TOITŪ TE WHENUA

LAND INFORMATION NEW ZEALAND

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146 TE MAWHAI ROAD, TE AWAMUTU

FORMER TOKANUI HOSPITAL
DEMOLITION AND REMEDIATION
HORIZONTAL INFRASTRUCTURE ASSESSMENT REPORT

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TE AWAMUTU

FORMER TOKANUI HOSPITAL DEMOLITION AND REMEDIATION HORIZONTAL INFRASTRUCTURE ASSESSMENT REPORT

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TOITŪ TE WHENUA – LAND INFORMATION NEW ZEALAND
FORMER TOKANUI HOSPITAL DEMOLITION AND REMEDIATION
HORIZONTAL INFRASTRUCTURE ASSESSMENT REPORT

EXECUTIVE SUMMARY

Introduction

The former Tokanui Hospital (the Site) is a former psychiatric hospital approximately 80 hectares (ha) in area located approximately 14km southeast of Te Awamutu, Waikato, with 74 buildings, a wastewater treatment plant, a swimming pool, eight substations, a closed landfill (also referred to as the 'existing disposal site') and substantial roading and underground infrastructure and services.

The Site is managed by Toitū Te Whenua Land Information New Zealand (LINZ) on behalf of the Crown in the Treaty Settlements Landbank. Land held in the Landbank is Crown land which has been declared surplus and can be used as cultural or commercial redress in Tiriti o Waitangi Settlement claims. The Tokanui Hospital is a deferred selection property in the Ngāti Maniapoto Deed of Settlement (the Deed) and forms part of the Maniapoto Settlement Claims Act 2022, which gives effect to the Deed. The Tokanui situation is unique as no other property included in a Treaty settlement has required demolition and remediation on this scale or required a commitment to undertake remediation in a deed of settlement. Under the Deed, Maniapoto and the Crown have agreed to a standalone process within the Property Redress Schedule, Part 9: Tokanui Hospital Deferred Selection Process (THDSP), for the transfer of the Site which details specific requirements for the demolition and remediation of the Site before it is available for transfer to Maniapoto. LINZ is the Government agency responsible for delivering this project.

"**Horizontal infrastructure**" is defined in the THDSP as: "*The roading and accessways, foundations and services that the Crown, with the consent of the relevant Ministers as required, decides must be retained on the relevant Tokanui Hospital deferred selection property, in accordance with paragraph 9.9 of the Deed*".

It should be noted, that at the date of this report, it is assumed that building foundations will be removed as part of the vertical demolition package rather than under horizontal infrastructure as stated in the Deed as the two are intrinsically linked. Building foundations have therefore been assessed under the Disposal Options Assessment (Fraser Thomas, 2023).

A decision has yet to be determined on how much of the horizontal infrastructure must be retained onsite. Four options were shortlisted and used to inform funding approval from Cabinet based on onsite versus offsite waste disposal AND the complete removal of all horizontal infrastructure or the removal of "some" horizontal infrastructure. "Some" horizontal infrastructure in this context was not defined, but was assumed for disposal options evaluation purposes to be 20%. However, due the potential significant cultural, environment, social, and economic impacts associated with this determination, approval to proceed must be obtained from the Minister of Land Information, Minister of Finance and Minister for Treaty of Waitangi Negotiations (together referred to as Ministers) and must take the views of the post settlement governance entity, Te Nehenehenui Trust, into account.

To assist this process, LINZ engaged Fraser Thomas Limited (FTL) to undertake this Horizontal Infrastructure assessment to determine the condition and extent of all existing horizontal infrastructure on the site, to help inform the decision on how much, if any, horizontal infrastructure should be retained. This report will also be used by LINZ to meet the requirements of paragraph 9.11 of the THDSP and the communication and engagement process set out in the Memorandum of Understanding with Te Nehenehenui, as part of providing Te Nehenehenui with relevant information to allow an informed view to be presented to Ministers.

Scope

The horizontal infrastructure was divided into the following asset groupings:

- All roading and associated paved areas;
- Retaining walls (1);
- Water, stormwater and wastewater reticulation;
- Building heating system, comprising an underground concrete ducting system, with steam and condensate pipes that were formerly used to heat the Site buildings; and,
- Utilities – power and telecom.

This assessment involved a desktop review of available information, comprehensive site investigations including site walkovers, pavement test pits and deflection measurements, CCTV and underground services detection, hydro excavation and topographical survey, followed by compiling updated horizontal infrastructure plans and updated assessment of asset quantities, condition and estimated residual lifetime.

Horizontal Infrastructure Assets – Inventory and Condition

The following tables provide an inventory of the existing assets and their condition, in terms of the adopted infrastructure groupings.

Table E1: Infrastructure Asset Inventory and Condition

Service	Length (m)	Status	Condition	Residual Lifetime and Other Comments
Roading	8630 (6.2ha area)	In use for Site access	Asphalt/chip seal generally poor; pavement itself appears structurally sound	Some roading areas have confirmed or potential coal tar in them; analysis indicates existing roading/paving will generally be at end of its lifetime on completion of demolition works due to estimated demolition traffic movements
Redundant road embankment crossing over Wharekōrino Stream	Estimated 6m wide x 80m long	Redundant	Likely moderate to poor (not confirmed due to flytipping over area)	Provides unsecured access into site; raises stream flood levels, potentially affecting existing disposal site; residual lifetime not assessed
Retaining walls	122 x 3 terraces 0.55-1.70m high	In use retaining hillside below road	Good	At least 20 years (visual assessment)
Concrete ducting (+ steam & condensate pipework and fittings)	2937m	Obsolete	Pipework & fittings generally poor to very poor; concrete ducting moderate	Pipework and fittings at end of their lifetime; concrete ducting could potentially be repurposed for future use (estimated 20+ years)

Water	Site: 2970m (ductile iron) 3390m (AC) Old supply: 790m (200mm dia AC)	Obsolete	Poor to very poor	At end of lifetime; mainly ductile iron in northern half of site and Asbestos cement (AC) in southern half + abandoned AC (200dia) and unknown trunk water supply line crossing site
Stormwater	1770m (trunk) 4463m (minor)	Trunk line conveys upgradient runoff	Moderate to Poor	675-900mm dia (trunk) 100-375mm dia (minor) Residual life – 10-30 years; trunk system better than minor
Wastewater	4907m	Obsolete	Poor to very poor	100-225mm pipe dia; At end of lifetime
Power (underground)	7321m	Obsolete	Inferred moderate to poor	Additional 1365m above ground Essentially at end of life, as obsolete
Telecom	4629m	Obsolete	Inferred moderate to poor	Essentially at end of life, as obsolete

Note: A further 550m of water pipe running from Te Mawhai Rd, to the west of the site, past houses along Te Mawhai Rd and to swimming pool could not be found through extensive on-site investigations and is unlikely to exist.

Table E2: Infrastructure Features Inventory and Condition

Asset/underground service	Comments	No	Condition
Power	Lightpoles (99), power poles (18), other (7)	124	Moderate to poor
Concrete ducting	Concrete duct access chambers (37)	37	Generally moderate
Water	Fire hydrants (41), valves (25)	66	Very poor
Stormwater	Manholes (145), catchpits (56)	201	Moderate
Wastewater	Manholes (152)	152	Poor to very poor
Telecom	Telecom post	7	Moderate
Unknown lids	4x4 lids	46	Moderate
Total		**633**	

Removal versus Retention Options

Selected assessment options come from the Deed settlement process, which requires disposal options to be compared for onsite versus offsite disposal, including scenarios where all horizontal infrastructure is removed versus "some" being retained. In this context, "some" has been defined in terms of the options set out below for different infrastructure groupings. The retention options are based on the following findings:

- Retaining some of the site's internal roading network is considered useful to provide ongoing vehicle access to the site.
- An existing retaining wall retains a hillside below an existing road and is in good condition.
- A trunk stormwater system conveys upgradient runoff from neighbouring properties to the west through the Site, and this needs to be maintained in some form in accordance with the Common Law right of "natural servitude'.
- The concrete duct system across the Site gives good site coverage and could potentially be repurposed as a conduit for some future services.

Table E3: Summary of Horizontal Infrastructure Removal versus Retention Options

Item	Must Retain (Essential)	Could Retain (Optional)		Complete Removal
Roading/ paving (6.2ha, 8600m)	Not applicable	**RD3:** 3.49ha roading/paving removed; replaced with 10,440m^3 soil backfill; 3.3km residual roading	**RD2:** 5.0ha removed; replaced with 15,000m^3 soil backfill; 1.5km residual roading	**RD1:** 6.20ha or roading/paving; replaced with 18,600m^3 soil backfill; no residual roading
Old road embankment & Culvert 3 (~1350dia)	Not applicable	**RD4 Add-on:** earthworks over 1800m^2 area of 5200m^3 volume, stream bank grading and riparian planting		
Retaining wall (3 terraces x 122m)	Not applicable	**RW1:** Keep retaining wall, possibly adding handrails		**RW2:** Remove retaining wall and undertake earthworks to recontour hillside
Concrete Ducts	Not applicable	**CD2:** Remove all pipework and fittings; keep concrete ducting and access chambers for possible repurposing for other use		**CD1:** Remove entire system (2937m); 880m^3 minimum backfilling
Trunk Stormwater	**SW1:** Stream restoration – 1770m, 24,800m^3 earthworks OR **SW2A:** Pipe replacement and upgrade – 1770m x 750-1050dia pipe OR **SW2B:** Line existing pipes to extend life by at least 50yrs	Not applicable		Not applicable
Other Services	Not applicable	**OS2C** - Partial removal: 633 surface features (MHs, fire hydrants, valve boxes, etc.) and associated infrastructure to		**OS1** - Complete removal: 633 surface features + minor stormwater pipes (4463m), wastewater

		800mm depth for pipes/ducts (excluding trunk stormwater system) and associated structures down to 1m depth.	pipes (4907m), water pipes (7700m), Power U/G (7321m), Power A/G (1365m), telecom (4629m)

Note: Option OS2C incorporates feedback from TNN following WSP's review of a draft version of this report, which recommended that the original "other services" removal depth of 600mm (Option OS2A) be increased by 200mm to 800mm depth. Only Option OS2C is referred to in this report.

Options Evaluation

The evaluation assessment approach was developed as a hybrid approach tailored to the Site, based on the following tools: Multi-criteria analysis (MCA), Mauri model and a range of Māori environmental assessment and performance indicator tools developed by Landcare Research. This hybrid approach was adopted to align with assessment criteria provided to the Te Nehenehenui and Ministers. Ministerial support of this criteria was provided in January 2023 *Tokanui Hospital: Decision-making process and criteria* (BRF 23-169 refers). The assessment was undertaken looking at environmental, social, cultural, economic criteria, with different weightings and a scoring system, consistent with the Mauri model, as explained in the following diagram. The indicative weighting was applied to support the priority order detailed in BRF 23-169 and may be updated following review of this report by Te Nehenehenui.

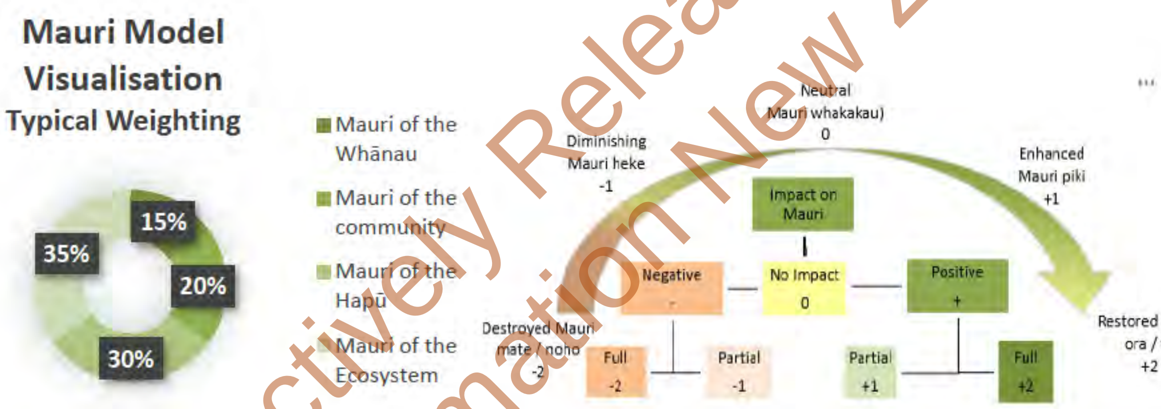

Figure E1: Mauri Model Visualisation (source: adapted from Morgan TKKB and Fa'aui TN (Sept 2014))

Within each criterion, a number of indicators were developed for evaluation, along with a number of sub-headings to help explain what each indicator[1] covered. For the cultural indicator criteria, information provided in Cultural Impact Assessment (CIA) and the cultural induction provided by mana whenua were used to inform this initial assessment. Engagement with Te Nehenehenui will further inform this scoring consideration. An additional "deliverability" assessment was also included, which involved a Yes/No/Likely/Unlikely assessment of the ability to deliver on the Crown's commitments under the Deed, taking into account the prescribed timeframes and delivery risks in terms of significant constraints and consentability. High level (budget) cost estimates were also included for each option. The results of this assessment are summarised in the following table, ranked in order of descending preference from left to right.

[1] An indicator is a single characteristic that represents a potential or actual effect which can be compared across options to evaluate their relative performance. Indicators need to be measurable in some way that is sufficient to allow evaluation (adapted from SuRF-UK, 2011).

Table E4: Evaluation Results

Infrastructure Grouping		Evaluation Summary			
		1st Choice	2nd Choice	3rd Choice	Addon
Roading/ paving	Description	RD3 – Remove 56% roading	RD2 – Remove 80% roading	RD1 – Remove 100% roading	+ RD4 – Remove redundant road embankment
	Scoring	1063	438	115	1245
	Cost – Capex	[redacted]	[redacted]	[redacted]	[redacted]
	Cost – 10yrs O&M	[redacted]	[redacted]	[redacted]	[redacted]
	Constraints/Risks	No	No	No	No
	Consentability	Yes	Yes	Yes	Yes
Retaining Wall (not scored)	Description	RW1 – Keep retaining wall	RW2 – Remove retaining wall		
	Costs	Not applicable	Not costed – minor works		
	Constraints/Risks	No	No		
	Consentability	Not applicable	Yes		
Trunk Stormwater	Description	SW2B – Line all stormwater pipes	SW2A – Replace and upgrade pipes	SW1- Stream restoration	
	Scoring	1033	180	-98	
	Cost – Capex	[redacted]	[redacted]	[redacted]	
	Cost – 10yrs O&M	[redacted]	[redacted]	[redacted]	
	Constraints/Risks	Yes	Minor (future liability)	Minor (future liability)	
	Consentability	Likely (non-complying)	Likely (non-complying)	Yes (stream diversion consent possibly needed)	
Concrete Ducting	Description	CD1 – Remove all	CD2 – Remove piping, keep ducting		
	Scoring	518	293		
	Cost – Capex	[redacted]	[redacted]		
	Cost – 10yrs O&M	[redacted]	[redacted]		
	Constraints/Risks	No	No		
	Consentability	Yes	Yes (if required)		
Other Services	Description	OS2C – Remove all AC pipe and	OS1 – Remove all		

		other services to 800mm depth and associated structures to 1m depth			
	Scoring	595	513		
	Cost - Capex	[redacted]	[redacted]		
	Cost – 10yrs O&M	[redacted]	[redacted]		
	Constraints/Risks	No	No		
	Consentability	Yes	Yes (if required)		

Notes:

1. New landowner will need to construct own roading for site access purposes, with associated O&M costs, which are not included in this assessment
2. Lower cost assumes all excavated materials reused for backfilling from other demolition works or disposed of onsite; upper cost assumes all excavated materials disposed of offsite as cleanfill.
3. Majority of costs associated with removal of AC water pipe (4.2km) = [redacted] including contingencies, design fees and escalation costs.

Any infrastructure removal works (including associated backfilling) involving volumes exceeding 1,000m^3 will require an earthworks resource consent for a discretionary activity from Waipa District Council. An additional consent is likely to be required for any works in close proximity to a wetland under the NES-Freshwater, with the potential for this to be a non-complying activity depending on the nature of the works. Consent may also be required for temporary stream diversions during the trunk stormwater works and for stream bed disturbance associated with removal of the redundant road embankment.

Conclusions and Recommendations

The assessment undertaken shows that the preferred options for the different infrastructure groupings evaluated are:

- RD3: Partial (56%) removal of all roading/paving where it no longer serves an access purpose and conversion of residual paving to farm access track standard to retain access.
- RD4 Addon: Additional removal of a redundant road embankment and the associated culvert 2.
- SW2B: Lining of the existing trunk stormwater system to extend its lifetime by at least 50 years.
- RW1: Keeping an existing small retaining wall which is in good condition and retains a portion of hillside below a road which is to be kept as part of Option RD3.
- CD1: Complete removal of the concrete ducting system.
- OS2C: Partial removal of all other services, involving the removal of all asbestos pipework and other services down to 800mm depth and associated structures down to 1m depth. Complete removal of all services scored only slightly less.

This report is based on the best information, currently available at the date of issuing this report. It is considered sufficient for Te Nehenehenui to provide an informed view (as per paragraph 9.11) and for LINZ to then obtain a decision from Ministers on the extent of infrastructure to be retained onsite as provided at paragraph 9.9.2 of the THDSP.

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DISPOSAL OPTIONS ASSESSMENT REPORT

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GLOSSARY

CONTAMINATED MATERIALS	Hazardous building materials that pose some level of risk to human health and/or the environment, such as asbestos or lead-based paint, which potentially affects materials handling, haulage and/or disposal requirements. *Please note, management of contaminated soil as part of the demolition and remediation project follows the remedial standards process as outlined in the Tokanui Hospital Deferred Selection Process.*
DEED OF SETTLEMENT (DEED)	The Ngāti Maniapoto Deed of Settlement signed by Maniapoto and the Crown, which was signed on 11 November 2021 and given effect by the Maniapoto Settlement Claims Act 2022, which came into force on 28 September 2022.
DEFERRED SELECTION PROPERTY	Is as defined in s154 of the Maniapoto Settlement Claims Act 2022. It means a property described in subpart A or C of part 4 of the property redress schedule for which the requirements for transfer under the deed of settlement have been satisfied.
DEMOLITION AND REMEDIATION WORKS*	The physical works required to carry out the demolition and remediation of each Tokanui Hospital deferred selection property (excluding any new disposal site or existing disposal site on that property) as described in paragraph 9.16
EXISTING DISPOSAL SITES*	The two existing sites (as described in the existing disposal consents) located on one of the Tokanui Hospital deferred selection properties that the Crown historically used to dispose of waste; indicated as 'Existing disposal sites' on the plan (subject to survey) 'Tokanui Hospital deferred selection properties' in part 7 of the attachments
GOVERNANCE ENTITY	The Ngāti Maniapoto post settlement governance entity, Te Nehenehenui Trust
HORIZONTAL INFRASTRUCTURE*	The roading and accessways, foundations and services that the Crown, with the consent of the relevant Ministers as required, decides must be retained on the relevant Tokanui Hospital deferred selection property, in accordance with paragraph 9.9 of the Deed. *Please note, at the date of this report, it is assumed that building foundations will be removed as part of the vertical demolition package rather than under horizontal infrastructure as stated in the Deed.*
MINISTERS*	The Minister of Finance, Minister for Land Information, and Minister for Treaty of Waitangi Negotiations
NEW DISPOSAL SITE*	A site which may be located on part of a Tokanui Hospital deferred selection property, such location to be determined in accordance with paragraph 9.9, where the Crown may, as part of the demolition and remediation works, dispose of contaminated and/or non-contaminated materials and waste in accordance with paragraph 9.12.
NON-CONTAMINATED MATERIALS	Building materials that do not contain any contaminated materials, as defined above and may be suitable for reuse and/or recycling
PURCHASED TOKANUI HOSPITAL DEFERRED	Means a Tokanui Hospital deferred selection property that is also a purchased deferred selection property

SELECTION PROPERTY*	
SETTLEMENT DATE	Is defined as s12 of the Maniapoto Settlement Claims Act 2022, being 24 November 2022.
VERTICAL BUILDING STRUCTURES*	All above-ground built structures on a Tokanui Hospital deferred selection property, excluding horizontal infrastructure

***Denotes definitions relevant to this report copied from the Tokanui Hospital Deferred Selection Process, Subpart A: Definitions.**

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HORIZONTAL INFRASTRUCTURE ASSESSMENT REPORT

1.0 INTRODUCTION

The former Tokanui Hospital (the Site) is a former psychiatric hospital approximately 80 hectares (ha) in area, with 74 buildings, a wastewater treatment plant, a swimming pool, eight substations, a closed landfill (also referred to as the 'existing disposal site') and substantial roading and underground infrastructure and services. The site location and extent is shown in Figure 1 below.

Figure 1: Site location and extent showing 4 deferred selection properties (refer section 4.3.1)

The Site is currently managed by Toitū Te Whenua Land Information New Zealand (LINZ) on behalf of the Crown but has been held in the Treaty Settlements Landbank since 1999 following the hospital's closure in 1998. Land held in the Landbank is Crown land which has been declared surplus can be used as cultural or commercial redress in Tiriti o Waitangi Settlement claims.

The Ngāti Maniapoto (herein referred to as Maniapoto) Deed of Settlement (the Deed), that was initialed in December 2020, acknowledged the cultural significance of the Site and the need for demolition and remediation of the Site before it can be offered to Maniapoto. The Tokanui situation is unique as no other property included in a Treaty settlement has required demolition and remediation on this scale or required a commitment to undertake remediation in a deed of settlement. In April 2021, Cabinet agreed new operational funding for LINZ to undertake the extensive work required to enable the inclusion of the Site as a redress in the Maniapoto Treaty of Waitangi Settlement. The Deed was signed by Maniapoto and the Minister for Treaty of Waitangi Negotiations on 11 November 2021 and the Maniapoto Settlement Claims Act 2022, which gives effect to the settlement, came into force on 28 September 2022.

Under the Deed, Maniapoto and the Crown have agreed to a unique, standalone process - Schedule 9: Tokanui Hospital Deferred Selection Process (THDSP) - which forms part of the Property Redress Schedule[2]. The THDSP details specific requirements for LINZ to complete the demolition and remediation of the Site and a Memorandum of Understanding (MoU) signed by Te Nehenehenui Trust and LINZ outlines the roles, relationship, accountabilities, responsibilities and expectations for the parties in relation to the delivery of the works.

"**Horizontal infrastructure**" is defined in the Deed as: "*The roading and accessways, foundations and services that the Crown, with the consent of the relevant Ministers as required, decides must be retained on the relevant Tokanui Hospital deferred selection property, in accordance with paragraph 9.9 of the Deed*".

It should be noted, that at the date of this report, it is assumed that building foundations will be removed as part of the vertical demolition package rather than under horizontal infrastructure as stated in the Deed as the two are intrinsically linked. Building foundations have therefore been assessed under the Disposal Options Assessment (Fraser Thomas, 2023).

A decision has yet to be determined on how much of the horizontal infrastructure must be retained onsite. Four options were shortlisted and used to inform funding approval from Cabinet based on onsite versus offsite waste disposal AND the complete removal of all horizontal infrastructure or the removal of "some" horizontal infrastructure. "Some" horizontal infrastructure in this context was not defined, but was assumed for disposal options evaluation purposes to be 20%. However, due the potential significant cultural, environment, social, and economic impacts associated with this determination, approval to proceed must be obtained from the Minister of Land Information, Minister of Finance and Minister for Treaty of Waitangi Negotiations (together referred to as Ministers) and must take the views of the post settlement governance entity, Te Nehenehenui Trust, into account.

LINZ have therefore engaged Fraser Thomas Limited (FTL) to undertake this horizontal infrastructure assessment to help inform the decision on how much, if any, horizontal infrastructure should be retained. For example, it may be beneficial to retain some roading to maintain vehicle access to and through the Site, while some stormwater infrastructure may need to be retained to convey upgradient runoff through the Site.

This report will also be used by LINZ to meet the requirements of paragraph 9.11 of the THDSP and the communication and engagement process set out in the MoU with Te Nehenehenui, as part of

[2] https://www.govt.nz/browse/history-culture-and-heritage/treaty-settlements/find-a-treaty-settlement/maniapoto/maniapoto-deed-of-settlement-documents/

providing Te Nehenehenui with relevant information to allow an informed view to be presented to Ministers.

2.0 OBJECTIVES

The primary objective of this Horizontal Infrastructure Assessment (HIA) is to determine the condition and extent of all existing horizontal infrastructure on the site, with this information then being used to inform decisions on the extent of this infrastructure to be removed or retained, both above (e.g. fire hydrants) and below ground (e.g. pipes), and to support related decisions on waste management. The intention of the investigations is not to produce as-built quality drawings, but instead sufficiently detailed plans and other investigation findings to inform the above.

Secondary objectives include:

(a) To adopt a holistic approach taking into account environmental, social, cultural and economic factors that meet LINZ requirements and stakeholder expectations, comply with industry best practice and government sustainability and broader outcome goals.

(b) To meet the Crowns requirements under paragraph 9.11.1 of the THDSP and the communication and engagement process set out in the MoU, by providing the governance entity with relevant information, including any supporting advice or material relied upon to inform Ministers approval, to allow the governance entity to provide an informed view on what horizontal infrastructure shall be retained, if any.

3.0 SCOPE

The scope of this Horizontal Infrastructure Assessment includes the following:

(a) Assessment of the current condition and extent of horizontal infrastructure within the Site, comprising:
- All roading and associated paved areas;
- Retaining walls (1);
- Water, stormwater and wastewater reticulation;
- Building heating system, comprising an underground concrete ducting system, with steam and condensate pipes that were formerly used to heat the Site buildings; and,
- Utilities – power and telecom.

(b) Desktop review of available information, comprehensive site investigations including site walkovers, pavement test pits and deflection measurements, CCTV and underground services detection, hydro excavation and topographical survey, followed by compiling updated horizontal infrastructure plans and assessment of asset quantities, condition and estimated residual lifetime.

(c) Review of relevant background information and specialist reports to help inform what infrastructure could be retained or needs to be retained.

(d) Use of this information to inform decisions on the extent of the horizontal infrastructure to be removed or retained, both above and below the ground, and to support decisions on waste management (latter is covered in a separate report).

(e) Detailed assessment of impacts of retaining the horizontal infrastructure groupings, including any risks associated with retention of assets, and the environmental, social, cultural and economic impacts.

(f) Detailed assessment of impacts of removing these infrastructure groupings, including considering any risks associated with removal of assets, level of soil disturbance (including estimated quantities) and the environmental, social, cultural and economic impacts.

(g) Provide a recommendation for a preferred approach, in consultation with LINZ.

(h) Contribute information to the Assessment of Environmental Effects (AEE) that enables the identification and development of strategic options (separate report by others).

4.0 BACKGROUND INFORMATION

4.1 SITE HISTORY

The site is part of 1,194ha of Māori land taken under the Public Works Act in 1910 for the Tokanui Hospital. The hospital opened in 1912 and closed in 1998 and the Site was transferred into the Treaty Settlements Landbank (managed by the Ministry of Justice at the time) to be used as redress to settle historical claims in 1999. The Site, along with the other properties in the landbank, transferred to LINZ in 2017.

The taking of the land and subsequent history while in Crown ownership is detailed in the historical account in clauses 2.183 to 2.189 of the Deed. Further history pertaining specifically to the delivery of the demolition and remediation project is provided in the Tokanui Psychiatric Hospital Archaeological Assessment (CFH Heritage, 2022), Preliminary Site Investigation (GHD, 2023 in draft at the time of this report), and the Cultural Impact Assessment (TAR, 2021).

4.2 MANIAPOTO: FUNDING TO REMEDIATE THE TOKANUI HOSPITAL SITE

In February 2021, Cabinet noted (MCR-21-MIN-0002) that, for the redress to be inserted into the Deed and before ratification of the settlement claims bill could commence, Cabinet needed to agree to new funding for LINZ to undertake the demolition and remediation project. At the same time, Cabinet agreed that the Ministers of Finance, Treaty of Waitangi Negotiations and Land Information are required to make any final decisions on the level of remediation (i.e. whether substantial roading and access, foundations and services will be retained or removed) and whether waste from the site will be transported offsite or contained in a purpose built disposal facility onsite. Details regarding the joint-Ministerial decision are described further in section 4.3.2, below.

