Manager Geosciences Ltd

Disclaimer

This report is provided on the condition that Geosciences Ltd disclaims all liability to any person or entity other than the client and Auckland Council in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Geosciences Ltd disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in our proposal and according to our general terms and conditions and special terms and conditions for contaminated sites.

Statement

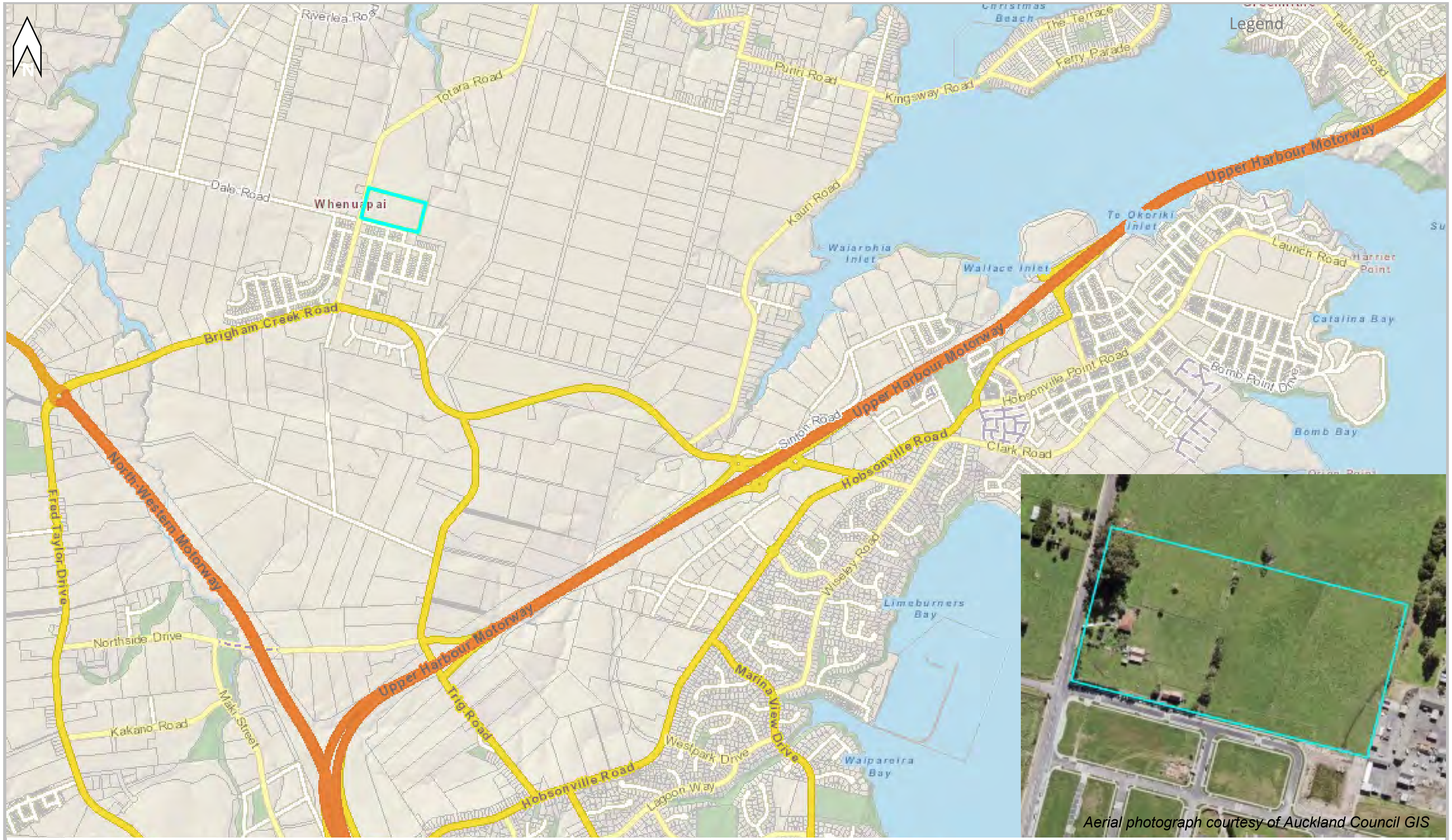
This site investigation has been prepared in accordance with the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011. It has been managed by a suitably qualified and experienced practitioner (SQEP); and reported on in accordance with the current edition of the Ministry for the Environment's *Contaminated Land Management Guidelines No.1 – Reporting on Contaminated Sites in New Zealand.*

8 LIMITATIONS

The conclusions and all information in this Report are given strictly in accordance with and subject to the following limitations and recommendations:

1. The assessment undertaken to form this conclusion is limited to the scope of work agreed between GSL and the client, or the client's agent as outlined in this Report. This report has been prepared for the sole benefit of the client and neither the whole nor any part of this report may be used or relied upon by any other party.
2. The investigations carried out for the purposes of the report have been undertaken, and the report has been prepared, in accordance with normal prudent practice and by reference to applicable environmental regulatory authority and industry standards, guidelines and assessment criteria in existence at the date of this report.
3. This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by GSL for use of any part of this report in any other context.
4. This Report was prepared on the dates and times as referenced in the report and is based on the conditions encountered on the site and information reviewed during the time of preparation. GSL accepts no responsibility for any changes in site conditions or in the information reviewed that have occurred after this period of time.
5. Where this report indicates that information has been provided to GSL by third parties, GSL has made no independent verification of this information except as expressly stated in the report. GSL assumes no liability for any inaccuracies in or omissions to that information.
6. Given the limited Scope of Works, GSL has only assessed the potential for contamination resulting from past and current known uses of the site.
7. Environmental studies identify actual sub-surface conditions only at those points where samples are taken and when they are taken. Actual conditions between sampling locations may differ from those inferred. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated and GSL does not guarantee that contamination does not exist at the site.
8. Except as otherwise specifically stated in this report, GSL makes no warranty or representation as to the presence or otherwise of asbestos and/or asbestos containing materials ("ACM") on the site. If fill has been imported on to the site at any time, or if any buildings constructed prior to 1970 have been demolished on the site or materials from such buildings disposed of on the site, the site may contain asbestos or ACM .
9. Except as specifically stated in this report, no investigations have been undertaken into any off-site conditions, or whether any adjoining sites may have been impacted by contamination or other conditions originating from this site. The conclusion set out above is based solely on the information and findings contained in this report.
10. Except as specifically stated above, GSL makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.
11. The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.
12. Use, development or re-development of the site for any purpose may require planning and other approvals and, in some cases, environmental regulatory authority and accredited site auditor approvals. GSL offers no opinion as to whether the current or proposed use has any or all approvals required, is operating in accordance with any approvals, the likelihood of obtaining any approvals, or the conditions and obligations which such approvals may impose, which may include the requirement for additional environmental works.
13. GSL makes no determination or recommendation regarding a decision to provide or not to provide financing with respect to the site. The on-going use of the site and/or planned use of the site for any different purpose may require the owner/user to manage and/or remediate site conditions, such as contamination and other conditions, including but not limited to conditions referred to in this report.
14. Except as required by law, no third party may use or rely on, this report unless otherwise agreed by GSL in writing. Where such agreement is provided, GSL will provide a letter of reliance to the agreed third party in the form required by GSL.
15. To the extent permitted by law, GSL expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this Report. GSL does not admit that any action, liability, or claim may exist or be available to any third party.
16. Except as specifically stated in this section, GSL does not authorise the use of this report by any third party.

FIGURES



geosciences ltd
ENVIRONMENTAL

Level 1, 47 Clyde Road, Browns Bay, 0630
Tel: (09) 475 0222

Title: **Figure 1—Site location**

Project name: 102 Totara Road, Whenuapai, Auckland

Reference: J1394
Date: 19/09/2019
Drawn: KW
Approved: CB

APPENDIX A CERTIFICATE OF TITLE

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier NA4A/1477
Land Registration District North Auckland
Date Issued 29 July 1964

Prior References
NA1166/90

Estate Fee Simple
Area 4.7551 hectares more or less
Legal Description Lot 1 Deposited Plan 53062

Registered Owners
Totara Gateway Trustee Limited as to a 1/2 share
Roderick McCrae Harre and Andrea Elizabeth Flora Harre as to a 1/2 share

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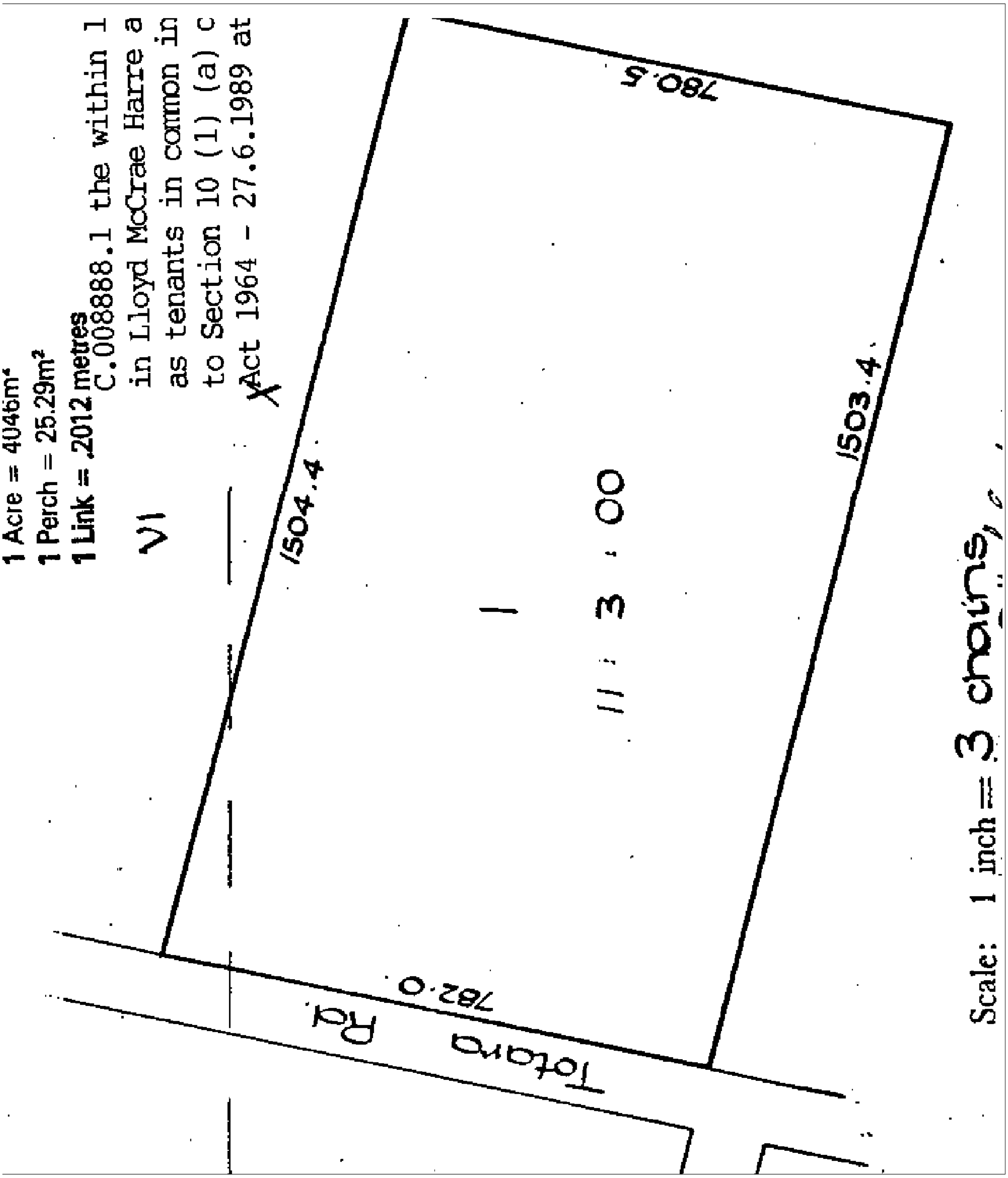
Interests



C.0088888.1 the within 1
in Lloyd McCrae Harre a
as tenants in common in
to Section 10 (1) (a) c
Act 1964 - 27.6.1989 at

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Historical Search Copy

R.W. Muir
Registrar-General
of Land

Constituted as a Record of Title pursuant to Sections 7 and 12 of the Land Transfer Act 2017 - 12 November 2018

Identifier	**NA4A/1477**
Land Registration District	**North Auckland**
Date Issued	29 July 1964

Prior References
NA1166/90

Estate	Fee Simple
Area	4.7551 hectares more or less
Legal Description	Lot 1 Deposited Plan 53062

Original Registered Owners

Lloyd McCrae Harre as to a 1/2 share

Lois Violet Harre as to a 1/2 share

Interests

9177796.1 Transmission of a 1/2 share/interest Lloyd McCrae Harre to Lois Violet Harre as Executor - 10.9.2012 at 8:28 am

10414652.1 Transfer of a 1/2 share/interest Lois Violet Harre to Totara Gateway Trustee Limited - 3.6.2016 at 2:23 pm

11264700.1 Transmission of a 1/2 share/interest Lois Violet Harre as Executor to Roderick McCrae Harre as Executor, Andrea Elizabeth Flora Harre as Executor and Lisa Janine Roberts as Executor - 4.2.2019 at 4:12 pm

11264700.2 Transfer of a 1/2 share/interest Roderick McCrae Harre as Executor, Andrea Elizabeth Flora Harre as Executor and Lisa Janine Roberts as Executor to Roderick McCrae Harre and Andrea Elizabeth Flora Harre - 4.2.2019 at 4:12 pm

Reference: 1166/90
Prior C/T.

Transfer No. A 22681
N/C. Order No.

Land and Deeds 69

No. 4A/1477

REGISTER

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT

This Certificate dated the 29th day of July one thousand nine hundred and sixty-four under the seal of the District Land Registrar of the Land Registration District of NORTH AUCKLAND

WITNESSETH that LOIS VIOLET HARRÉ wife of LLOYD McCRAE HARRÉ OF Whenuapai, farmer

is seised of an estate in fee-simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial underwritten or endorsed hereon) in the land hereinafter described, delineated with bold black lines on the plan hereon, be the several admeasurements a little more or less, that is to say: All that parcel of land containing 11 ACRES 3 ROODS more or less being Lot 1 Deposited Plan 53062 and being part Allotment 3 Parish of Waipareira.

DISTRICT LAND REGISTRAR NORTH AUCKLAND N.Z.

Assistant Land Registrar.

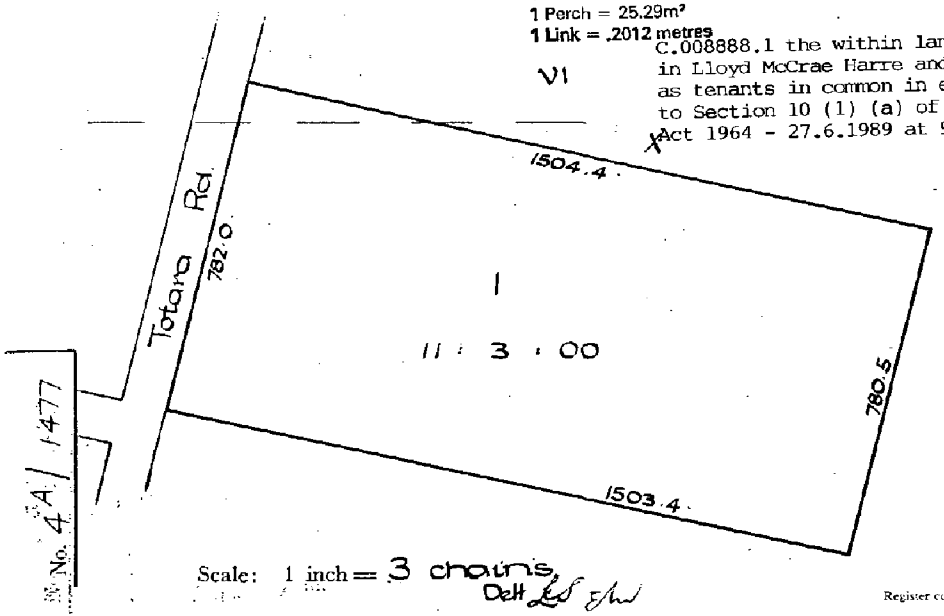
610476.2 Settled under the Joint Family Homes Act 1964 on the abovenamed 27.4.1976 at 10.12 o'c.
Cancelled see C.008888
For A.L.R.

