Sensitivity: General

Southern Wastewater Treatment Plant Discharge Options

Long List Report

Prepared for Hamilton City Council
Prepared by Beca Limited

7 August 2025

Contents

Appendices

Revision History

Revision N°	Prepared By	Description	Date
1	Farza Feizi, Petar Druskovich	Draft for Client Review	14/03/2025
2	Petar Druskovich, Farza Feizi	Final Report	07/08/2025

Document Acceptance

Action	Name	Signed	Date
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on behalf of	Beca Limited		

Executive Summary

The Waikato region is undergoing significant urban, industrial, and commercial growth, increasing demand on existing wastewater infrastructure. To address this, the Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) was developed, identifying a preferred option to manage wastewater from the southern part of the Waikato-Hamilton-Waipā metro area. A key component of this plan is the construction of a new Southern Wastewater Treatment Plant (SWWTP), which would service future development in southern Hamilton, the Waikato Regional Airport, and northern Waipā.

The Southern Metro DBC process included a site selection process to identify a preferred broad location for the SWWTP in the area immediately to the south of Hamilton. This short-list and site feasibility investigation concluded in August 2024 and recommended the preferred site for the SWWTP as a site that is owned by Hamilton City Council (HCC) between Peacockes Road and Raynes Road (Sharpe Farm).

The SWWTP is planned to be developed in stages, eventually serving a Population Equivalent (PE) of up to 200,000. The Southern Metro DBC assumed a land discharge for Stage 1, transitioning to river discharge from Stage 2 onwards, subject to further technical investigations as part of resource consent processes. HCC will seek consents for Stages 1 to 2b, covering up to 18,000 (PE) and an average daily flow of 3,600 m^3/day at the end of stage 2b. Commencement flows at stage 1 are estimated to be 400 m^3/day increasing to 1,900 m^3/day at the end of stage 2a.

Beca Ltd (Beca), on behalf of HCC, has conducted various investigations into alternative discharge options for the SWWTP, building on previous work, to assess the long-list options for the SWWTP which will inform the resource consent process. This work will reassess the broad assumptions made at the Southern Metro DBC with regards to discharge options.

This report assesses the technical feasibility of different discharge methods based on the projected flows outlined above and summarises the decision-making process with the Wastewater Kaitiaki Roopuu (established in November 2022) which builds on previous phases of the Southern Metro DBC programme of work.

As part of this report the following discharge methods have been assessed:

- Discharge to surface waterways
- Discharge to land (slow rate irrigation and rapid infiltration)
- Discharge to restored/constructed wetland
- Discharge to groundwater via deep bore injection
- Discharge to ocean outfall
- Reuse - potable and non-potable uses

A multi-criteria analysis (MCA) was carried out to assess each option against five categories: public health, environment, social and community, physical and constructability, and alignment with Te Ture Whaimana o te Awa o Waikato. Three in-person workshops were held with HCC and the Wastewater Kaitiaki Roopuu. Based on the long-list assessment and workshop feedback, the following shortlisted discharge methods will progress to the next phase of investigation:

- Discharge to the main stem of the Waikato River (either through a constructed wetland or naturalised discharge structure)
- Discharge to Surface Waterways – Potentially Nukuhau Mainstem (either through a constructed wetland or naturalised discharge structure)
- Discharge to land (rapid infiltration)
- Beneficial reuse at the Sharpe Farm site (including landscape irrigation and reuse within the wastewater treatment process)

1 Introduction

1.1 Background

The Waikato region is undergoing significant urban, industrial, and commercial growth, increasing demand on existing wastewater infrastructure. To address this, the Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) was developed, identifying a preferred option to manage wastewater from the southern part of the Waikato-Hamilton-Waipā metro area. A key component of this plan is the construction of a new Southern Wastewater Treatment Plant (SWWTP), which would service future development in southern Hamilton, the Waikato Regional Airport, and northern Waipā.

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The options considered in this Report include the following long-list discharge alternatives:

- Discharge to water:
  - Main stem of the Waikato River
  - Surface waterways – streams/drains draining to Waikato River
  - Constructed/restored wetland
- Discharge to land:
  - Rapid infiltration
  - Slow rate irrigation
- Discharge to groundwater – deep bore injection
- Discharge to coast–ocean outfall
- Reuse

1.2 Purpose of This Report

This report assesses conceptual long-list discharge options for the SWWTP and recommends those to be taken forward to a more detailed short-list assessment based on specific criteria. The process of developing and assessing the long-list options was undertaken with the established Wastewater Kaitiaki Roopuu for the SWWTP project that has been active through the earlier Southern Metro DBC phase of the project.

The report outlines the methodology used to develop and assess the long list of options, including a summary of previous and new investigations related to potential alternative discharge options and the existing environmental context. This report also summarises the feedback received during hui held with the Kaitiaki Roopuu. The diagram below (Figure 1) illustrates the optioneering process for the long-list discharge options documented in this report.

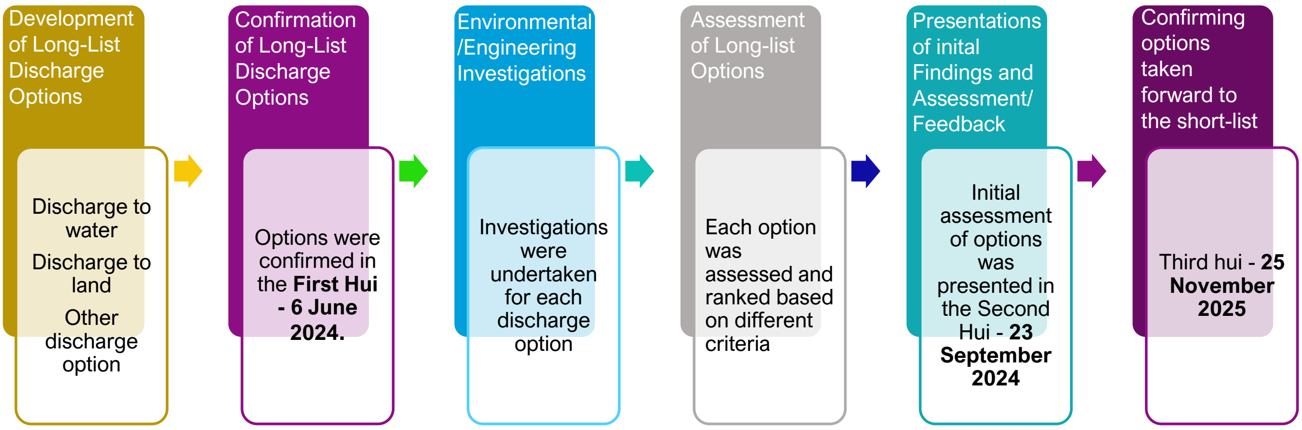


Figure 1. Diagram of the optioneering process for Confirming Shortlisted Options.

1.3 Information Reviewed

The documents listed below have informed the long-list investigation presented in this report and form the technical appendices:

- Waikato Baseline Water Quality Assessment - Southern Wastewater Treatment Plant, Beca Ltd, 2nd August 2024.
- Alternative Surface Water Discharge Investigation - Southern Wastewater Treatment Plant, Beca Ltd, 16th August 2024.
- Southern Wastewater Treatment Plant – Discharge to Wetland Feasibility Assessment, Beca Ltd, 14th August 2024.
- Southern Wastewater Treatment Plant Land Discharge Options Assessment: Land Feasibility Assessment, Beca Ltd, 16th August 2024.
- Southern Wastewater Treatment Plant – Deep Bore Injection High-Level Investigation, Beca Ltd, 9th August 2024.
- Southern WWTP Coastal Discharge Memorandum, Beca Ltd, 5th July 2024.
- Investigation Of Feasible Options For Reuse Of Treated Wastewater: Southern Wastewater Treatment Plant Long List Development, Beca Ltd, 16th August 2024.

2 Description of the Proposed Southern Wastewater Treatment Plant

2.1 Southern Wastewater Treatment Plant

Given that regional resource consents will only be sought for stages 1 to 2b (up to 18,000 PE or 3,600 m³/day), the predicted discharge flows for these stages have been used to investigate various discharge options (see Table 1). The Southern Metro DBC assumed Stage 1 would utilise a Sequencing Batch Reactor (SBR) treatment technology with land discharge, while Stage 2 will employ Membrane Bioreactor (MBR) technology with discharge to the Waikato River. As discussed earlier in this Report, this work is reassessing these high-level assumptions on the preferred discharge options discharge option made through the DBC.

Further work is proposed on the concept design of the WWTP process and staging which will revisit the treatment assumptions made in the Southern DBC noting the level of treatment is dependent upon the preferred discharge option.

Table 1. SWWTP Concept Staging (as per Southern Metro DBC)

Description		Serviced area	Starting demand	Cumulative Capacity
Stage 1	SBR* with discharge to land	Airport precinct	400 m^3/day (2,000 PE)	1,000 m^3/day (5,000 PE)
Stage 2a	MBR** with discharge to Waikato River	Airport precinct and Maatangi / Tamahere commercial areas	1,200 m^3/day (6,000 PE)	1,900 m^3/day (9,500 PE)
Stage 2b	MBR with discharge to Waikato River (additional reactors and membrane equipment)	Airport precinct, wet industry and Maatangi /Tamahere commercial areas	3,600 m^3/day (18,000 PE)	3,600 m^3/day (18,000 PE)

* SBR treatment technology with land disposal was proposed for the first stage through the Southern Metro DBC. This technology provides flexibility in terms of flows and load and will provide effluent quality that is suitable for application into or onto land. SBR is able to stop solids to reduce organic matter found in wastewater, which is done over a number of cycles, depending on the size of the tank.

** MBR treatment technology with discharge to water was proposed for the second stage through the Southern Metro DBC. MBR systems are aerobic activated sludge biological reactors, which combine the biological degradation process, known as "activated sludge", with solid-liquid separation by membrane filtration. This process results in high-quality effluent with low levels of suspended solids, pathogens, and nutrients

2.1.1 Project Objectives

The overarching Programme Objectives are set out in the Southern Metro DBC and state:

1. Before 2050 municipal wastewater discharges are no longer impacting on the ability of people to swim and collect kai from the Waikato River and connected waterways, thereby contributing to the restoration and protection of the health and wellbeing of the river.
2. The quality and extent of aquatic and terrestrial habitat and biodiversity in and around water bodies is enhanced through the reduction of wastewater treatment and discharge impacts before 2050.
3. Wastewater treatment solutions contribute to restoring and enhancing cultural connectivity/relationships with the river so that, before 2050, marae, hapū and iwi access to the river and other sites of

significance for cultural and customary practice within the Metro Area are no longer impeded by wastewater treatment solutions.

4. Maximise efficient use of resources and resource recovery to contribute to net zero greenhouse gas related emissions from wastewater treatment systems before 2050.
5. The wastewater solution provides sufficient capacity to ensure sustainable growth in the Metro Area in accordance with growth projection assumptions for the next 100 years.

These overarching Southern Metro DBC objectives have been translated into Project-specific objectives for the assessment of alternative discharge options. These objectives are:

1. To implement and operate a wastewater treatment and discharge solution for the south of Hamilton City, Airport, and northern Waipā District that contributes to the restoration and protection of the health and wellbeing of the river.
2. To seek restoration opportunities to enhance the quality and extent of aquatic and terrestrial habitat and biodiversity in and around the WWTP and discharge location.
3. To support mana whenua outcomes by taking a tikanga based approach from site selection through to operation.
4. Maximise efficient use of resources and resource recovery to contribute to net zero greenhouse gas related emissions from the wider Metro wastewater network.
5. To provide sufficient wastewater treatment and discharge capacity to enable sustainable and flexible growth in the south of Hamilton City, Airport, and northern Waipā District in accordance with growth projection assumptions.

2.2 Preferred Locations for the Wastewater Treatment Plant

The Southern Metro DBC process included investigating the area immediately south of Hamilton to identify a preferred location for the SWWTP. The 2024 Assessment of Alternative Sites Report undertaken by Beca further refined the locations identified in the Southern Metro DBC to four shortlisted sites. Using a multi-criteria analysis (MCA), Site 1 (Sharpe Farm) scored the highest, and was subsequently identified as the preferred option following the technical MCA process and the Tangata Whenua Effects Assessment Report (TWEAR) findings[1]. Sharpe Farm is described in Table 2 and shown in Figure 2 below.

Table 2. Description of the preferred sites for the SWWTP.

Site Name	Site Address	Site Owner	Area of Site	Title	Legal Description
Sharpe Farm (Site 1)	Raynes Road, Rukuhia	HCC	34.2 ha (two blocks which have an area of 19.35 ha and 14.85 ha).	SA72C/450	Lot 5-6 DPS 91837

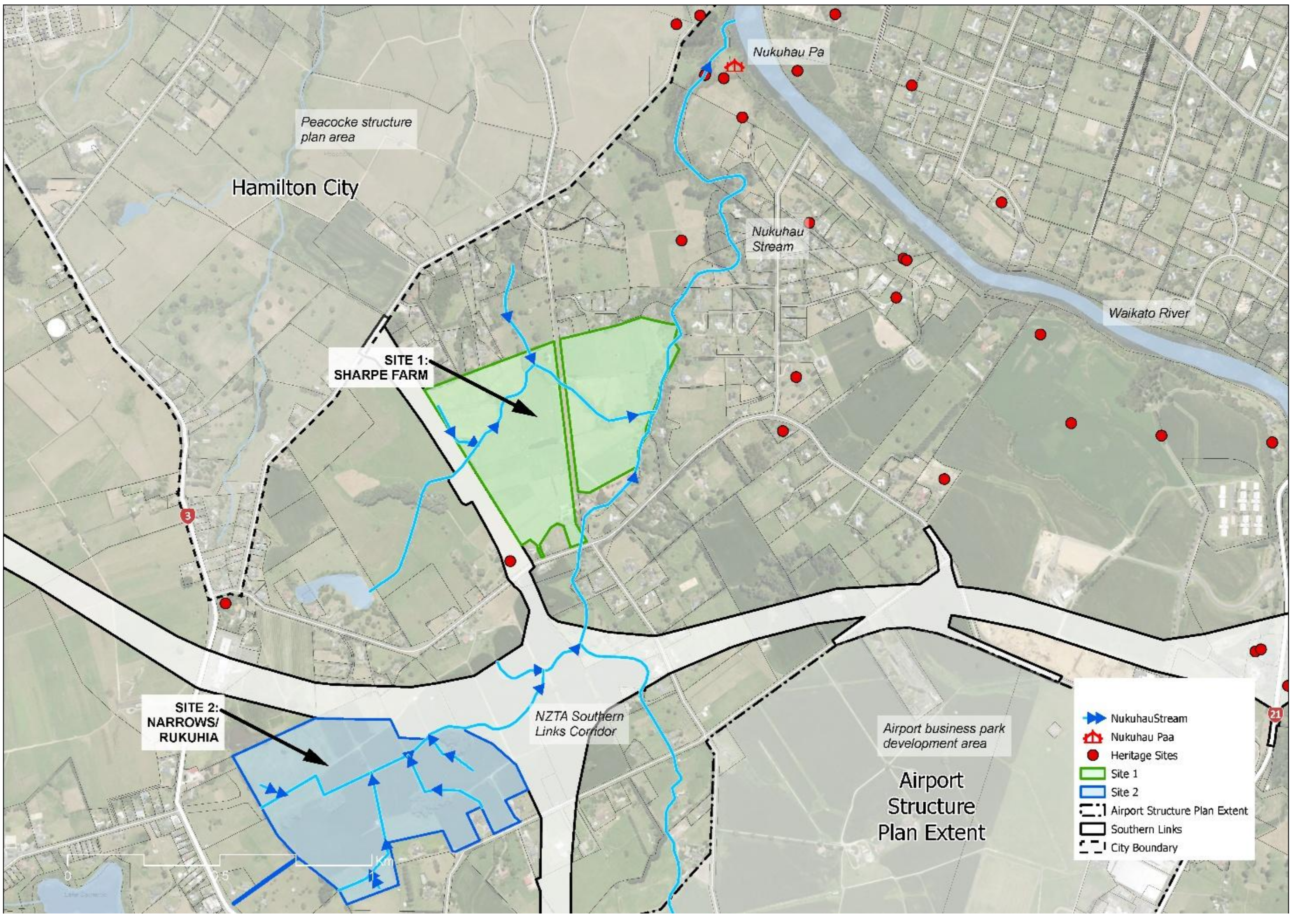


Figure 2. The preferred site for the Sothern WWTP (Site 1). Note Hamilton City Council boundary to the north/west, Southern Links designation to the west and south and Waikato River to the east (Source: Southern Wastewater Treatment Plant Assessment of Alternative Sites, Beca, 2024).

[1] Southern Wastewater Treatment Plant, Assessment of Alternative Sites, Beca, August 2024.

2.3 Proposed Treated Wastewater Quality

There is currently a wide variety of standards for treated wastewater discharge quality in the region due to the use of different technologies. A Memorandum of Understanding (MoU) was signed by the DBC Project Partnership Group[2] in April 2023, which established the minimum performance standards to be achieved by the projects in the Metro WW DBC (Northern/Southern). The agreement recommends adopting a consistent standard of treated wastewater quality for all WWTP discharges to water. These uniform standards should be implemented by 2031 or when the existing resource consents for discharge expire.

As described in the Southern Metro DBC MoU[3], the minimum Performance Standards considered for discharge to water are listed in Table 3.

Table 3. Agreed Southern Metro DBC MoU[2] minimum performance standards for discharge to water.

Parameter		Minimum Performance Standards for Discharge to Water	Minimum Performance Standards for Discharge to Land
Total Nitrogen (TN) (mg/L)	Annual Mean	<4.0	<20
Total Phosphorus (TP) (mg/L)	Annual Mean	<1.0	No specific limit
E. coli (cfu/100mL)	95th Percentile	<14	<500

The Water Services Authority – Taumata Arowai, has a released a discussion document on proposed wastewater environmental performance standards[4]. Hamilton City Council has prepared its submission on the draft wastewater discharge standards proposed by Taumata Arowai. The draft standards as proposed would result in a lower discharge quality than the Metro Wastewater Project Partners have committed to through the Programme Memorandum of Understanding. On 27 March 2025, the SWWTP Governance Group resolved to continue concept and preliminary design of the new WWTP to the higher MoU standards. This will be revisited once the proposed wastewater discharge standards are finalised by Taumata Arowai.

[2] The Project Partnership Group (PPG) comprises two representatives appointed by Waipa DC, 2 representatives appointed by Waikato DC, 2 representatives appointed by HCC, 6 representatives of Tangata Whenua, 2 of which appointed by Waikato-Tainui.

[3] The Hamilton-Waikato Southern Metropolitan Area Wastewater Detailed Business Case Preferred Option Report, Metro Wastewater Project Partners, May 2022.

[4] Consultation on proposed wastewater environmental performance standards discussion document, Taumata Arowai, February 2025.

3 Description of Long List Discharge Options

To inform the long-list options report, assessments have been undertaken to inform the technical feasibility of six discharge options. The following options have been considered in the long-list assessment options:

- Discharge to water:
  - Main stem of the Waikato River
  - Surface waterways – streams/drains draining to Waikato River
  - Constructed/restored wetland
- Discharge to land:
  - Rapid infiltration
  - Slow rate irrigation
- Discharge to groundwater – deep bore injection
- Discharge to coast–ocean outfall
- Reuse

This section provides a brief overview of the discharge methods listed above, as well as generalised constraints and advantageous.

3.1 Discharge to surface waterways

A significant proportion (approximately 45%) of wastewater treatment plants (WWTPs) in Aotearoa, New Zealand currently discharge treated wastewater to surface water[5]. Given the sensitivity of surface water as a receiving environment, discharge to surface water raises a range of social, cultural, and environmental concerns. These concerns necessitate the implementation of best practice approaches to minimise adverse effects on ecosystems and human health. When applied appropriately, discharge to surface water approaches can support ecosystem recovery, uphold cultural values, and contribute to more sustainable and adaptive wastewater management practices.

In the case of this long-list assessment, discharge to surface water has been considered via a constructed naturalised solution. An example of this is seen in the Cambridge WWTP, which uses a naturalised bankside structure to discharge treated wastewater into the Waikato River (Figure 3). While constructed bankside outfalls, such as that used by the Cambridge WWTP offer a method of discharge to surface water which avoids extensive in-river infrastructure, such as the Pukete WWTP outfall and diffuser (see Figure 3)These types of outfall/diffuser in-river structures have not been considered in this report given the general culturally offensive nature of structures in the bed of the River. This was confirmed at the first hui with the Kaitiaki Roopuu on 6 June 2024.

[5] The New Zealand Wastewater Sector, Prepared for Ministry for the Environment, October 2020.

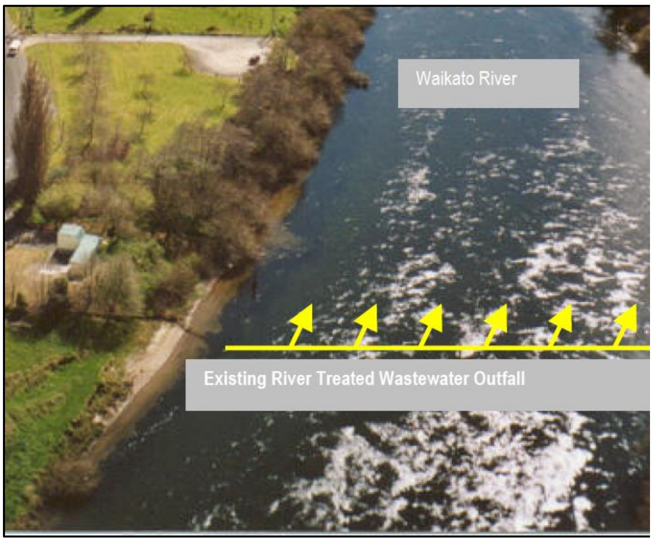


Figure 3. Images of naturalised bank-side outfall constructed for Cambridge WWTP (left) and Pukete constructed outfall (right).

Loudoun Water in Ashburn, Virigina, USA, provides a good international example of discharge to water via naturalised solutions. In this case, wastewater is treated to an extremely high standard and is discharged back into the environment via a rocky swale, containing a range of wetland plantings to create a natural stream effect, and to enhance the landscape (Figure 4).

Figure 4. Photo of naturalised discharge point from Loudoun Water in Ashurn, Virgina, USA.

While such naturalised methods of discharge do not offer any further significant natural treatment process benefits, the presence of such structures can assist in managing soil erosion and sediment, as well as promoting ecological health in waterways, providing amenity value and assist in positive public perception and education around highly treated wastewater discharges.

3.2 Discharge to land

Discharge to land discharge methods is adopted by approximately 34% of WWTPs across New Zealand (based on 2020 reporting). Consideration has been given to both rapid infiltration (RI) and slow rate infiltration (SRI) methods of discharge to land in the long-list assessment.

3.2.1 Rapid Infiltration

Rapid infiltration (RI) enables the discharge of significant volumes of treated wastewater onto relatively small areas of land (Figure 5). Treated wastewater is typically applied to shallow earthen basins, where it filters through the soil and eventually enters groundwater or nearby surface water. While RI is a low-cost, low-maintenance option, its use is limited by the need for specific site conditions—including highly permeable soils, minimal slope to avoid overland flow, and sufficient distance from bores and shallow groundwater. RI has been adopted by a number of wastewater treatment plants across New Zealand, including at Cambridge, Twizel, Te Paerahi and Rotoiti-Rotomā.

Figure 5. Examples of rapid infiltration beds (former RI beds at Cambridge WWTP on the right)

3.2.2 Slow Rate Irrigation

Slow Rate Irrigation (SRI) refers to the slow and controlled application of treated wastewater to a given land block, typically used for pasture, forests, and a variable of crops if the wastewater has been treated to a high enough standard. The rate of application used will typically be designed to maximise the removal of wastewater from the site via evapotranspiration and percolation, while reducing the chance of surface water run off as much as possible.

The two methods explored in the long-list assessment are sub-surface drip irrigation (SDI) and surface spray (Figure 6). The image on the left of Figure 6 shows an example of SDI at the Omaha Golf Course, which is a low pressure, highly efficient irrigation method, which allows for a high level of control over the volume and distribution. The image of the right of Figure 6 is an example of surface spray irrigation via a low pressure Centre Pivot irrigation system suitable for large landholdings.

Figure 6. Examples of sub-surface drip irrigation (left), and surface spray irrigation via Centre Pivot (right).

3.3 Discharge to restored/constructed wetlands

Wetlands can provide a cost-effective method for removing a range of pollutants from wastewater through physical settling, filtration, and biological processes. Similar to the natural treatment processes involved in surface water discharge (see Section 3.1), a constructed or restored wetland typically includes a naturalised area planted with native vegetation (Figure 7). Vegetation plays a crucial role in stabilising slopes, controlling erosion, and polishing the effluent by further removing suspended solids. However, these systems generally offer limited additional nutrient removal in the long term. If poorly maintained wetlands can add nutrients and other contaminants to treated wastewater from birdlife and ongoing maintenance requirements need to be considered.

Figure 7. Example of discharge to constructed wetland method.

3.4 Other Discharge Methods

3.4.1 Deep bore injection

Deep bore injection (DBI) is a relatively uncommon method of treated wastewater discharge, involving the injection of treated wastewater into deep, porous geological formations. This approach aims to minimise the risk of adverse effects on drinking water sources or surface water bodies by placing the discharge well below any connected groundwater systems (see Figure 8). In New Zealand, DBI has only been used in a limited number of industrial applications for stormwater and wastewater, with no known examples in municipal wastewater systems. The closest comparable case is at the Russell WWTP, which discharges treated effluent via shallow bore injection.

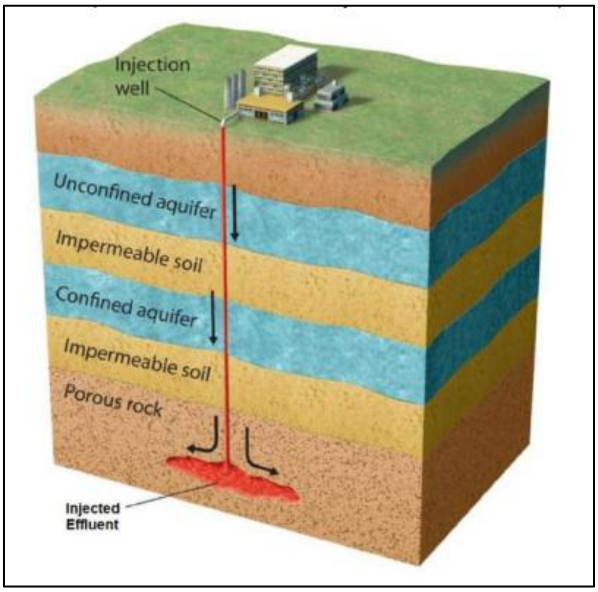


Figure 8. Visual representation of deep bore injection.

3.4.2 Discharge to coastal outfall

The coastal outfall method involves discharging treated wastewater directly into a coastal marine environment via an ocean or harbour outfall pipe. In this approach, treated wastewater is conveyed through a rising main to a designated outfall location, where it is released during the outgoing tide to maximise dilution and minimise potential impacts on sensitive coastal ecosystems and recreational water users. While coastal outfalls can be effective in dispersing treated effluent, they are typically associated with high capital and maintenance costs, complex consenting processes, and a high degree of public and cultural sensitivity.

3.4.3 Wastewater Re-use

Wastewater re-use (also referenced to as recycling or reclaimed water), is wastewater that has been treated to a high enough standard that it can be reused for a variety of purposes. Most commonly, the result is a discharge to land process, with highly treated wastewater being used for irrigation of pasture, parks, or crops. In New Zealand, this is commonly the case with golf courses, with a number of golf courses across the country receiving treated wastewater and using it for irrigation. An example of this is Omaha Golf Course, where Figure 9 shows the beneficial effects that has been achieved by applying highly treated wastewater to the fairway via sub-surface drip irrigation.

Figure 9. Omaha Golf Course – Subsurface drip irrigation of fairway (in the background) vs. unirrigated fairway (in the foreground).

There are also cases of highly treated wastewater being recycled for use in public gardens. Example of this being Whangarei District Council, which uses treated effluent for irrigation of garden beds, trees, and sports fields in its district.

Highly treated wastewater can offer a range of benefits for construction activities and industrial use. Wet industries are potential candidates for reuse applications. This could include shipping container washing facilities, or industries which use cooling towers. Where treated wastewater is used for industrial purposes, the final discharge point of that water should be carefully considered to avoid cumulative adverse effects on the receiving environment. Reuse of wastewater for construction is a further consideration and may involve replacing potable water used for concrete production with treated wastewater. It may also involve use of water for dust suppression. A key example of this occurring in New Zealand is the construction of Watercare's central interceptor. Sustainability was a key driver for this project and one of the sustainability innovations employed was the reuse of wastewater for construction water, reducing the demand on potable water supplies[6].

Regardless of the reuse application, careful consideration must be given to the quality of the treated wastewater, the method of application, and the potential risks to human and environmental health. While high-quality treatment technologies such as membrane bioreactors (MBRs) can significantly reduce contaminants, there may still be trace levels of chemical or microbial constituents that pose a risk through pathways such as runoff, splashback, or human contact. Reuse should therefore be supported by appropriate management plans and risk assessments to ensure protection of workers, the public, and the receiving environment.

[6] From concept to reality: The central interceptor sustainability journey, Philpott, O. and Cunis, S. (Watercare Services Limited).

4 Sustainability Factors

Of primary concern to HCC is the practical suitability of each option considered in this long-list process. Affordability and climate change have both been highlighted as key challenges within the HCC Annual Plan 2024-2034[7]. Understanding how the discharge methods being considered in this process will interplay with these suitability factors is crucial. As highlighted by the sections below, these factors have been considered through the MCA and detailed assessment process; however, more detailed consideration will need to be given to discharge methods taken carried through to the short-list process.

4.1.1 Flood Hazards and Climate Change

The Waikato region is experiencing more and more extreme weather events as a result of climate change. These climatic changes will impact the infrastructure and water services of the Waikato region, making it a key consideration when discussing new wastewater service or infrastructure options. To address this in the long-list assessments, the Waikato Regional Council (WRC) Scale Flood Hazard map and the Waipā District Plan flood areas have been considered as exclusion zones. While not completely addressing the concerns of flood hazards and climate change, these inclusions mitigate the potential of the chosen solution being suspectable to flood risk (with respect to discharge solutions).

4.1.2 Operational Efficiency

During the more detailed assessment of each discharge method, the assessment of each site's limitations was included. These assessments highlight the physical barriers for the discharge occurring at that particular site (i.e. in the case of discharge to surface water steep banks and dense vegetation leading to limited accessibility), as well as economic limitations (i.e. if the land parcel would need to be acquired, the distance from the SWWTP location). This high-level review for each site assesses how feasible discharge to a particular location would be and the factors that would need to be mitigated or impede operational efficiency.

[7] 2024-2034 Long-Term Plan – Ka hua. Ka puaawai. Ka ora. Volume 1, Hamilton City Council, July 2024.

5 Technical Investigations

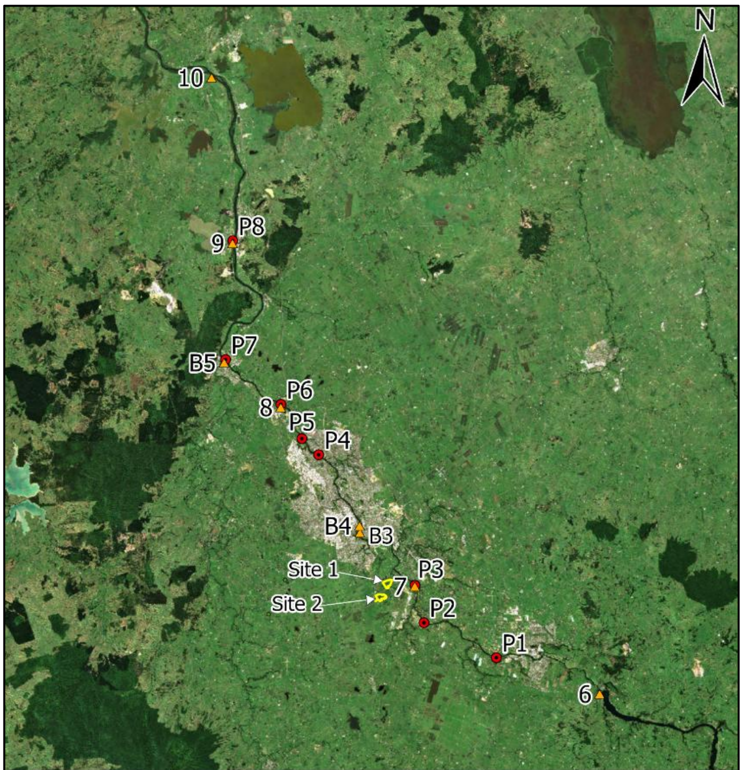
The following section provides a summary of each technical report produced to inform the long-list assessment processes.

5.1 Waikato River Baseline Water Quality and Ecology Assessment

Beca has conducted evaluations of the Waikato River to identify potential discharge locations to support the assessment of options during the long list phase.

To assess the potential implications of the potential discharge of treated wastewater to the Waikato River, a baseline assessment of the water quality of the Waikato River was undertaken to evaluate the sensitivity of the wider receiving environment for the proposed discharge. Waikato Regional Council has long-term monitoring sites at several locations on the Waikato River.

The analysis focused on the exiting water quality data of three sites (Hamilton-Narrows (7) and Narrows Boat Ramp (P3), both of which are upstream of the potential discharge site, and Flagstaff Park (P4), which is downstream of the potential discharge. These sites are part of Waikato Regional Council's long-term monitoring programme and have over 25+ years of data. Data was collected from seven further monitoring sites to fill in spatial gaps in the long-term records (Figure 10).



Name	Number	Name	Number
Pukerimu Water Intake	P1	Karapiro Tailrace	6
Mystery Creek Jetty	P2	Hamilton-Narrows	7
Narrows Boat Ramp	P3	Hamilton (Wellington St)	B3
Flagstaff Park	P4	Hamilton (Sewer Bridge)	B4
Pukete Boat Ramp	P5	Horotiu Bridge	8
Horotiu Bridge	P6	Ngaruawahia Bridge	B5
Ngaaruawahia Bridge	P7	Huntly (Tainui Bridge)	9
Huntly Bridge	P8	Rangiriri	10

Figure 10. Proposed sites for the SWWTP, WRC long-term water quality monitoring locations, and water quality locations monitored by Beca.

The data shows that both upstream and downstream monitoring locations exceeded their relative PC1 Short-term and 80-year median attribute states for nutrients (including total nitrogen (TN), total phosphorus (TP)) and microbiology (*Escherichia coli (E. coli)).*

- The recent three months of monitoring (February 2024 to May 2024) found the following:
- There was no difference in phosphorus (Dissolved reactive phosphorus (DRP) and TP) concentrations between the upstream (P3) and downstream (P4) monitoring locations.
- *E. coli* concentrations were higher downstream than in the upstream monitoring location.
- Toxicant (NH_4-N) concentrations were slightly higher at the upstream (P3) when compared to the downstream (P4) monitoring location.

Contaminant concentrations downstream of the future SWWTP discharge are predicted using mass balance calculations. According to the mass balance calculations, considering the low discharge volume at stage 2b (3,600 m^3/day with an 18,000 PE equivalent) and high dilution factor in the Waikato River, there was a negligible percentage increase (<1.5%) in contaminant concentrations under both average river flow and low river flow conditions. Therefore, the overall effects of the potential discharge on contaminant concentrations are considered to be negligible for Stage 1 and Stage 2b.

Estimations of mass load contributions were undertaken to understand the relative contribution of nutrients from the SWWTP to the wider Waikato River. The predicted nutrient loads to the Waikato River from the future SWWTP are relatively low and will contribute <1% of the nutrient loads in the Waikato River for both Stage 1 and Stage 2b. Merging the SWWTP consent process with the Pukete WWTP or implementing offsetting strategies are potential approaches to prevent nutrient loads from exceeding the baseline by reducing contaminants elsewhere in the catchment. The specific offsetting activities would need to be assessed, which could include planting on erosion-prone land and restoring riparian areas, in alignment with the goals of Te Ture Whaimana.

Additional investigation is recommended to confirm the exact discharge location (including establishing the most appropriate methodology). In addition, if surface water discharge is chosen as the preferred discharge location, undertaking ecological and further water quality investigations will be necessary to understand the impacts of treated wastewater discharge on the Waikato River.

5.2 Investigation Of Alternative Surface Water Discharge Options

Potential alternative surface water discharge options (to the Waikato River) were investigated as part of the broader discharge alternatives assessment. Surface water bodies within 15km of the WWTP site were initially identified, then subjected to an initial exclusion process which excluded:

- Land within identified flood hazard areas to minimise potential direct impacts on infrastructure but also potential contamination risks.
- Surface water bodies located on the other side of the Waikato River, due to the challenges and cost associated with the conveyance pipelines required to cross the Waikato River.

Given the cost associated with pipeline construction and the practicalities of discharging closer to the WWTP site, potential surface water discharge locations within 5 km of the SWWTP site were prioritised.

Five surface water bodies and ten sites were then selected for the assessment stage which included site visits of the waterbodies with observations being made from public land. The shortlisted waterbodies and the publicly accessible locations are shown in Figure 11. These sites were investigated during a site visit to assess their suitability as potential discharge locations.

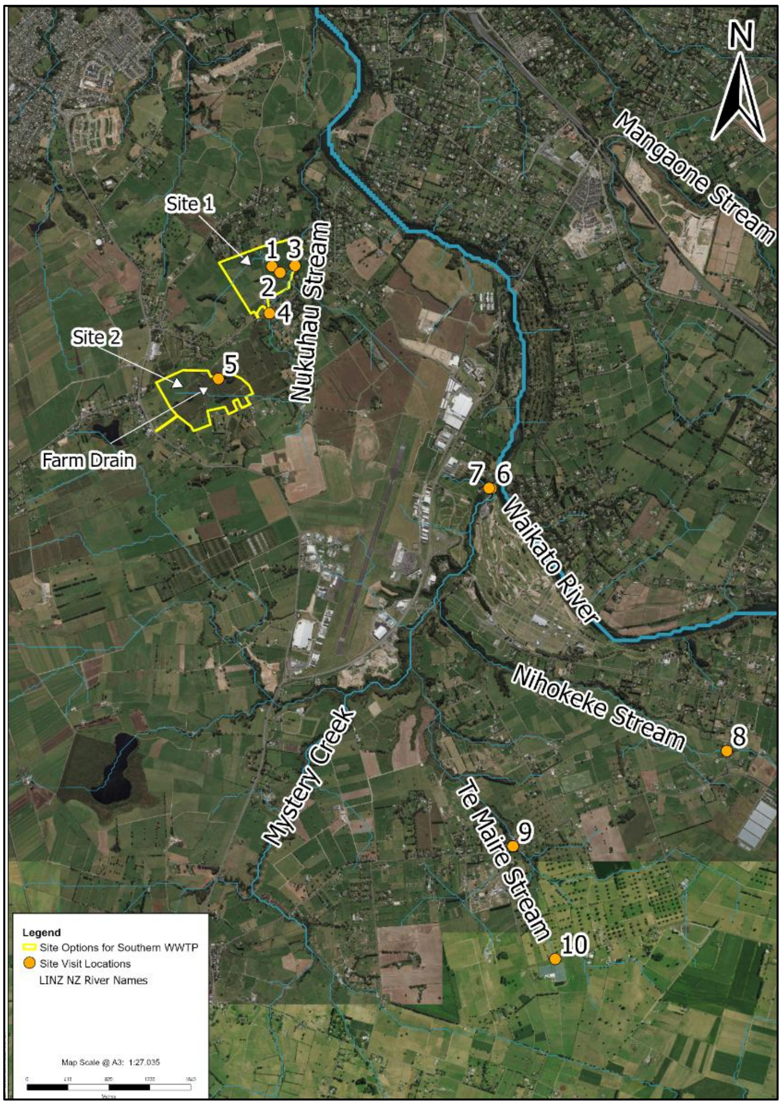


Figure 11. Site visit locations were taken to further assess surface water discharge feasibility.

Each of the 10 sites identified in Figure 11 were further reviewed using aerial photos, maps, and site visits. The process assessed the following characteristics of each site:

- Accessibility to the site
- Ownership status (public or private property)
- Surface water flow rate (slow, medium, fast)
- Vegetation coverage
- Availability of suitable areas for naturalised waterway discharge (size of flat areas and steepness of the stream banks),
- And width of the surface water channel (narrow, moderate, wide).

Following the site visit, six sites identified as potential discharge locations were unlikely to be feasible, three locations were considered potentially feasible, and one location (the Nukuhau Mainstream) was considered highly feasible (Figure 12). Sites that were unlikely to be feasible were found to have one or more of the of the following characteristics: narrow channels, slow flow rates, steep banks, poor accessibility, lack of available area for naturalised waterway, or were situated on private property. Potentially feasible sites had some good characteristics such as easy access and available land for construction of a naturalised discharge stream, which may enhance the ecological value of the site. However, these locations were also characterised by narrow channels and slow flow rates, reducing the overall feasibility.

The highly feasible site (Nukuhau Mainstream) is located in the preferred site for construction of the SWWTP (Site 1) and is owned by HCC. Therefore, the site has easy access and is in close proximity to the proposed sites for the SWWTP. Additionally, the Nukuhau Mainstream has a large flat area available for the construction of a naturalised waterway. Flows in the Nukuhau Stream have been observed to be variable, with visible flow in winter conditions, with areas of perennial flow and dry stream bed observed in site a visit in March 2025 during drought conditions. Acknowledging the cultural significance of the Nukuhau Stream, further collaboration with mana whenua is required to fully integrate their perspectives into the approach.

Subject to further engagement with the Kaitiaki Roopuu, the lower reaches of Mystery Creek may be investigated for a discharge along with the Nukuhau stream. This option is currently subject to confirmation.

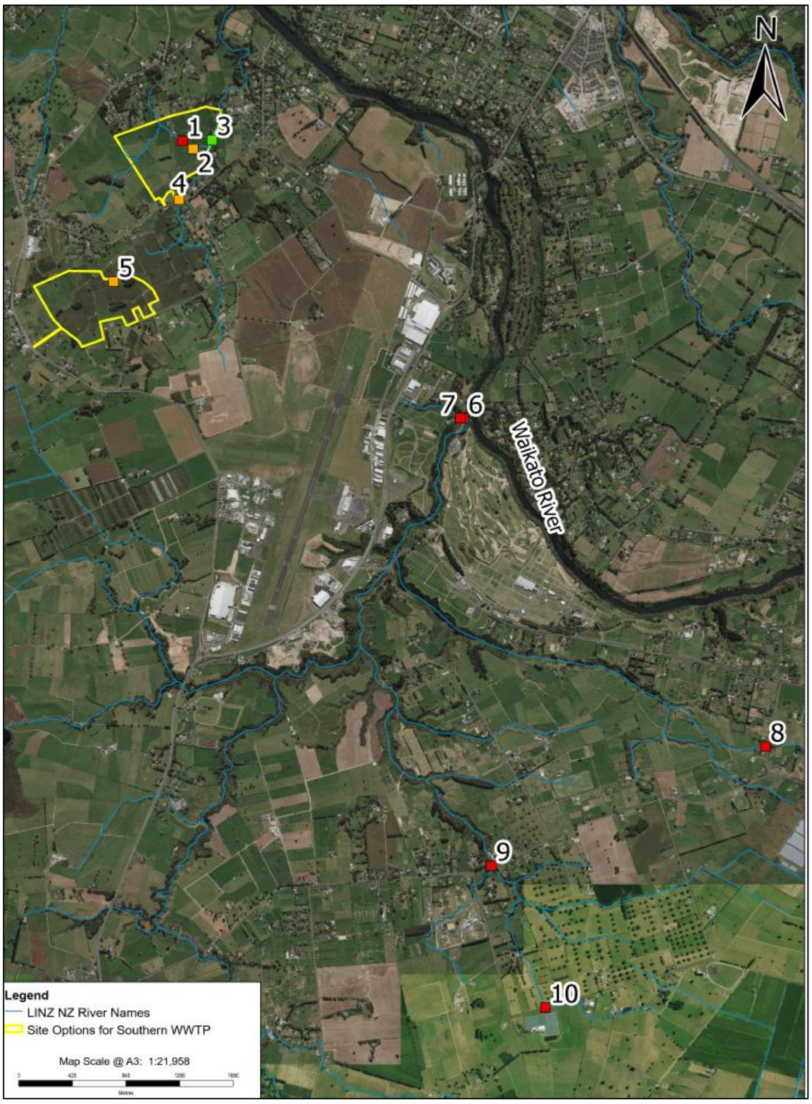


Figure 12. Assessment results. Locations found to be unlikely to be feasible in red, potentially feasible in orange, and highly feasible in green.

If an alternative surface water discharge is considered for further progression, additional investigations and work are recommended to enable a comprehensive assessment. This will provide a clear understanding of the requirements needed for an effective evaluation of the surface water discharge options. This work would include:

- An assessment of environmental effects to understand potential adverse effects of the discharge on receiving water quality, ecology and flooding.
- A Public Health assessment

- An assessment of cultural impacts and Tangata Whenua engagement
- Engineering Investigations: Preliminary assessment of maintenance and operational requirements, geotechnical and hydrology investigations, and discharge engineering design.

5.3 Discharge To Wetland Feasibility Assessment

This option involves the conveyance of treated wastewater to a constructed wetland (with a minimum area of 2.5ha), before entering surface waterways.

The approach taken on this option was to conduct a preliminary discharge to wetland feasibility assessment to screen for and map areas with underlying wetland characteristics (i.e. hydric soils and wetland hydrology) that might be suitable for restoration planting and wastewater discharge within 15 km[8] of SWWTP longlist options.

A desktop screening for historic and potential wetlands that might be suitable for restoration and wastewater discharge was undertaken for the subject area using ArcGIS Pro 3.0.3 desktop geospatial software. Areas excluded from the analysis included:

- Land on the northern side of the Waikato River[9]
- Areas within 20m of rivers and lakes (as mapped in LINZ River Polygons, LINZ River Lines, REC Lakes layers).
- Areas within 20m of land that is not zoned as Rural based on Waipa and Waikato District Plan Zones (Operative).
- Areas where ground slope is 12º or above
- Areas specifically identified for mineral resource value (Aggregate Extraction Policy Area layer)
- Areas within 30m of bores or geothermal wells.
- Land identified as susceptible to flooding (Waikato Regional Council Regional Scale Flood Hazard layer and District Plan Floodplain Management Area layer)
- Areas identified for future development (Peacocke Development Area, Southern Links Designation, Airport Business Park Development Area, and other Waipa District Council Designations).
- QEII covenants.
- Waikato Regional Council identified Significant Natural Areas and Outstanding Natural Features and Landscapes
- Current wetlands as mapped by WRC and Freshwater Ecosystems of New Zealand (FENZ)[10] and areas with restoration status of "Mature" or "Unavailable for Restoration" (Eco-index – Current Status and Restoration Priority for NZ layer)
- Hamilton City Council Proposed Significant Natural Areas Final (2021)
- Department of Conservation public conservation land
- Department of Conservation mapped non-migratory fish distributions

Outside of exclusion areas, approximately 13,317 ha was mapped as potentially restorable wetland. Of this, 10,088 ha was excluded based on size (less than the minimum 2.5 ha necessary for wastewater discharge)

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[8] 15km was selected as the upper distance at which conveying treated wastewater becomes impractical. Conveying wastewater greater distances is possible but comes with additional cost and operability considerations.

[9] The northern side of the Waikato River was excluded due to increased cost and complexity associated with transporting wastewater across the river.

[10] Current wetlands were excluded on the basis that constructed/restored wetlands offer better opportunities for wastewater treatment than natural wetlands as they can be designed for optimal performance (Verhoeven & Meuleman, 1999), and they have limited current conservation value (wetland extent is greatly reduced in the Waikato region and even degraded wetlands are expected to retain ecological value)

and/or wetland type/substrate (bogs and fens on peat or peat loam soil). This left a remaining 3228 ha of potentially restorable wetland that may be suitable for wastewater discharge (Figure 13).

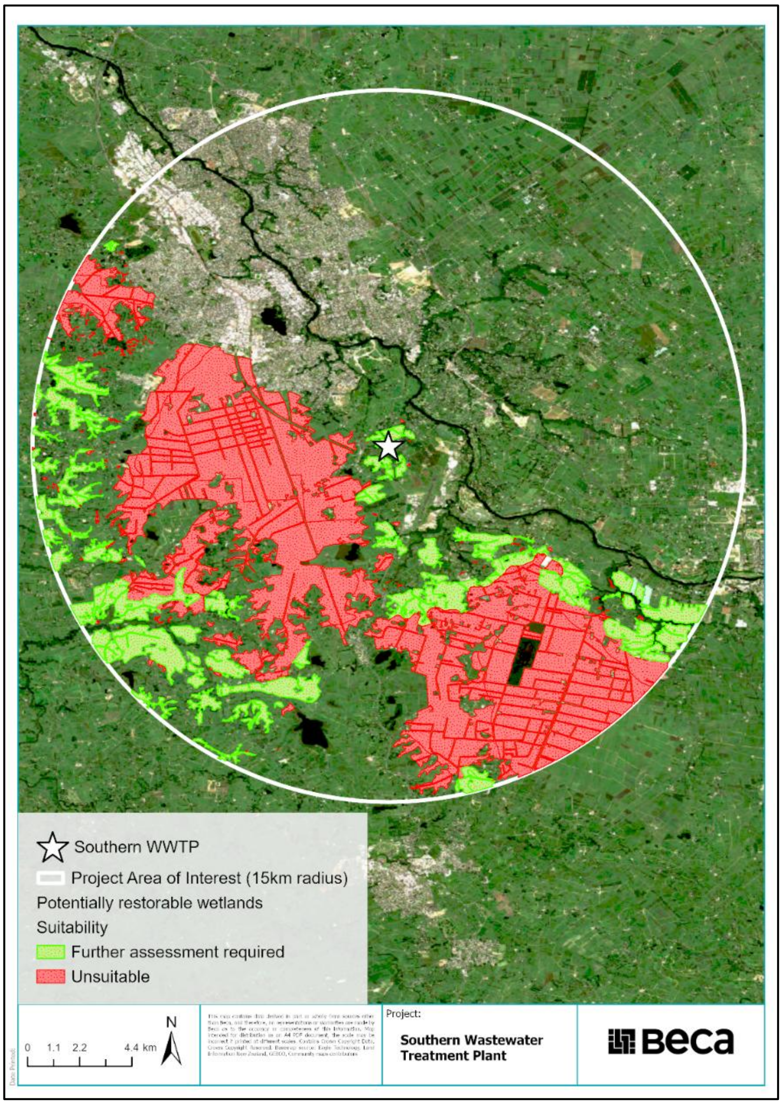


Figure 13. Result of initial screening of potentially restorable wetlands within the subject area.

Of the potentially suitable areas, a subset of six candidate sites were selected based on location within the parcels of land that comprise preferred locations for the SWWTP, or proximity to them, and location on publicly owned land. Each discrete polygon was considered as a site although these may be used together for the purposes of wetland restoration and wastewater discharge (Figure 14).