4.3 MANIAPOTO CLAIMS SETTLEMENT ACT 2022 REQUIREMENTS

4.3.1 Tokanui Hospital Deferred Selection Process Overview

As noted above, Maniapoto and the Crown agreed to a unique, standalone process for the demolition and remediation of the Site as set out in Part 9 of the Property Redress Schedule, which forms part of the Deed. The Deed was signed by Maniapoto and the Minister for Treaty of Waitangi Negotiations on 11 November 2021 and the Maniapoto Settlement Claims Act 2022, which gives effect to the settlement, received royal assent on 27 September 2022. This Act binds the Crown to meeting the requirements of the THDSP.

The following summarises the Crown's obligations in carrying out the demolition and remediation works. It is not intended to provide a full account of the requirement nor replace/override the terms of the THDSP. The Crown will:

- No later than two years following the settlement date, apply for all necessary consents required for the demolition and remediation works, and if relevant, the existing and/or new disposal sites. For clarity, the deadline to apply for consents is 24 November 2024;
- Comply with all necessary consents and approvals for the demolition and remediation works.
- Remediate the land in accordance with the applicable remediation standard as referred to in paragraphs 9.3 and 9.7 of the THDSP;
- Remove all vertical building structures from the property;
- Determine the extent of horizontal infrastructure to be removed, subject to Ministerial decisions described in 9.9 of the THDSP and outlined below in section 4.2.2; and,
- Ensure that, where the land has been damaged by the impact of the demolition and remediation works, it is left free of building debris, and is stabilised by grassing.

It is also worth noting that:

- The site has been divided into four deferred selection properties (refer Figure 1) allowing for staged transfer of each property to the PSGE as demolition and remediation works are completed.
- The Crown will transfer management of the on-site wastewater pump stations and associated infrastructure to either the PSGE or to the Waipā District Council, noting that LINZ completed decommissioning of the wastewater treatment plants and associated infrastructure in 2021.
- The Crown is not required to remediate the existing disposal sites or any new disposal site constructed on any of the four deferred selection properties but must maintain valid consents for any ongoing monitoring of these sites.
- The Crown must enter a MoU with the PSGE, setting out relationship principles and provides a process for communication in relation to the demolition and remediation works. Noting this was completed on 4 March 2022.

4.3.2 Ministerial Decision of Final Scope

As noted above, Cabinet agreed the requirement for joint Ministers to make final decisions affecting the scale and approach of the demolition and remediation works. The THDSP and the MoU outline the process for decision making, and specifies that the two matters for Ministerial decision are:

- whether demolition waste from the site, including hazardous materials, will be transported offsite for disposal, or contained in a new purpose-built containment cell (new disposal site); and/or,
- the extent of horizontal infrastructure, including roading and underground services, that will be retained onsite.

The THDSP requires that, before LINZ obtains the Ministers approval for the disposal options and horizontal infrastructure, LINZ will:

- provide the PSGE with relevant information concerning any horizontal infrastructure proposed to be retained, and any proposed new disposal site to allow the PSGE to provide an informed view, including any supporting advice or material relied upon to inform the joint Ministers' approval;

- consult with and take into account the views of the PSGE; and,
- ensure the PSGE's views are presented to the Ministers.

The THDSP also records Maniapoto's preference as opposing the creation of any new disposal site on any Tokanui Hospital deferred selection property.

4.3.3 Memorandum of Understanding

In May 2021, LINZ, representing the Crown, and the Maniapoto Māori Trust Board, as part of negotiating the terms of the Deed, agreed the terms of the "MoU in Relation to Remediation and Demolition of the Former Tokanui Hospital Site." The MoU was then signed by LINZ and the trustees of Te Nehenehenui, the PSGE of Maniapoto (together, the Parties) on 4 March 2022. The MoU outlines the roles, relationship, accountabilities, responsibilities and expectations of the Parties.

Of notable relevance to this assessment is the communication and engagement process between the Parties. The MoU outlines five stages in which information regarding any proposed new disposal site will be shared with Te Nehenehenui and how Te Nehenehenui will provide LINZ with its views on such a proposal and how these views will be provided to joint Ministers for decision on the final scope of works.

4.4 TOKANUI HOSPITAL: DECISION-MAKING PROCESS AND CRITERIA (BRF 23-169)

In December 2022, the Minister of Land Information agreed the criteria that will be used to assess and inform this disposal options assessment (BRF 23-169). The choice of criteria is important as it will ensure LINZ considers the right information as part of this options analysis. The briefing was forwarded to the Offices of the Minister of Finance and Minister for Treaty of Waitangi Negotiations and to Te Nehenehenui Trust.

The following criteria are unweighted and listed in order of priority and have been used as the basis of the options assessment undertaken in section 10 of this report.

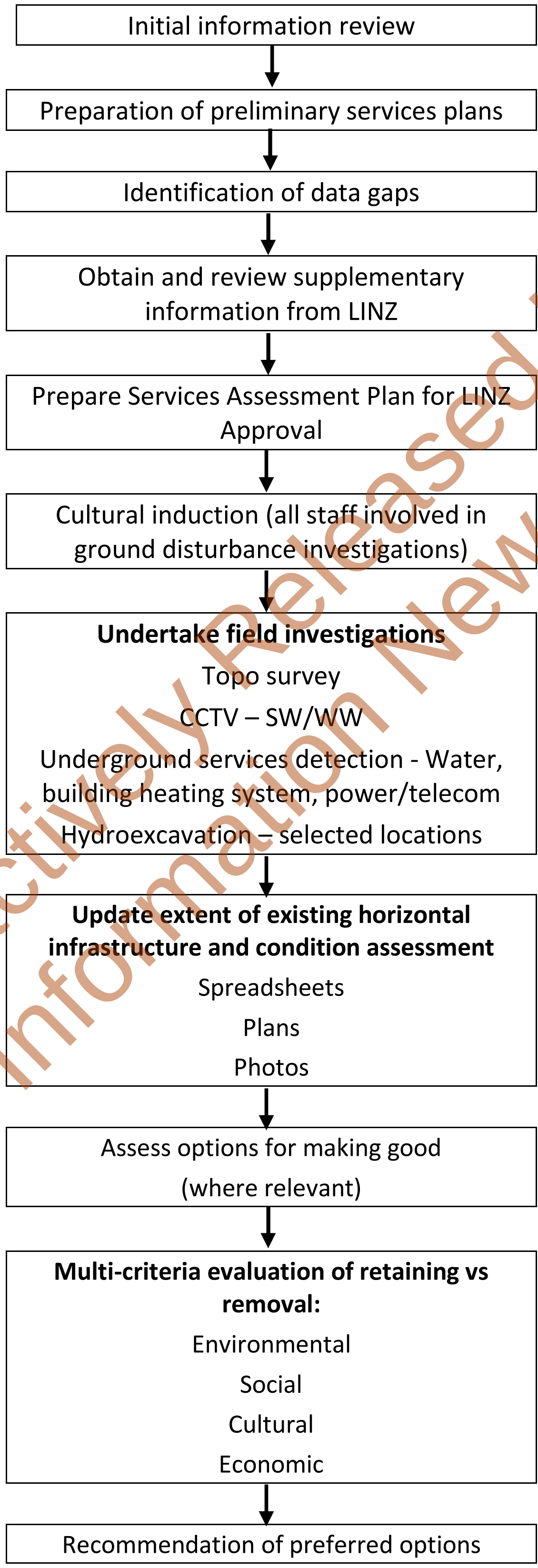
Table 1: Disposal Options Assessment Criteria agreed to by Ministers

Criteria	Key Considerations
Strategic alignment	• Assessment of ability to deliver on the Crown's commitments under the Deed, taking into account timeframes and delivery risks • Government Procurement Rules (Rule 16: Broader Outcomes Framework)
Crown-Iwi Relationship	• Alignment with formal feedback from the PSGE, representing the views of all Maniapoto iwi, hapu and whanau
Social and environmental effects	• Assessment of effects of works on cultural, archaeological, sustainability and other environmental values, and health and safety of suppliers • Condition of horizontal infrastructure
Value for money	• Cost to deliver project works • Future liabilities associated with the site are minimised

5.0 ASSESSMENT PROCESS

5.1 OVERVIEW

The assessment process is summarised in the following flowchart:



5.2 INITIAL INFORMATION REVIEW

The background information reviewed included the following:

- LINZ drawing "Horizontal Infrastructure Assessment – Building Area drawing" compiled by BCD, dated 2/5/2022 (referred to as "site plan"). The investigation area extent is the hospital extent shown on this drawing including any wastewater reticulation to the wastewater treatment plant (WWTP) in the NE corner of the site, but excluding the nurses home in the NW corner of the site, that is not shown on this drawing, but is referenced on earlier site drawings.
- Opus Existing services layout plan (1) and plan sheets (7) (2015).
- 43 archived drawings comprising sheets BD.234-1 to 43 inclusive. The drawings register provided comprises approximately 800 drawings in total, but with multiple duplicates (copies a and b). However, review of the titles of the drawings not provided but listed in the drawings register indicates these largely relate to building floor and structural plans – these are assumed to not be relevant to this investigation (as these relate to above ground buildings and associated vertical infrastructure).
- Multiple photos of buildings and structures in Areas 1-4 and other items (concrete service ducts).
- Further information shared during the site visit of 13 December 2022, particularly relating to the nature of the services trenches and nature and extent of existing retaining walls on-site.

5.3 PRELIMINARY SERVICES PLANS

From review of the above documents, preliminary plans were prepared by FTL using the Opus plans as the basis, showing the roading network and individual services, based on our best understanding of the existing situation, compiled from cross-checking the archived drawings provided against the Opus services plans and the other additional information provided by LINZ, as well as doing a number of common sense checks to make our own preliminary assessments of additional missing services. These plans were used as the basis for field investigations.

5.4 DATA GAPS ANALYSIS

This review indicated that the services information was incomplete and identified some conflicts, as summarised below:

- The steam and condensate lines on the archived plans relate to the concrete duct sections on the Opus plans. The archived plans provided (dwgs BD234-3 to 5) shows that new steam lines to Villas A-D and Hall also featured up to two additional hot water lines in some locations.
- The Opus plans do not show the concrete ducting extending to all buildings, which would be expected for the majority of buildings.
- The power cabling extent is missing connections to some buildings and some substations, while it is significantly different from the power distribution network shown on dwg BD234-41.
- The provided length of telecom cable on the Opus drawings is quite small at just 400m. Additional desktop information was obtained from Chorus, adding on 5700m.
- The water supply network is relatively extensive, but some sections are isolated from others and there is a lack of ring mains. Additional reticulation has been added to connect to the water treatment plant and water tower shown on the site plan (buildings B7 and B54).

- The stormwater network is fragmented. Contours from the LiDAR site survey were added to check if it terminates at appropriate locations and some additional information from dwgs BD 234-27 to 35 was added to fill in some gaps, while some judgements were made on additional missing reticulation.
- The wastewater reticulation shown on the Opus plans comprises multiple discrete sections with missing connectivity between sections and no pipes are shown going to the existing WWTP. The dwg BD234-21 shows proposed sewer line upgrading from the site to the WWTP from 1981, which is assumed to represent the best available information for this section of the reticulation. Again, some judgments were made on likely additional missing reticulation.
- The number of features to be captured by topo survey was estimated off these plans (e.g. concrete ducting access hatches, manholes, catchpits, power/light poles, etc.).

5.5 INFORMATION REQUESTS

This preliminary assessment was discussed with LINZ at the start of this project. Queries raised by FTL and further information provided by LINZ in response to those queries is summarised in Table 2. No revisions to the preliminary services plans were required to address these responses.

Table 2: Further Information Requests and LINZ Response

FTL Information Request	Summary of LINZ Clarifications
Feedback on FTL draft services plans, roading network and site feature information.	The drawings provided correlate with the service drawings provided to LINZ by the Ministry of Justice as part of an investigation undertaken by Opus Ltd. There is a variance in the totals calculated but this is acceptable to LINZ.
Any information on the methodology used by Opus to compile the service plan drawings, to get a better feel for their accuracy.	LINZ has reviewed all the historic OPUS/WSP reports and other existing information held on file in relation to the scoping of these investigations. There is no indication of how the position of the services were captured. There is mention of the use of LiDAR for the site survey, so it has been assumed that the service plan drawings were compiled form a combination of LiDAR and conventional survey methods.
Any information on the source of the services information shown on the LINZ GIS Solution for the hospital – i.e. were the services and associated features plotted from the Opus service plan drawings (including whether this was done from pdfs or the original AutoCAD drawings or from aerial imagery, or otherwise).	The services were plotted on the LINZ GIS Solution utilising the AutoCAD files prepared by WSP.
Latest information on any site contamination issues (e.g. any additional issues found by GHD but not yet reported on).	Early investigations were undertaken as part of project scoping and have been shared with FTL. A Preliminary Site Investigation and Detailed Site

	Investigation are in progress at the time of this report and will be shared with FTL once available.
Confirm nurses' home in the NW corner of the site is excluded from the scope of work, as currently assumed.	LINZ confirmed it is currently out of scope. If the site investigation identifies any services linking to the demolished structures, they will be investigated at that time.
Provide a schedule or updated drawing matching the building descriptions on the archived drawings (e.g. Villages A, B, C, D and Hall) to the building numbers (B1-B76) on the site location plan.	LINZ provided additional Site Plans and an Excel spreadsheet.

5.6 ASSESSMENT PLAN (AP)

A Services Assessment Plan (AP) was then prepared by FTL, based on the above information and roading and services plans prepared, including review of the additional information provided by LINZ.

The AP clearly set out the strategy for investigation works to ensure data was collected to inform the condition of the assets. It described the investigation methodology, taking into consideration the types of structures/services that were to be assessed and highlighted the key risks and mitigation measures to be employed during the assessment process.

From our experience of similar projects, it was considered more cost effective to put more time and effort into the investigation stage, rather than spending too much time on the desktop stage, as the archived drawings provided are not asbuilts and may not reflect what is in the ground. LINZ agreed with this approach and approved the AP.

It was agreed with LINZ that the field investigation work would not include investigating and assessing lateral lines to individual buildings.

5.7 INVESTIGATIONS, ANALYSIS AND REPORTING

The approved AP was then implemented, involving comprehensive field investigations, Investigations, data analysis and reporting, as set out in the following sections of this report.

6.0 FIELD INVESTIGATIONS

6.1 INTRODUCTION

Field investigations were undertaken of all horizontal infrastructure over the period March-May 2023 inclusive. These investigations involved the following sub-consultants:

- WSP – pavement test pits and Benkleman beam testing;
- Barry Satchell Consultants Ltd – field instrument surveys;
- Civtec – underground services detection; and,
- CST Group Limited – CCTV and hydroexcavation services.

All field workers undertook a health and safety induction and archaeological induction on-site prior to starting work. Those involved in ground disturbance works (pavement test pits and hydroexcavation) also took part in a cultural induction in February 2023.

This section begins with a summary of the hospital development timeline, as an indicator of infrastructure development timing and then describes for each service the following:

- Relevant background information;
- Methodology
- Results
- Condition/lifetime assessment

6.2 HOSPITAL DEVELOPMENT TIMELINE

As part of preparation for field work and to inform the horizontal infrastructure condition and lifetime assessment, historical aerial photographs were reviewed to understand how the hospital developed over time in terms of roads and buildings to give an indicator of the likely age of the associated horizontal infrastructure servicing the hospital development. Representative aerial photographs are included in Appendix A and summarised here. Drawing 33205/BSD001-004 shows the current state of hospital development using the aerial photograph from the LiDAR 2022 survey, with buildings colour coded to indicate the year they were first present on aerial photographs. Building IDs are from the LINZ Building Area Drawing; areas 1-4 relate to the 4Sight investigation groupings and are included for reference.

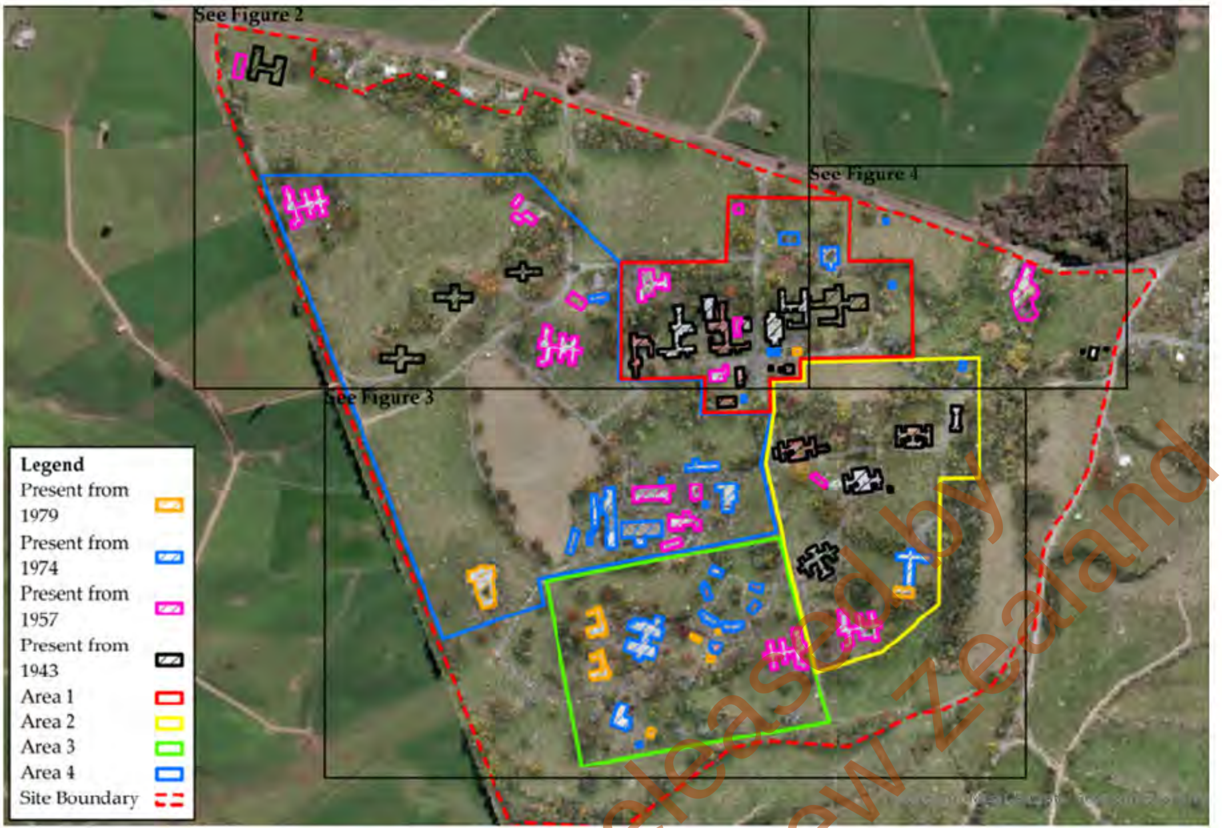


Figure 2: Dates different buildings were visible on aerial photographs (excerpt from drawing 33205/BD001)

Table 3: Hospital Development Timeline from Historical Aerials

Date	Description
1943	The hospital is developed in the central northern area, including a building to the east of B02 (labelled D01). Buildings centred on B21, B23, B27 and B29 are also present in the southern portion of the site, while there are three buildings in the central west area (labelled D02, 03 and 04) and the nurses home is visible in the NW corner of the site. The roading network is relatively extensive, including through the southern area of the site.
1957	New buildings have been added to the hospital comprising B55, B56, B58, B30, and B33 (all visible in aerial in pink colouring), as well as B75 (doctors flats) in the NW part of the site and buildings B66, B68 (boiler house), B69 and B74 in the "commercial" area. The boiler house is understood to have been used to provide the steam for the building heating (concrete ducting) system. The roading network is similar in extent.
1961	Site development is very similar to 1957.
1974	The hospital development has intensified with more dense buildings in the central and northern areas, while buildings B59 – B63, B65, B70, B71 & B73 have been added in the commercial area. New buildings B26, B36, B42 – B48, B51 have been added in the southern area along with B03, B04, B19, B25, B35 and B57 in the central portion of the site. The roading network has been extended to cover the southern portion of the site, with the remainder of the existing road generally unchanged.

1979	New buildings B49 & B50 have been added in the south of the site, while B53 has been added in the SW part of the site. This is the last aerial that buildings D01, 02, 03 and 04 are visible. The roading network is generally unchanged.
1995	The hospital development is largely unchanged, other than buildings D01-04 have been removed. The roading network is generally unchanged.
2017	A small connecting building has been added between buildings B27 & B28, No other significant changes from the 1995 aerial.

Overall, this timeline of hospital development shows:

- **Area 1:** The older horizontal infrastructure (1943 or earlier) is likely to be located in the central-east & northern part of the site. However, it may have been extended and upgraded as hospital development became more intense in this area up to 1974. After this, any further infrastructure development work in this area is expected to have been more limited, except for asset renewal. There may be some redundant horizontal infrastructure still in the ground that previously serviced building D01.
- **Area 2:** The south-eastern part of the site will have had horizontal infrastructure serving the northern half of this area from at least 1943 extending into the southern half of this area by 1957 and south-eastern corner by 1974.
- **Area 3:** The central southern part of the site was developed later, with horizontal infrastructure likely to have been added to this area between 1961 and 1974 except for B33 (present in 1957 aerial but likely served by Area 2 infrastructure) and then extended by 1979.
- **Area 4:** The commercial part of this area was progressively developed, starting from sometime between 1943-1957 (including the boiler house) and gradually expanded as shown in the 1957, 1974 and 1979 aerials. The rest of this area was developed gradually – buildings D02-D04 were present by 1943, with most other buildings being added by 1957, and B53 by 1979. The D02-04 buildings were removed sometime between 1979 and 1995 and the horizontal infrastructure that used to serve them may still be in the ground.

6.3 ROADING AND PAVING

6.3.1 Background Information

The earliest aerial photograph found to date shows the Site had been extensively developed as a hospital with an extensive roading network in 1944, and was gradually expanded over the coming years up to around 1966 when the site appears fully developed in accordance with its current layout. This indicates the original roading network is well in excess of 50 years old.

Detailed review of historical Site plans indicates these plans cover a number of different projects involving minor roading repairs/extensions and new carparking over the period 1975-79. Plans for different projects show typical road cross-sections, which indicate the pavement typically comprises 25-40mm AC (asphalt concrete), on 125-150mm M4 basecourse on 50mm sand or directly on subgrade, which represents a relatively "skinny" pavement. No plans have been found indicating whether any substantial resurfacing of the roading network was done.

The GHD Tokanui Hospital – Coal Tar Assessment letter report (draft, dated 2 Feb 2023) summarises the results of an investigation checking for the presence of coal tar in the binding of the pavement and underlying basecourse material on the hospital site, involving the collection and laboratory analysis of 26 pavement/basecourse samples for polycyclic aromatic hydrocarbons (PAHs) and TCLP (toxicity characteristic leaching procedure) testing of 12 asphalt samples for PAHs. This investigation found that Samples Asph 01, 02 and 05 are likely to be sealed with coal tar, with Asph 07 potentially also containing a percentage of coal tar. The coal tar samples contain PAHs at elevated concentrations (Benzo-a-pyrene (equivalent) (BaP(eq)) = 62, 38, 34 and 2.9mg/kg in samples 01 (pavement only), 02 and 05 (pavement and basecourse) and 07 (basecourse) respectively). Leaching of PAHs from all samples was very low. BaP(eq) is a measure of the potential overall PAHs carcinogenity. The results indicate this is low risk, with the guideline for commercial/industrial sites (outdoor workers), unpaved areas being 35mg/kg. In this case, these results derive from paved areas and hence the PAHs are likely to be tightly bound to the pavement as indicated by the TCLP leaching results, meaning the 35mg/kg guideline will be conservative.

Figure 3 shows that the areas with elevated BAP(eq) concentrations are generally located along the main entrance road, running north to south (except for location 6) and at one location around the eastern road. During their pavement pit investigation, WSP also noted "possible coal tar" at five locations as highlighted in the pale blue circles below.

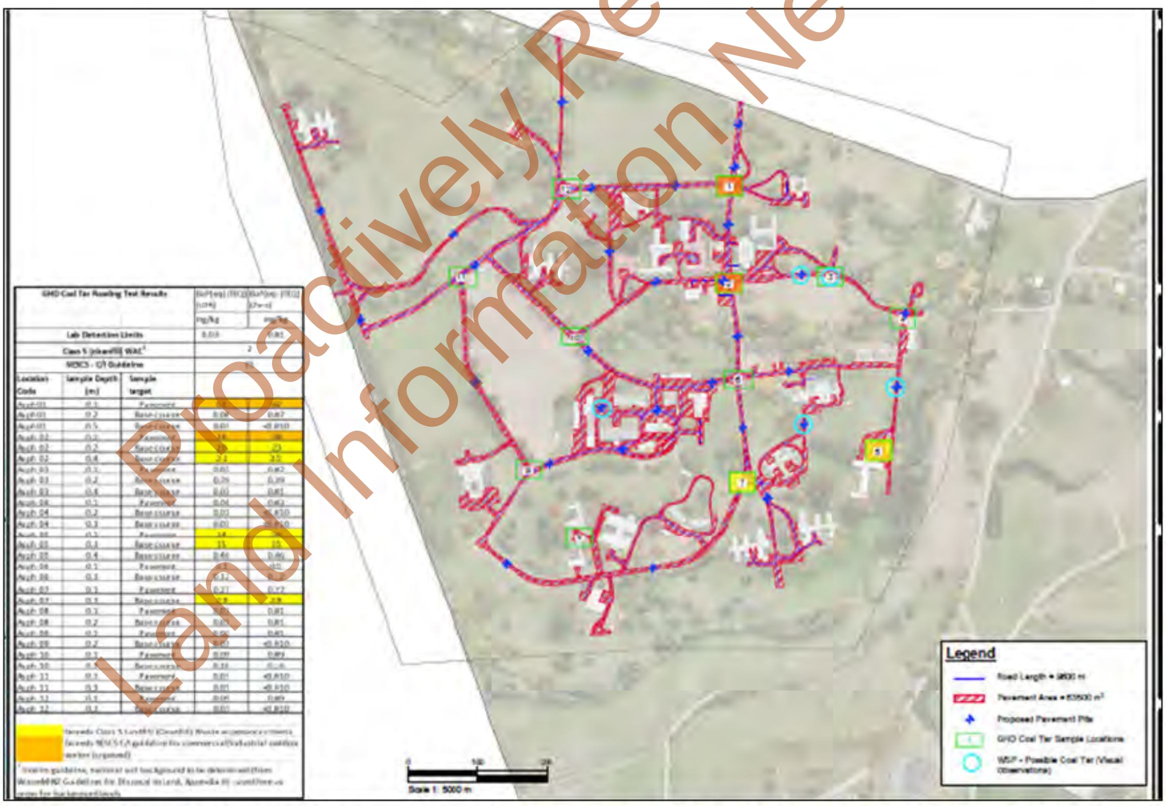


Figure 3: Visual Observations – Confirmed or Potential Coal Tar (refer drawing 33205/1701 for higher resolution image)

6.3.2 Methodology

The following methodology was undertaken to assess the roading/paving network:

- Visual inspection of existing roading network by FTL senior civil engineer to New Zealand Transport Agency (NZTA) / Waka Kotahi guideline (June 2017) and monitoring of work done by WSP as part of quality assurance/control (QA/QC) checks.
- Coring and test pitting (pavement pits) of roadways to determine the construction make up – pavement thickness, basecourse and subbase and subgrade + associated CBR testing: 39 tests at approximately 300m intervals (Austroads recommendation for rural land use) but with test locations adjusted taking into account the road network. Test pit locations were mapped onsite and cross-checked against nearby site features. Methodology would involve:
  - underground service check at each location (by Civtec);
  - excavation of the pavement pit;
  - logging of basecourse, subbase and subgrade layers by suitably qualified WSP staff;
  - undertaking DCP test to a minimum depth of 0.9 m below the start level in the base of the pit;
  - undertaking shear vane tests in subgrade material (peak and residual strength values);
  - photographs of each pit and photograph showing each pit location;
  - pavement pit log;
  - reinstatement of pavement pits to 'like for like' state i.e. back to pre-pit reinstatement but with no resealing;
  - provision of a factual field and laboratory test report, including reference to test standards, all test results and site plan showing pavement pit and DCP locations.
- Corresponding calculations of roading materials utilising testing results – this was done in CAD using measured roading lengths and widths off the drawings provided and/or the Lidar orthophoto and the investigation findings.
- Benkelman Beam Testing of the existing roadways near the pavement pit locations (39 tests). Beam testing locations were recorded by survey.
- Assessment of remaining life span of existing roading and risks associated with site traffic increasing due to clearance works, utilising historical construction plans, information on past traffic and predicted future traffic, including site clearance traffic and the testpit/beam testing results.