B.772623.1 Mortgage to John Baxter Western Connett - 20.1.1988 at 9.15 o'c.
B871727.1 DISCHARGED 5/8/1988
A.L.R.

Waitemata S.D.

METRIC AREA IS ~~4.7550ha~~ 4.4550ha
Conversion Factors:
1 Acre = 4046m²
1 Perch = 25.29m²
1 Link = .2012 metres

C.008888.1 the within land is now revested in Lloyd McCrae Harre and Lois Violet Harre as tenants in common in equal shares pursuant to Section 10 (1) (a) of the Joint Family Homes Act 1964 - 27.6.1989 at 9.00 o'c
A.L.R.



Scale: 1 inch = 3 chains
Dett

Register copy for L. & D. 69, 71,72

C.667707.1 Mortgage to Trust Bank Auckland Limited - 19.10.1994 at 11.58 o'c

DISCHARGE

C 926736, 28 | 11 Aug

A.L.R.

APPENDIX B HISTORICAL AERIAL PHOTOGRAPHS

Title:	**Figure 1—Historic aerials**	**Reference:**	J1394
Project name:	102 Totara Road, Whenuapai	**Date:**	17/09/2019
		Drawn:	KW
geosciences	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Approved:**	CB

Title:	**Figure 1—Historic aerials**	**Reference:**	J1394
Project name:	102 Totara Road, Whenuapai	**Date:**	17/09/2019
geosciences Ltd ENVIRONMENTAL	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Drawn:**	KW
		Approved:	CB

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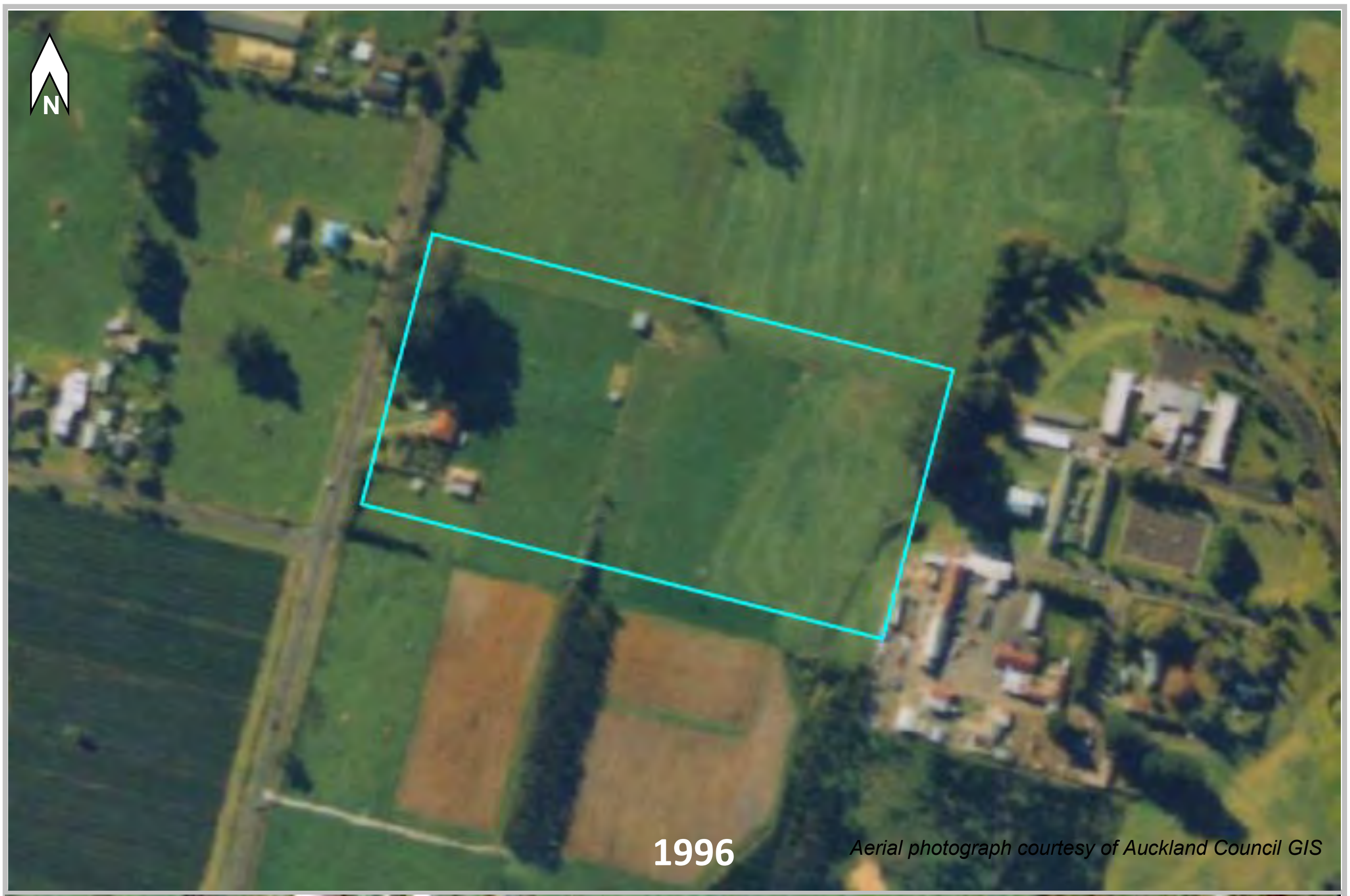
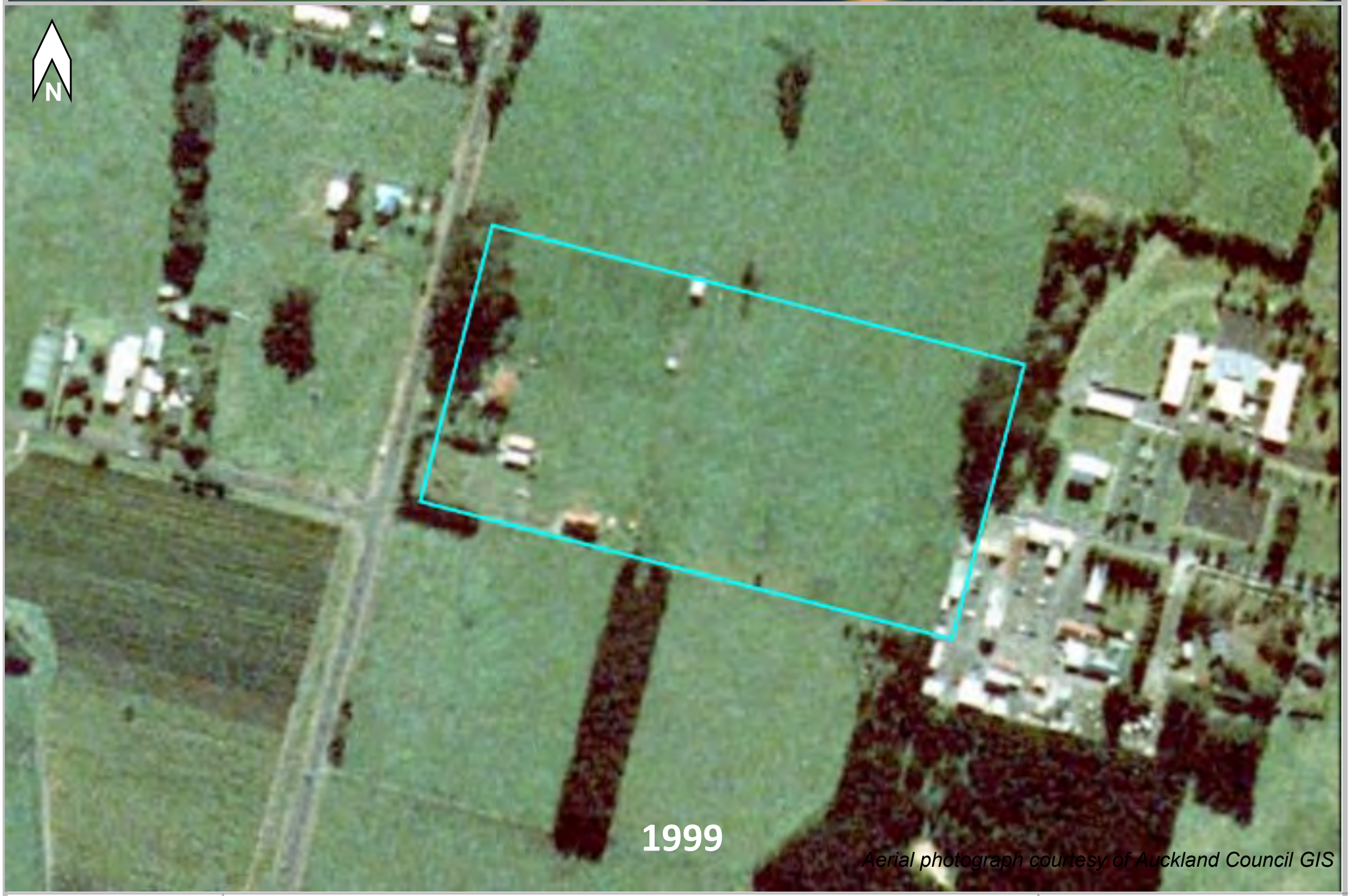
		Approved:	CB





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Aerial photograph courtesy of Auckland Council GIS

Aerial photograph courtesy of Auckland Council GIS

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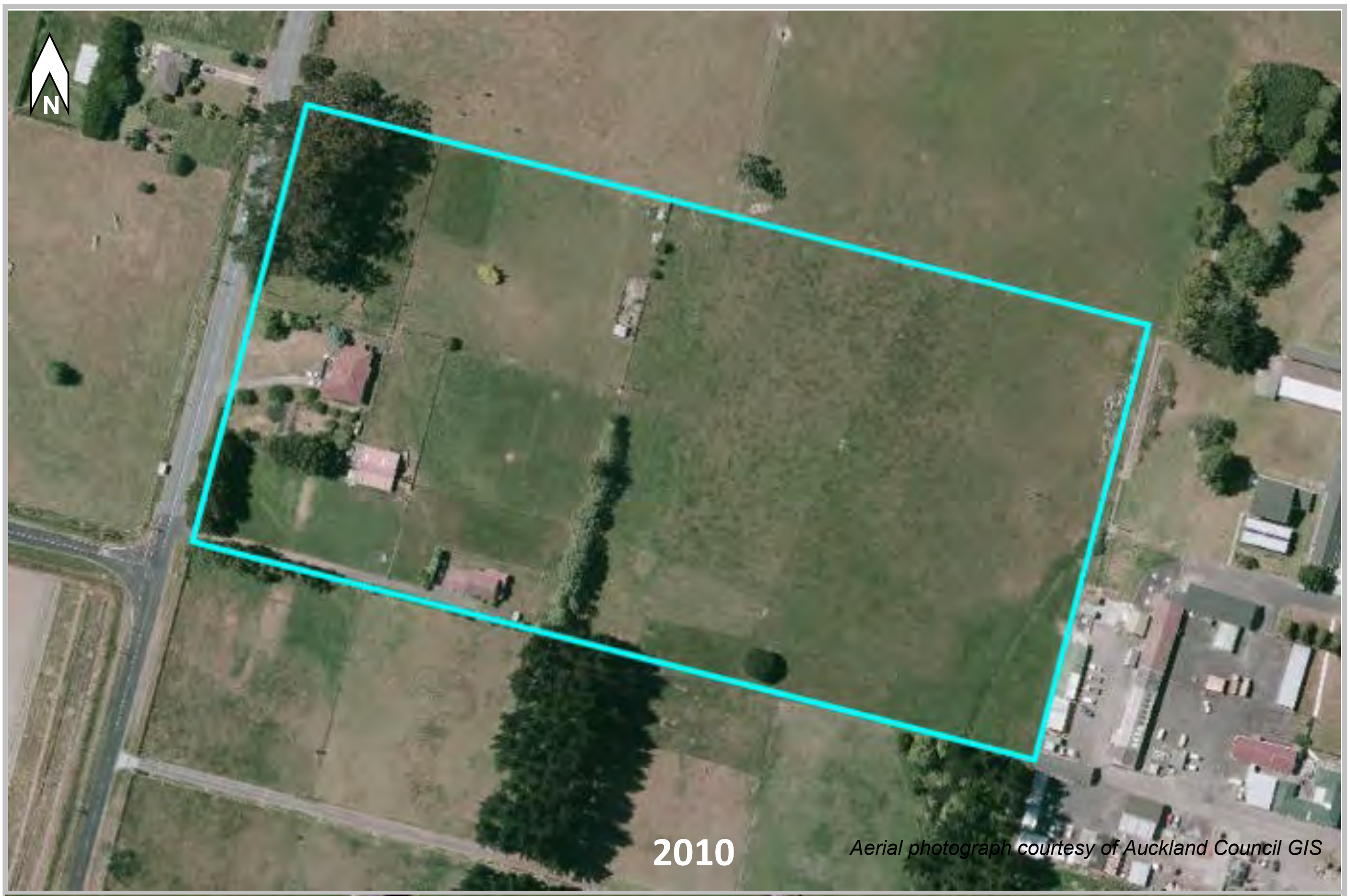
Project name:	102 Totara Road, Whenuapai	**Drawn:**	KW
geosciences ltd ENVIRONMENTAL	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Approved:**	CB



Aerial photograph courtesy of Auckland Council GIS

Aerial photograph courtesy of Auckland Council GIS

Title:	**Figure 1—Historic aerials**	**Reference:**	J1394
Project name:	102 Totara Road, Whenuapai	**Date:**	17/09/2019
		Drawn:	KW
geosciences ltd ENVIRONMENTAL	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Approved:**	CB

Aerial photograph courtesy of Google Earth

Aerial photograph courtesy of Auckland Council GIS

Title:	**Figure 1—Historic aerials**	**Reference:**	J1394
Project name:	102 Totara Road, Whenuapai	**Date:**	17/09/2019
		Drawn:	KW
geosciences ltd ENVIRONMENTAL	Level 1, 47 Clyde Road, Browns Bay, 0630, Tel: (09) 475 0222	**Approved:**	CB

APPENDIX C PROPERTY FILE EXTRACTS

N Riding [illegible]tekere.

Roll No. 327A / 204/

County of Waitemata

№ 4172

BUILDING PERMIT

Date 11.12.63.

Owner of Section L.V. HARRE,

Address No. 2. R.D., Kumeu.

This Permit is granted to the undermentioned person authorising the following building work on

Lot No. 1, D.P. 9146, Part of Allot. 3, Waipareira Parish.

on ~~Western Boundary~~ TOTARA, Road Whenuapai in accordance with the plans lodged and

subject to the following conditions: Subject to the provisions of Sect. 22 (5) of the Counties Amendment Act, 1961.

10-12 Airport Road

Nature of proposed work

Dwelling.

Harre and Silcock,
222 Te Atatu Road,
TE ATATU.

Value of work, £ 4,950

Fee £18 : - : - Rec. No 11061

For the Waitemata County Council.

L. L. JONES,
County Clerk.

per ....
County Building Inspector.

UP 84945

APPLICATION No. 800/13 PERMIT No. 4172

VALUATION Roll No. 327A/2041 DATE ISSUED 11.12.1963

DATE STAMP
RECEIVED
- 4 DEC 1963
WAITEMATA COUNTY COUNCIL
(INSPECTORS DEPT.)

WAITEMATA COUNTY COUNCIL

P.O. BOX 5440 — NEWTON, AUCKLAND, C.2

Application for a Building Permit

OWNER OF SECTION. NAME LOIS VIOLET HARRÉ PHONE No. 659 WHENUAPAI
(BLOCK CAPITALS)

PRESENT POSTAL ADDRESS NO 2 RD KUMEU

BUILDER. NAME HARRÉ AND SILCOCK PHONE No. 4710 HND

POSTAL ADDRESS 222 Te Atatu Rd Henderson

(Note:—Permit will be posted to builder unless otherwise requested).

NATURE OF PROPOSED BUILDING WORK Construction of a Dwelling

VALUE OF WORK £4950 FEE £18 : 0 : 0 (See back page).

FULL LEGAL DESCRIPTION OF SECTION (as appears on either rate demand or title deeds).