Figure 14. Six candidate sites were selected for further assessment after initial screening. Note the red areas are the 'exclusion area'

The six candidate sites selected for further investigation were modelled as historic swamp wetlands. Due to their close proximity to one another, all of the sites had similar constraints associated with:

- Drainage to the Nukuhau Stream and Waikato River (sensitive receiving environment)
- Known presence of species of conservation concern (long tailed bats, At -Risk fish species), or potential presence of species of conservation concern (copper skink).
- Risks of flooding due to requirements to fill in drainage channels for restoration/re-wetting.

A number of constraints associated with restorability were also noted. Sites 1-4 had less obvious signs of wetland hydrology, and these sites are likely to be more difficult to establish (or re-establish) hydrology and create a functional wetland ecosystem within. These sites may also require earthworks/recontouring to protect against nutrient/contaminant mobilisation to the receiving environment.

Site 6 was considered the most suitable site for further investigation due to its size (27ha) which allows for greater flexibility, potential restorability (evidence of elevated water table and underlying wetland characteristics), and location at the top of the catchment. Assuming infilling of artificial drains, the nearest watercourse is located >200m away.

Site 6 has also been identified as a potential offsetting location for Southern Links, so may not be available for restoration. If a discharge to wetland option were to be progressed, further investigations necessary to evaluate feasibility and constraints associated with the candidate site(s) could include:

- Ground truthing of desktop information (soil investigations, review of historic aerial imagery to verify accuracy of modelled historic wetland extent, site walkover to confirm artificial drain locations and areas of suitable fauna habitat).
- Hydrological assessments (water balance assessments, investigation of connection to groundwater).
- eDNA sampling and fauna surveys (if areas of suitable habitat may be impacted).

5.4 Land Discharge Options Assessment

Beca undertook an assessment to identify land parcels suitable for discharge to land within a 15 km radius of the proposed SWWTP. The assessment considered feasible land parcels under four scenarios (Table 4). Wastewater flow projections were used to estimate the irrigation area, buffer area, and total land area that would be required for the four scenarios assessed (Table 4). The low hydraulic loading scenarios are designed for Slow Rate Irrigation (SRI), and the high hydraulic loading scenarios designed for rapid infiltration.

Table 4. Area required for land discharge.

Parameters	Low hydraulic loading rate of 3 mm/day	High hydraulic loading rate of 25 mm/day*
Scenario 1 – Stage 1 Flow		
Average daily flow (m^3/day)	400	400
Irrigated Area for Stage 1 (ha)	13.3	0.8
Buffer required (ha)**	6.7	0.2
Total Land Area Required for Stage 1 (ha)	20	1
Scenario 2 – Stage 2b Flow		
Average daily flow (m^3/day)	3,600	3,600
Irrigated Area for Stage 2b (ha)	120	7
Buffer required (ha)**	60	2
Total Land Area Required for Stage 2b (ha)	180	9

* For rapid infiltration systems
** 50% land area for low hydraulic loading rate and 25% land area for high hydraulic loading rate.

Geographic information Systems (GIS) data was used to apply a first-class exclusion process followed by a multi-criteria analysis (MCA) of potentially suitable areas. The first-class exclusion zone was initially developed for a 15 km area of interest (AOI) based on the following criteria:

- Exclude land that is 20 m in proximity to all lakes and rivers.
- Exclude land that is 20 m in proximity of land areas not zoned as rural.
- Exclude all flood susceptible land.
- Exclude land with a slope greater than 12°.
- Exclude land with a soil drainage classed as very poorly drained.
- Exclude land that is within 30 m of bores or geothermal wells.
- Exclude areas that are identified for mineral extraction.
- Exclude development areas included the Airport Business Park Development Area, and the Peacocke Development Area.
- Exclude areas designated for Southern Links.

Based on the first class-exclusion, land suitable for discharge was broadly identified (Figure 15). Further filtering was then applied to determine specific land parcels that would be suitable. During this filtering process available land data was cleaned of any land area below 1 ha, cleaning of data with parcel intents labelled ROAD, HYDRO, etc, and remaining land parcels smaller than then respective land requirements (see Table 4 above) removed. The process outlined above resulted in a list of 17 sites for Stage 1 for high hydraulic loading rate (Stg1-HH), 5 sites for Stage 2b for high hydraulic loading rate (Stg2-HH), 18 sites for Stage 1 for low hydraulic loading rate (Stg1-LH), and 11 sites for Stage 2b for low hydraulic loading rate (Stg2-LH).

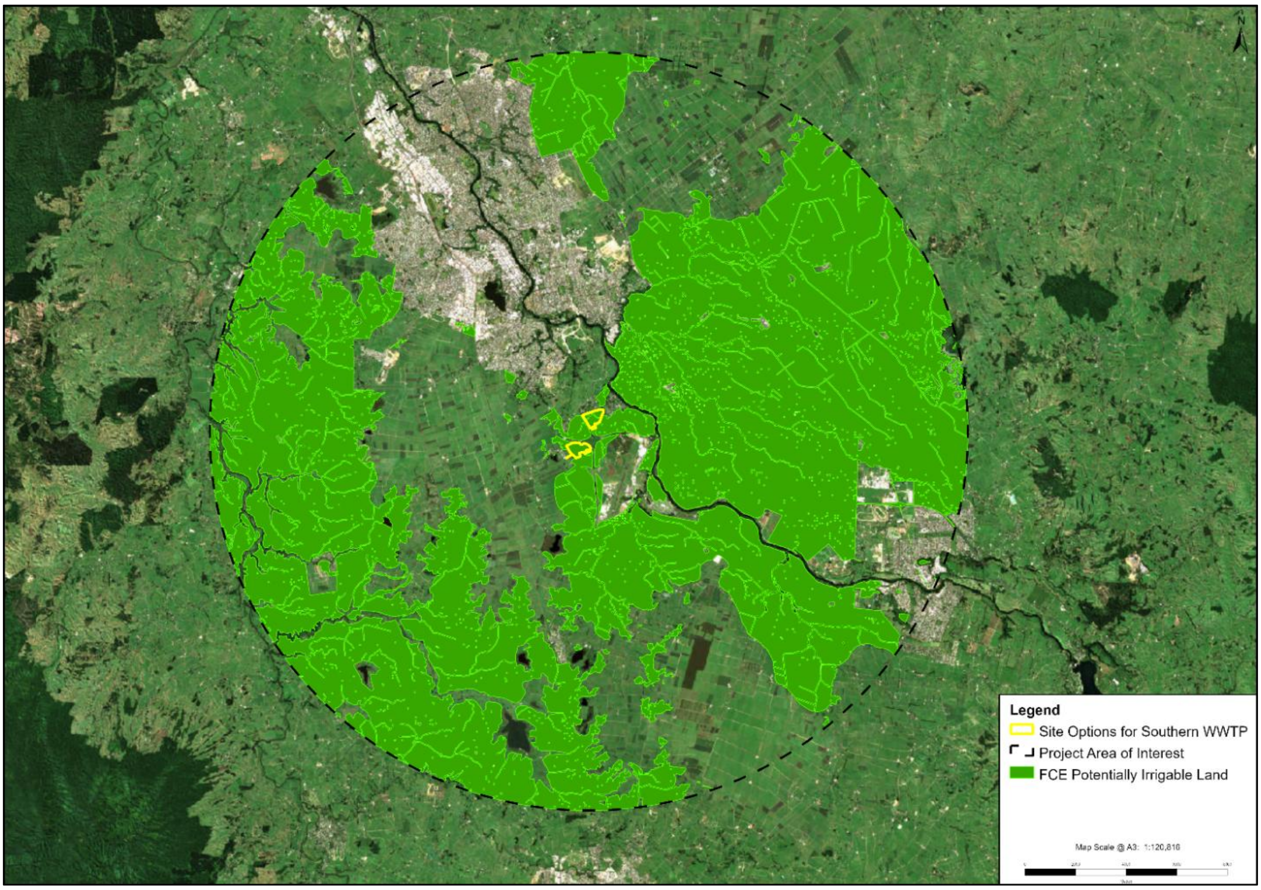


Figure 15. the 15km first-class exclusion zone investigated

Each of these sites were ranked from 1 – 5 against a range of MCA factors such as slope, soil drainage, land use type, distance to SWWTP. Through this process the sites visualised in Figure 16 were identified as the most feasible sites for treated wastewater discharge to land. All five of these sites have a mixture of land-uses which will require further consultation with landholders, and more detailed feasibility investigations. Stage 2 sites will also require further investigation regarding the presence of documented cultural heritage site. While all sites have potential limits, irrigation to land at each of these sites is possible given the soil profile and characteristics. Further consideration may need to be given if the recommended site for Stage 2 – LH is pursued, as the site is approximately 7.5 km from the proposed SWWTP location, and on the other side of the Waikato River.

Further work is dependent on the decision-making process of pursuing the discharge to land option further or the exploration of other discharge options. If these options were to be moved forward, further investigations should include:

- Site-specific investigations to assess the findings from the desktop investigation (soil and hydrogeological investigations);
- Landowners should be engaged to assess the potential availability of land for treated wastewater discharge; and
- Feasibility of piping wastewater from the treatment plant to discharge location. This is particularly relevant for Stage 2 – LH.

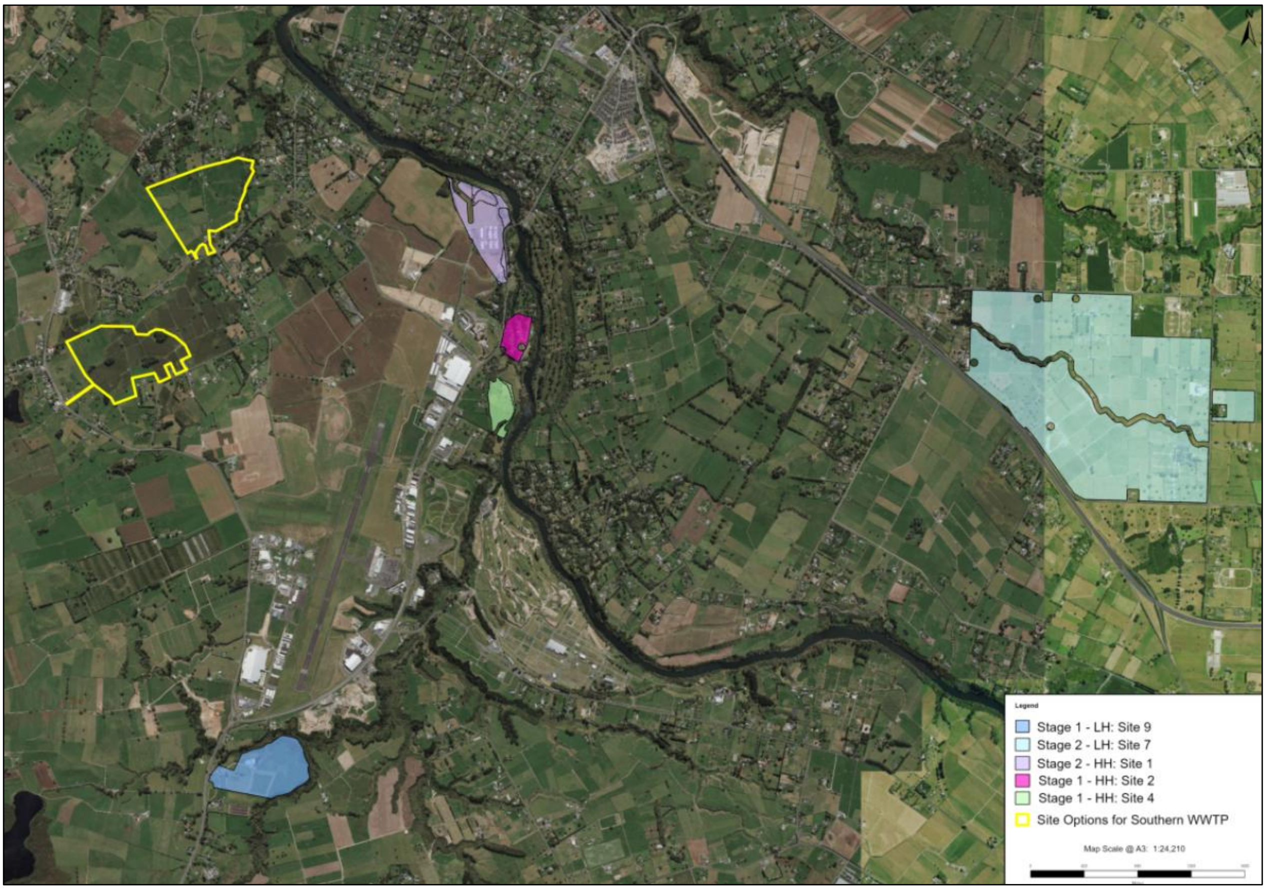


Figure 16. Most feasible land parcels for each discharge to land scenario, based on MCA criteria.

5.5 Deep Bore Injection

As part of the optioneering of disposal methods for the SWWTP, deep bore injection (DBI) has been considered, and a high-level feasibility study has been produced by Beca. This feasibility study has been completed for the two short listed sites identified for the SWWTP, Sharpe Farm (Site 1) and Narrows/Rukuhia (site 2). To consider the feasibility of DBI for each site, the following variables have been reviewed:

- **Suitable geological unit(s) for DBI** - Based on the available geological data and pending the results of further investigation, it is likely that any proposed DBI will likely need to target the Tauranga Group sediments at depth.
- **Local and regional groundwater conditions –** Given the limited data on groundwater conditions at the depths likely to be targeted for DBI, further investigations, both detailed desktop study and drilling, would be needed to confirm groundwater conditions at the selected sites and identify downstream receptors.
- **Potential effects on receptors –** Several potential receptors were identified: Nukuhau stream and its tributaries, The Waikato River, and the 158 bores within 3 km of the selected locations of interest. For all these potential receptors, further investigations would be required to confirm.
- **Requirements of water treatment** – the targeted aquifer may be vulnerable to treated wastewater and vice versa, the groundwater conditions and its potential reaction with the discharge could potentially affect the operation of the injection bores, e.g., corrosion etc., which could potentially require a higher level of treatment of the wastewater. The chemical conditions of the wastewater and the aquifers need to be thoroughly investigated to determine risks and likely level of treatment of the wastewater.
- **Cost of investigation and construction –** The use of existing bores for DBI is unlikely to be an option based on Council records. If an existing bore hole is identified for DBI use, the following would need to be undertaken before the bore can be identified as a viable option:
  - The borehole log and construction records need to be reviewed,

  - The bore conditions need to be confirmed using downhole camera logging, particularly, the integrity of the bore casing needs to be checked to confirm no leakage,
  - Hydraulic conductivity testing will need to be undertaken to confirm aquifer suitability if no recent testing has been undertaken.
  - If new bores are to be constructed, preliminary drilling and hydrogeological testing will need to be undertaken to identify a suitable disposal unit.
- **Public perception –** There will likely be public concerns for injecting treated wastewater to an underground environment due to factors untested in New Zealand such as emerging contaminants and potential effects on drinking water sources/receiving environments, therefore, public perception and expectations need to be well managed.

Overall, the feasibility study found that the success of DBI would primarily depend on:

- The geological and hydrogeological environment
- Sufficient hydraulic separation between the disposal depth and upper units, particularly those used for water supply, and
- Sufficient aquifer storage that can accommodate the discharge.

Should the DBI be the preferred option to proceed, a more detailed desktop study is required to review the local and regional geological and hydrogeological conditions and identify any potential down gradient receptors. Unless there are any red flags identified, the desktop study should be followed up by site investigations to confirm suitability.

5.6 High Level Conveyance Investigation for Discharge to Coast Option

Among the high-level feasibility studies undertaken, Beca included a high-level desktop assessment on the feasibility of coastal discharge for treated effluent from the SWWTP. The conveyance route assessment is summarised below:

- Rising main diameter: OD250 PN16 equating to 1.28m/s at 41.7 L/s
- The alignment is approximately 56.7km long
- The peak static height that would need to be overcome is approximately 175 m

Key obstacles identified for this alignment included:

- Railway crossings
- Multiple stream and bridge crossings
- The route runs along the SH23 and would require a considerable amount of traffic management.

Due to the typography and length of the rising main multiple booster pump stations would be required to convey the treated wastewater to the ocean outfall.

The assumed discharge location at Raglan Harbour is likely to be highly offensive to tāngata whenua and the community of Raglan, with a long standing offense to the existing discharge from the Raglan township to the mouth of the harbour. Any new discharge, even with a high quality, is likely to be highly controversial.

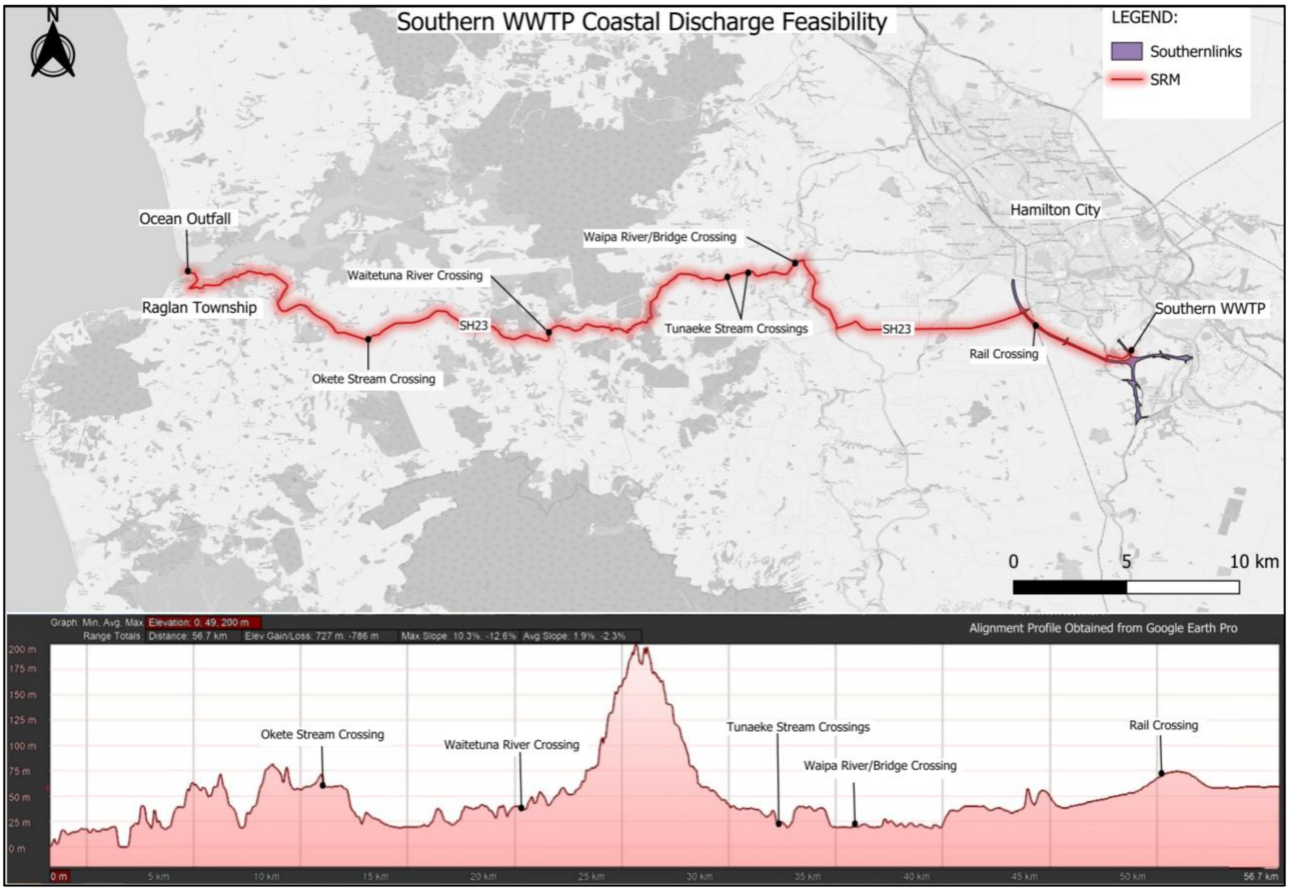


Figure 17. Assessed alignment for SWWTP discharge to coastal marine environment feasibility study.

5.7 Investigations of Feasible Options for Reuse of Treated Wastewater

A desktop feasibility assessment to determine theoretically appropriate wastewater reuse options for the SWWTP was undertaken. The methodology employed a review of the available guidelines for wastewater reuse from Australasia, consideration of wastewater reuse types employed within New Zealand, and a desktop assessment of the suitability of a range of wastewater reuse options for the Southern WWTP based on assumed wastewater quality as well as available reuse sites within the vicinity of the WWTP proposed locations. The assessment of possible sites for reuse was based on a desktop review and no discussions with landowners or operators have been undertaken at this stage.

Worldwide, technologies and management systems for water recycling have advanced significantly over the years, ensuring safe and successful operations across a wide range of schemes. However, the absence of national guidelines for water recycling in New Zealand has resulted in relying on voluntary adoption of various international standards which has led to inconsistencies and increased challenges in implementing water recycling practices effectively. Those international guidelines most commonly employed are the Australian guidelines for wastewater reuse including:

- Australian Guidelines for Water Recycling (AGWR) : Managing Health and Environmental Risks (Phase1), 2006
- Victorian guideline for water recycling, Environment Protection Authority Victoria, Publication 1910.2, March 2021
- Queensland Guideline for low-exposure recycled water schemes, 2022

These three guidelines look at the quality of the wastewater, in particular the level of pathogen removal, to apply wastewater classes. These classes correlate to wastewater reuse types that would be plausible and would not cause a significant risk to public health. Lower classes of wastewater require greater levels of controls including controlled access, set back distances, and spray drift controls. These controls are necessary because recycled water, with the exception of purified recycled water (which undergoes extensive treatment and can be used to replenish drinking water sources), is not safe for human consumption.

Despite a lack of New Zealand specific guidelines, wastewater reuse within New Zealand is not a new or novel approach. Common approaches to wastewater reuse overlap with the shift towards the discharge of treated wastewater to land, such as the reuse of wastewater for irrigation purposes (e.g. irrigation to pasture). However, the approach to reuse has centred around the disposal of wastewater, rather than utilising treated wastewater as a resource to reduce the pressure on potable water supplies. Cultural restrictions including mātauranga understandings of wastewater as polluted water which is in a state of tapu and diminished mauri have also not been fully investigated with regards to wastewater reuse.

Irrigation to golf courses using sub surface irrigation as well as spray irrigation is one of the more common forms of wastewater reuse in New Zealand such as operating examples at Omaha WWTP (North Auckland), Kinloch WWTP (Taupo), Bell Island WWTP (Tasman), Seddon Sewage Treatment Plant (Marlborough), and proposed at Mangawhai WWTP (Kaipara). Reuse of wastewater for the irrigation of public gardens, parks and sports fields is somewhat less common; however, it is being explored by some councils (including Whangārei District Council and Tauranga City Council) where there is pressure on potable water supplies.

Agricultural reuse is also common in New Zealand however this 'reuse' is interchangeable with 'discharge to land'. Discharge to pastoral grazing land is the most common such as in Taupo and planned for in the Central Hawkes Bay. Marlborough District Council is also exploring discharge to grape vines for the Blenheim WWTP. Discharge to horticultural crops is less common and regulatory approval from the horticultural industry, such as from Horticulture New Zealand, will likely also be required. Discharge to pasture or to crops used to feed lactating animals is not allowed by the dairy co-operative Fonterra and as such discharge to dairy pastures has not been possible.

Other wastewater uses including industrial use, reuse in the construction sector, and potable reuse are less common. New Zealand effectively already has unplanned indirect potable reuse of treated wastewater occurring in the Waikato (e.g. treated wastewater discharged to the Waikato River is subsequently abstracted downstream for drinking water); however, legislative changes to the New Zealand Drinking Water Standards would be required in order to facilitate direct potable reuse of treated wastewater. Watercare has been leading the charge on potable wastewater reuse with their recycled water pilot plant at Mangere WWTP with a potable and non-potable treatment system. Whilst this plant is only investigating the potential for possible potable reuse in the future, the non-potable treated water is being used in the Central Interceptor's tunnelling activities.

With this information in mind, a desktop assessment on the feasibility of wastewater reuse for the Southern WWTP was undertaken. This started with an assessment of the proposed wastewater effluent quality against the Australian guidelines as a benchmark. Based on the available information for the proposed Stage 1 and 2 treatment plants, it is anticipated that the MBR plant could potentially meet the Class A treated wastewater (in accordance with the Victorian guideline for water recycling 2021 and the Queensland Guideline for low-exposure recycled water schemes 2022) provided the required pathogen log removals can be met, whilst the SBR plant is likely to meet Class C wastewater and therefore wastewater reuse is likely to require greater controls.

Following this, the following wastewater reuse options were investigated:

Reuse for golf courses, sports fields and parks

- Agricultural Reuse
- Industrial Reuse
- Reuse for the construction sector
- Indirect Potable Use

For the Stage 1 SBR plant, the feasibility assessment showed that discharge to pastoral land or fodder crops is the most feasible. Irrigation to food crops is less likely to be feasible. Spray drift control, the use of subsurface irrigation, and/or the application of buffer zones may also be needed to minimise public health risks. Treated wastewater from the SBR plant could be used for irrigation to golf courses, gardens, sports fields and parks where there is no public access; and subsurface drippers will most likely be required. A thorough risk assessment should be undertaken for any proposed reuse to determine the mitigation measures needed to protect environmental sensitivities and public health.

Treated wastewater from the SBR may be suitable for wet industry provided there is no worker exposure, and a thorough risk assessment had been undertaken to address any public health risks; however, it is considered that due to the limited availability of wet industry within the vicinity of the proposed treatment plant sites, this reuse option is unlikely to be feasible for the SBR plant. Due to the level of disinfection set out in the specifications for the SBR plant, it is also unlikely that the treated wastewater can be used for the construction sector.

For the Stage 2 MBR plant, the feasibility assessment showed that agricultural reuse including irrigation to pasture and fodder crops and irrigation to non-food crops (including plant nurseries) as well reuse for golf courses, sports fields and parks is likely to be feasible. This includes using a sprinkler system with some restrictions including buffer zones and spray drift control although a combination of sub-surface drippers (for areas with public access) and spray irrigation (for areas without public access) may also be preferred. The level of treatment that could be provided by the MBR plant would also be important for determining the dispersal method. There are available sites within the vicinity of the proposed WWTP location that could be investigated further.

Reuse in the construction sector may also be feasible for wastewater from the MBR plant if the treated wastewater can meet the required level of disinfection to minimise construction worker risk. There are a number of future construction areas within the vicinity of the proposed Southern WWTP that could be investigated. Industrial reuse may also be possible; however, there do not appear to be any immediate options in the vicinity of the WWTP at this time.

Indirect potable reuse may end up forming part of the scheme as well if there is a discharge to the Waikato River.

To consent any reuse option including agricultural reuse and reuse for golf courses, sports fields and parks, further investigations are recommended as follows:

- Geotechnical investigations for land and wetland discharges
- Investigations of discharge effects on the environment
- Investigations of discharge effects on ecology
- Investigation of discharge effects on human health for land discharges and reuse options
- Investigation of discharge locations
- Land use investigations
- Investigations in flooding potential from land discharge options
- Engineering studies and design
- Investigations of capital and operational cost impacts
- Investigations of tāngata whenua preference

6 Assessment of the Long List Options

6.1 Assessment Criteria Background and Context

To assist in shortlisting the discharge options from the long list, a traffic light assessment scoring method (Table 5) was used alongside the development of specific criteria. This assessment, along with consultation outcomes with the Kaitiaki Roopuu, was used to guide decisions on the next steps for determining a preferred discharge option.

Table 5. MCA traffic light assessment criteria.

(green)	Meets criteria well
(amber)	Marginally meets the criteria
(red)	Does not meet the criteria
(dark red)	Fatally flawed

Given the high-level nature of the assessment and option development at this phase, carbon considerations and detailed cost estimates will be undertaken and assessed at the next phase of discharge method selection. The assessment criteria used for short listing the long list options were developed from the previous project objectives (described in Section 4.1.1) are listed below and described in Table 6:

- Public Health
- Environment
- Social and Community
- Physical and Constructability
- Extent to which the option gives effect to The Vision and Strategy for the Waikato River (Te Ture Whaimana o te Awa o Waikato)

As part of this assessment, three in-person workshops were held with HCC Subject Matter Experts, Waikato Regional Council consenting staff, and the Project Kaitiaki Roopuu:

- First Workshop: Review of Long List of Options (June 6th)
- Second Workshop: Initial Technical Findings and Long List Assessment/Feedback (September 23rd)
- Third Workshop: Confirming Feedback and Options for Short-List (November 25th)

In the first workshop, the proposed long-list options were presented, feedback was gathered, and the long-list discharge options were confirmed. During the second workshop, Beca presented the initial technical findings of the long-list assessment along with the assessment criteria, and further feedback was collected. The outcome of this session resulted in valuable feedback from the working group regarding various options and experience with similar solutions on other project upgrades (i.e. Cambridge WWTP), which helped refine the initial long-list options. In the final workshop, Beca presented the proposed shortlist of discharge options, received feedback, and confirmed the shortlist. During this wānanga series, it was also agreed that tangata whenua would prepare a parallel Tangata Whenua Effects Assessment Report (TWEAR) to detail the methodology undertaken to refine the long list of options to a short list of options using the previously established Matariki Framework. That work captures their specific cultural narrative and whakaaro / thoughts to arrive at the agreed short list of options and should be read in conjunction with this report. .

The final shortlisted discharge options, following the feedback from the workshops, are listed in Table 6 and Table 7 below:

Table 6. SWWTP Discharge Options Long List Assessment Criteria.

Criteria	Issue/Topic	Description/Explanation
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	Risk of public exposure to waterborne pathogens and contaminants, such as nitrates, in the following ways: • Direct contact with discharge site or wetland immediately downstream of discharge; • Direct contact with the receiving environment, for example through contact recreation; • Indirect exposure through food gathering (such as shellfish, fish, watercress, waterfowl, etc.) and groundwater use.
Environment	Water quality effects	Potential effects on freshwater (surface and ground)
	Aquatic ecology effects	Potential effects on aquatic ecosystems
	Terrestrial ecology effects	• Potential effects on terrestrial ecosystems and soils • Assessing the project's potential to create opportunities for activities such as restoration
Social and community	Amenity value and aesthetics	• Potential effects on the natural and built environment (e.g. visual, odour, noise) • Risk of social acceptance and perception of new technology
	Recreation	• Extent to which the project enhances or detracts from recreational activities • Evaluating how much the project either enhances or diminishes the availability of new recreational opportunities
Physical and Constructability	Land availability	Adequate and secure land must be available for the required infrastructure
	Adaptable and flexible	Due to the uncertainty associated with future growth, a feasible option must be able to adapt to changing conditions such as increased flows and loads, discharge quality requirements, input requirements, and energy availability.
	Buildability, accessibility	• Consideration of access to the site / conveyance route for construction, likely enabling works requirements, level of environmental controls expected extent of greenfield vs existing features to manage; • Distance and complexity of conveyance to potential discharge sites regarding length and potential complexity of routes along roads.
	Operational and engineering resilience	• Potential to be sufficiently resilient to natural hazards and climate change and operational failure; • Ability for option to accommodate wet weather flows that exceed the design; • Access to utilities/power • Risks of untested or unintended outcomes • Availability of relevant expertise and resources

Criteria	Issue/Topic	Description/Explanation
Te Ture Whaimana o te Awa o Waikato	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	Te Ture Whaimana o te Awa o Waikato is for a future where a healthy Waikato River sustains abundant life and prosperous communities who, in turn, are all responsible for protecting the health and wellbeing of the Waikato River, and all it embraces, for generations to come.

6.2 Response to Assessment Criteria

The traffic light scoring for the long-list options, assessed against each sub-topic, is detailed in the more comprehensive individual assessment tables in Appendix A (Preliminary Long List Assessment – Southern Wastewater Discharge – September 2024). A high-level summary of each key consideration against the primary criteria is provided below in Table 7.

Table 7. Key considerations against primary criteria for each discharge option.

Long List Option	Summary Comments	Alignment with Project Objectives	Carry forward to Short-List?
Indirect discharge to the Waikato River through a Naturalised Bank-side Discharge	Although there may be minor environmental effects from discharging treated wastewater into the river, this direct discharge might not align entirely with Te Ture Whaimana o te Awa o Waikato. Further offsetting may be required given it is a new discharge to the Waikato River or the cumulative benefits of wastewater treatment upgrade projects through the Metro DBC could also be considered. Additional investigation is recommended to confirm the exact discharge location, including establishing the most appropriate methodology. If surface water discharge is chosen as the preferred discharge location, undertaking ecological and further water quality investigations will be necessary to understand the impacts of treated wastewater discharge on the Waikato River. It is likely that private land adjacent to the riverbank will be required to be acquired, and the conveyance route will be constructed on public roads. The construction difficulty of the conveyance route is expected to be similar to that of comparable projects.	• This option is largely consistent with the project objectives. • Enhancement of habitat and biodiversity value may be facilitated through effectively establishing the bank-side discharge. • While the option may have an negligible adverse effect on water quality, this has been minimised significantly through a high level of treatment provided by MBR technology and the cumulative positive effects of the Metro DBC. • Given the high flow of the Waikato River, there is potentially flexibility to accommodate growth in the region.	Yes Standalone Option Limitations: No limitations
Discharge to Surface Waterways – Nukuhau Mainstream	While there may be some environmental effects from discharging to the stream, these effects are not expected to be significant and can be quantified through investigations, including assessments of water quality, ecology, flooding, and public health to inform effective mitigation strategies. The conveyance route can be constructed on private land, as the site is very close to the SWWTP and is owned by HCC. Construction of the conveyance route is anticipated to be straightforward, similar to other projects. The route is shorter than alternative options and offers more land for landscape enhancement, making it a more desirable choice. The cultural impact of this option will require assessment given discharge to Nukuhau Stream. Engineering investigations would need to be undertaken, and include preliminary assessments of maintenance and operational requirements, geotechnical and hydrological investigations, and discharge engineering design.	• This option is largely consistent with the project objectives. • Enhancement of habitat and biodiversity value may be facilitated through the creation of green spaces accessible to the public. • While the option may have a potential negative effect on water quality, this has been minimised significantly through a high level of treatment. • This option is somewhat flexible, given the pipeline can be sized to accommodate future flows. However, further information would be needed on the ability of this option to accommodate wet weather flows and	Yes Standalone Option Limitations: Uncertain

Long List Option	Summary Comments	Alignment with Project Objectives	Carry forward to Short-List?
		higher flows over time as the connected population increases.	
Discharge to Restored/Constructed Wetlands	While the discharge to a wetland may have some environmental effects, these are not expected to be significant as the proposed MBR discharge provides high-quality treated wastewater. Converting the land to a wetland could create valuable habitat for indigenous fauna. Feasible Sites (Site 3 and Site 4), located at Sharpe Farm, are owned by HCC and therefore there are no uncertainties about property acquisition. It is likely that this option can be combined with an associated surface water discharge to the Nukuhau Stream or Waikato River.	• This option is largely consistent with the project objectives. • Provides good restoration opportunities, given the conversion of pasture to wetland could create habitat for terrestrial fauna. • With regards to water quality, there is some concern regarding the potential for the high-quality wastewater (discharged from the WWTP) to be degraded through contamination from bird life etc. as the treated wastewater flows through the wetlands. • The feasible sites exceed the current land size requirements, providing some flexibility for growth. However, further information is needed to understand whether this option would be able to accommodate wet weather flows.	Yes Standalone Option Limitations: Uncertain
Discharge to Land – Rapid Infiltration – Stage 1 (Sites 2 and 4)	The suitable sites for land discharge using rapid infiltration systems require smaller areas compared to slow rate irrigation and are near the Waikato River. This proximity means there could be some negative environmental effects from contaminants potentially reaching surface water bodies or groundwater through soil infiltration, However, the effects are deemed minor due to the high quality of treated wastewater and soil's ability to effectively remove contaminants. Further information is required on site specific geology, groundwater and associated stability risks. Engaging with the landowner is essential, and there are uncertainties regarding land acquisition.	• This option is largely consistent with the project objectives. • Suitable land is privately held and landowner discussions are required to progress this option. • The potential need to acquire further surrounding land blocks if expansion is required limits flexibility to account for growth in the region. • Avoiding a discharge direct to surface water contributes to the objective of protecting the health and wellbeing	Yes Standalone Option Limitations: Uncertain

Long List Option	Summary Comments	Alignment with Project Objectives	Carry forward to Short-List?
		for the river. However, risk remains for surface water during wet weather and for groundwater for generally. • Further investigations are required to determine available land and site-specific soil types/constraints.	
Discharge to Land – Slow Rate Irrigation – Stage 1 (Site 9)	Discharging to land at a low hydraulic loading rate and with appropriate buffers may result in minor environmental effects. This option could be relatively high-cost due to the land area required and the length of the pipeline. Extensive investigation and assessment will be necessary to support resource consent, though this discharge method has been successful in similar sensitive environments in New Zealand. Engaging with the landowner is crucial, and land acquisition is uncertain. However, an alternative option is Site 1, located at Sharpe Farm, which is owned by HCC, however these soils are not suitable for year round application of treated wastewater and an alternative discharge environment will be required during periods when the soil is saturated.	• This option is largely inconsistent with the project objectives. • Soils are not suitable for year-round application of treated wastewater and an alternative discharge environment will be required during periods when the soil is saturated.	No: Standalone Option Limitations: Uncertain
Discharge to Land – Rapid Infiltration – Stage 2 (Site 1)	The suitable sites for land discharge using rapid infiltration systems are near the Waikato River. This proximity means there could be some negative environmental effects from contaminants potentially reaching surface water bodies or groundwater through soil infiltration. However, the effects are deemed minor due to the high quality of treated wastewater and soil's ability to effectively remove contaminants. Therefore, the potential impact on freshwater (both surface and groundwater) is considered low. Engaging with the landowner is essential, and there are uncertainties regarding land acquisition.	• This option is largely consistent with the project objectives. • Avoiding a discharge direct to surface water contributes to the objective of protecting the health and wellbeing for the river. However, risk remains for surface water during wet weather flows and for groundwater for generally. • Further investigations are required to determine available land and site-specific soil types/constraints.	Yes Standalone Option Limitations: Uncertain
Discharge to Land – Slow Rate Irrigation – Stage 2 (Site 7)	Discharging to land at a low hydraulic loading rate and with appropriate buffers may result in minor environmental effects. This option could be relatively high-cost due to the large land area required and the length of the pipeline. Extensive investigation and assessment will be necessary to support resource consent, though this discharge method has been successful in similar sensitive environments in New Zealand. Engaging with the landowner is crucial, and land	• Option does not align well with project objectives due to significant land area requirements and extensive investigations required to reduce current uncertainties.	No

Long List Option	Summary Comments	Alignment with Project Objectives	Carry forward to Short-List?
	acquisition could be uncertain. However, there are several nearby sites that may be suitable for expansion if needed. Additionally, since the site is situated across the Waikato River from the SWWTP, a longer pipeline will be required compared to other land discharge options. This increased distance adds to the project's cost and complexity.	• The significant private land area required potentially makes it difficult to be flexible for population growth. • There is a likelihood to limit adverse effects on aquatic and terrestrial habitat through this option, however, further investigations would be required.	
Discharge to Groundwater – Deep Bore Injection	This option is considered high-risk because it relies on highly specific geological conditions to be effective. Additionally, determining whether the geological conditions are suitable requires extensive and costly investigations upfront. Further treatment is likely required to mitigate risks.	• Option does not align well with the project objectives. • Option does not facilitate restoration or habitat enhancement opportunities for the Waikato River or its tributaries. • The large number of unknowns impedes on the ability to ensure this option will provide sufficient capacity in the future.	No Standalone Option Limitations: Uncertain
Discharge to coast – Ocean Outfall	Although the change in water quality is expected to be negligible, a comprehensive assessment of potential effects on aquatic ecosystems will be necessary. The considerable distance of the discharge site from the SWWTP requires a very long pipeline, which increases both complexity and cost. The pipeline is likely to be very difficult to operate. Community and cultural objections are likely to be a fatal flaw.	• This option is inconsistent with the project objectives. • The significant length of the pipeline required for this option does not lend itself to easily accommodate unforeseen growth in the region. • Further, there are minimal restoration opportunities associated with this discharge option and the option does not enhance the extent of aquatic and terrestrial habitat and biodiversity.	No Standalone Option Limitations: Uncertain
Reuse	Reuse at the Sharpe Farm site was agreed to be taken forward in the form of irrigation to landscaping areas within the site and appropriate reuse within the wastewater treatment process (e.g. cleaning uses).	• Option aligns well with project options, particularly considering the resource recovery objective.	Yes

6.3 Relative Capital Costing

The relative capital cost associated with each option has been determined. More comprehensive costing will need to be included in the short-listing process. The preferred discharge locations for each option are further detailed in the subsequent sub-sections.

A preliminary assessment of relative capacity cost has been undertaken for each discharge option investigated. A basic classification system has been used based to provide an indication of the capital required to implement each option, in relation to other options discussed. The classification structure used is as follows:

- Relatively low-cost option
- Relatively medium-cost option
- Relatively high-cost option

Extremely high-cost option

Table 8 indicates the relative costing for each discharge option. Both discharge to the Nukuhau mainstem and to wetland are considered to have relatively low capital requirements. This is due to their proximity to the SWWTP site, and the fact that the most feasible sites are already owned by HCC. The most feasible sites for discharge to land all require land acquisition and have therefore been classified as medium cost options. Finally, deep bore injection and discharge to coast have been classified as extremely high-cost options. This is due to the cost associated with adopting emerging technology such as DBI, and the significant length of pipeline required to establish a coastal outfall.

Table 8. Overview of relative capital costs for each discharge options assessed.

Long-list Discharge Option	Relative Capital Cost	Details
Discharge to the main stem of the Waikato River.	Medium cost	• Longer pipeline required compared to Nukuhau stream surface water and wetland discharge options. • Private land acquisition likely required.
Discharge to surface water – Nukuhau Mainstem	Low cost	• Site is owned by HCC. • Proximity to SWWTP allows for a shorter pipeline compared to other options.
Discharge to wetland (close to Nukuhau)	Low cost	• Site is owned by HCC. • Proximity to SWWTP allows for a shorter pipeline compared to other options.
Discharge to land – Rapid Infiltration (Stage 1 – Site 2 & 4)	Medium cost	• Private land acquisition is required. • Site 1 is not suitable.
Discharge to land – Slow Rate Irrigation (Stage 1 – Site 9)	Medium cost	• Private land acquisition is required is site 1 (owned by HCC) is not used.
Discharge to land – Rapid Infiltration (Stage 2 – Site 1)	Medium cost	• Private land acquisition is required.
Discharge to land – Slow Rate Irrigation (Stage 2 – Site 6)	High cost	• Private land acquisition required. • Preferred site is across the Waikato River. • A longer pipeline will be required compared to other land discharge options.
Deep Bore Injection	Extremely high cost	• Due to newness of the technology.
Discharge to Coast, Ocean	Extremely high cost	• Due to the length of the pipeline (~57 km).

7 Conclusion and Recommendations

Based on the outcomes of this long-list assessment, feedback received from HCC's subject matter experts, Waikato Regional Council consenting staff, and the Kaitiaki Roopuu during the wānanga series, the discharge methods that are emerging as being preferable for shortlist assessment include the following:

- Discharge to the main stem of the Waikato River (either wetland or naturalised discharge)
- Discharge to surface waterways – Nukuhau Mainstem (either wetland or naturalised discharge)
- Discharge to land, rapid infiltration stages 1 and 2
- Reuse at the Sharpe Farm site (note: beneficial re-use will be retained alongside other shortlisted options as it supports all project objectives).

Broadly, it is recommended that the following investigations are undertaken for each discharge method on the short-list option list:

- Site specific layouts should be developed for each option, including options for conveyance alignments and discharge locations to the Waikato River.
- Potential wetland and naturalised discharge structure layouts should be developed for the surface water discharge options.
- Landowner discussion should progress for potential rapid infiltration discharge to land sites.
- A further assessment of environmental effects should be progressed to understand potential adverse effects on the receiving environment.

A

Appendix A - Preliminary Long List Options Assessment Summary

Preliminary Long List Options Assessment Summary– Southern Treated Wastewater Discharge

Options Overview

This document presents a preliminary assessment of conceptual long list options for the Southern Wastewater Discharge for discussion. This assessment, along with consultation outcomes with tangata whenua, will guide decisions on next steps for determining short-listed options for further assessment. The assessment summaries provided in this document are for the options presented in the table below.

Long-List Discharge Options	MoU Treatment Standard	
	Discharge to land Standard	Discharge to Water Standard
Discharge to Main Stem of the Waikato River	✗	✓
Discharge to Surface Waterways – Streams/Drains Draining to Waikato River	✗	✓
Discharge to Restored/Constructed Wetland	✗	✓
Discharge to Land – Slow Rate Irrigation	✓	✗
Discharge to Land – Rapid Infiltration	✗	✓
Deep Bore Injection	✗	?
Discharge to Coast, Ocean	✗	✓
Treated Wastewater Reuse	Applying the appropriate standard based on the reuse activities	

Traffic Light Assessment Criteria

Scoring method – Traffic Light –how each of the 'criteria' are scored

(green)	Meets criteria well
(amber)	Marginally meets the criteria
(red)	Does not meet the criteria
(dark red)	Fatally flawed

Criteria	Issue/Topic	Description/Explanation
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	Risk of public exposure to waterborne pathogens and contaminants, such as nitrates, in the following ways: • Direct contact with discharge site or wetland immediately downstream of discharge; • Direct contact with the receiving environment, for example through contact recreation; • Indirect exposure, through food gathering (such as shellfish, fish, watercress, waterfowl, etc.) and groundwater use.
Environment	Water quality effects	Potential effects on freshwater (surface and ground)
	Aquatic ecology effects	Potential effects on aquatic ecosystems
	Terrestrial ecology effects	• Potential effects on terrestrial ecosystems and soils • Assessing the project's potential to create opportunities for activities such as restoration
Social and community	Amenity value and aesthetics	• Potential effects on the natural and built environment (e.g. visual, odour, noise)

		• Risk of social acceptance and perception of new technology
	Recreation	• Extent to which the project enhances or detracts from recreational activities • Evaluating how much the project either enhances or diminishes the availability of new recreational opportunities
Physical and Constructability	Land availability	Adequate and secure land must be available for the required infrastructure
	Adaptable and flexible	Due to the uncertainty associated with future growth, a feasible option must be able to adapt to changing conditions such as increased flows and loads, discharge quality requirements, input requirements, and energy availability.
	Buildability, accessibility	• Consideration of access to the site / conveyance route for construction, likely enabling works requirements, level of environmental controls expected, extent of greenfield vs existing features to manage; • Distance and complexity of conveyance to potential discharge sites regarding length and potential complexity of routes along roads.
	Operational and engineering resilience	• Potential to be sufficiently resilient to natural hazards and climate change and operational failure; • Ability for option to accommodate wet weather flows that exceed the design; • Access to utilities/power • Risks of untested or unintended outcomes • Availability of relevant expertise and resources
The Vision and Strategy for the Waikato River (Te Ture Whaimana o te Awa o Waikato)	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	Te Ture Whaimana o te Awa o Waikato is for a future where a healthy Waikato River sustains abundant life and prosperous communities who, in turn, are all responsible for protecting the health and wellbeing of the Waikato River, and all it embraces, for generations to come.

Relative Capital Cost

$	Relatively low-cost option
$$	Relatively medium-cost option
$$$	Relatively high-cost option
$$$$	Extremely high-cost option

Standalone Option Limitations

Not all options in the Long-List of Discharge Options can function independently, as some may not handle flows from both Stage 1 and Stage 2 due to limitations such as flow rate of the discharge location (for discharge to water options), land area, wet weather conditions. As a result, some options need to be combined with others to be feasible. The table below provides information on the feasibility of each option for standalone use and indicates where further investigation is required.

Long-List Discharge Options	Standalone Option?
Discharge to Main Stem of the Waikato River	✓ **No limitation** (The discharge to the Waikato River is capable of handling flows from both Stage 1 and Stage 2.)
Discharge to Surface Waterways – Streams/Drains Draining to Waikato River	? **Uncertain** (Further investigation is needed, as the discharge to surface waters may only be able to handle flows for Stage 1.)
Discharge to Restored/Constructed Wetland	? **Uncertain** (Further investigation is needed, as the discharge to wetland may only be able to handle flows for Stage 1.)
Discharge to Land – Slow Rate Irrigation	? **Uncertain** (more investigation is required)
Discharge to Land – Rapid Infiltration	? **Uncertain** (more investigation is required)
Deep Bore Injection	? **Uncertain** (more investigation is required)
Discharge to Coast, Ocean	? **Uncertain** (more investigation is required)
Treated Wastewater Reuse	? **Uncertain** (more investigation is required)

Discharge Location: Discharge to Groundwater – Deep Bore Injection

Description

Deep bore injection (DBI) involves pumping treated wastewater into the subsurface using bores and the ability to implement the method depends on the geological environment of the sites and the units that receive the water should be well isolated from aquifers which are used for water supply. There are many factors influencing feasibility for deep bore injection such as area the unit cover and primary and secondary porosity of the unit which creates space for the discharge.

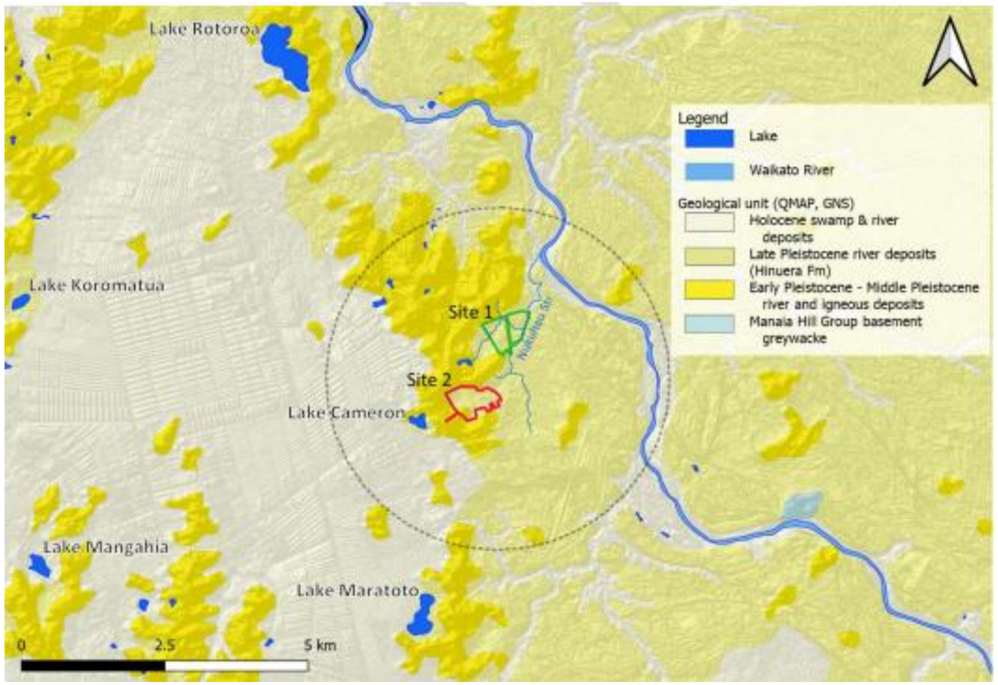
Should the DBI be the preferred option to proceed, a more detailed desktop study is required to review the local and regional geological and hydrogeological conditions and identify any potential down gradient receptors. Unless any red flags were identified, then site investigations should follow. Understanding the chemical characteristics of the aquifer and wastewater will also be required to understand any potential adverse impacts on the aquifer and operation of the injection bores.