A total of 15 additional roading/pavement basecourse and subgrade samples were collected, with these samples being stored until a decision is made as to whether testing is required or not. Lab testing, if done, would include testing of the basecourse for water content, particle size distribution, plasticity index and CBR (soaked) and of the subgrade for reactivity and CBR (soaked and unsoaked) for 15 samples. In our opinion, testing is unlikely to be required based on the roading options considered in this report.

6.3.3 Visual Assessment

Visual observations of the roading network are summarised below, followed by representative photographs. More details and site photos are appended.

Table 4: Roading Visual inspections - Summary Findings

Item	Assessment
Shape	Generally good - no rutting or significant depression; some settlement at service manholes and trenches
Surface	Chipseal and asphalt – poor condition Horizontal and alligator cracks, potholes, patchy at some locations, moss Multiple joints and lack of joint seal Some surface flushing at the main entrance Uneven at some service manholes Chipseal instability at some locations
Drainage	Good condition Kerb and channel at most locations Vegetation overgrown, moss, ponding at some intersections Inverse cross-fall at some locations, potential ponding issue
Geometric	Flat to moderate longitudinal gradient Good dual cross-fall on main roads; single cross-fall on side roads Poor cross-fall at some intersections, leads to ponding issue Speed humps at some locations Inverse cross-fall at some locations, potential ponding issue
Shallow/Deep-seated damage	Mostly shallow surficial damage Some deep-seated at service trenches and intersections

Figure 4: Typical good dual cross-fall, kerb and channel but overgrown

Figure 5: Typical settlement at service trench road crossings

Figure 6: Typical surface cracks

Figure 7: Typical joint without seal

Figure 8: Typical potholes

Figure 9: Typical speed hump

6.3.4 WSP Ground Investigations

WSP's pavement investigations factual report is attached in Appendix B. The following tables summarise the testpit logs and beam testing results. These results are then interpreted in Section 6.3.5 of this report.

Table 5: Test Pits Summary

Pit No.	Depth (mm)	Surface	Layers encountered	Layers sampled	Pit No.	Depth (mm)	Surface	Layers encountered	Layers sampled
TP01	450	Asphalt	B/C, S/B, Fill, S/G	B/C, S/G	**TP17**	700	Chipseal	B/C, Fill, S/G	B/C, S/G
TP02	430	Asphalt	B/C, S/B, S/B, Fill, S/G	N/S	**TP18**	550	Chipseal	B/C, S/B, S/G	N/S
TP03	500	Asphalt	B/C, S/B, S/G	B/C, S/G	**TP19**	600	Asphalt	B/C, S/B, Fill	B/C, Fill
TP04	270	Asphalt	B/C, S/G, S/G, S/G	N/S	**TP20**	230	Chipseal	B/C, S/G	N/S
TP05	400	Chipseal	B/C, S/G	B/C, S/G	**TP21**	450	Chipseal	B/C, S/B, Fill, S/G	B/C, S/G
TP06	320	Chipseal	B/C, Fill, S/G	N/S	**TP22**	500	Asphalt	B/C, Fill, S/G	N/S
TP06a	450	Asphalt	B/C, Fill, S/G	Fill, S/G	**TP23**	450	Chipseal	B/C, S/G	B/C, S/G
TP07	200	Chipseal	B/C, S/G	N/S	**TP23a**	200	Asphalt	B/C, Fill, S/B, S/G	N/S
TP08	400	Chipseal	B/C, S/G	B/C, S/G	**TP24**	400	Chipseal	B/C, S/G	B/C, S/G
TP08a	200	Chipseal	B/C, S/G	N/S	**TP24a**	300	Chipseal	B/C, Fill, S/G	N/S
TP09	400	Chipseal	B/C, S/G	B/C, S/G	**TP25**	550	Chipseal	B/C, S/G	B/C, S/G
TP10	300	Asphalt	B/C, S/B, S/G	N/S	**TP25a**	400	Chipseal	B/C, S/G	N/S
TP10a	450	Chipseal	B/C, S/G	B/C, S/G	**TP26**	400	Chipseal	B/C, S/G	B/C, S/G
TP10b	600	Asphalt	B/C, S/B, Fill	N/S	**TP26a**	200	Chipseal	B/C, S/G	N/S
TP11	600	Asphalt	B/C, Fill	B/C, Fill	**TP27**	500	Chipseal	B/C, S/G	B/C, S/G
TP12	400	Chipseal	B/C, Fill, S/G	N/S	**TP28**	500	Asphalt	B/C, S/G	B/C, S/G
TP13	600	Asphalt	B/C, Fill	B/C, Fill	**TP29**	450	Chipseal	B/C, S/B, Fill, S/G	N/S
TP14	240	Chipseal	B/C, S/B, S/G	N/S	**TP30**	350	Asphalt	B/C, S/B, S/G	S/G
TP15	400	Chipseal	B/C, S/G	B/C, S/G	**TP30a**	250	Asphalt	B/C, S/G	N/S
TP16	400	Chipseal	B/C, S/G	N/S					

Note: B/C - basecourse, S/B – subbase, S/G – subgrade, N/S – not sampled.

Table 6: Benkelman Beam Test Summary

Location	Deflection (mm)	Location	Deflection (mm)	Location	Deflection (mm)	Location	Deflection (mm)
TP01	1.61	**TP09**	1.20	**TP17**	1.23	**TP25**	1.17
TP02	0.82	**TP10**	2.21	**TP18**	0.93	**TP25a**	0.56
TP03	0.88	**TP10a**	1.15	**TP19**	0.86	**TP26**	1.67
TP04	1.12	**TP10b**	0.84	**TP20**	1.10	**TP26a**	2.15
TP05	0.92	**TP11**	2.21	**TP21**	0.40	**TP27**	0.64
TP06	1.64	**TP12**	0.48	**TP22**	2.32	**TP28**	2.20
TP06a	3.71	**TP13**	1.21	**TP23**	1.97	**TP29**	1.19
TP07	2.43	**TP14**	2.03	**TP23a**	2.40	**TP30**	1.50
TP08	1.34	**TP15**	2.32	**TP24**	0.52	**TP30a**	0.50
TP08a	2.31	**TP16**	1.05	**TP24a**	0.66		

6.3.5 Pavement Evaluation/Condition Assessment

Overall, the existing road is in a reasonable condition except for some localised failures. Most of the failures are surficial, indicating a good structure pavement. The existing asphalt and chip-seal surfaces are in poor condition and appear to be at the end of their life, evidenced by potholes, cracks and moss developing. The road generally has good drainage except for some localised issues and around the intersections. Kerb and channel are in good condition but require cleaning. There is some localised settlement near service trenches crossings and inspection chambers.

The following table provides a summary of the investigation results and root cause analysis. Refer to the Appendices B and C and to drawing 33205/1700 for more details.

Table 7: Pavement Evaluation/Condition Assessment

Item	Assessment
Shape	The roads are generally in good shape without rutting or significant depression. Some settlement was observed at service manholes and trenches, indicating poor backfill and compaction.
Surface	The existing surface comprises approximately 30mm of asphalt and chip-seal. The existing surfaces are in poor condition and appear to be at the end of their life, evidenced by potholes, cracks and moss developing. However, no deformation, heaving, shoving or rutting was observed, indicating the underlying pavement is structurally sound.
Drainage	The road generally has good drainage with well-formed kerb and channel at most locations. There are catchpits at regular intervals, typically in moderate to poor condition. The kerb and channel are overgrown with grass and moss and require cleaning. There are some localised ponding issues around the carparks and intersections due to poor cross-fall. If the pavement is retained, drainage improvement will most likely be necessary as moisture ingress is often the cause of pavement deterioration. Any pavement rehabilitation should be undertaken in conjunction with drainage improvement.
Geometric	The roads are generally 5.4m and 7.0m wide, suitable for two-way traffic. The roads have flat to moderate longitudinal gradients with good dual cross-fall on the main roads and single cross-fall on the side roads. However, some intersections and parking areas have poor cross-fall, which leads to drainage issues. Any pavement rehabilitation should be undertaken in conjunction with reshaping the road to improve cross-fall and drainage.
Pavement thickness	The road pavement varies significantly across the site. The total pavement depth ranges between 100mm and 600mm, with a mean of 300mm. The basecourse thickness is between 30mm and 380mm with a mean of 170mm, comprising medium dense to dense well-graded AP40. There is up to 350mm of fill at some locations.

	The existing pavement thickness is generally suitable for the historical low-traffic volume environment at the site. However, as explained below, the predicted construction traffic will significantly shorten its design life.
Deflection	The Benklemen Beam deflection ranges between 0.4 and 3.7mm. The high deflection values are generally in parking areas. In contrast, most roads have a deflection value of less than 1.6mm, suitable for the historical low-traffic volume at the site. High deflection is generally associated with inadequate pavement strength and thickness and poor subgrade. Any pavement rehabilitation should focus on those areas.
Potholes	Potholes were observed at some locations, generally associated with a lack of surface waterproofness, dirty basecourse and poor drainage, particularly near the intersections, trenches and speed humps. Potholes should be fixed to prevent further deterioration. Treatment should focus on surface waterproofness along with improving cross-fall and drainage. The minimal treatment is to apply a pothole patch. However, structural asphalt patches should be considered in flat areas where the cross-fall can not be improved.
Subgrade	The existing subgrade strength CBR ranges from 1% to 10%. The weakest subgrade was found in the parking areas. Most road subgrade CBR is between 4% and 10%, indicating a weak to moderate subgrade. At TP10 and 11, the subgrade CBR is 2% indicating a very weak subgrade. A subgrade CBR of 4% has been adopted for the pavement evaluation.
Shallow/Deep-seated damage	Most of the damage is shallow surficial, indicating that the underlying pavement is structurally sound. Some deep-seated failures were observed at service trenches indicating poor backfill and compaction.

6.3.6 Demolition/Remedial Works Design Traffic

As explained in section 6.2.1, the Site roading network and associated paving is estimated to be over 50 years old. However, it is likely that the existing pavement was mainly subject to light vehicles, such as cars, utility, vans, ambulances etc. These light vehicles contribute very little to pavement structural deterioration, evidenced by the minimal structural failure observed during the site investigation in May 2023. Therefore, only future heavy construction vehicles are considered in this assessment.

The AECOM Onsite Land Disposal Feasibility Study dated 2019 refers to the total volume of demolition materials, contaminated soil and horizontal infrastructure of approximately 156,000m^3 (loose measure). It is estimated that approximately 8,670 trucks and trailers are required to shift this material either offsite to an existing landfill in the Waikato region or onsite to any new onsite landfill, based on 18m^3 per truck and trailer. The total truck and trailer movements are 17,340 (two-way).

The damage index was estimated using the presumptive traffic load distribution for rural roads as outlined in AUSTROADS Pavement Design, Appendix 7.4, Table A7.4.2. This is calculated in terms of the ESA or "Equivalent Standard Axles", which is defined as "A measure defining the cumulative damaging effect to the pavement of the design traffic".

The following axle groups were used:

Truck = a front Single Axle Single Tyres and a rear Tandem Axle Dual Tyres (SAST + TADT)

Trailer = 2 x Tandem Axle Dual Tyres (2 x TADT)

Average No of Axle Groups per Heavy Vehicle (N-HVAG) = 4 (truck and trailer)

ESA/N-HVAG = 0.9 (weighted)

ESA/HV = 3.6

ESA = 17,340 x 3.6 = 62,424 (or 6.24 x 10^4)

The predicted heavy vehicle traffic is equivalent to the cumulative heavy vehicle traffic on a typical urban local access road over a 20 year design period as defined in Table 7.9, AUSTROADS Pavement Design for Light Traffic.

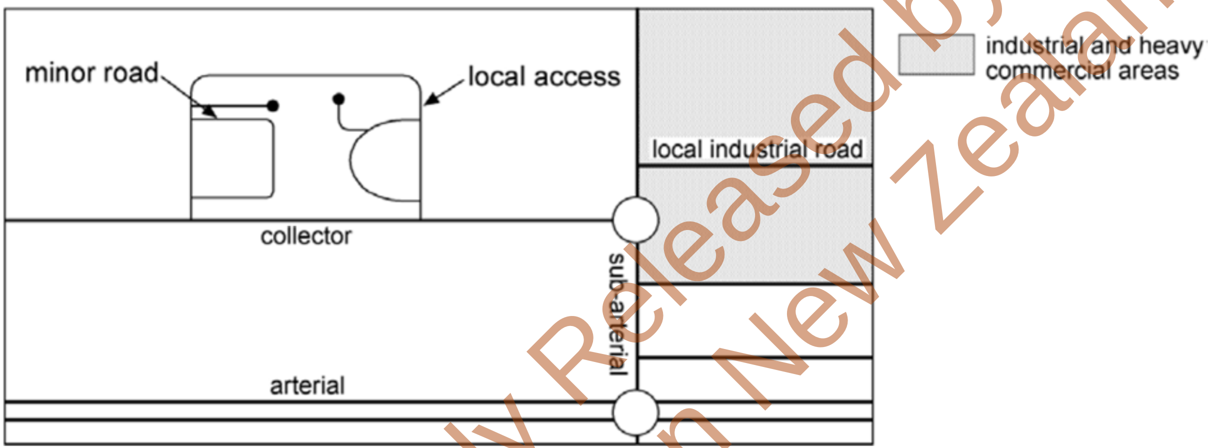


Figure 10: Typical urban street hierarchy

6.3.7 Pavement Life

The pavement analysis is based on the Empirical method specified in AUSTROAD Technical Report Pavement Design and Pavement Design for Light Traffic.

The analysis focused on the main road with the highest **design traffic of 6.24 x 10^4 ESA**. The detailed pavement analysis is appended.

The existing asphalt and chip-seal surface is at the end of its service life and unlikely to be able to withstand the construction traffic.

Apart from the main entrance, the pavement is expected to be at the end of its service life after the site-clearing work.

Table 8: Estimated Pavement Remaining Capacity

TP number	Pavement depth (mm)	Subgrade CBR	Deflection	Pavement Capacity (ESA)	Remaining Capacity
TP1	310	6	1.61	3×10^5	79%
TP2	400	6	0.82	3×10^6	98%
TP3	290	4	0.88	2×10^4	0%
TP4	160	8	1.12	2×10^3	0%
TP7	170	4	2.43	$< 1 \times 10^3$	0%
TP8	160	4	1.34	$< 1 \times 10^3$	0%
TP8A	170	4	2.31	$< 1 \times 10^3$	0%
TP13	220	6	1.21	1×10^4	0%
TP16	380	8	1.05	1×10^7	99%
TP17	230	4	1.23	1×10^3	0%
TP18	320	4	0.93	7×10^4	11%
TP25	300	6	1.17	2.5×10^5	75%

6.3.8 Road Embankment across Wharekōrino Stream

There is a redundant road embankment crossing the Wharekōrino Stream that provided an historical side road entrance to the Site. This road is included here as part of the hospital roading network as this road currently serves no purpose and hence could potentially be removed as part of site demolition works.

The location of this road crossing is highlighted in red below. A site inspection of this crossing indicates there appears to be a culvert (identified as culvert 2 below) running under the embankment, but this has not been able to be confirmed yet, due to the culvert being completely submerged. This culvert is estimated to have a diameter of 1350mm to be consistent with the upstream culvert 3. The road embankment is relatively high, with an estimated height of 5.5m from the stream bed to the embankment crest. This culvert has a significant influence on flood levels affecting the existing disposal site (highlighted in pink below) while the road embankment acts as a dam, affecting stream flow patterns and ecology. The embankment itself is heavily overgrown and has been subject to flytipping. The ground surface across the embankment is very uneven and a safety hazard.

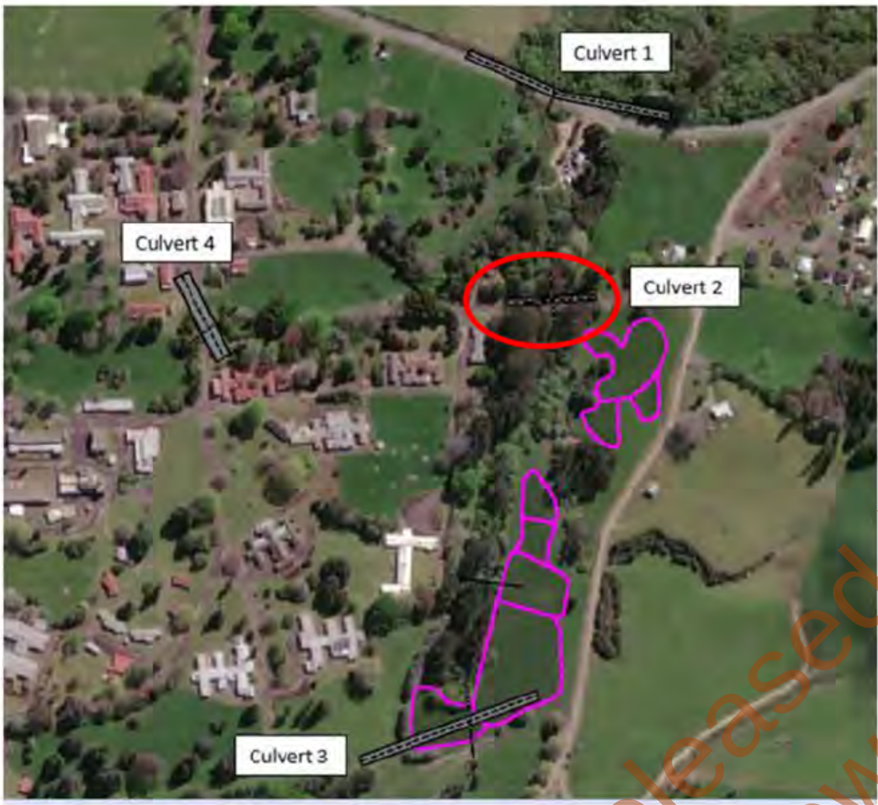


Figure 11: Redundant Road Embankment Crossing Wharekōrino Stream

	
Typical vegetation by road embankment	Likely location of culvert 3 under embankment

Figure 12: Redundant Road Embankment Crossing Wharekōrino Stream

6.4 RETAINING WALLS

6.4.1 Background Information

There is one retaining wall onsite located near Building B56. This wall comprises three terraces as shown below.

Figure 13: Retaining Wall location to northwest of Building B56

6.4.2 Methodology

A visual inspection of the existing retaining wall was undertaken by a FTL senior civil engineer to assess its condition.

6.4.3 Results and Condition Assessment

The retaining wall comprises a rock mortar wall made up of three terraces of total length 1202 and of variable height from 0.55 to 1.70m. Terrace dimensions from top to bottom, measured off the LINZ survey data, are:

- Terrace 1: 36m long of variable height from 0.75-1.08m.
- Terrace 2: 43m long of variable height 0.79-1.03m.
- Terrace 3: 43m long of variable height 0.55-1.70m.

Figure 14: Three views of retaining wall showing the terraces and its general condition

Table 9: Retaining Wall Condition Assessment

Item	Visual Assessment
General condition	Good
Any cracking/bulging	None observed
Any out of plumb sections, leaning over	None observed
Slightly leaning back into slope	None observed
Mortar cracks/weathering/soft spots/falling out	None observed
Visual damage	None observed
Any slumps	None observed
Any sections close to trees (potential tree root issue)	None observed

Overall, the retaining wall is in good condition and is an attractive feature.

6.5 CONCRETE DUCTING (BUILDING HEATING SYSTEM)

6.5.1 Background Information

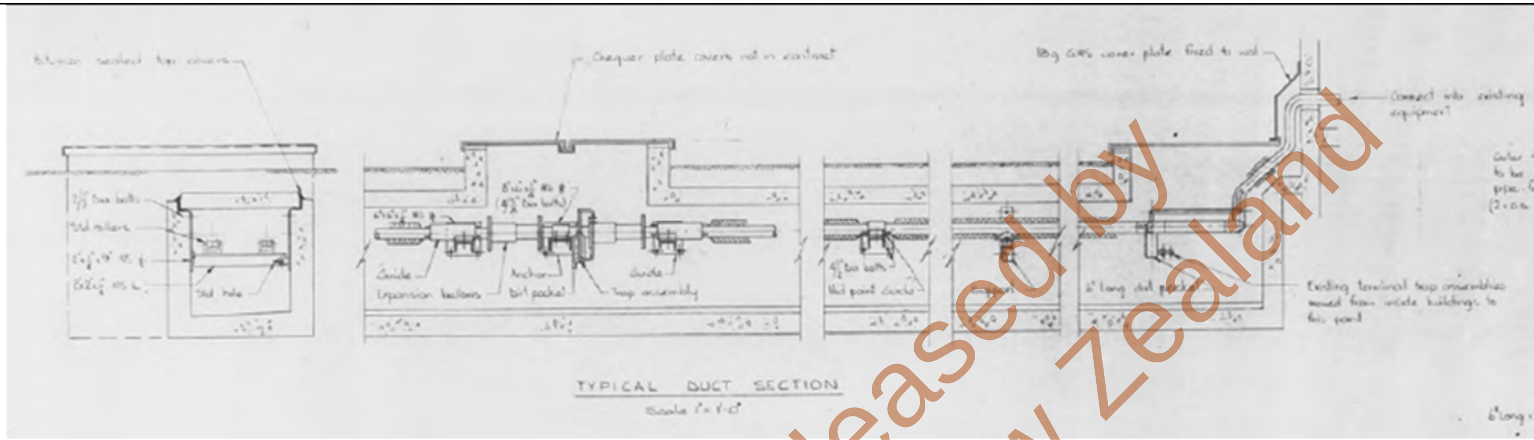
The Tokanui hospital village had an extensive building heating system comprising steam pipes supplied from the hospital boiler to the majority of buildings, and return condensate pipes. This pipe network was located within concrete ducting with access chambers at regular intervals and is referred to as the "concrete ducting" system in this report.

Review of historical aerial imagery indicates that the boiler house was constructed sometime between 1944 and 1957 as can be seen by comparing the aerials below in Figures 15 and 16. It is assumed that the concrete ducting would have been installed around the same time, and potentially extended up to around 1979 when the hospital reached its maximum extent. Hence the concrete ducting system is likely to be somewhere between 46-79 years old.

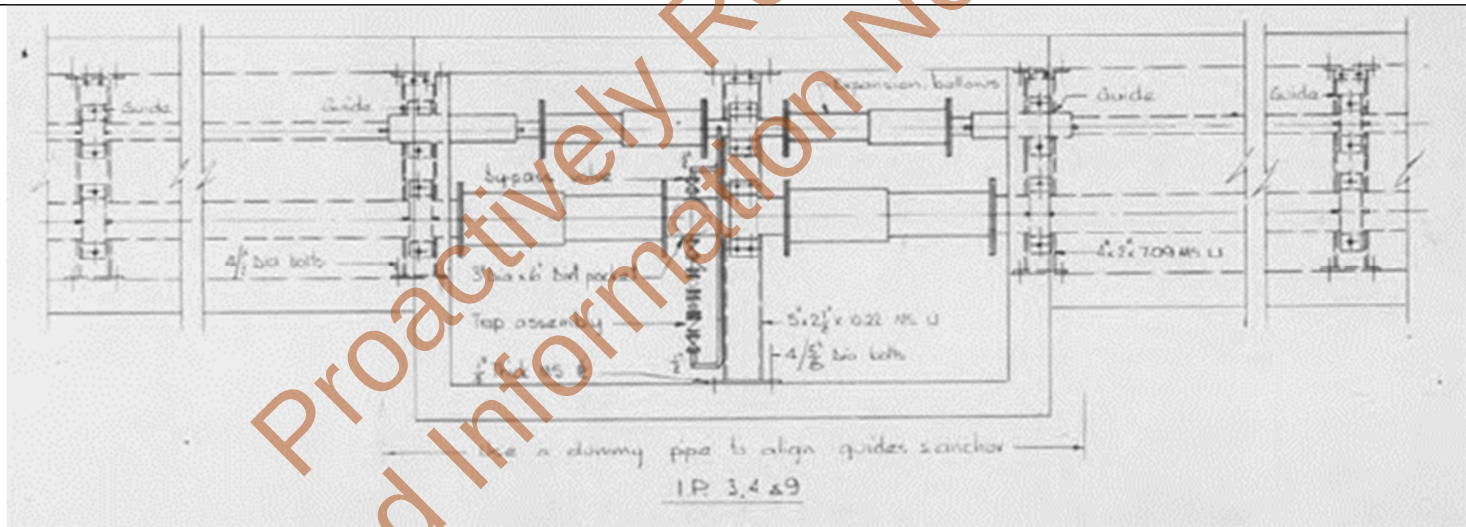
Historical archived plans show that the steam lines were generally ungalvanized mild steel of either medium or heavy grade. The condensate lines were copper. In some areas there was a third pipe, conveying hot water pipes as well, but some drawings refer to this as "to be removed". Bronze anchors and guides for the condensate pipes are referred to on some drawings. Pipe sizes are shown as varying from 1.5" to 2.5" (38-63mm for condensate) and 2"-6" (50-150mm) for steam. The pipe system includes significant numbers of valves, anchors, brackets and guides. Cover over the concrete ducting varies but is around 400mm on the drawings reviewed, which only cover a small part of the overall system. Figure 17 provides some examples of the concrete ducting system layout.