LOT 1 OP 9146 PART OF ALLOT 3 Waipareira Parrish

NAME OF PREVIOUS OWNER OF SECTION JAMES NEIL ANDERSON AND LOIS VIOLET HARRÉ

AREA OF SECTION 10 Acre(s). Frontage 416 Feet.

ROAD NAME [illegible] ~~WESTERN BOUNDRY~~ LOCALITY WHENUAPAI

To [illegible] **FOR OFFICE USE ONLY**

Footpath-Deposit	~~Refund~~
Fee / /	Amount / /
Recpt.	To
Paid By	
Date	Date

Remarks: This is Now Lot
1 DP DP.53082
16868

Permit issued subject to the following conditions:—

APPROVED By E C Memme BUILDING INSPECTOR 10/12/63 DATE

APPROVED BY E C Memme DRAINAGE INSPECTOR 10/12/63 DATE

FEE £ 18 : – RECEIPT No. 11061 DATE 4.12.63

UP—68108

APPROVED
IN ACCORDANCE WITH
TOWN PLANNING SCHEME
SIGNED
DATE 8.12.63

SPECIFICATION

FOUNDATIONS

If solid concrete. Size of footings 12"x12" Walls Reinforcing 4 - 1/2 MS Rods

~~If~~ concrete blocks. Size 16x8x8 VIBROPAK Spacing —

N.B.—All blocks must be at least 12" in to ground on a 12" x 12" x 4" concrete pad.

FRAMING

	Size	Spacing	Span	Timber
Jack Studs (Note: If base over 6ft. in height, Jack studs to be spaced at 20in. centres).	—	— Along Runs.		—
Bearer Plates	12x5 RSJ	Supported in centers with ONE 10x10 pillars		
Floor Joists	9x2	14"	13'0"	TAN. PINUS
Outer Studs	4x2	18"		" "
Inner Studs	4x2 + 3x2	18"		" "
Ceiling Joists	4x2	18"		" "

Bottom Plates. Size 4x2 + 3x2 Top Plates. Size 4x2 + 3x2

Noggins. Size WALL THICKNESS Number of rows of noggins 3

N.B.—**Minimum** stud height for dwellings is 8 feet.

ROOF

Covering DECRAMASTIC TILES Ridges. Size 9x1 TAN Purlins. Size

Collar ties. Size 6x1 Sarking. Size — Under Purlins 4x3

	Size	Spacing.	Span	Timber
Rafters	4x2	24"		TAN PINUS

MISCELLANEOUS

Flooring. Size 4x1 T&G Exterior Sheathing BRICK VENEER

Inside lining GIB BOARD + FIBER CEILINGS

Is any second hand material to be used in the proposed constructions? NO

N.B.—Top window trimmers must be checked ½" or otherwise supported.

SANITATION

Privy Type WC e.g. Water closet, chemical pan or night soil?

N.B.—If chemical pan or night soil pan, the privy building must be at least 15' away from any dwelling.

DRAINAGE & PLUMBING

All drainage and plumbing must be carried out by registered tradesmen. If it is intended to install a septic tank, now or in the future, the site must be inspected by the Sanitary Inspector before building is commenced.

IT IS MOST IMPORTANT that buildings should not be occupied before complete plumbing and drainage systems have been installed and officially approved.

Signature of Applicant L. J. Harré

SITE PLAN

RESIDENTIAL SECTIONS

The site plan must be accurately drawn to the scale provided (16 feet to 1 inch).

ALL OTHER SECTIONS

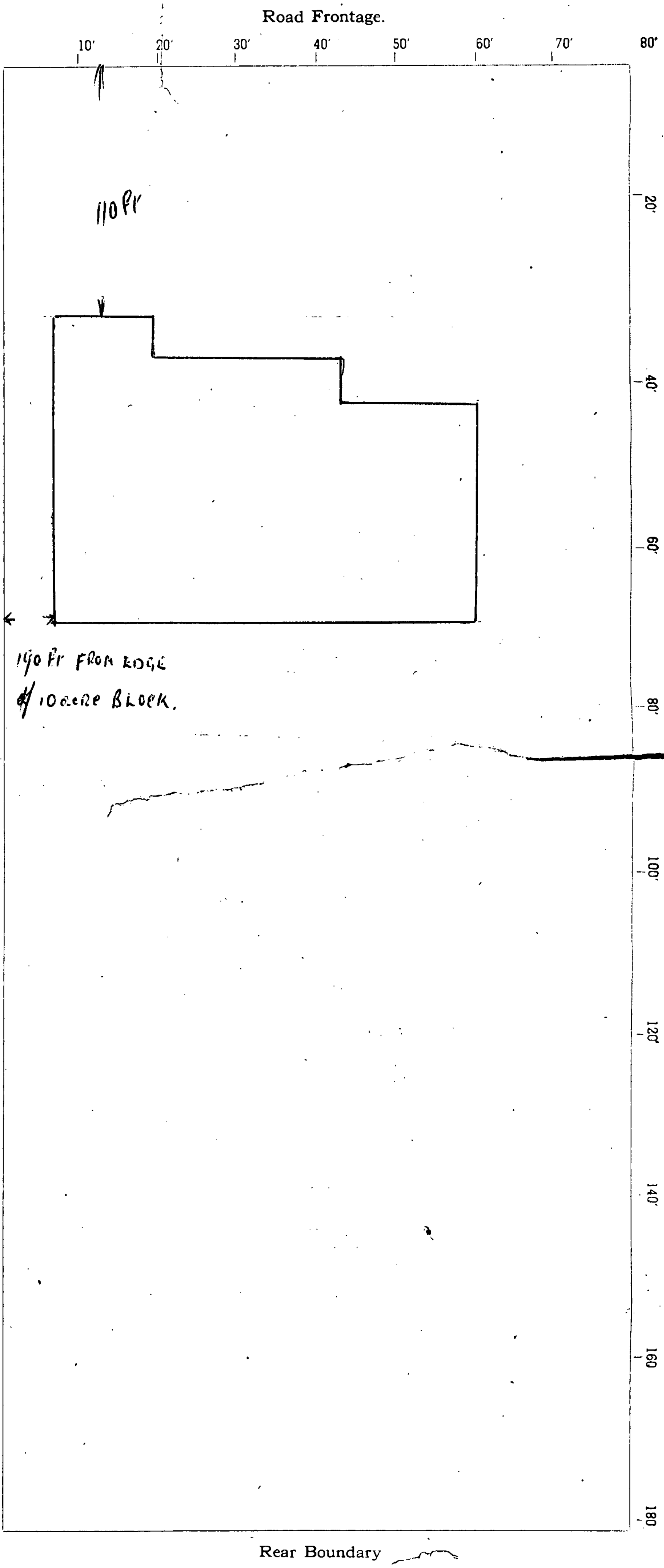
(including farms, etc.)

Please state scale used.

Note

1. This site plan must show the desired position of the proposed building and also ALL existing buildings.
2. Distances of each building from boundary lines must be clearly indicated.
3. No building shall be erected closer than 3 feet to a side boundary. This measurement is from the fascia board in the case of an overhanging roof.
4. Separate plans, drawn to scale (preferably ⅛" or ¼" to 1'), must be submitted, showing a ground plan, and elevations of two sides. In cases of extensions to existing buildings, these plans should show the whole building, and the extension should be shaded or coloured.
5. Applications must be made in duplicate and two copies of the plan must be supplied if applying for a permit to erect a dwelling, bach or if any plumbing or drainage is to be installed.
6. Location plan must be completed.

PENCIL DRAWINGS WILL NOT BE ACCEPTED.



This and the succeeding pages form the specification referred to in our Agreement dated this ....day of..............1963.

EMPLOYER ....

CONTRACTOR ....

WITNESS ....

SPECIFICATION of work to be done and materials to be used in the erection of a Residence at West Boundary Rd., Whenuapai.

CONTRACT. This contract includes the supply and delivery of all materials, Labour, fittings, tools, plant etc. complete and necessary for the due and proper completion of the building as shown on the plans and herein specified in a thorough and workmanlike manner in strict accordance with the Local By-Laws and to the satisfaction of the Owner. No lower grade than O.B. timber shall be allowed in any part of the work. All timber to be treated as to get the best results for both seasoning and straightness. All joints to be properly scarfed and checked or otherwise jointed in an approved manner and everything securely nailed. In exposed woodwork, all nails to be punched. All work to be fixed level, plumb and true and no butts will be allowed where same can be concealed. All exposed interior timbers to be hand dressed and sanded.

PERMITS: Contractor to comply with the Labour and Building By-Laws of the District; to apply for and obtain all the necessary permits and to pay all fees for same.

PROVIDE & FIX: The words "provide" and "fix" shall be construed to mean "provide and "fix" where used separately unless otherwise specified.

INSURANCE: The Contractor to have all his employees covered against accident by an "Employer's Liability Policy" and to take out Insurance against fire for a sum sufficient to cover 75% of the contract sum. Both policies to remain in force until the building is taken over by the Owner. Fire insurance to be placed with a reputable Company.

SETTING OUT: The Contractor will do all setting out, and be responsible for same.

MATERIALS WORKMANSHIP: All workmanship to be careful, thorough and in accordance with the best trade practice, and all materials must be of the best of their respective kinds, unless distinctly otherwise specified. Workmanship shown on the plans or specified and not shown, must be supplied as though shown and specified. Materials shown but not specified must be of the kind commonly employed for the service it is intended to perform. All materials to be new and the best of their respective kinds. All figured dimensions shall be taken in preference to scale and strictly adhered to, and all detail drawings shall supersede these to a smaller scale.

EXTRAS: No extras will be allowed for unless authorised in writing by the Owner, and paid for as such.

STABILITY ETC.: The Contractor shall carefully brace and support all parts of his work against damage by wind and also protect same from damage by water. He shall also make good damage to adjoining property of every kind arising out of his works.

CLEANING: The Contractor at the conclusion of the operations shall have all ceilings, walls and woodwork carefully dusted and wiped down, windows washed and glass left free from scratches, floors brushed and wiped and the entire building left in perfectly clean condition for occupation.

TURFING: Area covered by house to be turfed and left clean of all stumps roots etc. and carted away on site where directed.

MAINTENANCE: Period to be thirty days after the Owner has taken possession. Any defects in materials, workmanship or any part or parts that require replacing or adjusting which have been included in this contract shall be adjusted or replaced as specified in this specification at the Contractor's own expense.

MATERIALS: In the event of any materials herein specified not being procurable at the time it is required or will tend to stop the progress of the contract, such materials may be substituted with other mateeials, provided however, that the substituted materials conform with the Local By-Laws and to the wishes of the Owner whom the Contractor is to notify first. At the conclusion of the contract, the Contractor will adjust any difference in cost.

BASE WALLS: To be 8" Vibcorak block with 8" x 10" reinforced concrete band.

Walls to be laid true to level in straight lines and plumb with mortar. Exterior of all blockwork to be plastered and splash coated. Clean out all cavities and flush all joints in the brickwork on the inside.

VENTS: Provide concrete mouseproof vents spaced 3 ft. away from angles and approx. 6 ft. between.

FLOOR JOISTS: To be 9 x 2 and gauged to an even surface and nailed with 3" and 4" nails to all bearers and plates. All joints to be lapped on a bearer.

BRICKLAYER AND CONCRETOR.

CONCRETE: All concrete work to be carried out according to the Local By-Laws. For general purposes, the mixture shall be 4-2-1 metal, ~~and~~ sand and cement or 6 parts river shingle to 1 part cement well mixed and rammed into trenches and boxing immediately after mixing.

MORTAR: To be composed of four parts clean, sharp and washed sand to one part Portland cement. Use Mortaflex at the rate of 1 gallon to 1 cubic foot of cement.

BRICKS: For all exterior walls and chimneys to be selected common Glenburn bricks or selected Tunnel kiln using Bullnosed bricks for external corners and window openings. All bricks to be well wetted and allowed to partially dry out before being laid. No bats will be allowed unless necessary for bond. Joints shall not exceed 5/16" in thickness and the work to be carried out regularly with no work rising more than one foot above existing work. All exterior joints to be well raked as work proceeds, and on completion of brickwork to be pointed with a mixture of 3 parts silica sand to 1 part coloured cement, using a 1/4" flat pointing tool. Colour of cement to be chosen by Owner. The whole of exterior brickwork on completion to be cleaned down with a weak solution of acid and left clean and tidy to Owner's satisfaction.

FOOTINGS: The footings shall be 12 x 12 reinforced with four ½" M.S. rods. The footings shall be horizontal on the bottom throughout and stepped to suit the nature of the ground.

DAMPCOURSE: All timbers in contact with concrete or brickwork to have Malthoid under.

CHIMNEY: Chimney to be precast concrete Petrous No. 1.

CHIMNEY FOOTING: Chimney footings to be a concrete slab 6" wider each side of brickwork and reinforced with 3/8" M.S. rods at 12" centres.

FRONT PORCH FLOOR: To be 4" thick concrete with slight fall to front, reinforced with 3/8" M.S. rods at 9" centres both ways. Steps are to be 6" risers 12" treads finished as per porch floor. Back porch to be finished as for front porch.

LAUNDRY: Provide one single 2 ft. concrete wash tub and fix on concrete stand.

CARPENTER AND JOINER.

ALL MATERIALS ARE TO BE THE BEST OF THEIR RESPECTIVE KINDS AND GRADES AND LAID TRUE TO THEIR VARIOUS LEVELS AND CONSTRUCTED IN A PROPER TRADESMANLIKE MANNER TO MAKE THE WHOLE OF THE WORKS SOUND CONSTRUCTION AND TO COMPLY WITH THE LOCAL BY-LAWS IN EVERY RESPECT AND TO THE ENTIRE SATISFACTION OF THE BUILDING INSPECTOR.

JOINERY.

All exterior door and window frames to be as shown in plans, to be grooved, treated and constructed in a proper manner and primed before fixing. Exterior door frames to be fitted with 3/8" galv. weather bar in sills.

SASHES: All sashes and fanlights to be cedar or totara to the sizes as shown on plan and details. All sashes to be neatly fitted and hung with Whitco fittings. Allow for split sashes where shown on plans. All sashes except where otherwise mentioned to be glazed with 18 oz. clear glass. Landscape sashes to be glazed with drawn plate or 3203 glass. Bathroom and W.C. sash will be glazed obscure to Owner's choice.

DOORS: All interior doors except where otherwise mentioned to be 6'6 x 2'8 x 1¾ H.T.P. flush panel hung on three 3½ steel butts. Front door and back door to be glass doors, 2'10" wide x 1¾ ht. Totara H & P hung on three 4" butt hinges. Wardrobes and linen press doors to be 6'6 x 2' approx. and same pattern as interior doors, hung on three 3½" butt hinges. Kitchen cupboard doors to be flush panel to the dimensions required and hung on 2¼" A.C. hinges and fitted with handles and catches complete, to the Owner's choice.

CITY OF WAITEMATA

Roll No. / /
32740/358/2

BUILDING PERMIT

№ 12461

Owner of Section HARRE. L.M.

Date 24th July 1979

Address Totara Rd, Whenuapai.

THIS PERMIT is granted to the undermentioned person authorising the following building work on Lot No. 1 D.P.53062

on 102 - 104 Totara Rd, Whenuapai. in accordance with the plans lodged and

subject to the following conditions: 1) Spouting, downpipes and stormwater drainage to be provided to the approval of the Inspector. 2) To notations on plans.

Nature of proposed work TRACTOR SHED.

R.M. HARRE,
35 Toru St,
TE ATATU NORTH

Value of work, $3,500

Fee $ 23 0: 0 Rec. No. J7 18/6/79

For the Waitemata City Council

Duly Authorised Officer.

FOR FURTHER CONDITIONS SEE OVER

ity Press 50659/79

Building Inspected. Date .... Insp. Intls. ....

7/9/79 Footing ....

5/10/79 P/Floor ....

28/11/79 ~~Post~~ Roof post holes ....

9/2/81 Final - Stormwater drainage required.

Final Inspection 15/7/81 ....

.... Inspector

Register Noted. Date ....

City of Waitemata

Telephone HSN 61-195, 61-119
PRIVATE BAG, HENDERSON
AUCKLAND 8.
ADDRESS ALL CORRESPONDENCE
TO THE CITY SECRETARY

JOHN HENRY CENTRE
6 PIONEER ST.
HENDERSON
AUCKLAND 8.