There are various risks in developing the DBI which would need to be thoroughly identified and be reviewed and managed throughout the project. The potential risks include but are not limited to:

- Not encountering a sandy unit that is confined and laterally extensive; and
- The unit having upward flow zones and low enthalpy geothermal systems at depth.

Local Geological Units

Geological units in the lower Waikato catchment area, within the Hamilton Basin, are largely graben or fault bound depression, flanked by greywacke rangers (Pakaroa to the west and Hakarimata to the east). The basin is infilled with a thick sequence of largely alluvial Tauranga Group sediments. The deep sandy units of the Tauranga group present in the sites of interest, in particular those with a suitable confining layer, could be suitable for DBI. However, there are a number of associated risks which would require further investigation.



1. Discharge to Groundwater – Deep Bore Injection – Multi Criteria Assessment Summary

Criteria	Criteria	Assessment Summary
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	Proposed MBR discharge offers high quality of treated wastewater with low *E. coli* concentrations, however discharging potential emerging contaminants into an aquifer introduces uncertainties in terms of environmental effects, and therefore might result in a high impact on public health if that water were to be subsequently abstracted. A possible mitigation for this is discharging wastewater into the aquifer to a potable reuse standard, as is practiced in other countries. However, this comes at a very high cost.
Environment	Water quality effects	• Contamination of groundwater and freshwater systems, including potential contaminants from corrosion of deep bore injection equipment, is a concern. However, given the high quality of treated wastewater from the MBR system, the risk is minimal. • Likely to contribute to groundwater flow, due to the inland location (further assessment required). • There is a potential risk of impacting downstream receptors, including connections to surface water bodies, which requires further assessment to identify. However, due to the high quality of treated wastewater from the MBR system, this risk is considered minimal.
	Aquatic ecology effects	Potential for freshwater ecological effects depending on groundwater connections to surface waterbodies. However, very long travel times are likely to mitigate any adverse effects.
	Terrestrial ecology effects	Not applicable for deep bore injection
Social and community	Amenity value and aesthetics	Public concerns may arise regarding the injection of treated wastewater into an underground environment, so it will be important to manage public perception and expectations carefully. While deep bore injection is commonly used abroad, in

Criteria	Criteria	Assessment Summary
		New Zealand it is primarily confined to the disposal of process wastewater from the oil and gas industry.
	Recreation	Further investigation would be required to determine if contaminants could be transported to freshwater recreational areas from connections to groundwater.
Physical and Constructability	Land availability	• A relatively small amount of land would be required to construct the disposal site, however the location would need to be determined following extensive geological investigations.
	Adaptable and flexible	• Extensive investigation required to determine whether suitable conditions are present. • Large volume of storage required and there might not be sufficient separation between water supply and disposal geological units. • Suitable groundwater storage areas are generally within more permeable sand and gravel layers, which are likely used for water supply.
	Buildability, accessibility	• Not employed for wastewater disposal in New Zealand therefore there is limited experience with this type of construction. • Conveyance route would need to be determined following extensive investigation to find suitable site. • May require a higher level of treatment than currently allowed for.
	Operational and engineering resilience	• This option would physically be resilient to natural hazards and climate change but may require a greater level of maintenance compared to other options. • This option may be less effective due to limited suitable geology, therefore risk of significant wet weather storage or potential wet weather discharge into nearby waterbodies during wet conditions, compared to other alternatives. • Given that this technology is relatively new and has not yet been implemented in New Zealand, there may be challenges related to the availability of relevant

Criteria	Criteria	Assessment Summary
		expertise and resources, as well as potential risks associated with untested or unintended outcomes.
Te Ture Whaimana o te Awa o Waikato	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	This option may not be aligned with Te Ture Whaimana and other regional policy direction.
Relative capital cost		This is likely to be an extremely high-cost option due to the newness of the technology. Additionally, it may only be feasible to discharge wastewater treated to a potable standard, which will require an Advanced Water Treatment (AWT) treatment plant.
Summary Comments		This option is considered high-risk because it relies on highly specific geological conditions to be effective. Additionally, determining whether the geological conditions are suitable requires extensive and costly investigations upfront. Further treatment is likely required to mitigate risks.
Carry forward to Short-List?		No (to be confirmed following engagement with iwi) Standalone Option Limitations: Uncertain

Discharge Location: Discharge to coast – Ocean Outfall

Description

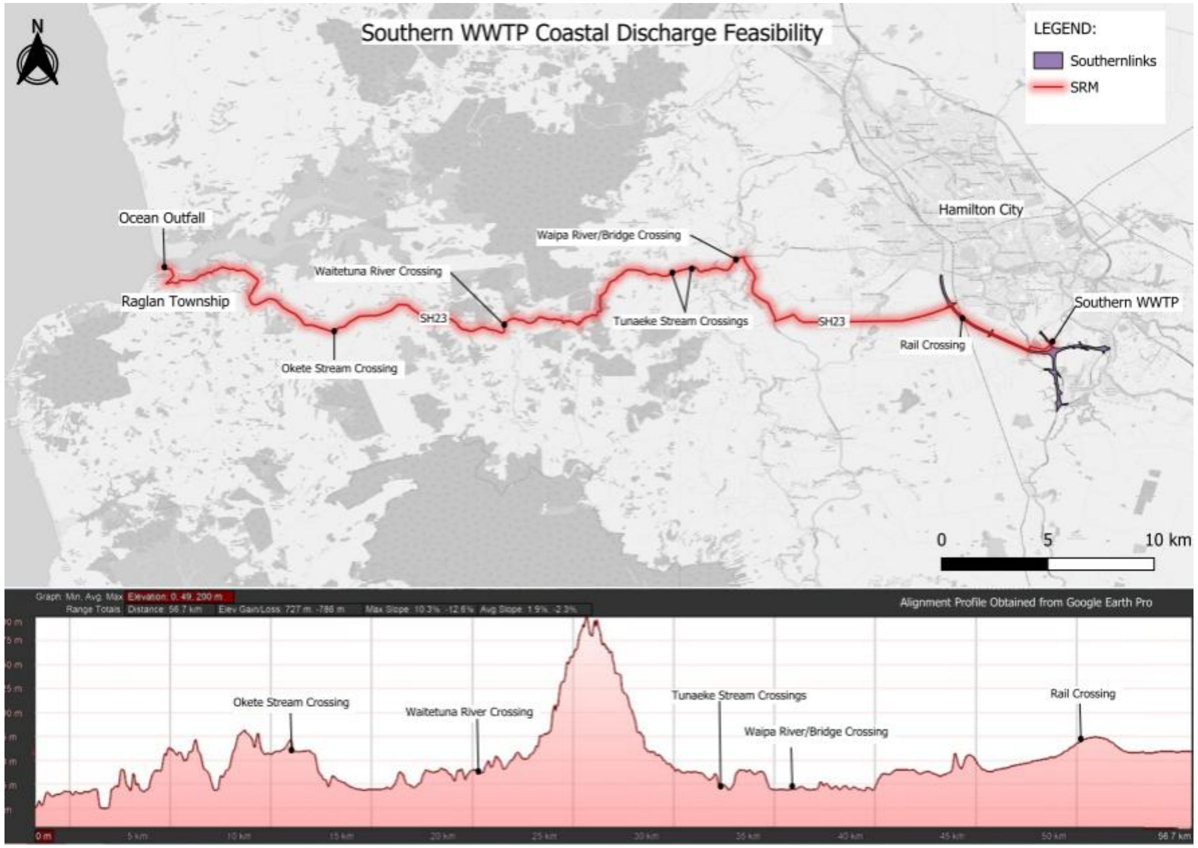
The option to discharge treated wastewater to an ocean outfall would require a rising main to be constructed, transporting treated wastewater to the location of an ocean outfall. For this option to be feasible a number of variables must be considered, in particular the physical barriers present which may present obstacles to constructing an alignment which would transport the treated wastewater to the desired location.

Based on the assessment undertaken, several barriers such as railway crossings, stream and bridge crossings, and the high requirement for traffic management are key obstacles to achieving discharge to the Raglan Harbour outfall. The peak static height of the alignment would be approximately 175 m, and therefore, the alignment would likely require multiple booster pump stations to convey the treated effluent to the ocean outfall.

The discharge would need to occur on the outgoing tide to be flushed from the Raglan Harbour, however this would be an extremely difficult scheme to operate given the very long pipeline and need to manage flows / storage within the system.

Location

The ocean outfall considered is close to the existing outfall at the Raglan Harbour. The alignment would closely follow the road corridor and be approximately 56.7km in length.



2. Discharge to coast – Ocean Outfall – Multi Criteria Assessment Summary

Criteria	Criteria	Assessment Summary
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	• There is a risk of exposure to waterborne pathogens due to public access at the coastal discharge location. However, proposed MBR discharge offers high quality of treated wastewater with low *E. coli* concentrations, resulting in a minimal impact on public health. • The potential for contact with waterborne pathogens through recreational use of the coast should be assessed through a quantitative microbial public health risk assessment. • Since kaimoana (shellfish) gathering occurs at the potential discharge site, there is a risk of contamination that could impact this practice. However, it should be considered that the quality of treated wastewater is expected to be high and therefore minimizes the risk. • A more detailed assessment is needed to evaluate the likelihood and potential impact of these effects.
Environment	Water quality effects	• The discharge is expected to have a negligible effect on water quality due to the significant dilution provided and high quality of treated wastewater.
	Aquatic ecology effects	• While the change in water quality is expected to be negligible, a comprehensive assessment of potential effects on aquatic ecosystems will be necessary. There might be possible adverse toxicity effects due to increased concentrations of toxicants such as nitrate. However, given the high level of dilution and the quality of treated wastewater is expected to be high, these effects are anticipated to be minimal.
	Terrestrial ecology effects	The construction of the pipeline and discharge structure may have potential impacts on terrestrial ecology.
Social and community	Amenity value and aesthetics	• Odour effects are minimised due to the level of treatment and dilution. However, the long length of the pipeline may result in long retention times,

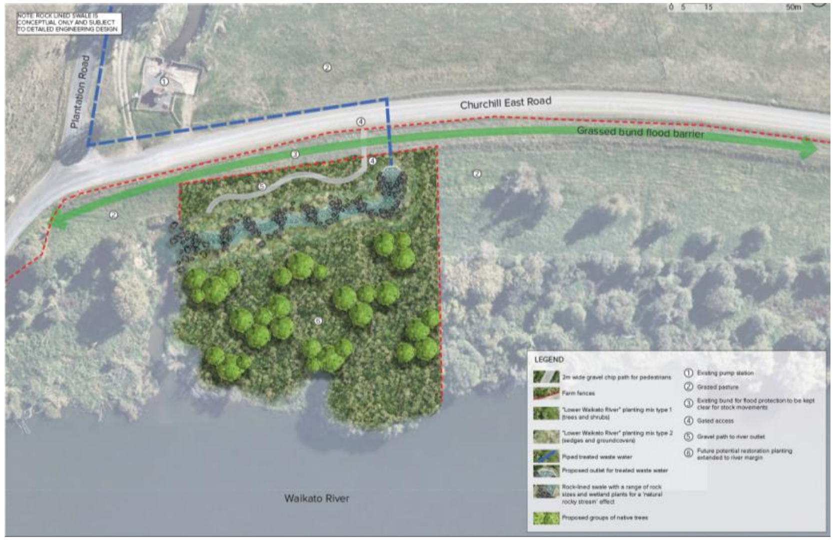
Criteria	Criteria	Assessment Summary
		increasing the risk of treated wastewater turning septic, which could cause odour issues at the discharge site. Therefore, an odour assessment may be needed to confirm the potential for any impacts. • Social acceptance is not expected to be a concern, as the technology used for the discharge of treated wastewater is established and not new.
	Recreation	• Potential reduction in recreational use of the coast could occur due to public perceptions of the discharge. • A further social impact assessment may be necessary, including community engagement and consideration of results from a quantitative microbial risk assessment.
Physical and Constructability	Land availability	• This option necessitates crossing Māori land close to the point in discharge. Given the length of the pipeline additional private land crossings are also likely to be required.
	Adaptable and flexible	• Extensive investigation is needed to determine if the conditions are suitable. • The pipeline can be sized to accommodate future flow increases. • The option utilises a straightforward discharge methodology.
	Buildability, accessibility	• Standard construction methodologies, similar to those used in other wastewater conveyance projects, are anticipated to be applicable, pending civil investigations. However, the length of the pipeline may introduce construction complications. • The conveyance route needs to be determined. The site's considerable distance from the SWWTP necessitates a longer pipeline, increasing complexity (approximately 56.7km in length). • While suitable site access is expected, extensive traffic management will likely be required. • Standard erosion and sediment controls are anticipated. • Further investigation is needed to confirm specific technical requirements.

Criteria	Criteria	Assessment Summary
	Operational and engineering resilience	• There are some risks associated with accessing utilities and power for pump stations. Additionally, the very long pipeline may present risks of untested or unintended outcomes. • The pipeline will be difficult to operate given likely requirements to discharge on the outgoing tide. • Odour and septicity issues will likely arise and will require careful management. • There are no risks concerning the availability of relevant expertise and resources, as the technology is well-established.
Te Ture Whaimana o te Awa o Waikato	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	This option will not be aligned with Te Ture Whaimana and other regional policy direction as it involves direct discharge of contaminants into a waterbody. Further assessment is required to evaluate the compliance of this discharge with Te Ture Whaimana o te Awa o Waikato.
Relative capital cost		Likely to be an extremely high-cost option due to the length of the pipeline (~57 km).
Summary Comments		Although the change in water quality is expected to be negligible, a comprehensive assessment of potential effects on aquatic ecosystems will be necessary. The considerable distance of the discharge site from the SWWTP requires a very long pipeline, which increases both complexity and cost. The pipeline is likely to be very difficult to operate.
Carry forward to Short-List?		No (to be confirmed following engagement with iwi) Standalone Option Limitations: Uncertain

Discharge Location: Discharge to Waikato River

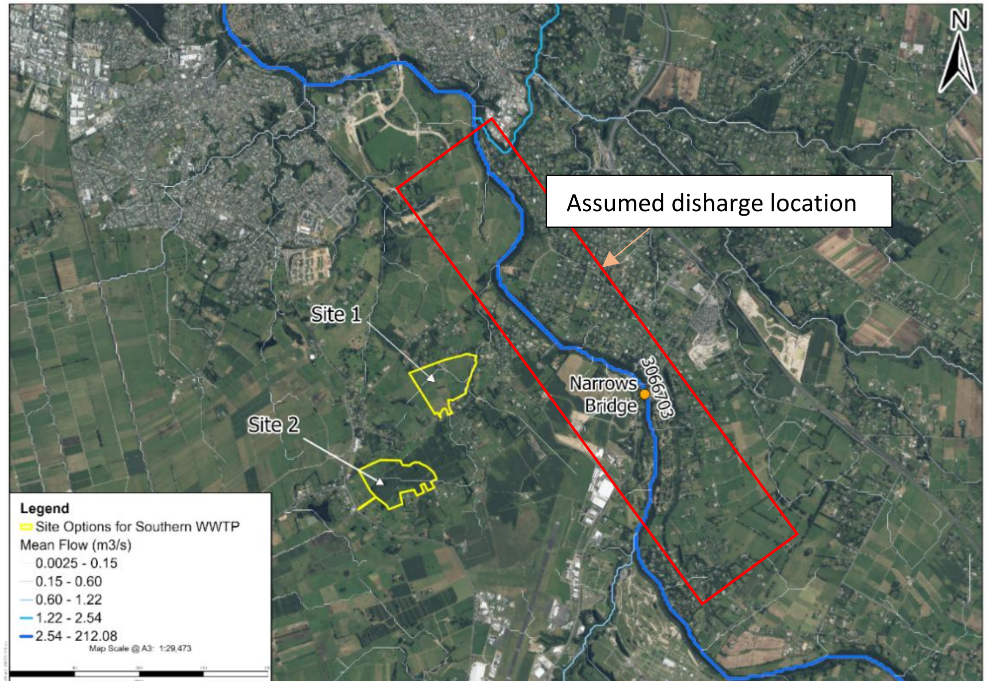
Description

This discharge option would be the discharge of treated wastewater indirectly to the Waikato River through a naturalised bankside rock channel with restoration planting. No structure would be planned on the River bed. The figure below shows an example of this option, depicting an indirect discharge to the Waikato River through a constructed, naturalised solution.



Location/Findings

The discharge location is assumed to be located upstream of Hamilton and downstream of Mystery Creek. Further work is required to identify specific discharge location options.



3. Discharge to water – Main stem of the Waikato River – Multi Criteria Assessment Summary

Criteria	Criteria	Assessment Summary
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	Public access to the discharge location presents a risk of exposure to waterborne pathogens. However, the proposed MBR discharge provides high-quality treated wastewater with low *E. coli* concentrations, which minimises the impact on public health. ▪ A quantitative microbial public health risk assessment should be conducted to evaluate potential contact with waterborne pathogens through recreational use of the river. ▪ If food gathering occurs in the area, there is a potential risk of contamination. However, the high quality of treated wastewater is expected to reduce this risk.
Environment	Water quality effects	The discharge is anticipated to have a negligible impact on water quality, due to both the river's ability to dilute the discharge and the high quality of the treated wastewater.
	Aquatic ecology effects	Although the change in water quality is expected to be negligible, a thorough assessment of potential impacts on aquatic ecosystems will be necessary. Potential adverse effects, such as increased toxicity from contaminants like nitrate, should be considered. However, due to the expected high quality of the treated wastewater and the river's dilution effect, these adverse impacts are anticipated to be minimal.
	Terrestrial ecology effects	Landscape enhancement, planting, and restoration activities may offer ecological benefits by supporting indigenous terrestrial fauna.
Social and community	Amenity value and aesthetics	Moderate likelihood of negative public perception and potential visual impacts
	Recreation	Public perception of the discharge could lead to reduced recreational use of the river and its downstream areas. Further social impact assessment may be needed,

Criteria	Criteria	Assessment Summary
		including community engagement and results from a quantitative microbial risk assessment.
Physical and Constructability	Land availability	Requires less land compared to discharge to land and constructed wetlands options, however likely that private land adjacent to the riverbank will be required to be acquired.
	Adaptable and flexible	Given the high flow of the Waikato River, there is likely flexibility in the amount of discharge.
	Buildability, accessibility	Further investigation is needed to evaluate potential discharge points. Standard construction methods, similar to those used in other wastewater conveyance projects, are expected to be applicable, pending civil assessment. Standard erosion and sediment control measures are anticipated. Additional investigation is required to confirm technical requirements.
	Operational and engineering resilience	Some flood risk is present; however, maintenance is expected to be minimal due to the relatively simple discharge method.
Te Ture Whaimana o te Awa o Waikato	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	While MBR treated wastewater is expected to be of high quality, its direct discharge into the Waikato River may not align with Te Ture Whaimana o te Awa o Waikato given this will be a new discharge. Offsetting may be required under Plan Change 1 to the Waikato Regional Plan. Further assessment is needed to determine how well this discharge complies with Te Ture Whaimana o te Awa o Waikato.
Relative capital cost		This is likely to be a relatively medium-cost option (depending on discharge location). Longer pipeline required compared to surface water and wetland discharge options that occur within the site of the WWTP.

Criteria	Criteria	Assessment Summary
Summary Comments		Although there may be minor environmental effects from discharging treated wastewater into the river, this direct discharge might not align entirely with Te Ture Whaimana o te Awa o Waikato. Further offsetting may be required given it is a new discharge to the Waikato River. It is likely that private land adjacent to the riverbank will be required to be acquired, and the conveyance route will be constructed on public roads. The construction difficulty of the conveyance route is expected to be similar to that of comparable projects.
Carry forward to Short-List?		Yes (To be confirmed following engagement with iwi) Standalone Option Limitations: No limitations

Discharge Location: Surface waterways – Nukuhau Mainstream

Description

Surface water discharge has the potential to drive habitat restoration and landscape enhancement at a selected site, particularly when incorporating nature-based solutions. To ensure minimal impact on ecosystems and human health, it is crucial to implement best practice solutions.

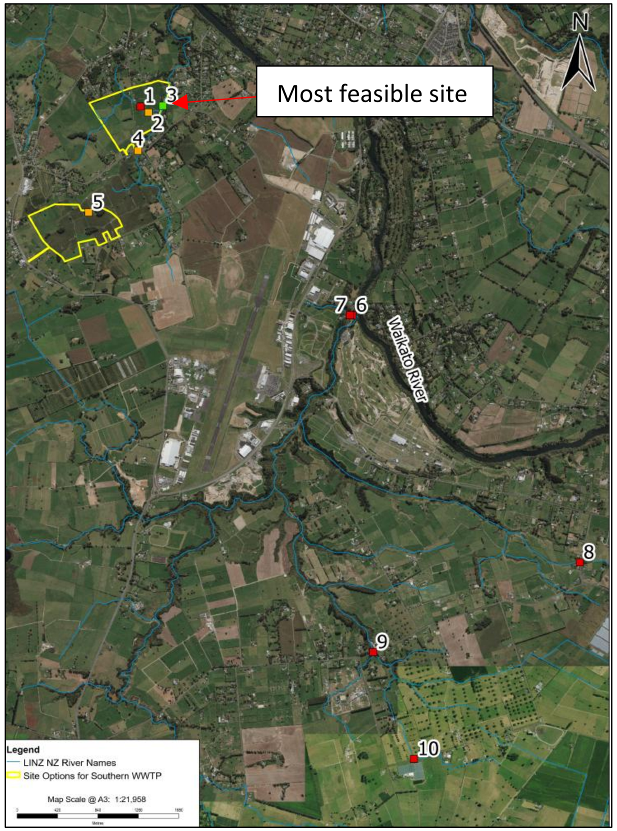
The assessment identified the **Nukuhau Mainstem** as the most feasible site for surface water discharge. It offers the fastest water flow among the investigated locations and has a large, flat area suitable for constructing a naturalised waterway.

Further investigations would be required to assess potential adverse effects on water quality, ecology, flooding, and public health. Additionally, a cultural impact assessment may be included in this investigative phase.

Potential discharge sites at Sharpe Farm

Location

The Nukuhau Mainstem is in close proximity to the proposed SWWTP location. Since the site is within the SWWTP area and currently owned by HCC, it is easily accessible.



Various sites considered as potential discharge locations

4. Surface waterways – Nukuhau Mainstream – Multi Criteria Assessment Summary

Criteria	Criteria	Assessment Summary
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	• Very high quality MBR discharge proposed with very low *E. coli* concentrations. • There are no recreational sites in the immediate vicinity of the site. However, there is potential for contact with waterborne pathogens through recreational use of the Waikato River downstream of the indirect discharge. Therefore, the public health effect should be assessed through a quantitative microbial public health risk assessment. • There are no recorded mahinga kai sites in the vicinity of the land parcel. However, if food gathering were to occur, there is a potential risk of contamination that could impact this practice. Further investigation is needed to ensure that the reach of the Nukuhau Stream is not currently used for mahinga kai or considered as a future mahinga kai site.
Environment	Water quality effects	• The discharge of treated wastewater into surface water is likely to impact water quality. However, given the stream's available flow dilution will help mitigate some of these effects. Detailed modeling and mixing studies are necessary to fully understand the extent of the impact. • Further mitigation can be achieved by maintaining a high standard of wastewater treatment and implementing restoration activities where feasible
	Aquatic ecology effects	• Potential ecological impacts may include increased algae growth and reduced dissolved oxygen levels, which could harm aquatic organisms. Although the proposed MBR discharge offers high quality of treated wastewater with low *E. coli* and ammonia concentrations, there might be a potential risk of toxic effects due to elevated concentrations of toxicants such as nitrate. While high dilution is likely to mitigate these effects, careful consideration must be given to periods of low stream flow and wet weather conditions. • A comprehensive effects assessment is required.

Criteria	Criteria	Assessment Summary
	Terrestrial ecology effects	• Landscape enhancement, planting, and restoration activities can offer ecological benefits by supporting indigenous terrestrial fauna. However, this option may necessitate the removal of some vegetation near the Nukuhau Stream.
Social and community	Amenity value and aesthetics	• The Nukuhau mainstem is well vegetated and distant from residential areas, reducing the likelihood of odour issues. This risk is further mitigated by the high level of treatment provided by MBR. • Proposed landscape enhancement planting will create green spaces potentially accessible to the public.
	Recreation	• Public perception of the discharge may lead to a reduction in recreational use of the river and its downstream areas. • A further social impact assessment, including community engagement may be necessary.
Physical and Constructability	Land availability	• The area is generally flat, providing sufficient space for the construction of a naturalised waterway. Compared to land discharge options, this approach requires a relatively small amount of land. Additionally, since the site is owned by HCC, there are no concerns regarding land acquisition.
	Adaptable and flexible	• The pipeline can be sized to accommodate future flow increases. Further investigation may be needed to assess the option's ability to accommodate wet weather flows. • The site is in close proximity to the SWWTP, and this option offers a straightforward discharge method.
	Buildability, accessibility	• The site's proximity to the SWWTP allows for a shorter pipeline compared to other options. • Ample space is available for the construction of a naturalised waterway. • Standard construction methodologies used in other wastewater conveyance projects are expected to be applicable, subject to civil investigations.

Criteria	Criteria	Assessment Summary
		• Standard erosion and sediment control measures are anticipated. • Additional investigations are required to confirm technical requirements, including geotechnical assessments and contaminated land evaluations.
	Operational and engineering resilience	• While flooding is not expected, a minimal risk still exists. • The relatively simple discharge method is anticipated to require less maintenance. • Additional considerations are needed for managing wet weather flow discharges. • There are no identified risks regarding the availability of relevant expertise and resources, as the discharge method is relatively straightforward and well-understood.
Te Ture Whaimana o te Awa o Waikato	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	Contaminants will enter the Waikato River indirectly. Offsetting may be required under Plan Change 1 to the Waikato Regional Plan. Further assessment is needed to evaluate alignment with Te Ture Whaimana o te Awa o Waikato.
Relative capital cost		This is likely to be a relatively Low-cost option for stage 1. The site is owned by HCC. Its proximity to the SWWTP allows for a shorter pipeline compared to other options. An additional discharge option may be required to accommodate long-term (Stage 2b) flows.
Summary Comments		While there may be some environmental effects from discharging to the stream, these effects are not expected to be significant and can be quantified through investigations to inform effective mitigation strategies. The conveyance route can be constructed on private land, as the site is very close to the SWWTP and is owned by HCC. Construction of the conveyance route is anticipated to be straightforward, similar to other projects. The route is shorter than alternative options and offers more land for landscape enhancement, making it a more desirable choice. The cultural impact of this option will require assessment given discharge to Nukuhau Stream.
Carry forward to Short-List?		Yes (to be confirmed following engagement with iwi) Standalone Option Limitations: Uncertain

Discharge Location: Restored/Constructed Wetlands

Description

This option involves conveying treated wastewater to a constructed wetland that would be restored as part of the project. The feasibility assessment considered factors such as slope, soil drainage, land use, and distance from the WWTP.

Wetlands are highly effective at removing pollutants through physical, chemical, and biological processes, including sedimentation, precipitation, adsorption, and denitrification. If implemented, treated wastewater would be discharged via a naturalized rocky channel planted with native vegetation to prevent erosion, flowing horizontally over the wetland sediment.

Site 6 was identified as the most feasible location. It is over 200 m from the nearest watercourse (assuming infill of artificial drains) and offers high restoration potential due to its high water table and natural wetland characteristics. 'Site 6' is located near arrows and Rukuhia road. The site has a land area of 27 Ha, an excess of the required 25 Ha, allowing for greater flexibility. However, it should be noted that Site 6 is a proposed bat restoration area for Southern Links, which may render this site infeasible. Alternative options are Sites 3 and Site 4, located at Sharpe Farm, which is owned by HCC.

Considering the notes above, Site 6 is not a feasible option for discharge. Consequently, we have conducted the Multi-Criteria Assessment for Sites 3 and 4, which are the feasible options for discharge to a wetland.

Location

5. Restored/Constructed Wetlands – Site 3 and/or 4 – Multi Criteria Assessment Summary

Criteria	Criteria	Assessment Summary
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	• There is no public access to the potentials discharge locations as the sites (site 3 and 4) are located on private land (owned by HCC); however, there is a potential risk of contaminants entering groundwater. Further investigation is required to assess this risk. • Based on the available information, there are no recreational sites in the immediate vicinity of the potential sites. • There are no known mahinga kai sites in the vicinity of the land parcels. However, there is a potential risk of microbial pathogens entering groundwater that may be used for human consumption.
Environment	Water quality effects	• The wetland is expected to effectively maintain surface water quality. However, artificial drains on the site may discharge eventually to the Waikato, potentially impacting water quality. However, the potential effects on water quality are expected to be minor considering the high quality of treated wastewater. Additionally, a hydrogeological assessment is needed to evaluate potential effects on groundwater flow.
	Aquatic ecology effects	There is potential for adverse toxic effects resulting from the discharge of contaminants as the proposed MBR discharge will provide high-quality treated wastewater with low concentrations of *E. coli* and ammonia.
	Terrestrial ecology effects	• The conversion of pasture to wetland could create habitat suitable for indigenous fauna.
Social and community	Amenity value and aesthetics	• The area presents an opportunity for natural enhancement.
	Recreation	• The location is not currently near existing recreational areas. Since both sites are on private land, no adverse effects on recreational activities are expected.
Physical and Constructability	Land availability	• The proposed land areas exceed the minimum requirement, providing flexibility in design. Sites 3 and Site 4, located at Sharpe Farm, are owned by HCC.

	Adaptable and flexible	• Further consideration is needed to ensure adaptability for increased discharge during wet weather flows and whether the wetland can accommodate these flows. The feasible sites exceed the minimum land size requirement, providing flexibility if additional area is needed.
	Buildability, accessibility	• Further investigation is needed to confirm technical requirements, including geotechnical and hydrological assessments. • It is anticipated that standard construction methodologies, similar to those used in other wastewater conveyance projects, can be applied, pending civil investigations. • The required pipe length will be relatively short, as the feasible locations are in close proximity to the proposed SWWTP site.
	Operational and engineering resilience	• Further investigation to assess the flood risk may be required. • This option would require some maintenance, especially during the establishment phase of the wetland. • No identified risks concerning access to utilities or power, nor are there concerns about untested or unintended outcomes. • There are no risks related to the availability of relevant expertise and resources.
Te Ture Whaimana o te Awa o Waikato	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	Discharging to the wetland is likely to align with Te Ture Whaimana and other regional policy directions, as contaminants will not be directly discharged into the Waikato River. Offsetting may be required under Plan Change 1 to the Waikato Regional Plan. However, concerns regarding potential flow into nearby waterways will need to be addressed and carefully considered.
Relative capital cost		This is likely to be a relatively low-cost option. Sites 3 and 4 are owned by HCC. Its proximity to the SWWTP allows for a shorter pipeline compared to other options.
Summary Comments		While the discharge to a wetland may have some environmental effects, these are not expected to be significant as the proposed MBR discharge provides high-quality treated wastewater. Converting the land to a wetland could create valuable habitat for indigenous fauna. Feasible Sites (Site 3 and Site 4), located at Sharpe Farm, are owned by HCC and therefore there are not uncertainties about property acquisition.

Carry forward to Short-List?	To be confirmed following engagement with iwi. Standalone Option Limitations: Uncertain

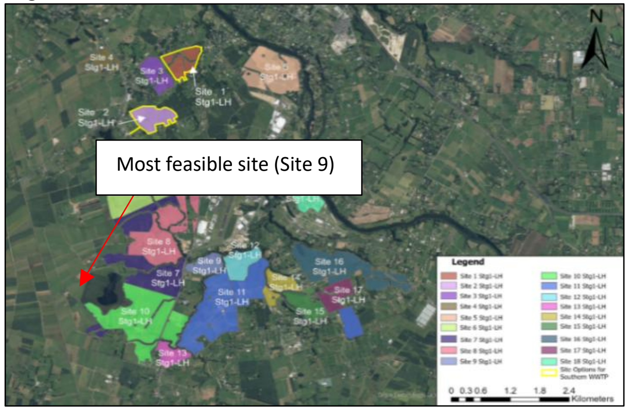
Discharge Location: Land Discharge – Stage 1

Potential suitable sites for discharge of treated wastewater were assessed for two hydraulic loading rates (a low hydraulic loading rate of 3 mm/day), and a high rate of 25 mm/day). Both loading rates were considered alongside an average daily flow of 400 m^3/day (Stage 1). This feasibility assessment considered a range of criteria such as slope, soil drainage, land use type, and distance from the WWTP.

Low Hydraulic Loading Rate

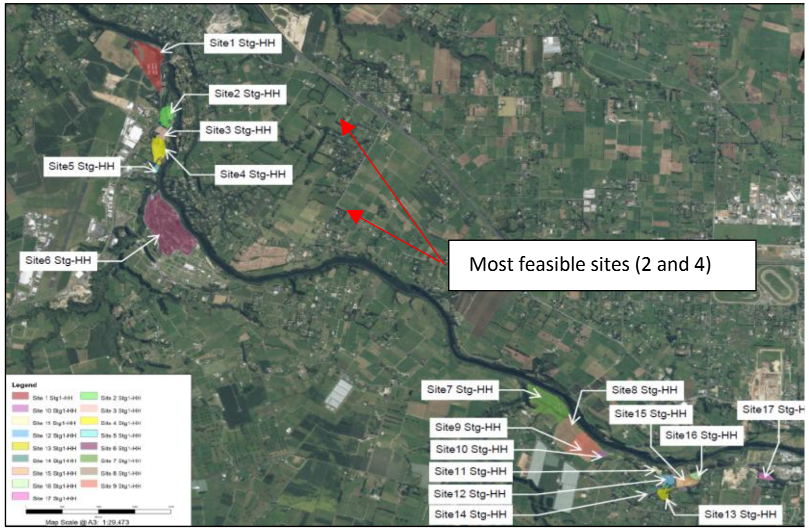
'Site 9' was identified as the most feasible option under a low hydraulic loading rate. The minimum area required under this stage is 20 Ha. Site 9 has an area of 24 Ha, exceeding the minimum requirements. 100% of the site has a slope less than 7º and is approximately 3.5 km from the proposed WWTP location. 'Mystery Creek' runs along the eastern parameter of the site and is considered a Significant Natural Area (SNA). Because this SNA is along the margins of the site, the buffer area included in calculations should also adequate protections to the SNA if this land parcel is selected for irrigation. The proposed discharge method for Stage 1 is subsurface drip irrigation.

The other option is Site 1. The Nukuhau Mainstem is in close proximity to the site. Since the site is within the SWWTP area and currently owned by HCC, it is easily accessible. Following the allocation of land for the WWTP construction, approximately 20 Ha of land remain available, which would be sufficient for discharge during Stage 1 as the minimum area required under this stage is 20 Ha.



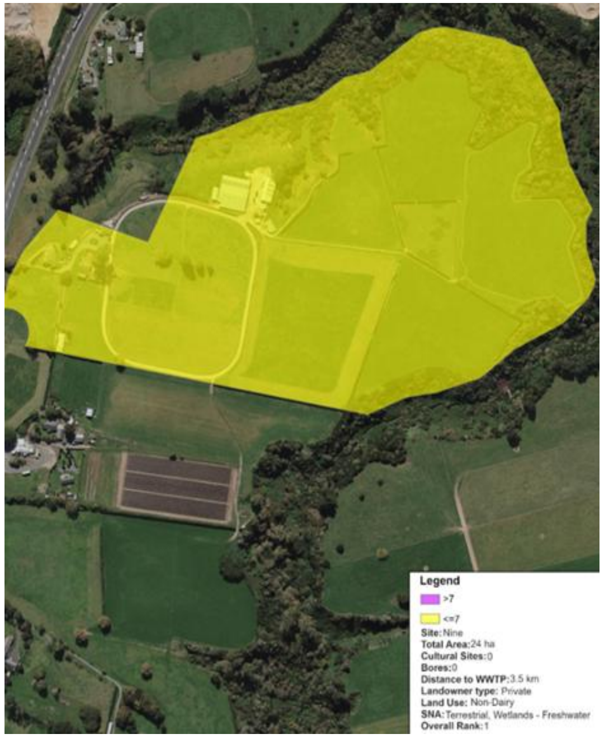
High Hydraulic Loading Rate

Sites 2 and 4 were identified as the most feasible option under a high hydraulic loading rate. The minimum area required under this stage is 1 Ha. A high hydraulic loading rate requires highly permeable soils to allow for adequate soakage. All two sites have more than 90% moderately to well drained soils allowing for this. These sites are between 2.6 – 2.7 km from the SWWTP. Alongside further geotechnical investigation, Site 4 is in close proximity to a cultural site and will require further engagement with mana whenua. The proposed land discharge methods for high loading rates include either Rapid Infiltration Basin Systems (RIBS) or high-rate drippers.

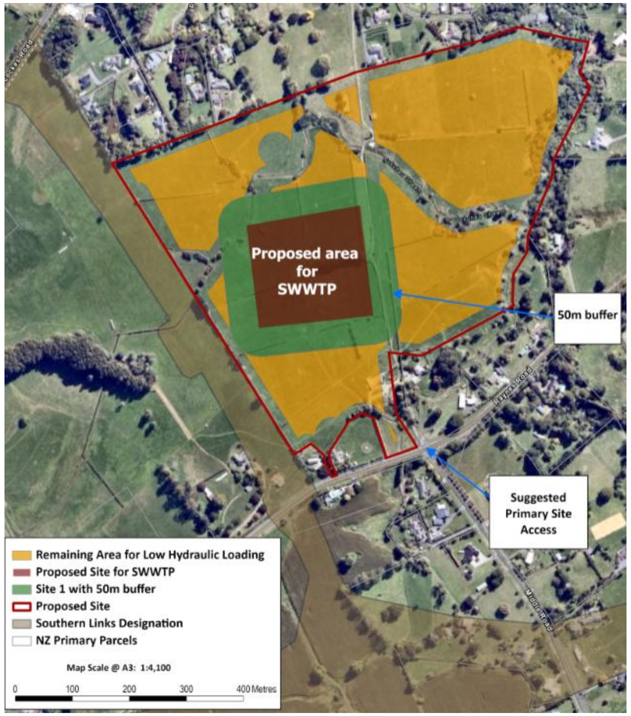


Low Hydraulic Loading Rate

Site 9:

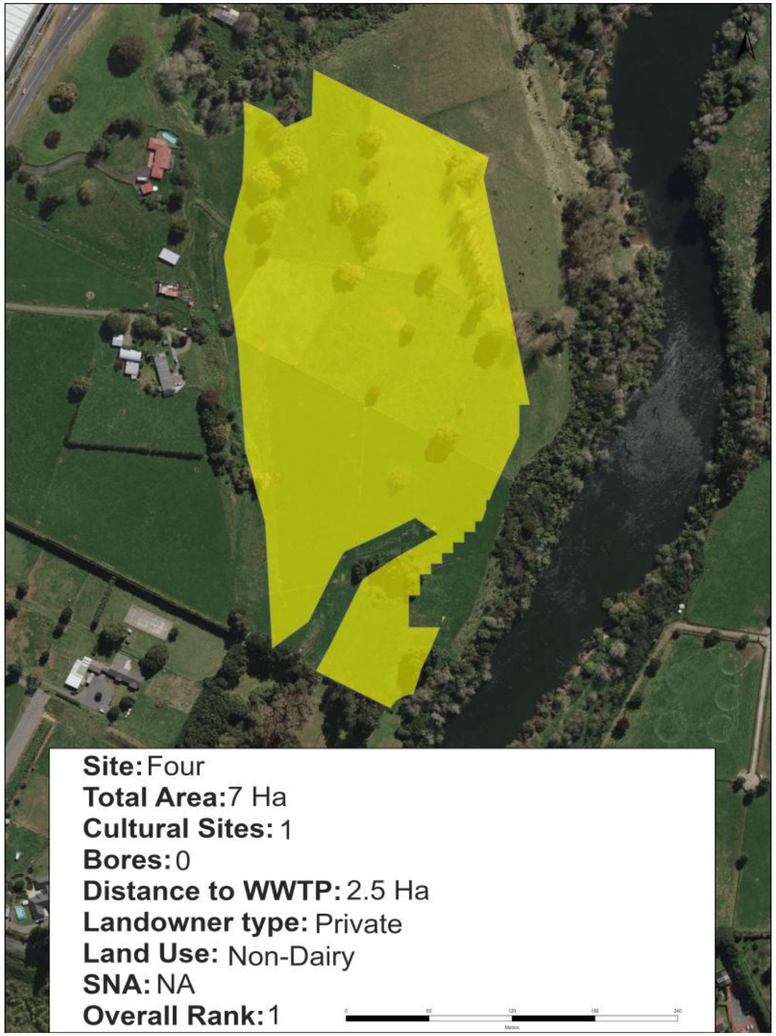


Site 1 (Sharpe Farm):



High Hydraulic Loading Rate

Sites 2 and 4:



6. Land Discharge – Stage 1 – Low Hydraulic Loading Rate – Multi Criteria Assessment Summary

Criteria	Criteria	Assessment Summary
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	• Based on the available information, there are no recreational sites in the immediate vicinity of the site. • There are no known mahinga kai sites in the vicinity of the land parcel. However, there is a potential risk of microbial pathogens entering groundwater used for human consumption.
Environment	Water quality effects	• There is potential for contaminant discharge to impact either groundwater or surface water. For surface water, this risk may arise from wet weather overflow, while for groundwater, it could be due to diffuse routes. Implementing a buffer of 50 m between the site and the nearest surface water body is recommended. Given the well-draining soil profile and the presence of this buffer, the risk of discharge to surface water is low. • A suitable application rate ensures that treated wastewater moves through the soil via matrix flow, maximizing travel time and contact with soil particles, which helps prevent overland flow. Wet weather storage during the wet season allows treated wastewater to be absorbed by the soil and vegetation, further reducing the risk of seepage into groundwater. However, the impact on groundwater quality may vary depending on the groundwater depth. • Nitrogen and phosphorus loads should be assessed to determine their suitability for the soil and the potential lag times before entering groundwater.
	Aquatic ecology effects	• There are no wetlands or water bodies of natural significance in the immediate vicinity. However, there may be potential adverse impacts associated with the potential water quality effects.
	Terrestrial ecology effects	• There is a low likelihood of adverse effects on terrestrial ecology, but further assessment is needed to confirm this.
Social and community	Amenity value and aesthetics	• The risk of spray drift, odour generation, and transport to nearby residential areas, including lifestyle blocks, is non-existent since the discharge will occur below the surface. • The technology used for the discharge of treated wastewater is well-established and not new.
	Recreation	Site 9 and Site 1 are not close to existing recreational areas. Since both sites are on private land, no adverse effects on recreational activities are expected.

Criteria	Criteria	Assessment Summary
Physical and Constructability	Land availability	Site 9 is on private land, which introduces uncertainty regarding property acquisition. Private land acquisition is required if Site 1 (owned by HCC) is not used.
	Adaptable and flexible	• Several surrounding sites may be feasible for expansion if needed. However, expanding the site would necessitate the acquisition of additional land.
	Buildability, accessibility	• Standard construction methodologies, similar to those used in other wastewater conveyance projects, are anticipated, pending civil investigations. • The conveyance route needs to be determined; however, the site's proximity to the SWWTP is advantageous. • Access to the site is expected to be suitable, though traffic management will be necessary. • Further investigation is required to confirm technical requirements, including geotechnical and contaminated land assessments.
	Operational and engineering resilience	• The land is not on a floodplain and is likely to be sufficiently resilient to natural hazards. • There could be potential issues with this the option's ability to handle wet weather flows during winter, especially considering the close proximity to Mystery Stream. Further investigation may be required. • No identified risks regarding access to utilities or power, and there are no concerns about untested or unintended outcomes. • There are no risks related to the availability of relevant expertise and resources.
Te Ture Whaimana o te Awa o Waikato	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	• Land discharge is likely to align well with Te Ture Whaimana and other regional policy directions, as contaminants will not be directly discharged into the Waikato River. • A low application rate ensures that treated wastewater is absorbed through matrix flow, maximising travel time and contact with soil particles, which helps prevent overland flow.
Relative capital cost		This is likely to be a relatively medium-cost option given the size of the land required for Stage 1 in comparison to other options. Private land acquisition is required if Site 1 (owned by HCC) is not used.

Criteria	Criteria	Assessment Summary
Summary Comments		Discharging to land at a low hydraulic loading rate and with appropriate buffers may result in minor environmental effects. This option could be relatively high-cost due to the land area required and the length of the pipeline. Extensive investigation and assessment will be necessary to support resource consent, though this discharge method has been successful in similar sensitive environments in New Zealand. Engaging with the landowner is crucial, and land acquisition is uncertain. However, alternative option is Site 1, located at Sharpe Farm, which is owned by HCC.
Carry forward to Short-List?		Yes (to be confirmed following engagement with iwi) Standalone Option Limitations: Uncertain

7. Land Discharge – Stage 1 – High Hydraulic Loading Rate – Multi Criteria Assessment Summary

Criteria	Criteria	Assessment Summary
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	• The section of the Waikato River adjacent to the site is frequently used for recreational activities such as jet skiing, which might present a risk of the general public coming into contact with the site. However, proposed MBR discharge offers high quality of treated wastewater with low E. coli concentrations, resulting in a minimal impact on public health. Additionally, any remaining pathogens in the discharged wastewater will be filtered out by the soil before the water reaches the river. • There are no specific mahinga kai sites in the vicinity of the land parcel. However, there is a potential risk of microbial pathogens entering groundwater used for human consumption.
Environment	Water quality effects	• The sites are located in close proximity to the Waikato River. A buffer of 50 m between the site and the nearest surface water body should be considered to ensure the stability of the bank. In rapid infiltration systems, water percolates through the soil, eventually reaching the aquifer system, flowing to a surface water body, or being recovered by pumping. • Given the well-draining soil profile and expected high quality of treated wastewater, potential effects on freshwater (both surface and groundwater) are considered low. Also, the groundwater level in the area is modeled to be at a relatively high depth, further hydrological investigation is needed to confirm this.
	Aquatic ecology effects	There is a potential risk of contaminants entering water bodies through rapid infiltration systems, as water percolates through the soil and eventually reaches the aquifer system before flowing to surface water bodies. Further investigation is required to assess this risk.

Criteria	Criteria	Assessment Summary
	Terrestrial ecology effects	• There may be no adverse effects on terrestrial ecology, but further assessment is necessary to confirm this.
Social and community	Amenity value and aesthetics	• There may be potential odour risks due to the high loading rate of the discharge. However, the risk is minimal due to the high quality of the treated wastewater from the MBR system and the use of subsurface discharge. • There are no anticipated risks to social acceptance, as the technology used for the discharge of treated wastewater is established and not new.
	Recreation	Since both sites are on private land, no adverse effects on recreational activities are expected.
Physical and Constructability	Land availability	The proposed discharge locations are on private land, which introduces uncertainty regarding property acquisition. Additionally, the site areas are large.
	Adaptable and flexible	• The large land area offers significant flexibility for development. • Several surrounding sites may be feasible for expansion if needed.
	Buildability, accessibility	• Standard construction methods, similar to those used in other wastewater conveyance projects, are expected to be applicable, pending civil investigations. • The conveyance route needs to be determined, although the site's proximity to the SWWTP is advantageous. • Access to the site is anticipated to be suitable. • Further investigation is required to confirm technical requirements, including geotechnical assessments and evaluations of contaminated land.
	Operational and engineering resilience	• The land is not located on a floodplain and is likely to be largely resilient to natural hazards. • Further investigation may be needed to assess the option's ability to accommodate wet weather flows, especially given its proximity to Mystery Stream and the Waikato River. • No identified risks related to access to utilities or power, and there are no concerns about untested or unintended outcomes.

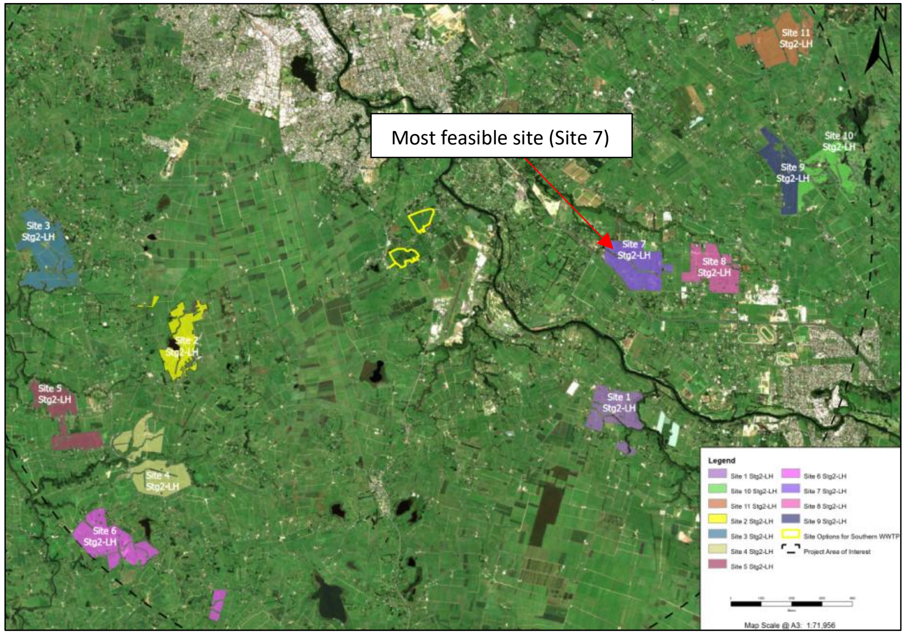
Criteria	Criteria	Assessment Summary
		• There are no risks concerning the availability of relevant expertise and resources.
Te Ture Whaimana o te Awa o Waikato	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	• Land discharge is likely to align with Te Ture Whaimana and other regional policy directions, as contaminants will not be directly discharged into the Waikato River. • However, there is potential for contaminant runoff from the rapid infiltration systems to impact the Waikato River. • Offsetting may be required under Plan Change 1 to the Waikato Regional Plan.
Relative capital cost		This is likely to be a relatively medium-cost option in comparison to other options. Private land acquisition is required.
Summary Comments		The suitable sites for land discharge using rapid infiltration systems require smaller area compared to slow rate irrigation and are near the Waikato River. This proximity means there could be some negative environmental effects from contaminants potentially reaching surface water bodies or groundwater through soil infiltration, However, the effects are deemed minor due to the high quality of treated wastewater and soil's ability to effectively remove contaminants. Therefore, the potential impact on freshwater (both surface and groundwater) is considered low. Engaging with the landowner is essential, and there are uncertainties regarding land acquisition.
Carry forward to Short-List?		Yes (to be confirmed following engagement with iwi) Standalone Option Limitations: Uncertain

Discharge Location: Land Discharge – Stage 2

Potential suitable sites for discharge of treated wastewater were assessed for two hydraulic loading rates (a low hydraulic loading rate of 3 mm/day), and a high rate of 25 mm/day). This feasibility assessment considered a range of criteria such as slope, soil drainage, land use type, and distance from the WWTP. The two sites identified under stage one should be considered tentative options, as at this stage no engagement with landowners has occurred.