Figure 15: View of paddock with red circle showing future boiler house location (1944 aerial)

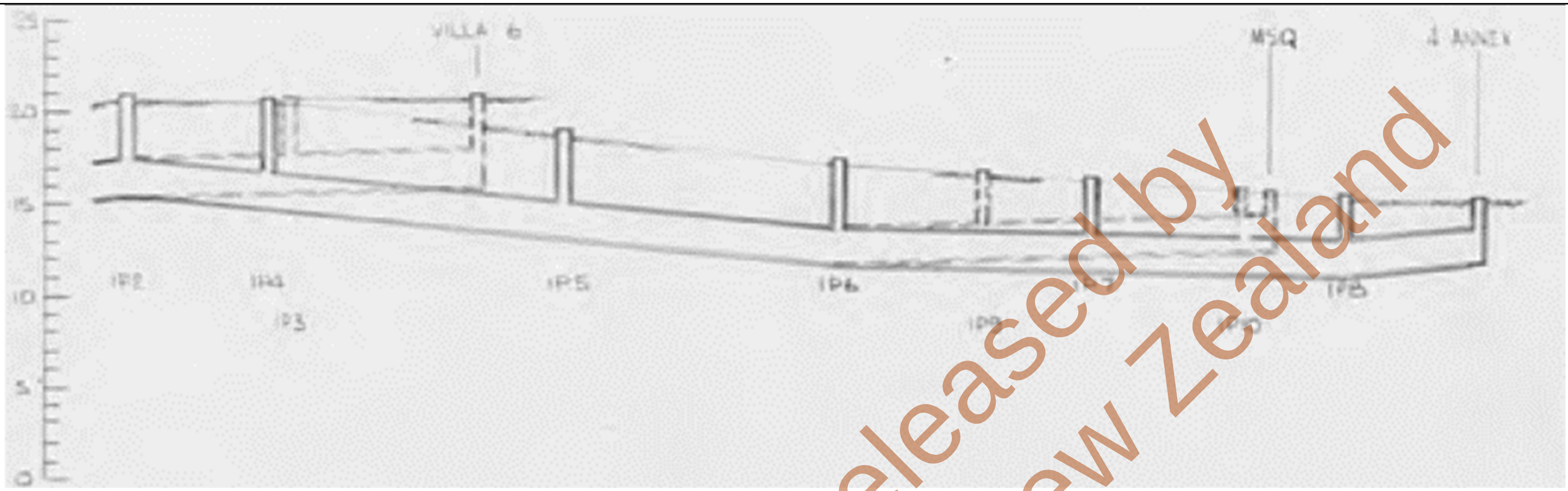
Figure 16: View of boiler house (1957 aerial)



A. Typical duct section – from drawing "IP2 to Villas 4, 5, 6 + Annex and Male Staff Quarters" (1971) (archive reference BD.234-12)



B. IP 3, 4 & 9 from drawing "IP2 to Villas 4, 5, 6 + Annex and Male Staff Quarters" (1971) (archive reference BD.234-12)



C. Long-section from drawing "IP2 to Villas 4, 5, 6 + Annex and Male Staff Quarters" (1971) (archive reference BD.234-11)

D. Long-section from drawing "Villas 8 & 9" (1971) (archive reference BD.234.09)

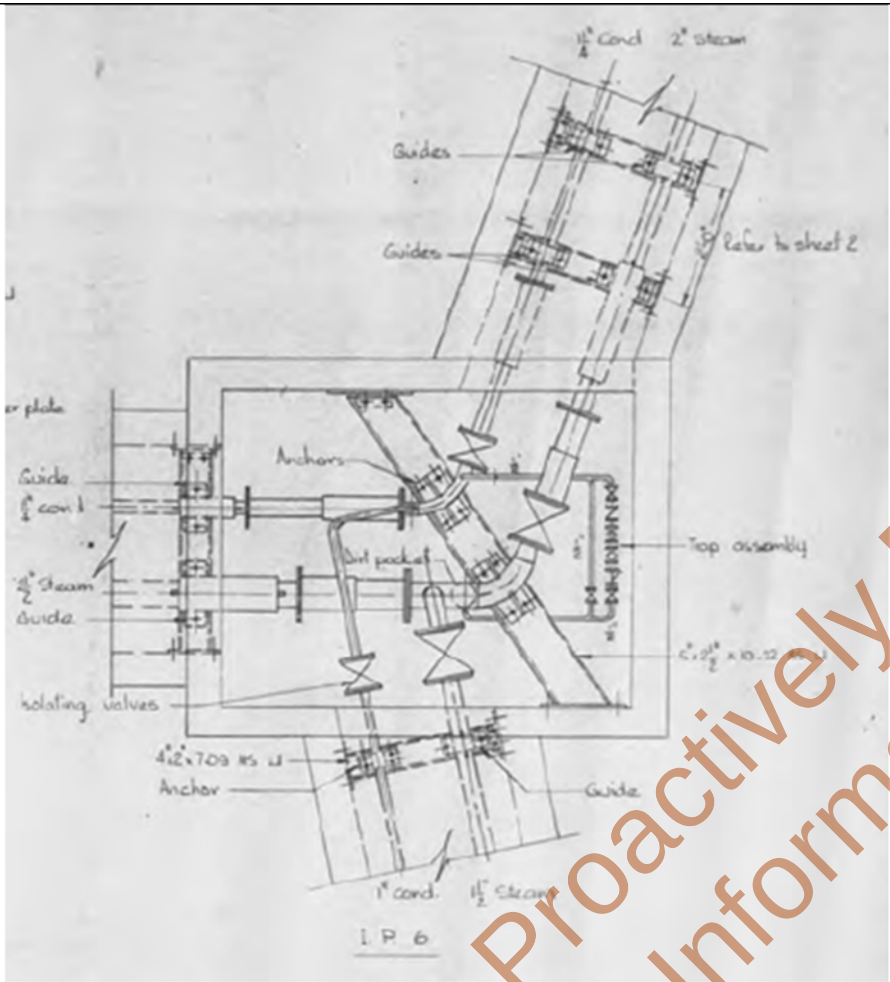
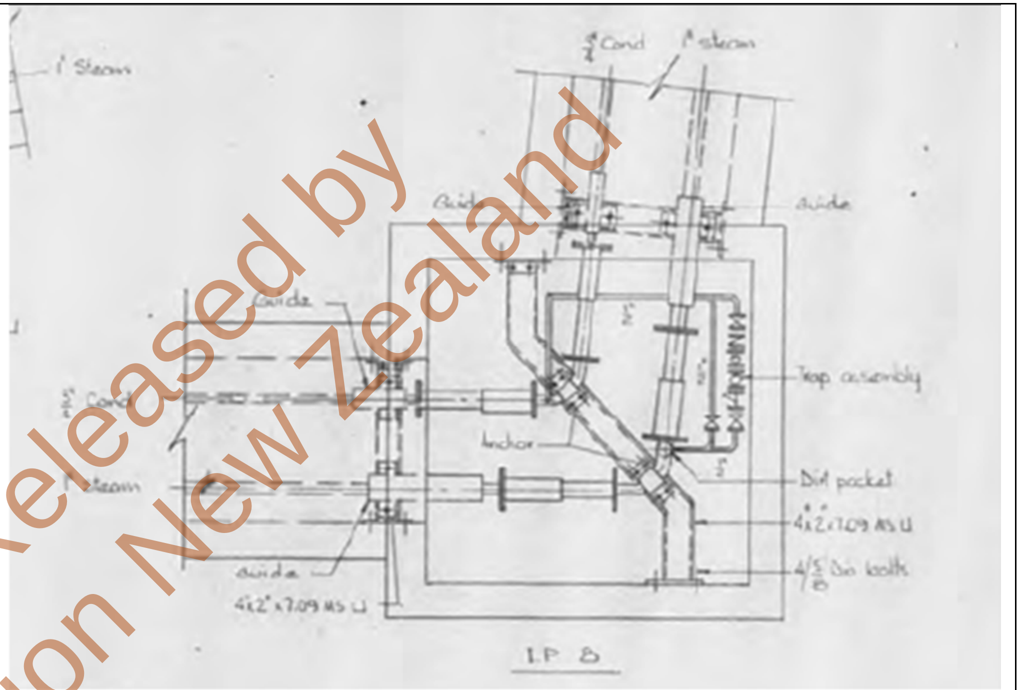
E	F
	
E. IP 6 from drawing "IP2 to Villas 4, 5, 6 + Annex and Male Staff Quarters" (1971) (archive reference BD.234-11)	F. IP8 from drawing "IP2 to Villas 4, 5, 6 + Annex and Male Staff Quarters" (1971) (archive reference BD.234-11)

Figure 17: Typical Steam Pipe Duct Sections, Longsections and Details

6.5.2 Methodology

From the preliminary site visit and discussions with CST Group/Civtec, it was agreed that CCTV survey of the concrete ducting was not viable, as the access chambers inspected had multiple pipes with brackets and supports running through these ducts. As archived plans showed the steam lines comprising ungalvanized mild steel and the condensate lines comprising copper, EML survey was considered viable. Hence, the following approach was undertaken instead:

- EML survey by Civtec along the concrete ducting network to confirm the alignment and depth of this system.
- Follow up visual inspection and topographical survey of access chambers to capture pipe diameters, locations, chamber lid levels and depths, including photos of the access chamber and inside the chamber.
- Assessment of remaining life span of concrete ducting and associated pipework based on visual inspection. This will include assessment of potential to recover the metal pipework and fittings for recycling as scrap metal.

6.5.3 Results

Concrete ducting layout plans are set out in drawing 33205/1500, with associated long-sections in drawings 1510-1513.

The EML survey confirmed the alignment shown on the WSP/Opus plans was generally correct.

Onsite observations have been undertaken by FTL staff to confirm the condition, size and cover of the concrete ducts and pipes.

The total confirmed concrete ducting length is 2937m, along with 37 access chambers. This is based on a synthesis of the surveys undertaken by WSP/Opus and EML, with the remaining information based on assumptions derived from the duct design drawings.

Ducts:

- Concrete ducts have an average cover of 0.3m, but in some sections the concrete duct is at ground level, and in other areas there is up to 1.2m cover.
- The size of the concrete ducts was measured to be approximately 500 x 600mm (inner measurements, i.e., void space)) with 100mm thick reinforced concrete walls. However, there is some variability between different access chambers.
- Based on onsite observations, there was no obvious deterioration of the concrete ducts, but no access was possible to the duct space between each access chamber. Hence, only a small portion of the overall concrete ducting system was inspected, making it difficult to draw conclusions about the entire system.

Chambers:

- 37 concrete service chambers measuring approximately 1.75m wide x 1.25m long have been located at ducting intersections, or changes in direction.
- Some of the chambers are at ground level and some are 0.5 - 1.0m out of the ground as pictured below.
- As with the ducts, the concrete and reinforcing are largely undamaged.

Pipes:

- The ducts generally carry two pipes, the larger one was the steam pipe and the smaller one the condensate pipe. In some chambers, three pipes were observed, with the third pipe possibly being a hot water pipe as shown on some of the archived drawings.
- The steam pipes appear to be mild steel, as shown on archived plans. This pipe and any other steel fittings in the chambers have significant rust, but are still intact and all of the pipe supports are also intact.
- The condensate pipes appear to be copper, based on a lack of significant rusting and the blue/green colouration on many pipes.
- Fittings and brackets appear to comprise a range of metals, including some brass fittings.
- It was expected there might be some lagging around the steam pipes but there were no signs of any lagging in all the access chambers inspected. It was not possible to check for lagging in the ducting between chambers.

	
Typical Concrete duct access chamber (chamber is above ground)	Chamber – central area

	
Chamber – LID K01 located at B55 Ward K	Chamber – LID K01 located at B55 Ward K showing the internal duct height as 500mm
	
Chamber – LID K01 showing 50mm cover where the duct connects to the building	Chamber 1606 at B48 Ward 16 (BSCL photo 092110)


Chamber EDU04 at B51 EDU (BSCL photo 141406)

Chamber K12 Located NW of the site (BSCL photo 114040)


Chamber H08 located at B48 Ward 16 (BSCL photo 101117)


Chamber 925 located at B29 Ward 7 (BSCL photo 135614)


Chamber 911 located at B30 Ward 8 (BSCL photo 133524)

Chamber 1301 located at B44 Building 13 (BSCL photo 111437)

Chamber 505 located at B27 Ward 5 (BSCL photo 145044)

Chamber H14 located north of substation 8 (BSCL photo 095615)

Chamber L20 located at B71 Garage (BSCL photo 131918)

Chamber L20 located at B71 Garage (BSCL photo 131926)

Figure 18: Photos of the Concrete Ducting System

6.5.4 Condition Assessment

As stated earlier, the majority of the concrete ducting system is likely to be of similar age to the boiler house (constructed between 1944-57) and is likely to have been extended over the years since then until the hospital was developed to its full extent by 1979.

The concrete ducting system is obsolete and serves no purpose currently.

The pipework and associated fittings are in poor condition and would have an asset condition rating of poor (4) or very poor (5). They are all metal (mild steel and copper pipes and some brass fittings) and hence of value as scrap metal.

No asbestos lagging were viewed in the access chambers inspected. It is also possible that some form of lagging (likely asbestos) may have been used to insulate the steam pipes between chambers and could still be in place but this has not been checked as part of this investigation. The contactor's methodology for any pipe removal will need to allow for checking for this and following appropriate protocols if any asbestos lagging was found.

The concrete access chambers and ducting are in reasonable condition, noting that the concrete ducting between each chamber was not inspected as part of this investigation. The ducting and access chamber system could potentially be left in place for repurposing for future services reticulation as it forms an extensive network covering most of the Site approximately 2.9km long.

6.6 WATER RETICULATION

6.6.1 Background Information

Former Trunk Watermain

WSP (March 2022) undertook an investigation of the DN200 AC Trunk watermain condition that provides water to the hospital. This trunk watermain connects to the Waipa DC (District Council) Te Awamutu public water supply system at Puniu Road, and traverses across private farmland in a relatively straight line to Tokanui, terminating at the water supply reservoirs at Tokanui. The overall length of the trunk watermain from the Waipa DC supply point is approximately 5.95 km. It is understood that this trunk watermain was installed around the late 1970s to early 1980s, replacing an earlier supply line. It is inferred from this that the hospital water supply network is even older.

Site	Easting	Northing
1	1803170	5789069
2	1803246	5788361
3	1803242	5787406
4	1803536	5785846
5	1803897	5784791
6	1804953	5784298

Figure 19: Trunk Watermain Testing Locations (Site is on left hand side of image)

WSP advise in this report that approximately 0.95km of the AC trunk watermain that ran through the former hospital precinct was replaced with a DN180, PE100, PN12.5 pipeline in 2021, that runs outside the Site. WSP/Opus drawings for these upgrade works refers to the old AC trunk watermain being abandoned, rather than removed. The location of the abandoned watermain is shown on Figure 20, from WSP/Opus drawings. These abandoned lines comprise the following:

- The main water supply line that enters the Site at its central northern boundary and runs to the water treatment plant and then in an easterly direction, likely across the redundant road crossing to a reservoir located offsite to the east. This line is the one most likely to be the 200dia AC trunk watermain. Its length scaled off the WSP/Ops drawings is 800m (of which 700m is within the investigation area). It is assumed from the drawings provided that there was a direct connection from this watermain to the water treatment plant. Another possibility is that the watermain continued to the reservoir and a gravity return line provided water to the treatment plant. At the eastern site boundary, the WSP/Opus drawing 45 refers to the trunk watermain connecting to an existing 150dia ductile iron main, 0.9m deep.
- There are two, likely smaller, water supply lines shown as being abandoned on the eastern side of the site, one shown as supplying water to the former WWTP and the other of unknown purpose. These lines have estimated lengths of 300m scaled off the WSP/Opus drawing. These pipes have not been included in the water supply inventory as they are located outside the investigation area.
- There is a third line which is supplied from a separate supply along Te Mawhai Road to the west of the site, which supplied water to the houses along Te Mawhai Road and to the Site's swimming pool. The main line, ignoring the lateral house connections is 550m long, measured off the WSP/Opus drawing. The separate WSP/Opus drawing 85, detail 10 refers to the existing watermain along Te Mawhai Road being DN100 stainless steel pipe, 1m deep (from drawing C45). It is inferred from this that the pipe running through the site is 100mm diameter, but the pipe material needs confirming as it would be unusual for an underground line to be stainless steel.

These drawings also show that the existing houses along Te Mawhai Road and the two clusters to the east of the site (Croasdale Rd and Tokanui Village) are provided with water from the new watermain and are now independent of any water reticulation within the Tokanui hospital village itself. This means that removal of the water reticulation system within the Site will not cut off the water supply to users outside of the Site.

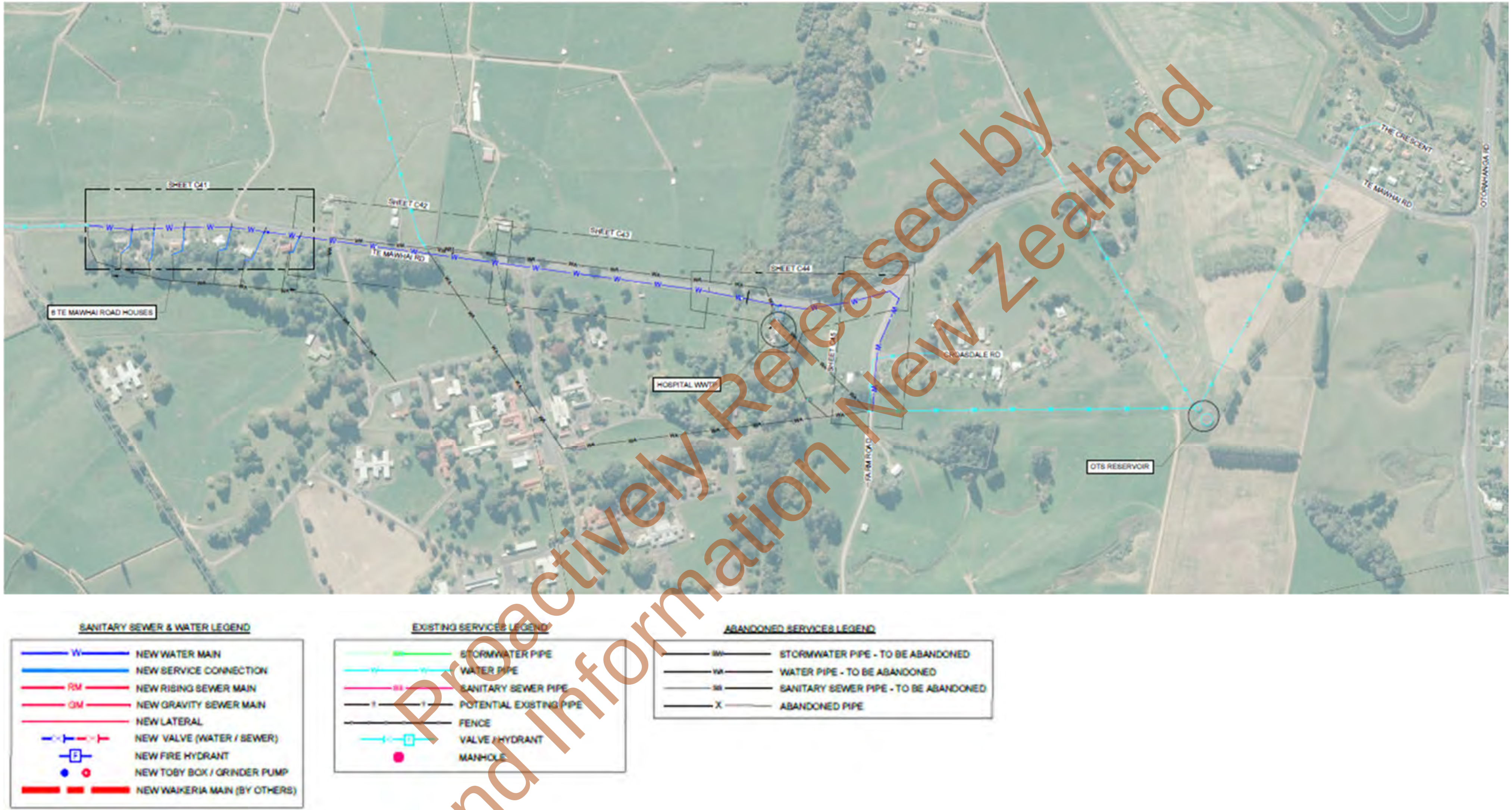


Figure 20: Water Overview Plan (from WSP /Opus drawing 3-39371.00(02) C40 Revision 1)

Hospital Internal Water Supply

The water reticulation system within the Site itself comprises an extensive network of water reticulation servicing the hospital buildings. A water tower used to be located at B54 and a water treatment plant in Building B07, as shown in Figure 21 below.

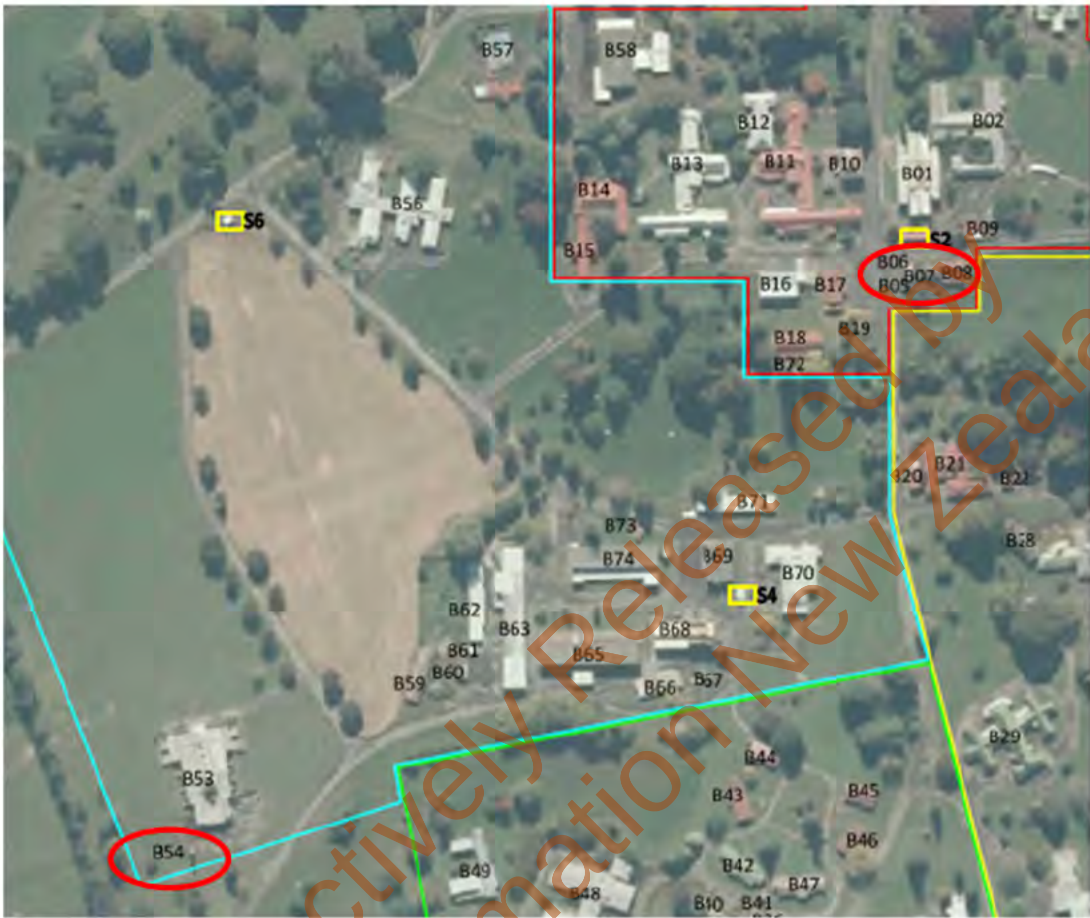


Figure 21: Site Layout Plan showing location of the former Water Treatment Plant (B07) and the water tower (B54)

Very limited information was bound on the water supply system within the Site on archived plans. The exception was the plan below from 1969 which shows a 6" (150mm dia) watermain in the southern part of the site near building B48.

Figure 22: Existing and proposed underground services showing 6" (150mm dia) water main in southern half of site (Multi-handicap villa is building B48) (2969); archive reference BD234-1

6.6.2 Farm Water Supply System

There is a separate water supply system providing water to troughs for a stock water supply. The extent of this system is shown on Figure 23. This system was not inspected as part of this assessment, as it comprises an operative farm water supply and is separate from and independent of the Site's former water supply.

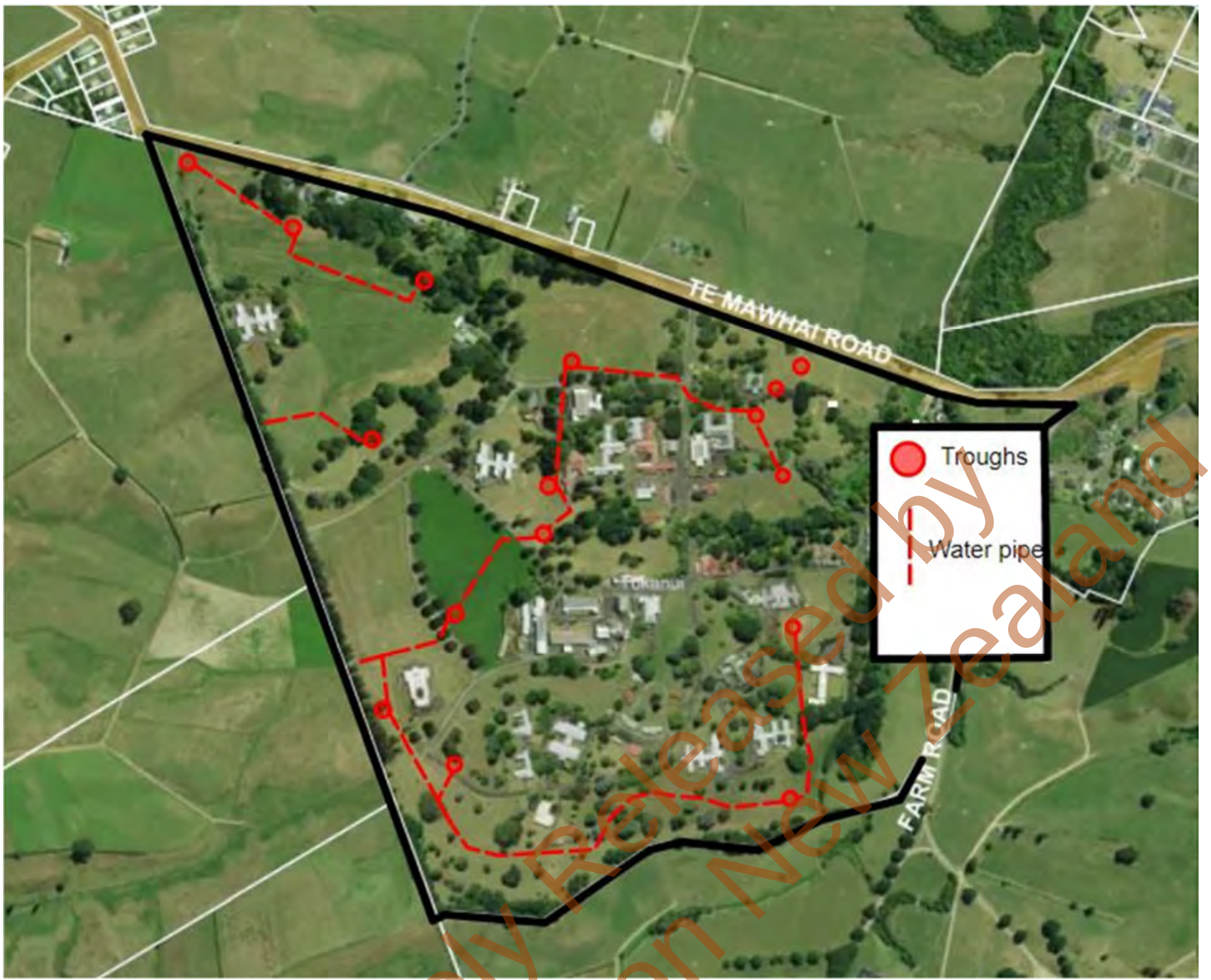


Figure 23: Independent Farm Animal Water Supply

6.6.3 Methodology

The following methodology was used to investigate the Site's existing water reticulation network:

- Visual inspection of assets, including fire hydrants and valve boxes, based on the Opus services plans.
- EML survey tracing of the water supply network.
- Investigation around valves and other features to determine depths to the top of the water supply pipes.
- Potholing in relevant locations by hydro excavation to confirm depth, size and condition of asset, where necessary based on the findings from the above works.
- Topographical survey of pothole locations and identified features (valve chambers, fire hydrants, water meters, etc.).
- Review of water system findings and a supplementary site inspection to check particular areas and fill in identified information gaps.
- Results compilation and condition assessment; preparation of drawings and supporting appendices. The condition assessment was based on the following grading system from the NZWWA (1999) New Zealand Infrastructure Asset Grading Guidelines – Water Assets".