JPB:AR

9 February 1981

Mr R M Harre
35 Toru Street
TE ATATU

Dear Sir,

RE: BUILDING PERMIT 12461 - Tractor Shed on Lot 1 DP 53062 TOTARA ROAD, WHENUAPAI

In connection with the above building permit, I would advise that an inspection of the property on 9.2.81 has revealed that the following points require attention before the file can be finalised and the road damage deposit refunded:-

STORMWATER DRAINAGE TO BE PROVIDED TO THE APPROVAL OF THE INSPECTOR

Once the above work has been completed, you are requested to contact the Building Inspector at the above address on any week day between the hours of 8.30 and 9.45a.m. so that a further inspection can be arranged.

Alan ? JB. 27/3

Yours faithfully,

J.P. BRABBS
for CITY INSPECTOR

Work not done. Discussed with Mrs Harre. B/u in normal manner without writing

8/4/81

Copy sent to:
Mr L M Harre

102-104 Totara Road
WHENUAPAI

15/7/81

CITY OF WAITEMATA

Roll No. / /
32740/358/2

BUILDING PERMIT

№ 12461

Owner of Section HARRE. L.M.

Date 24th July 1979

Address Totara Rd, Whenuapai.

THIS PERMIT is granted to the undermentioned person authorising the following building work on Lot No. 1 D.P.35062

on 102 - 104 Totara Rd, Whenuapai. in accordance with the plans lodged and

subject to the following conditions: 1) Spouting, downpipes and stormwater drainage to be provided to the approval of the Inspector. 2) To notations on plans.

Nature of proposed work TRACTOR SHED.

R.M. HARRE,
35 Toru St,
TE ATATU NORTH

Value of work, $3,500

Fee $ 23 0: 0 Rec. No. 37 18/6/79

For the Waitemata City Council

Duly Authorised Officer.

Unity Press 50659/79

APPLICATION No. 251/12
FINAL CHECK Initials
Date 23/7

PERMIT No. 12461
DATE ISSUED 24/7/79
Authorised Officer

HEAD OFFICE DATE STAMP
RECEIVED
19 JUN 1979
Waitemata City Council Inspectors Dept.

CITY OF WAITEMATA

JOHN HENRY CENTRE, 6-8 PIONEER STREET, HENDERSON
POSTAL ADDRESS: PRIVATE BAG, HENDERSON 8 — PHONE: HSN 61-195 and 61-119
INSPECTORS DEPARTMENT ON GROUND FLOOR

BUILDING PERMIT APPLICATION

OWNER OF SECTION: NAME L. M. HARRE (BLOCK CAPITALS) PHONE No. WEI 8659
PRESENT POSTAL ADDRESS TOTARA RD. WHENUAPAI
BUILDER: NAME R. M. HARRE PHONE No. HSN 45.019
POSTAL ADDRESS 35 TORU ST TE ATATU NTH
(Permit will be posted to builder unless otherwise requested)
SIGNATURE OF APPLICANT R M Harre

NATURE OF PROPOSED BUILDING WORK

TRACTOR SHED

VALUATION ROLL NO.
32740/358/2

FULL LEGAL DESCRIPTION OF THE PROPERTY (as per Rate Demand or Title Deeds)

LOT 1
D.P. 53062

VALUE OF WORK

Building (including the materials for Plumbing & Drainage)	$3500.00
***Drainage** (excluding materials)	$
***Plumbing** (excluding materials)	$
•**Building Permit Fee**	$23.00

*Separate permits to be obtained by Drainlayer and Plumber.
•Fee to be assessed on value of work excluding amount upon which Drainage and Plumbing Fees payable and may be paid at time of lodging application.

†A further 25% is payable on this fee where structural check is required.

FLOOR AREA OF PROPOSED WORK

Basement	
Ground Floor	72 sq.m
First Floor	
Others	
Total	72 sq.m

Building Research Act 1969
LEVY ON TOTAL VALUE OF $3,000 OR MORE INCLUDING DRAINAGE AND PLUMBING WORK
Fee: $1.00 per $1000 or part thereof

Amount of Levy	4.00
Receipt No.	J7
Date	18/6/79

NAME OF PREVIOUS OWNER OF SECTION
AREA OF SECTION: 4.7551 Ha ~~square metres~~ (Show large sites in hectares) FRONTAGE: 150 metres
ROAD NAME TOTARA RD LOCALITY WHENUAPAI

IMPORTANT — SEE INSTRUCTIONS ON PAGE FIVE

FOR OFFICE USE ONLY

REMARKS

Permit issued ~~subject to the following conditions~~ TO NOTATIONS ON PLANS
SPOUTING DOWNPIPES AND STORMWATER DRAINAGE TO BE PROVIDED TO THE APPROVAL OF THE INSPECTOR

Approved by a. Foster Building Inspector 30/6/79 Date
Approved by G Bonifacio Plumbing/Drainage Inspector 4-7-79 Date
Approved by Health Inspector Date

Town Planning Zoning Rural A Date and Officer
Approved by GJM Town Planning Officer 20/6/79 Date

Building Permit Fee	$23.00	Receipt No. J7	Date 18/6/79
Structural Checking Fee *	$5.75	Receipt No. e100 ✓	Date 19/7/79
Road Damage Deposit Fee	$100.00	Receipt No.	Date ✓
Road Damage Deposit Refund	$	To	Date
Cost of Vehicular Crossing	$ EXS/S		Date

Electricity Transmission Lines: ~~Present~~/Not present over property Initials GS Date 3/7/79	WCC Sanitary and Stormwater Sewers checked — Release/~~Hold~~ Initials GB Date 3/7/79	Location of ARA Trunk Sewers checked — Release/~~Hold~~ Initials GB Date 3/7/79

6

PLEASE REFER TO INSTRUCTIONS ON PAGE FIVE

SPECIFICATION

TO BE COMPLETED BELOW FOR MINOR BUILDINGS
(Full specifications are required for all other work)

FOUNDATIONS

If solid concrete. Size of footings 300 x 300mm Walls 200mm Reinforcing D12

If concrete blocks. Size .... Spacing ....

N.B. — All blocks must be at least 300mm into ground and set on a 300mm x 300mm x 100mm concrete pad.

FRAMING

	Size	Spacing	Span	Timber
Jack Studs	100x50	600 mm		No1 MG
Bearer Plates	100x75			No1 MG T
Floor Joists	150x50	450 mm	2.70 m	No1 MG
Outer Studs	100x50	600 mm		No1 MG
Inner Studs	100x50	600 mm		" "
Ceiling Joists				

Bottom Plates Size 100x50 Top Plates Size 100x50

Noggins Size 100x50 Number of rows of noggins 2 ROWS

N.B. (a) Minimum stud height for dwellings is 2.4m.
(b) Top window trimmers must be checked 15mm or otherwise supported.

ROOF

Covering 24g GALV. IRON Ridges Size .... Purlins Size 150x50

Sarking Size .... Under Purlins ....

	Size	Spacing	Span	Timber
TRUSSES ~~Rafters~~	100x50	2.90 m	6.00 m	No1 MG RAD

MISCELLANEOUS

25mm TAN R/S RAD

Flooring Size 150x25 R/S TAN RAD Exterior Sheathing BOARD & BATTEN

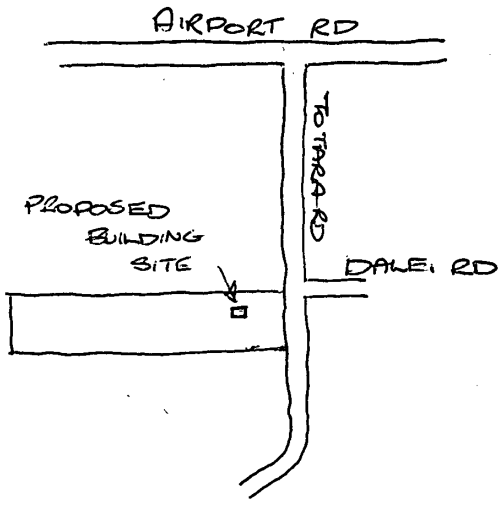
Inside Lining ....

Is any second-hand material to be used in the proposed Construction? NO If YES, then a separate application must accompany this form.

SANITATION

Privy Type .... e.g. water closet, chemical pan or other type?

LOCALITY SKETCH TO SHOW LOCATION OF BUILDING SITE
(Must be completed)



DRAINAGE AND PLUMBING

ALL DRAINAGE AND PLUMBING MUST BE CARRIED OUT BY REGISTERED TRADESMEN. IF IT IS INTENDED TO INSTALL A SEPTIC TANK, NOW OR IN THE FUTURE, THE SITE MUST BE INSPECTED BY THE INSPECTOR BEFORE BUILDING IS COMMENCED.

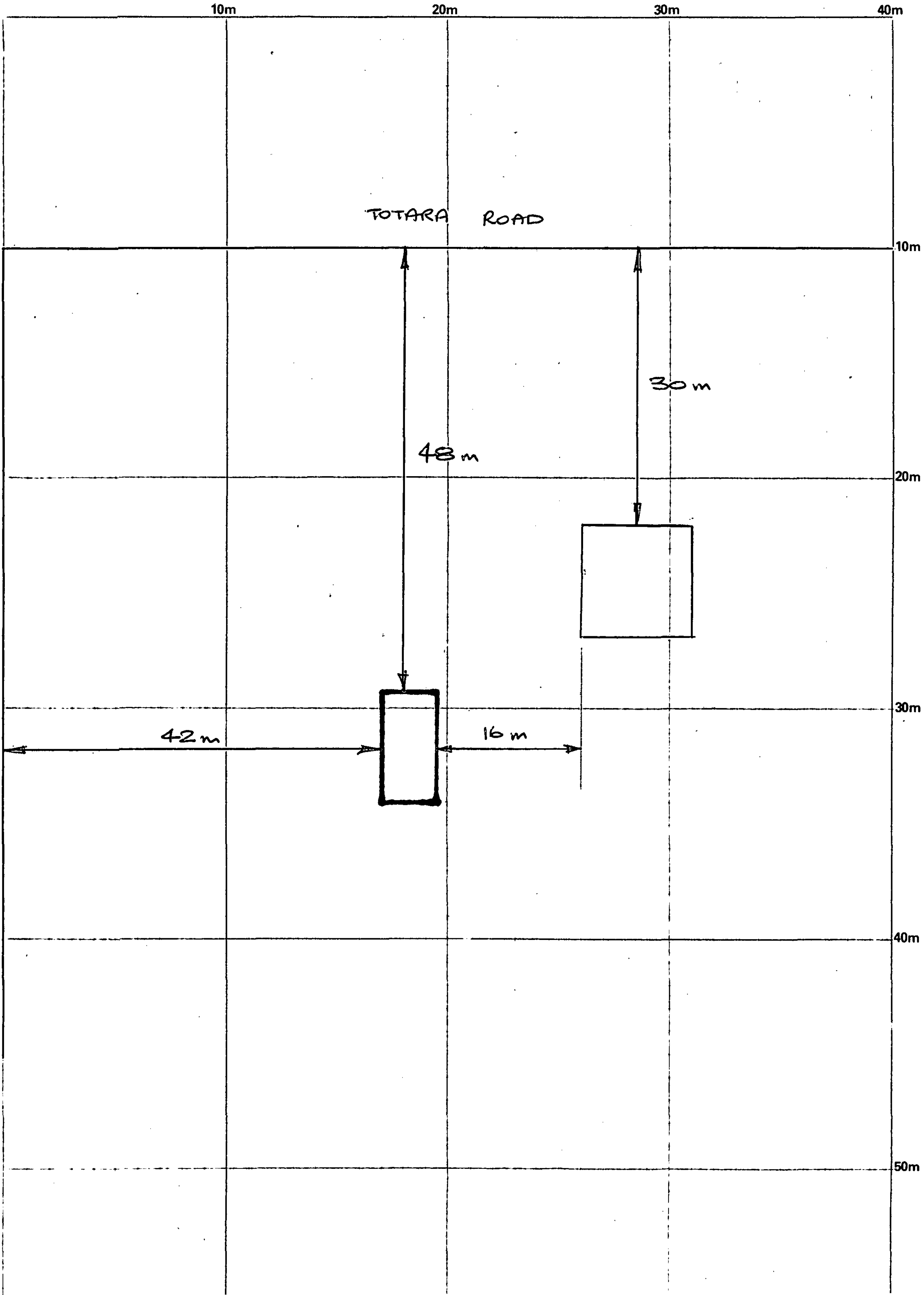
IT IS MOST IMPORTANT THAT BUILDINGS SHOULD NOT BE OCCUPIED BEFORE COMPLETE PLUMBING AND DRAINAGE SYSTEMS HAVE BEEN INSTALLED AND OFFICIALLY APPROVED.

PLUMBING AND DRAINAGE PERMITS MUST BE OBTAINED BEFORE ANY PLUMBING OR DRAINAGE WORK IS COMMENCED.

PLEASE REFER TO INSTRUCTIONS ON PAGE FIVE

SITE PLAN: (a) All existing buildings are to be shown in black ink and new buildings in red.
(b) For residential sections the site plan must be accurately drawn to the scale provided. 1:200 (i.e., one square equals one metre).
(c) All other sections (including farms, etc), please state scale used.
(d) All dimensions MUST be specified.

ROAD BOUNDARY



FOR OFFICE USE ONLY

REPORT ON COMMERCIAL OR INDUSTRIAL BUILDING
STRUCTURAL ENGINEER'S REPORT

REPORT C (1)

B.P. APPLICATION NO. 251/12

APPLICANT's NAME: L.M. HARRE

BUILDER'S NAME: R.M. HARRE

PROPOSAL: TRACTOR SHED

LEGAL DESCRIPTION: LOT: 1 D.P. 53062

ROAD NAME & LOCALITY: TOTARA RD WHENUAPAI.

CALCULATIONS & STRUCTURAL CHECK

1\. THE FOLLOWING AMENDMENTS, ALTERATIONS OR ADDITIONAL INFORMATION MUST BE MADE (OR SUPPLIED), BEFORE APPROVAL CAN BE CONSIDERED: (Please list clearly, and date and sign requirements):-

1) Roof structure. ✓
2) Lateral bracing to Section of wall exceeding 6m. ✓
3) Verandah beam/supports/pads.
4) Overspanned joists (Section A-A)
5) Overspaced blocks + overspanned bearer (Section A-A).

*(a) RECOMMENDATION:
The matters listed in (1) above (when applicable), have been settled to my satisfaction and I recommend that the application be APPROVED subject to the following conditions:-

EXTRA NOTES AS SHOWN.

*(b) ~~I recommend that the application be NOT APPROVED for the following reasons:~~

* Delete not applicable

Dealth with by V. Hoppe Date 11/7/79
(STRUCTURAL ENGINEER)

City of Waitemata

JOHN HENRY CENTRE
6 PIONEER ST.
HENDERSON
AUCKLAND 8.

Telephone HSN 61-195, 61-119
PRIVATE BAG, HENDERSON
AUCKLAND 8.
ADDRESS ALL CORRESPONDENCE
TO THE CITY SECRETARY

JPB:YMM

13 July 1979

Mr.R.M.Harre,
35 Toru St,
TE ATATU NORTH.

Dear Sir,

RE: BUILDING PERMIT APPLICATION 251/12 - Tractor Shed on Lot 1 DP 53062 Totara Road, Whenuapai.

In connection with the above building permit application, you are advised that a structural checking fee of $5.75 is required.

Please forward your remittance with the duplicate copy of this letter direct to the writer at the above address so that your application can be finalised.

Yours faithfully,

Brabbs

J.P.BRABBS
for CITY INSPECTOR

e100. BP

10 JUL 1979

CITY OF WAITEMATA

PRIVATE BAG HENDERSON, 8

This receipt is **NOT** a permit. No work is to be executed until a **PERMIT** is **OBTAINED.**

Received from R. McHazze

Details of payment.

B Pap. 251/12

02-051-22 Building Permit Fee	
02-052-22 Plumbing & Drainage Permit Fees	
03-955-22 Structural Checking Fee	5 75
- 82-22 Private Crossing	
- 653-22 Footpath Damage Deposit	
- 656-22 Building Research Levy	
TOTAL $	5 75

CASH	☐
CHEQUE	☑

only.