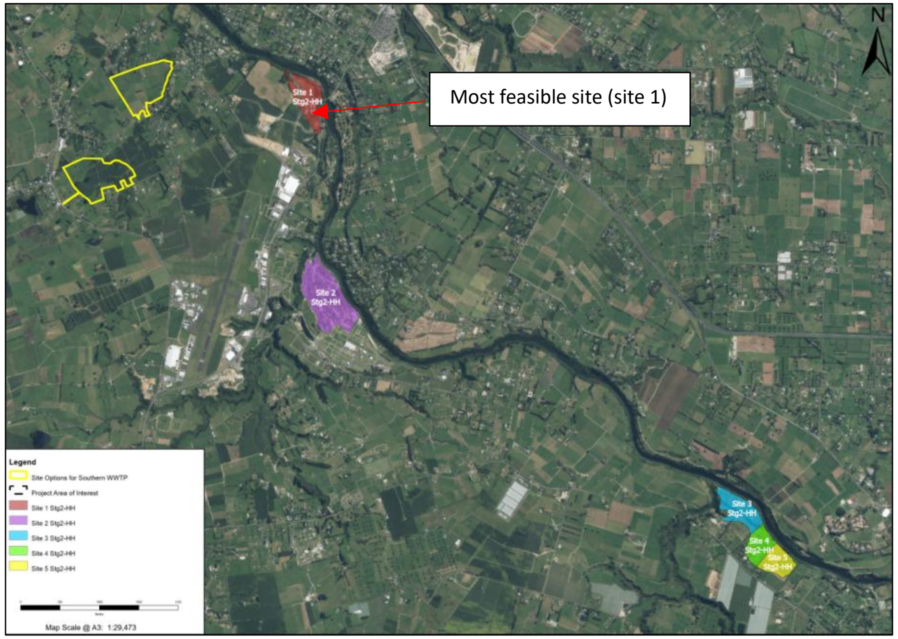
Low Hydraulic Loading Rate

The minimum area required under this stage is 180 Ha. 'Site 7' was identified as the most feasible option under a low hydraulic loading rate. This site has a has a total available area of 233 Ha, 100% of the site has a slope less than 7º and is approximately 3.5 km from the proposed WWTP location. A stream runs through the center of this site, and a 20 m buffer has been applied to the land area. Further investigations would need to explore the three cultural sites, and four bores located on this land parcel.



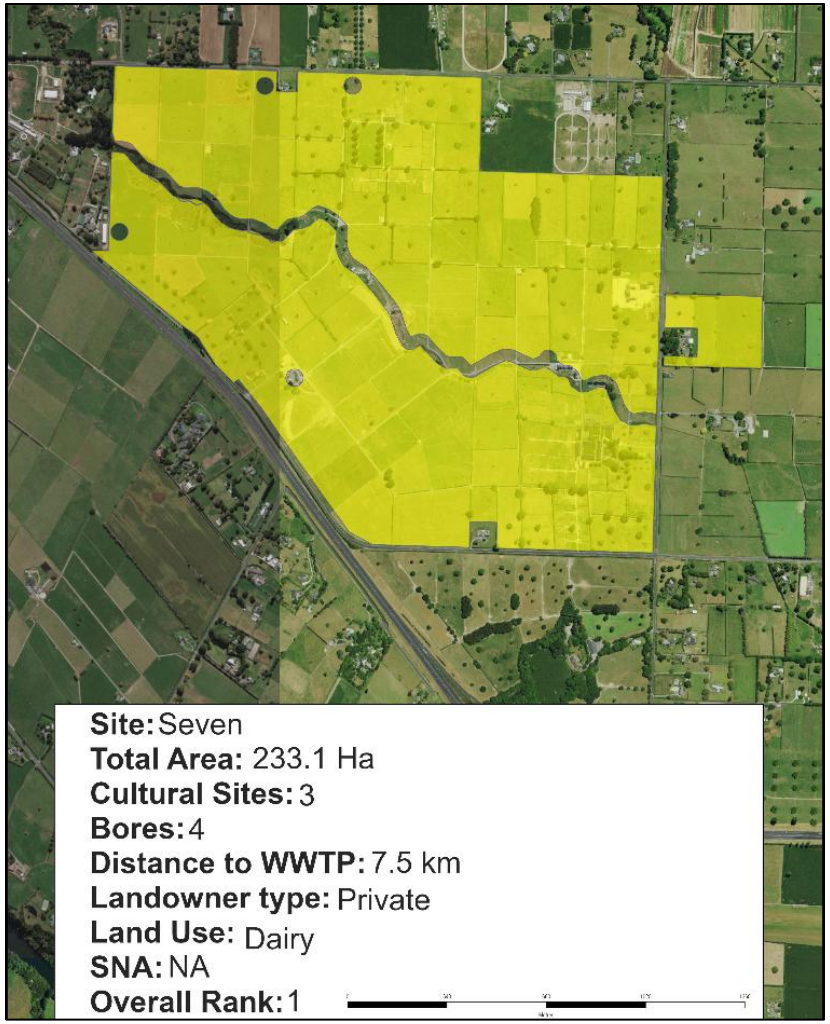
High Hydraulic Loading Rate

The minimum area required under this stage is 9 Ha. The most feasible site, Site 1, located 2.7km km from the WWTP. The site has an approximate area of 19.4 Ha, and approximately 78% of the area has a slope less than 7º. Sections of the land greater than 7º are located around the margins of the land parcel, and further consideration would need to be given to potential effects of this topography.



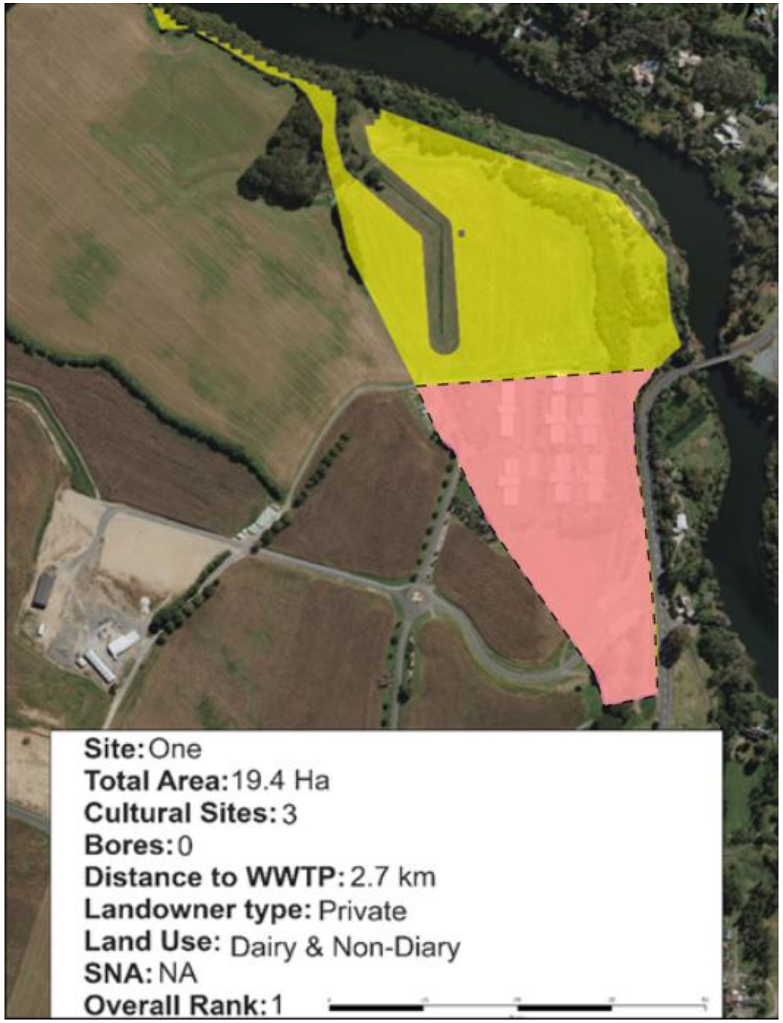
Low Hydraulic Loading Rate

Site 7:



High Hydraulic Loading Rate

Site 1:



8. Land Discharge – Stage 2 – Low Hydraulic Loading Rate – Multi Criteria Assessment Summary

Criteria	Criteria	Assessment Summary
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	• Based on the available information, there are no recreational sites in the immediate vicinity of the site. • No known mahinga kai sites are located in the vicinity of the land parcel. However, there is a potential risk of microbial pathogens entering groundwater used.
Environment	Water quality effects	• There is potential for contaminant discharge to enter groundwater or surface water. For surface water, this could occur due to wet weather overflow, while for groundwater, it may happen through diffuse pathways. A buffer zone of 50 m to the nearest surface water body (Mangaomapu Stream) should be considered. • Given that the soil profile is predominantly well-draining and a buffer is in place, the risk of discharge to surface water is relatively low. • An appropriate application rate ensures that treated wastewater moves through the soil via matrix flow, which maximises travel time and contact with soil particles, thus minimising the risk of overland flow. • Wet weather storage during the wet season further supports this by allowing treated wastewater to be absorbed by soil and vegetation, reducing the risk of groundwater contamination. • However, nitrogen and phosphorus loads should be assessed to ensure they are suitable for the soil and to evaluate potential lag times for entering groundwater
	Aquatic ecology effects	• There are no wetlands or water bodies of natural significance in the immediate vicinity.

Criteria	Criteria	Assessment Summary
	Terrestrial ecology effects	• There may be no adverse effects on terrestrial ecology, but further assessment is necessary to confirm this.
Social and community	Amenity value and aesthetics	• There might be some potential risk of spray drift, odour generation, and transport to nearby residential areas, including lifestyle blocks. To minimise potential effects, an appropriate buffer distance should be established. • There are no social acceptance risks associated with this practice, as it employs established technology for treated wastewater discharge. • However, there are three cultural sites either on the property or in close proximity, which could pose some risk to acceptance and may require further consideration.
	Recreation	• The location is not near any existing recreational areas, and it is unlikely that the land will affect the availability of new recreational opportunities.
Physical and Constructability	Land availability	The proposed discharge location is on private land, and the land area required for Stage 2 is large (180 Ha). These would introduce uncertainty regarding the process of property acquisition.
	Adaptable and flexible	• The land area satisfies the requirements for discharge based on anticipated future flows for Stage 2. • There could be potential issues with wet weather storage to handle wet weather flows during winter. Further investigation may be required. • There are several adjacent sites that could potentially be utilised for expansion if necessary.
	Buildability, accessibility	• Standard construction methodologies, similar to those used in other wastewater conveyance projects, are anticipated, pending civil investigations. • The conveyance route needs to be determined. Given that the site is located across the Waikato River from the SWWTP, a longer pipeline will be

Criteria	Criteria	Assessment Summary
		necessary compared to other land discharge options, which adds to the complexity of the project. • While suitable site access is expected, traffic management will be required. • Further investigation is needed to confirm technical requirements, including geotechnical and contaminated land assessments.
	Operational and engineering resilience	• The land is not situated on a flood plain and is likely to be resilient to natural hazards. • Further investigation may be needed to assess the option's capacity to handle wet weather flows, particularly considering the proximity of Mangaomapu Stream. Due to high flow rates expected in Stage 2, especially during winter, onsite storage will likely be necessary. • There are no identified risks related to access to utilities or power, and no concerns about untested or unintended outcomes. • There are no risks regarding the availability of relevant expertise and resources, as this is a well-established technology.
Te Ture Whaimana o te Awa o Waikato	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	• Land discharge aligns well with Te Ture Whaimana and other regional policy directives by ensuring that contaminants are not directly discharged into the Waikato River. Using a low application rate ensures that treated wastewater is absorbed into the soil through matrix flow, maximizing travel time and contact with soil particles, and effectively preventing any risk of overland flow. • It should be noted that year-round discharge to land is unlikely to be feasible; therefore, some form of storage or an alternative discharge method will likely be required.
Relative capital cost		• This is likely to be a relatively high-cost option. Private land acquisition is required. The preferred site is across the Waikato River from the SWWTP, a longer pipeline will be necessary compared to other land discharge options.

Criteria	Criteria	Assessment Summary
Summary Comments		Discharging to land at a low hydraulic loading rate and with appropriate buffers may result in minor environmental effects. This option could be relatively high-cost due to the large land area required and the length of the pipeline. Extensive investigation and assessment will be necessary to support resource consent, though this discharge method has been successful in similar sensitive environments in New Zealand. Engaging with the landowner is crucial, and land acquisition could be uncertain. However, there are several nearby sites that may be suitable for expansion if needed. Additionally, since the site is situated across the Waikato River from the SWWTP, a longer pipeline will be required compared to other land discharge options. This increased distance adds to the project's cost and complexity.
Carry forward to Short-List?		No (to be confirmed following engagement with iwi)

9. Land Discharge – Stage 2 – High Hydraulic Loading Rate – Multi Criteria Assessment Summary

Criteria	Criteria	Assessment Summary
Public Health	Public health effects due to microbiological quality of treated wastewater and other contaminants	• The stretch of the Waikato River adjacent to the site is frequently used for recreational activities, such as jet skiing. The section of the Waikato River adjacent to the site is frequently used for recreational activities such as jet skiing, which might present a risk of the general public coming into contact with the site. However, proposed MBR discharge offers high quality of treated wastewater with low E. coli concentrations, resulting in a minimal impact on public health. Additionally, any remaining pathogens in the discharged wastewater will be filtered out by the soil before the water reaches the river. • There are no known mahinga kai sites in the vicinity of the land parcel. However, there is a potential risk of microbial pathogens entering groundwater used for human consumption. A detailed hydrological assessment is needed to evaluate this risk.
Environment	Water quality effects	• The site is in close proximity to the Waikato River. A buffer zone of 50 m would be established to the nearest surface water body. In rapid infiltration systems, water percolates through the soil, eventually reaching the aquifer, flowing to a surface water body, or being recovered through pumping. • Given the well-draining soil profile and expected high quality of treated wastewater, potential effects on freshwater (both surface and groundwater) are considered low. Also, the groundwater level in the area is modeled to be at a relatively high depth, further hydrological investigation is needed to confirm this.
	Aquatic ecology effects	• There is potential risk of contaminants entering waterbodies in the rapid infiltration systems as the water percolates through the soil until it eventually enters the aquifer system, flowing to a surface water body. However, expected high quality of treated wastewater, potential effects on aquatic ecology are considered low. Would require further investigation.

Criteria	Criteria	Assessment Summary
	Terrestrial ecology effects	• There may be no adverse effects on terrestrial ecology due to expected high quality of treated wastewater, but further assessment is required to confirm this.
Social and community	Amenity value and aesthetics	• There may be potential odour risks, particularly as self-catering accommodation is situated in the southern part of the land parcel. However, the risk is minimal due to the high quality of the treated wastewater from the MBR system and the use of subsurface discharge. • Social acceptance is not anticipated to be an issue, as the technology used for treated wastewater discharge is not new. • However, there are three cultural sites on or near the site that could pose risks to acceptance.
	Recreation	The location is not near any existing recreational areas, and it is unlikely to impact the availability of new recreational opportunities.
Physical and Constructability	Land availability	Proposing the discharge location on private land introduces uncertainty regarding property acquisition.
	Adaptable and flexible	• The land area meets the required specifications for land discharge based on anticipated future flows for Stage 2. • There are several adjacent sites that may be suitable for expansion if necessary.
	Buildability, accessibility	• Standard construction methodologies, similar to those used in other wastewater conveyance projects, are expected to be applicable, pending civil investigations. • The conveyance route needs to be determined, though the site's proximity to the SWWTP may facilitate this process. • While suitable access to the site is anticipated, traffic and access restrictions may be necessary. • Further investigation is needed to confirm technical requirements, including geotechnical and contaminated land assessments.

Criteria	Criteria	Assessment Summary
	Operational and engineering resilience	• The land is not situated on a floodplain and is expected to be resilient to natural hazards. • Further investigation may be needed to assess the option's capacity to handle wet weather flows, particularly due to its close proximity to the Waikato River. • There are no identified risks concerning access to utilities or power, and no untested or unintended outcomes have been noted. • There are no risks related to the availability of relevant expertise/resources.
Te Ture Whaimana o te Awa o Waikato	Extent to which the option gives effect to Te Ture Whaimana o te Awa o Waikato	• Land discharge is likely to be aligned with Te Ture Whaimana and other regional policy direction from the perspective that will not be directly discharged to the Waikato River. • Contaminant runoff in the rapid infiltration systems could, however, impact Waikato River. • Offsetting may be required under Plan Change 1 to the Waikato Regional Plan.
Relative capital cost		• This is likely a relatively medium-cost option in comparison to other options. Private land acquisition is required.
Summary Comments		The suitable sites for land discharge using rapid infiltration systems are near the Waikato River. This proximity means there could be some negative environmental effects from contaminants potentially reaching surface water bodies or groundwater through soil infiltration. However, the effects are deemed minor due to the high quality of treated wastewater and soil's ability to effectively remove contaminants. Therefore, the potential impact on freshwater (both surface and groundwater) is considered low. Engaging with the landowner is essential, and there are uncertainties regarding land acquisition.
Carry forward to Short-List?		Yes (to be confirmed following engagement with iwi) Standalone Option Limitations: Uncertain

Reuse Options – Non-Potable Reuse and Potable Reuse

A desktop feasibility assessment was undertaken to determine theoretically the suitability of a range of wastewater reuse options for the Southern WWTP based on assumed wastewater quality as well as available reuse sites within the vicinity of the WWTP proposed locations. The following wastewater reuse options were investigated:

1. Reuse for golf courses, sports fields and parks

2. Agricultural Reuse

3. Industrial Reuse

4. Reuse for the construction sector

5. Indirect Potable Use

In accordance with the Victorian guideline for water recycling 2021 and the Queensland Guideline for low-exposure recycled water schemes 2022:

Stage 1 with Sequential Batch Reactor (SBR) treatment technology: SBR plant is likely to meet Class C wastewater and therefore wastewater reuse is likely to require greater controls.

Stage 2 with Membrane Bioreactor (MBR) technology: MBR plant could potentially meet the Class A treated wastewater.

Reuse options	Feasibility Assessment
Feasible Reuse Options for Stage 1 with SBR Technology (Class C)	
Reuse for golf courses, sports fields and parks	• Irrigation to golf courses, gardens, sports fields and parks where there is no public access.
Agricultural Reuse	• Agricultural reuse including irrigation to pasture and fodder crops and irrigation to non-food crops.
Industrial Reuse	• Wet industry provided there is no worker exposure and a thorough risk assessment had been undertaken to address any public health risks.
Feasible Reuse Options for Stage 2 with MBR Technology (Class A)	
Reuse for golf courses, sports fields and parks	• Irrigation to golf courses, gardens, sports fields and parks, Hamilton airport runway apron.
Agricultural Reuse	• Irrigation to pasture and fodder crops and irrigation to non-food crops (including plant nurseries). • Irrigation to food crops (i.e. fruits with limited or no ground contact and/or where the skins are removed before consumption; vineyard grapes), depending on the level of treatment the MBR plant can achieve.
Industrial Reuse	• Wet industry
Process Reuse	• Process water use, land scaping
Reuse for the construction sector	• Construction activities: The level of disinfection provided by the MBR plant during detailed design will be key to determining whether the use is appropriate as worker exposure is highly likely.
Indirect Potable Use	• Discharge to water is already being considered for the MBR plant as part of the long-term options assessment).

Recommendation: It is recommended that this option be included in the short-list for further consideration alongside other alternatives.

Relative Capital Cost

Long-List Discharge Options	Relative Capital Cost	Details
Discharge to Main Stem of the Waikato River	$$	Longer pipeline required compared to surface water and wetland discharge options. Some private land acquisition likely required.
Discharge to Surface Waterways – Nukuhau Mainstream	$	The site is owned by HCC. Its proximity to the SWWTP allows for a shorter pipeline compared to other options.
Discharge to Restored/Constructed (Close to Nukuhau)	$	The site is owned by HCC. Its proximity to the SWWTP allows for a shorter pipeline compared to other options.
Discharge to Land – Rapid Infiltration (Stage 1 – Site 2 and 4)	$$	Private land acquisition is required (The minimum area required is 1 Ha).
Discharge to Land – Slow Rate Irrigation (Stage 1 – Site 9)	$$	Private land acquisition is required if Site 1 (owned by HCC) is not used. The minimum area required is 20 Ha.
Discharge to Land – Rapid Infiltration (Stage 2 – Site 1)	$$	Private land acquisition is required. The minimum area required is 9 Ha.
Discharge to Land – Slow Rate Irrigation (Stage 2 – Site 6)	$$$	Private land acquisition is required. The preferred site is across the Waikato River from the SWWTP, a longer pipeline will be necessary compared to other land discharge options. The minimum area required is 180 Ha.
Deep Bore Injection	$$$$	Likely to be an extremely high-cost option due to the newness of the technology.
Discharge to Coast, Ocean	$$$$	Likely to be an extremely high-cost option due to the length of the pipeline (~ 57 km).

B

Appendix B – Alternative Surface Water Discharge Investigation

Sensitivity: General

Alternative Surface Water Discharge Investigation

Southern Wastewater Treatment Plant

Prepared for Hamilton City Council
Prepared by Beca Limited

7 August 2025

Contents

Revision History

Revision Nº	Prepared By	Description	Date
1	Enfys Radley	Draft for Client Review	16/08/2024
2	Enfys Radley	Final	07/08/2025

Document Acceptance

Action	Name	Signed	Date
Prepared by	Enfys Radley		07/08/2025
Reviewed by	Farza Feizi		07/08/2025
Approved by	Garrett Hall		07/08/2025
on behalf of	Beca Limited		

Executive Summary

Environmental and engineering investigations are being conducted to develop and assess various options for discharging treated wastewater from the future Southern Wastewater Treatment Plant (SWWTP). Among the discharge methods being considered is a discharge to an alternative surface water location to the Waikato River. Beca was commissioned by Hamilton City Council (HCC) to explore the potential of discharging treated wastewater from the SWWTP indirectly into the Waikato River through a surface water which is located within 15 km of the SWWTP. The surface water discharge could be a means of driving habitat restoration, landscape enhancement at a selected site, or including nature-based solutions, it is important to note that this would require highly treated wastewater.

After a GIS desktop review, seven surface water bodies were selected for further investigation. Out of these, five surface water bodies were chosen for detailed assessment based on proximity and site accessibility. A site visit included ten locations across these five surface water bodies (as shown in Figure 1). During the site visit, qualitative data was collected to evaluate the feasibility of alternative surface water discharge at each site. The factors considered included site accessibility, ownership (private property), flow rate (slow, medium, fast), vegetation cover, suitability for naturalised discharge, and other factors that may affect surface water discharge feasibility.

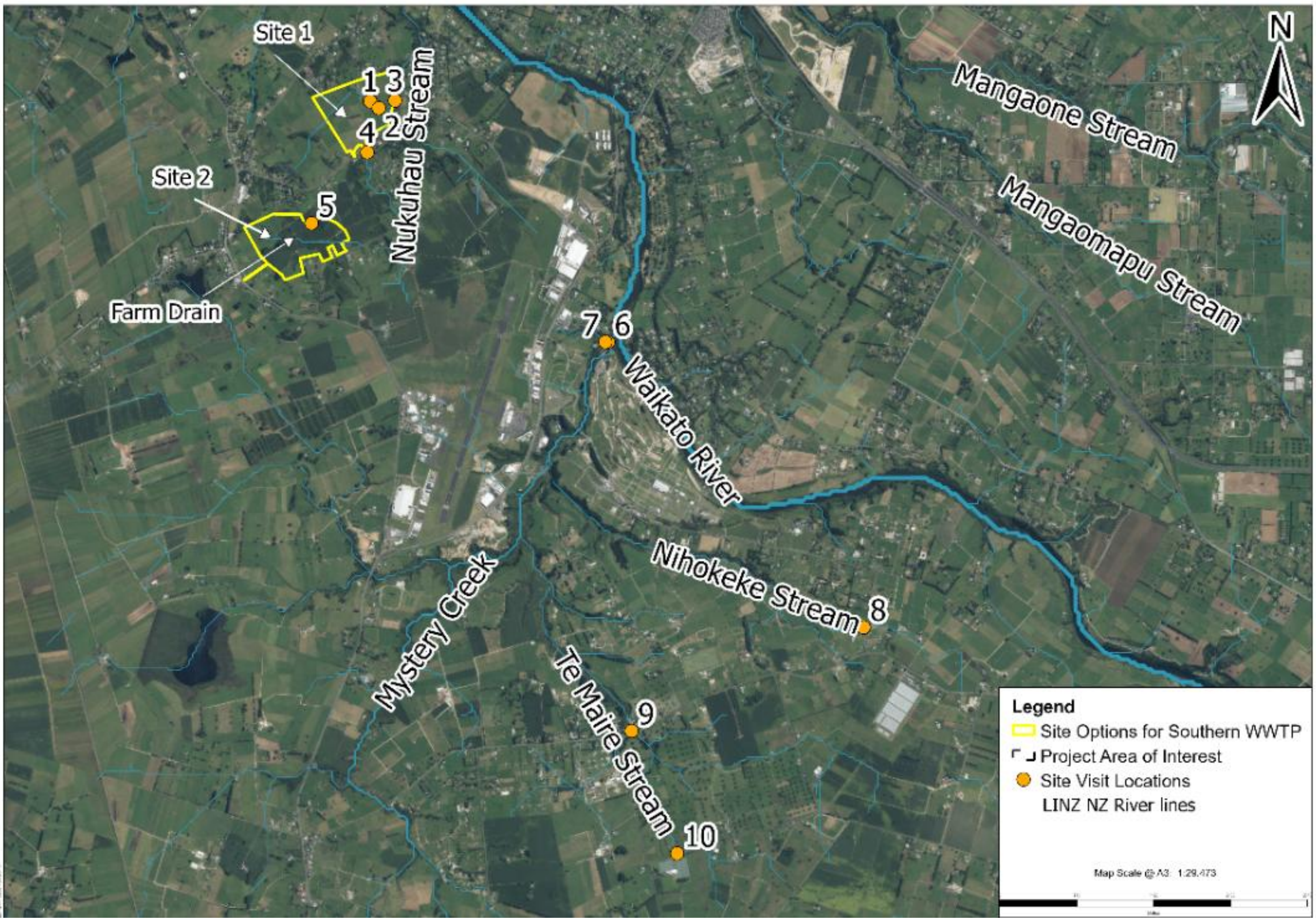


Figure 1. Surface waterbodies and site visit locations.

The assessment of an alternative surface water discharge location (that is not the Waikato River) found the following:

- Six sites were considered unfeasible, including Tributary of Nukuhau Stream (1), Mystery Creek (east) (6), Mystery Creek (west) (7), Nihokeke Stream (8), Te Maire Channel (9), and Te Maire Stream (10), due to narrow channels, slow flow, steep banks, poor accessibility, insufficient space for naturalized waterways, or private property issues.
- Three locations were considered potentially feasible for a surface water discharge, including Nukuhau Stream (2), Nukuhau Stream (next to Site 1 boundary) (4), and the Farm Drain (5), due to their easy access and flat areas available for a naturalised waterway. However, these locations had narrow channels and slow flow rates, which limit their feasibility.
- The assessment identified Nukuhau Mainstream (3) as the most feasible location for a surface water discharge. Located in Site 1 and owned by HCC, it offers easy access and proximity to the proposed SWWTP sites. It also has the fastest water flow out of all the site visit locations and a large flat area suitable for a naturalised waterway.

Recommendations:

The following investigations are recommended, if an alternative surface water discharge is considered for further progression, to provide a clear understanding of the requirements needed for an effective evaluation of the surface water discharge options.

- An assessment of environmental effects to understand potential adverse effects of the discharge on receiving water quality, ecology and flooding.
- Public Health assessment – Quantitative Microbial Health assessment
- An assessment of cultural impacts and Tangata Whenua engagement
- Engineering Investigations: Preliminary assessment of maintenance and operational requirements, geotechnical and hydrology investigations, and discharge engineering design.

1 Introduction

1.1 Background

The Waikato region is undergoing significant urban, industrial, and commercial growth, resulting in increasing demand on existing wastewater infrastructure. To address this, the Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) was developed, identifying a preferred option to manage wastewater from the southern part of the Waikato-Hamilton-Waipā metro area. A key component of this plan is the construction of a new Southern Wastewater Treatment Plant (SWWTP), which would service future development in southern Hamilton, the Waikato Regional Airport, and northern Waipā.

The Southern Metro DBC process included a site selection process to identify a preferred broad location for the SWWTP in the area immediately to the south of Hamilton. This short-list and site feasibility investigation concluded in August 2024, and recommended the preferred site for the SWWTP as a site that is owned by Hamilton City Council (HCC) between Peacockes Road and Raynes Road (Sharpe Farm).

The SWWTP is planned to be developed in stages, eventually serving a Population Equivalent (PE) of up to 200,000. The Southern Metro DBC assumed a land discharge for Stage 1, transitioning to river discharge from Stage 2 onwards, subject to further technical investigations as part of resource consent processes. HCC will seek consents for Stages 1 to 2b, covering up to 18,000 (PE) and an average daily flow of 3,600 m³/day at the end of stage 2b. Commencement flows at stage 1 are estimated to be 400 m³/day increasing to 1,900 m³/day at the end of stage 2a.

Beca Ltd (Beca), on behalf of HCC, has conducted various investigations into alternative discharge options for the SWWTP, building on previous work, to assess the long-list options for the SWWTP which will inform the resource consent process. This work will reassess the broad assumptions made at the Southern Metro DBC with regards to discharge options.

Environmental and engineering investigations are being conducted to develop and assess various options for discharging treated wastewater from the future SWWTP. Among the discharge methods being considered is a discharge to streams/drains flowing to the Waikato River.

1.2 Scope and Objectives

Beca have been commissioned by HCC to explore the potential of discharging treated wastewater from the SWWTP indirectly into the Waikato River through a surface water discharge which is located within 15 km of the SWWTP. The surface water discharge could be a means of driving habitat restoration, landscape enhancement at a selected site, or including nature-based solutions.

In particular this report includes the following:

- A description of the investigation area for a surface water discharge solution;
- A description of the assessment methodology, including the Geographic Information System (GIS) and site visit assessment criteria;
- An assessment of potential surface water discharge options; and
- A summary of the potential surface water discharge assessment and recommendations for further work[1].

[1] This assessment does not include an evaluation of direct discharges into the Waikato River, as this is covered in the Task 1 report (Waikato River baseline water quality and ecology assessment).

1.3 Information Reviewed

- The Hamilton-Waikato Southern Metropolitan Area Wastewater Detailed Business Case Preferred Option Report, Metro Wastewater Project Partners, April 2022.
- Southern Wastewater Treatment Plant Assessment of Alternative Sites, Beca, 2024.

2 Description of the Environment

2.1 Southern Wastewater Treatment Plant

As described in the Southern Metro DBC[2], the SWWTP is proposed to be staged over time with an ultimate Population Equivalent (PE) of 200,000. However, at this stage of the optioneering process, HCC will only be seeking regional discharge consents for Stage 1 and Stage 2b, which will have a total discharge capacity of 1,000 m^3/day and 3,600 m^3/day, respectively.

As presented in Table 1, the Southern Metro DBC assumed that Stage 1 will involve using Sequential Batch Reactor (SBR) treatment technology with discharge to land and Stage 2 will use a Membrane Bioreactor (MBR) and discharge to the Waikato River. However, this Project is reassessing the assumptions related to the staging and final discharge environment for each phase. If investigations finds that a discharge to land is not possible, Stage 1 will require bringing forward the MBR treatment technology requirement in order to meet minimum discharge concentrations for a discharge to water.

Table 1. Southern Wastewater Treatment Plant Concept Staging (Source: Southern Metro Detailed Business Case[2])

Description		Serviced area	Starting demand	Cumulative Capacity
Stage 1	SBR* with discharge to land	Airport precinct	400 m^3/day (2,000 PE)	1,000 m^3/day (5,000 PE)
Stage 2a	MBR** with discharge to Waikato River	Airport precinct and Mātangi / Tamahere commercial areas	1,200 m^3/day (6,000 PE)	1,900 m^3/day (9,500 PE)
Stage 2b	MBR with discharge to Waikato River (additional reactors and membrane equipment)	Airport precinct, wet industry and Mātangi /Tamahere commercial areas	3,600 m^3/day (18,000 PE)	3,600 m^3/day (18,000 PE)

* SBR treatment technology with land disposal is proposed for the first stage. This technology provides enormous flexibility in terms of flows and load and will provide effluent quality that is suitable for application into or onto land. SBR is able to stop solids to reduce organic matter found in wastewater, which is done over a number of cycles, depending on the size of the tank.

** MBR treatment technology with discharge to water is proposed for the second stage. MBR systems are aerobic activated sludge biological reactors, which combine the biological degradation process, known as "activated sludge", with solid-liquid separation by membrane filtration. This process results in high-quality effluent with low levels of suspended solids, pathogens, and nutrients

2.1.1 Proposed Treated Wastewater Quality

Currently, there is a wide variety of standards for treated wastewater discharge quality in the Region due to the use of different technologies. A Memorandum of Understanding (MoU) was signed by the DBC Project Partnership Group in April 23 which established the minimum performance standards to be achieved by the projects in the Metro WW DBC (Northern/Southern). The agreement recommends adopting a consistent standard of treated wastewater quality for all WWTP discharges to water. These uniform standards should be implemented by 2031 or when the existing resource consents for discharge expire. As mentioned above, the

[2] The Hamilton – Waikato Southern Metropolitan Area Wastewater Detailed Business Case – Preferred Option Report, Metro Wastewater Project Partners, April 2022.

proposed treatment technology for both Stage 1 and Stage 2b is considered MBR for discharge to water, which will provide a high level of wastewater treatment.

According to the Southern Metro DBC MoU[3], the minimum Performance Standards considered for discharge to water are listed in Table 2. These standards are utilised in Section 5 of this report where a high-level assessment of effect of the discharge on water quality of the Waikato River is provided.

Table 2. Agreed Southern Metro DBC MoU[2] minimum performance standards for discharge to water.

Parameter	Minimum Performance Standards for Discharge to Water	
Total Nitrogen (TN) (mg/L)	Annual Mean	<4.0
Total Phosphorus (TP) (mg/L)	Annual Mean	<1.0
E. coli (cfu/100mL)	95th Percentile	<14

2.2 Preferred Southern Wastewater Treatment Plant Sites

An assessment of Alternative Sites[4] was undertaken by Beca to investigate possible sites for the SWWTP in the area south of Hamilton. The assessment included the four locations that were shortlisted in the Southern Metro DBC which were taken forward and assessed using a multi criteria assessment (MCA). Out of the four shortlisted sites, Sharpe Farm (Site 1) and Narrows/ Rukuhia (Site 2) were identified as the preferred sites for the SWWTP. The preferred locations for the SWWTP (Site 1 and Site 2) are described in Table 3 and are shown in Figure 2. Following the technical MCA process and the findings of the Tangata Whenua Effects Assessment (TWEA), Sharpe Farm has been identified at the preferred site. Sharpe Farm scored the highest in both the unweighted and weighted MCA[5]. However, for either of these options to proceed further, the agreed discharge quality presented in Table 3 would need to be met.

Table 3. Description of the preferred sites for the Southern WWTP.

Site Name	Site Address	Site Owner	Area of Site	Title	Legal Description
Sharpe Farm (Site 1)	Raynes Road, Rukuhia	HCC	34.2 ha (two blocks which have an area of 19.35 ha and 14.85 ha).	SA72C/450	Lot 5-6 DPS 91837
Narrows/ Rukuhia (Site 2)	71 Narrows Road/Ohaupo Road	The site is owned by the Crown and administered by New Zealand Transport Agency Waka Kotahi	35 ha	RT 534321	Lot 1 DP 420545

[3] The Hamilton-Waikato Southern Metropolitan Area Wastewater Detailed Business Case Preferred Option Report, Metro Wastewater Project Partners, May 2022.

[4] Southern Wastewater Treatment Plant Assessment of Alternative Sites, Beca, 2024.

[5] Southern Wastewater Treatment Plant, Assessment of Alternative Sites, Beca, August 2024.

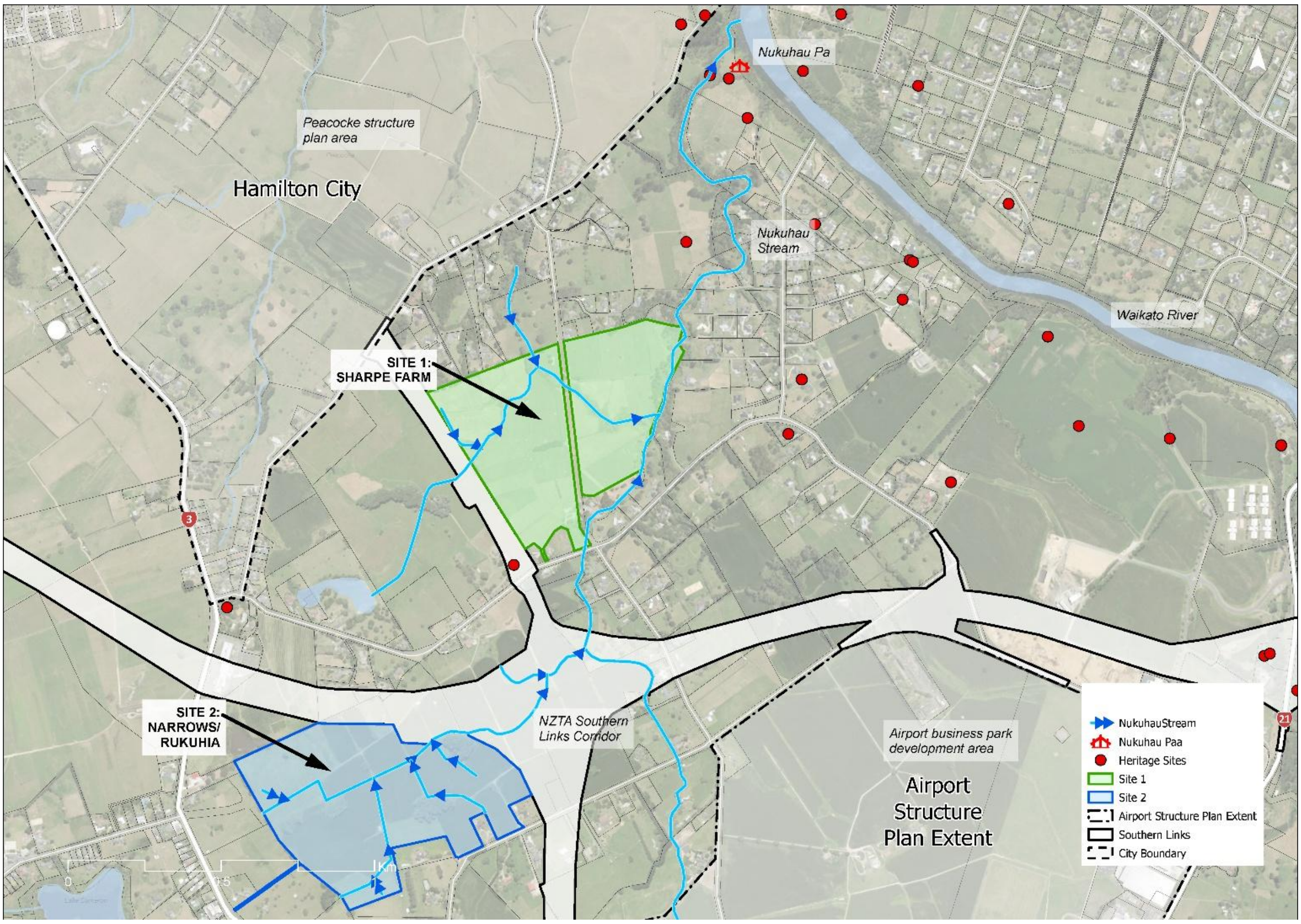


Figure 2. The preferred sites for the Southern WWTP (Site 1 and Site 2).

3 Examples of Best Practice Solutions/ Nature Based Solutions

Surface water discharge requires best practice solutions to ensure minimal impact on ecosystems and human health. Implementing best practice solutions can promote habitat restoration and landscape enhancement. Properly managed surface water discharge supports the recovery of ecosystems and contributes to sustainable management practices. Additionally, best practice solutions can potentially provide additional wastewater treatment; however, this is dependent on several factors, including vegetation type, flow rate, infiltration capacity, and discharge volume. This section presents two examples of Nature-Based Solutions (i.e. including a restoration/replanting component) for discharge options, showing how the discharge of high-quality treated wastewater can be managed to create a naturalized discharge into surface water.

3.1 Te Kauwhata Wastewater Naturalised Discharge

The recent investigation of alternative discharge options for treated wastewater from Te Kauwhata WWTP identified the preferable methods as a Water Hub concept that avoids areas of cultural significance and land discharge. The Water Hub location needed to have sufficient land to create a naturalised discharge stream, which would flow by gravity into the Waikato River, along with landscape and restoration planting. Two potential locations for this naturalised discharge have been identified: 'Water Hub A' and 'Water Hub B,' which are shown in Figure 3 and Figure 4 below. As shown in the below figures, the Water Hub options feature a rock-lined swale and wetland plants, designed to create a naturalised rocky stream that flows into the Waikato River.

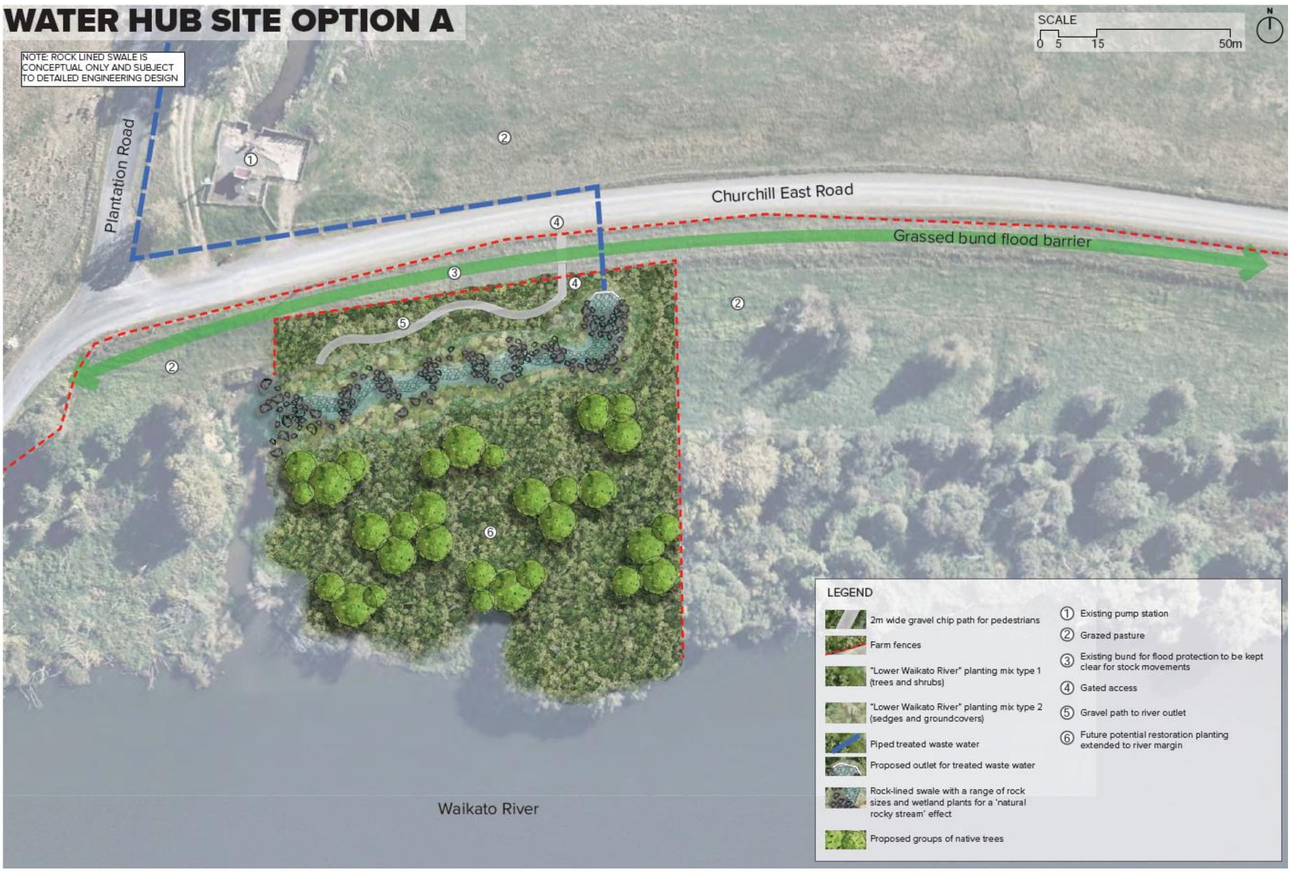


Figure 3. Water Hub Site Option A

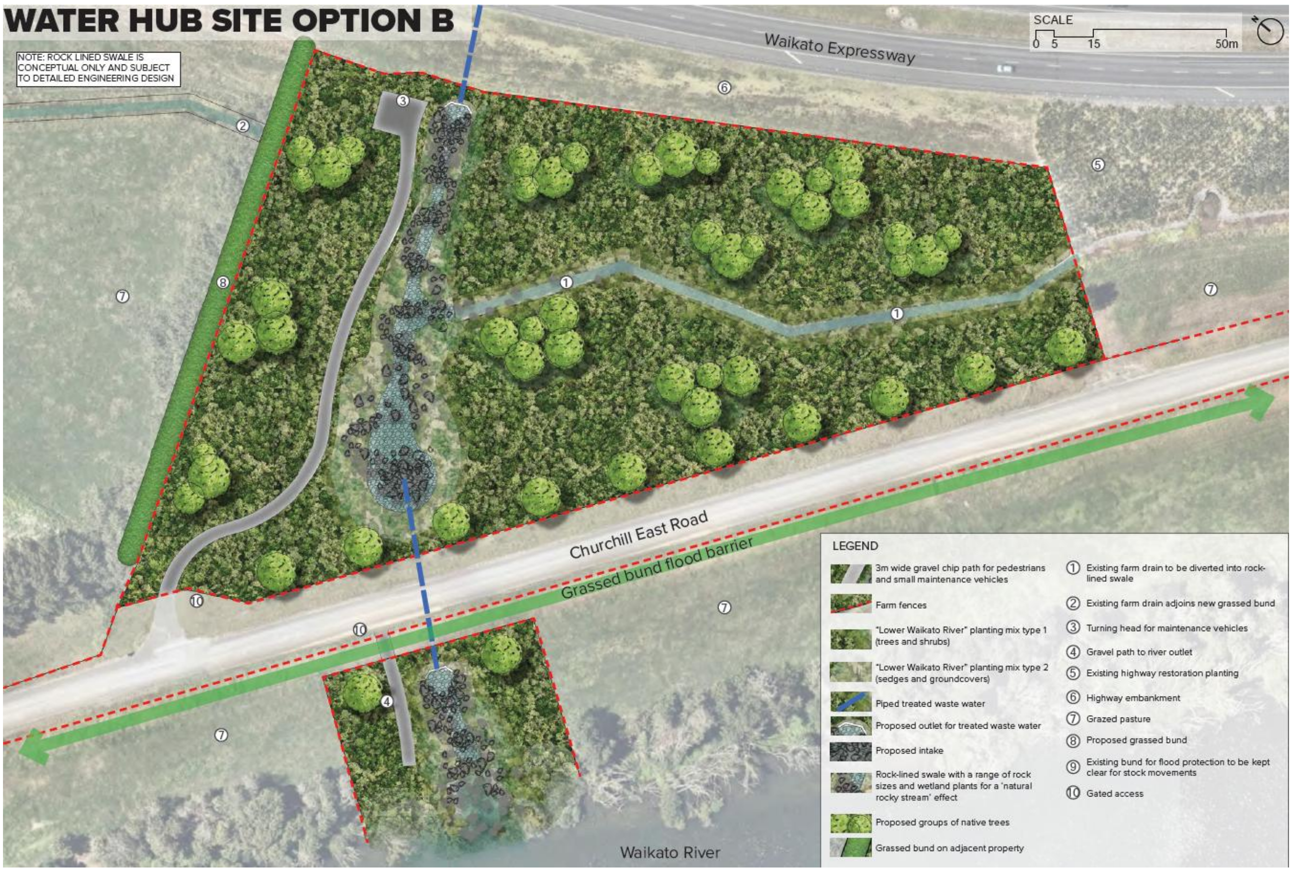


Figure 4. Water Hub Site Option B

3.2 Cambridge Wastewater Discharge Structure

The investigation into alternative discharge options for treated wastewater from the Cambridge WWTP identified an indirect discharge to the Waikato River as the preferred method. The discharge structure design includes a gabion basket wall on the upper slope and a riprap rock buttress extending from the mid to lower slope. Treated wastewater is discharged via 200mm diameter pipes located behind the gabion wall, then flows over or through the gabion baskets and along an approximately 50-metre-long riprap to the Waikato River. The system is designed to accommodate the projected average 2061 flows of 11,300 m³/day (11 million litres/day). The discharge structure is shown in Figure 5.

Figure 5. Photograph of the Cambridge indirect discharge stream (Source: Kaitiaki Roopuu Hui Presentation, Hamilton City Council, June 2024).

3.3 Loudoun Wastewater Discharge

An example of best practice solutions, also known as Nature-Based Solutions, is Loudoun Water in Ashburn, Virginia, USA. Loudoun Water manages wastewater discharge through its Broad Run Water Reclamation Facility (WRF). This facility treats wastewater to meet or exceed state and federal water quality standards before discharging it back into the environment. The treatment process includes screening, primary treatment, biological treatment, secondary clarification, filtration, and disinfection. The treated wastewater is then discharged into a naturalized waterway within a rocky swale, complemented by a range of wetland plantings to create a natural stream effect and enhance the landscape (see Figure 6).

The area is fully open to the public and provides an accessible feature demonstrating reuse. Fish are also visible in the water creating a water feature and cultural indicator.

Figure 6. Photos from Loudoun Water in Ashburn, Virginia, USA (photos taken during a site visit by Beca team in 2023).

Implementing best practices for surface water discharge, such as sediment basins and riparian buffers, can prevent soil erosion and sedimentation in water bodies. These practices help manage surface water discharge sustainably, protecting water resources and promoting the ecological health of the waterway.

4 Methodology

The sections below provide a summary of the desktop review process used to identify surface water discharge options and outlines the criteria used for a site visit to assess the identified surface water discharge locations.

4.1 Step 1 – Identifying Surface Waterbodies Using a GIS Investigation

A GIS investigation is conducted to identify all surface waterways within a 15 km radius of the proposed sites for the new SWWTP.

4.2 Step 2 – Exclusion of Surface Waterways within Waikato Flood Protection and Land Drainage Assets

In this step, any surface waterways that are part of the Waikato flood protection and land drainage assets are identified and excluded from the assessment as any discharge to these drainage assets would likely impact on potential flood risk and/or management practices. For this purpose, the Waikato Regional Hazards Portal[6] is created to allow access to regional natural hazard information, assisting the public, local authorities, and other stakeholders in assessing risks in relation to natural hazards. The Waikato Regional Hazard Portal datasets used in the GIS investigation are briefly described below. These datasets are used to identify and exclude any surface waterways that are part of the Waikato flood protection and land drainage assets.

4.2.1 Regional Scale Flood Hazard

The Regional Scale Flood Hazard data provided by Waikato Reginal Council (WRC) is based on both qualitative and quantitative data to create a comprehensive overview of area susceptible to flooding, including surveys, photos, aerial imagery, elevation data, flood modelling, and flood drainage scheme information.