Table 10: Water Mains and Sewage Pumping Mains and Service Pipes – Condition Grading Table

Condition Grade	Water mains and Sewage Pumping Mains	Service Pipes
1 Very Good	Modern pipe material designed to current standards with no pipewall or joint failures and no evidence of internal or external degradation.	Modern pipe material designed to current standards with no evidence of internal or external degradation.
2 Good	As condition 1, but not designed to current standards in respect of pressure ratings, design specification, jointing or corrosion protection. Deterioration causing minimal influence on performance.	As condition 1, but not designed to current standards. Deterioration causing minimal influence on performance.
3 Moderate	Water mains or sewage pumping mains which are generally sound, although with a few pipewall or joint failures or evidence of some external or internal degradation. Some deterioration beginning to be reflected in performance.	Service pipes which are generally sound, although with a few failures requiring replacement or repair. Some deterioration beginning to be reflected in performance.
4 Poor	Water mains or sewage pumping mains with a significant level of pipewall or joint failures or evidence of significant external or internal degradation causing, or likely to cause a marked deterioration in performance in the medium term. Some asset replacement or rehabilitation needed within the medium term.	Service pipes with a significant level of failures requiring replacement or repair or with significant internal or external corrosion and likely to cause a marked deterioration in performance in the medium term. Some asset replacement or rehabilitation needed within the medium term.
5 Very Poor	Unsound water mains or sewage pumping mains with extensive pipewall or joint failures, or significant external or internal degradation, which has failed or about to fail in the near future, causing unacceptable performance. No life expectancy, requiring urgent replacement or rehabilitation.	Unsound service pipes with high level of failure or significant external or internal degradation, which has failed or about to fail in the near future, causing unacceptable performance. No life expectancy, requiring urgent replacement or rehabilitation.

6.6.4 Results and Condition Assessment

The existing water reticulation layout plans are set out in the drawing set 33205/1200.

The EML survey was quite successful at picking up the water reticulation network in the northern half of the site, and confirmed that the pipes in these areas was metallic. The EML survey picked up watermains as being approximately 0.9m deep throughout the northern half area. This included finding water supply lines still in place that used to serve the now removed buildings D01 (north-eastern corner) and DO2-DO4 (western side).

The EML survey could not pick up any water supply system in the southern half of the site, due to these pipes being non-metallic. Hence, hydro excavation survey was used to confirm pipe alignments and depths in this area, followed by supplementary visual inspections for valves and fire hydrants. Some of the hydroexcavation pits did not pick up any water lines where expected, confirming the absence of such lines in these areas (or the routing may be different than what was shown on the WSP/Opus plans).

The abandoned water supply pipes shown on the WSP/Opus water reticulation plans were provided to FTL following the initial investigation and hence were not specifically checked for during the initial site inspection or EML survey. Based on the EML survey not being able to detect any non-metallic water supply pipes onsite, it is likely to have not been able to find this AC watermain. Some checks were made during the further site inspection of May 2023, but no valve boxes or any other indications of these pipes were found. However, this was a relatively basic check, due to a lack of time. Hence, no condition assessment has been made of this system. However, the WSP / Opus trunk watermain condition assessment (March 2022) assessed the condition of this trunk watermain to range from Grade 2 (good condition) to Grade 4 (poor condition). They assigned an overall grading of 3 (moderate condition) to the 5km long watermain (which includes the 950m portion running through the Site), with some sections in worse condition. They concluded that this pipeline is generally unlikely to be at risk of pressure failure before the early 2040s; however, some sections may be at risk from 2037.

Further investigation of the Site's water supply system was conducted on a site visit on the 24th May 2023. Hydrant locations to the north and south of the site were excavated to determine the material, condition and pipe size of the watermain. It was found on site that the watermain in the northern area found by the EML scans were unpainted 100NB ductile iron pipes wrapped in denso tape. Based on inspections on the above ground hydrants and valve chambers which have heavily corroded pipes, it is inferred that the corrosion has most likely propagated into the underground pipes as they are unpainted. Hence, it is expected that the existing ductile iron pipes are in generally poor to very poor condition (grades 4-5).

To the south of the site, it was found that the pipes which could not be determined by the EML scans were 100 to 200NB asbestos cement (AC) pipes. The condition of the AC pipe was not very clear; however it is inferred that the pipes are likely to be in poor condition.

Discussions with LINZ identified that the length of asbestos watermain had a major impact on infrastructure removal costings. Hence, further hydroexcavation and investigations of the existing extent of the asbestos cement (AC) watermain pipes was undertaken by Civtec in collaboration with Fraser Thomas to more accurately delineate the extent and location of AC pipe. This involved a site walkover by Civtec with FTL to check the watermain pipes in the southern area on the 30/06/23. During the site walkover, it was also confirmed that the 200NB AC pipe to the east of the site as per the OPUS plans does exist, as an air valve chamber mounted on a 200NB pipe was found at the approximate location as shown on the OPUS plans. Civtec undertook further hydroexcavation work during 03/07/23 to 07/07/23. The Civtec hydroexcavations were undertaken at the southern area of the subject site where their initial EML scans did not pick up any watermains. The hydroexcavation investigations confirmed that most of the water pipes as shown on the OPUS survey that were not picked up in their EML scans were AC pipes. This confirmed our initial assumption of these pipes being AC. There were some limitations to the Civtec hydroexcavations in which their GPR scanning could not locate the full route of the existing 200NB AC pipe as per the OPUS plans. In addition, it was found that some of the pipe routes from the OPUS initial survey were incorrect; however the full extent of the correct routes could not be picked up by GPR scanning. Refer to Appendix E for the Civtec hydroexcavation logs.

Civtec were unable to find the third line shown as a separate supply along Te Mawhai Road to the west of the site, which supplied water to the houses along Te Mawhai Road and to the Site's swimming pool, as shown in Figure 20. The swimming pool was found to have a separate water supply connection off the main hospital supply. Hence, this supply line (550m) is unlikely to exist.

The table below provides a summary of the existing watermain assets on the subject site.

The water treatment and water tower were not inspected during the site visit due to time and access limitations.

Table 11: Existing Watermain Asset Inventory and Condition

Item	Materials	Length (m)	Diameter (mm)	Average Depth	Condition	Comments
Watermain (north of the site)	Ductile Iron	2970	100,150,200	0.9-1.0	3 (average) 4 (some sections)	Corrosion on unpainted sections
Watermain (south of the site)	Asbestos Cement (AC)	3390	100,150,200	0.9-1.0	3 (average) 4 (some sections)	
Watermain (east of the site)	Asbestos Cement (AC)	790	200	0.9-1.0	3 (average) 4 (some sections)	
Watermain (unknown material north west of the site)	Assumed stainless steel	550	100	0.9-1.0 (estimate)	N/A	Civtec could not locate this pipe – inferred unlikely to exist
Hydrant Boxes	N/A	# 41 hydrants			5 (corrosion)	Heavy pitting and corrosion
Valve Pits	Concrete Pits	# 25 Valve boxes			5 (corrosion)	Heavy pitting and corrosion

	
Pothole adjacent to fire hydrant. 150NB (200OD) Ductile Iron Pipe found at approx. 1m depth. Pipe wrapped in denso tape.	Pothole in southern area of site adjacent to fire hydrant: 100NB AC pipe at 1.2m depth.
	
180mm diameter AC pipe exposed during hydroexcavation at location 17, refer to Civtec documents.	Inspection of a valve chamber at the northern area of the site showing heavily pitted and corroded pipes.

<table>
<tr><td></td><td>
</td></tr>
<tr><td>Air valve chamber found on the 200NB AC line east of the site as per the OPUS plans</td><td>Location 35 (refer to photos below)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>150mm AC pipe found at location 35, refer to Civtec documents.</td><td>In ground hydrant found at approx. location 35</td></tr>
</table>

Figure 24: Water supply investigation potholes in the northern and southern areas

6.7 STORMWATER RETICULATION

6.7.1 Background Information

Review of site topographical data and aerial photographs shows that stormwater runoff from rural farm land to the west of the site flows into and through the site via a combination of open channels and pipe reticulation, discharging into a tributary of the Wharekōrino Stream and then flowing to the north under Te Mawhai Road, into the Pūniu River a short distance downstream. This system is referred to as the trunk stormwater system.

The 4Sight ecological assessment found three natural wetlands within the Site at different locations along the trunk stormwater system. These wetlands are described in more detail in Section 7 of this report.

Archived plans show that the stormwater system was designed to have some flood detention areas located in the central and north-eastern corner of the site, before discharging into a tributary of the Wharekōrino Stream. A stormwater pipe is shown on these plans as running under the flood detention basin, which has separate culverts feeding into it, with a re-entry structure conveying water from the flood detention basin into the underlying stormwater system. This system is shown in Figure 25 below.

The Wharekōrino Stream drains through the eastern side of the site. Field investigations found that it is piped through the old disposal site by a 1350 diameter culvert (culvert 3 in Figure 13), while another culvert (culvert 2 in Figure 13) is inferred to run under the redundant road embankment crossing over the stream into the site.

The stream then flows under Te Mawhai Rd via a completely submerged culvert. Waipa District Council have advised that this culvert is a 1600mm dia concrete pipe (according to their RAMM records) installed in the early 1970s. Water ponding is common along the Wharekōrino Stream both above and below Te Mawhai Road, with no obvious cause being found from a stream bank walkover down to the Puniu River junction. However, this section of the stream is referred to as "swamp" on some old survey plans so the ponding could potentially be due to the stream bed gradient being very flat. The stream catchment at culvert 3 is 440ha increasing to over 600ha at Te Mawhai Road, so the stream has constant flow in it.

These culverts were not specifically investigated as part of this assessment, other than efforts were made to locate and check culvert 2 as part of the separate roading assessment.

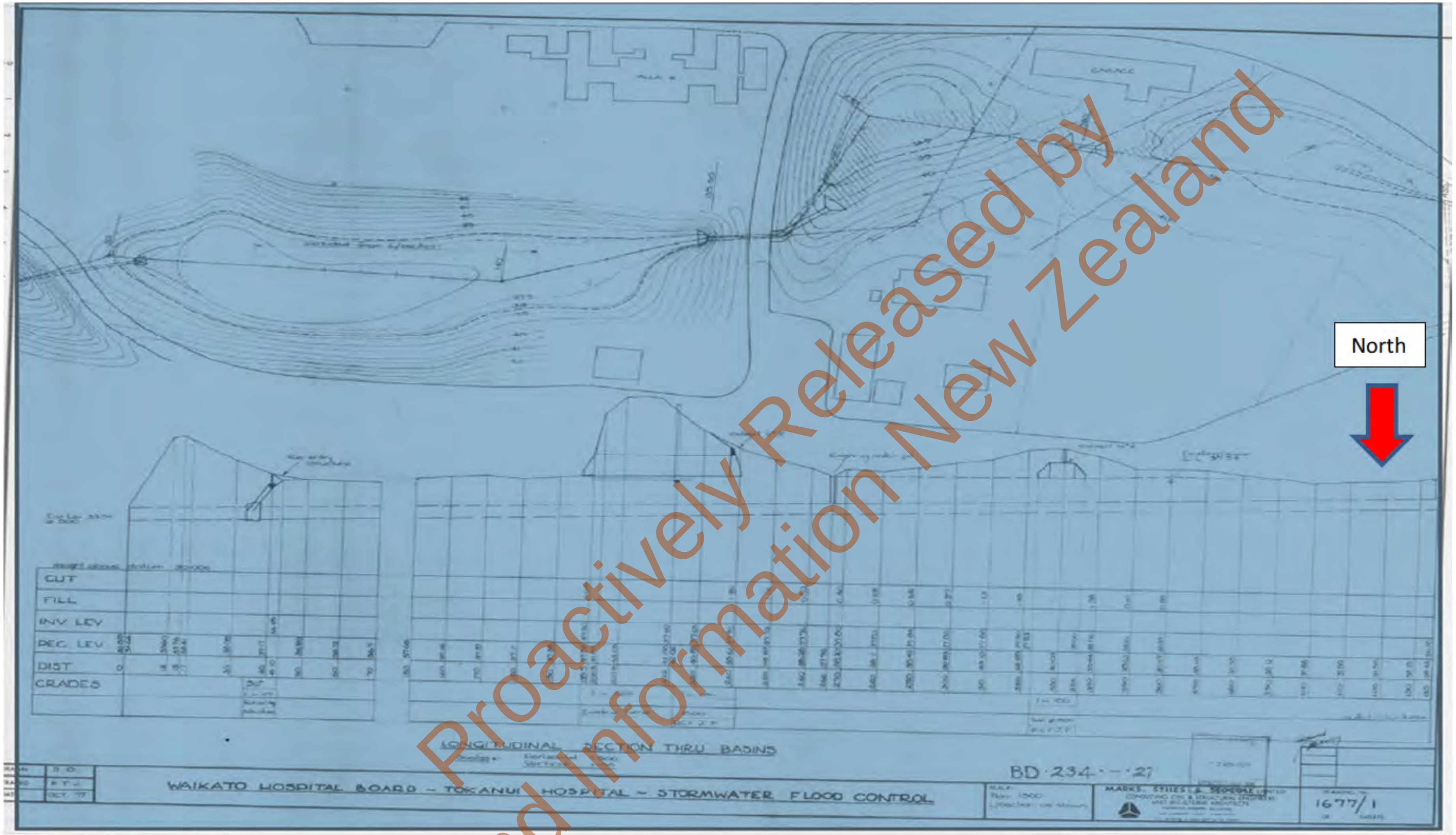


Figure 25: Tokanui Stormwater Flood Control (October 1977) (archive reference BD234-27). Note plan orientation is opposite to normal.

6.7.2 Methodology

The following methodology was used to investigate the Site's stormwater system:

- CCTV survey of the stormwater system focusing on main and submain lines to assess its condition, using a combination of crawler camera unit and pushrod camera for smaller pipes. This generally excluded pipes connected to individual buildings as discussed at the prestart meeting. CCTV logsheets are included in Appendix F.
- Follow up topographical survey utilising Precise Levelling Survey Equipment at accessible locations (manholes, chambers, culvert inlet/outlets) to collect relevant information, particularly pipe materials, depths (z values) at manholes and pipe inlet/outlets. Each manhole has a photo of the area and of the invert. The first photo will have a small white board included with the date, time, feature and survey point number.
- Data review and analysis, followed by a supplementary field inspection to check particular areas and fill in identified information gaps.
- Condition assessment, capacity calculations and residual lifespan assessments. The condition assessment was based on the following grading system from the NZWWA (1999) New Zealand Infrastructure Asset Grading Guidelines – Water Assets". The capacity calculations were limited to the trunk stormwater system which needs to be retained in some form.
- Drawings preparation and compilation of relevant appendices.

Table 12: Wastewater and Stormwater Drains and Manholes – Condition Grading Table

Condition Grade	Wastewater and Stormwater Drains	Wastewater and Stormwater Manholes
1 Very Good	Modern pipe material designed to current standards with no structural defects and no evidence of internal or external degradation.	Sound modern structure well maintained with no problems with the manhole structure, invert, pipe entries, manhole cover or manhole cover frame.
2 Good	As condition 1 but not designed to current standards in respect of manufacturer's specification, jointing or corrosion protection. Some deterioration, for example, circumferential cracking or minor joint defects causing minimum influence on performance	As condition 1, but showing minor wear and tear and minor deterioration. Some surface damage to the structure but no corrosion staining, cracking or loss of stability.
3 Moderate	Sewer pipes which are generally sound, although with some defects (for example deformation 0% to 5% and cracked or fractured or longitudinal/ multiple cracking or occasional fractures or external pipewall degradation) over not more than 25% of the length. Some deterioration beginning to be reflected in performance.	Functionally sound structure but showing some signs of wear and tear. Some minor cracking, staining or signs of vegetation.

4 **Poor**	Sewer pipes with a significant level of defects (for example, deformation 5% to 10% and cracked or fractured or broken or serious loss of level or external pipewall degradation) over not more than 50% of the length causing, or likely to cause, a marked deterioration in performance in the medium term. Some asset replacement or rehabilitation needed within the medium term.	Structure functioning but with problems due to significant infiltration, loss of stability or deformation. Manhole cover or frame showing signs of corrosion causing difficulties for man entry. Step irons showing signs of corrosion.
5 **Very Poor**	Unsound sewer pipes with a high level of defects (for example, deformation > 10% and cracked or fractured or broken, already collapsed or extensive areas of missing fabric), or grade for over > 50% of length, causing unacceptable performance. No life expectancy, requiring urgent replacement or rehabilitation.	Serious structural problems having a detrimental effect on the performance of the manhole structure.

6.7.3 Results and Condition Assessment

Stormwater system layout drawings are set out in drawings 33205/1100-1109 with associated pipe and manhole drainage schedule information on drawings 33205/1120-1126.

The CCTV survey was quite successful at picking up the stormwater drainage network throughout the subject site. It was found that the trunk stormwater main takes flows from the wetland at the north west of the site and the catchments to the neighbouring lot to the west of the site. The trunk stormwater pipe traverses from the north to south of the site and from the west to the east and ranges from 675mm to 900mm diameter reinforced concrete pipes. As shown on the figure below, the trunk stormwater pipes meet at approximately the centre of the site at manhole L.0 which is a large manhole with a grated inlet before traversing to the east where there is an outlet to the Wharekōrino stream. As shown by the black lines and nodes on the figure below, certain sections (mostly to the east) of the stormwater trunk main were fully submerged (flooded) and couldn't be surveyed.

During the site investigation and reviewing the CCTV results, it was found that the trunk stormwater pipes were in moderate condition with major cracking at certain locations causing groundwater infiltration into the pipes. It was found that the north-western wetland area had constant water draining into the 900mm diameter trunk main; however this could be because there were days of heavy rain before our site visit.

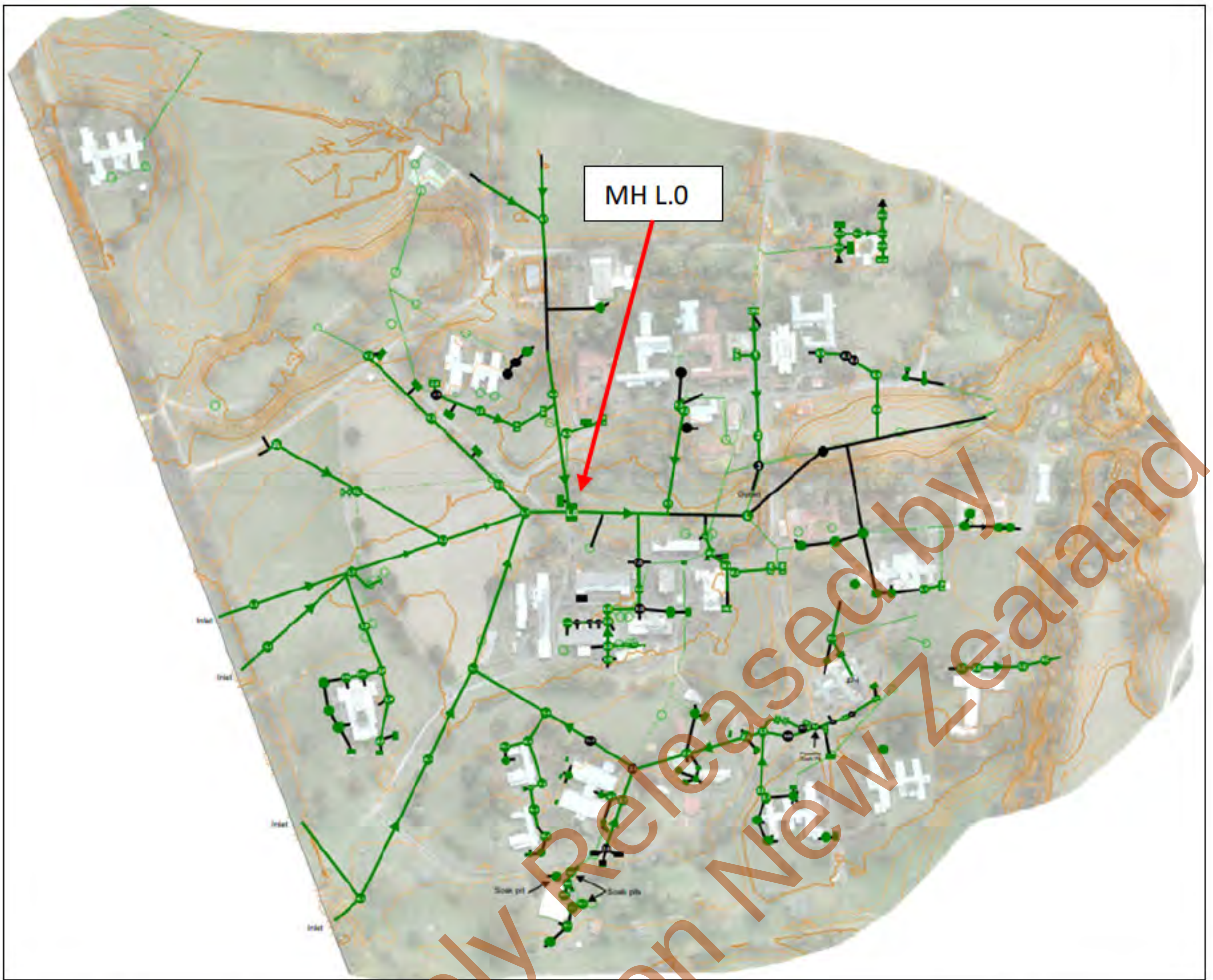


Figure 26: CCTV as-built map of the existing stormwater system on the site (black = flooded pipes during CCTV investigation)

	
North western wetland inlet into the 900mm diameter trunk stormwater line.	Manhole connected to the north western wetland inlet located near B75 (Doctors Flat).

	
Grated lid at manhole L.0 where the trunk sewer forms a junction towards the east.	Benching and running water inside manhole L.0 where the trunk 900mm diameter stormwater pipes form a junction.
	
Trunk main grated inlet from eastern detention area to the stream (flooded possibly from a blockage or backwater).	View of the stream which the outlet discharges to (standing on the road looking down).

Figure 27: Stormwater Trunk System Photos

Whilst the scope did not include investigating building laterals, it was found onsite that some buildings had many manholes around them and it was not possible to know if these were stormwater or wastewater manholes, lateral connections or not, until opened up. It was quite common to find these manholes to be installed in situations where inspection chambers would typically be used today.

The remainder of the stormwater drainage across the subject site ranges from a 100mm – 150mm building lateral connection to a 375mm diameter reinforced concrete pipe. As shown on the CCTV drainage map, the stormwater connections from the existing buildings and road catchpits mostly connect into the stormwater trunk main which has a single discharge point to the stream. The exceptions to this are the stormwater drainage at building B03 and building B26. For building B03 it is unknown as to where the stormwater drains to as the CCTV shows that the outlet heads north before entering a flooded section. For building B26, the CCTV results shows that the stormwater drains via a separate outlet to the Wharekōrino Stream. This was confirmed on site as the manholes around the building were opened and found that the stormwater has a single path going east towards the stream.

Other features of the stormwater drainage found on site were:

- The stormwater connection at building B55 is likely to have a cross connection into the above ground steel wastewater pipe. This was inferred on site as the stormwater manholes were running with water (presuming from groundwater infiltration) and the wastewater pipe above ground had water leaking out from the joints.
- The stormwater laterals at building B23 were shown to outlet separately into the stream on the CCTV results; however our site investigation confirmed that this was not the case and that it connects into the trunk main.

	
Wastewater pipe at building B55 (water was observed to be leaking from the joints)	Stormwater and wastewater at B23 heading to west (CCTV shows the SW here heads east to the stream)

Figure 28: Stormwater Non-Trunk System Photos

As shown on Figure 29, the CCTV and our site investigation findings were different to the archived drawing which has a long section detail of the trunk stormwater main. The archived drawings shows that the flood detention areas in the middle of the site (at manhole L.0 location) and at the trunk main stream outlet (see Figure 27 photos) were connected together via two culverts (labelled culvert 1 and 2 in the figure below). These two culverts were not found during our site investigation and are unlikely to be there, particularly culvert 1, the location of which is now an open field.

The system's eastern flood detention area comprises a flooded grated inlet, possibly from a pipe blockage or backwater effects. It could be seen that the grated inlet connects into a 900mm pipe which bends down into the ground which indicates that the 900mm trunk main runs under the grated inlet, which is consistent with the archived design drawing for this area.

Figure 29: Snip of the archived stormwater long section drawing

The existing stormwater assets inventory and condition assessment is summarized below.

Table 13: Existing Stormwater Assets Inventory and Condition Assessment

Item	Materials	Length (m)	Diameter (mm)	Average Depth	Condition	Comments
Trunk Stormwater						
Pipe	RC	1102	900	3m	3 (Lateral defects present)	Constant running water
Pipe	RC	209	825	2m	3 (Faulty joints)	
Pipe	RC	292	750	2m	3 (Faulty joints)	
Pipe	RC	165	675	2m	3 (Faulty joints)	
MH	RC	2	1500	2m	3 (cracking)	1 manhole
MH	RC	20	1800	2m	3 (cracking)	6 manholes
MH	RC	15	3000	3m	3 (cracking)	6 manholes
MH	RC	5	3200	3m	3 (cracking)	2 manholes
Minor Stormwater						
Pipe	EW	138	100	1m	3 (minor defects)	
Pipe	EW	936	150	1m	3 (minor defects)	
Pipe	RC	2364	225	2m	3 (minor defects)	

Pipe	RC	852	300	2m	3 (minor defects)	
Pipe	RC	173	375	2m	3 (minor defects)	
MH	RC		1050	2m	3 (minor defects)	128 manholes
MH	RC		1200	2m	3 (minor defects)	2 manholes
CP	RC	36	N/A	0.6m	3 (minor defects)	56 catchpits

6.8 WASTEWATER RETICULATION

6.8.1 Background Information

The Site had its own independent wastewater reticulation system conveying wastewater to a wastewater treatment plant (WWTP) located in the north-eastern corner of the Site adjacent to the Wharekōrino Stream. The WWTP was decommissioned in 2021 and a new gravity sewer line was installed along Te Mawhai Road to a new wastewater pump station located at the former WWTP location which pumps wastewater into the new Waikeria Wastewater rising main along SH3 (Otorohanga Road). This rising main also collects wastewater from the two residential clusters to the east of the site (Croasdale Rd and Tokanui Village). This means that removal of the wastewater reticulation system within the Site will not cut off any of these existing houses outside of the Site.

Figure 30 provides a schematic plan showing the new rising main, while Figure 31 provides an engineering plan of the same rising main in the vicinity of the Site.