Receipt is acknowledged of amount pri

2 100 ********575=a 67

CITY TREASURER p.p. ....

City of Waitemata

JOHN HENRY CENTRE
6 PIONEER ST.
HENDERSON
AUCKLAND 8.

Telephone HSN 61-195, 61-119
PRIVATE BAG, HENDERSON
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ADDRESS ALL CORRESPONDENCE
TO THE CITY SECRETARY

9/2/81

Mr R. M. Hasse,
35 Tom St
Te atatu.

Dear Sir,

RE: BUILDING PERMIT 12461 - Tractor Shed on Lot 1 DP 53062 Totara Rd Whenuapai.

In connection with the above building permit, I would advise that an inspection of the property on 9/2/81 has revealed that the following points require attention before the file can be finalised and the road damage deposit refunded:-

1) ~~SPOUTING DOWNPIPES AND~~
STORMWATER DRAINAGE TO BE
PROVIDED TO THE APPROVAL
OF THE INSPECTOR

Once the above work has been completed, you are requested to contact the Building Inspector at the above address on any week day between the hours of 8.30 and 9.45a.m. so that a further inspection can be arranged.

Yours faithfully,

J.P. BRABBS
for CITY INSPECTOR

Copy sent to:

Mr L. M. Hasse
102-104 Totara Rd
Whenuapai.

MONITORING CHECK SHEET

Consent Number : 981696

Propertry ID : ~~Lot 1 DP 53062~~ 492

Property Location : 102 Totara Rd, Whenuapai

Legal Description : Lot 1 DP 53062

Inspection date : 7/05/01

Compliance Y/N : Y

Comments :

All conditions have been met

ENTERED

J.F. Denton

Reinspection date 2 :

Comments :

Reinspection date 3 :

Comments :

Legal action initiated :

Final clearance : 07/05/01

98/4205 $ Ø nor
2/5/2001

DIPROSE
CONSULTANTS LTD
CIVIL & STRUCTURAL ENGINEERS

27 September 1999 Job no. 98135

ENTERED

Mr R Harre
102 Totara Rd
Whenuapai
AUCKLAND

Dear Sir,

INSPECTION OF EFFLUENT DISPOSAL SYSTEM FOR MINOR DWELLING AT 102 TOTARA RD, WHENUAPAI

As required by council, we have visited the above mentioned property and observed the effluent disposal system that has been constructed.

We note that the system that was installed was not a Reflection Nibbler Jnr System as specified in our report Job no. 98135/1 dated 21 September 1999. An Oasis Clearwater series 2000 has instead been installed.

Based on the information provided by the manufacturer we believe that the Oasis Clearwater series 2000 system should perform quite suitably for your purposes. Please refer to the asbuilt plan supplied by the Contractor for the layout of the system.

We were unable to observe the system in its entirety but discussions with the Contractor suggest that the system has been competently constructed. At the time of our visit the system was complete and we understand that it has been functioning satisfactorily.

We are satisfied on reasonable grounds that the treatment system and disposal field have been installed generally in accordance with normal acceptable practice for this type of system and the relevant recommendations given in our above mentioned report but noting that the system has been substituted by a Oasis Clearwater series 2000 system.

295 Lincoln Rd
Waitakere City.
P O Box 77038, Mt Albert.
Ph/Fax: 0-9-836 5522
Mobile: 0-25-749 949

Note that this letter does not certify that the treatment plant itself is as per the manufacturers design.

We trust the above is satisfactory for your present requirements. If we can be of further assistance, please do not hesitate to contact us.

Yours faithfully,
DIPROSE CONSULTANTS LTD

P L Diprose BE (Hons), MIPENZ, Registered Engineer

Waitakere *City Council*
Te Taiao o Waitakere

Waitakere City Council
Civic Centre
6 Waipareira Ave
Waitakere City

Private Bag 93109
Henderson
Waitakere City

Telephone
09 836 8000

Facsimile
09 836 8001

DX CX 10250 Auckland Mail Centre

Email: info@waitakere.govt.nz

21 September 1998

LOIS VIOLET HARRE
102 TOTARA RD
WHENUAPAI
WAITAKERE CITY 1250

* 102-104 Totara Rd *
Whenuapai

Dear Sir/Madam

Resource Consent Application Number RMA981696
Location: 102-104 TOTARA RD, WHENUAPAI, WAITAKERE CITY 1008.

I am pleased to advise that your Resource Consent (Planning) application has been considered and consent has been granted pursuant to sections 94, 104, 105, and 108 of the Resource Management Act 1991.

The report considering your application and the decision which has been made is attached. The conditions must be met for your consent to be valid.

Please note also that you must establish the activity within two years. If that does not happen the consent lapses and you may need to apply for an extension or a new consent.

If you are dissatisfied with the decision or conditions of consent you have an opportunity to object to the Council. If you want to do this you will need to write a letter outlining your concerns. You should refer to section 357 of the Resource Management Act 1991 which covers objections to decisions (see the guideline attached). Any objections must be made in writing within 15 working days of your receipt of this letter.

Please contact MATT HEALE of the Resource Management Section (extn 8621) if you have any general queries about the enclosed report or decision.

If you are dissatisfied with the decision and are considering lodging an objection you may wish to discuss the matter first with Peter Reaburn, Planning Manager (836-8014).

Yours faithfully

P.P.

Peter Reaburn
PLANNING MANAGER

ENTERED

AS BUILT DRAINAGE PLAN

Waitakere City Council
Te Tatao o Waitakere

SITE INFORMATION

Building Consent No: 98004205

Inspector:

Owners Name: HARRIE

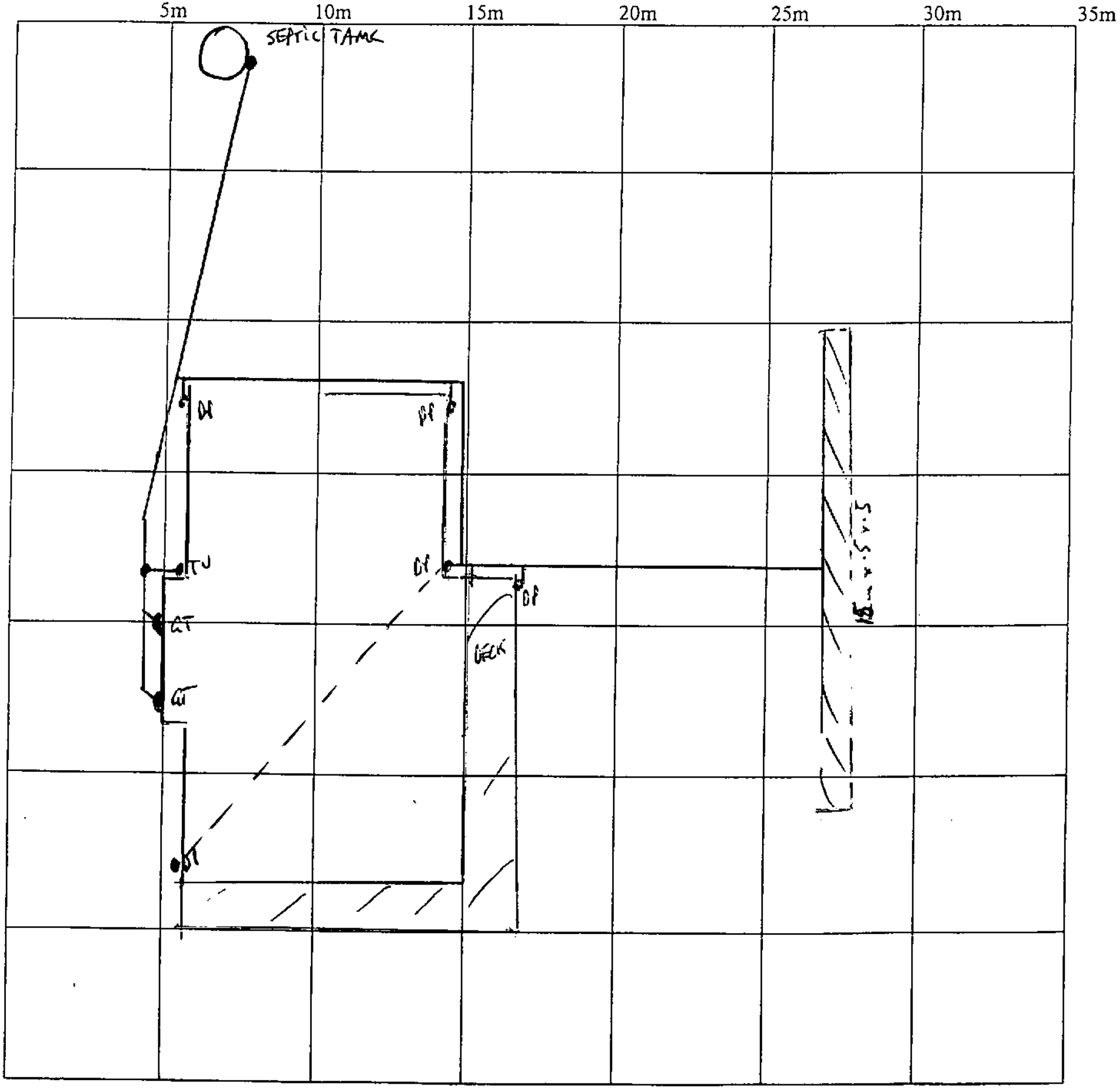
Drainlayers Name: MARK WINSLOW

Site Address: 102 TOTARA RD WHEN

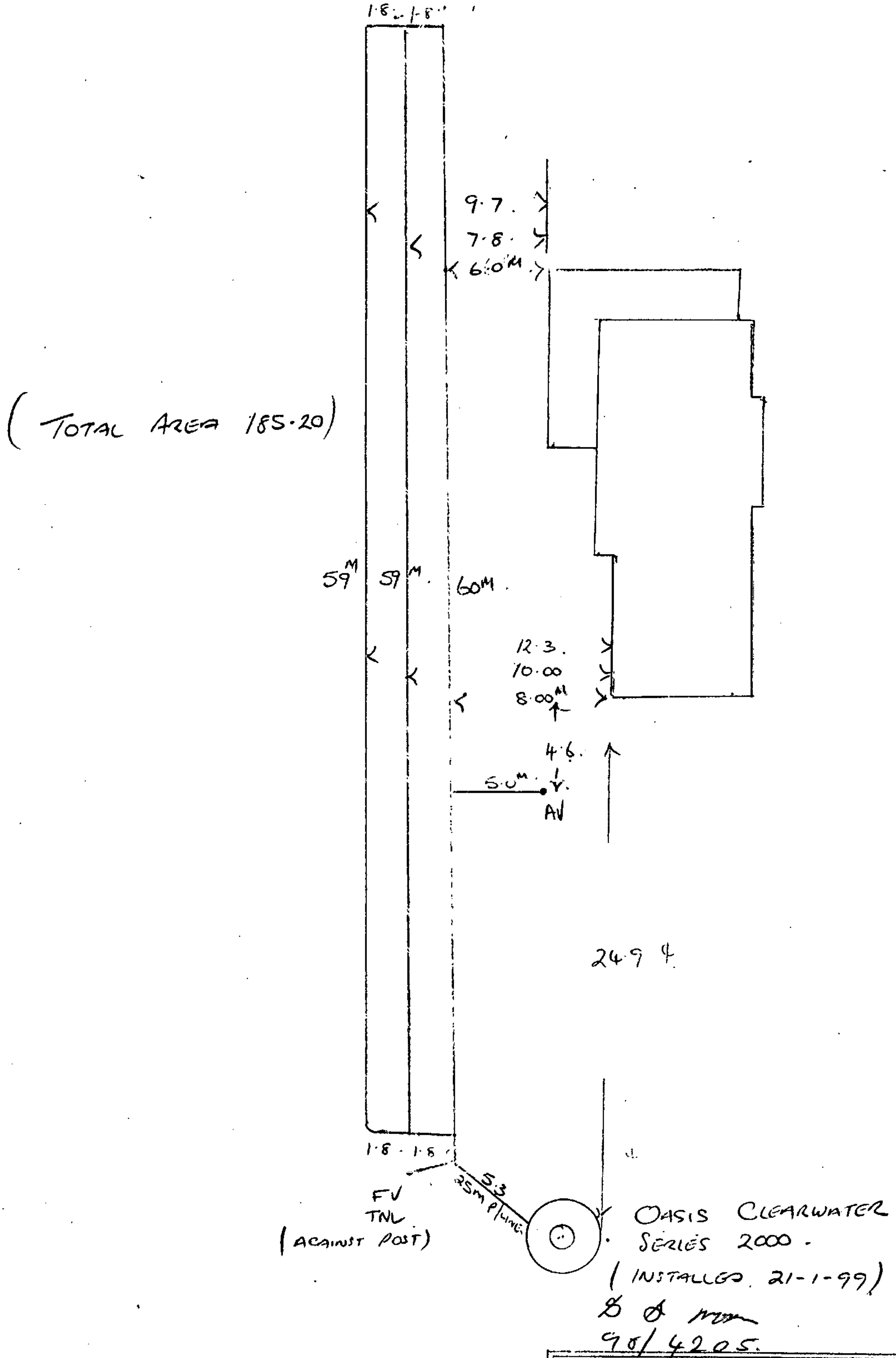
Lot: 1 DP: 53062

Date inspected: 20/4/99

Drainage plans are required for all new work and extensions to drains including effluent disposal systems. The plan is to be completed accurately drawn in ink to a scale of 1:200 and must show clearly the street boundary, property boundaries, outline of the buildings as well as the layout of ALL drains and inspection fillings. Please indicate the scale used if it is different than 1:200. Please ensure that this as built plan is completed prior to the inspection of the drainage work. Failure to comply may delay the approval of your work.



102 TOTARA ROAD 492



Harre House.
102 Totara Road
Whenuapai.
ID: 492
Scale 1:200.

ENTERED

DRAINAGE 1 LTD

REGISTERED DRAINLAYERS
FREEPHONE 0800 888 248, PO BOX 626 OREWA
GST Number: 90-024-272

Oasis Clearwater
ENVIRONMENTAL SYSTEMS

FIELD SERVICE REPORT/TAX INVOICE S 1384

NAME: Lloyd Harre PHONE/CONTACT NUMBER: 416 8659

SITE ADDRESS: 102 Totara Rd Whenuapai

POSTAL ADDRESS:

COUNCIL: Waitakere DATE LAST SERVICED: 1 12 08 DATE THIS SERVICE: 2 7 09

Your Oasis Clearwater Home Sewage Treatment Plant was serviced and inspected on the date shown above. The results are as follows:

	CONDITION	REMARKS
Control Panel Mode Lights		
Control Panel Audible Alarm		
Field Isolator Switch	5	
Effluent Pump	4	
Aerator	3	Noisy + Air leaking
Zabel Filter	4	

5=Excellent 1=Poor

	CONDITION	REMARKS
Lids and Manholes	3	Need new bolts.
Bio Mass	5	
Sludge Buildup	5	
Sludge Recycle Pump	4	
Clarifier	3	
Arkel Filter	4	

5=Excellent 1=Poor

Irrigation area evidence of run off or water logging? (1) Normal Area (2) Reduced Area Yes / No

NOTES System has recently been flooded causing sludge to get in pump chamber. Need to clean filter monthly to prevent flooding.

Oasis Contact number (03) 3440262 or Ross Bicknell

WARNING: Correct landscaping around your unit is essential. Warranty of mechanical and electrical equipment is void if flooding occurs. 021 943 001

DRAINAGE 1 LTD

DRAINAGE 1 LTD

REGISTERED DRAINLAYERS

FREEPHONE 0800 888 248, PO BOX 626 OREWA

GST Number: 90-024-272

Oasis Clearwater
ENVIRONMENTAL SYSTEMS

FIELD SERVICE REPORT/TAX INVOICE S 1237

NAME: Llyod Harre PHONE/CONTACT NUMBER: 416 8659

SITE ADDRESS: 102 Totara Rd Whenuapai

POSTAL ADDRESS:

COUNCIL: Waitakere DATE LAST SERVICED: 29 5 08 DATE THIS SERVICE: 1 12 . 08

Your Oasis Clearwater Home Sewage Treatment Plant was serviced and inspected on the date shown above. The results are as follows:

	CONDITION	REMARKS
Control Panel Mode Lights	5	
Control Panel Audible Alarm	No	Sound
Field Isolator Switch	5	
Effluent Pump	4	
Aerator	4	
Zabel Filter	5	

5=Excellent 1=Poor

	CONDITION	REMARKS
Lids and Manholes		
Bio Mass	5	
Sludge Buildup	5	
Sludge Recycle Pump	5	
Clarifier	5	
Arkel Filter	5	

5=Excellent 1=Poor

Irrigation area evidence of run off or water logging? (1) Normal Area (2) Reduced Area ~~Yes~~ / No

NOTES

WARNING: Correct landscaping around your unit is essential. Warranty of mechanical and electrical equipment is void if flooding occurs.