4.2.2 Floodplain Management Areas and the Hazard Flood Extent

The two Waikato GIS datasets, Floodplain Management Areas and Hazard Flood Extent, both provide models of a 1% annual exceedance probability (AEP) rainfall event along the Waikato River. The Floodplain Management Areas dataset shows flood-prone zones mainly from the main river channels, excluding some tributaries and ponding areas; however, the Hazard Flood Extent data includes some of the tributaries of the Waipa and Waikato Rivers.

4.2.3 Flood Protection and Land Drainage Assets

The Flood Protection and Land Drainage Assets provide information on the culverts and open drains which are managed by WRC and are utilised in the rural land drainage network. These assets are designed to drain water from a 10% Annual Exceedance Probability (AEP) rainfall event within three days. The drainage network is in place to reduce the level of pastoral damage by reducing ponding in rural areas.

4.2.4 Waipā District Plan – Special Feature Area: Flood Hazard

This data provides information on what areas are located within flood hazard areas as identified in the Waipa District Plan.

This assessment uses red highlights to indicate surface waterways located within a WRC flood protection or land drainage asset, and green highlights to indicate those that are not part of these assets.

[6] See: https://www.waikatoregion.govt.nz/services/regional-hazards-and-emergency-management/regional-hazards-portal/

4.3 Step 3 – Identification of Surface Waterbodies Outside Waikato Flood Management and Land Drainage Assets for Further Assessment

In this step, surface waterbodies that are not part of Waikato's flood management protection or land drainage assets are identified for further investigation and assessment. These surface waterbodies are reviewed using aerial photos and maps to identify suitable discharge locations, considering their distance from the proposed SWWTP and accessibility for site visits.

4.3.1 Step 4 – Site Visit and Assessment Criteria

The shortlisted discharge locations from the previous step are visited to gather the information needed to assess the feasibility of these sites for surface water discharge. Key details recorded during a site visit on the 3 July 2024, include site accessibility, surface water flow rate, vegetation coverage, availability of suitable areas for naturalized waterway discharge, and any other relevant information.

The qualitative data collected during the site visit are used to assess the feasibility of alternative surface water discharge at each location. The factors evaluated during the site visit are Table 4and the colour code used in the feasibility assessment is presented in Table 5.

Table 4. List of factors evaluated during the site visit.

Factors evaluated during the site visit	Preferred Characteristics for a Surface water discharge.	Characteristics that would likely hinder a surface water discharge
Site Access	Easily accessible	Not easily accessible
Ownership status	Located on public land	Located on private property
Flow Rate	Medium to fast flow rate	Slow flow rate
Vegetation Cover	Good vegetation cover on stream banks	Highly dense vegetation cover (trees and large plants) unsuitable for replanting.
Area for naturalised waterway	Relatively large flat area available	Moderate to very steep stream banks
Channel Width	Wide channel	Narrow channel

Table 5. Colour Code for assessment of feasibility of surface water discharge locations.

Colour Code	Feasibility Assessment
(green)	Discharge location highly likely to be feasible
(amber)	Discharge location may be feasible
(red)	Discharge location is unlikely to be feasible

5 Assessment of Potential Surface Water Discharge Locations

5.1 Identified Surface Waterbodies

As shown in Figure 7 and listed in Table 6, most of the surface waterbodies identified within the 15 km investigation area are tributaries of the Waikato River; however, most of the surface waterbodies near the western boarder of the investigation area flow into the Waipā River. Additional maps of the investigation area are provided in **Appendix A**, including a larger scale map and maps including the names and locations of the identified surface waterbodies.

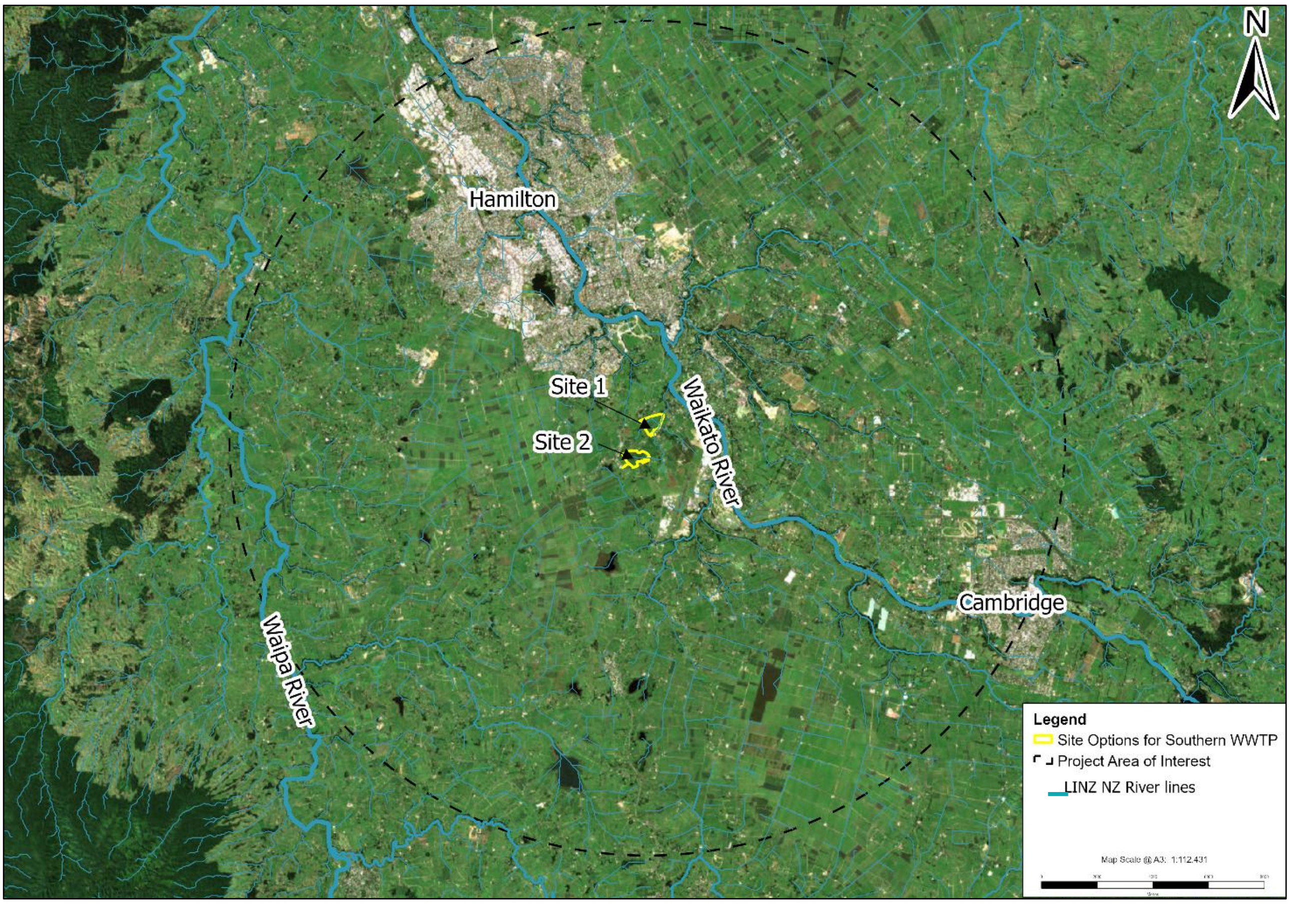


Figure 7. Surface waterbodies in the investigation area and preferred SWWTP locations (Site 1 and Site 2 (outlined in yellow) (Source: ArcGIS 2024).

All surface waterbodies identified within the 15 km investigation area located to the east of the Waikato River were excluded from the assessment. This exclusion is due to the challenges and cost associated with the conveyance and construction required for piping treated wastewater across the Waikato River for discharge. The streams that have been taken forward and the streams that have been excluded from the investigation are listed in Table 6.

Table 6. Surface water bodies identified in the investigation area.

Surface Waterbodies taken forward in the Assessment	Distance to Site 1 (km)	Distance to Site 2 (km)
Nukuhau Stream	Flows along the eastern boarder	0.5
Mangakotukutuku Stream	2.1	2.5

Surface Waterbodies taken forward in the Assessment	Distance to Site 1 (km)	Distance to Site 2 (km)
Nihokeke Stream	3.4	4.0
Mystery Creek	3.5	2.5
Te Maire Stream	4.5	6.5
Waitawhiriwhiri Stream	6.6	6.3
Koromatua Stream	7.3	7.0
Mangahia Stream	9	7.9
Ohote Stream	9.4	9.3
Mangawhero Stream	9.5	9.0
Mangaotama Stream	10.7	9.4
Waipā River	13.2	12.5
Surface Waterbodies Excluded from the Assessment		
Mangaone Stream	3.3	4.6
Mangaharakeke Stream	4.0	5.5
Mangaomapu Stream	4.5	5.4
Mangaonua Stream	4.6	5.8
Komakorau Stream	9.9	11.0
Kirikiriroa Stream	11.2	12.2
Te Awa O Katipaki Stream	13.7	14.2

5.2 Waikato Flood Protection and Land Drainage Assets Exclusions

Table 7 lists the surface water options identified in the investigation area and highlights those that have been identified as being a part of the Waikato flood protection and land drainage assets. For detailed information on the assessment criteria used to evaluate these locations, refer to Section 0

Table 7. Surface waterbodies assessment results based on Waikato Regional Hazard Portal datasets.

Identified Surface Water	Desktop Assessment Criteria				
	Located in a Floodplain management area	Regional scale flood hazard	Flood Protection and Land Drainage Assets	Waipa District Plan – Special Feature Area: Flood Hazard	Hazard flood extent 1 – AEP October 2021
Nukuhau Stream					
Mangakotukutuku Stream					
Nihokeke Stream					

Identified Surface Water	Desktop Assessment Criteria				
	Located in a Floodplain management area	Regional scale flood hazard	Flood Protection and Land Drainage Assets	Waipa District Plan – Special Feature Area: Flood Hazard	Hazard flood extent 1 – AEP October 2021
Mystery Creek					
Te Maire Stream					
Waitawhiriwhiri Stream					
Koromatua Stream					
Mangahia Stream					
Ohote Stream					
Mangawhero Stream					
Mangaotama Stream					
Waipā River					
Mangakaware Stream					

Note: Red highlight indicates that the location is located in a WRC flood protection or land drainage asset and Green highlight indicate that the location is not located in a WRC flood protection or land drainage asset.

From the assessment shown in Table 6, seven surface waterbodies that are not located in a Waikato flood management protection or utilised as a land drainage asset have been identified for further investigation and assessment.

Following this assessment, it was determined that the potential surface water discharge locations within 5 km of the SWWTP should be prioritised. This reduces the required length of the conveyance pipeline and reduces maintenance and construction costs due to longer piping distances. Therefore, Waitawhiriwhiri Stream and Mangawhero Stream have been excluded from the assessment as they are located more than 5 km away from the preferred SWWTP Sites (Site 1 and Site 2).

Additionally, Mangakotukutuku Stream was excluded from the assessment due to the ecological improvements seen since the Mangakotukutuku Stream Care Group[7] was formed in 2006. Due to efforts from both the care group and HCC, the stream now supports rich biodiversity and is highly valued by the community, therefore making it unsuitable for discharge of treated wastewater. The Mangakotukutuku Stream also flows through Hamilton City urban area.

In addition to the potential surface water discharge locations which are not located in a WRC flood protection or land drainage asset, a farm drain located in Site 2 is included in the next stage of the assessment. This farm drain was not identified in the GIS investigation.

[7] See: https://www.lawa.org.nz/get-involved/news-and-stories/waikato-regional-council/2014/september/river-of-the-month-mangakotukutuku

Considering the exclusions above, five surface waterbodies were selected for the next stage of assessment. The shortlisted waterbodies and their publicly accessible locations are listed in Table 8 and are shown in Figure 8, Figure 9, and Figure 10. These shortlisted surface waters were investigated during a site visit to assess their suitability as potential discharge locations.

Table 8. Identified surface waterbody locations for site visit.

Surface Waterbody	Site visit Locations	Coordinates
Nukuhau Stream	(1) Tributary of Nukuhau Stream	37°50'23.5"S 175°19'14.7"E
	(2) Nukuhau Stream	37°50'25.5"S 175°19'18.1"E
	(3) Nukuhau Mainstream	37°50'23.4"S 175°19'24.7"E
	(4) Nukuhau Stream (next to Site 1 boundary)	37°50'39.1"S 175°19'14.1"E
Farm Drain (Site 2)	(5) Farm Drain	37°50'58.4"S 175°19'00.4"E
Mystery Creek	(6) Mystery Creek (east)	37°51'34.0"S 175°20'46.9"E
	(7) Mystery Creek (west)	37°51'33.4"S 175°20'46.6"E
Nihokeke Stream	(8) Nihokeke Stream	37°52'57.0"S 175°22'26.6"E
Te Maire Stream	(9) Te Maire Channel	37°53'30.4"S 175°20'59.5"E
	(10)Te Maire Stream	37°54'06.8"S 175°21'18.0"E

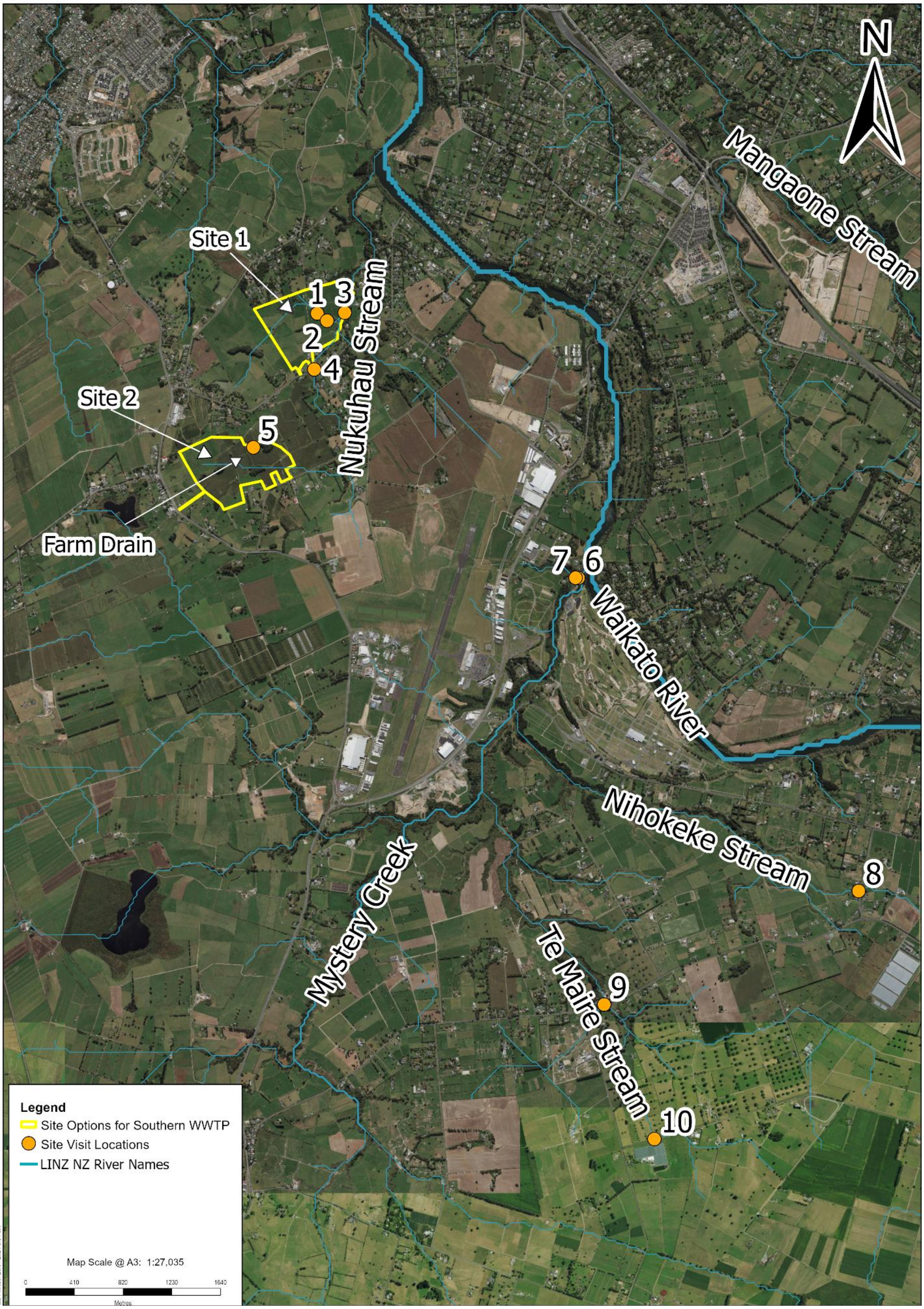


Figure 8. Site visit locations.

Figure 9. Zoomed map of the four sites at Site 1.

Sensitivity: General

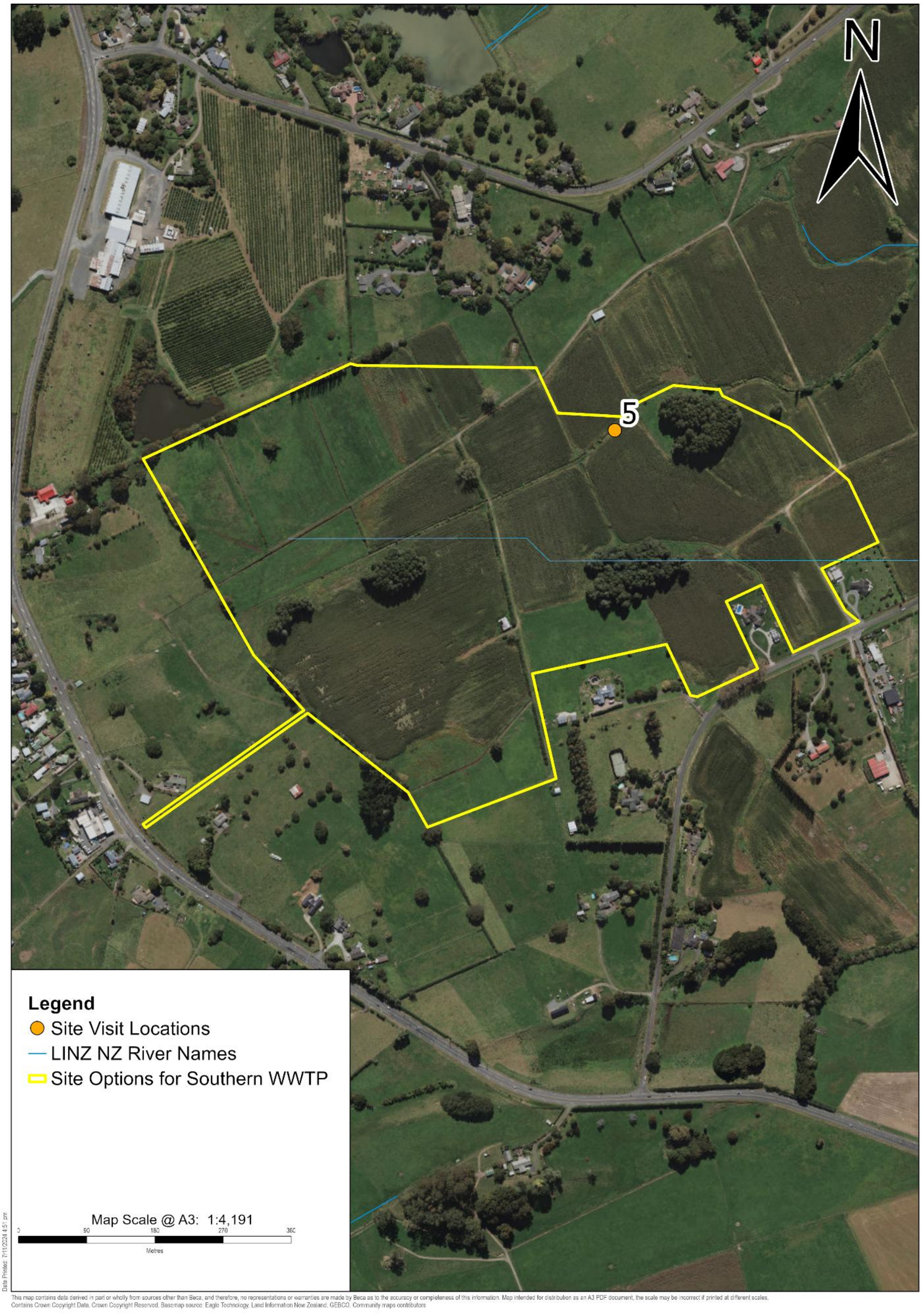


Figure 10. Zoomed map of the site visit location at Site 2.

5.3 Site Visit (Response to Assessment Criteria)

A site visit was undertaken by two representatives of Beca (Farza Feizi (senior environmental scientist) and Enfys Radley (environmental scientist)) on 3 July 2024 to further assess the five surface waterbodies identified as potential discharge locations. Ten locations across the five surface waterbodies were included in the site visit, as shown in Figure 8 and listed in Table 6. The findings of the site visit along with representative photos taken of those sites are presented in Table 9.

Table 9. Alternative surface water discharge locations feasibility assessment.

Identified Surface Water locations	Site Visit Location/Photos	Site Visit Assessment	Discharge Location Feasibility
Tributary of Nukuhau Stream(1)	 	• Located in one of the preferred SWWTP Sites (Site 1 (owned by HCC)) and in close proximity to Site 2 (the other preferred site for SWWTP). • The tributary is narrow with a slow flow. • There is not enough flat area on both sides of the stream where a naturalised discharge stream could be constructed; and the sides of the tributary are too sloped. • There are dense grasses on both sides of the tributary.	**Discharge location is unlikely to be feasible** given the tributary is narrow with a low flow.
Tributary of Nukuhau Stream (2)	 	• Located in Site 1 (owned by HCC) and in close proximity to Site 2. • The stream has a good water level; however, is has a slow-medium flow. • The area is generally flat and there is a large flat area where a naturalised discharge stream could be constructed. This site has the potential to promote habitat restoration. • There are dense grasses and a few trees on both sides of the stream.	**Discharge location may be feasible** considering there is a large flat area and sufficient level, however, there is a slow water flow.

Identified Surface Water locations	Site Visit Location/Photos	Site Visit Assessment	Discharge Location Feasibility
Nukuhau Mainstem (3)	 	• Located in Site 1 (owned by HCC) and in close proximity to Site 2. • The stream has a good water level and has a medium flow. • The area is generally flat and there is a large flat area for construction of a naturalised waterway. • There are dense grasses and trees on both sides of the stream.	**Discharge location highly likely to be feasible** considering there is a large flat area and a good water level and a medium water flow.
Nukuhau Stream (4) (next to site 1 border)	 	• Located close to the boarder of Site 1 and in close proximity to Site 2. • The stream is narrow with a slow flow. • There stream banks slope towards the stream. • There is a relatively flat area on both sides of the stream for construction of a naturalised waterway. • There are grasses on both sides of the stream and a suitable area for replanting available.	**Discharge location may be feasible** considering there is an area available for planting and construction of a naturalised waterway. However, the stream is narrow with a slow flow and the flow level might not be suitable for wastewater discharge.

Identified Surface Water locations	Site Visit Location/Photos	Site Visit Assessment	Discharge Location Feasibility
Farm Drain (5)	 	• Located in Site 2 (owned by Waka Kotahi) and in close proximity to Site 1. • The area on both sides of the drain is flat and has space available for a naturalised waterway. • The drain banks are too steep and are densely vegetated with grasses and a few trees. • The drain is narrow and has a slow to medium flow.	**Discharge location may be feasible** considering there is an area available for construction of a naturalised waterway. However, the stream banks are too steep, and the drain is narrow with a slow to medium flow.
Mystery Creek (east) (6)	 	• The stream in this location has very steep banks and therefore has poor accessibility. • It seems that there is not enough area for construction of a naturalised discharge stream. • The stream has a high flow rate. • The stream banks are densely vegetated with grasses, shrubs, and trees.	**Discharge location is unlikely to be feasible** considering it has very steep banks, is densely vegetated, and has poor accessibility.

Identified Surface Water locations	Site Visit Location/Photos	Site Visit Assessment	Discharge Location Feasibility
Mystery Creek (west) (7)	 	• Mystery Creek (2) is located on the opposite side of the road to Mystery Creek (1). • There is a small flat area that could be suitable area for a naturalised waterway. • The stream banks are in general gently sloping; however, there are some areas which are steep. • The stream banks are densely vegetated with grasses and a few trees. • The stream is narrow and has a slow flow.	**Discharge location is unlikely to be feasible** considering there is only a small area available for a naturalised waterway and the stream is narrow with a slow flow.
Nihokeke Stream (8)	 	• This location might be located on private property and there was not enough area for construction of a naturalised discharge stream. • The stream is narrow and has a very slow to stagnant flow. • The stream banks are steep on both sides.	**Discharge location is unlikely to be feasible** considering that this location might be situated on private land and the stream is narrow with a very slow to stagnant flow.

Identified Surface Water locations	Site Visit Location/Photos	Site Visit Assessment	Discharge Location Feasibility
Te Maire Stream (9)	 	• The stream was not visible from the roadside and is located on private property. • The stream banks appeared to be steep. • The stream is narrow and has a very slow flow. • There was not enough area for construction of a naturalised discharge stream.	**Discharge location is unlikely to be feasible** considering the stream at this location is situated on private property and has slow flow.
Te Maire Stream (10)	 	• The stream is narrow and has a medium flow. • The stream banks are densely vegetation with grasses and some shrubs. • The stream in this location is potentially located on private property. • This location is next to a road, therefore there is not enough flat area on both sides of the stream where a naturalised discharge stream could be constructed.	**Discharge location is unlikely to be feasible** considering the stream at this location is situated on private property.

5.4 Results of Assessment

The feasibility assessment findings after the site visit for discharging surface water to an alternative location are presented in Figure 11. The assessment identified Nukuhau Mainstream (3) (shown in green) as a highly feasible option for surface water discharge. Locations marked in orange indicate that the discharge may be feasible, while those marked in red suggest that the discharge is unlikely to be feasible.

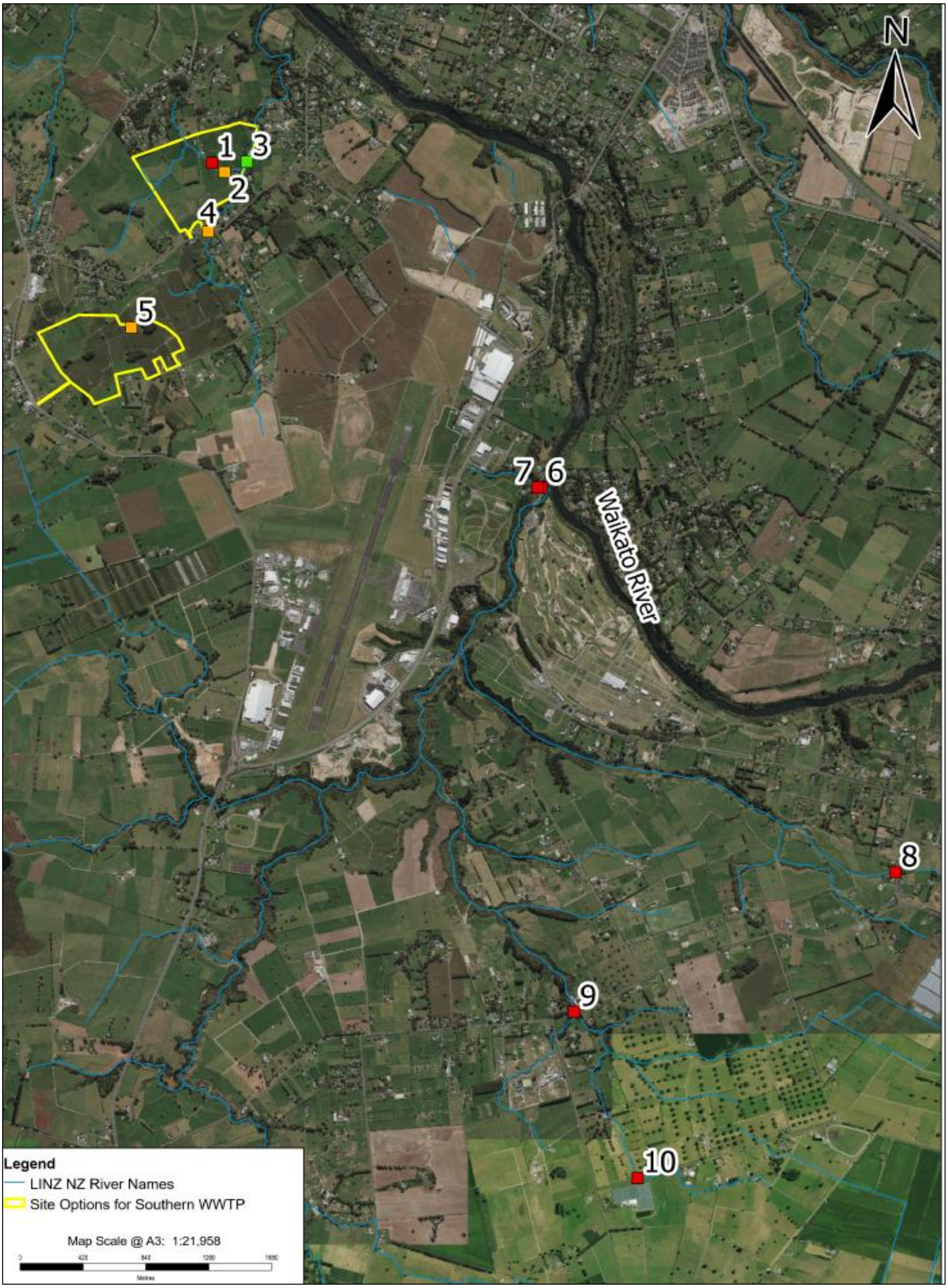


Figure 11. Assessment Results.

5.5 Cultural Effects

In the assessment of the suitability of the locations for surface water discharge, a cultural assessment has not been undertaken. Should these options proceed further, consultation with tangata whenua and cultural values and impacts assessment will be required for any alternative surface water discharge locations that are identified in this report.

6 Summary and Conclusions

The assessment of an alternative surface water discharge location found the following:

- Following a GIS desktop investigation, seven surface waterbodies that are not located in a Waikato flood management protection or utilised as a land drainage asset were identified for further investigation and assessment.
- Considering the exclusions regarding proximity and ecological values, five surface water bodies were shortlisted for the next stage of assessment.
- Through a GIS investigation, ten locations (that were identified as being publicly accessible) across the five shortlisted surface water bodies were included in the site visit. These sites were investigated to assess their suitability as potential discharge locations.
- The qualitative data collected during the site visit were used to assess the feasibility of alternative surface water discharge at each location. The factors considered included: accessibility to the site, ownership status (private property), surface water flow rate (slow, medium, fast), vegetation coverage, availability of modifiable areas for naturalised waterway discharge, and any additional considerations that may affect surface water discharge feasibility.
- Following the site visit, six of the sites identified as potential discharge locations were unlikely to be a feasible option. These sites include Tributary of Nukuhau Stream (1), Mystery Creek (6), Mystery Creek (7), Nihokeke Stream (8), Te Maire Channel (9), and Te Maire Stream (10). These locations were found to have one or more of the characteristics including narrow channels, slow flow rates, steep banks, poor accessibility, lack of available area for naturalised waterway, or were situated on private property. Limited flow, particularly during summer months, is a critical concern for surface water discharge, potentially leading to adverse ecological impacts and water quality deterioration. Furthermore, sites on private property present challenges for access and potential use for surface water discharge purposes.
- The assessment identified three locations as potentially feasible for surface water discharge. These locations include Nukuhau Stream (2), Nukuhau Stream (next to Site 1 boundary) (4), and the Farm Drain (5). These sites had some good characteristics such as easy access and available land for construction of a naturalised discharge stream, which may enhance the ecological value of the site. However, these locations were also characterised by narrow channels and slow flow rates, reducing the overall feasibility.
- The feasibility assessment found Nukuhau Mainstream (3) that is highly likely to be a feasible option for a surface water discharge. This stream is located in the preferred site for construction of the SWWTP (Site 1) and is owned by HCC. Therefore, the site has easy access and is in close proximity to the proposed sites for the SWWTP. Additionally, Nukuhau Mainstream had the faster water flow out of all the surface water locations, with a large flat area available for construction of a naturalised waterway. Acknowledging the cultural significance of the Nukuhau Stream, further collaboration with mana whenua is required to fully integrate their perspectives into approach.

Recommendations:

If an alternative surface water discharge is considered for further progression, additional investigations and work are recommended to enable a comprehensive assessment. This will provide a clear understanding of the requirements needed for an effective evaluation of the surface water discharge options.

- An assessment of environmental effects to understand potential adverse effects of the discharge on receiving water quality, ecology and flooding.
- Public Health assessment – Quantitative Microbial Health assessment
- An assessment of cultural impacts and Tangata Whenua engagement

- Engineering Investigations: Preliminary assessment of maintenance and operational requirements, geotechnical and hydrology investigations, and discharge engineering design.

7 Limitations

This report has been prepared by Beca Limited (Beca) solely for Hamilton City Council (the Client). Beca has been requested by the Client to provide an Alternative Surface Water Discharge Investigation for the proposed Southern Wastewater Treatment Plant (SWWTP). This report is prepared solely for the purpose of to exploring the potential of discharging treated wastewater from the SWWTP indirectly into the Waikato River through a surface water discharge. The contents of this report may not be used for any purpose other than in accordance with the stated Scope.

This report is prepared solely for the Client. Beca accepts no liability to any other person for their use of or reliance on this report, and any such use or reliance will be solely at their own risk.

Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency, and sufficiency of all information provided to it by, or on behalf of, the Client or any third party, including the information listed above, and has not independently verified the information provided. Beca accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the information provided.

The contents of this report are based upon our understanding and interpretation of current legislation and guidelines (“Standards”) as consulting professionals and should not be construed as legal opinions or advice. Unless special arrangements are made, this report will not be updated to take account of subsequent changes to any such Standards.

This report should be read in full, having regard to all stated assumptions, limitations, and disclaimers.

A

Appendix A – Maps of all the Waterbodies included in the Assessment


Ohote Stream
Waipa River
Waipa River
Waitawhiriwhiri Stream
Waikato River
Mangaonua Stream
Mangaonua Stream
Koromatua Stream
Koromatua Stream
Mangakotukutuku Stream
Mangaharakeke Stream
Nukuhau Stream
Mangaone Stream
Waikato River
Waipa River
Mangaomapu Stream
Nihokeke Stream
Waikato River
Mystery Creek
Te Maire Stream
Mangahia Stream
Waipa River
Rangitukia Stream
Mangawhero Stream
Mangaotama Stream
Mangaotama Stream
Waipa River
Mangakaware Stream
Mangakara Stream
Mangaio Stream
Mangamauku Stream
Mangawawa Stream
Ngaparierua Stream
Waipa River
Mangapiko Stream
Mangapiko Stream
Mangapiko Stream
Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors


Waikato River
Waitawhiriwhiri Stream
Mangaonua Stream
Waitakaruru Stream
Mangaonua Stream
Mangakotukutuku Stream
Mangaharakeke Stream
Waikato River
Nukuhau Stream
Mangaone Stream
Waitakaruru Stream
Mangaharakeke Stream
Mangaonua Stream
Mangaomapu Stream
Mangaone Stream
Waikato River
Nihokeke Stream
Te Maire Stream
Karapiro Stream
Waikato River
Waikato River
Mystery Creek
Mangawhero Stream
Mangawhero Stream
Mangaotama Stream
Mangapiko Stream
Mangapiko Stream
Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors


Waikato River
Te Awa O Katipaki Stream
Komakorau Stream
Kirikiriroa Stream
Ohote Stream
Waitawhiriwhiri Stream
Mangaonua Stream
Koromatua Stream
Mangakotukutuku Stream
Mangaone Stream
Mangaharakeke Stream
Nukuhau Stream
Mangaomapu Stream
Mystery Creek
Te Maire Stream
Nihokeke Stream
Mangahia Stream
Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

C

Appendix C – Discharge to Wetlands Feasibility Assessment

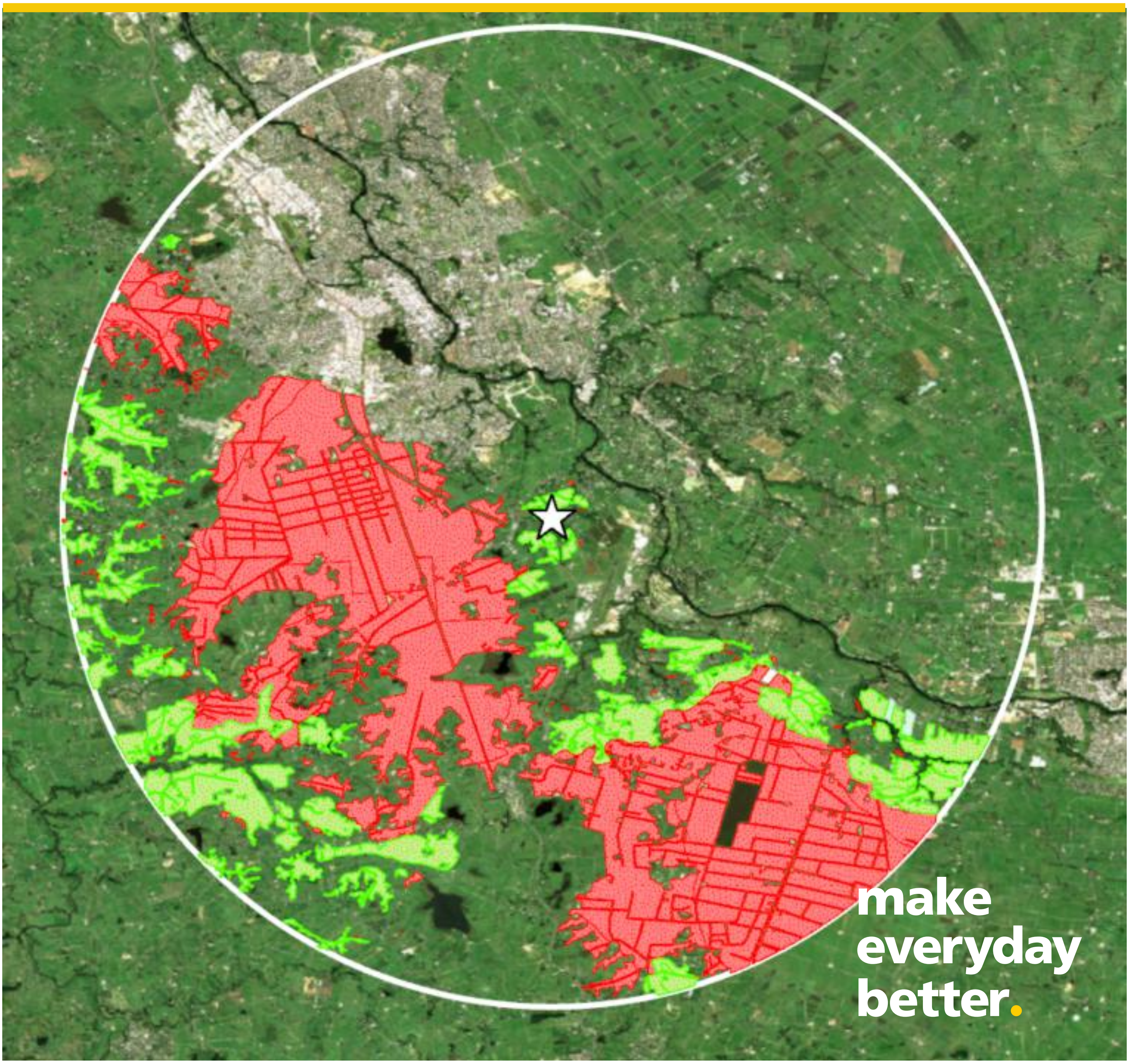
Sensitivity: General

Southern Wastewater Treatment Plant - Discharge to Wetland Feasibility Assessment

Prepared for Hamilton City Council

Prepared by Beca Limited

7 August 2025



Contents

Appendices

Revision History

Revision N°	Prepared By	Description	Date
1	Sarah Busbridge	Draft for technical review	03/08/2024
2	Sarah Busbridge	Draft for approval	05/08/2024
3	Sarah Busbridge	Draft for client review	14/08/2024
4	Garrett Hall	Final	07/08/2025

Document Acceptance

Action	Name	Signed	Date
Prepared by	Sarah Busbridge		07/08/2025
Reviewed by	Claire Webb		07/08/2025
Approved by	Garrett Hall		07/08/2025
on behalf of	Beca Limited		

Executive Summary

The Waikato region is undergoing significant urban, industrial, and commercial growth, increasing demand on existing wastewater infrastructure. To address this, the Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) was developed, identifying a preferred option to manage wastewater from the southern part of the Waikato-Hamilton-Waipā metro area. A key component of this plan is the construction of a new Southern Wastewater Treatment Plant (SWWTP), which would service future development in southern Hamilton, the Waikato Regional Airport, and northern Waipā.

The Southern Metro DBC process included a site selection process to identify a preferred broad location for the SWWTP in the area immediately to the south of Hamilton. This short-list and site feasibility investigation concluded in August 2024 and recommended the preferred site for the SWWTP as a site that is owned by Hamilton City Council (HCC) between Peacockes Road and Raynes Road (Sharpe Farm).

The SWWTP is planned to be developed in stages, eventually serving a Population Equivalent (PE) of up to 200,000. The Southern Metro DBC assumed a land discharge for Stage 1, transitioning to river discharge from Stage 2 onwards, subject to further technical investigations as part of resource consent processes. HCC will seek consents for Stages 1 to 2b, covering up to 18,000 (PE) and an average daily flow of 3,600 m³/day at the end of stage 2b. Commencement flows at stage 1 are estimated to be 400 m³/day increasing to 1,900 m³/day at the end of stage 2a.

One of the disposal methods being considered is a discharge to a wetland that would be restored as part of the project.

Beca has been commissioned by HCC to conduct a preliminary discharge to wetland feasibility assessment to screen for and map areas with underlying wetland characteristics (i.e. hydric soils and wetland hydrology) that might be suitable for restoration planting and wastewater discharge within 15 km of SWWTP. Assessment against a set of suitability criteria was then undertaken for a subset of candidate sites located within the parcels of land that comprise preferred locations for the SWWTP, or in close proximity to them on publicly owned land.

Outside of exclusion areas, approximately 13,317 ha was mapped as potentially restorable wetland. Of this, 10,088 ha was excluded on the basis of size (less than the minimum 2.5 ha necessary for wastewater discharge) and/or wetland type/substrate (bogs and fens on peat or peat loam soil). This left a remaining 3,228 ha of potentially restorable wetland that may be suitable for wastewater discharge.

Six short-listed candidate sites selected for further investigation were all modelled as historic swamp wetlands. Due to their close proximity to one another, all of the sites had similar constraints associated with:

- Drainage to the Nukuhau Stream and Waikato River (sensitive receiving environment)
- Known presence of species of conservation concern (long tailed bats, At -Risk fish species), or potential presence of species of conservation concern (copper skink).
- Risks of flooding due to requirements to fill in drainage channels for restoration/re-wetting.

A number of constraints associated with restorability were also noted. Sites 1-4 had less obvious signs of wetland hydrology and these sites are likely to be more difficult to establish (or re-establish) hydrology and create a functional wetland ecosystem within. These sites may also require earthworks/recontouring to protect against nutrient/contaminant mobilisation to the receiving environment.

Site 6 was considered the most suitable site for further investigation, however this site has been identified as a potential offsetting location for Southern Links, so is unlikely available for wetland regeneration. If a discharge to wetland option were to be progressed, further investigations necessary to evaluate feasibility and constraints associated with the candidate site(s) would include:

- Ground truthing of desktop information (soil investigations, review of historic aerial imagery to verify accuracy of modelled historic wetland extent, site walkover to confirm artificial drain locations and areas of suitable fauna habitat).
- Hydrological assessments (water balance assessments, investigation of connection to groundwater).
- eDNA sampling and fauna surveys (if areas of suitable habitat may be impacted).

1 Introduction

The Waikato region is undergoing significant urban, industrial, and commercial growth, resulting in increasing demand on existing wastewater infrastructure. To address this, the Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) was developed, identifying a preferred option to manage wastewater from the southern part of the Waikato-Hamilton-Waipā metro area. A key component of this plan is the construction of a new Southern Wastewater Treatment Plant (SWWTP), which would service future development in southern Hamilton, the Waikato Regional Airport, and northern Waipā.

The Southern Metro DBC process included a site selection process to identify a preferred broad location for the SWWTP in the area immediately to the south of Hamilton. This short-list and site feasibility investigation concluded in August 2024, and recommended the preferred site for the SWWTP as a site that is owned by Hamilton City Council (HCC) between Peacockes Road and Raynes Road (Sharpe Farm).

The SWWTP is planned to be developed in stages, eventually serving a Population Equivalent (PE) of up to 200,000. The Southern Metro DBC assumed a land discharge for Stage 1, transitioning to river discharge from Stage 2 onwards, subject to further technical investigations as part of resource consent processes. HCC will seek consents for Stages 1 to 2b, covering up to 18,000 (PE) and an average daily flow of 3,600 m^3/day at the end of stage 2b. Commencement flows at stage 1 are estimated to be 400 m^3/day increasing to 1,900 m^3/day at the end of stage 2a.

Beca Ltd (Beca), on behalf of HCC, has conducted various investigations into alternative discharge options for the SWWTP, building on previous work, to assess the long-list options for the SWWTP which will inform the resource consent process. This work will reassess the broad assumptions made at the Southern Metro DBC with regards to discharge options.

Environmental and engineering investigations are being conducted to develop and assess various options for discharging treated wastewater from the future SWWTP. Among the discharge methods being considered is a discharge to a wetland that would be restored as part of the project.

1.1 Purpose and scope

Considering that one of the potential discharge options from the SWWTP is to discharge to wetland, Beca has been commissioned by HCC to identify potentially suitable wetland restoration sites within a 15 km radius of the preferred SWWTP sites on the southern side of the Waikato River and evaluate the suitability of a subset of candidate sites in close proximity to the SWWTP.

The scope of this assessment includes:

- Identification of potentially suitable sites within 15 km of the short listed SWWTP sites using geospatial and publicly available data. This focussed on a desktop review of areas with underlying wetland characteristics (i.e. hydric soils and wetland hydrology) that might be suitable for restoration planting and wastewater discharge. Certain areas were excluded from analysis during initial screening (see Section 4.2.1).
- A high-level evaluation of the suitability of mapped potentially restorable wetland areas based on wetland type, areal extent, and underlying soils.
- A selection of candidate sites based on potential suitability, location within the parcels of land that comprise short listed SWWTP sites, or close proximity to them, and land ownership.
- A more targeted assessment of suitability of the candidate sites considering:
  - Modelled wetland type and expected hydrosystem
  - Soil and drainage
  - Modifications and restorability

  - Species records/habitat for species of conservation concern
  - Sensitivity of the receiving environment
- Recommendations for further work that would be required if discharge to wetland was progressed further as a short-listed option.

This assessment does not include any site investigations and is reliant on publicly available desktop information.

2 Description of the Proposed Southern Wastewater Treatment Plant

2.1 Southern Wastewater Treatment Plant

Given that regional resource consents will only be pursued for stages 1 to 2b (up to 18,000 PE or 3,600 m³/day), the anticipated discharge flows for these stages will be used for calculations in the subsequent sections (Table 1). According to Table 1, the Southern Metro DBC assumed that Stage 1 would employ sequencing batch reactor (SBR) treatment technology with land discharge, while Stage 2 would utilise Membrane Bioreactor (MBR) technology with discharge into the Waikato River. However, Southern Metro DBC is currently reassessing these assumptions regarding the staging and final discharge environments for each phase.

Table 1. SWWTP Concept Staging.

Description		Serviced area	Starting demand	Cumulative Capacity
Stage 1	SBR* with discharge to land	Airport precinct	400 m^3/day (2,000 PE)	1,000 m^3/day (5,000 PE)
Stage 2a	MBR** with discharge to Waikato River	Airport precinct and Mātangi / Tamahere commercial areas	1,200 m^3/day (6,000 PE)	1,900 m^3/day (9,500 PE)
Stage 2b	MBR with discharge to Waikato River (additional reactors and membrane equipment)	Airport precinct, wet industry and Mātangi /Tamahere commercial areas	3,600 m^3/day (18,000 PE)	3,600 m^3/day (18,000 PE)

* SBR treatment technology with land disposal is proposed for the first stage. This technology provides enormous flexibility in terms of flows and load and will provide effluent quality that is suitable for application into or onto land. SBR is able to stop solids to reduce organic matter found in wastewater, which is done over a number of cycles, depending on the size of the tank.

** MBR treatment technology with discharge to water is proposed for the second stage. MBR systems are aerobic activated sludge biological reactors, which combine the biological degradation process, known as "activated sludge", with solid-liquid separation by membrane filtration. This process results in high-quality effluent with low levels of suspended solids, pathogens, and nutrients

2.2 Preferred Locations for the Wastewater Treatment Plant

The Southern Metro DBC process involved exploring the area immediately south of Hamilton to identify a preferred location for the SWWTP. The 2024 Assessment of Alternative Sites5 undertaken by Beca further refined the locations identified by Southern Metro DBC, narrowing them down to four shortlisted sites. Through a multi-criteria analysis (MCA), Site 1 (Sharpe Farm) and Site 2 (Narrows/Rukuhia) emerged as the preferred locations for the Southern WWTP. These preferred sites are detailed in Table 2 and are shown in Figure 1. Following the technical MCA process and the findings of the Tangata Whenua Effects Assessment

(TWEA), Sharpe Farm has been identified at the preferred site. Sharpe Farm scored the highest in both the unweighted and weighted MCA[1].