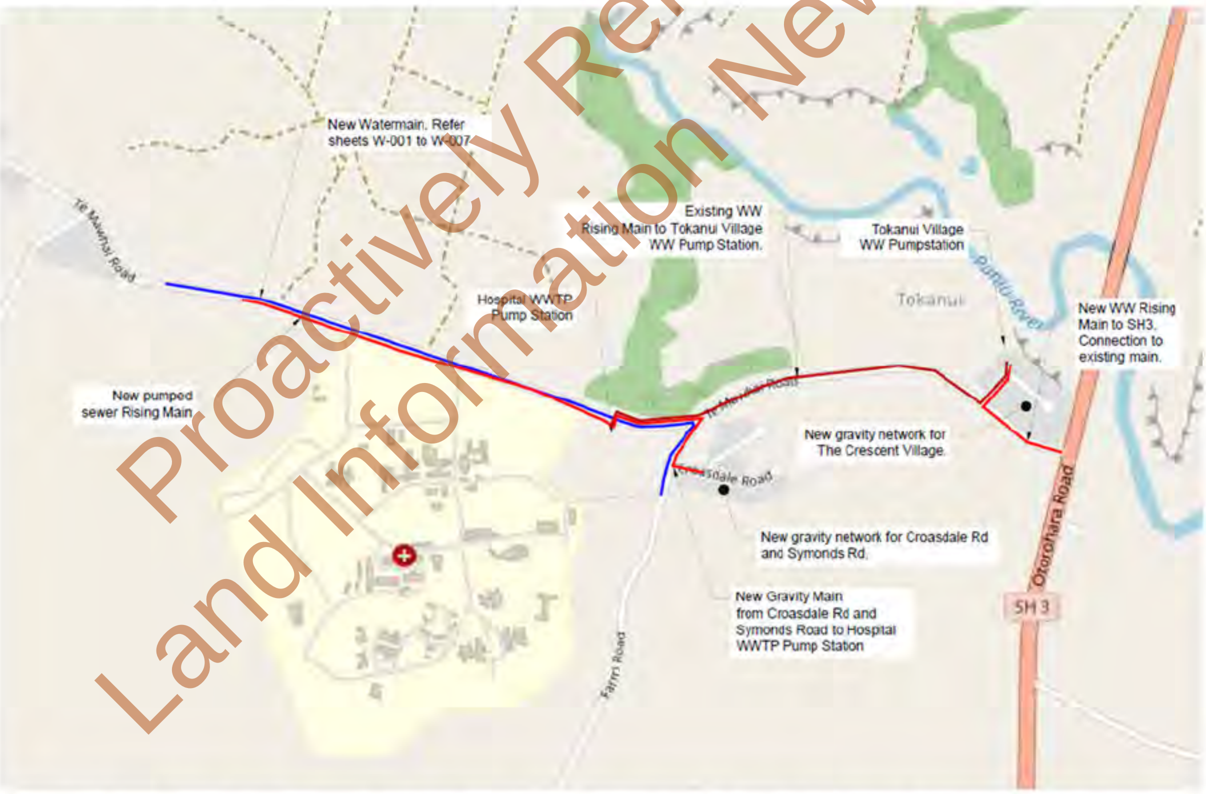


Figure 30: Waipa Civil Tokanui Village and Hospital WWTP Pump Station Asbuilt Drawing Set, Issue 1, Oct 2021

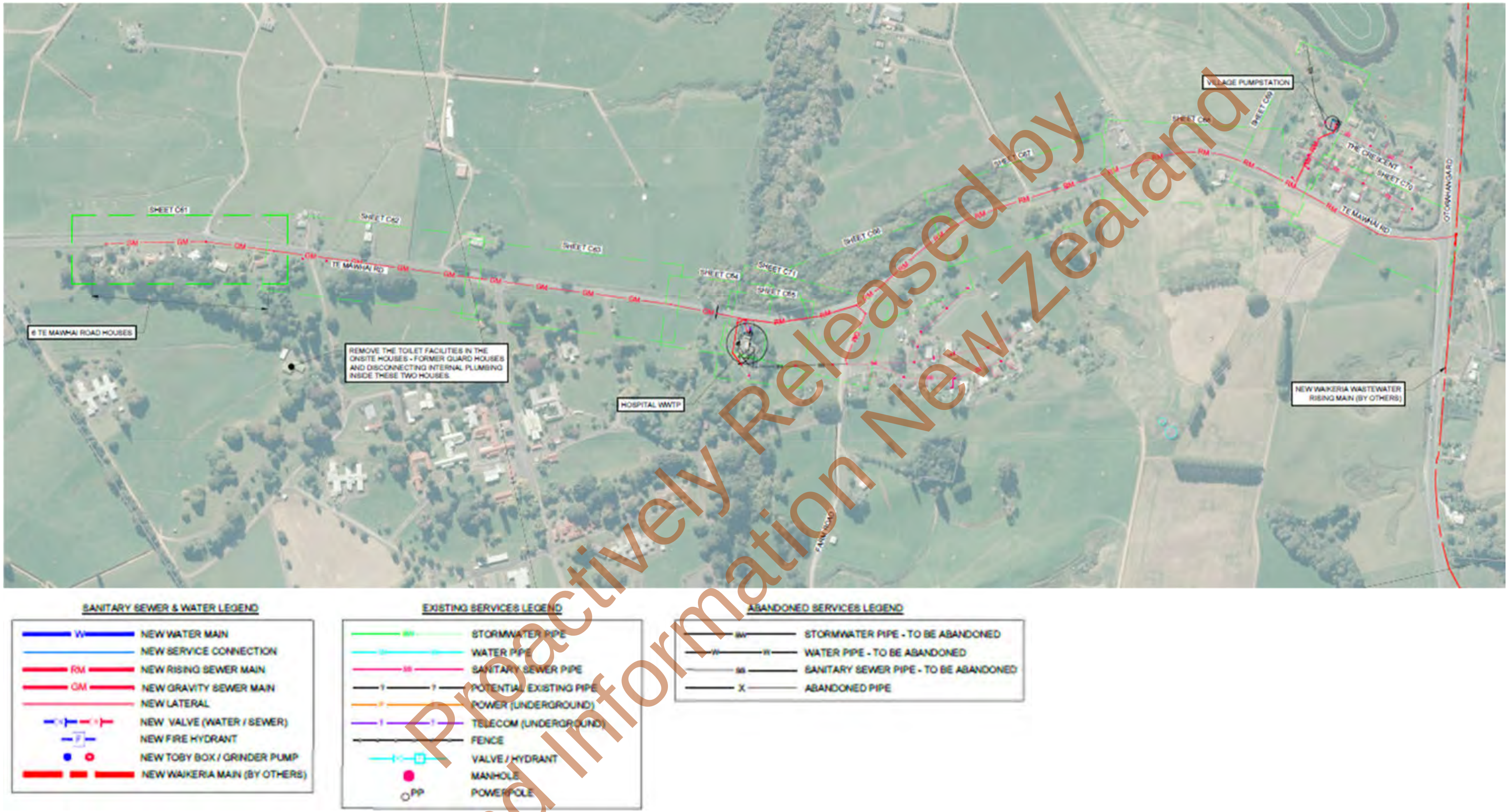


Figure 31: Wastewater Upgrades Overview Plan (from WSP /Opus drawing 3-39371.00(02) C60 Revision 1)

6.8.2 Methodology

The following methodology was used to investigate the Site's wastewater system:

- CCTV survey of the stormwater system focusing on main and submain lines to assess its condition, using a combination of crawler camera unit and pushrod camera for smaller pipes. This generally excluded pipes connected to individual buildings as discussed at the prestart meeting. CCTV logsheets are included in Appendix F.
- Followup topographical survey utilising Precise Levelling Survey Equipment at accessible locations (manholes, chambers, culvert inlet/outlets) to collect relevant information, particularly pipe materials, depths (z values) at manholes and pipe inlet/outlets. Each manhole has a photo of the area and of the invert. The first photo has a small white board included with the date, time, feature and survey point number.
- Data review and analysis, followed by a supplementary field inspection to check particular areas and fill in identified information gaps.
- Condition assessment and residual lifespan assessments.
- Drawings preparation and compilation of relevant appendices.

6.8.3 Results and Condition Assessment

The CCTV survey for the wastewater picked up most of the wastewater lines; however the main trunk sewer going through the middle of the site to the pump station in the north east corner of the site was mostly unable to be surveyed as the lines were blocked and filled with water.

It was found that the wastewater pipe system comprised of 100mm, 150mm and 225mm diameter pipes throughout the Site with 225mm pipes being found on the CCTV survey connecting into the trunk sewer. As the remainder of the trunk sewer was flooded, it is assumed that this is 225mm diameter as well.

Figure 32 displays the CCTV as-built map for the existing wastewater found on the site.

Wastewater system layout drawings are set out in drawings 33205/1000-1009 with associated pipe and manhole drainage schedule information on drawings 33205/1020-1025.

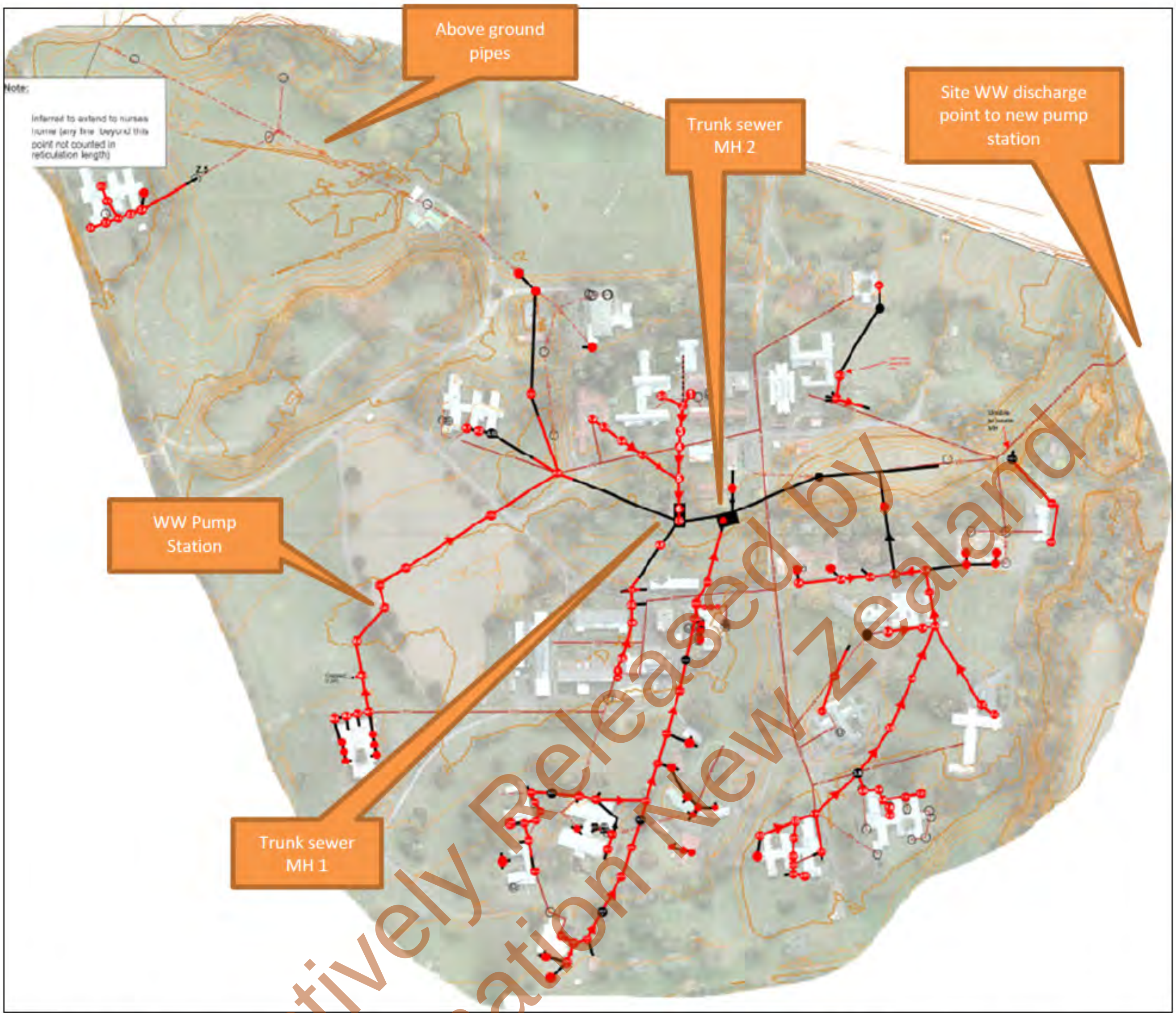


Figure 32: CCTV as-built map of the existing wastewater on the subject site (black = show flooded MHs and pipes)

The wastewater trunk sewer traversing through the middle of the site was investigated on site (labelled as MH 1 and MH 2 above) and was found to be very deep (approximately 4m). MH 1 was found to be a multi chamber with a lateral connection drop into the deep sewer pit as shown in Figure 33 below. MH 2 was unable to be assessed as the pit was filled with water.

	
Trunk Sewer (MH1)	Deep pit taking the dropper going to the east (MH1)
	
Lateral dropper connection into Trunk Sewer (MH1)	MH2 unable to be observed as the pit was filled with water

Figure 33: Photos of the trunk wastewater sewer system through the site

A wastewater pump station was found in the southwestern area of the site at the location shown on Figure 34. This wastewater pump station is known to service building B52 (Old house by the EDU). To the north west of the site, above ground DN150 steel wastewater pipes were found, with these pipes being heavily corroded. As mentioned in the stormwater section, it is possible that these pipes have cross connections to stormwater as it was seen on site that water was leaking from the pipe joints and there are no known stormwater connections into the wetland in the northwestern area.

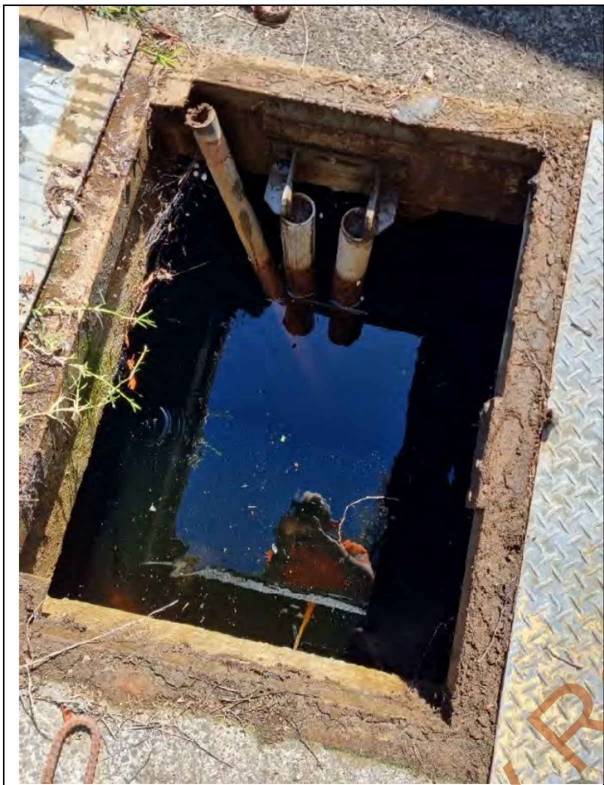
	
Flooded Wastewater Pump Station (from CST CCTV survey)	Corroded DN150 steel pipe above ground (found in northwest of the site)

Figure 34: Photos of other wastewater features found on the site

As for stormwater, whilst the scope did not include investigating building laterals, it was found onsite that some buildings had many manholes around them and it was not possible to know if these were wastewater or stormwater manholes, and lateral connections or not, until opened up. It was quite common to find these manholes to be installed in situations where inspection chambers would typically be used today.

During the CCTV survey, some manholes were found to be flooded and were pumped out to enable the CCTV survey to continue. Prior to pumping out, water samples were collected and tested to determine where the water could be disposed of. Two of the three water samples collected contained elevated levels of copper, lead and/or zinc exceeding the ANZECC guidelines for 95% protection of freshwater species, while slightly elevated E. coli levels were present in one sample, as summarised in Table 14. Water from these manholes was disposed of by sucker truck as trade waste.

Table 14: Manhole sample analytical results

Table 1 - Manhole Sampling Analytical Results

Analyte		MH601	MH501	MH518	ANZG Freshwater 95% protection species [1]
Sampled Date		16 March 2023	16 March 2023	16 March 2023	
General Parameters	**Units**				
pH	pH	6.4	7.1	6.7	-
Total Suspended Solids	g/m^3	3	3	< 3	-
Escherichia coli	MPN/100ml	48	109	1	-
Total Metals					
Arsenic	g/m^3	< 0.0011	< 0.0011	< 0.0011	0.024
Cadmium	g/m^3	< 0.000053	0.000099	< 0.000053	0.0002
Chromium	g/m^3	< 0.00053	0.00062	< 0.00053	0.0033
Copper	g/m^3	0.0023	0.0061	0.0026	0.0014
Lead	g/m^3	0.00104	0.0156	0.0021	0.0034
Nickel	g/m^3	< 0.00053	0.00173	0.00072	0.011
Zinc	g/m^3	0.042	0.190	0.112	0.008

Notes:
Any results exceeding adopted criteria are shaded accordingly.

1: Australian and New Zealand Guidelines for Fresh Water and Marine Water Quality - Default Guidelines Values

Table 15 provides a summary of the wastewater assets inventory and condition assessment. Most of the wastewater pipes were found to be in a poor or very poor condition with cracking, joint defects both laterally and longitudinally with evidence of infiltration ingress into the system.

Table 15: Existing Wastewater Assets Inventory and Condition Assessment

Item	Materials	Length (m)	Diameter (mm)	Average Depth	Condition	Comments
Pipe	EW	405	100	1m	4-5	Cracking – joint defects
Pipe	EW	3701	150	2m	4-5	Cracking – joint defects
Pipe	RC	800	225	2m	4-5	Cracking – joint defects
MH	RC	1050	1050	2m	4-5	64 manholes
MH	RC	675	675	1m	4-5	88 manholes

6.9 UTILITIES – POWER AND TELECOM

6.9.1 Background Information

The WSP/Opus services plans showed 5300m of power cables running through the site, including connections to most of the Site buildings.

However, the archived plan BD234.41 showed a significantly different power supply layout, linking all of the eight substations on the site. This layout is reproduced below in Figure 35, with orange highlighting added for emphasis.

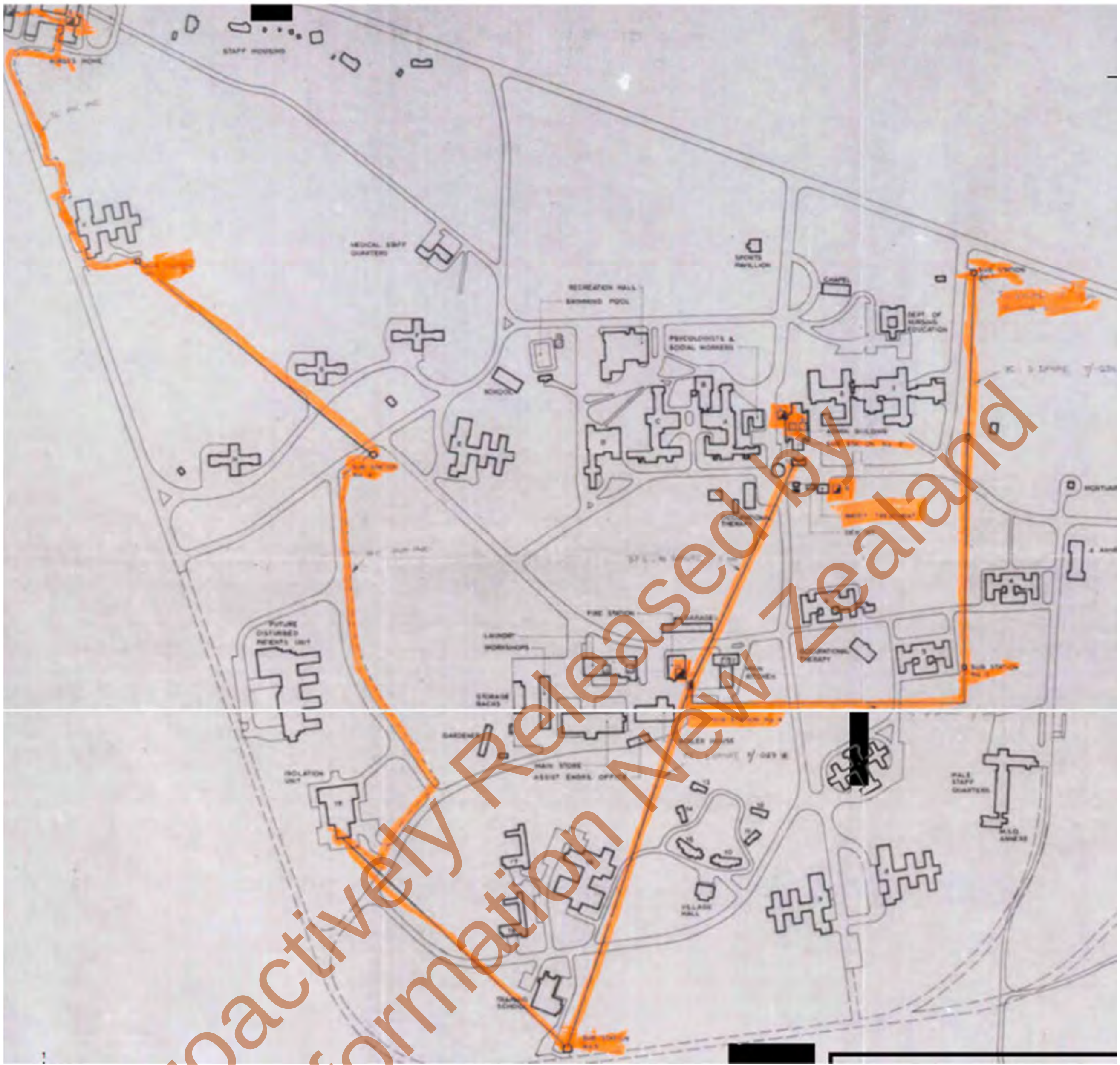


Figure 35: Power cable as built plan

The SWP service plans only showed 300m of telecom lines. Supplementary as-built information was obtained from Chorus, adding an additional 5000m of telecom lines.

6.9.2 Methodology

The following methodology was used to investigate the Site's power and telecom systems:

- EML survey of selected locations to confirm the alignment and depth of the network.
- FTL topo survey to capture key data at exposed potholing locations to accurately capture location and depth and other identified features (e.g. power and light poles, pull pits, etc.), including photos of visible assets.
- Data review and analysis, followed by a supplementary field inspection to check particular areas and fill in identified information gaps.
- Condition assessment and residual lifespan assessments.
- Drawings preparation and compilation of relevant appendices.

6.9.3 Results and Condition Assessment

Power and comms layout plans are set out in drawings 33205/1300 and 1400 respectively.

EML service scans found underground power and comms throughout the site quite successfully. Further to this, the topographical survey picked up all existing light poles on the site along with the power poles and comms pits. Overhead power lines were also present and recorded. Figure 36 below displays the service scanning map showing the water, power and telecom (Chorus) lines found.

Figure 36: EML Service scan sketch

Civtec also conducted hydroexcavation on the power and comms at 37 locations on site to check for any asbestos cement (AC) ducting in Oct/Nov 2023. It was found that most of the power and comms cables were direct buried with occasional power cables being ducted in steel pipes and comms in 100mm PVC ducts. No asbestos cement ducting was found for the existing power and comms. Refer to Appendix E for the associated Civtec documentation.

The following table provides an asset inventory of the power and comms. The condition of these assets was not fully investigated, due to the non-intrusive investigation methodology adopted. However, it is inferred to be moderate to poor, based on the age of these assets and the condition of any visible above ground power/telecom features.

Table 16: Existing power and comms asset inventory

Item	Length (m) or Number (#)	Average Depth	Comments
Below Ground Power	7321m	0.9m	Assumed ducted in 100mm pipes
Light Poles	# 99	N/A	
Above Ground Power	1365m	N/A	
Power Poles	# 18	N/A	
Underground Comms	4629m	0.9m	
Comms pits	# 7	0.9m	Assumed ducted in 32mm pipes
Unknown lids	# 46	N/A	Likely either power or telecom but not opened to confirm

6.10 SUMMARY

The following tables provide a summary of the assets inventory and condition assessment for the infrastructure groupings adopted in this report. The residual lifetime is a qualitative assessment, estimated based on the asset condition and also taking into account whether the asset is obsolete/redundant. It is not based on any quantitative analysis (e.g. lab testing), except for roading.

Table 17: Assessed Roading and Services Extents and Condition

Service (m length)	Length (m)	Status	Condition	Residual Lifetime and Other Comments
Roading	8630 (6.2ha area)	In use for Site access	Asphalt/chip seal generally poor; pavement itself appears structurally sound	Some roading areas have confirmed or potential coal tar in them; analysis indicates existing roading/paving will generally be at end of its lifetime on completion of demolition works due to estimated demolition traffic movements
Redundant road embankment crossing over Wharekōrino Stream	Estimated 6m wide x 80m long	Redundant	Likely moderate to poor (not confirmed due to flytipping over area)	Provides unsecured access into site; raises stream flood levels, potentially affecting existing disposal site; residual lifetime not assessed
Retaining walls	122 x 3 terraces 0.55-1.70m high	In use retaining hillside below road	Good	At least 20 years

Concrete ducting (+ steam & condensate pipework and fittings)	2937	Obsolete	Pipework & fittings generally poor to very poor; concrete ducting moderate	Pipework and fittings at end of their lifetime; concrete ducting could potentially be repurposed for future use (estimated 20+ years)
Water	Site: 2970 (ductile iron) 3390 (AC) Old supply: 790 (AC)	Obsolete	Poor to very poor	At end of lifetime; mainly ductile iron in northern half of site and Asbestos cement (AC) in southern half + abandoned AC trunk water supply line crossing site
Stormwater	1770 (trunk) 4463 (minor)	Trunk line conveys upgradient runoff	Moderate to Poor	675-900mm dia (trunk) 100-375mm dia (minor) Residual life – 10-20 years; trunk system better than minor
Wastewater	4907	Obsolete	Poor to very poor	100-225mm pipe dia; At end of lifetime
Power (underground)	7321	Obsolete	Inferred moderate to poor	Additional 1365m above ground Essentially at end of life, as obsolete
Telecom	4629	Obsolete	Inferred moderate to poor	Essentially at end of life, as obsolete

Note: A further 550m of water pipe running from Te Mawhai Rd, to the west of the site, past houses along Te Mawhai Rd and to swimming pool could not be found through extensive on-site investigations and is unlikely to exist.

Table 18: Infrastructure Features Inventory and Condition

Asset/underground service	Comments	No	Condition
Power	Lightpoles (99), power poles (18), other (7)	124	Moderate to poor
Concrete ducting	Concrete duct access chambers	37	Generally moderate
Water	Fire hydrants (41), valves (25)	66	Very poor
Stormwater	Manholes (149), catchpits (56)	201	Moderate
Wastewater	Manholes (152)	152	Poor to very poor

Telecom	Telecom post	7	Moderate
Unknown lids	4x4 lids	46	Moderate
Total		**633**	

7.0 FACTORS AFFECTING DECISION ON HORIZONTAL INFRASTRUCTURE TO BE RETAINED

7.1 HERITAGE, ARCHAEOLOGY & CULTURAL SIGNIFICANCE

The CFG Heritage Limited (CFG) Archaeological Assessment (February 2023) states that there are no recorded archaeological sites in the project area, and there are no records of archaeological work undertaken either in or near the vicinity of the project area. However, it is located near the southern banks of the Pūniu River, which was central to the pre-European Māori settlement of the area, adjacent to major battles during the Waikato War, and would become the southern boundary of Te Rohe Pōtae (the King country), all of which suggests previously unrecorded archaeological material may be present.

CFG advise that the area around Tokanui Hospital itself has not been well surveyed, with archaeological field work tending to be focused on developed settlements or constrained by development plans. Six archaeological sites are recorded within 2km of the hospital grounds, all of which are pre-European Māori pā.

CFG refer to how in 1923 concerns were raised by Raureti Te Huia regarding two urupā (cemeteries or burial sites) which the Government had failed to protect as promised. One of these has been identified as the nearby Pukekawakawa burial reserve, which is outside the project area. The exact location of the second is unknown, although it is believed to be within the hospital grounds (Te Muraahi & Maniapoto 2021: 48).

CFG undertook a hillshade LiDAR model analysis of the site and identified the following areas of potential archaeological interest:

- This comprises a hill that extends through the centre of the former Tokanui Hospital in the form of a headland, bordered by a stream (large pink area, western side in Figure 37). Although there is evidence of ground modification for roading and structures across the hill, there is potential for previously unrecorded archaeological sites being present here based on its position as a high point surrounded by historic wetlands, in an area which historic sources and oral traditions indicate was used by Māori pre-1900.
- This is a small hill on which the former Tokanui Hospital morgue stands and comprises a headland resting at the intersection of, and overlooking, two small streams (small pink triangular area, eastern side in Figure 37). The hill is covered in exotic trees, with native undergrowth and has a stepped eastern slope.

CFG and Iwi have also identified a number of other areas as culturally significant to mana whenua. These are shown in blue on Figure 37.

Removal of existing horizontal infrastructure from these areas of heritage, archaeological and cultural significance will require further assessment and development of accidental discovery protocols to follow in the event of soil disturbance finding something of potential interest.

All archaeological sites, based on evidence of pre-1900 human occupation, whether recorded or not, are protected by the provisions of the Heritage New Zealand Pouhere Taonga (NZHPT) Act 2014 and may not be destroyed, damaged or modified without an authority issued by Heritage New Zealand Pouhere Taonga.

It is understood that the Archaeological Authority requirement does not exclude a particular area from disturbance associated with any redevelopment, demolition or remedial works, but introduces a further process that has to be gone through before any works are undertaken in such areas, with the potential risk that archaeological features may be found, triggering further investigations and protection/relocation/management measures.