DRAINAGE 1 LTD
REGISTERED DRAINLAYERS
FREEPHONE 0800 888 248, PO BOX 626 OREWA
GST Number: 90-024-272

Oasis Clearwater
ENVIRONMENTAL SYSTEMS

FIELD SERVICE REPORT/TAX INVOICE S 1095

NAME: Lloyd Harre PHONE/CONTACT NUMBER: 4168659
SITE ADDRESS: 102 Totara Rd Whenuapai
POSTAL ADDRESS:
COUNCIL: Waitakere DATE LAST SERVICED: Nov 07 K/W. DATE THIS SERVICE: 29 5 08

Your Oasis Clearwater Home Sewage Treatment Plant was serviced and inspected on the date shown above. The results are as follows:

	CONDITION	REMARKS
Control Panel Mode Lights		
Control Panel Audible Alarm		
Field Isolator Switch	5	
Effluent Pump	4	
Aerator	4	
Zabel Filter	4	

5=Excellent 1=Poor

	CONDITION	REMARKS
Lids and Manholes	4	
Bio Mass	3	
Sludge Buildup	3	
Sludge Recycle Pump	5	
Clarifier	5	
Arkel Filter	5	

5=Excellent 1=Poor

Irrigation area evidence of run off or water logging? (1) Normal Area (2) Reduced Area Yes / No

NOTES Primary chamber needs emptying
Raam blocked at far end, dug up and repaired.

WARNING: Correct landscaping around your unit is essential. Warranty of mechanical and electrical equipment is void if flooding occurs.

APPENDIX D SITE PHOTOGRAPHS

PLATE 1: ACCESS TO MAIN DWELLING FROM TOTARA ROAD

PLATE 2: ORIGINAL DWELLING VIEWED FROM TOTARA ROAD

PLATE 3: EASTERN SIDE OF THE ORIGINAL DWELLING

PLATE 4: BREATHER VALVE FOR SEPTIC TANK ASSOCIATED WITH THE ORIGINAL DWELLING

PLATE 5: CHICKEN SHEDS TO THE NORTHWEST OF THE DWELLING

PLATE 6: PENS SURROUNDING THE BARN / TRACTOR SHED

PLATE 7: INTERIOR OF BARN / TRACTOR SHED

PLATE 8: RESIDUAL TREE STUMPS FROM FORMER SHLETERBELT

PLATE 7: STORMWATER FLOWPATH IN SOUTHEAST CORNER OF SITE, ADJACENT TO AIRBASE

PLATE 8: MINOR DWELLING ON SOUTHERN BOUNDARY

PLATE 7: MINOR DWELLING

PLATE 8: PORTACOM SITUATED ON PADDOCK TO THE SOUTH OF RESIDENTIAL DWELLING AND BARN

PLATE 7: LOOKING EAST OVER DOMESTIC FRUIT TREES AND GRAPE VINE SHADEHOUSE

PLATE 8: SHADE HOUSE / PERGOLA FOR GRAPEVINES

Site Management Plan (SMP)

98 – 102 Totara Road, Whenuapai

Reference Number: Rep-1685/SMP/Nov21

Prepared for: Maraetai Land Development

29 November 2021

Geosciences Limited
47 Clyde Road, Browns Bay, Auckland
PO Box 35-366, Browns Bay, Auckland
(09) 475 0222
info@geosciences.co.nz www.geosciences.co.nz

DISCLAIMER

This site management plan is provided on the condition that Geosciences Ltd disclaims all liability to any person or entity other than the client and Auckland Council in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Geosciences Ltd disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in our proposal and according to our general terms and conditions and special terms and conditions for contaminated sites.

STATEMENT

This plan has been prepared in acknowledgement of the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011. It has been authorised by a suitably qualified and experienced practitioner (SQEP); and has been prepared with the intention of providing practices and procedures for the management of potentially contaminated land that meets the criteria of the NES, the MfE guidelines and the requirements of Maraetai Land Development's development plans.

Report prepared on behalf of GSL by:	Report and authorised on behalf of GSL by:
David Wilkinson	Carl O'Brien
Senior Environmental Scientist	Director
G*e*osciences Ltd	G*e*osciences Ltd

TABLE OF CONTENTS

LITS OF TABLES

LIST OF FIGURES

APPENDICES

1 INTRODUCTION

It is proposed to develop the site through the change in landuse from rural residential land / vacant rural land to residential landuse in line with the wider development of Whenuapai under the future urban zoning. As previous investigation (refer Section 2 below) identified potentially contaminating landuses on discrete portions of the site, a Site Management Plan (SMP) is required to document the practices and procedures necessary to mitigate risks associated with the potential mobilisation of contaminants during soil disturbance activities.

Table 1: Site Details

Address	Legal description	Area	Zoning
98-100 Totara Road, Whenuapai	Lot 2 DP 81411	11.61 Ha	Future Urban Zone
102 Totara Road, Whenuapai	Lot 1 DP 53062	4.7551 Ha	Future Urban Zone
Total Area		16.37 Ha	

The properties at the addresses in Table 1 above and shown on Figure 1, are hereafter referred to collectively as 'the site' in this report. The site comprises two large rural residential lots predominantly utilised for pastoral grazing with three residential dwellings located in the north, west and south, the site lies adjacent to the New Zealand Defence Force Whenuapai Air Force Base and further rural residential and rural production activities in the wider area.

GSL understands that earthworks will likely be required across the full extent of the site in order to prepare suitable building platforms, infrastructure and services. In accordance with the National Environmental Standards (NES), this SMP has been prepared to document the site practises to be in place for the protection of human and environmental health as a result of the potential mobilisation of contaminants in soil during soil disturbance works on site. This SMP also documents the site validation requirements relating to the decommissioning of onsite effluent disposal systems associated with the residential occupation of the site.

2 PREVIOUS INVESTIGATIONS AND POTENTIAL CONTAMINANTS

Geosciences Ltd (GSL) has undertaken the following site investigations on the two properties:

- Preliminary Site Investigation (PSI) of 98-100 Totara Road, Whenuapai - *LtR-1073/PSI/May18 (Revised 10 November 2021)*; and
- Preliminary Site Investigation (PSI) of 102 Totara Road, Whenuapai - *Ltr-1394/PSI/Sep19 (Revised 10 November 2021)*

Both of the above investigations included review of historical aerial photographs of the properties, review of the certificates of title, Council property file and visual inspection / walkover of the properties. The investigations revealed that both properties have a similar developmental history, in that they were developed from vacant rural pasture between 1972 (102 Totara Road), and 1996 (98-100 Totara Road) through the construction / relocation of residential dwellings.

As the site is not serviced by reticulated wastewater services, all three residential dwellings on site are serviced by domestic septic tanks and effluent disposal infrastructure. Auckland Council considers that such devices meet the threshold for HAIL activity under Item G.5 and G.6 on the Ministry for the Environment (MfE) Hazardous Activities and Industries List (HAIL). Additionally, due to the age of the original dwelling on 102 Totara Road and the relocated dwelling on 98-100 Totara Road, GSL noted the potential for lead based paint to have been utilised on exterior surfaces on two of those structures. The potential impacts of lead based paint can be encompassed under Item I on the MfE HAIL only where a risk to human or environmental health is present. As the newer dwelling located on the southern boundary of 102 Totara Road was constructed in the early 2000's it is not considered to have been subject to the use of lead based paint.

Due to the small scale of any areas potentially impacted by the use of lead based paints and onsite effluent disposal, the PSI's for both properties concluded that any impacted area could be addressed through remediation by offsite disposal of soil as a permitted activity under Regulation 8(3) of the NES.

The PSI's did not identify any evidence for any HAIL having been undertaken on the wider site area outside the residential dwelling curtilages and effluent disposal systems. It was concluded that outside of those distinct areas on site, it was highly unlikely that the development of the wider site area would result in any risk to human health or the environment.

2.1 ESTIMATED IMPACTED AREAS

Based on GSL's experience, lead concentrations are expected to be elevated within a 3 m halo surrounding each of the original dwellings on site. The following areas will be considered to have been impacted by lead based paint (demarcated on Figure 2):

- 98-100 Totara Road:
    - Area: 234 m^2
    - Depth: 300 mm
    - Volume: 67.2 m^3
- 102 Totara Road:
    - Area: 238 m^2
    - Depth: 300 mm
    - Volume: 71.4 m^3
- ***Total Area:*** ***462 m^2***
- ***Total Volume:*** ***138.6 m^3***

With respect to the septic tanks and disposal fields, no as built plans were included on the property files. In GSL's experience, standard septic tanks in pre-1990s installations are generally 4,500 l or similar, single skin concrete tanks with an overflow / liquid drainage line which will likely be present for 98-100 Totara Road. Auckland Council GEOMaps indicates a "hi-tech" septic tank associated with the newer dwelling on the southern boundary of 102 Totara Road, however no further information about the system was identified but suggests this is likely a modern multi chamber system and shallow drip line discharge.

As the only potentially impacted soil resulting from the tanks themselves is a small amount of soil directly underlying the tank, if a leak had occurred, and the soil directly underlying any dripper lines, only a very small volume of soil will require disposal in order to address the septic tanks and disposal lines. The majority of soil disturbed can be reused to backfill any excavations required to remove and decommission the system. The locations of the septic tanks are also indicated on Figure 2 and GSL expects that <50m^3 of soil disturbance will be required to address the effluent systems.

3 STATUTORY REQUIREMENTS

The following SMP has been prepared in order to address the requirements of the following regulations of the NES and AUP(OP) respectively.

3.1 NATIONAL ENVIRONMENTAL STANDARDS

As the PSI's for each of the properties identified that actually or potentially contaminating landuse activities are more likely than not to have occurred on the site, the regulations of the NES are considered to be applicable to any change in landuse, subdivision and development of the piece of land. However, as the potentially impacted areas are minor in relation to the overall size of the site, GSL considers that any remedial works required can easily meet the permitted activity requirements of Regulation 8(3) of the NES. Regulation 8(3) allows for the small-scale disturbance and offsite disposal of soil where the following criteria are met:

> a) *"Controls to minimise the exposure of humans to mobilised contaminants must -*
>   i. *Be in place when the activity begins;*
>   ii. *Be effective while the activity is done;*
>   iii. *Be effective until the soil is reinstated to an erosion resistant state;*
>
> b) *The soil must be reinstated to an erosion resistant state within 1 month after serving the purpose for which the activity was done*
>
> c) *The volume of disturbance on soil must not be more than 25 m^3 per 500 m^2;*
>
> d) *Soil must not be taken away in the course of the activity except that -*
>   i. *For the purpose of laboratory analysis, any amount of soil may be taken away as soil samples;*
>   ii. *For all other purposes combined, a maximum of 5 m^3 per 500 m^{2}may be taken away per year.*
>
> e) *Soil taken away in the course of the activity must be disposed of at a facility licensed to receive soil of that kind;*
>
> f) *The duration of the activity must be no longer than two months;*
>
> g) *The integrity of a structure designed to contain contaminated soil must not be compromised."*

For a piece of land of this size (16.37 Ha) Regulation 8(3) allows for the disturbance of up to 8,185 m^3 and the offsite disposal of up to 1,637 m^3 of soil per year, as a permitted activity.

The volume of soil required to be disturbed to address potentially lead based paint impacted soil and the decommissioning of the effluent disposal systems is deemed to fall comfortably within the volumes allowed as a permitted activity.

3.2 AUCKLAND UNITARY PLAN (OPERATIVE IN PART)

As with the NES, the rule E.30.6.1.2 allows for the small scale disturbance of soil on actually or potentially contaminated soil as a permitted activity while the following criteria are met:

1. *"The volume of soil disturbed must not exceed:*
   a. *200 m^3 per site; or*
   b. *200 m^3 per project for sites or roads with multiple concurrent land disturbance projects, where the cumulative total volume of soil disturbance associated with each given project will be used when determining activity status; or*
   c. *an average depth and width of 1 m for linear trenching by network utilities in the road or rail corridor. For the purposes of this rule the rail corridor does not include land more than 10 m from the rail tracks.*
2. *Prior to the activity commencing:*
   a. *the Council must be advised of the activity in writing if the volumes of soil disturbed on land containing elevated levels of contaminants exceeds 25 m^3, including details of the measures and controls to be implemented to minimise discharges of contaminants to the environment, and such controls are to be effective for duration of the activity and until the soil is reinstated to an erosion-resistant state; and*
   b. *control on linear trenching must be implemented to manage discharges to the environment from trenches acting as migration pathways for contaminants;*
3. *Any discharge from land containing elevated levels of contaminants must not contain separate phase liquid contaminants including separate phase hydrocarbons.*
4. *The duration of the soil disturbance on a site must not exceed two months.*
5. *Any contaminated material removed from the site must be disposed of at a facility or site authorised to accept such materials."*

GSL considers that the remedial works required to address potentially lead impacted soil and the decommissioning of the effluent disposal systems can readily meet the allowable 200 m^3.

4 SITE MANAGEMENT PLAN

This site-specific management plan (SMP) provides procedures for the handling of potentially contaminated excavated soil material because of the proposed development at 98-102 Totara Road, Whenuapai (Figure 1). It is to be submitted to Auckland Council for approval before works commence on site.

The practices and procedures in this plan are intended to ensure that health, safety, and environmental risks associated with the proposed earthworks activities at 98-102 Totara Road are managed to an acceptably low level. It is not intended that this SMP should replace the contractor's site-specific health and safety plan or earthworks and sediment control plan, but should be enacted in conjunction with these documents.

4.1 RESPONSIBILITIES AND SITE MANAGEMENT

The appointed earthworks contractor will assign a 'site manager' to the project that will be responsible for the implementation of this SMP during the proposed works at the site.

4.2 ENGAGEMENT OF CONTAMINATED LAND ADVISOR

GSL will be available in the role of Contaminated Land Advisor (CLA) and will provide on-call direction in relation to contamination / disposal issues for the project. GSL area a professional advisor, suitably qualified and experienced in the investigation, reporting, remediation, and validation of contaminated land.

The main functions of the CLA are to:

- Assist in inspecting / screening potentially contaminated material;
- Assess the effectiveness of environmental control measures;
- Manage the collection and analysis of any soil samples (if required) in accordance with the Ministry for the Environment's (MfE) Contaminated Land Management Guideline No 1, (Reference 5);
- Provide assessments of the investigation;
- Make recommendations based on findings; and
- Maintain regular liaison with the authorities if necessary.

4.3 BRIEFING SESSIONS

The site manager is to commission a briefing session for relevant staff and subcontractors prior to the commencement of works. The briefing session will include as a minimum:

- Known areas of impacted soil material;
- Appropriate PPE and safety measures;
- Familiarisation with the requirements of the SMP;
- Guidance for identifying contaminated material as works progress (Appendix B); and
- Procedures to be followed should contaminated material be encountered (Appendix B).

4.4 HEALTH AND SAFETY PROCEDURES

While this SMP provides steps that are required because of the concentrations of arsenic identified during the DSI, the earthworks contractor is ultimately responsible for the H&S procedures related to the earthworks.

The concentration of heavy metals in soil within the potentially impacted areas, are not expected to exceed the human health standards for site workers, as outlined in the soil contaminant health standards ($SCS_{(HEALTH)}$) of the NES. However, it is important to utilise a conservative methodology in order to protect the health of site users and ecological receptor during remedial works. Consequently, provisions must be established, and adhered to, in order to ensure the health and safety of workers during soil disturbance in the impacted areas as identified in Section 2.1 above.

Inhalation is the most important exposure risk related to airborne contaminants in dust while direct contact with skin or eyes is the secondary route of entry in this case. The primary protection for site workers will be to utilise mechanical excavation methodologies and direct loadout to trucks for offsite disposal where possible, minimising the potential for any direct contact with soil.