Table 2: Description of the Shortlisted Sites for the SWWTP

Site Name	Site Address	Site Owner	Area of Site	Title	Legal Description
Sharpe Farm (Site 1)	Raynes Road, Rukuhia	HCC	34.2 ha (two blocks which have an area of 19.35 ha and 14.85 ha).	SA72C/450	Lot 5-6 DPS 91837
Narrows/ Rukuhia (Site 2)	71 Narrows Road/Ohaupo Road	The site is owned by the Crown and administered by NZTA	35 ha	RT 534321	Lot 1 DP 420545

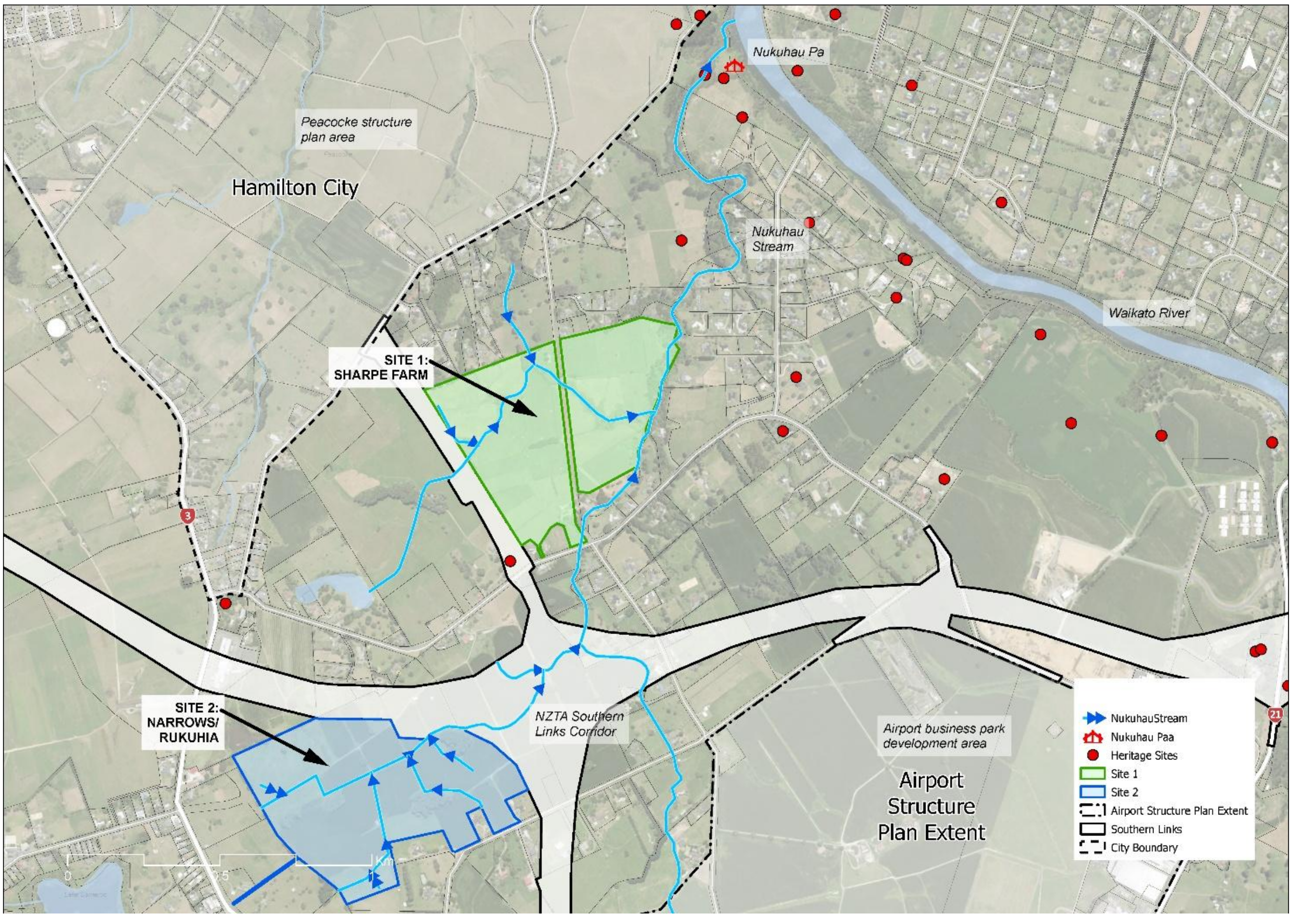


Figure 1. The preferred sites for the Southern WWTP (Site 1 and Site 2) (Source: Southern Wastewater Treatment Plant Assessment of Alternative Sites, Beca, 2024).

[1] Southern Wastewater Treatment Plant, Assessment of Alternative Sites, Beca, August 2024.

3 Discharge to Wetland Methods

Wetlands can be extremely cost-effective at removing a variety of pollutants from wastewaters by physical settling and filtration, chemical precipitation and adsorption, and biological metabolic processes that result in burial, storage in vegetation, and denitrification (Day et al., 2004; Verhoeven & Meuleman, 1999).

If progressed, the discharge of treated wastewater to the wetland would likely be through a naturalised rocky channel planted with native vegetation to prevent erosion and scour. Wastewater would then flow horizontally through the wetland. An example of this type of naturalised discharge is shown below in Figure 2. It is expected that wastewater discharged to the wetland will be treated to a very high-quality high quality using MBR technology and therefore the primary function of the wetland will be to provide land based contact prior to entering the receiving environment.

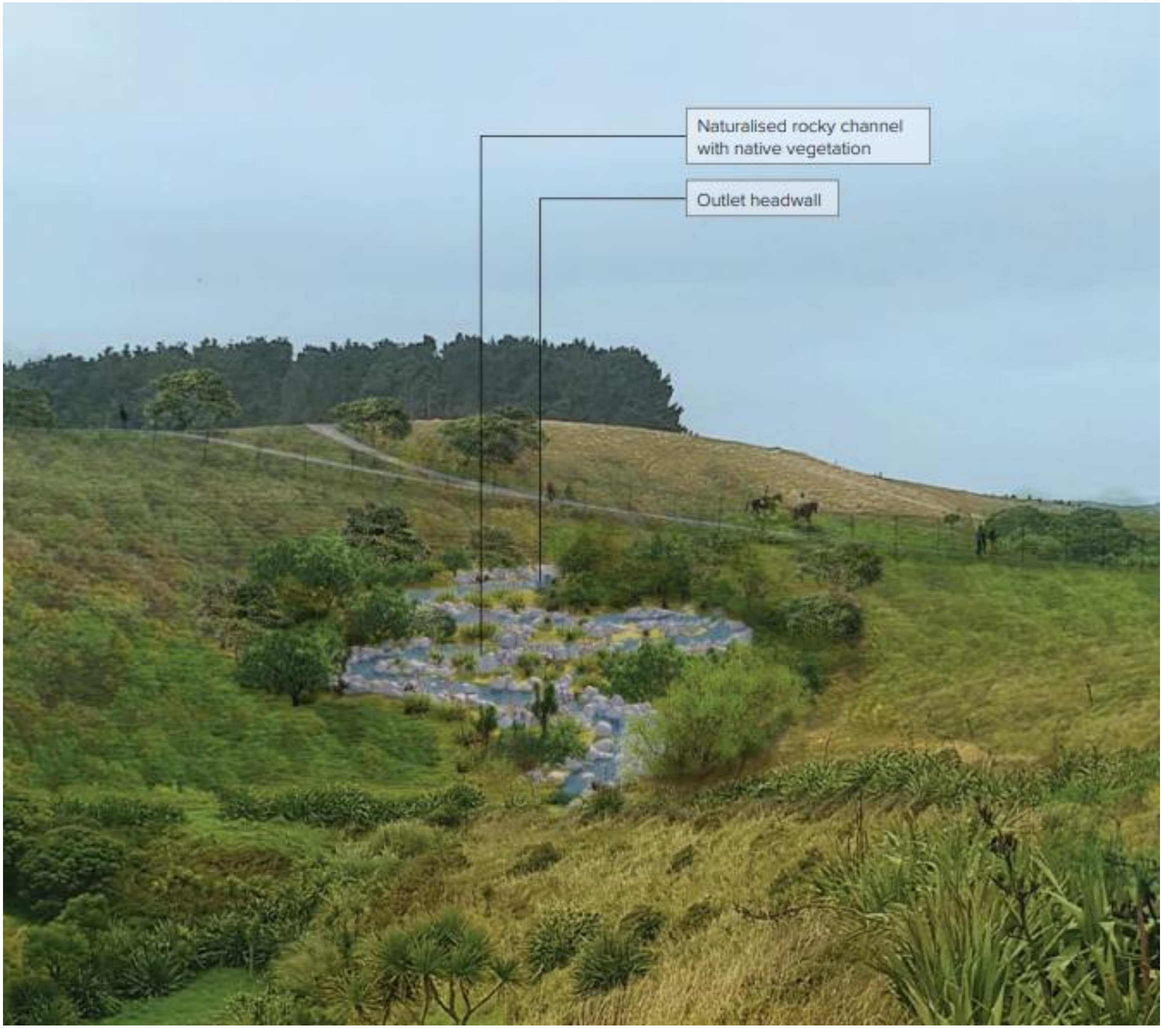


Figure 2. Example of discharge to wetland methods (artist impression).

Other examples include more traditional constructed wetlands such as the one below shown at the Portland WWTP, Whangarei District. This wetland follows at two-stage oxidation pond treatment process.

Figure 3: Constructed wetland at Portland WWTP, Whangarei.

4 Assessment Methodology

4.1 Identification and mapping of historic and potential wetlands

Desktop screening for historic and potential wetlands that might be suitable for restoration and wastewater discharge was undertaken for the subject area (15km radius from the short listed SWWTP sites) using ArcGIS Pro 3.0.3 desktop geospatial software.

The subject area was split into a grid overlaid with geospatial layers showing modelled pre-human wetland extent[2], soil drainage (Manaaki Whenua, 2024), soil type (FSL), 1m LiDAR contours, and exclusion areas (see below). Each 1 km^2 grid that was not subject to exclusion criteria and included modelled historic wetland was cross referenced with 1m LiDAR contours and boundaries adjusted as necessary. To identify any additional potential wetland areas outside of modelled historic wetland polygons, aerial photography was analysed for characteristic hydrophytic vegetation, evidence of inundation or soil saturation, and characteristic wetland colours and patterns. Dwellings were excluded from potential wetland polygons.

As it is difficult to identify all wetland types accurately from aerials, the resultant mapping of historic and potential wetland areas should not be considered exhaustive or relied upon for accuracy.

The mapping and analysis were achieved using the datasets outlined in Appendix A. Areas excluded from analysis (see Figure 4) included:

- Land on the northern side of the Waikato River[3]
- Areas within 20m of rivers and lakes (as mapped in LINZ River Polygons, LINZ River Lines, REC Lakes layers).
- Areas within 20m of land that is not zoned as Rural based on Waipa and Waikato District Plan Zones (Operative).
- Areas where slope is 12° or above
- Areas designated as mineral resources (Aggregate Extraction Policy Area layer)
- Areas within 30m of bores or geothermal wells.
- Land designated as susceptible to flooding (Waikato Regional Council Regional Scale Flood Hazard layer and District Plan Floodplain Management Area layer)
- Areas designated for current and future development (urban zoned land, Peacocke Development Area, Southern Links Designation, Airport Business Park Development Area, and other designations within Waipa District).
- QEII covenants.
- Waikato Regional Council identified Significant Natural Areas and Outstanding Natural Features and Landscapes
- Current wetlands as mapped by WRC and FENZ[4] and areas with restoration status of “Mature” or “Unavailable for Restoration” (Eco-index – Current Status and Restoration Priority for NZ layer)
- HCC Proposed SNA Final (2021)
- DOC public conservation land

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[2] Freshwater Ecosystems of New Zealand (FENZ) historic wetland typology (Leathwick et al., 2010).

[3] The northern side of the Waikato River was excluded due to increased cost and complexity associated with conveying treated wastewater across the river.

[4] Current wetlands were excluded on the basis that constructed/restored wetlands offer better opportunities for wastewater treatment than natural wetlands as they can be designed for optimal performance (Verhoeven & Meuleman, 1999), and they have limited current conservation value (wetland extent is greatly reduced in the Waikato region and even degraded wetlands are expected to retain ecological value)

- DOC mapped non-migratory fish distributions
- Waipa District Council - Peat Lake Catchment Areas, and Biodiversity River and Stream Corridor layers

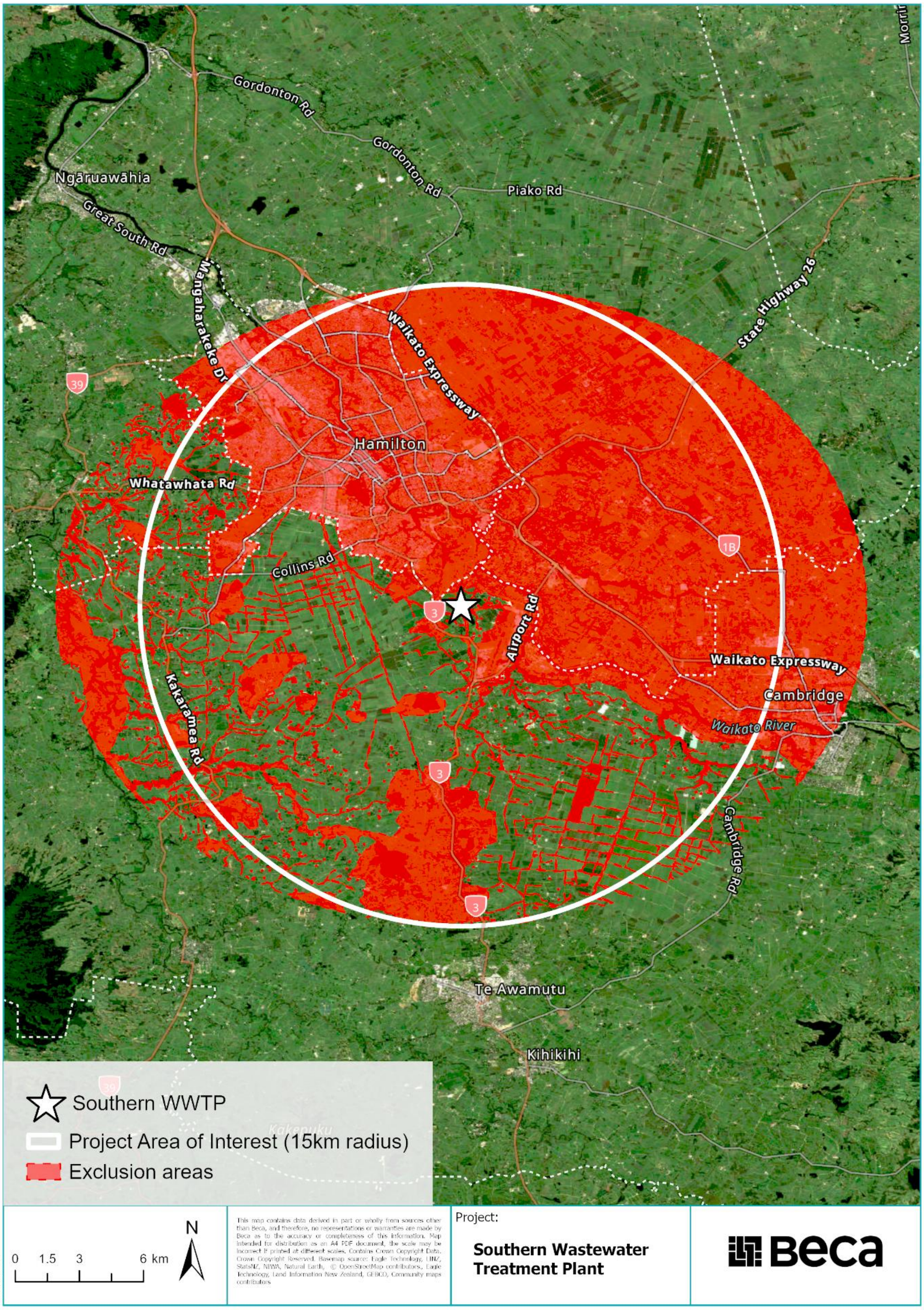


Figure 4. Areas excluded from analysis based on the above criteria.

4.2 Suitability for wastewater discharge

4.2.1 Initial screening and selection of candidate sites

Once mapping was complete, the suitability for wastewater discharge was then assessed. Initial screening excluded wetlands if any of the following criteria were met:

- Extent was <25,000m^2 (the minimum size deemed suitable on the basis of calculations, 2-day retention, 300 mm water depth to provide opportunities for natural treatment processes)
- Classified as a low fertility wetland type (i.e. bogs and fens) where modelled as a historic wetland on peat or peat loam soils on the basis that:
  - Excessive wastewater addition to a nutrient-poor wetland systems such as bogs can result in fundamental shifts in ecosystem composition (Cooke, 1991) making it difficult to restore a representative ecosystem.
  - Peat soils have a low phosphorus retention capacity and flooded peat soils pose a risk of becoming a net source of phosphorus/contaminants over time on former agricultural land (Kreyling et al., 2021).

Due to the lack of detailed desktop information available, areas were not able to be deemed suitable but rather were categorised as either “Unsuitable” or “Further Assessment Required”.

A subset of candidate sites was then selected for further scrutiny based on location within the parcels of land that comprise preferred locations for the SWWTP, or close proximity to them, and location on publicly owned land. Each discrete polygon was considered as a site although these may be combined for the purposes of wetland restoration and wastewater discharge.

4.2.2 Feasibility assessment of candidate sites

Short-listed candidate sites were further considered against the following criteria:

- Modelled wetland type and predicted hydrosystem
- Soil and drainage
- Modifications and restorability
- Species records/habitat for species of conservation concern
- Sensitivity of the receiving environment

Based on these factors, high level commentary on the feasibility of restoring the sites for wastewater discharge purposes has been provided, along with recommendations for further investigations should the discharge to wetland option be progressed.

5 Ecological Context

The assessment area is located within the Hamilton Ecological District (ED) in the Waikato Ecological Region (McEwen, 1987). Historically, the area would have consisted of bog, fen and swamp wetland, scrub and fernland, and swamp forest (Leathwick et al., 2010; McEwen, 1987). However, these areas have been extensively drained and presently, outside of the urban centre, the ED is almost entirely farmed.

Remnants of the once extensive lake and wetland system include Lake Rotoroa (Hamilton Lake), Lake Rotokaeo (Forest Lake), and Horseshoe Lake (and Lake Waiwhakareke) near Hamilton City[5]. The Waikato River and its tributaries also form an extensive gully system which contain small pockets of kahikatea and rare swamp maire forest.

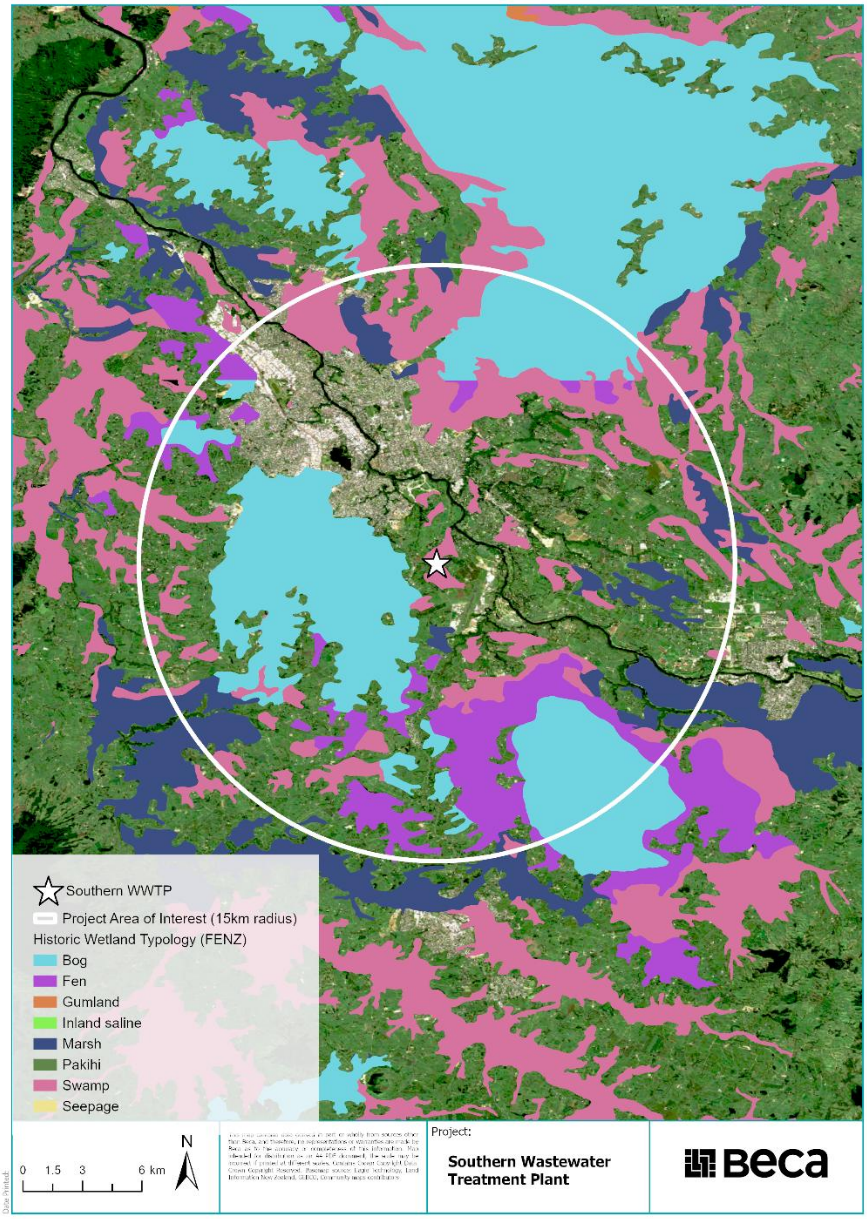


Figure 5. Historic wetland extent in relation to the SWWTP and project area of interest.

[5] https://www.waikatoregion.govt.nz/environment/water/freshwater-wetlands/

6 Assessment Results

6.1 Overview of GIS analysis

Within the subject area not covered by the exclusion criteria listed in section 4.1, modelled historic and potential wetland extent covered approximately 13,317 ha. Of this area, 10,088 ha was deemed unsuitable based on size (less than the minimum 2.5ha necessary for wastewater discharge) and/or wetland type/substrate (bogs and fens on peat or peat loam soil), and 3,228 ha was deemed potentially suitable for wastewater discharge. Resultant mapping showing potential wetland extent outside of exclusion areas, and evaluation of suitability is shown in Figure 6 below.

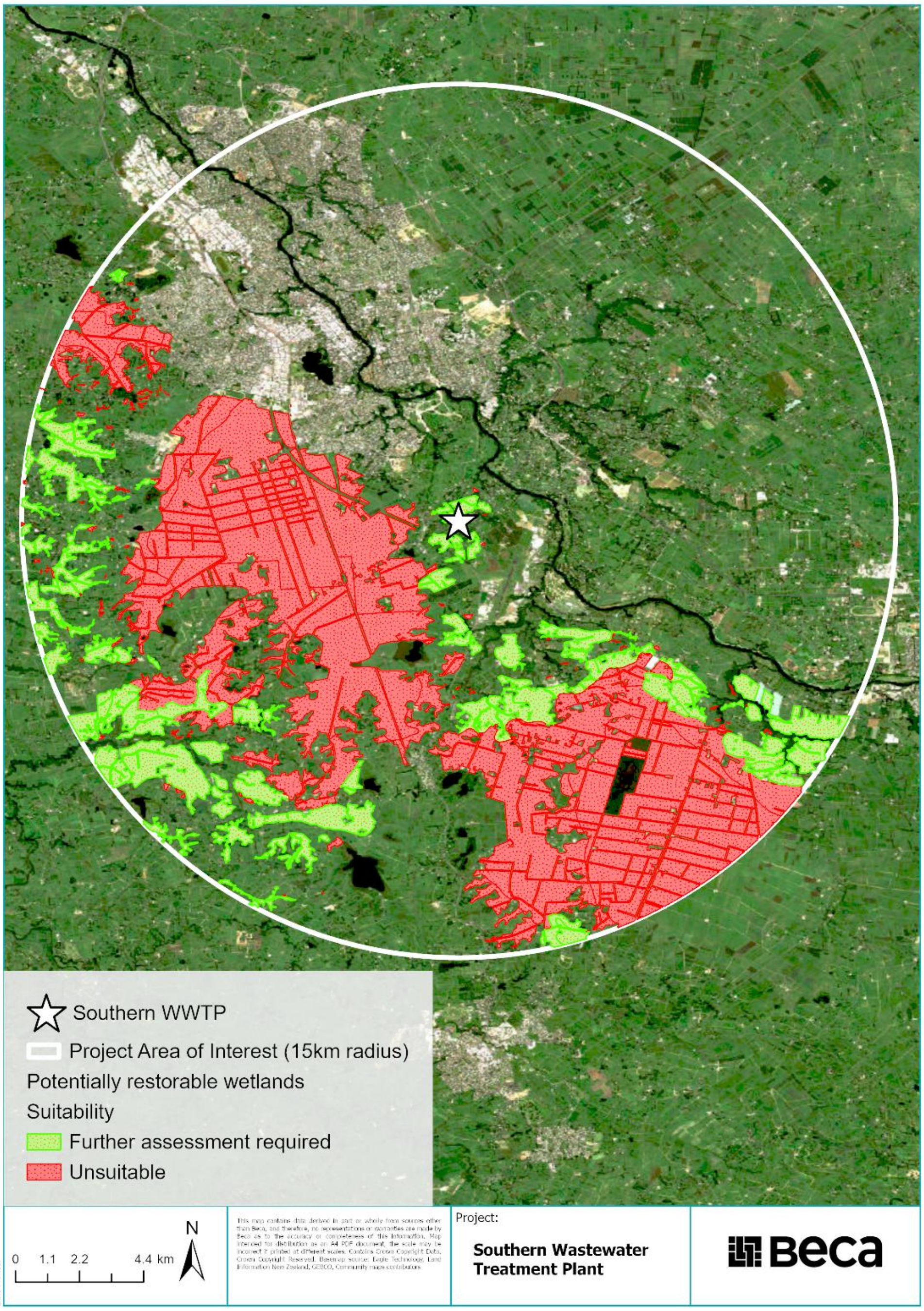


Figure 6. Result of initial screening of potentially restorable wetlands within the subject area.

6.2 Assessment of shortlist candidate sites

Of the potentially suitable areas, a subset of six candidate sites were selected based on location within the preferred location (Sharpe farm) for the construction of the SWWTP or being located on publicly owned land is close proximity to the WWTP sites. Each discrete polygon was considered as a site although these may be used together for the purposes of wetland restoration and wastewater discharge.

These sites were further considered against various criteria as set out in Section 4.2.2 (see Table 4). The six candidate sites are shown on Figure 7. Details of each site are provided in Table 3.

Figure 7. Six candidate sites selected for further assessment after initial screening

Table 3. Short-list candidate site details

Site Number	Parcel ID - Title No.	Area	Owner	Location	
1	6552366 - SA72C/450	3.2ha	Hamilton City Council	Site 1 – Sharpe Farm	
2	6552366 - SA72C/450	10ha (3.8 ha likely to be taken up by proposed plant as indicated by red hatched polygon)	Hamilton City Council	Site 1 – Sharpe Farm	
3	6552365 - SA72C/450	7.3ha	Hamilton City Council	Site 1 – Sharpe Farm	
4	6552365 - SA72C/450	4.4ha	Hamilton City Council	Site 1 – Sharpe Farm	

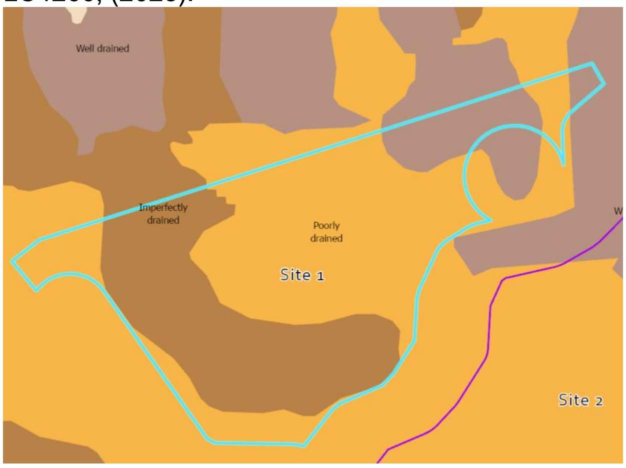
Site Number	Parcel ID - Title No.	Area	Owner	Location	
5	6828735 - 237617	2.7ha	NZTA	Narrows Road	
6	6628858 - SA73A/858 7192849 - 534321	27ha	NZTA	Site 2 - Narrows/Rukuhia and adjacent land	

To further investigate the potential suitability of candidate sites for wastewater discharge and restoration, the following was considered:

- Modelled wetland type – All candidate sites were modelled as historic swamp wetlands. Swamps are typically high nutrient wetlands which play an important role in naturally filtering out sediments and nutrients (Cooke, 1991). Discharge of wastewater to swamps is likely to allow for restoration to a more representative state.
- Soil and drainage –The soil and drainage characteristics of each candidate site has been described where adequate desktop information was available.
- Modifications and restorability – High level commentary is provided on the extent to which the candidate site has been subject to modification, the likelihood that the site may be able to be restored, and what might be required for restoration.
- Species records – A review of species records and likelihood that the area might provide potential habitat for species of conservation concern is provided. Terrestrial fauna have been considered along with freshwater fauna as restoration of the site may involve clearance/loss of terrestrial habitat.
- Sensitivity of the receiving environment- a description of the receiving environment is provided as the risk of downstream eutrophication will need to be considered if the restoration site is in close proximity or directly connected via watercourses.

The suitability of each of the candidate sites was evaluated against these factors using a traffic light scoring system where green indicates few or no constraints, yellow indicates presence of some constraints that warrant further investigation or management, and red indicates significant constraints which may render the site unsuitable. A summary of the feasibility of development for wastewater discharge and restoration is provided at the end of each site assessment.

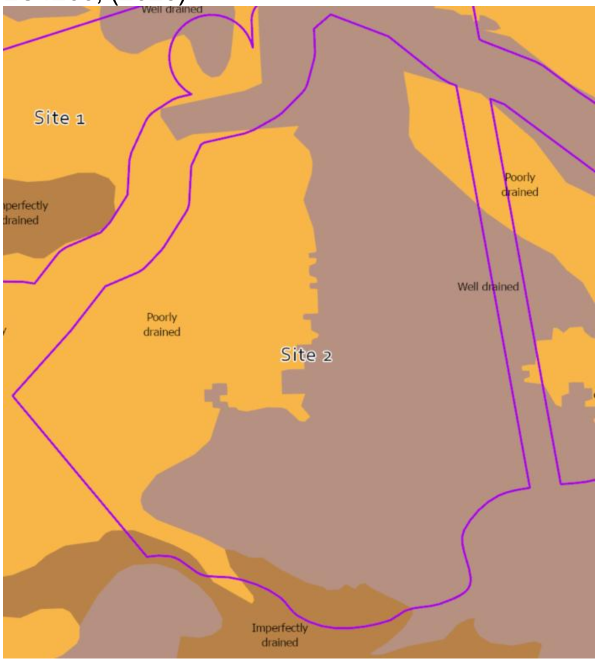
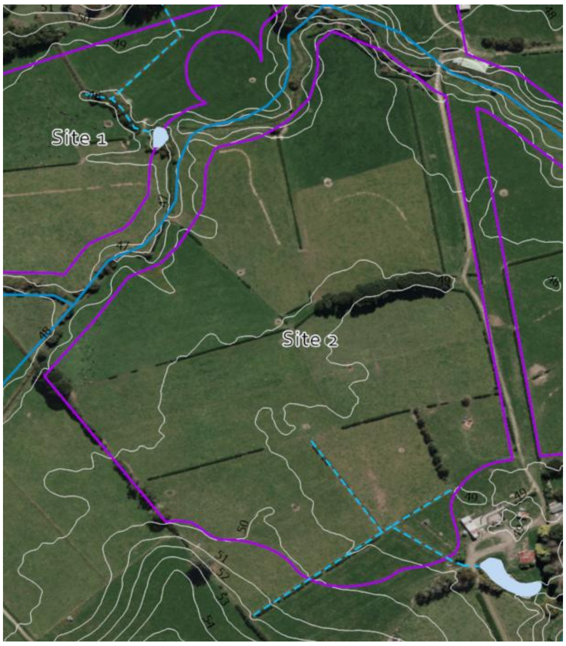
Table 4. Candidate site assessment against suitability criteria.

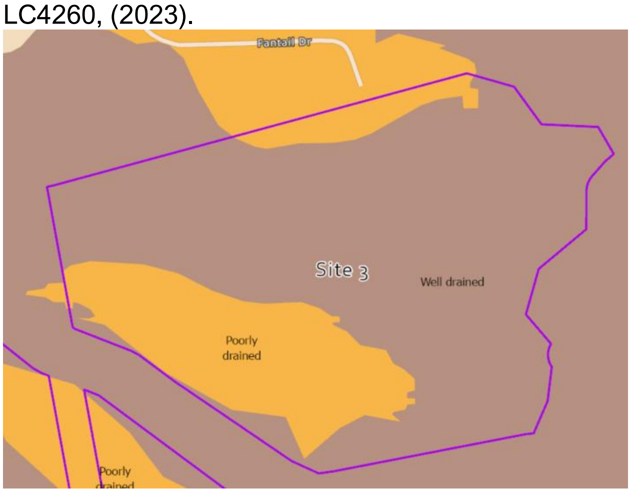
Site 1 (Sharpe Farm)		Suitability
Modelled historic wetland type (FENZ)[6] and predicted hydrosystem	Palustrine[7] swamp	
Soil and drainage (S-Map)	Soils were investigated by Manaaki Whenua (2023) and found to consist predominantly of imperfectly or poorly drained alluvium. Grey colours in the subsoil indicates waterlogging for considerable periods of the year. Well-drained soils mapped by Grange et al. (1939) were not evident. A water table was often encountered between 57 and 70 cm below the soil surface in February 2023. Wetter areas of the farm had drainage ditches. For further information, see Manaaki Whenua Contract Report: LC4260, (2023). 	
Modifications and restorability	The site is currently grazed by cattle. Unmapped drains are present within the site and connect with tributaries and the Nukuhau Stream that flow to the Waikato River. These drains may need to be in-filled to re-wet the site and re-establishing wetland hydrology could be challenging, although soils have suitable hydric characteristics. Recontouring of the site might be necessary to create a functional wetland while minimising receiving environment impacts.	

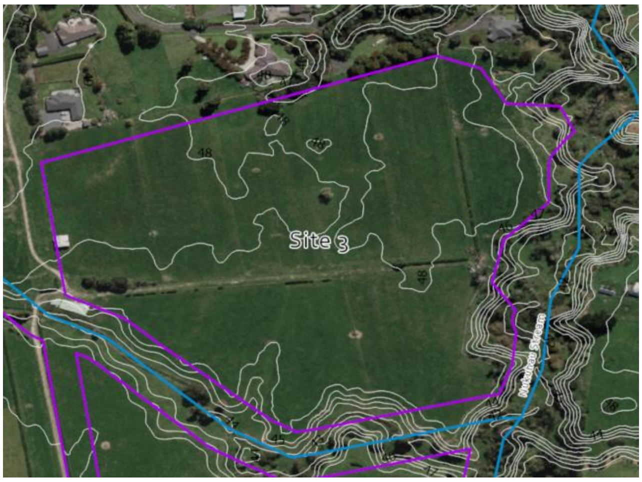
[6] FENZ “historic wetlands typology” layer describes the estimated historic distribution of wetlands, including predictions of their expected historic composition, based on information stored in the New Zealand Land Resource Inventory.

[7] Palustrine: a hydrosystem of all freshwater wetlands fed by rain, groundwater, or surface water, but not directly associated with estuaries, lakes, or rivers (Johnson & Gerbeaux, 2004).

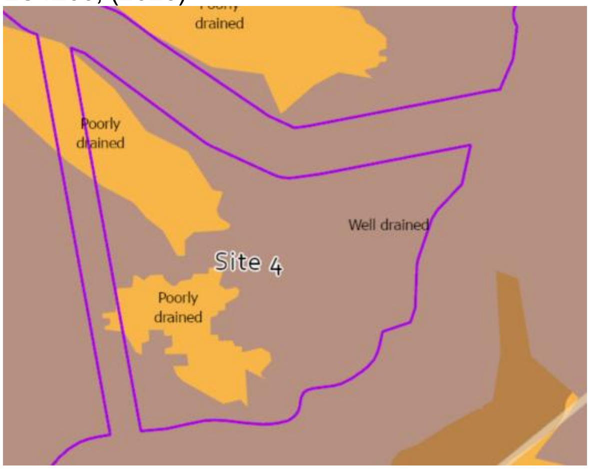
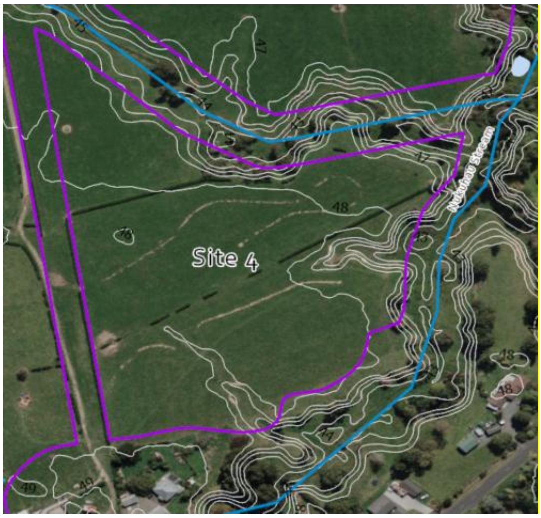
		
Species records	Long tailed bats – located within known long tailed bat roosting area (if trees in the site are cleared, this may require bat management) At Risk fish species (giant kōkopu, longfin eel, kōaro) present in sub-catchment	
Sensitive receiving environment	Watercourse adjacent to south and east of site which drains to the Nukuhau Stream and then the Waikato River. Gainsford Road Gully Proposed SNA located downstream (Site ID: 21)	
Feasibility	Some constraints are present due to the presence of species of conservation concern, and proximity to the Waikato River. The site is highly modified and further investigations are necessary to ensure it is suitable for restoration and that restoration is feasible.	
Site 2 (Sharpe Farm)		
Modelled wetland type (FENZ) and predicted hydrosystem	Palustrine swamp	
Soil and drainage	Soils were investigated by Manaaki Whenua (2023) and found to consist predominantly of imperfectly or poorly drained alluvium. Grey colours in the subsoil indicates waterlogging for considerable periods of the year. Well-drained soils mapped by Grange et al. (1939) were not evident. A water table was often encountered between 57 and 70 cm below the soil surface in February 2023. Wetter areas of the farm had drainage ditches.	

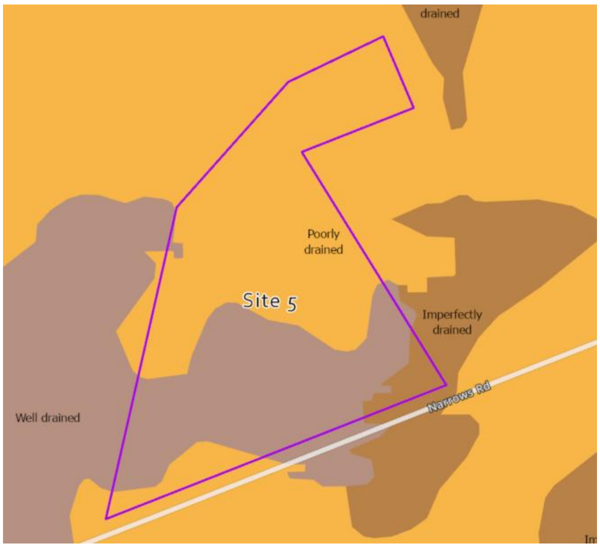
<table>
<tr><td></td><td>For further information, see Manaaki Whenua Contract Report: LC4260, (2023).

</td><td></td></tr>
<tr><td>Modifications and restorability</td><td>The site is currently grazed by cattle. Unmapped drains are present to the south of the site These drains may need to be in-filled to re-wet the site and re-establishing wetland hydrology could be challenging, although soils have suitable hydric characteristics. Recontouring of the site may be necessary to create a functional wetland while minimising receiving environment impacts.

</td><td></td></tr>
<tr><td>Species records</td><td>Long tailed bats – located within known long tailed bat roosting area (clearance of trees may require bat management)
Copper skink present in surrounds – hedgerows may include suitable habitat.</td><td></td></tr>
</table>

	At Risk fish species (giant kōkopu, longfin eel, kōaro) present in sub-catchment	
Sensitive receiving environment	Watercourse adjacent to north of site which drains to Nukuhau Stream and then the Waikato River. Gainsford Road Gully Proposed SNA located downstream (Site ID: 21)	
Feasibility	Some constraints due to the presence of species of conservation concern, and proximity to the Waikato River. Care would need to be taken to prevent nutrient mobilisation to adjacent watercourses. The site is highly modified and further investigations are necessary to ensure restoration is feasible (particularly restoration of hydrology)	
Site 3 (Sharpe Farm)		
Modelled wetland type (FENZ) and predicted hydrosystem	Palustrine swamp	
Soil and drainage	Soils were investigated by Manaaki Whenua (2023) and found to consist predominantly of imperfectly or poorly drained alluvium. Grey colours in the subsoil indicates waterlogging for considerable periods of the year. Well-drained soils mapped by Grange et al. (1939) were not evident. A water table was often encountered between 57 and 70 cm below the soil surface in February 2023. Wetter areas of the farm had drainage ditches. For further information, see Manaaki Whenua Contract Report: LC4260, (2023). 	
Modifications and restorability	The site is currently grazed. As the site is raised in relation to the adjacent stream, establishing or re-establishing wetland hydrology could be challenging although suitable hydric soil characteristics are present. Recontouring of the site may be necessary to create a functional wetland while minimising receiving environment impacts.	

		
Species records	Long tailed bats – located within known long tailed bat roosting area (clearance of trees may require bat management) Copper skink present in surrounds – hedgerows and scrub to south-east may include suitable habitat. At Risk fish species (giant kōkopu, longfin eel, kōaro) present in sub-catchment	
Sensitive receiving environment	Watercourse adjacent to south and east of the site which drains to Nukuhau Stream and then the Waikato River. Gainsford Road Gully Proposed SNA located downstream (Site ID: 21)	
Feasibility	Some constraints due to the presence of species of conservation concern, and proximity to the Waikato River. Care would need to be taken to prevent nutrient mobilisation to adjacent watercourses. The site is highly modified and further investigations are necessary to ensure restoration is feasible (particularly restoration of hydrology), and that historic modelling[8] is accurate.	
Site 4 (Sharpe Farm)		
Modelled wetland type (FENZ) and predicted hydrosystem	Palustrine swamp	
Soil and drainage	Soils were investigated by Manaaki Whenua (2023) and found to consist predominantly of imperfectly or poorly drained alluvium with the south-western corner consisting of clayey volcanic tephra with restricted subsoil permeability. Being in a toeslope landscape position, the soils receive water from upslope and the soils show signs of periodic waterlogging, even in the topsoil. Lateral flow of surface-applied treated wastewater to this site is likely to generate seepage zones at the base of slopes.	

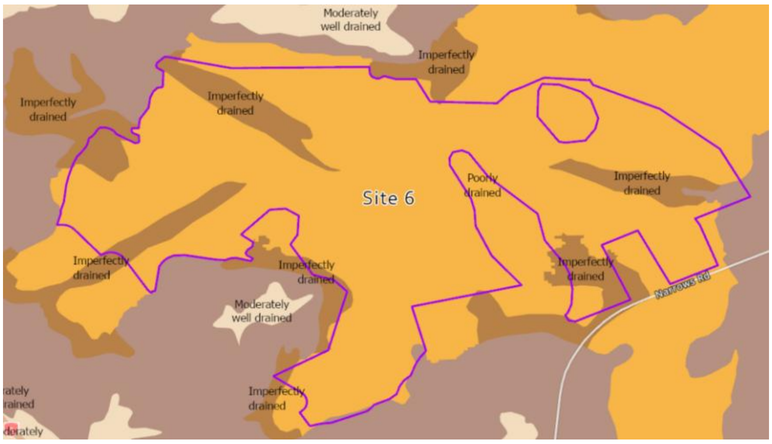
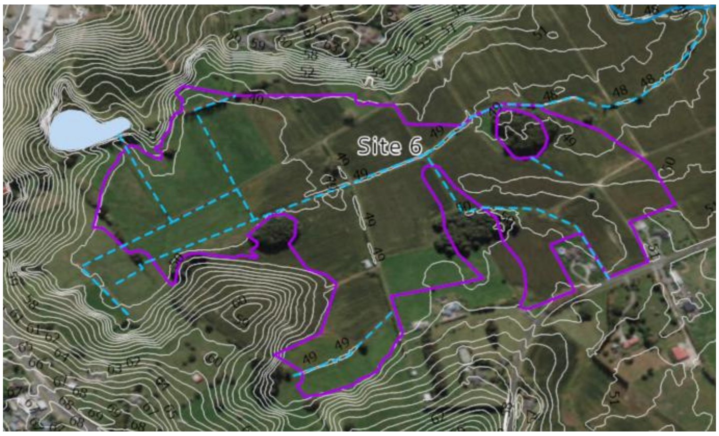
[8] FENZ "historic wetlands typology" layer describes the estimated historic distribution of wetlands, including predictions of their expected historic composition, based on information stored in the New Zealand Land Resource Inventory.

	For further information, see Manaaki Whenua Contract Report: LC4260, (2023). 	
Modifications and restorability	The site is currently grazed. As the site is raised in relation to the adjacent stream, establishing or re-establishing wetland hydrology across a large proportion of the area could be challenging although suitable hydric soil characteristics are present. Recontouring of the site may be necessary to create a functional wetland while minimising receiving environment impacts. 	
Species records	Long tailed bats – located within known long tailed bat roosting area (clearance of trees may require bat management) Copper skink present in surrounds – hedgerows, overgrown herbaceous vegetation and scrub may include suitable habitat. At Risk fish species (giant kōkopu, longfin eel, kōaro) present in sub-catchment	
Sensitive receiving environment	Watercourse adjacent to north and east of site which drains to Nukuhau Stream and then the Waikato River. Gainsford Road Gully Proposed SNA located downstream (Site ID: 21)	
Feasibility	Some constraints due to the presence of species of conservation concern, and proximity to the Waikato River. Care would need to be taken to prevent nutrient mobilisation to adjacent watercourses.	

	The site is highly modified and further investigations are necessary to ensure restoration is feasible (particularly restoration of hydrology across a large area of the site), and that historic modelling[9] is accurate.	
Site 5		
Modelled wetland type (FENZ) and predicted hydrosystem	Palustrine swamp	
Soil and drainage	Orthic (GOT). Brown, gley, and allophanic soil orders. Clays, silts, sand and loam. Low nitrogen leach susceptibility, low – high bypass flow susceptibility, P-retention estimate – 73%. Poorly drained, imperfectly drained, and well drained soils.  	*Further assessment required by soil scientist.*
Modifications and restorability	The site is currently used for cropping. Unmapped drains are present. These drains would need to be filled in to re-wet the site and could create flooding risks for the adjacent land, although this could potentially be managed by design. Some evidence of wetland characteristics (i.e. stunted vegetation growth patterns) is present and the site may be restorable without re-contouring.	

[9] FENZ “historic wetlands typology” layer describes the estimated historic distribution of wetlands, including predictions of their expected historic composition, based on information stored in the New Zealand Land Resource Inventory.

		
Species records	Long tailed bats – located within known long tailed bat roosting area (clearance of trees may require bat management) At Risk fish species (giant kōkopu, longfin eel, kōaro) present in sub-catchment.	
Sensitive receiving environment	Artificial drains in the site flow into the Nukuhau Stream and then the Waikato River. Gainsford Road Gully Proposed SNA located downstream (Site ID: 21)	
Feasibility	Some constraints due to the presence of species of conservation concern, and the receiving environment (Waikato River). Site is potentially restorable although it only just meets the size requirements (2.7ha). Drains would need to be filled to re-wet the site which may help reduce risk of nutrient mobilisation to the receiving environment (without connection via drains the site is set back ~60m from the nearest watercourse) but flooding risks would need to be considered.	
Site 6 (Narrows Road Site)		
Modelled wetland type (FENZ) and predicted hydrosystem	Palustrine swamp	
Soil and drainage	Soils were investigated by Manaaki Whenua (2023) and found to consist predominantly of poorly drained alluvium. Deep drains are indicative of the poorly drained soils while soft surface conditions in the embayments are associated with very poorly drained soils. Very poorly drained soils have a lot of organic matter in the topsoil and both poorly and very poorly drained soils have indications of waterlogging to the base of the topsoil, or even above this level in the case of very poorly drained soils. For further information, see Manaaki Whenua Contract Report: LC4260, (2023).	

		
Modifications and restorability	The site is currently used for cropping and grazing and a number of access tracks traverse the property. Numerous unmapped drains are present and water is visible in these in aerial imagery indicating the water table is elevated and the site retains good wetland restoration potential. Soils also present suitable hydric characteristics. These drains would need to be in-filled to re-wet the site and could create flooding risks for the adjacent properties, but due to the size of the site, careful selection of a restoration location could help limit the risk. The site is likely to be restorable without re-contouring, although it should be noted that it may be used as an offsetting and mitigation site for the Southern Links (NZTA) and therefore not be available for restoration. 	
Species records	Long tailed bats – <u>located within known long tailed bat roosting area and known detections present within the site</u> (clearance of trees should be avoided). Patches of kahikatea/indigenous vegetation present within the site which may provide habitat for indigenous fauna. At Risk fish species (giant kōkopu, longfin eel, kōaro) present in sub-catchment.	
Sensitive receiving environment	Artificial drains in the site flow into tributaries of the Nukuhau Stream which then flows into the Waikato River. Gainsford Road Gully Proposed SNA located downstream (Site ID: 21)	
Feasibility	Some constraints due to the presence of species of conservation concern and the receiving environment (Waikato River). In particular, the site has a number of	

	Threatened – Nationally Critical long tailed bat records, but as long as mature vegetation is retained, wetland restoration may benefit bat populations via creation of foraging habitat. The site is potentially restorable and covers a large area (27ha) in excess of land requirements. Drains would need to be filled to re-wet the site which may help reduce risk of nutrient mobilisation to the receiving environment (without connection via drains the site is set back >200m from the nearest watercourse) but flooding risks would need to be considered. Although potentially suitable, this site is likely to be used as an offsetting and mitigation site for the Southern Links (NZTA) and therefore not be available for restoration.

7 Summary and Recommendations

The subject area was historically covered in large areas of bog, fen, marsh and swamp wetland. Outside of exclusion areas, approximately 13,317 ha was mapped as potentially restorable wetland. Of this, 10,088 ha was excluded on the basis of size (less than the minimum 2.5ha necessary for wastewater discharge), and/or wetland type/substrate (bogs and fens on peat or peat loam soil). This left a remaining 3,228 ha of potentially restorable wetland that may be suitable for wastewater discharge.

The six candidate sites selected for further investigation were all modelled as historic swamp wetlands. Due to their close proximity to one another, all of the sites had similar constraint associated with:

- Drainage to the Waikato River
- Presence of species of conservation concern (long tailed bats, At Risk fish species), or potential presence of species of conservation concern (copper skink).
- Risks of flooding due to requirements to fill in drainage channels for re-wetting

A number of constraints associated with restorability were also noted. The accuracy of historic modelling of Sites 2-4 as wetlands is questionable, and these sites are likely to be more difficult to establish (or re-establish) hydrology and create a functional wetland ecosystem within. It is expected that these sites would require earthworks/recontouring (although it also cannot be presumed that other sites will not at this early stage).

Site 6 was considered the most suitable site for further investigation, however this site has been identified as a potential offsetting location for Southern Links, so is unlikely available for wetland regeneration. If a discharge to wetland option were to be progressed, further investigations necessary to evaluate feasibility and constraints associated with the candidate site(s) would include:

- Ground truthing of desktop information (soil investigations, review of historic aerial imagery to verify accuracy of modelled historic wetland extent, site walkover to confirm artificial drain locations and areas of suitable fauna habitat).
- Hydrological assessments (water balance assessments, investigation of connection to groundwater).
- eDNA sampling and fauna surveys (if areas of suitable habitat may be impacted).

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9 Limitations

This report has been prepared by Beca Limited (Beca) solely for Hamilton City Council (the Client). Beca has been requested by the Client to provide a desktop-based Discharge to Wetland Feasibility Assessment for the proposed Southern Wastewater Treatment Plant (SWWTP). This report is prepared solely for the purpose of mapping potentially restorable wetlands within proximity to the SWWTP and evaluating their potential suitability for wastewater discharge (Scope). The contents of this report may not be used for any purpose other than in accordance with the stated Scope.

This report is prepared solely for the Client. Beca accepts no liability to any other person for their use of or reliance on this report, and any such use or reliance will be solely at their own risk.

Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency, and sufficiency of all information provided to it by, or on behalf of, the Client or any third party, including the information listed above, and has not independently verified the information provided. Beca accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the information provided.