Figure 37: Tokanui Hospital Site – Heritage, Archaeological and Cultural Areas of Interest

7.2 HIGHLY PRODUCTIVE LAND USE CLASSIFICATION

The National Policy Statement for Highly Productive Land came into force in October 2022 and places restrictions on rezoning, subdivision and land use proposals on land that meets the transitional definition of Highly Productive Land (HPL) – Land Use Capability (LUC) Classes 1-3, with some exceptions. This transitional definition applies until each relevant territorial authority provides a regional policy statement containing HPL maps for their region and this policy statement is operative.

The site is zoned 'Rural Zone' (Waipā District Plan, 2019 – Map 12), while LUC maps indicate that most of the site (refer Figure 38) falls under LUC Class 2 which is defined as "*very good multiple-use land, slight limitations, suitable for cropping, viticulture, berry fruit, pastoralism, tree crops and forestry*". Hence, the majority of the Site would be classified as HPL Class 2 under the NPS-HPL.

However, Soil and LUC Consultant, Dr Scott Fraser, has advised that the LUC maps do not accurately reflect what was on the Tokanui village land in the 1980s, which needs to be considered when planning site restoration works. He considers that areas of the Site occupied by existing infrastructure would not currently be considered HPL.

He has further advised that to restore the land to LUC Class 2 or 3:

- horizontal infrastructure would need to be removed to allow for normal cultivation activities associated with arable land. To allow for some crops that require deep tillage, **no infrastructure within the top 30cm** would be a requirement.
- Site drainage also needs to be taken into consideration. Any surface or sub-surface drainage required to maintain land as 3w or better would need to be maintained or developed to meet the requirement of HPL. According to Table 14 in Lynn et al. (2009) a 3w subclass can have a moderately high water table (within 45cm of the soil surface) for 6 months of the year. Removal of horizontal infrastructure would need to take account of any works required to maintain drainage across the area to be restored to HPL.

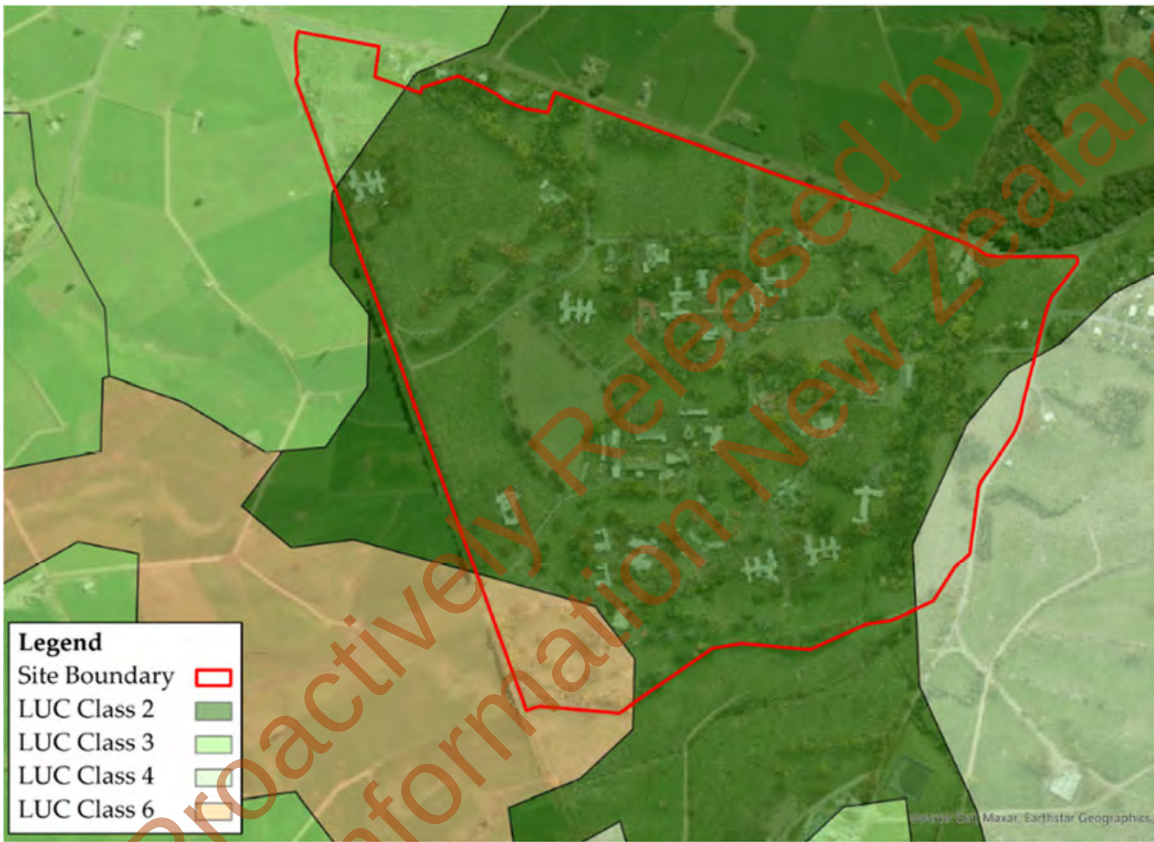


Figure 38: Tokanui Hospital Site – HPL Class 1 and 2 Overlay

7.3 ECOLOGY

4Sight (February 2023) undertook an ecological opportunities, constraints, and mapping investigation to provide information on the sites ecological state and to identify any potential constraints arising from the demolition works that may trigger additional consenting requirements. This comprised a desktop review and site investigation to identify any ecological features, potential fauna habitat and species within the Site boundary. Wetland delineation was undertaken in accordance with the wetland delineation methods set out in the National Policy Statement for Freshwater Management (NPSFM).

Natural Wetlands: Their investigation identified three natural wetlands within the Site.

1. Wetland 1 is located within a large depression area that is understood to function as a flood detention basin, with water temporarily stored in the basin discharging through a culvert at the eastern end of this basin into the Wharekōrino Stream.
2. Wetland 2 is located downstream of this and comprises an area with a channelised water flow and with surface water bordering the riparian zone, with hydrophytic vegetation present within the riparian margins.
3. Wetland 3 is a modified natural wetland. Drainage channels with wetland indicative vegetation run through the area and were historically created to allow for grazing of the area. The area was wet underfoot during the site visit.

Images 1-3 from the 4Sight Memorandum are reproduced below showing each of these wetlands in Figure 39, while the mapped wetland extents are shown in Figure 40, also reproduced from the 4Sight Memorandum.

Image 1: Looking down to wetland 1.

Image 2: Looking across wetland 2.

Image 3: Looking across a section of Wetland 3.

Figure 39: Tokanui Hospital Site – Wetland Images from 4Sight Ecological Assessment (2023)

The 4Sight Legislative/Consenting Review (April 2022) advises that the National Environmental Standards for Freshwater (NES-FW) sets out requirements for carrying out certain activities that pose risks to freshwater and freshwater ecosystems. This includes regulations for carrying out earthworks outside of, but within a 100m setback from, a natural wetland and a regulation which states it is prohibited to undertake earthworks within a natural wetland if this results in, or is likely to result, in the complete or partial drainage of all or part of a natural wetland.

Under Section 3.22 of the NES-FW, every regional council must include the following policy (or words to the same effect in its regional plan:

(f) the regional council is satisfied that:

(i) the activity is necessary for the purpose of constructing or operating a new or existing landfill or cleanfill area; and

(ii) the landfill or cleanfill area:

(A) will provide significant national or regional benefits; or

(B) is required to support urban development as referred to in paragraph (c);

(C) is required to support the extraction of aggregates as referred to in paragraph (d); or

(D) is required to support the extraction of minerals as referred to in paragraph (e); and

(iii) there is either no practicable alternative location in the region, or every other practicable alternative location in the region would have equal or greater adverse effects on a natural inland wetland; and

(iv) the effects of the activity will be managed through applying the effects management hierarchy."

Some drainage channels are present through Wetland 3, while Wetland 1 is located above some stormwater and wastewater reticulation, which may make removal of this infrastructure difficult without damaging these wetlands.

Terrestrial Features - Trees, Bats and Native Birds

Terrestrial vegetation types within the site included large exotic trees, ornamental trees, and large native trees. Large trees (≥15+ m) were scattered throughout the site. Native trees identified on site include Totara, Rimu and Kauri.

The ecological assessment recommends that all large trees (native and exotic) on Site are retained to avoid adverse effects on bats and native birds and to retain amenity values within a highly modified district. If removal of large trees is required, native tree species should be avoided where possible.

Some horizontal infrastructure passes under or in close proximity to existing large trees, which may make its removal difficult without damaging the trees. Removal of any large trees to facilitate horizontal infrastructure removal is also not favoured, as it may have adverse effects on bats and native birds. Management plans and/or appropriate mitigation measures will need to be put in place to minimise potential ecological impacts (e.g. Bat Management Plan, Avifauna Management Plan, tree felling protocols). An Arborist may also need to be engaged to ensure the protection of the trees that are to be retained.

Figure 40: Tokanui Hospital Site – Natural Wetlands, Native Vegetation and Large Native Trees from 4Sight Ecological Assessment

7.4 SURFACE WATER CONVEYANCE

CFG (February 2023) refer to the hospital site being located at the junction of three waterways, noted in ML 6748 drawn in 1889 as Makaroa, Tarutahi and Wharekōrino Swamps as shown in Figure 41. Of these swamps, the Wharekōrino Stream is still present and includes swamp like features, while the Tarutahi Swamp appears to be part of the Wharekōrino Stream above the site, and the Makaroa Swamp is no longer present.

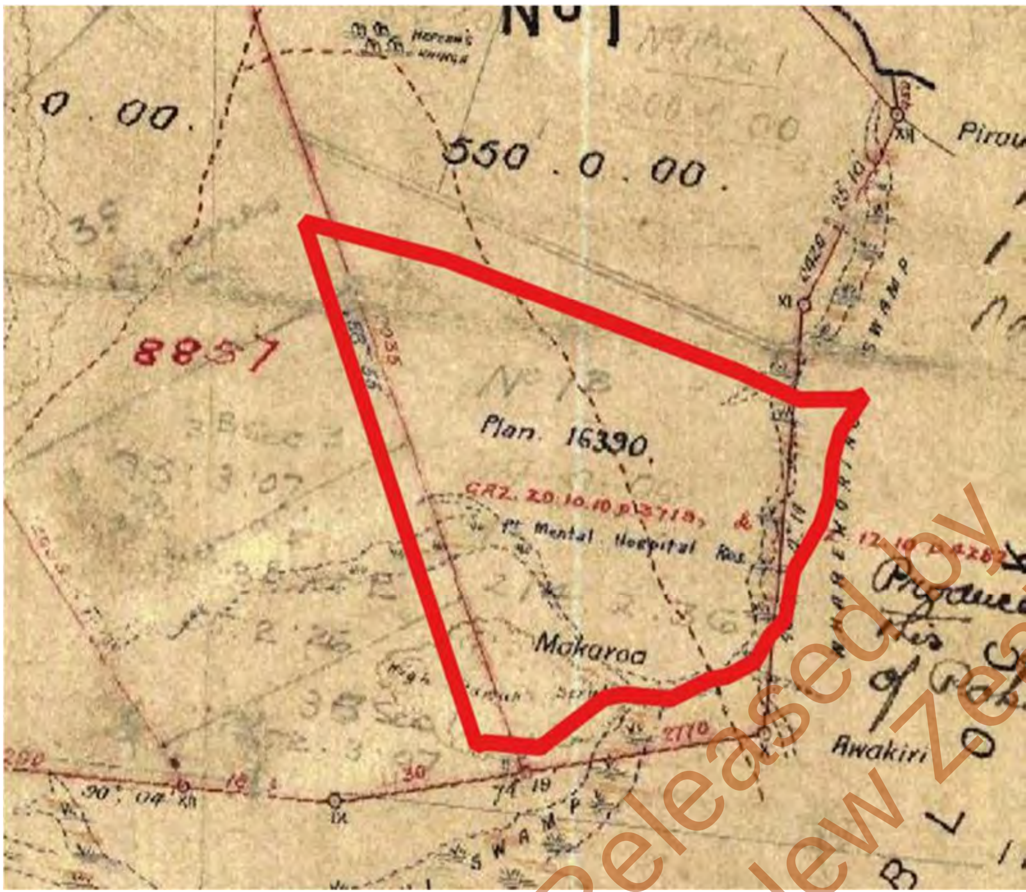


Figure 41: Tokanui Hospital Site – Historical Plan showing former swamps (from CFG, 2023)

Investigation of the Site's stormwater system has found that runoff from upgradient farmland to the west of the site has been piped through the site as shown in Figure 42 below, meaning these historical watercourses have been infilled and also realigned as the stormwater pipe system alignment differs from the historical swamp/watercourse alignment.

CCTV investigation has shown that these stormwater pipes are in relatively moderate to poor condition. Under the common law right of 'natural servitude', a duty exists for a lower landowner to accept the natural flow of water from a higher landowner. This means that as the properties to the west are higher than the Tokanui site, they are entitled to allow water from their property to flow onto the Tokanui site and the Site landowner will not be able to stop the water flow or claim nuisance against them (unless the runoff wasn't caused by the ordinary use of their land). This means that it would be sensible to ensure that there is infrastructure on the Tokanui site to manage that water flow. This means that the existing stormwater pipe "trunk main" drainage system will either need to be repaired, replaced or removed and a stream reinstated along its current alignment or the historic alignment (the latter practice is known as "stream daylighting").

Figure 42: Tokanui Hospital Site – Current Trunk Stormwater Reticulation conveying upgradient runoff through Site

8.0 INFRASTRUCTURE RETENTION ANALYSIS

This section provides a discussion on the horizontal infrastructure that could be retained or must be retained.

8.1 ROADING/PAVEMENT

Existing roading and paving cover approximately 6.2ha or approximately 8% of the Site's land area, with the roading network being approximately 8.6km long. The existing asphalt and chip-seal surfaces are in poor condition and appear to be at the end of their life, evidenced by potholes, cracks and moss developing. Some areas of roading also have confirmed or possible coal tar in them. The pavement itself appears to be structurally sound but is assessed to generally be at the end of its life om completion of the demolition works.

It is considered that it will be required to have some vehicle access to the Site in order to manage it and hence it may be useful to retain some of the existing roading to provide ongoing vehicle access to the Site, repairing it to "farm access track" standard for the Site. The alternative is to remove all roading and paving, restoring the maximum land area to productive land use, but eliminating all farm vehicle access routes. All options include removal of any roading or paving that did not provide site access, therefore under all options at a minimum 56% of the roading will be removed. Hence, three options have been considered here:

- **Option RD1** - Complete removal: Removing all roading and paving, covering an estimated 6.2ha, comprising the asphalt or chip seal cover, basecourse and subbase down to average depth of 300mm and backfilling with suitable soils to match what is on site (18,600m^3 required). In this case, new access tracks would need to be installed to provide vehicle access to the Site.
- **Option RD2** - Substantial removal (80%): Removing all "blue" and "green" roading as shown in Figure 43, covering an estimated 5.00ha to 300mm depth and keep & repair the "red" (main) roading; soil backfill required = 15,000m^3. This would leave approximately 1.5km of roading in place.
- **Option RD3** - Partial removal (56%): Removing all "blue" roading/paving (minor roading around buildings) as shown on Figure 43, covering an estimated 3.49ha to 300mm depth and keep and repair the "red" and "green" roading to maintain good vehicular access across majority of Site; soil backfill required = 10,440m^3. This would leave approximately 3.3km of roading in place.

Road repair for the roading left in place would involve removal of the seal (chip seal and asphalt), including any areas with confirmed coal tar; see drawing 33205/1701), topup with appropriate hardfill and trimming/shaping to create good standard, farm access tracks. These options are shown on drawing 33205/1702.

Figure 43: Site Roading/Paving showing what could possibly be retained in red and green colours for Options RD2 and RD3.

In addition, **Option RD4** is a potential "add-on" to each of options RD1, RD2 and RD3. It involves removal of the obsolete eastern road crossing over Wharekōrino Stream into site, involving estimated earthworks over an area of 1800m^2 of 5200m^3, reforming of stream banks and riparian planting. This option is shown on drawing 33205/1710.

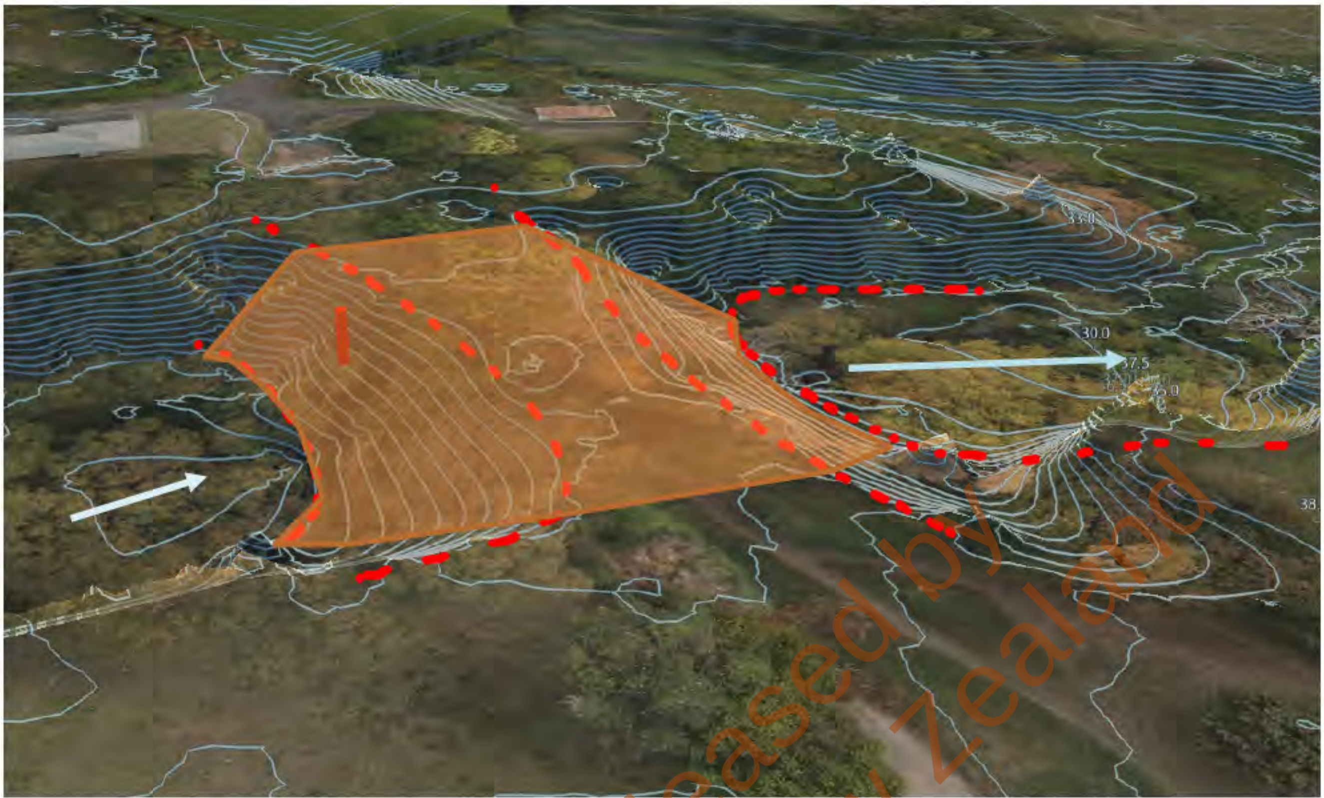


Figure 44: Obsolete road embankment that could be removed in orange; arrows show stream flow direction

8.2 RETAINING WALL

The single retaining wall on the Site comprises three terraces of total approximate length 120m, ranging in height from 0.55-1.70m. This wall provides an important function, retaining part of the hillside between the above road and below building. It abuts an archaeological authority area (hillside). Parts of it are relatively high (>1m) and it could pose a possible safety issue to people or grazing animals in the future due to the absence of any handrails, while it does restrict the use of this area.

- **Option RW1:** Keep the retaining wall. It is a localised feature, retains the hillside berlow an existing road which would be kept as part of Option RD3 and is in good condition. Any concerns about safety could be addressed by installing handrails along any sections over 1m high.
- **Option RW2:** Remove the retaining wall. This would involve earthworks to recontour the hillside to a stable batter, based on a geotechnical slope stability assessment. The recontouring should ideally be done to avoid crossing the road above the wall, which also avoids the Archaeological Authority area.

8.3 CONCRETE DUCTING

The concrete ducting system comprises the steam and condensate pipes formerly used for heating the site's buildings, contained inside concrete ducting and accessed by large concrete chambers that protrude above the ground. This system is contained entirely within the Site and is obsolete and can be removed without affecting any neighbouring properties. The options considered here are:

- **Option CD1** - Complete removal of all concrete ducting, pipework and fittings, and associated access chambers. A minimum of 880m^3 of backfill material is estimated to be required, as well as excavation works to remove the soil overlying the ducting, temporarily stockpile it and then replace it on completion of ducting removal.
- **Option CD2** - Partial removal, involving removal of all the pipework and associated fittings inside the ducting, but leaving the concrete ducting and access chambers for possible future reuse for other services (e.g. future water supply for site use or irrigation, etc.). This is likely to involve less soil disturbance, depending on the contractor's methodology.

This option is shown on drawing 33205/1801.

8.4 TRUNK STORMWATER

As described in Section 7 of this report, under the common law right of 'natural servitude', a duty exists for a lower landowner to accept the natural flow of water from a higher landowner. Drawing 33205/1600 shows the upgradient stormwater catchments to the west of the Site that drain through it. Hence, a means of conveying this upgradient runoff through the site must be provided for. This is currently achieved by the trunk stormwater pipe system, comprising a total length of 1770m of 675-900dia pipe in moderate to poor condition. The following options were considered for providing for upgradient runoff to flow through the Site:

- **Option SW1:** Removing the trunk stormwater system and undertaking earthworks (estimated to be 24,800m^3) to replace these pipes with an engineered, open channel system, which would be naturalised, essentially restoring a stream network through the Site ("stream restoration" option), along with a 3m riparian margin at the top of the stream banks on each side. Refer drawing 33205/1601 for details.
- **Option SW2A:** Upgrading the trunk stormwater system through the site, replacing all damaged/end of life pipes, effectively giving it at least another 50yrs of life ("pipe replacement & upgrade" option).
- **Option SW2B:** Lining the trunk stormwater system, with an internal sleeve, that would extend its life by at least 50 years and involves minimal ground disturbance.

Refer drawing 33205/1610 for details of Options SW2A and SW2B.

For Option SW1, its capacity is controlled by the selected channel base width and side slopes, tying into existing levels at the upstream and downstream ends and the Site topography. Preliminary channel dimensions are a 1m base width, side slopes of 1V:3H and a typical 1.5-2.0m depth. The maximum excavation depth required is 4.5m deep, while there is also quite a high batter (6.5m) in one area, due to Site topography. This channel has significantly more capacity than the current piped system.

The adopted riparian planting width of 3m comes from WRC 2020/12 "Riparian Characteristics of Pastoral Waterways in the Waikato Region, 2002-2017" which refers to an earlier WRC publication which advises that *"on flat land and for improved water quality outcomes (e.g. a reduction in suspended sediment), buffer widths of 1 to 3 m for grassed margins are thought to be acceptable (Waikato Regional Council, 2004)".*

Retaining the trunk stormwater system would also involve protecting the natural wetlands present on the Site and retaining the inlet/outlet connections to the existing flood detention areas, subject to flood modelling to confirm these areas are still needed. The lower trunk system runs under one of these wetlands that has formed in a flood detention basin.

These options do not consider the lateral stormwater system that serves the Site's buildings and roadings, which are covered under the "other services" assessment.

It is not known if any farm field/tile drains rely on the stormwater system to drain to. This will need checking for both options, with provision made to connect any farm drains into the upgraded system.

8.5 OTHER SERVICES

Other services covers minor (non-trunk) stormwater, water supply, wastewater reticulation, power and telecom utilities. All of these services are obsolete and can be removed without affecting any adjacent properties. The options considered here are:

- **Option OS1:** Complete removal of all other services. This represents large scale works, involving significant soil disturbance across the majority of the site.
- **Option OS2C:** Partial removal, involving removal of all surface features, all known AC pipes, and all other below ground infrastructure to a depth of 800mm for pipes/ducts (excluding trunk stormwater system) and 1m for associated structures, followed by reinstatement with soil and topsoil. Any services deeper than 800mm would be capped and abandoned.

Option OS2C incorporates feedback from TNN following WSP's review of a draft version of this report, which recommended that the original "other services" removal depth of 600mm (Option OS2A) be increased by 200mm to 800mm depth.

This option is shown on drawing 33205/1800.

These options do not cover the trunk stormwater or concrete ducting.

The OS2C approach is consistent with standard industry practice for dealing with redundant services – i.e. abandoning and capping is normal practice, except when removal is required for other reasons (e.g building foundations are to be located in an area with abandoned pipes). The abandoned assets will need recording on asbuilt plans for future reference. This infrastructure would then only be removed and disposed of if or when disturbed in future, as part of future Site redevelopment.

8.6 RESOURCE RECOVERY POTENTIAL FOR ANY REMOVED INFRASTRUCTURE

This is referred to in the separate Fraser Thomas (2023) Disposal Options report.

9.0 COSTS

9.1 BASIS

Costs for each of the options considered were estimated using the following approach:

9.1.1 General

- Average rates from LINZ for different construction/demolition activities, plant and personnel and disposal facility rates, updated by LINZ to May 2023.
- Estimation of loading, haulage and disposal costs for different waste materials. Factors were applied to some material categories on the base loading and haulage rates to reflect these materials have stricter handling and transport requirements (e.g. asbestos).
- Haulage was based on a worst-case scenario of all clean materials being disposed of to GRP Ltd (Glen Afton, 83km away one way) and all other materials being disposed to Hampton Downs Landfill, being the furthest from the site (99km one way).
- Loading and haulage times were estimated from consideration of travel distance and time, other similar projects and experience.
- Allowance for contractor Preliminary and General (P&G) costs of 10%.
- Allowance for erosion and sediment controls in accordance with Waikato region requirements.
- Contingency of 25% on physical works costs, recognising this is a high level estimate.
- Variable allowance for consenting costs based on preliminary consenting requirements advice from 4Sight Consulting Ltd.
- Variable allowances for consultants and other professional fees of 7.5-15%, depending on the estimated design input required.
- Allowance for escalation costs of 6%, based on the works being started in mid-2024.

9.1.2 Roading

- Roading/paving material quantities from aerial plans, survey and site inspections, based on an average depth of 300mm.
- Allowing additional costs for removal of pavement containing coal tar.
- Allowing for archaeological/cultural standover where roading crosses identified archaeological/cultural features.
- Allowing for import of suitable subsoils and topsoil, followed by grassing to restore the removed roading/paving areas to productive land use.
- Allowing for converting the residual roading to farm access tracks, involving removing the pavement surfacing (chip seal or asphalt), topping up the basecourse with appropriate hardfill, trimming and grading.
- Road embankment removal costs (RD4) allow for clearing vegetation, scrub and trees, removing flytipped waste in this area, removing any redundant road surface and basecourse, excavation to remove the embankment itself, the associated culvert and inlet/outlet structures followed by trimming/shaping the stream banks, retopsoiling, grassing and riparian planting, with a provisional allowance for hay mulching.

9.1.3 Stormwater

- Demolition and removal of all existing stormwater pipes and structures (options SW1 and SW2A).
- Rates for new pipes, culverts, manholes and other structures from QV Cost Builder.
- For SW1, excavation of new stream channel, bank trimming/shaping, topsoil import, grassing and riparian planting and replacement of existing 900mm dia culverts under the road.
- Two options considered for SW1 to check sensitivity to what is done with excavated materials. Option SW1A assumes that excess spoil from the excavation works is reused for backfilling of demolition works (e.g. building foundations, removed roading, etc.) or stockpiled onsite (e.g. landscaping feature). Option 1B assumes all excess spoil is removed offsite as clean material.
- For SW2A, replacement of existing pipework with "next size up" pipework, to give the system some increased capacity to allow for climate change effects.
- For Option SW2B, exiting pipework is lined, with high level costs obtained from supplier.
- Allowance for stream flow diversion during the works (all).