The Health and Safety Guidelines on the Clean-up of Contaminated Sites developed by Occupational Safety and Health Services (OSH) provides reference to appropriate H&S measures that can be adopted for contaminated sites. A copy of this guideline can be provided on request.

4.5 PERSONAL PROTECTIVE EQUIPMENT

The minimum Personal Protective Equipment (PPE) which should be available on-site will be in accordance with the contractor's specific health and safety plan. Additional PPE that may be required include:

- Protective leather or rubber gloves
- Safety glasses
- Dust masks

The site manager will use his discretion with regard to the use of the additional PPE and might call on the CLA for advice on this matter.

5 PROPOSED REMEDIAL WORKS

The remedial consist of the removal of potentially lead impacted soil from the immediate curtilages of the dwelling at 98-100 Totara Road and the original dwelling on 102 Totara Road, and the removal of the septic tanks associated with all three dwellings on the site. The following sections detail the procedures to be followed to address the excavation and offsite disposal of potentially impacted soil.

GSL notes that in the interest of efficiency, remedial earthworks can be undertaken alongside demolition of the residential dwellings and can therefore be undertaken by the same contractor.

5.1 EROSION AND SEDIMENT CONTROLS

Erosion and sediment controls in accordance with Auckland Council Guidance Document GD05 *Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region* will be in place and effective prior to, and for the duration of any soil disturbance activities and until the site is restored to an erosion resistant state on completion of works.

Erosion and sediment controls will be in accordance with the primary contractor's site-specific erosion and sediment control plan.

5.2 DUST CONTROLS

Where remedial works are undertaken in dry conditions dust controls in accordance with the *Good Practice Guide for Assessing and Managing the Environmental Impacts of Dust Emission* (MfE 2001) are required to minimise pollutants becoming airborne in dust and reduce stormwater sediment loads. Dust generation can be controlled by light, frequent water spraying and the covering of any stockpiled materials.

The site manager has the responsibility of managing the suppression of dust on site for the duration of soil disturbance. Water usage should be frequent enough to suppress the generation of dust, but not so heavy as to generate sediment laden run off.

5.3 LEAD BASED PAINT EARTHWORKS PROCEDURES

As a conservative approach, a 3m halo of topsoil surrounding the two dwellings (Figure 2) are assumed to be impacted by lead based paint to a depth of approximately 300 mm (or subgrade level, whichever is reached first). As the dwelling on the southern boundary of 102 Totara Road is modern, it is not considered to be impacted by lead based paint and no remedial works associated with lead based paint are required.

The estimated volume of topsoil material to be disturbed because of the remedial earthworks is 138.6 m^3. This material will consist mostly of topsoil with small amounts of turf and clay soils.

The procedures below will be followed to ensure that potentially contaminated soil is adequately handled and disposed of off-site.

- The affected areas, as shown in Figure 3, will be marked with marker pegs, fluorescent paint or other suitable markings in the field;
- Prior to earthworks commencing, the contractor will arrange for the disposal of soil and excavated material at a landfill facility that is licenced to accept soil of this nature;
- excavated soil will be loaded directly into a truck or trailer and taken directly to a facility authorise to receive soil of this kind;
- An area on site will be prepared for the temporarily stockpiling of material of suspicious nature that might be encountered during the earthworks;
- Any temporary stockpiles will be managed (kept damp) to ensure that there is no excess dust generated from the stockpiles;
- Silt fencing will be placed around any temporary stockpiles to ensure that there is no excess sediment run-off from the stockpiles;
- The CLA will be notified and inspect any suspicious or noxious material that might be encountered during the earthworks. If necessary, the CLA will take soil samples for analysis of any foreign material that is discovered. The CLA will advise on the disposal of any such material;
- Upon completion of the excavation the site manager shall ensure that plant and equipment are cleaned and decontaminated appropriately; and
- A landfill manifest or weigh bridge dockets of all material disposed of at a managed fill or landfill facility will be kept.

5.3.1 LEAD BASED PAINT VALIDATION REQUIREMENTS

On the completion of the remedial works as detailed above validation will, in the first instance, be through a visual inspection to confirm the scope of remedial works has been carried out in accordance with the SMP. Following visual confirmation, five validation soil samples will be collected from each remedial area, accounting for 10 total validation soil samples for the analysis of lead only.

Should any validation soil sample return a concentration of lead in excess of the NES residential 10% soil contaminant standard (210 mg/kg), further remedial works will be instructed, and further validation samples collected until compliant results are obtained.

5.4 SEPTIC TANK AND EFFLUENT DISPOSAL FIELD REMOVAL

Prior to the excavation of the septic tanks and disposal fields on site, the site manager / contractor will arrange for the tanks to be emptied through the use of an approved waste removal company utilising a suction truck specifically designed for this purpose. The waste will be disposed of by the appointed contractor to an approved liquid effluent receiving facility.

Once empty, the tanks will be carefully excavated and removed from site. Excavations in each area will commence around the sides of the tank to reveal the tanks construction and layout, carefully advancing to allow the full tank to be lifted out for disposal or recycling offsite and to expose the disposal field infrastructure. As the overburden from the tank and disposal filed are not identified in the conceptual model as being at risk of soil contamination due to the gravity led infiltration to soil, all overburden from the excavation of the tank and disposal infrastructure should be stockpiled adjacent to the tank and disposal trenches to utilize as backfill once validation has confirmed successful remediation has been undertaken.

Depending on the construction material and condition of the tank, it will either be disposed of to an appropriately licensed facility (e.g. landfill) or sent to a location for recycling under approved conditions.

After the tank has been pulled, the associated disposal infrastructure (overflow / dripper lines) will be excavated alongside a small volume of soil underlying the pipework and disposed of to an appropriately licensed landfill facility. The effluent disposal pipes should be ‘chased out’ using an excavator starting at the septic tank through to termination.

The use of experienced contractors and licensed disposal locations will provide the primary controls in managing any actual or potential risks or adverse effects associated with the decommissioning process.

5.4.1 EARTHWORKS PROCEDURES

The procedures documented in Section 5.3, alongside erosion and sediment controls and dust controls above will be utilized for the duration of the excavation offsite disposal and validation of the septic tanks and effluent disposal systems.

5.4.2 SEPTIC TANK VALIDATION REQUIREMENTS

Following completion of removal and decommissioning works for the three septic tanks and disposal infrastructure, GSL will visually inspect the full extent of all excavations to confirm that all disposal infrastructure has been removed from the site. In conjunction with the visual assessment, validation soil samples will be collected on the basis of:

- one soil sample from the base of each tank pit;

- one soil sample per 15 lineal meters from the base of the disposal trenches.

Soil samples will target the base of the tank pit and soil directly underlying disposal infrastructure being the worst-case scenario for long-term discharge. Validation soil samples will be submitted for the analysis of a suite of heavy metals. Analytical results will be compared against the NES residential 10% homegrown produce standard as a suitably conservative remedial goal.

In the event that nay soil samples return concentrations that exceed the remedial goal, GSL will, in discussion with the landowner, determine the extent of any further remedial excavations that may be required, and further validation soil sampling will follow until such a time as all validation soil samples comply with the remedial goal.

6 CONTINGENCIES

In the event that other contamination is encountered on the site during the works, the site manager, in consultation with the CLA, will either:

- Identify the material in situ if possible (staining, odour, visible fibres or refuse etc.); or
- Excavate the material to a suitable leak proof and covered skip-bin or truck and take representative samples for analysis, placing the material on hold for appropriate disposal; or
- Halt excavations in the immediate vicinity of the discovery while the material is sampled in-situ, and removal / disposal options explored once the analytical results are returned.

An appropriate log will be kept by the site manager of any unidentified contamination encountered during the excavations.

GSL has produced a contaminated soil discovery guideline (CSDG) document that outlines the signs, risks, and remedial actions required for contamination scenarios that may be encountered during earthworks (Appendix B).

Suspicious material will be investigated by the CLA and laboratory analysed if deemed necessary. The CLA will advise on the disposal options of any uncertain materials. Disposal options can include:

- remove to an appropriate temporary stockpile area for further testing and analysis; or
- disposal at a cleanfill, managed fill or landfill facility.

The appointed contractor might have their own discovery procedures based upon their specific experiences in working with contaminated land of various natures (urban to rural). Contractor specific documents may be used alongside or in conjunction with this SMP.

If any staff, contractors, or consultants discover contamination, they should notify the site manager immediately, who should enact the provisions of the plan.

6.1 FIBROUS MATERIAL (ASBESTOS)

It is not anticipated that any asbestos materials will be encountered within soil on the site. Prior to demolition or removal, all buildings and structures must be subject to an appropriately intrusive building materials survey to identify the location and extent of and asbestos containing materials present and inform on removal requirements.

However, should asbestos containing materials (ACM) be identified in the soil matrix, all works shall cease (including the excavation and disposal of affected materials) until the provisions of the *Health and Safety at Work (Asbestos) Regulations* are exercised.

ACM identification will primarily be through visual identification by a suitably competent person. Any fibrous material observed during excavations will be visually inspected, photographed and representative sample submitted to an accredited laboratory for analysis. Following receipt of results, the site manager in conjunction with the CLA shall determine what, if any, further remedial steps may be required, including the provisions of asbestos removal control plans, semi-quantitative analysis, or site assessment under the WorkSafe endorsed *BRANZ New Zealand Guidelines for Assessing and Managing Asbestos in Soils* (November 2017).

7 VALIDATION

Upon completion of the remedial works, a site validation report (SVR) will be completed and provided to Auckland Council. The SVR will include:

- The quantity of soil material removed from site, including copies of the disposal manifests;
- A description of any unforeseen contaminated soil material encountered during the remedial works;
- Laboratory analytical results from any soil testing that occurred during the remedial works; and
- Any incidences or complaints that occurred during the earthworks.

8 REFERENCES

1. Ministry for the Environment (2011) - Draft Users Guide National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health. Ministry for the Environment, Wellington, New Zealand.
2. Ministry for the Environment (2011) – *Methodology for Deriving Standards for contaminants in Soil to Protect Human Health.* Ministry for the Environment, Wellington, New Zealand.
3. Ministry for the Environment (2011) — *Contaminated Land Management Guidelines No.1: Reporting on contaminated Sites in New Zealand*. Ministry for the Environment, Wellington, New Zealand.
4. Ministry for the Environment (2003) — *Contaminated Land Management Guidelines No.5: Site Investigation and Analysis of Soils*. Ministry for the Environment, Wellington, New Zealand.
5. Department of Labour (1999) — *Health and Safety Guidelines on the Cleanup of Contaminated Sites.* Occupational Safety and Health Services. Department of Labor. Wellington. ISBN 0-477-03546-9.

FIGURES

geosciences ltd
ENVIRONMENTAL

Level 1, 47 Clyde Road,
Browns Bay, 0630
Tel: (09) 475 0222

Figure 1 - Site Locality

98-102 Totara Road, Whenuapai

Reference:	J1685
Date:	29/11/2021
Drawn:	DW
Approved:	COB

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Browns Bay, 0630
Tel: (09) 475 0222

Figure 2 - Remediation Areas

98-102 Totara Road, Whenuapai

Reference:	J1685
Date:	29/11/2021
Drawn:	DW
Approved:	COB

APPENDIX A: CONTAMINATED SOIL DISCOVERY GUIDELINES

CONTAMINATED SOIL DISCOVERY GUIDELINES (CSDG)

Reference Number: GSL/CSDG

Geosciences Limited
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PO Box 35-366, Browns Bay, Auckland
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info@geosciences.co.nz www.geosciences.co.nz

DISCLAIMER

These guidelines are provided on the condition that Geosciences Ltd disclaims all liability to any person or entity in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of these guidelines. Furthermore, Geosciences Ltd disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or any part of the contents of these guidelines of all matters not explicitly stated within the guidelines and according to our general terms and conditions and special terms and conditions for contaminated sites.

STATEMENT

These guidelines have been prepared in acknowledgement of the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011. They have been authorised by a suitably qualified and experienced practitioner (SQEP); and have been prepared with the intention of providing practices and procedures for the management of potentially contaminated land which meets the criteria of the NES and the MfE guidelines.

Prepared on behalf of GSL by:	Reviewed and authorised on behalf of GSL by:
Colin Jowett Snr Environmental Scientist Geosciences Ltd	Johan Faurie Principal Geosciences Ltd

TABLE OF CONTENTS

1 INTRODUCTION

Contaminated land can be defined as, '*any land that has been adversely affected through the impact of human activity that has resulted in a significant alteration to the chemical, inorganic or organic characteristics of the naturally occurring soil material of the land*'.

Such a definition leaves a broad spectrum of potential physico-chemical characteristics which may apply. It is not the purpose of these guidelines to attempt to define all of the possible activities, characteristics, processes, or chemical compounds which may have an adverse impact upon naturally occurring soil material.

However, in the current field of contaminated soil investigation, disturbance, remediation and validation, and within the context of the *National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health* (NES) there are situations that may be uncovered, or may present themselves in other ways, where the impact of man-made activities are both hazardous, in terms of human risk, and significant, in terms of environmental risk.

It should be noted that not all hazardous and significant contamination sources can be discerned by the eye, the ear or the nose and that any suspected occurrence of soil contamination should be scientifically investigated through the most appropriate means available.

It is hoped that this document can provide some additional guidance, examples, and discussion points around the investigation and assessment of particularly 'gross' or visually, olfactory and auditory significant contamination events, sources or plumes. It should not be taken that this document can replace suitable qualifications and experience, but rather can be used as general guide to the field practical methods used to immediately assess, prepare, and undertake the safe handling and immediate containment or excavation of contaminated soil materials.

2 PURPOSE

The practices and procedures in this report are intended to provide a field-practical process for the identification, assessment and management of grossly contaminated soil that may be encountered during earth breaking activities or other sub surface soil disturbance. These processes are intended to provide guidance on health, safety and environmental risks and risk management associated with earth breaking activities when gross evidence of contamination is encountered.

The practices and procedures outlined provide for first layer risk control and are one of many stages in the applicable health, safety and environmental risk management process. It is not intended to replace site specific health and safety plans, nor can it provide for every possible eventuality encountered in the field and cannot be reasonably expected to replace significant relevant on-the-job experience.

The *Health and Safety Guidelines on the Clean-up of Contaminated Sites* developed by Occupational Safety and Health Services (OSH) provides reference to appropriate H&S measures that can be adopted for contaminated sites and this is a key reference document when dealing with contaminated materials. These guidelines do not intend to replace the guidance provided in that document and, if in doubt, it is the more preferable guidance document on provisions for Health and Safety when operating on contaminated soil sites.

3 INADVERTENT DISCOVERY OF CONTAMINATION

It is assumed that a site which has already been identified as 'contaminated' has been assessed with respect of the inorganic or organic characteristics which exceed the applicable criteria or threshold values as defined by the relevant legislation, rules, or plans. Identified contaminated sites will therefore already have appropriate protocols in place for the ongoing assessment, investigation, remediation and validation of the areas that have been defined as contaminated and have plans and procedures in place to protect both human health and the environment.

It still remains possible however, that unknown, unidentified or even identified but under-estimated, contamination may exist on such a site, or on a supposed 'non-contaminated' site. Such unknown contamination may be encountered as underground lenses (conglomerates of contamination in a localised zone), layers (widespread zone of contamination occurring along a stratified zone), hotspots (individual occurrences in a single location not otherwise connected), columns (vertical bands of contamination) or a plume (a zone of contamination moving along or through an aquifer / underground flow path and usually associated with seasonal or permanent groundwater flow).

In the event that 'unknown contamination' is encountered then it is advisable to have available some form of reference documentation that can provide insight to the frontline staff on the immediate signs, symptoms and actions that should be identified, assessed or considered while further advice is sought.

In all events encountering unknown soil contamination, a suitably qualified and experienced practitioner (SQEP) should be contacted for further advice, assessment and investigation.

4 GENERAL PROCEDURES

Below is a summarized guide of applicable steps which should be considered if any grossly contaminated material is encountered. The contaminated soil discovery guideline factsheets at the back of the report provide further details on the explicit health, safety and environmental risks associated with particular contamination scenarios, and the procedures to follow, however, in all instances the following general procedures summarized within the headings below should be considered. The steps highlighted below should not be considered exhaustive nor considered solely in step-by-step fashion, it may be necessary to conduct one or more actions at the same time or in differing order as a result of changing circumstances 'on the ground'.