The contents of this report are based upon our understanding and interpretation of current legislation and guidelines ("Standards") as consulting professionals and should not be construed as legal opinions or advice. Unless special arrangements are made, this report will not be updated to take account of subsequent changes to any such Standards.

This report should be read in full, having regard to all stated assumptions, limitations, and disclaimers.

A

Appendix A – Spatial datasets utilised

Appendix A: Spatial datasets utilised

Table 5. Spatial data sets used to identify potential wetland areas and constraints.

GIS Dataset	Source
Slope	Land Environments of New Zealand (LENZ)
Soil Drainage	Landcare Research Information Systems (LRIS)
Land use	Operative District Plan Zones (Waipa and Waikato)
Bores	Waikato Regional Council Data Portal
Flood Management	Waikato Regional Council Data Portal; Regional Scale Flood Hazards
Rivers	Land Information New Zealand (LINZ)
Lakes	River Environment Classification (REC)
Minerals & Mining	Aggregate Extraction Policy Area
Zoning	Waipa And Waikato District Plan Zones (Operative).
Airport Business Park Development Area	Waipa District Plan (Industrial Zone)
Peacocke Development Area	Hamilton City Council District Plan (Future Urban Zone)
Southern Links	GIS dataset provided by HCC
QEII National Trust Covenants	QEII National Trust
Significant Ecological Areas and Outstanding Natural Features and Landscapes	Waikato Regional Council
Current Status and Restoration Priority for NZ layer	Eco-index
Proposed SNA Final (2021)	Hamilton City Council
Public Conservation Land	Department of Conservation
Current and Historic Wetlands (Typology)	Freshwater Ecosystems of New Zealand (FENZ)
Non-migratory fish distributions	Department of Conservation
Peat Lake Catchment Areas	Waipa District Council
and Biodiversity River and Stream Corridors	Waipa District Council
Waikato long-tailed bat distribution	WRC (based on DOC BioWeb databases)
Herpetofauna records	Department of Conservation (BioWeb)
New Zealand Freshwater Fish Database	NIWA

D

Appendix D – Discharge to Land Options Assessment

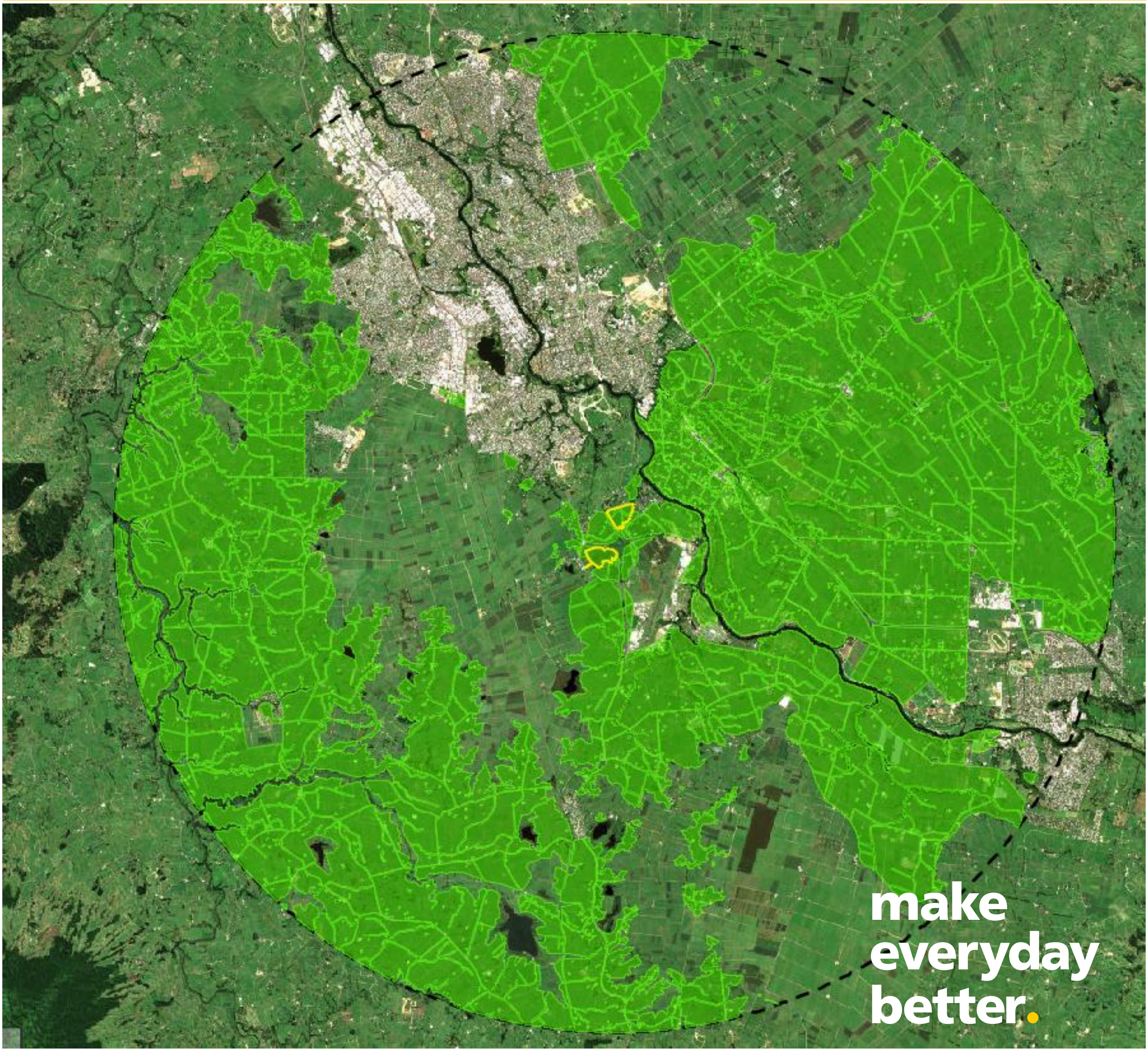
Sensitivity: General

Southern Wastewater Treatment Plant Land Discharge Options Assessment

Land Feasibility Assessment

Prepared for Hamilton City Council
Prepared by Beca Limited

7 August 2025



Contents

Appendices

Revision History

Revision N°	Prepared By	Description	Date
1	Petar Druskovich, Farza Feizi	Draft for Client Review	16/08/2024
2	Petar Druskovich, Farza Feizi	Final Report	07/08/2025

Document Acceptance

Action	Name	Signed	Date
Prepared by	Petar Druskovich, Farza Feizi		07/08/2025
Reviewed by	Garrett Hall		07/08/2025
Approved by	Garrett Hall		07/08/2025
on behalf of	Beca Limited		

Executive Summary

The Waikato region is undergoing significant urban, industrial, and commercial growth, increasing demand on existing wastewater infrastructure. To address this, the Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) was developed, identifying a preferred option to manage wastewater from the southern part of the Waikato-Hamilton-Waipā metro area. A key component of this plan is the construction of a new Southern Wastewater Treatment Plant (SWWTP), which would service future development in southern Hamilton, the Waikato Regional Airport, and northern Waipā.

The Southern Metro DBC process included a site selection process to identify a preferred broad location for the SWWTP in the area immediately to the south of Hamilton. This short-list and site feasibility investigation concluded in August 2024 and recommended the preferred site for the SWWTP as a site that is owned by Hamilton City Council (HCC) between Peacockes Road and Raynes Road (Sharpe Farm).

The SWWTP is planned to be developed in stages, eventually serving a Population Equivalent (PE) of up to 200,000. The Southern Metro DBC assumed a land discharge for Stage 1, transitioning to river discharge from Stage 2 onwards, subject to further technical investigations as part of resource consent processes. HCC will seek consents for Stages 1 to 2b, covering up to 18,000 (PE) and an average daily flow of 3,600 m³/day at the end of stage 2b. Commencement flows at stage 1 are estimated to be 400 m³/day increasing to 1,900 m³/day at the end of stage 2a.

Beca has been commissioned by HCC to carry out a land discharge options assessment, presenting the findings of a desktop feasibility study for discharging treated wastewater to land from the SWWTP.

The discharge to land methods assumed for development of assessment parameters were Rapid Infiltration (RI) and Slow Rate Irrigation (SRI) (Surface and Sub-surface). These discharge options are viable depending on geomorphic and hydrological conditions. For example, RI requires smaller land parcels and is gravity fed meaning the costs of operation tend to be lower. The method requires fast draining soils, and considerations for groundwater level. SRI allows for controlled discharge of treated wastewater via irrigation. This slow release provides beneficial for nutrient removal, especially nitrogen.

Since regional resource consents will be sought only for stages 1 to 2b (up to 18,000 PE or 3,600 m³/day), the anticipated discharge flows for these stages will be used to investigate options for discharging treated wastewater to land. Therefore, this report details the assessment of land suitability under four discharge scenarios (Stage 1 for high hydraulic loading rate (Stg1-HH), Stage 2b for high hydraulic loading rate (Stg2-HH), Stage 1 for low hydraulic loading rate (Stg1-LH), and Stage 2b for low hydraulic loading rate (Stg2-LH)) and within a 15 km radius of the proposed SWWTP location.

The work has been completed by utilising geographic information systems (GIS) data to apply first-class exclusion process followed by a multi-criteria anlaysis (MCA) of potentially suitable sites. After the first-class exclusion process, 18 sites for Stg 1-LH, 17 sites for Stg 1 – HH, 11 sites for Stg 2 – LH, and 5 sites for Stg 2 - HH were ranked for technicial suitability against a range of MCA factors such as slope, soil drainage, land use type, and distance between the site and the SWWTP. Following the MCA assessement, the sites below were found to be the most technicially feasible under the area and requirements for each scenario:

- Stg 1-LH: Site 9
- Stg 1- HH: Site 2 and 4
- Stg 2 – LH: Site 7
- Stg2 – HH: Site 1

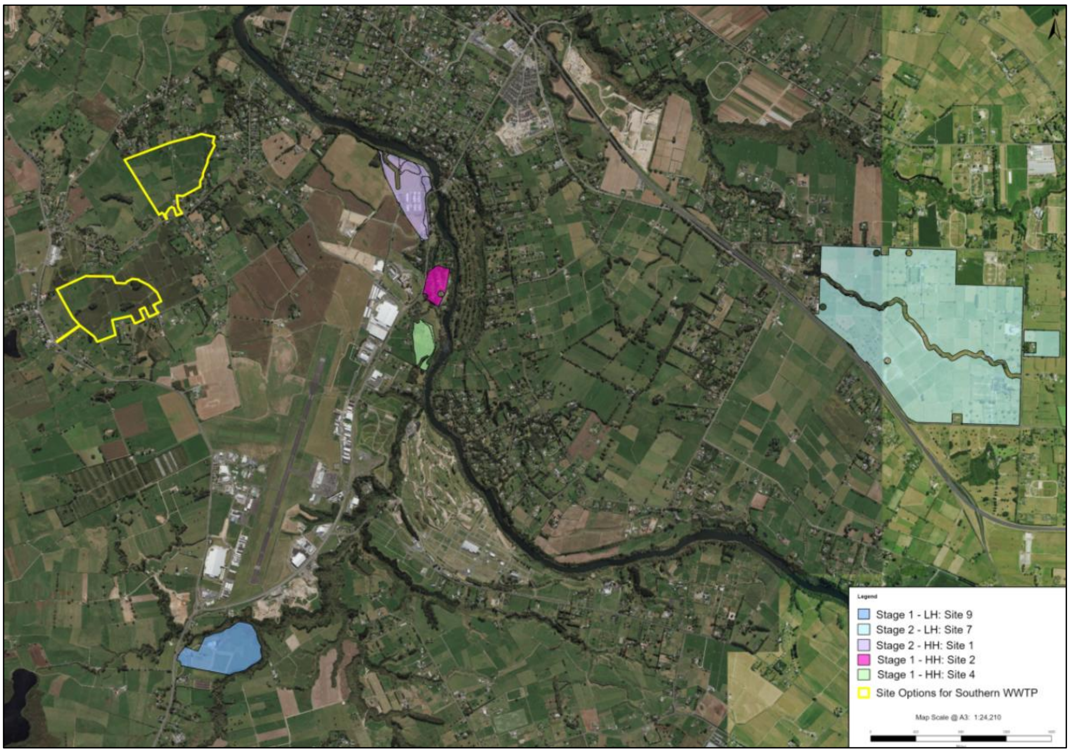


Figure 1. Most feasible land parcels for each discharge to land scenario, based on MCA criteria.

Future investigations should be undertaken to understand the availability of the sites, confirm site conditions and suitability of discharge method, and particularly to understand potential effects on the receiving environment. Further work will depend on the decision to either pursue the land discharge option or explore alternative discharge options. If these options were to be progressed, further investigations should include:

- Site-specific investigations to assess the findings from the desktop investigation (soil and hydrogeological investigations).
- Landowners should be engaged to assess the potential availability of land for treated wastewater discharge.
- Feasibility of piping wastewater from the treatment plant to discharge location. This is particularly relevant for Stg 2 – LH.
- Investigation into potential costs associated with adopting this discharge method.

1 Introduction

The Waikato region is undergoing significant urban, industrial, and commercial growth, resulting in increasing demand on existing wastewater infrastructure. To address this, the Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) was developed, identifying a preferred option to manage wastewater from the southern part of the Waikato-Hamilton-Waipā metro area. A key component of this plan is the construction of a new Southern Wastewater Treatment Plant (SWWTP), which would service future development in southern Hamilton, the Waikato Regional Airport, and northern Waipā.

The Southern Metro DBC process included a site selection process to identify a preferred broad location for the SWWTP in the area immediately to the south of Hamilton. This short-list and site feasibility investigation concluded in August 2024 and recommended the preferred site for the SWWTP as a site that is owned by Hamilton City Council (HCC) between Peacockes Road and Raynes Road (Sharpe Farm).

The SWWTP is planned to be developed in stages, eventually serving a Population Equivalent (PE) of up to 200,000. The Southern Metro DBC assumed a land discharge for Stage 1, transitioning to river discharge from Stage 2 onwards, subject to further technical investigations as part of resource consent processes. HCC will seek consents for Stages 1 to 2b, covering up to 18,000 (PE) and an average daily flow of 3,600 m^3/day at the end of stage 2b. Commencement flows at stage 1 are estimated to be 400 m^3/day increasing to 1,900 m^3/day at the end of stage 2a.

Beca Ltd (Beca), on behalf of HCC, has conducted various investigations into alternative discharge options for the SWWTP, building on previous work, to assess the long-list options for the SWWTP which will inform the resource consent process. This work will reassess the broad assumptions made at the Southern Metro DBC with regards to discharge options.

1.1 Purpose

Considering that one of the potential discharge options from the SWWTP is to discharge to land, Beca has been commissioned by HCC to conduct a land discharge options assessment. The purpose of this report is to present the findings of a desktop feasibility assessment for the discharge of treated wastewater to land from the SWWTP. The objective is to identify potentially suitable sites for land discharge within a 15 km radius of the SWWTP site.

While the Southern DBC conducted a high-level evaluation of potential land discharge options, it did not assess specific land parcels using GIS. This proposed assessment represents the next level of analysis, aiming to meet Resource Management Act 1991 (RMA) requirements by evaluating alternative land discharge environments in detail.

1.2 Scope

The scope of this assessment incudes:

- Review of previous relevant assessments including:
  - Site shortlist discharge assessment, Beca., 2023
  - Soil Information for four Hamilton Southern Wastewater Treatment Plant Land Treatment Sites, Manaaki Whenua., April 2023
- Sourcing the following data to develop a GIS platform:
  - Slope, soil type, and soil drainage layers from Land Resource Information (LRIS) portal
  - Land Information New Zealand (LINZ) river polygons and polylines
  - Lake polygons from River Environment Classification (REC)
  - Flood susceptible land from Waikato Regional Council (WRC) data portal

    - Land use from Waipā and Waikato District Plans
    - Areas zoned for development from Hamilton and Waipā District Plans
- Review of land discharge parameters:
    - Current and future flow estimates
    - Rain and soil moisture data from the NIWA National Climate Database (Hamilton Aero AWS Climate Station)[1]
- Development of first-class exclusion criteria and secondary multi-criteria analysis measures
- Assessment of land parcels within a 15 km radius of the central point of SWWTP site options against first class exclusion criteria and further multi-criteria assessment for ranking suitable land parcels.

[1] https://cliflo.niwa.co.nz/

2 Description of the Proposed Southern Wastewater Treatment Plant

2.1 Southern Wastewater Treatment Plant

Given that regional resource consents will only be pursued for stages 1 to 2b (up to 18,000 PE or 3,600 m^3/day), the anticipated discharge flows for these stages will be used for calculations in the subsequent sections (Table 1). According to Table 1, the Southern Metro DBC assumed that Stage 1 would employ Sequencing Batch Reactor (SBR) treatment technology with land discharge, while Stage 2 would utilise Membrane Bioreactor (MBR) technology with discharge into the Waikato River. However, Southern Metro DBC is currently reassessing these assumptions regarding the staging and final discharge environments for each phase. Therefore, this report will include a land discharge assessment for both Stage 1 and Stage 2b. The wastewater is treated using SBR or MBR technology before being discharged to land.

Table 1. SWWTP Concept Staging.

Description		Serviced area	Starting demand	Cumulative Capacity
Stage 1	SBR* with discharge to land	Airport precinct	400 m^3/day (2,000 PE)	1,000 m^3/day (5,000 PE)
Stage 2a	MBR** with discharge to Waikato River	Airport precinct and Mātangi / Tamahere commercial areas	1,200 m^3/day (6,000 PE)	1,900 m^3/day (9,500 PE)
Stage 2b	MBR with discharge to Waikato River (additional reactors and membrane equipment)	Airport precinct, wet industry and Mātangi /Tamahere commercial areas	3,600 m^3/day (18,000 PE)	3,600 m^3/day (18,000 PE)

* SBR treatment technology with land disposal is proposed for the first stage. This technology provides enormous flexibility in terms of flows and load and will provide effluent quality that is suitable for application into or onto land. SBR is able to stop solids to reduce organic matter found in wastewater, which is done over a number of cycles, depending on the size of the tank.

** MBR treatment technology with discharge to water is proposed for the second stage. MBR systems are aerobic activated sludge biological reactors, which combine the biological degradation process, known as "activated sludge", with solid-liquid separation by membrane filtration. This process results in high-quality effluent with low levels of suspended solids, pathogens, and nutrients

2.2 Preferred Locations for the Wastewater Treatment Plant

The Southern Metro DBC process involved exploring the area immediately south of Hamilton to identify a preferred location for the SWWTP. The 2024 Assessment of Alternative Sites[2] undertaken by Beca further refined the locations identified by Southern Metro DBC, narrowing them down to four shortlisted sites. Through a multi-criteria analysis (MCA), Site 1 (Sharpe Farm) and Site 2 (Narrows/Rukuhia) emerged as the preferred locations for the Southern WWTP. These preferred sites are detailed in Table 2 and are shown Figure 2. Following the technical MCA process and the findings of the Tangata Whenua Effects Assessment (TWEA),

[2] Southern Wastewater Treatment Plant Assessment of Alternative Sites, Beca, 2024.

Sharpe Farm has been identified at the preferred site. Sharpe Farm scored the highest in both the unweighted and weighted MCA[3].

Table 2. Description of the shortlisted sites for the SWWTP.

Site Name	Site Address	Site Owner	Area of Site	Title	Legal Description
Sharpe Farm (Site 1)	Raynes Road, Rukuhia	HCC	34.2 ha (two blocks which have an area of 19.35 ha and 14.85 ha).	SA72C/450	Lot 5-6 DPS 91837
Narrows/ Rukuhia (Site 2)	71 Narrows Road/Ohaupo Road	The site is owned by the Crown and administered by Waka Kotahi	35 ha	RT 534321	Lot 1 DP 420545

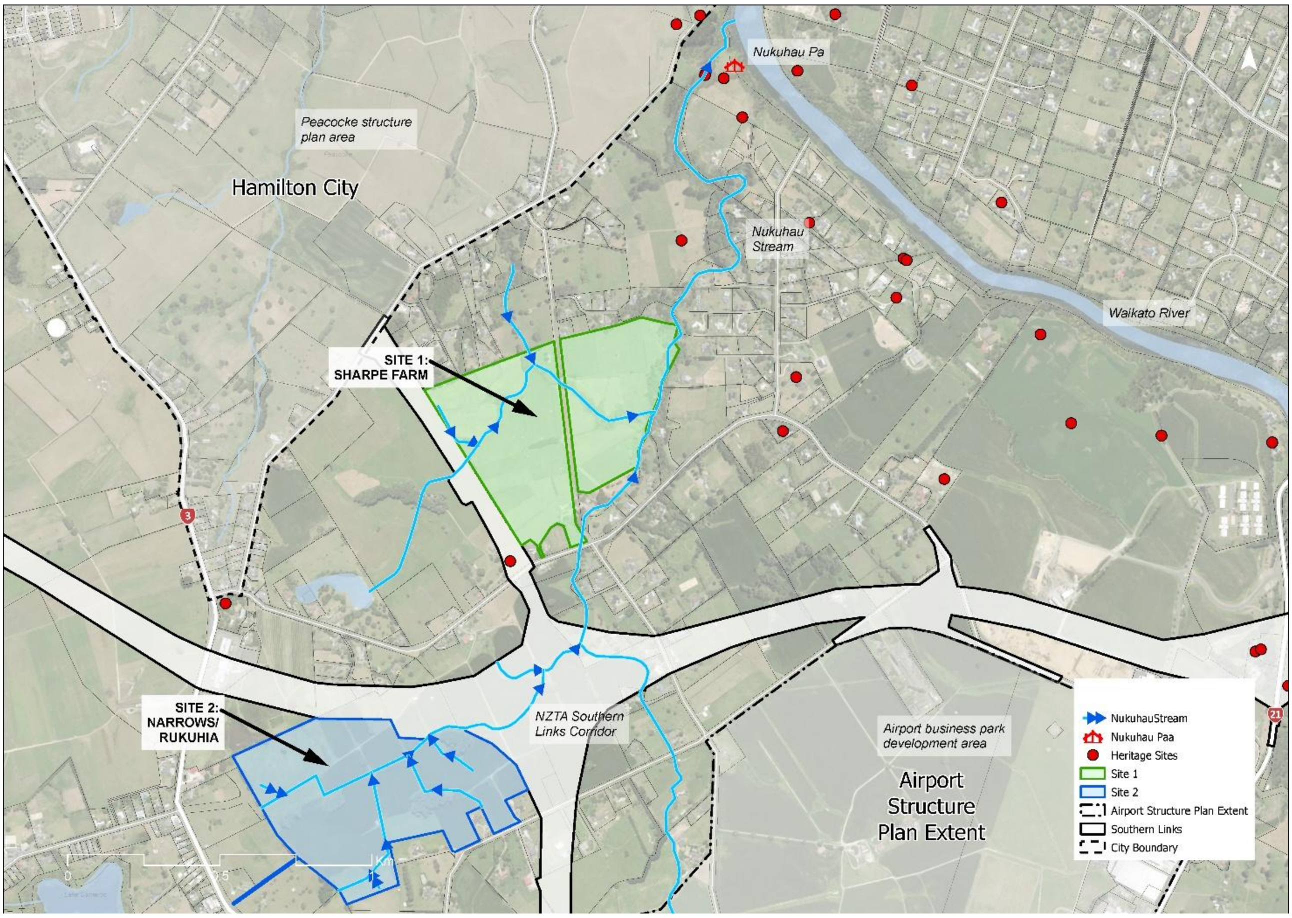


Figure 2. The shortlisted sites for the Southern WWTP (Site 1 and Site 2).

[3] Southern Wastewater Treatment Plant, Assessment of Alternative Sites, Beca, August 2024.

3 Background Information

The following section summarises alternative land discharge options that have been considered in previous reporting, as well as any geotechnical investigations that have been undertaken.

3.1 Site short-list discharge assessment, Beca, 2023

Beca undertook a preliminary desktop investigation of options for discharge of treated wastewater to land from the SWWTP. This was based on two scenarios:

- Scenario 2A: SWWTP would service industrial growth around the airport, Cambridge, Matangi, Ōhaupō, and a portion of south Hamilton; and
- Scenario 4A: SWWTP would service a smaller area, taking flows from the airport industrial area, Matangi and Ōhaupō.

Based on these two scenarios, a preliminary assessment of feasibility to discharge to land has been considered across eight sites. These sites were selected during the long-list assessment process, which explored potential sites within 7 km from each proposed SWWTP sites, and the following key considerations:

- Land ownership
- Land characteristics
- Sensitive receiving environments

Across the eight sites, the feasibility of discharging to land was categorised as either 'may be feasible' or 'likely partially feasible'. Most sites under Scenario 2A required further geotechnical investigations to better understand the soil drainage suitable of the sites. In Scenario 4A, slow rate irrigation was suggested as the most feasible option given poorly draining peat soils. A summary of analysis of discharge to land short-list options is included in Table 3.

Table 3. Summary of discharge to land short-list options analysis conducted by Beca in 2023.

Sites	Scenario 2A	Scenario 4A
Site 1 Site 2 Site 3	**May be feasible** – Sites 1 – 3 require further geotechnical investigation.	**Likely to be partially feasible** – Sites 1 – 3 is likely suitable for low-rate irrigation, requiring further geotechnical investigation.
Site 4	**May be feasible** - Options constrained by presence of poor draining peat soils	**Likely to be partially feasible** – Site 4 is likely suitable for low-rate irrigation, constrained by poorly draining peat soils.
Site 5	**Likely to be partially feasible** – Site 5 is composed of well-draining allophonic, loamy soils, however, poorly draining peat soils to the west and south of the site limits slow rate irrigation options, There is the potential for rapid infiltration beds onsite for at least a portion of the discharge flow – further geotechnical investigations would be required.	
Site 6	**Likely to be partially feasible** – Poorly draining peat soils limits slow rate irrigation options, however, there is potential for rapid infiltration.	
Site 7	**May be partially feasible** - Requires further geotechnical investigation.	
Site 8	**May be partially feasible** - Requires further geotechnical investigation.	

3.2 Soil Information for four Hamilton Southern Wastewater Treatment Plant Land Treatment Sites, Manaaki Whenua, April 2023

A soil assessment was undertaken by Manaaki Whenua – Landcare Research in 2023 to provide a more nuanced understanding of the soil profiles of four potential sites for land discharge of treated wastewater from the future SWWTP. The sites in this study were selected based on the preliminary options assessed in the Detailed Business Case[4], as well as further considerations for land considered easy to acquire, or already in crown or council ownership[5]. The four sites are shown below in Figure 3.

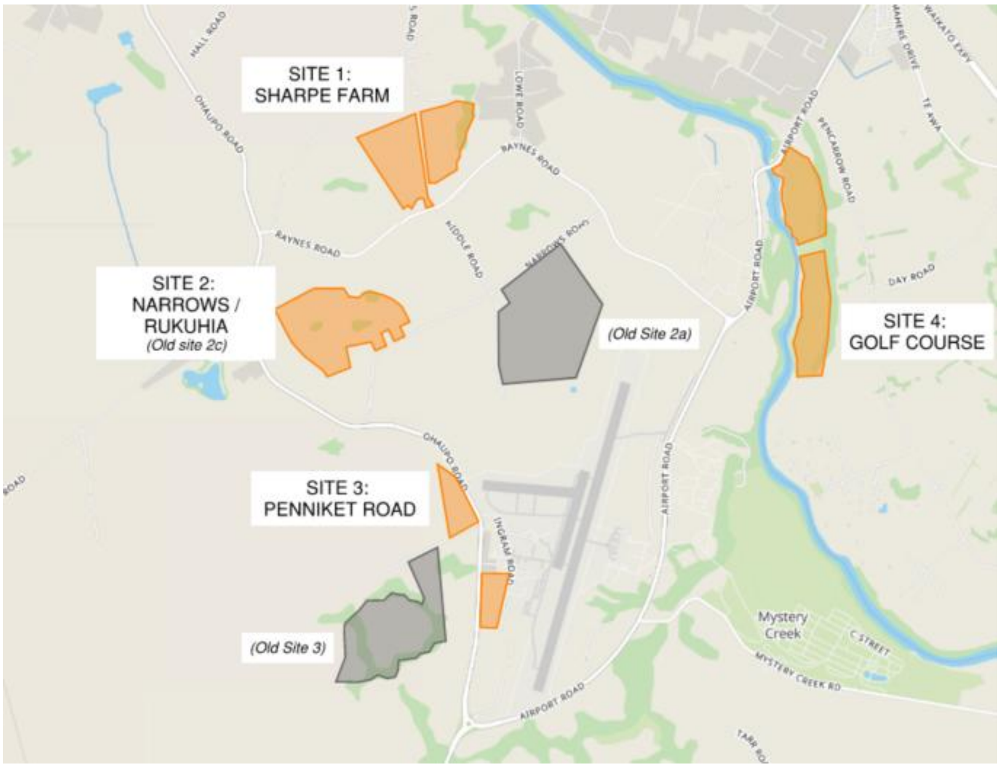


Figure 3. Location of preliminary option sites for the SWWTP.

According to the assessment, the low-lying areas of both Sharpe Farm and Narrows Road are composed of poorly draining alluvium soils, and the elevated/rolling areas of these land areas are developed in order clay volcanic tephra. Due to the poorly draining soil profile in both sites, these land areas were considered likely inadequate for treated wastewater application. However, deficit irrigation of topsoil was found to be a potential option.

The soil profile of the Golf Course site is developed in well-draining sandy soils. Due to this, an application of treated wastewater would likely move through the soil profile rapidly, meaning the site is likely sufficient for year-round wastewater application.

Finally, for both sites on Penniket Road (3N and 3S), the well-draining soil provides minimal limitations, allowing for year-round application. However, the application rate will need to be matched to soil infiltration and permeability rates. Both sites also were found to have a high or very high anion retention, meaning they would be able to retain large amount of residual phosphorus with minimal leaching into surface water bodies or groundwater, alleviating potential adverse effects on water quality.

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[4] The Hamilton-Waikato Southern Metropolitan Area Wastewater Detailed Business Case – Preferred Options Report. GHD Advisory & Beca., April 2022.

[5] Southern Wastewater Treatment Plan - Assessment of alternative sites. Beca., October 2023.

4 Land Discharge Methods

4.1 Cultural Context

Within the wider metro area there are six significant iwi/hapū: Ngāti Māhanga, Ngāti Hauā, Ngāti Korokii-Kahukura, Ngāti Tamainupō, Ngāti Mahuta, and Waikato Tainui. The southern towns (Cambridge & Te Awamutu) include Ngāti Maniapoto, Raukawa, Ngāti Apakura, Ngāti Hikairo, and Paretekawa.

All iwi and hapū mentioned above connect to the central Waikato River, a river of great significance. In 2010, the Waikato-Tainui Raupatu Claim Settlement Act 2010 was established, which gave statutory recognition to Vision and Strategy for the Waikato River (Te Ture Whaimana o Te Awa o Waikato). This strategy articulates a clear vision for the Waikato River:

> "*Our Vision is for a future where a healthy Waikato River sustains abundant life and prosperous communities who, in turn, are all responsible for restoring and protecting the health and wellbeing of the Waikato River, and all it embraces, for generations to come*".

Alongside *Te Ture Whaimana o Te Awa o Waikato*, several iwi/hapū environmental management plans have also been produced[6]. These documents inform HCC on the expectations of mana whenua when it comes to land use, engagement, and environmental protections. Within these documents, most iwi/hapū have discussed the cultural and environmental issues created by urban wastewater infrastructure, advocating for further enhancements to wastewater infrastructure, as well as opposing further discharges into the Waikato River and its tributaries because of the cultural significance of the river.

Discharge of treated wastewater to land is understood to be a less offensive option compared to discharge to the river by Tāngata Whenua, noting that there are still likely to be cultural impacts of the discharge, which would need to be assessed by the appropriate group / person throughout the decision-making process[7].

4.2 Rapid Infiltration

Rapid infiltration (RI) is one land discharge techniques that uses the physical soil environment to treat wastewater. Compared with other treatment methods, a much larger volume of wastewater on a much smaller land area can be discharged in rapid infiltration. In this system, wastewater is applied to earthen basins on high permeability soils. Then, the water percolates through the soil until it eventually enters the aquifer system, flowing to a surface water body, or being recovered by pumping it back to surface. The water recovered via pumping may be treated further and used for industrial or irrigation practices depended on water quality and regulations. It is typically recommended that RI is not used in active agricultural or horticultural areas due to the high potential of waterlogging and nutrient leaching.

RI may be considered desirable in terms of cost, as RI systems tend to be gravity fed and relatively simple/ cost effective to operate. Typically, an RI bed will require several days to drain and refresh before being ready to be used for the subsequent application. Because of this, individual beds for RI systems can be relatively small, and if discharge is to occur on a regular basis, several beds will be required.

RI has previously been used for the Cambridge WWTP. However, as Waipā District Council has explored the discharge options for the new Cambridge WWTP, RI beds was considered inappropriate given geotechnical

[6] Huri Taiaawhio ko ngaati maahuta e – Ngaati Mahuta ki te Huaauru Environmental Management Plan, Te Ruunanga o Ngaati Mahuta ki te Hauaauru, Huhuranguru 2025.

Ngāti Taminupō Matauranga and Taonga Management Plan, Ngā Uri o Taminupō ki Whāingaroa Trust, December 2021

Waikato-Tainui Environmental Plan, Waikato-Tainui Te Kauhanganui Incorporated, August 2013.

[7] Wastewater Disposal and the NPS-FM 2020: What does the future look like?, Pattle Delamore Partners.

and construction risks presented by the site[8]. Instead, a gabion wall/rip-rap structure leading into the Waikato River has been selected and installed as the discharge option.

Ultimately, the use of RI requires relatively specific environmental and hydrological conditions. Because of this, it is not a discharge method often employed for large WWTPs within New Zealand. The following are some key environmental considerations if RI is to be employed:

- The more permeable the soil the more suitable the area is for RI
- Distance and activity of surrounding land blocks to minimise risk of negatively impacting productive (e.g. horticulture, intensive agriculture) or ecologically significant land blocks
- Minimal slope to minimise potential overland flow
- Groundwater level to minimise risk of groundwater intrusion
- Proximity to bores to minimise risk of water contamination risk

4.3 Slow Rate Irrigation

Slow rate irrigation (SRI) is the controlled discharge of treated wastewater to land. Discharge through SRI can be facilitated through discharging to pasture, forests, and a variety of crops. Nutrients in the treated wastewater can be beneficial for a variety of vegetation that SRI can be implemented on. The use of SRI can be beneficial for the additional removal of contaminants such as nitrogen. Nitrogen is found in treated wastewater at elevated levels and the use of SRI could result in additional removal of nitrogen before entering a freshwater environment.

In New Zealand, the most common land use for SRI is permanent pasture. Permanent pasture is suitable for SRI as it can adapt to wet conditions and does not require cultivation. Permanent pasture has the ability to provide the best performance as it is able to achieve year-round nutrient removal as well as allow stable topsoil to increase over time, which is critical for achieving high infiltration capacity required for wastewater disposal. The above assumptions however require that a well-drained soil is present.

Slow rate irrigation on crop land can also be utilised; however, it requires periods of restricted or no wastewater disposal during critical growth periods and harvesting of plants. It is important to note that crops irrigated for treated wastewater are not for human consumption and are often used for cut and carry grass used for hay making but can only be fed to dry stock. Crop irrigation also disturbs the topsoil and has the risk of compacting the soil during harvesting periods, however this can be managed through appropriate soil management practices such as crop cover and tillage management.

Tree irrigation is also commonly used in New Zealand on sites with sloping contours and susceptibility to erosion. The use of trees for slow rate irrigation is also possible, however; tree irrigation requires a tree establishment period before irrigation can occur and discharge rates would require monitoring to reduce the risk of long-term build-up of “salts”[9] (which would also be the case for cropland as discussed above). Tree irrigation also requires careful management as excess irrigation to trees, specifically commercial forests, can result in adverse effects on tree growth and lower quality wood. However, forestry will contribute towards a carbon sink and provide carbon credits.

Slow rate irrigation is designed for slow application of treated wastewater on a vegetation area to allow for percolation and evapotranspiration. The two main methods of SRI are spray irrigation and subsurface irrigation. The site conditions like topography and hydrogeology influence the method of SRI that can be applied. There are also other conditions to consider when determining the appropriate land for SRI such as:

- Slope of the area and avoiding steep land with a slope no greater than 25°.

[8] https://www.waipadc.govt.nz/your-waipa/majorprojects/cambridge-wastewater-treatment-plant

[9] Salts refer to dissolved minerals commonly found in wastewater (sodium, chloride, calcium, magnesium, etc)

- The lesser the slope on land, the more suitable the land is for SRI.
- Minimising the distance between land for discharge and the WWTP
- The types of soils within the land.

Discharge of treated wastewater using SRI can be accomplished through seasonal irrigation or daily irrigation to land. Seasonal irrigation requires a wet weather storage provision or an alternate discharge location for the wet season where there is a low soil moisture deficit. Irrigating with low soil moisture deficit is utilised to ensure the irrigated treated wastewater is taken up into the soils and vegetation matrix with minimal losses to groundwater. A non-deficit irrigation system irrigates outside of these times as well and includes potential for losses of water and nutrients to groundwater.

4.3.1 Sub-Surface Drip Irrigation

Sub-surface drip irrigation (SDI) is a low-pressure, highly efficient irrigation method which provides significant control over the volume and distribution of treated wastewater being applied to a land area. This system is installed below the surface of the soil profile within the topsoil layer between 100 and 150 mm deep, and treated wastewater is slowly irrigated to the root zone. This method of irrigation allows for a direct and controlled means of irrigating. SDI can work well across a range of soil types and environmental factors, with the ability of the user to determine emitter and line distances based on these requirements.

Advantages of subsurface drip irrigation systems such as higher irrigation efficiency, less environmental and health risks, no odour and aerosol risk, lower level of required wastewater treatment and lower risk of clogging favour the subsurface drip irrigation method.

4.3.2 Spray Irrigation

In spray irrigation, sprinkler heads (typically using a head that minimize evaporation or misting) are used for directing water in all directions simultaneously. It also may consist of a rotating or impact stream head that delivers water over a wider radius outward and downward.

In spray irrigation methods, environmental and health risks can be managed by upgrading WWTPs to a high level of secondary treatment with multiple disinfection stages to achieve the required reduction in the concentrations of pathogenic viruses, protozoa and bacteria. By having a high level of treatment, odours beyond the boundary of sites are not expected to be offensive in spray methods. In addition, design and operation of the spray irrigation should be such that the public health and nuisance effects from spray drift will be negligible. However, these required upgrades in WWTPs and spray systems will increase the capital cost of spray irrigation method substantially.

5 Land Discharge Parameters

5.1 Description of Climate

The closest weather station to the proposed Southern WWTP locations is the Hamilton Aero AWS Climate Station, situated approximately 2 km from the central points of the two proposed WWTP sites. Figure 4 below presents the average monthly mean soil moisture deficit[10] recorded at this station from June 2019 to May 2024[11]. The data shows that winter months typically experience lower soil moisture deficit. This low soil moisture deficit, combined with higher rainfall in winter, suggests that the soil may be unsuitable for irrigation during this period.

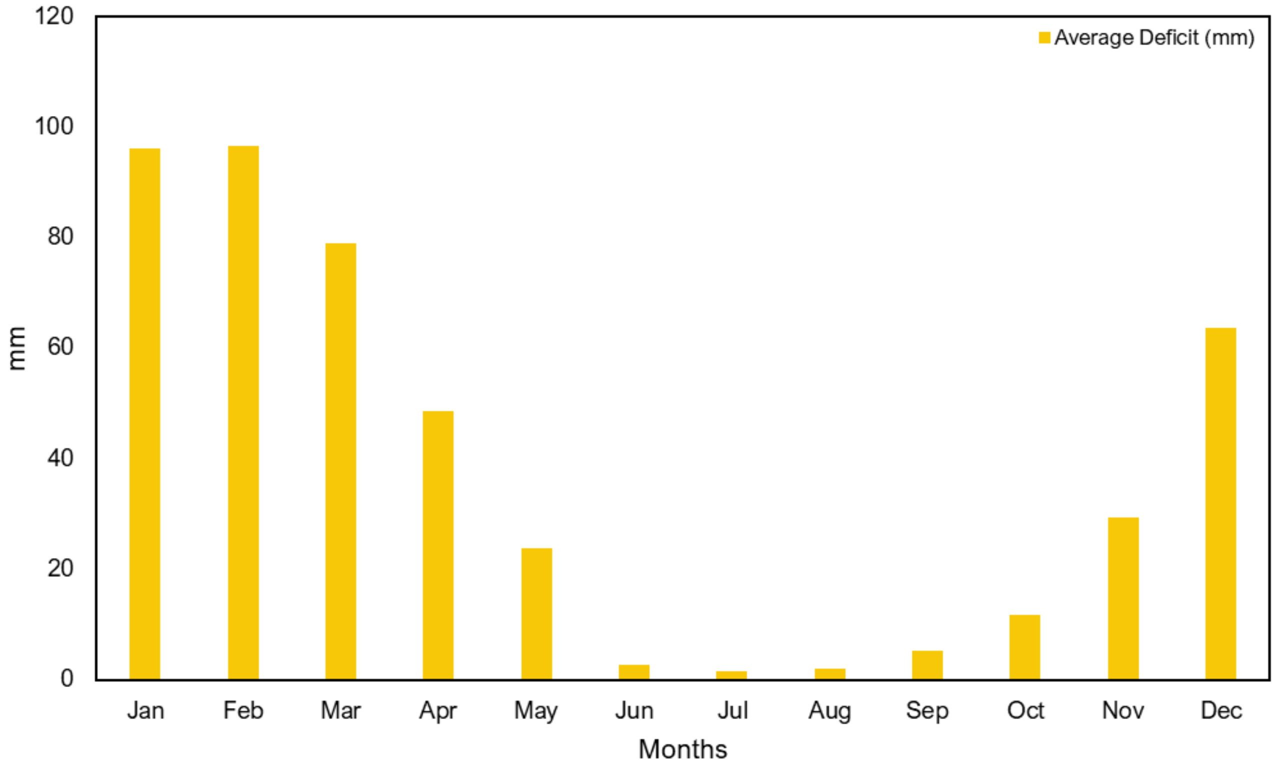


Figure 4. The average deficit each month between 2019 – 2024 using the NIWA weather station location in Hamilton Aeros Aws.

5.2 Land Area Requirements

HCC has indicated that regional resource consents will only be sought for stages 1 to 2b (up to 1000 m^3/day (5,000 PE) for Stage 1 and up to 3,600 m^3/day (18,000 PE) for Stage 2b).

For stages 1 and 2b, two scenarios were evaluated to estimate the land needed to handle the discharge of treated wastewater flows (Table 4). Scenario 1 assumes a hydraulic loading rate of 3 mm/day for slow-rate irrigation, suitable for soils with low permeability or during wet weather when hydraulic loading is limited. As seen in Table 4, this would require larger land parcels to accommodate risks of surface runoff, leaching, or waterlogging. Scenario 2 assumes a higher hydraulic loading rate of 25 mm/day, appropriate for high-rate

[10] Soil moisture deficit refers to the difference between the current moisture level in the soil and the level at which plants have optimal access to water.

[11] https://cliflo.niwa.co.nz/

irrigation systems in soils with high permeability through rapid infiltration. It should be noted that the actual soil permeability and appropriate hydraulic loading rates for any site need to be determined through on-site investigations, including permeability tests and soil moisture deficit assessments. However, the values used in this assessment provide a useful estimate of the land area required and help refine potential site selection.

Table 4. Area Required for Land discharge.

Parameters	Low hydraulic loading rate of 3 mm/day	High hydraulic loading rate of 25 mm/day*
Scenario 1 – Stage 1 Flow		
Average daily flow (m^3/day)	400	400
Irrigated Area for Stage 1 (ha)	13.3	0.8
Buffer required (ha)**	6.7	0.2
Total Land Area Required for Stage 1 (ha)	20	1
Scenario 2 – Stage 2b Flow		
Average daily flow (m^3/day)	3,600	3,600
Irrigated Area for Stage 2b (ha)	120	7
Buffer required (ha)**	60	2
Total Land Area Required for Stage 2b (ha)	180	9

* For rapid infiltration systems
** 50% land area for low hydraulic loading rate and 25% land area for high hydraulic loading rate.

6 Assessment Methodology

GIS software was used to initially screen site suitability for land discharge by excluding land areas that failed critical criteria. A detailed description of the first-class exclusion process[12] outcomes is in Section 7. This first-class exclusion zone was initially developed for the 15 km area of interest (AOI) based on the following criteria:

- Exclude land that is 20 m in proximity to all lakes and rivers.
- Exclude land that is 20 m in proximity of land areas not designated as rural.
- Exclude all flood susceptible land.
- Exclude land with a slope greater than 12°.
- Exclude land with a soil drainage classed as very poorly drained.
- Exclude land that is within 30 m of bores or geothermal wells.
- Exclude areas that are designated as Aggregate Extraction Areas within district plans.
- Exclude development areas included the Airport Business Park Development Area, and the Peacocke Development Area.
- Exclude areas designated for Southern Links (New Zealand Transport Agency Waka Kotahi).

The analysis was achieved using the datasets as outlined in Table 5 to conduct the exclusion zones and criteria analysis referenced above.

Table 5. Spatial data sets used to identify land discharge constraints.

GIS Dataset	Source
Slope	Land Environments of New Zealand (LENZ)
Soil Drainage	Landcare Research Information Systems (LRIS)
Land use	Operative District Plan Zones (Waipā and Waikato)
Bores	Waikato Regional Council Data Portal
Flood Management	Waikato Regional Council Data Portal; Regional Scale Flood Hazards
Rivers	Land Information New Zealand (LINZ)
Lakes	River Environment Classification (REC)
Minerals & Mining	Aggregate Extraction Policy Area
Airport Business Park Development Area	Waipā District Plan (Industrial Zone)
Peacocke Development Area	Hamilton City Council District Plan
Southern Links	*Data requested from HCC

After the first-class exclusion process, a filtering of characteristics for the remaining area was conducted resulting in candidate sites. A Multi-Criteria Analysis (MCA) was then conducted on candidate sites. This process allows for the remaining sites after the first-class exclusion to be ranked based on their suitability for land discharge.

[12] Process to identify and apply high level requirements to either exclude or include land parcels in further analysis.

7 First-Class Exclusion Results

The following figures show the results of the GIS analysis and application of the first-class exclusion criteria within a 15 km radius around the central point of the two proposed locations (Site 1 (Sharpe Farm) and Site 2 (Narrows/Rukuhia) for the SWWTP.

7.1 Land Designated as Rural

Waipa and Waikato District Plans were included to determine the zoning associated with the AOI. 20 m buffers were created between rural production zoned land and all other zoned land. As seen in Figure 5 below, the land designated as Not rural production zoned land and all other zoned land are excluded (orange area) and the majority of the AOI is classified as rural and therefore considered as potentially viable for land discharge.

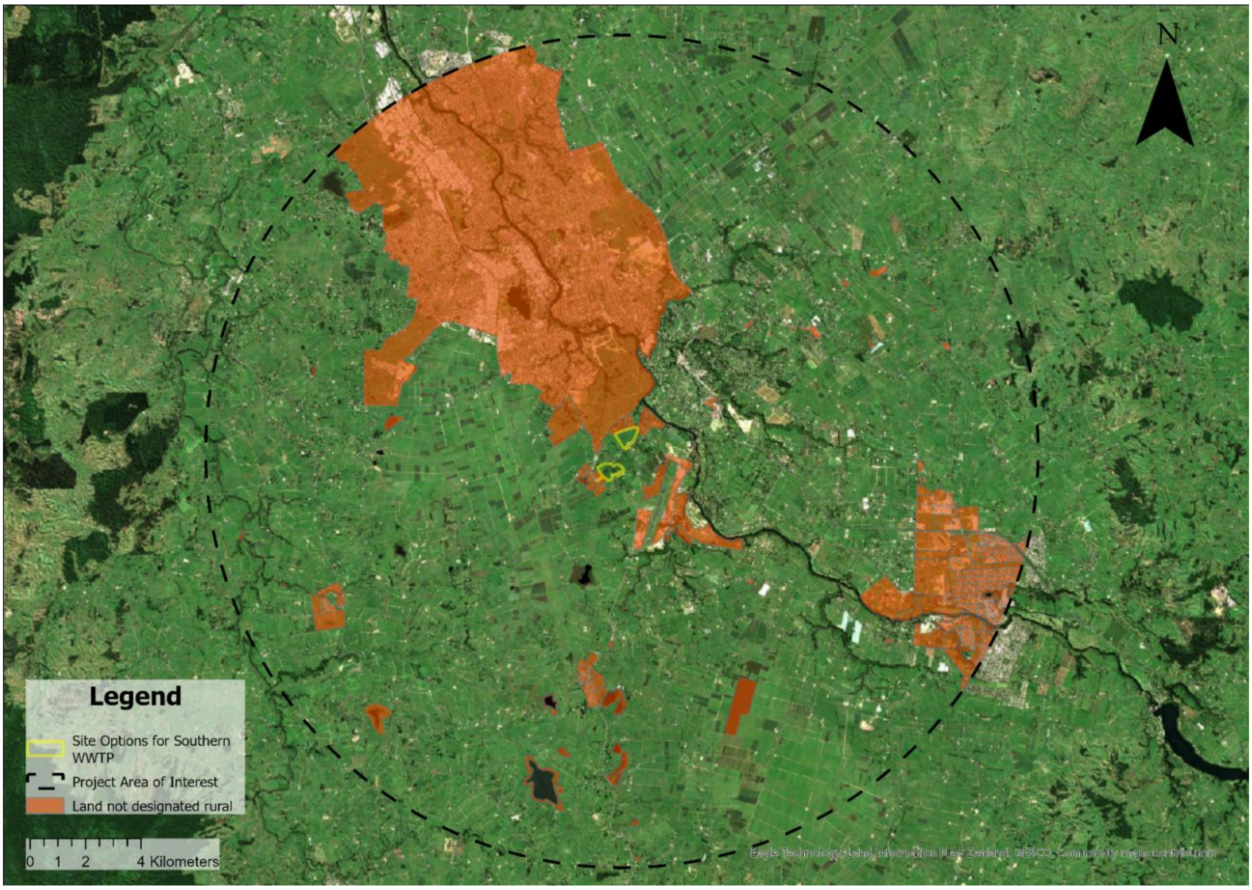


Figure 5. Land designated as rural production within the AOI (excluding other land use and not rural area).

7.2 Land 20 m from Lakes and Rivers

The outlines of rivers were derived from the LINZ River Polygon and LINZ River Lines (Pilot) layers. Polygons of lakes were revived from REC. Polygons of waterbodies were given a buffer of 20 m as per the exclusion criteria (Figure 6).