9.1.4 Concrete Ducting

- CD1: Allowance for excavation of soil overlying ducting, and temporary stockpiling, followed by ducting and pipework removal (for recovery as scrap metal), backfilling with suitable subsoils, retopsoiling and grassing.
- CD2: Allowance for removal of the pipework and fittings within the ducting only, assuming a clean sawcut of the duct lids to access the pipes and reinstatement with epoxy mortar sealing to reinstate the concrete duct lids.

9.1.5 Other Services

- Allowance for complete removal of all asbestos pipe, including associated controls in accordance with best practice (e.g. decontamination units, suitably qualified/experienced personnel) and allowing for disposal of some contaminated soil around the pipe due to pipe deterioration or soil cross-contamination during pipe removal.
- Allowance for complete or partial removal of all other services, using excavators and labourers, backfilling with appropriate soils, retopsoiling and grassing.

9.1.6 Operation and Maintenance (O&M) Costs

- Assumed defects liability period of 12 months applies and hence does not include any remedial works over this period as O&M costs.
- Ongoing operation and maintenance costs after this, based on:
  - High level estimates with an estimated uncertainty of ±25%.
  - Routine maintenance, not allowing for any extreme weather events.
  - No ongoing O&M costs where infrastructure is completely removed.
  - Maintenance of any existing roading that is converted to farm gravel access tracks assuming 3% of the total retained road area requires maintenance each year, involving topping up the hardfill and an excavator and labourer fixing any scour/erosion and drainage issues (composite rate of [redacted]/m^2/yr used). For Option RD1, a similar rate could be applied by the landowner to any new roading installed by them.

- o Maintenance of any planted areas (Options RD4 and SW1) at a rate of 5% of the actual planting costs.
- o Maintenance of replacement or lined stormwater pipes, based on 0.25% of the new pipe installation cost (same rate for both SWW2A and SW2B).
- o Maintenance for Options CD2 and OS2C where some infrastructure is left in the ground, associated with repairing any broken or damaged access lids (Option CD2 only) and addressing any subsidence/scour/erosion along the alignment of the residual buried infrastructure based on 2 days per year for Option CD02 and8 days for Option OS2C, using an excavator at [redacted]/day (2023 prices).
- o Routine maintenance – e.g. reinstating cap/topsoil cover, fixing any scour/erosion, etc.

- Estimation of total O&M costs over a 10yr period based on an average inflation rate of 2.1% over the period 2013-22, compounded over the 10 year period.

9.2 COST ESTIMATES

These costs are summarised below in Table 19. Key points are summarised below:

- Roading/paving removal options (RD1-RD3) costs increase as the extent of roading/paving removed increases.
- SW2A (pipe replacement/upgrade) costs are estimated to be more expensive than SW1 (stream restoration), when the excavated soils are reused/disposed of onsite, but becomes less expensive if all excavated soil has to be disposed of offsite as cleanfill.
- SW2B (pipe relining) is clearly the lowest cost option – supplier costs for this option would need confirming by site inspection by the supplier.
- Complete ducting system removal (CD1) is approximately 70% greater than the cost of partial ducting removal (CD2).
- Complete removal (OS1) of all other services (i.e. excluding trunk stormwater and concrete ducting) is very costly at [redacted] This is primarily due to the scale of the infrastructure removal involved, effectively equivalent to a small village and the estimated cost for asbestos pipe removal (4.2km at [redacted] for complete removal, or [redacted] including contingencies, design fees and escalation costs).

Table 19: Options Cost Comparison

Infrastructure Grouping	Option	Description	Cost ($)		Comments
			Capex	O&M (10yrs)	
Roading	RD1	100% roading/paving removal	[redacted]		
	RD2	80% roading/paving removal			
	RD3	56% roading/paving removal			
	RD4	Redundant road embankment removed			"Addon" to other roading options

Trunk Storm-water	SW1	Removal of existing trunk stormwater system and stream reinstatement	[redacted]	Lower cost based on excavated soil reused/disposed onsite; upper cost based on disposal offsite
	SW2A	Replacement of existing trunk stormwater system with new pipes	[redacted]	
	SW2B	Lining of existing stormwater system	[redacted]	
Concrete Ducting	CD1	Complete removal of concrete ducting including internal steam/condensate pipework and fittings	[redacted]	
	CD2	Removal of ducting pipework and fittings only	[redacted]	
Other Services	OS1	Complete removal of all non-trunk stormwater, wastewater, water and utilities	[redacted]	
	OS2C	Complete removal AC water pipes and partial removal of all other services down to 800mm for pipes/ducts and 1000m for underground structures	[redacted]	

10.0 OPTIONS ASSESSMENT

This section explains the options assessed in accordance with the Deed, the assessment process and outcome. The assessment considers environmental, social, cultural and economic factors and risks associated with both removing or retaining different assets.

10.1 SELECTED OPTIONS

Selected assessment options come from the Deed settlement process, which requires disposal options to be compared for onsite versus offsite disposal, including scenarios where all horizontal infrastructure is removed versus "some" being retained. In this context, "some" has been defined in terms of the options set out in Section 8 for different infrastructure groupings.

This evaluation does not include:

- Assessing waste disposal options (covered in separate FTL (2023) report.
- Assessing the impacts of vertical infrastructure demolition/removal on the site, as this is common to the options considered;
- Assessing the impact of reuse/recycling, as this will be promoted across all options;
- Assessment of how contaminated soil will be managed as part of the overarching project (this scope of work is being undertaken in line with the remediation standards set out in the THDSP).
- Assessment in respect of the existing disposal sites, as per Part 9.13 of the Deed.

Table 20: Summary of Horizontal Infrastructure Removal versus Retention Options

Item	Must Retain (Essential)	Could Retain (Optional)		Complete Removal
Roading/ paving (6.2ha, 8600m)	Not applicable	**RD3:** 3.49ha, 10,440m^3 backfilling	**RD2:** 5.0ha, 15,000m^3 backfilling	**RD1:** 6.20ha or roading/paving, 18,600m^3 backfilling
Old road embankment & Culvert 3 (~1350dia)	Not applicable	**RD4 Add-on:** earthworks over 1800m^2 area of 5200m^3 volume, stream bank grading and riparian planting		
Retaining wall (3 terraces x 122m)	Not applicable	**RW1:** Keep retaining wall, possibly adding handrails		**RW2:** Remove retaining wall and undertake earthworks to recontour hillside
Concrete Ducts	Not applicable	**CD2:** Remove all pipework and fittings; keep concrete ducting and access chambers for possible repurposing for other use		**CD1:** Remove entire system (2937m); 880m^3 minimum backfilling
Trunk Stormwater	**SW1:** Stream restoration – 1770m, 24,800m^3 earthworks OR **SW2A:** Pipe replacement and upgrade – 1770m x	Not applicable		Not applicable

	750-1050dia pipe OR **SW2B:** Line existing pipes to extend life by 50⁺yrs		
Other Services	Not applicable	**OS2C** - Partial removal: 633 surface features (MHs, fire hydrants, valve boxes, etc.) and associated infrastructure to 800mm depth pipes/ducts (excluding trunk stormwater system) and removal of inground structures to 1m depth.	**OS1** - Complete removal: 633 surface features + minor stormwater pipes (4463m), wastewater pipes (4907m), water pipes (7150m), Power U/G (7321m), Power A/G (1365m), telecom (4629m)

10.2 ASSESSMENT APPROACH

10.2.1 Process Overview

The evaluation assessment approach was developed as a hybrid approach tailored to the Site, based on the following tools:

(a) Multi-criteria analysis (MCA): This can be used to assess multiple criteria, both quantitative and qualitative relating to a proposed project. MCA can be used to compare different alternatives and options and assist with conversations between the project proponent and stakeholders to help inform decision making.

(b) Mauri model: The Mauri Model Decision Making Framework was developed in New Zealand and is unique in its approach to the management of water resources as the framework offers a transparent and inclusive approach to considering the environmental, economic, social and cultural aspects of the decisions being contemplated. It is consistent with the RMA sustainability framework and incorporates both western scientific and indigenous world views.

(c) Landcare Research has developed a range of Māori environmental assessment and performance indicator tools, primarily in relation to freshwater resources.

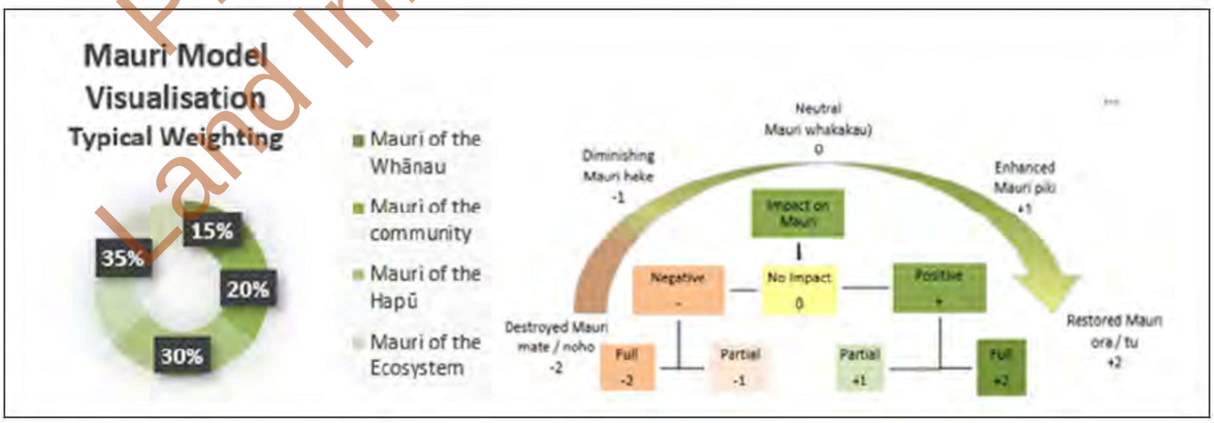


Figure 45: Mauri Model Visualisation (source: adapted from Morgan TKKB and Fa'aui TN (Sept 2014))

10.2.2 Assessment Criteria and Indicators

The assessment was undertaken looking at environmental, social, cultural, economic criteria consistent with the Mauri model and taking into account the criteria agreed to by the Crown to assess and inform the disposal options assessment (refer section 4.4 of this report). The choice of criteria is important as it will ensure LINZ considers the right information as part of this options analysis. Within each criteria, a number of indicators[3] were developed for evaluation, along with a number of sub-headings to help explain what each indicator covered. These

Table 21: Assessment Criteria, Indicators and Sub-headings

Criteria	Indicator	Sub-heading
Environmental	Effects on land use/ productivity	Impervious areas extent Residual materials breakdown over time Contamination of the land Associated effects on land use/productivity
	Effects on surface water	Quantity – peak flows/volumes Quality Silt/sediment Scour/erosion
	Groundwater effects	Groundwater table effects (groundwater levels) Quality Use
	Ecological effects	Plants/trees/birds and other fauna Aquatic species
	Air emissions	Dust/odour Particulate/volatile gases Greenhouse gases (carbon dioxide, methane)
	Sustainability	Reuse/recycling Resilience (e.g. ability to cope with climate change effects) Legacy (future generation) issues
Social	Public health and safety	Physical injury Contaminant effects on human health Traffic impacts
	Worker health and safety	Physical injury Contaminant effects on human health Traffic impacts
	Neighbourhood effects	Dust, noise, odour, vibration, traffic

[3] An indicator is a single characteristic that represents a potential or actual effect which can be compared across options to evaluate their relative performance. Indicators need to be measurable in some way that is sufficient to allow evaluation (adapted from SuRF-UK, 2011).

		Changes to surface runoff flow patterns
	Amenity/land use	Nuisance Visual effects Land use limitations
	Employment opportunities	Short term during works Long term – ongoing maintenance
	"Wellbeing" perceptions	Dislike of leaving infrastructure in ground that is reminder of site's history Site "not quite cleaned up" perception
Cultural	Loss of mauri	Loss of a "health and spirit" which permeates through all living and non-living things - plants, animals, water and soil
	Destruction of wāhi tapu (cultural/spiritual) sites	Ancestral burial sites Loss of cultural heritage Disruption of cultural connectivity Damage Iwi relationships Impact on land and resources
	Kiatiakitanga (guardianship) and Whenua (land)	Extent of Māori active involvement in control, management and protection of land Restrictions on land use (physical, contamination, etc.) causing loss of resources/ opportunities for economic development
	Healing the land (Papatūānuku)	Soil health
	Restoration of water services (Wai Ora)	Water quality Ecology
	Mahinga kai (garden, cultivation, food gathering places)	Garden, cultivation, food gathering places Collecting plants for various (e.g. medicine, weaving) purposes (e.g. toetoe, raupo, harakeke, paopao)
Economic	Physical works costs (capex)	Capex cost scores were made on a qualitative, judgement basis
	Ongoing maintenance costs (opex)	Opex cost scores were made on a qualitative, judgement basis
	Effects on land value	Impact of infrastructure removal/retention works on land value
	Effects on potential earnings from land	Extent and productivity/health of land area available for use
	Minimisation of future liabilities	Legacy effects of residual infrastructure left in place

An additional "deliverability" assessment was also included, which involved a Yes/No/Likely/Unlikely assessment of the ability to deliver on the Crown's commitments under the THDSP, taking into account the prescribed timeframes and delivery risks in terms of:

- Significant constraints/project risks
- Consentability

10.2.3 Scoring Considerations

Under each criteria indicator, notes were added to the evaluation spreadsheet, summarising relevant scoring considerations. One example for each criteria are given below, while the complete notes can be viewed in the spreadsheet in Appendix D. For the cultural scoring consideration, wording from the Deed, Cultural Impact Assessment and the cultural induction provided by mana whenua were used to inform initial assessment. Engagement with Te Nehenehenui will further inform this scoring consideration.

Table 22: Example of Scoring Considerations for Specific Indicators for each Criteria for different Infrastructure Groupings

Criteria, Indicator and Sub-headings	Scoring Considerations
TRUNK STORMWATER - ENVIRONMENTAL **Surface water effects:** ***Quantity peak flows/volumes*** ***Quality Silt/sediment,*** ***Scour/erosion***	**SW1 - Stream restoration:** > Restoring streams through site will return site to similar "surface water" conditions to pre-hospital development. > Associated riparian planting will help to maintain water quality. > Will involve significant earthworks (3.6ha, 30,000m^3) requiring significant silt/sediment controls and generating a lot of vehicle traffic (excavators, trucks, etc.) > Stormwater diversions will need to be in place during works to convey upgradient runoff around active works areas. > Potential dewatering particularly at downstream end where existing pipe system is flooded. > Mitigation of potential scour/erosion needs to be designed for (greater risk than in piped system). **SW2 - Pipe replacement & upgrade:** > Replacing/upgrading trunk stormwater lines will ensure upgradient flows are safely conveyed through Site below ground level for at least another 50yrs (with ongoing maintenance required). > Stormwater diversions will need to be in place during works to convey upgradient runoff around active works areas, but for shorter time than SW1 works which are expected to take longer. > Pipe replacement will involve significant trenching (1770m length), with erosion and sediment controls and potentially dewatering required - any dirty water will required treatment prior to discharge. **SW2B - Pipe lining:** > Minimal ground disturbance involved during works. > Pipe system capacity expected to be similar to existing
ROADING – SOCIAL: **Worker health & safety:**	**RD1-RD3:**

Physical injury ***Contaminant effects on human health*** ***Traffic impacts***	> All roading options remove roading/paving that does not provide site access and will remove coal tar present in road pavement and at localised locations where it is present in the basecourse, with workers needing to wear appropriate PPE during these works (noting that existing risk is considered low as contaminants are tightly bound to pavement). > Risk of accident from trucks carrying removed roading/paving offsite and possibly importing backfill materials to site (if not sourced from site): Risk decreases in following order: RD1 > RD2 > RD3 based on reducing volume of vehicle movements. > Construction Management Plan will set out safe working procedures to manage associated worker H&S risks. **RD4:** > Road crossing has been subject to fly tipping and is heavily overgrown and uneven underfoot, posing a H&S risk to construction workers > Removal of embankment materials offsite will increase demolition traffic on public roads, if removed offsite (290 truck and trailers)
CONCRETE DUCTING – CULTURAL: **Loss of mauri:** ***Loss of a "health and spirit" which permeates through all living and non-living things - plants, animals, water and soil***	**CD1:** > Removal of entire ducting system should help restore mauri (effect more pronounced than CD2) **CD2:** > Removal of ducting pipework and fittings only but leaving actual ducting in place may have less of a restorative effect on Mauri, as residual infrastructure still present, but not visible apart from access pits
ECONOMIC **Minimisation of future liabilities:** ***Legacy effects of residual infrastructure left in place***	**OS1:** > Will eliminate long term liabilities **OS2C:** > Deeper obsolete infrastructure left in place does represent a long term liability when or if this is disturbed for other development activities, but potentially may never be disturbed (practice of leaving abandoned infrastructure insitu unless removal required for other reasons is common and generally accepted). The residual deeper infrastructure should also be recorded on plans for future reference to help manage this risk.

10.2.4 Weightings

Evaluation spreadsheet weightings for environmental, social, cultural and economic criteria were adopted from typical weightings used in the Mauri model. The adopted weightings were applied to support the priority order detailed in BRF 23-169 and may be updated following review of this report by Te Nehenehenui. These weightings can be adjusted by the participants involved in the evaluation or alternatively sensitivity testing can be done with different weightings to check the effect this has on the ranking of different options.

Table 23: Criteria Weightings

Criteria	No of Indicators	Selected Weighting
Environmental	6	35%
Social	6	20%
Cultural	6	30%
Economic	6*	15%
Total	24	100%

Note: * With the economic criteria, the physical works (capex) costs indicator was given double scoring, as it was considered this indicator should be given more weighting than the other economic factors. This also meant that each criteria had the same effective number of factors, so that all scores are directly comparable.

10.2.5 Scoring

The adopted scoring system was again based on the Mauri model, with five scoring options, ranging from -2 (full negative) through 0 (no impact) to +2 (fully positive). The five scores are listed below.

Table 24: Evaluation Scoring System

Score				
-2	-1	0	1	2
Fully negative	Partly negative	No impact	Partly positive	Fully positive

Scores for each criteria are obtained by summing up the scores of individual indicators and then multiplying those scores by the criteria weighting. The overall score for each option is then obtained by summing up the weighted criteria scores, with the options then ranked.

10.2.6 Interpreting Results

With evaluation processes of this nature, it is important not to use the evaluation spreadsheet as a black box, ***it is a process to aid the decision making process NOT to replace it***. Therefore, one of the most important steps after completing the scoring/ranking process is to look at the results and see if they 'make sense'. If it can not be explained why one option ranks higher or lower than another, then the individual scores for each criteria should be checked. Often it may simply be an error (putting the wrong number in the wrong box) or a realisation that the score given the first time was not quite right; or by reviewing the individual criteria scores, it becomes clearer why the option ranked the way it did.

The way the results are reported is also important. The rankings are generated automatically by the excel formula. When reporting these rankings it is important to approximate the rankings by giving options that score within 10 to 25 points of each other as an equal ranking. The MCA process is not an 'exact science' and so the reporting of the results should also reflect the approximate nature of the process. For example, if the option had the following 'Total Score', the ranking would be reported as follows:

Total Score	655	633	775	789	702
Ranking	4th=	4th=	1st=	1st =	3rd

10.3 ASSESSMENT RESULTS

Preliminary assessment results of the infrastructure removal versus retention options, based on LINZ and FTL inputs, are summarised in the following tables for each infrastructure groupings, with details in Appendix D. The retaining wall options were assessed on a more qualitative basis, as this is a localised asset.

10.3.1 Retaining Wall

RW1 (keep retaining wall) was considered the best option in this case, subject to Te Nehenehenui feedback. The retaining wall is a local feature, comprising three terraces of total length 122m, is in good condition and functional, retaining the hillside below an existing road which would be kept as part of the preferred roading option, RD3. It is also adjacent to an archaeological authority area (hill feature). Any safety concerns could be addressed by installing some handrails along sections over 1m high.

10.3.2 Roading

The scorings are summarised in Table 25. They show:

- The preferred option is RD3 (56% roading/paving removed) with a total score of 1063.
- The second preferred option is RD2 (80% road/paving removal) with a total score of 438.
- The third preferred option is Rd1 (100% roading/paving removal) with a total score of 115.

The selection hierarchy of RD3 > RD2 > RD1 as the most preferred option is primarily controlled by the environmental, social and economic criteria, as there are multiple benefits to retaining a significant portion of the existing roading network, compared with nothing at all. The RD4 Addon of removing the redundant road embankment scored strongly positive (1245 points), as this was seen as having multiple benefits across all criteria.

4Sight have advised that Options RD1-RD3 will all require an earthworks consent under the Waipa District Plan for a discretionary activity (as volume >1000m^3). No consents are required under the Waikato Regional Plan. An additional consent is likely to be required for any works in close proximity to a wetland under the NES-Freshwater – this may apply to RD1, RD2 and to a lesser extent RD3. It should be viable to obtain consents by November 2024, as no significant investigation or design work are required for these options, other than possibly identifying a suitable onsite borrow source for backfill material.

For RD4, an earthworks consent for a discretionary activity will be required under the Waipa District Plan. The option can likely be undertaken as a permitted activity under regional and national planning rules, but it is recommended that a pre-application meeting be held with Waikato Regional Council to check whether the culvert removal triggers consent under the Regional Plan or NES-Freshwater.

Table 25: Evaluation Summary – Roading/Paving

Criteria	RD1	RD2	RD3	RD4 Addon
Description	All roading/paving (100%) removed	Most roading/paving (80%) removed	Moderate roading/paving (56%) removed	Removal of Culvert 2 road embankment
	Weighted Scores			
Environmental	158	210	403	420
Social	-200	-80	180	210
Cultural	240	255	270	540
Economic	-83	53	210	75
Total	**115**	**438**	**1063**	**1245**
Ranking	3	2	1	N/A
Deliverability Assessment				
Significant Constraints	No	No	No	No
Consentability	Yes	Yes	Yes	Yes

10.3.3 Trunk Stormwater

The scorings are summarised in Table 26. They show:

- The preferred option is SW2B (pipe lining) with a total score of 1033.
- The second preferred option is SW2A (pipe replacement/upgrading) with a total score of 180.
- The third preferred option is SW1 (stream restoration) with a total score of -98.

The selection hierarchy of SW2B > SW2A > SW1 is consistent across each of the criteria evaluated. SW2B involves minimal ground disturbance, no real traffic movements and will extend the pipe system lifetime by 50+yrs. SW1, whilst restoring the stream system, involves significant earthworks and associated heavy machinery/vehicle movements and results in some loss of land to other use.

Option SW1 is also considered to have some significant constraints and risks. It is a larger, more complex project than the SW2 options, with a significant design component to complete before November 2024 to enable consents to be lodged by then.

4Sight Consulting have advised that an earthworks consent will be required for SW1 as a discretionary activity under the Waipa District Plan and a non-complying activity under Regulation 54 of the NES-Freshwater, due to the works being in close proximity to wetland features onsite. However, 4Sight advise that returning the waterways to their natural state would be a favourable option although not expressly provided for by the current regulations.

SW2A will likely also be a discretionary activity under the Waipa District Plan (but further investigation is required to check whether these works considered are considered to be maintenance or upgrade activities) and a non-complying activity under the NES-Freshwater, due to works being in close proximity to wetland features onsite.

In contrast, it is likely that SW2B will not require any consents other than possibly for a temporary stream diversion during the works. This means it should also be the easiest option to deliver.

Table 26: Evaluation Summary – Trunk Stormwater

Criteria	SW1	SW2A	SW2B
Description	Stream restoration	Pipe replacement and upgrade	Pipe Lining
Weighted Scores			
Environmental	18	53	385
Social	-70	0	340
Cultural	105	165	255
Economic	-150	-38	53
Total	**-98**	**180**	**1033**
Ranking	3	2	1
Deliverability			
Significant Constraints/ Risks	Yes	Minor (future liability)	Minor (future liability)
Consentability	Likely (non-complying activity)	Likely (non-complying activity)	Yes (temporary stream diversion during works)

10.3.4 Concrete Ducting

The scorings are summarised in Table 27. They show:

- The preferred option is CD1 (complete removal of all concrete ducting) with a total score of 518.
- The second preferred option is CD2 (partial removal – pipework only with concrete ducting retained) with a total score of 293.

The selection of Option CD1 over CD2 as the most preferred option is primarily controlled by the social, cultural and economic criteria. One factor making CD2 difficult to score is that there is no current proposal on how these ducts might be reused – it could potentially score better if a reuse purpose was known.

Option CD1 would require a resource consent for excavation works and backfill material (if sourced from onsite) if the combined volume exceeds 1000m^3 as a discretionary activity under the Waipa District Plan. Option CD2 is less likely to be required in this case, depending on the pipework removal methodology.

Table 27: Evaluation Summary – Concrete Ducting

Criteria	CD1	CD2
Description	Complete concrete ducting removal	All piping within ducting removed, but ducting and access chambers retained
Weighted Scores		
Environmental	0	70
Social	120	80
Cultural	270	75
Economic	128	68
Total	**518**	**293**
Ranking	1	2
Deliverability		
Significant Constraints/Risks	No	No
Consentability	Yes	Yes (if required)

10.3.5 Other Services

The scorings are summarised in Table 28. They show:

- The preferred option is OS2C (partial removal) with a total score of 595.
- The second preferred option is OS1 (full removal) with a total score of 513.

The difference in the scoring is relatively marginal in this case, with selection of Option OS2C over OS1 being primarily due to the environmental and economic indicators.

Both options have no significant constraints/risks.

Option OS1 would likely require an earthworks consent for excavation works associated with pipes and structures removal if disturbance volume is over 1000m^3 as a discretionary activity under the Waipa District Plan. Option OS2C is less likely to require a resource consent, as disturbance volumes should be under this threshold.

Table 28: Evaluation Summary – Other Services

Criteria	OS1	OS2C
Description	Complete removal	Partial removal down to 800mm depth + structures down to 1m depth + all AC piping
Weighted Scores		
Environmental	0	35
Social	40	80
Cultural	360	300
Economic	113	180
Total	**513**	**595**
Ranking	2	1
Deliverability		
Significant Constraints/ Risks	No	No
Consentability	Yes	Yes (if required)

11.0 SUMMARY AND CONCLUSIONS

The assessment undertaken shows that the preferred options for the different infrastructure groupings evaluated are:

- RD3: Partial (56%) removal of all roading/paving and conversion of residual paving to farm access track standard.
- RD4 Addon: Additional removal of a redundant road embankment and the associated culvert 2.
- RW1: Keeping an existing small retaining wall which is in good condition and retains a portion of hillside below a road which is to be kept as part of Option RD3.
- SW2B: Lining of the existing trunk stormwater system to extend its lifetime by at least 50 years.
- CD1: Complete removal of the concrete ducting system.
- OS2C: Partial removal of all other services, involving the removal of all asbestos pipework and other services down to 800mm depth and associated structures down to 1m depth. Complete removal of all services scored only slightly less.

Any infrastructure removal works (including associated backfilling) involving volumes exceeding 1,000m^3 will require an earthworks resource consent for a discretionary activity from Waipa District Council. An additional consent is likely to be required for any works in close proximity to a wetland under the NES-Freshwater, with the potential for this to be a non-complying activity depending on the nature of the works. Consent may also be required for temporary stream diversions during the trunk stormwater works and for stream bed disturbance associated with removal of the redundant road embankment.

This report is based on the best information, currently available at the date of issuing this report. It is considered sufficient for Te Nehenehenui to provide an informed view (as per paragraph 9.11) and for LINZ to then obtain a decision from Ministers on the extent of infrastructure to be retained onsite as provided at paragraph 9.9.2 of the THDSP.

12.0 LIMITATIONS

The professional opinion expressed herein has been prepared solely for, and is furnished to our client, Toitū Te Whenua – Land Information New Zealand, on the express condition that it will only be used for the purpose for which it is intended.

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