4.1. STOP

- Stop working immediately and exclude others from working in the immediate area.
- Switch off machinery, generators etc., and establish a safe zone around the area dependent upon the assumed risk.

  - For example, a gas release from an old landfill can be considered potentially toxic and / or explosive and a zone of approximately 10m may be considered appropriate depending upon the scale of the event.
  - A series of dark red, brown or black stains in a pit with no odorous or free liquid discharges is unlikely to be immediately hazardous and the safe zone may extend to only the excavation edges.
- Prevent ingress or egress of stormwater, rainwater or wash water and stop all further activity immediately associated with the area.
- At this stage the extent, type and risk to health as a result of contamination is unknown – proceed with care and caution.

4.2. ADVISE THE SITE MANAGER

The site manager (or designated person) is the person principally in charge of health and safety on the site. They should also be familiar with these guidelines. The following steps are generally completed by the site manager or completed on the manager's delegation.

4.3. CONTAIN

If the contamination is leaving the site, or has the potential to leave the work site, then it should be contained. At this stage, the exact nature and risk of the contamination may not be known, so appropriate care and caution should be exercised. Some or all of the following methods may be used to contain the contamination:

- Sediment fences and straw bales;
- drain covers and sandbags;
- absorbent booms, spill mats, 'kitty litter' etc. can all be utilized to protect the environment from further release; and
- If containment is not possible, immediately contact:
  - ***Auckland Pollution Hotline*** **(09) 377 3107**.

4.4. ASSESS THE RISK

Not all contaminants, or all instances of contamination, will require special provisions or procedures. Similarly, an instance of contamination may be falsely or incorrectly reported. Not all stains are contamination, or all apparent plumes of oil on a liquid surface, are man-made occurrences.

- Refer to the factsheets at the back of these guidelines.
- Make a note of any or all of the following. It may be necessary to document and record some or all of the findings, for forwarding to the SQEP, as odours may dissipate and water may dry up or soak back into the soil:
  - Appearance – staining, trickling, flowing, bubbling (gas escape), thick, sticking to tools and equipment, sliding off tools etc.

  - Odour – sweet, sour, petrol-like, tar-like, sharp etc.
  - Colour or colours
  - Miscibility i.e. does it or does it not mix with water. Oil / solvents etc. do not mix with water and creates a coloured sheen on the water surface.
- If gross contamination is confirmed (or strongly suspected) then the appropriate measures should be put in place, dependent upon the risks concerned as defined in the factsheets. A half buried rusted drum of waste batteries will require different safety procedures to the discovery of a buried pile of asbestos cement board, for example.

4.5. CONTACT THE CLA (SQEP)

Contact the on-call contaminated land advisor – provide digital photographs if safely possible to do so. Talk to the CLA. They may advise additional steps to follow; they may be required to come to site.

4.6. RESTRICT ACCESS

Following the assessment of the risk, the safety zone can now be better defined.

- With reference to the factsheets, restrict access to the safe zone to only those members of the team that need to be there. It may be necessary in the case of potentially explosive vapour release, to cordon off a significant sized area and prevent working, or vehicular access, within that area.
- Consider the potential flow paths of vapours along trenches, down slopes, through drains etc.
- Access can be restricted through purely visual means, e.g. warning sings, via fencing or by staff management (security guard for example) or a mixture of all three based upon the site manager’s assessment and the extent of the contamination.

4.7. ESTABLISH A WORKING TEAM AND PROVIDE WITH APPROPRIATE PPE

Before continuing, establish a team of competent trained individuals who can deal with the matter and ensure that they have, and are correctly wearing, the appropriate PPE for the situation at hand as defined in the factsheets. Consider the following when establishing the team:

- Experience – have they handled such a situation before?
- Competence – are they familiar with the tools, equipment, PPE and procedures that will be employed?
- Comfort – not all staff are comfortable with unknown situations. Will they be comfortable in this situation?

4.8. EXCAVATE

At some point, the contamination is likely to be removed. This may not be the case in every instance and the regulations allow for other actions such as in-situ remediation, stabilisation, encapsulation etc. and the SQEP will advise on the specific methodologies required. In certain circumstances a more detailed remedial plan may have to be compiled which will document specific goals, validations and disposal actions. The SQEP will advise on the requirements of the regulations. In most cases of localised acute instances of gross contamination, they can be safely managed immediately in the interests of protecting human health and the environment. In this case, some or all of the following processes should be followed:

- Excavation / Isolation – solid contaminants, soil, drums, refuse etc. can be excavated, by machine or by hand, directly into a covered truck or sealed skip, preventing further potential spread and isolating the contaminants for assessment and disposal;
- Vacuum extraction – contaminated water may be sucked up into a vacuum tanker, provided that there is no risk of reaction or explosion, where it can be isolated for assessment and disposal. DO NOT MIX water / liquid from more than one event in a vacuum truck;
- Separation – large separate items, such as asbestos sheet fragments, can be collected by hand, separated from the soil matrix and placed in double skinned plastic bags for appropriate disposal; and
- Absorbance – contaminated water, hydrocarbons and chemicals can all be absorbed through the use of contaminated pads, pillows and booms which can then be placed in sealed skips or bags and isolated for appropriate disposal.

4.9. DOCUMENT

Keep written documents, including digital photographs, of all measures used to contain or cleanup the contamination. This might include some or all of the following:

- Assessment measures used e.g. laboratory analysis, in-situ analysis (e.g. XRF), smell, behaviour in water (miscibility etc.), pH indicator test etc.;
- Staff involved in clean-up and experience;
- Methods used, problems encountered, discussions with SQEP;
- Complaints by third parties (e.g. odours, colour changes to local waterways etc.);
- Excavation or separation methods used, names of contractors etc.;
- Volumes extracted;
- Conditions of cartage, e.g. skip bin, covered truck, closed wheelie bins etc.
- Location of final disposal and disposal documentation e.g. tip dockets, weighbridge receipts etc.

4.10. DISPOSE

In order to ensure that all material is disposed of correctly, ensure the safe and licensed disposal of the material in accordance with the requirements outlined by the SQEP. In the majority of cases, examples of gross contamination are likely to require disposal at a licensed landfill facility e.g. Redvale Landfill or Hampton Downs Landfill. Other licensed facilities may exist that can handle potentially contaminated material, that may also be able to provide assistance.

- Contaminated liquids will not be received at landfill for disposal and must go to a licensed liquid disposal facility. Sewerage contaminated liquids can probably go directly to the nearest local sewer treatment facility, but chemical contaminated liquid will be required to go to an appropriate liquid treatment plant.
- Drums of unknown or unidentified waste may have to go to a solid / liquid hazardous waste handling plant.
- Contaminated PPE will also require appropriate disposal.
- In all instances, the receiving facility will be unlikely to receive and handle the material without some form of analysis or assessment of the composition of the waste.
- Keep all transport and disposal dockets for the final report.

4.11. REPORT

Communications and documentation will be kept during the procedures but a final report should be provided to the project manager detailing all of the steps, communications and records as required.

This report provides assurance to the regulatory authority that all the necessary steps have been followed and the matter has been adequately and professionally dealt with.

5 FACTSHEETS

5.1. PETROLEUM HYDROCARBONS

ACTIVITY

- Petroleum service station
- Vehicle workshop
- Gasworks sites

POTENTIAL CONTAMINATION

- Total Petroleum Hydrocarbons (TPHs)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Benzene, Toluene, Ethylxylene, and Xylenes (BTEX)
- Heavy Metals

DESCRIPTION

Petroleum-contaminated soils have a brown / black discolouration and an ‘oily’ consistency. Petroleum products, such as diesel and petrol, are insoluble in water and can form oil slicks in excavated areas such as trenches. Petroleum products in soil can be detected by the characteristic odour of petrol and diesel. BTEX produces a much ‘sweeter’ odour similar to that of paint-thinners.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Adverse reactions to strong hydrocarbon odours are possible, e.g. headaches, blurred vision, nausea. Contaminants can be absorbed into body via inhalation of dust, contact with skin, or ingestion. Leaked fuels can migrate into groundwater, potentially contaminating drinking water.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical / oil resistant steel-capped boots; (2) disposable coveralls; (3) chemical-resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face respirator.

HANDLING AND DISPOSAL

Pooled hydrocarbon spills can be removed using suitable absorbent materials or collected by a suitably rated vacuum tanker. Spills can also be transferred to a sealed container by an appropriately rated vacuum pump or similar. Hydrocarbon contaminated soil can be placed in a sealed leak proof skip bin or truck for disposal at a facility authorised to receive material of that kind.

5.2. HEAVY METALS

ACTIVITY

- Metal workshop
- Metallisation works
- Electroplating industries
- Timber treatment facilities

POTENTIAL CONTAMINATION

- Heavy Metals

DESCRIPTION

Gross contamination of heavy metals in soils can cause bands of discolouration within the soil profile. Pools of discoloured water (yellow, blue, red, orange) in excavated areas, such as trenches, are indicative heavy metal contamination. Solvents used for metal preparation, like BTEX, can form 'sheen' on the surface of water and produce a 'sweet' odour similar to that of paint-thinners.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Contaminants can be absorbed into body via inhalation of dust, contact with skin, or ingestion. Heavy metals have the ability to leach further into soil and eventually into groundwater, potentially contaminating drinking water. A consideration should be given to the potential of pH alteration as metal finishing plants often employ acidic solutions for metal preparation.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical / oil resistant steel-capped boots; (2) disposable coveralls; (3) chemical resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face mask or respirator.

HANDLING AND DISPOSAL

Heavy metal-contaminated soil can be placed in a truck and covered with tarpaulin for disposal at a facility authorised to receive material of that kind.

5.3. DRY CLEANERS

ACTIVITY

- Dry-cleaners

POTENTIAL CONTAMINATION

- Volatile hydrocarbons (trichloroethylene, tetrachloroethylene, carbon tetrachloride)

DESCRIPTION

It is difficult to distinguish soil contamination by solvents used for dry-cleaning. However, the solvents can form a bilayer with water they are less dense than water. The odours associated with dry-cleaning agents are very distinctive and can be described as 'sickly sweet', causing dizziness and nausea.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Contaminants can be absorbed into body via inhalation of vapours, contact with skin, or ingestion. Depending on atmospheric conditions, dry-cleaning agents may readily evaporate. Extended exposure to dry-cleaning agents can affect the central nervous system. Gross contamination of dry-cleaning agents in soil can migrate past the water table, making remediation complex.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical / oil resistant steel-capped boots; (2) disposable coveralls; (3) chemical-resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face respirator.

HANDLING AND DISPOSAL

Pooled hydrocarbon spills can be removed using suitable absorbent materials or collected by a suitably rated vacuum tanker. Spills can also be transferred to a sealed container by a suitably rated vacuum pump or similar. Solvent contaminated soil, including drums or containers, can be placed in a sealed leak proof skip bin for disposal at a facility authorised to receive material of that kind.

5.4. TANNERY / LEATHER PROCESSING

ACTIVITY

- Leather manufacture / treating facility

POTENTIAL CONTAMINATION

- Heavy Metals (particularly chromium)
- Solvents
- Pesticides
- Bleaching agents

DESCRIPTION

Gross contamination of chromium in soils, caused in the tanning stage of treating leather, can cause orange and blue bands of discolouration within the soil profile. Pools of discoloured water (orange, blue, green) in excavated areas, such as trenches, are indicative chromium and metal contamination.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Contaminants can be absorbed into body via inhalation of vapours and dust, contact with skin, or ingestion. Wastewater produced from the tanning process can have excessive levels of chromium and sulphides which can cause gross soil contamination if inadequately handled.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical / oil resistant steel-capped boots; (2) disposable coveralls; (3) chemical-resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face mask or respirator.

HANDLING AND DISPOSAL

Pooled liquid spills can be removed by using tailor-designed absorbent materials and via tanker or pump. Contaminated soil can be placed in a sealed skip bin or covered truck for disposal at a facility authorised to receive material of that kind.

5.5. ASBESTOS

ACTIVITY

- Improper disposal of asbestos-containing building materials

POTENTIAL CONTAMINATION

- Asbestos (fibres)

DESCRIPTION

Asbestos in soil is most likely due to burial of building materials. Asbestos fibres are usually entrained in a substrate material, making identification difficult. Broken cement, floor tiles, roof shingles, insulation, heat shields, and textured ceiling tiles manufactured between the 1950s and 1980s are likely to contain asbestos.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Asbestos can be absorbed into the lungs via inhalation of fibres. A significant acute or chronic exposure can lead to mesothelioma, asbestosis and lung cancer. Buried asbestos is relatively stable; however, disturbing asbestos during excavations could lead to the production of harmful fibres.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) disposable coveralls; (2) washable PVC gloves; (4) safety glasses; (5) suitably graded full face or half face P3 respirator.

HANDLING AND DISPOSAL

KEEP DAMP to suppress fibre generation. Large fragments may be collected by hand and place in double skinned plastic bags. Asbestos-contaminated soil can be placed in a sealed skip bin for disposal at a facility authorised to receive material of that kind. Soil of this kind can also be transported via sealed doubled bags or a sealed skip bin.

5.6. REFUSE

ACTIVITY

- Inorganic / Organic refuse disposal

POTENTIAL CONTAMINATION

- Variable, dependant on the type of refuse
- Contaminants could arise from liquid waste, putrid organic waste, and any material that would normally be sent to a licensed landfill

DESCRIPTION

Refuse in soil is most likely due to burial of waste materials that should have normally been sent to landfill. Waste could include, but not limited to, paint cans, oil / hydrocarbon containers, and putrid household waste. The odour of buried refuse is likely to be extremely pungent.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Due to the variability of types of refuse and waste, it is difficult to distinguish human health and environmental risks. Individual assessment of the risks will be required.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical-resistant steel-capped boots; (2) disposable coveralls; (3) chemical-resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face mask or respirator.

HANDLING AND DISPOSAL

Handling and disposal of refuse will be dependent upon the waste material identified.

5.7. PESTICIDES

ACTIVITY

- Horticultural activity
- Pesticide manufacture

POTENTIAL CONTAMINATION

- Pesticides, including DDT, dieldrin, and other organochloride pesticides (OCPs)

DESCRIPTION

Persistent use and storage of pesticides associated with horticultural activities are the main contributors to pesticide-related contamination in soil. Illegal burial of pesticide drums and containers may be encountered on production and agricultural sites. Pesticides are often found as fine, white powders.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Pesticide contaminants can be absorbed into body via inhalation of dust, contact with skin, or ingestion. Extended exposure to organochloride pesticides can disrupt the endocrine system as well as affecting DNA. DDT and its breakdown products, DDD and DDE, are highly persistent and do not breakdown easily in soil. DDT and its isomers have the ability to magnify through the food chain (bioaccumulate).

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical-resistant steel-capped boots; (2) disposable coveralls; (3) chemical-resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face mask or respirator.

HANDLING AND DISPOSAL

If bulk pesticide storage containers are found, the site manager must be advised. Pesticide-contaminated soil can be placed in a truck and covered with tarpaulin for disposal at a facility authorised to receive material of that kind.

5.8. SEWAGE

ACTIVITY

- Underground sewage tanks / pipelines

POTENTIAL CONTAMINATION

- Raw sewage
- Bacteria / pathogens
  (*Escherichia coli*, *Vibrio cholerae*, etc.)

DESCRIPTION

Sewage in soil is most likely due to leaking underground septic tanks and / or sewer pipelines. The odour of sewage is likely to be extremely pungent.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Pathogens in sewage-contaminated soil can be absorbed into body via contact with skin or ingestion. Exposure to raw sewage can infect a person with an array of harmful pathogens, such as E. coli, which originate from faecal matter in wastewater. Gross contamination of raw sewage can lead to eutrophication of lakes, rivers, and other receiving bodies of water.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical-resistant steel-capped boots; (2) disposable / liquid repellent coveralls; (3) chemical-resistant / waterproof gloves; (4) safety glasses; (5) suitably full face mask or face shield.

HANDLING AND DISPOSAL

If raw sewage is encountered, the site manager must be advised. Sewage-contaminated soil can be placed in a truck and covered with tarpaulin for disposal at a facility authorised to receive material of that kind.