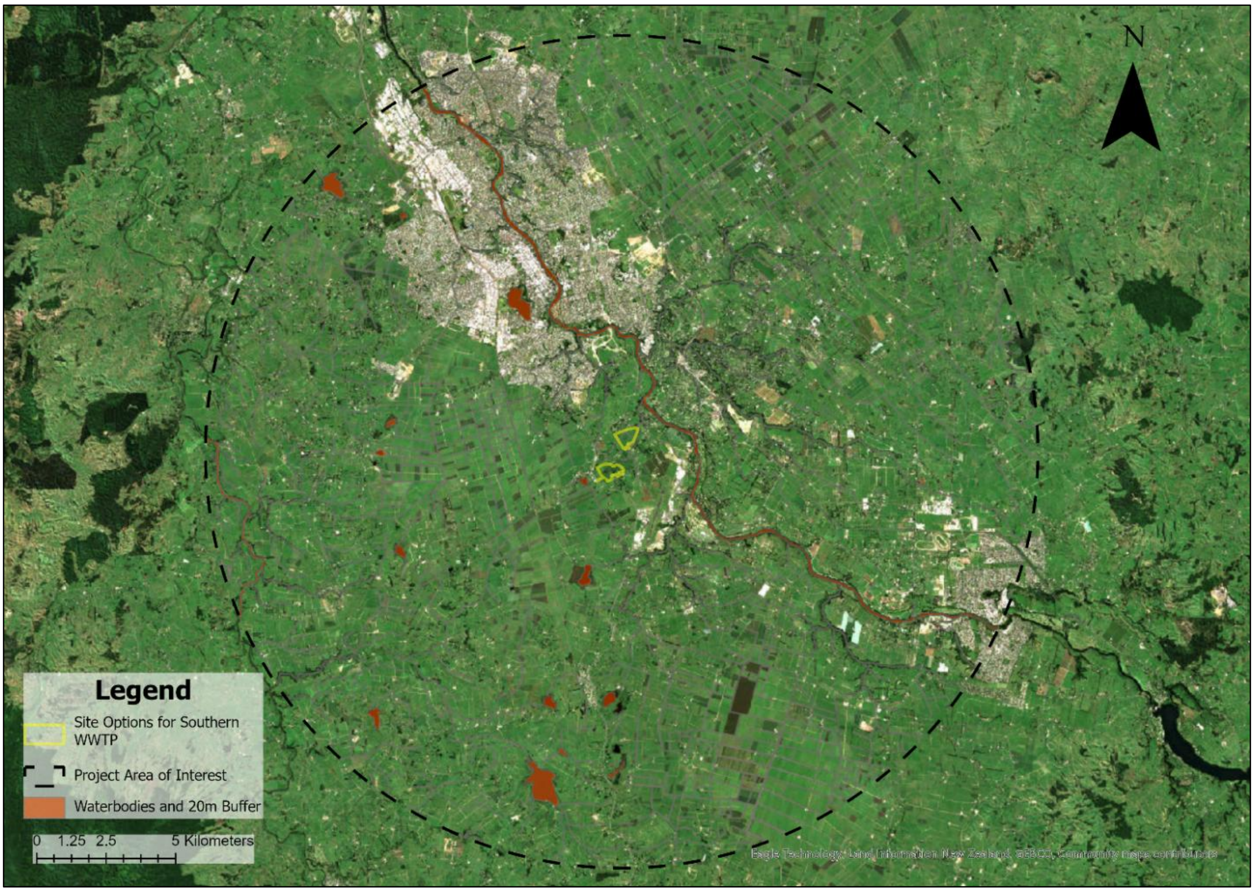


Figure 6. Waterbodies and 20 m buffers within the AOI.

7.3 Land Zoned a Flood Hazard

Flood plains were mapped using the Regional Scale Flood Hazard layer of the Waikato Regional Council data portal. Figure 7 presents areas prone to flooding mapped within the AOI. These areas have been excluded due to the potential damage to infrastructure and contaminated runoff that could be caused in the event of a 1 in 100-year flood event that results in the failure of stop banks.

Figure 7. Land zoned as flood hazard land within the AOI.

7.4 Land with Slope > 12°

Slopes greater than 12° have been added as an exclusion zone due to the propensity for runoff to be produced from these slopes. Data from LENZ Slope was used for this exclusion (Figure 8).

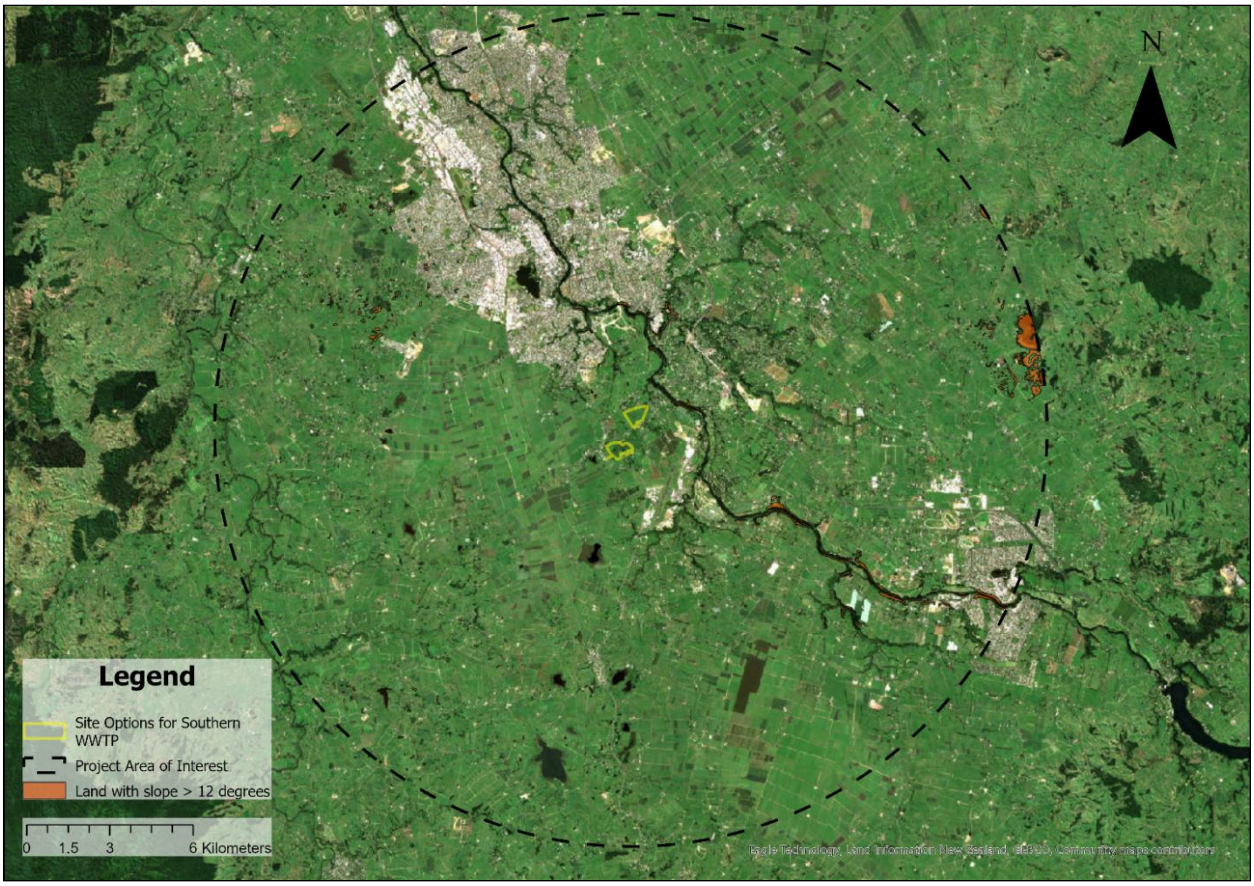


Figure 8. Land greater than 12° slope within the AOI.

7.5 Land with Poorly Drained Soils

Soil drainage classifications were extracted from the S map Soil Drainage GIS layer from the LRIS portal. The soil drainage classes were already classified based on the likelihood of seasonal wetness. The classifications were:

- Well drained
- Moderated well drained
- Imperfectly drained
- Poorly drained
- Very poorly drained

Areas with very poorly drained soils have been excluded from consideration as they could result in overloading soils with water resulting in surface runoff from discharge to land. The land that is classed as very poorly drained soils is observed in Figure 9.

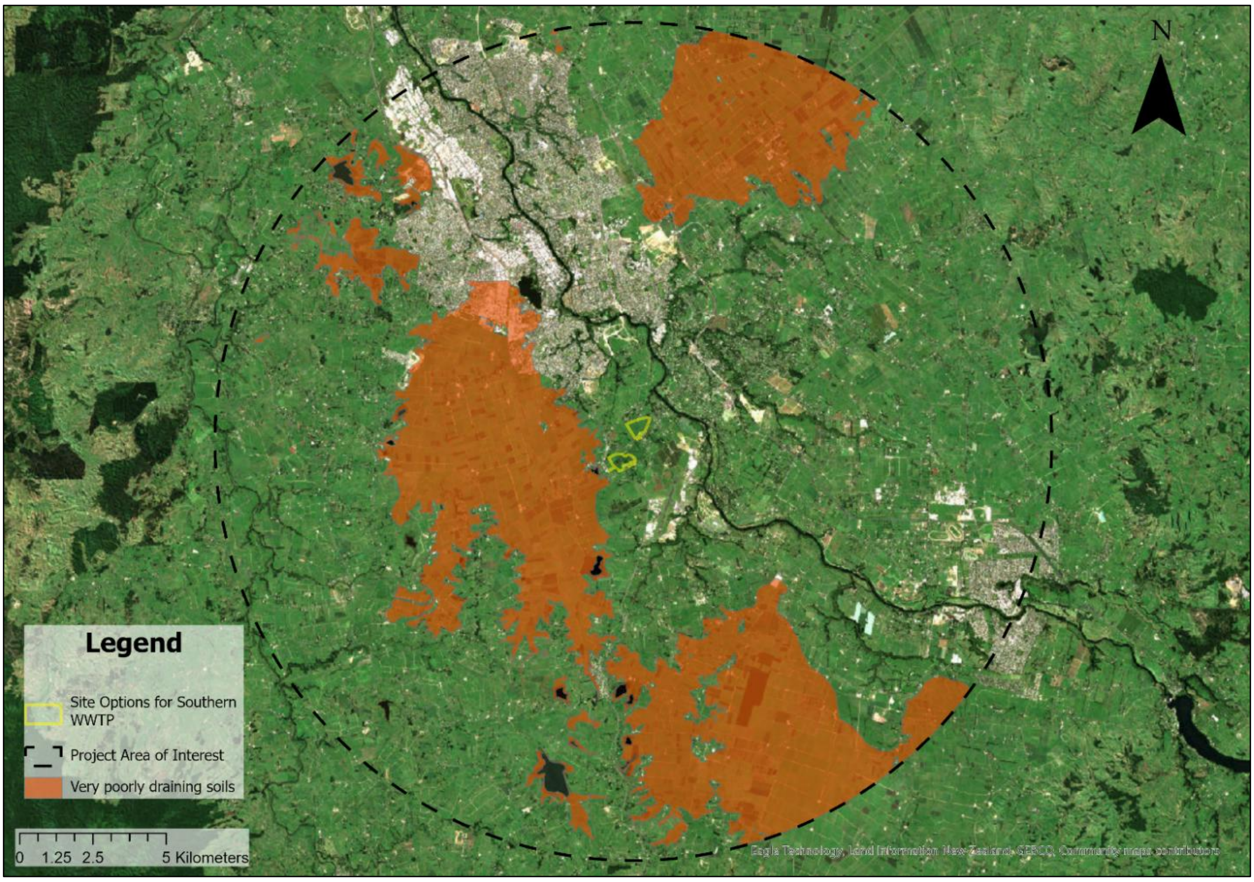


Figure 9. Area with very poorly draining soils categories within the AOI.

For the purposes of this analysis a high-level approach was used to give an indicative drainage class that could be associated with the underlying soil as a comparison tool for potential sites. On-site testing to confirm the drainage of the soil for the short-list of potential land parcels may need to be undertaken.

7.6 Minerals and Mining

Mineral and mining areas have been mapped using the Waikato District Council data portal, and their layers of areas zoned for coal mines or aggregate extraction. These areas have been excluded within the AOI, as policy 4.5A.3 of the operative Waikato District Plan states the ability to access and extract minerals from these areas should not be compromised[13].

Figure 10. Areas designated within the Waikato District Plan for coal mines or aggregate extraction.

[13] https://eplan.waikatodistrict.govt.nz/?docId=ZfNEg1yBYks%3d

7.7 Bores and Geothermal Wells

The location of bores and geothermal wells has been taken from the Waikato Regional Council data portal. A 30 m buffer has been placed around each bore or geothermal well and mapped within the AOI (Figure 11).

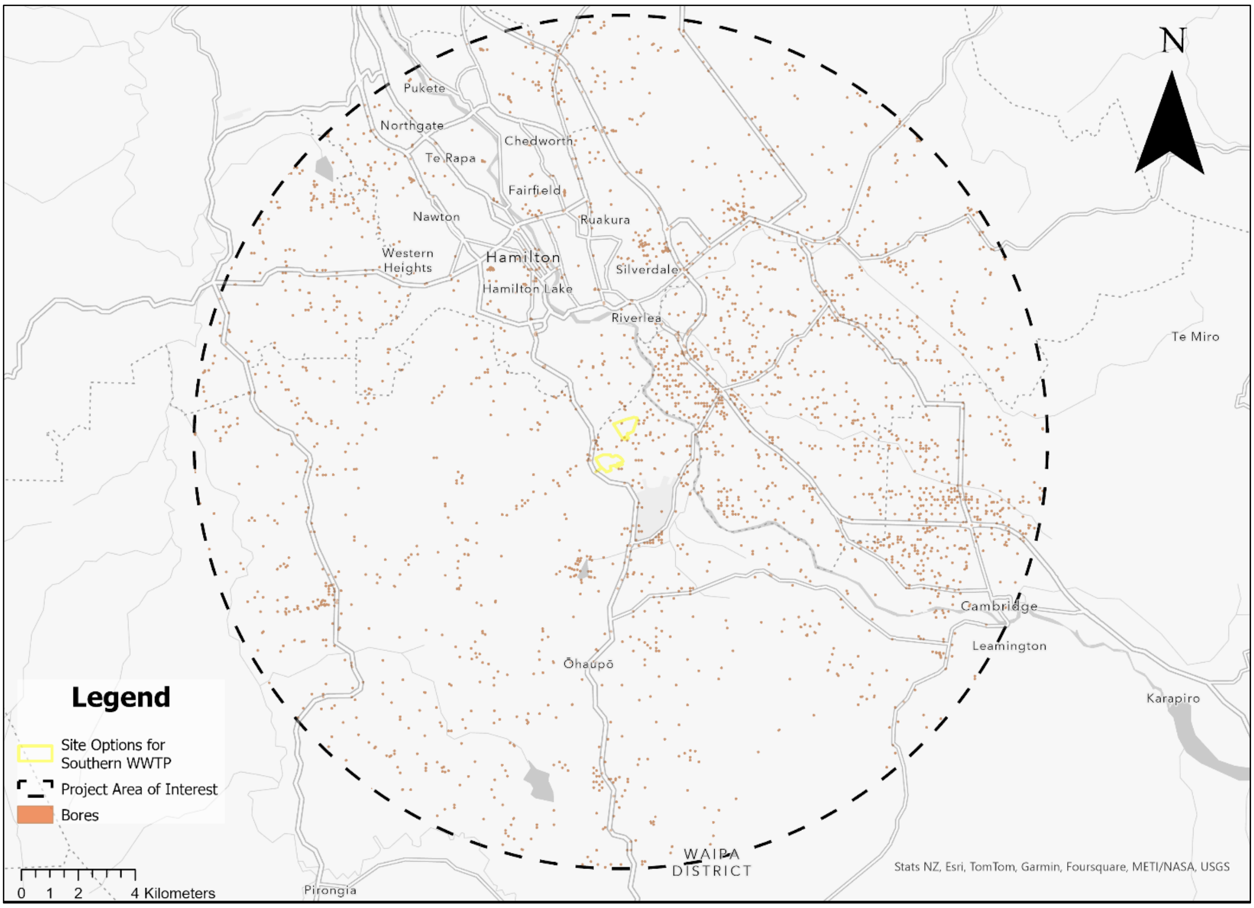


Figure 11. Bores and Geothermal wells with 30 m buffers within the AOI.

7.8 Airport Business Park Development Area

The Airport business park development area has been derived from the Waipā District Plan (Figure 12). This area has been zoned within the Waipa District Plan, much of it already developed or in the process of development. This area has been excluded from the AOI.

Figure 12. Airport business park development area within the AOI.

7.9 Peacocke Development Area

The Peacocke Development Area polygon has been derived form the Hamilton City Council District Plan (Figure 13). This 740 hectare area has been zoned as a development area within the district plan to provide for the City's future urban growth. This area has been excluded from the AOI.

Figure 13. Peacocke Development Area within the AOI.

7.10 Southern Links Designation

The Southern Links designation layer was received through a data request to HCC. The Southern Links is a roading infrastructure project in development to connect the southern areas of Hamilton City to the broader Hamilton and Waikato roading network. This area has been excluded from the AOI.

Figure 14. NZTA Southern Links designation within AOI.

7.11 Remaining Land After First Class Exclusion

Figure 15 shows the land that is suitable to be considered for land discharge after the first-class exclusions have been implemented.

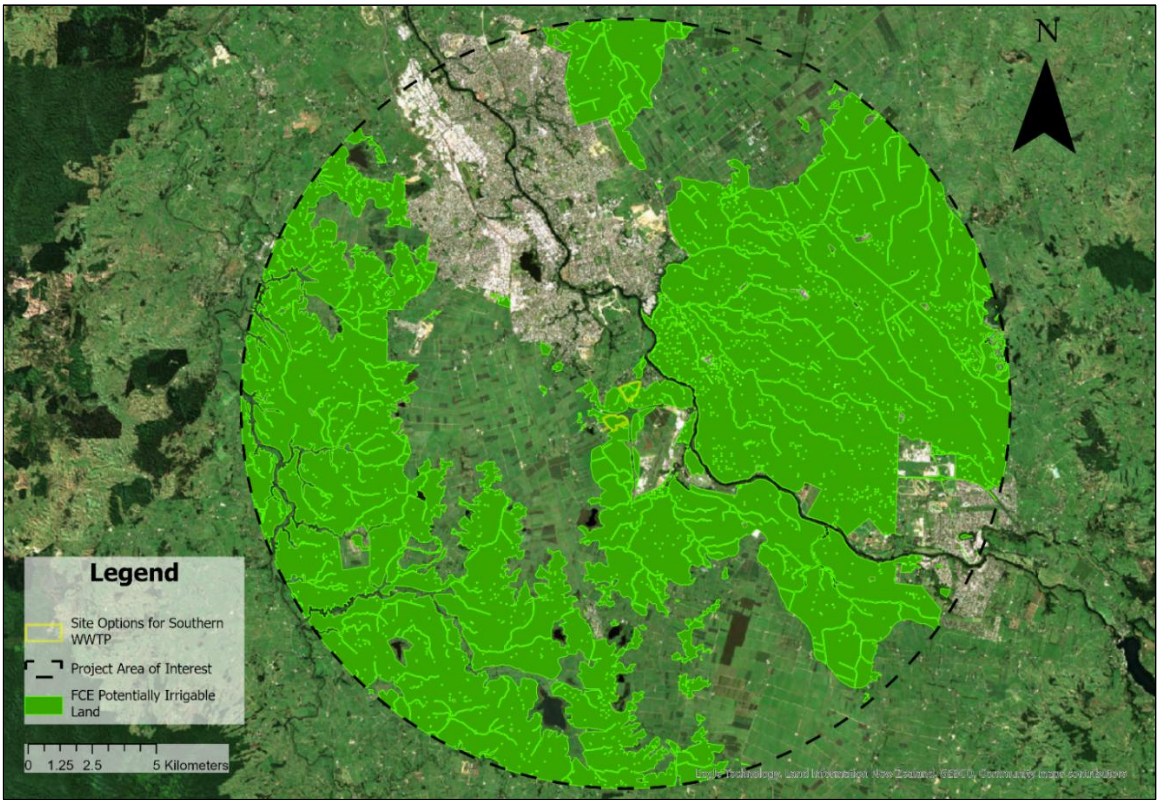


Figure 15. Remaining land after first-class exclusion within the AOI.

7.12 Filtering of Remaining Land

Further filtering was applied to determine the potentially suitable land parcels which include the following:

- Available land data initially cleaned of any land area below 1 Ha.
- Additional cleaning of remaining data with parcel intents labelled ROAD, HYDRO, etc. which hold unusable land for discharge.
- Parcel properties are merged based on ownership and proximity. This is done so that total land available from a single owner/ownership group can be used providing that the parcel properties are close together.
- Any land remaining with less than 20 Ha (Stage 1 for low hydraulic loading rate) and 180 Ha (Stage 2 for low hydraulic loading rate) is excluded due to being less than the total area for the land calculated as the discharge area.
- For high-rate irrigation systems in pumice soils with high permeability through rapid infiltration, any land remaining with less than 1 Ha (Stage 1 for high hydraulic loading rate) and 9 Ha (Stage 2 for high hydraulic loading rate) is excluded due to being less than the total area for the land calculated as the discharge area.

The process outlined above resulted in a list of 17 sites for Stage 1 for high hydraulic loading rate (Stg1-HH), 5 sites for Stage 2b for high hydraulic loading rate (Stg2-HH), 18 sites for Stage 1 for low hydraulic loading rate (Stg1-LH), and 11 sites for Stage 2b for low hydraulic loading rate (Stg2-LH). These shortlisted sites were further considered against various criteria as set out in Section 1. The candidate sites are shown from Figure 16 to Figure 19, and a more detailed outline of each site is provided in **Appendix A**.

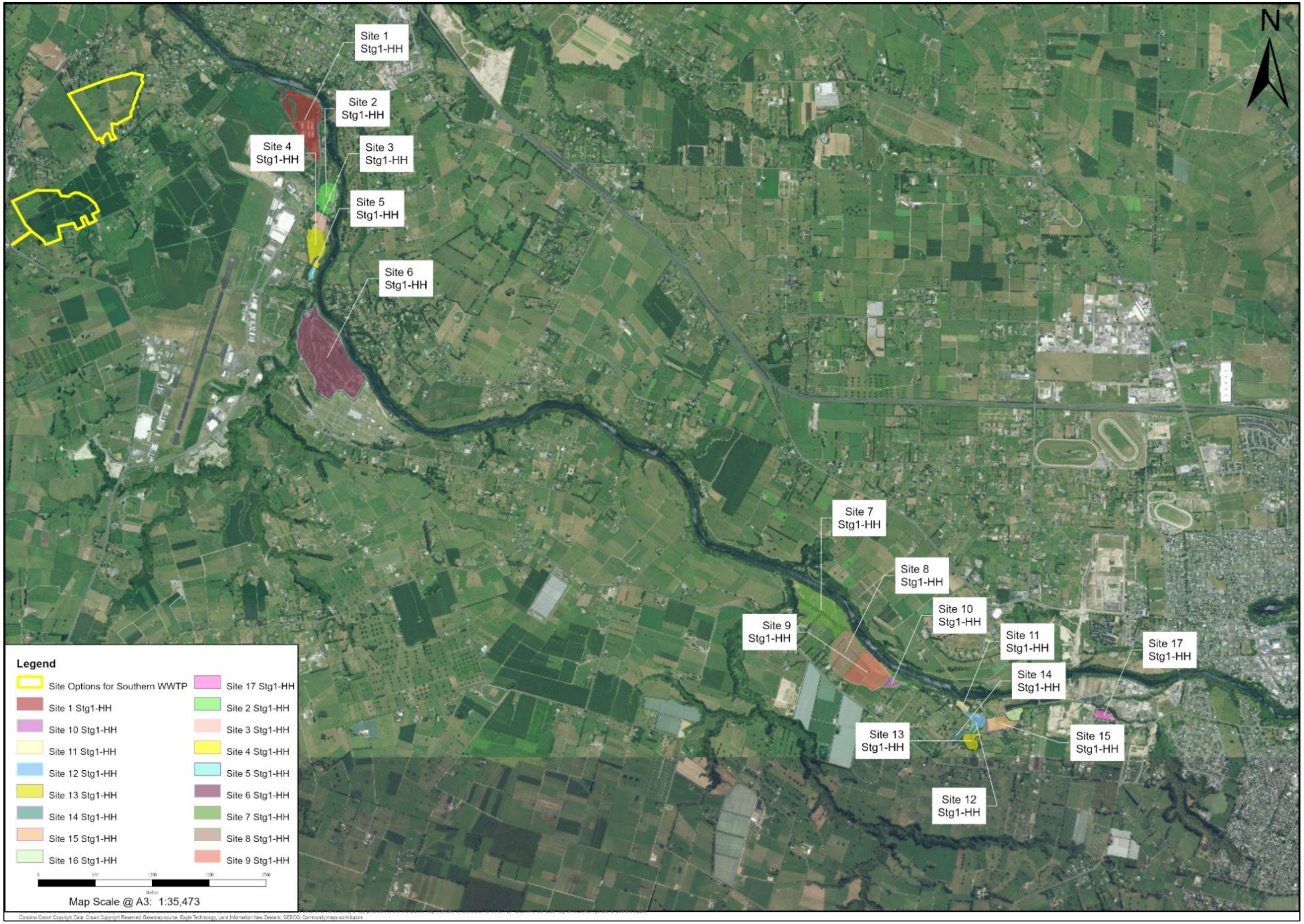


Figure 16. Candidate sites after the first-class exclusion for Stage 1 Flow and High hydraulic loading rate of 25 mm/day (land area required = 1 ha).

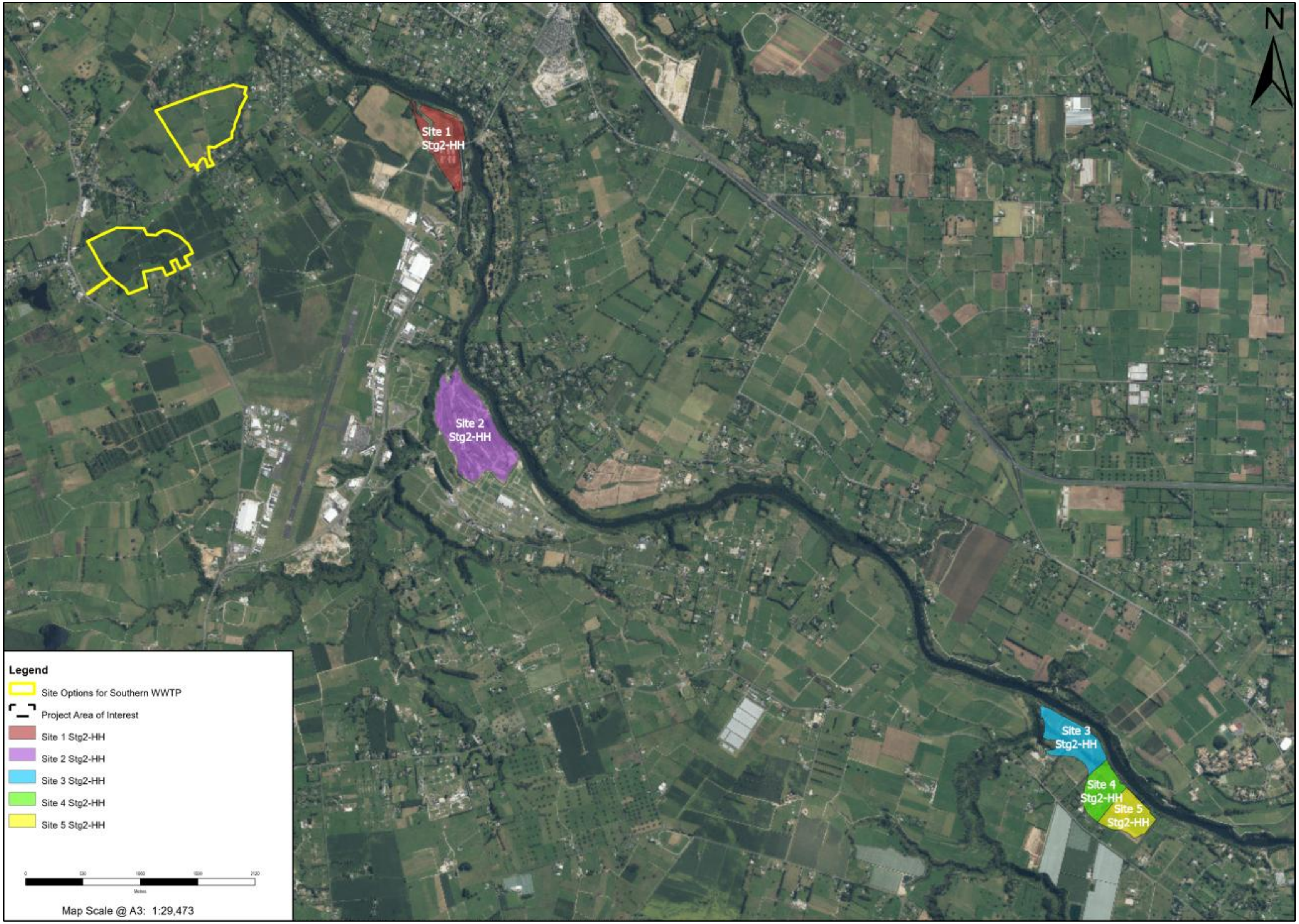


Figure 17. Candidate sites after the first-class exclusion for Stage 2 Flow and High hydraulic loading rate of 25 mm/day (land area required = 9 ha).

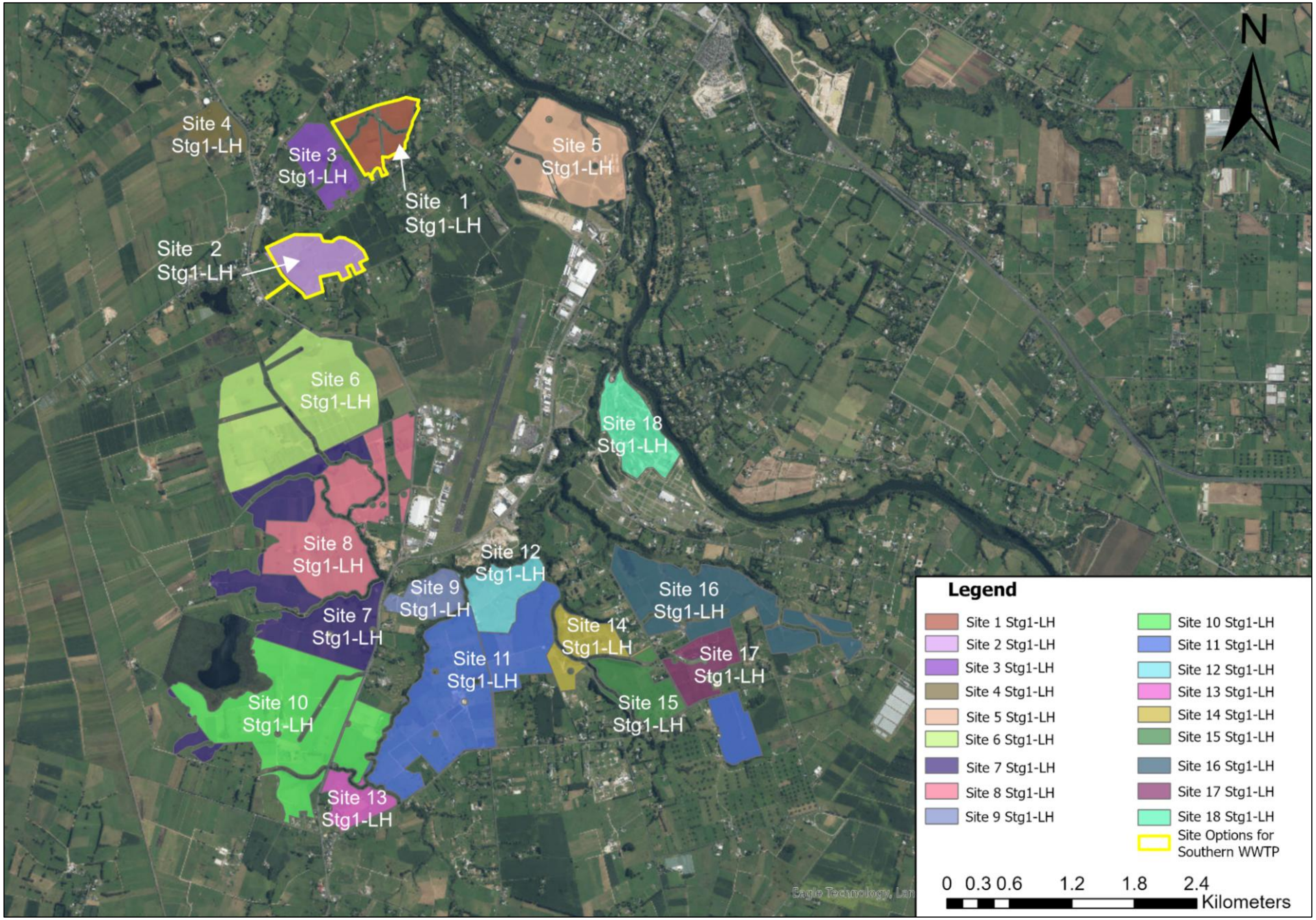


Figure 18. Candidate sites after the first-class exclusion for Stage 1 Flow and Low hydraulic loading rate of 3 mm/day (land area required = 20 ha).

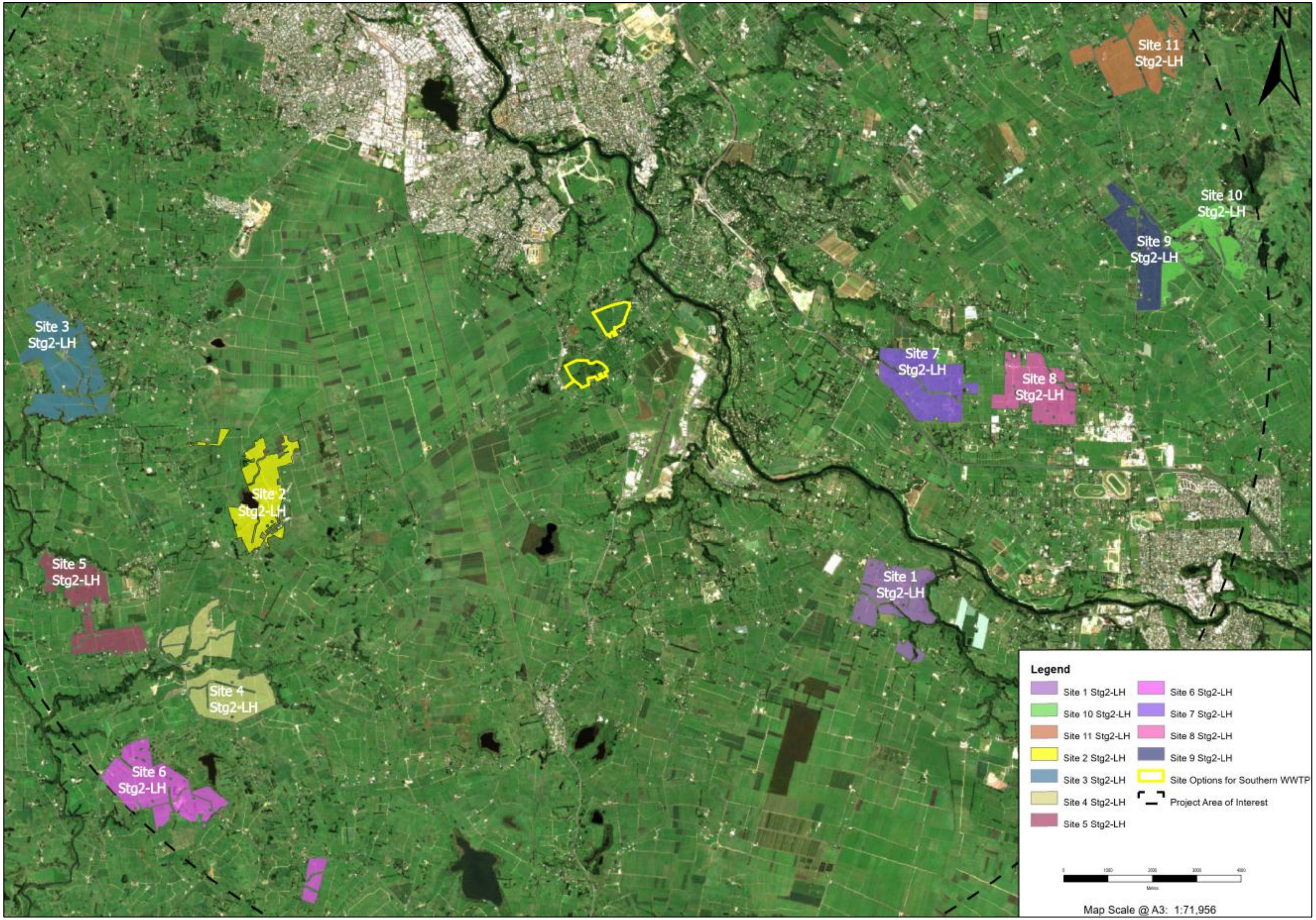


Figure 19. Candidate sites after the first-class exclusion for Stage 2b Flow and Low hydraulic loading rate of 3 mm/day (land area required = 180 ha).

8 Multi-Criteria Analysis and Results

8.1 MCA Weighting

Following the first-class exclusion process, the following number of sites remained for each scenario and were assessed using an MCA:

- Stage 1 LH – 18 Sites
- Stage 1 HH – 17 Sites
- Stage 2 LH – 11 Sites
- Stage 2 HH – 5 Sites

The MCA have been used to rank and determine the most feasible candidate site for land discharge. This process evaluated each site based on four criteria: slope, soil drainage, land use compatibility, and distance from the WWTP. Additional information was then gathered to identify any other factors that might affect the suitability of these sites for land discharge. This information, detailed in **Appendix A**, includes:

- Significant Natural Areas (SNA)
- Ownership type (private or public)
- Cultural sites
- On-site bores

The MCA employs a weighting system to rank the candidate sites. Various scenarios were also considered through a sensitivity analysis. The weight of each criterion, as shown in Table 6, was determined by evaluating the importance of each factor in relation to the technical feasibility of land discharge. A larger weighting in assigned to slope and soil drainage, as these are the core environmental components that would enable or technically restrict the ability to implement a discharge to land method. Distance to WWTP has been included to account for the cost and infrastructure that would be required to connect the discharge site with the SWWTP.

Table 6. MCA weighting

Criteria	Weighting %
Slope	33
Soil Drainage	33
Land use types	17
Distance to WWTP	17

The MCA analysis involved using a scoring matrix to assign scores, which the MCA weighting would then use to calculate an overall ranking. Each factor has attributes scored on a scale from one to five. For example, in the case of slope, a score of one was given to a candidate site with less than 20% of its area having a slope of less than 7°, while a score of five was given to a site with 80% or more of its land having a slope of less than 7°. The rationale for scoring each factor is explained in detail in **Appendix B**, along with the scores assigned to each candidate site.

8.2 Results

8.2.1 MCA Rankings for Candidate Sites without Weighting

After assigning scores, the MCA ranked the results without applying weightings (Figure 20, Figure 21, Figure 22 and Figure 23). Table 7 shows the sites which emerged as the top candidates for each scenario without applying the weightings.

Table 7. Top ranked sites based on MCA without weighting.

Scenario	Top Candidate(s)
Stage 1 – Low Hydraulic Loading Rate	Site 9
Stage 1 – High Hydraulic Loading Rate	Site 2 and 4
Stage 2 – Low Hydraulic Loading Rate	Site 1 and 7
Stage 2 – High Hydraulic Loading Rate	Site 1

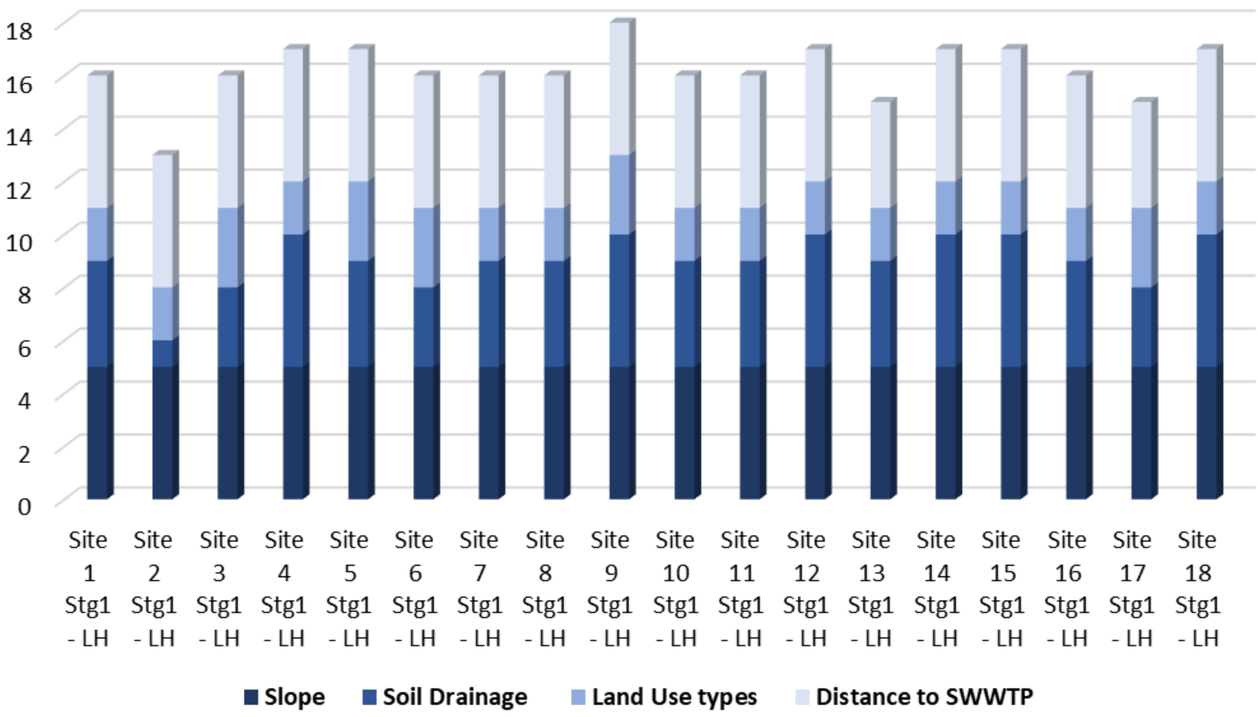


Figure 20. Stage 1 low hydraulic loading sites without weighting.

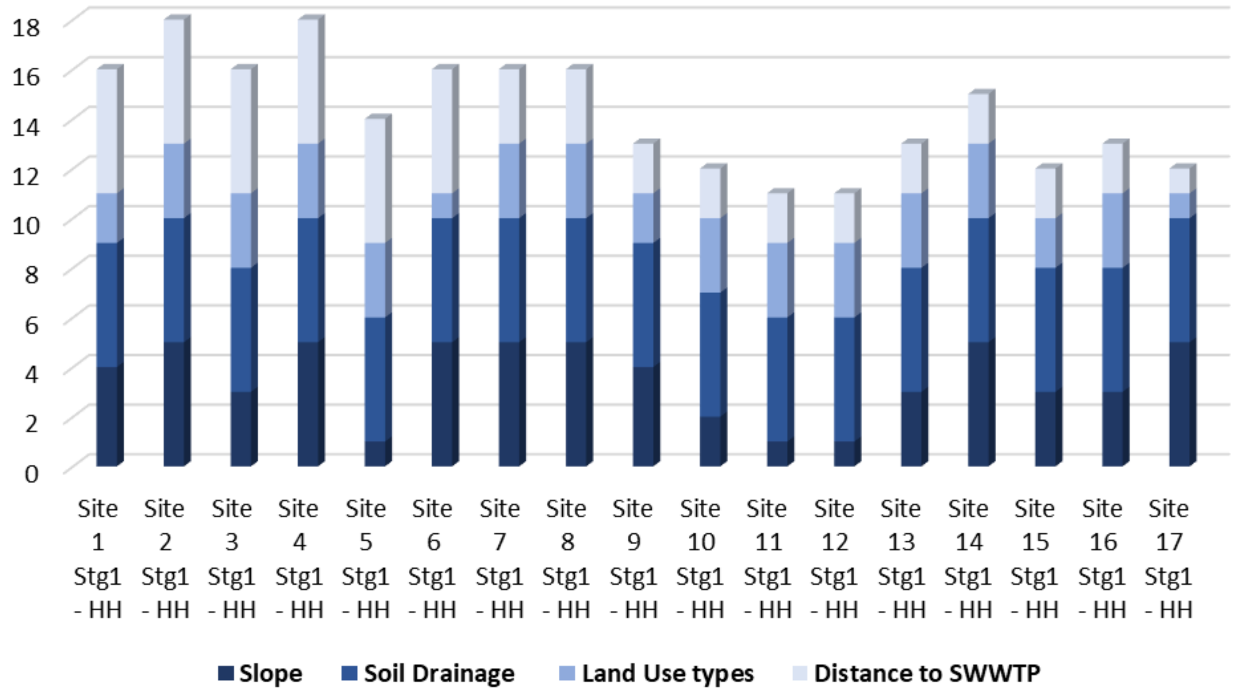


Figure 21. Stage 1 high hydraulic loading sites without weighting.

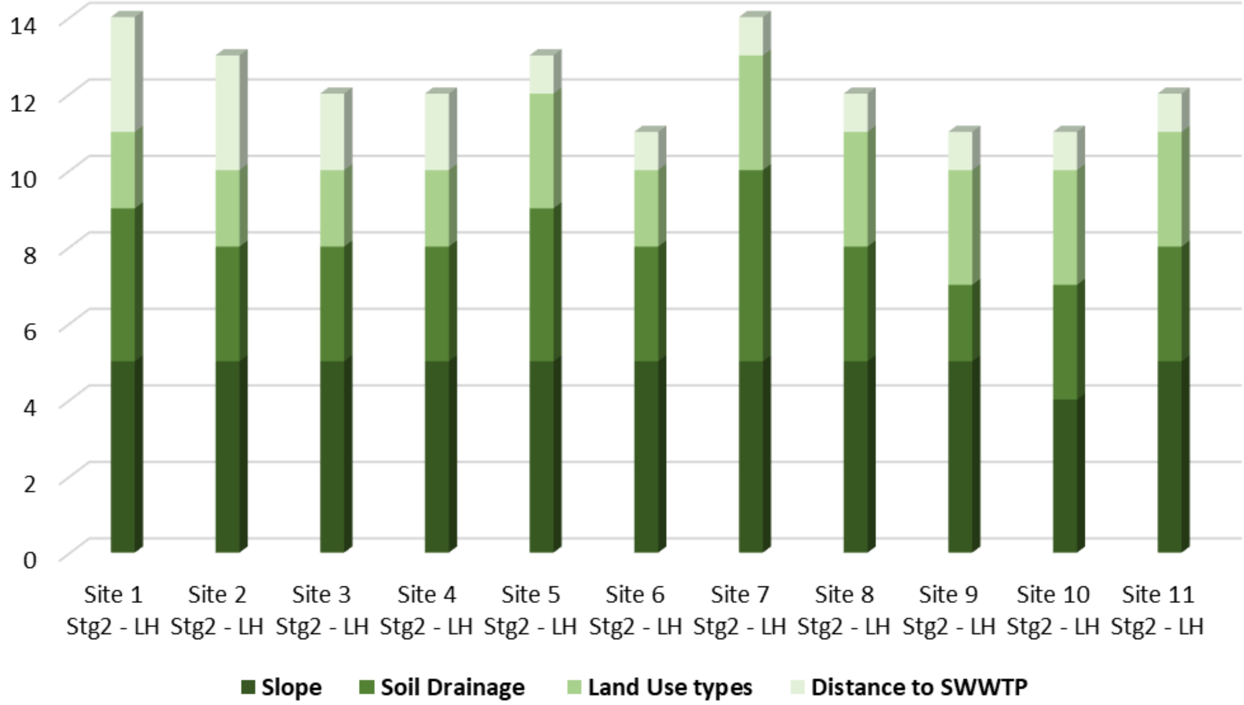


Figure 22. Stage 2 low hydraulic loading sites without weighting.

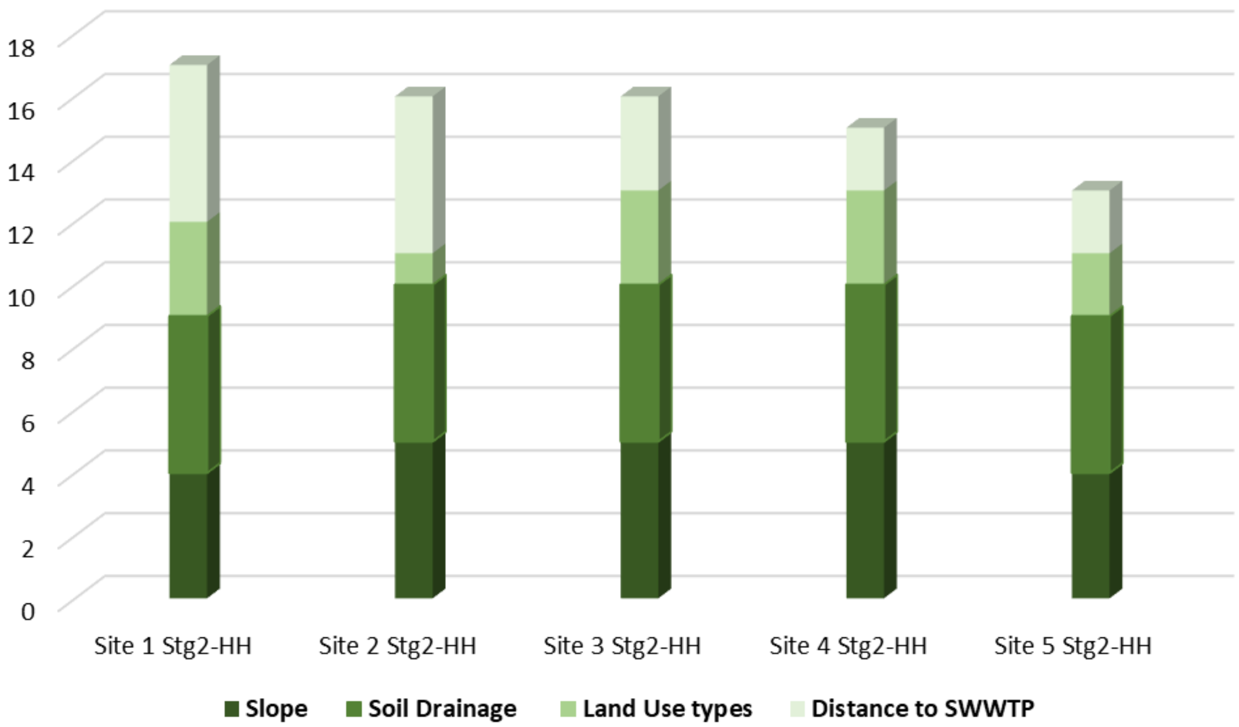


Figure 23. Stage 2 high hydraulic loading sites without weighting.

8.2.2 MCA Rankings for Candidate Sites with Weighting

The ranking of the MCA with the determined weightings are shown in Figure 24, Figure 25, Figure 26, Figure 27, and summarised in Table 8. The highest ranked candidate sites have remained the same as unranked status Applying the weightings resulted in Site 7 emerging as the highest-ranked candidate for Stage 2 – Low Hydraulic Loading Rate.

Table 8. Top ranked sites based on MCA with weighting.

Scenario	Top Candidate(s)
Stage 1 – Low Hydraulic Loading Rate	Site 9
Stage 1 – High Hydraulic Loading Rate	Sites 2 and 4
Stage 2 – Low Hydraulic Loading Rate	Site 7
Stage 2 – High Hydraulic Loading Rate	Site 1

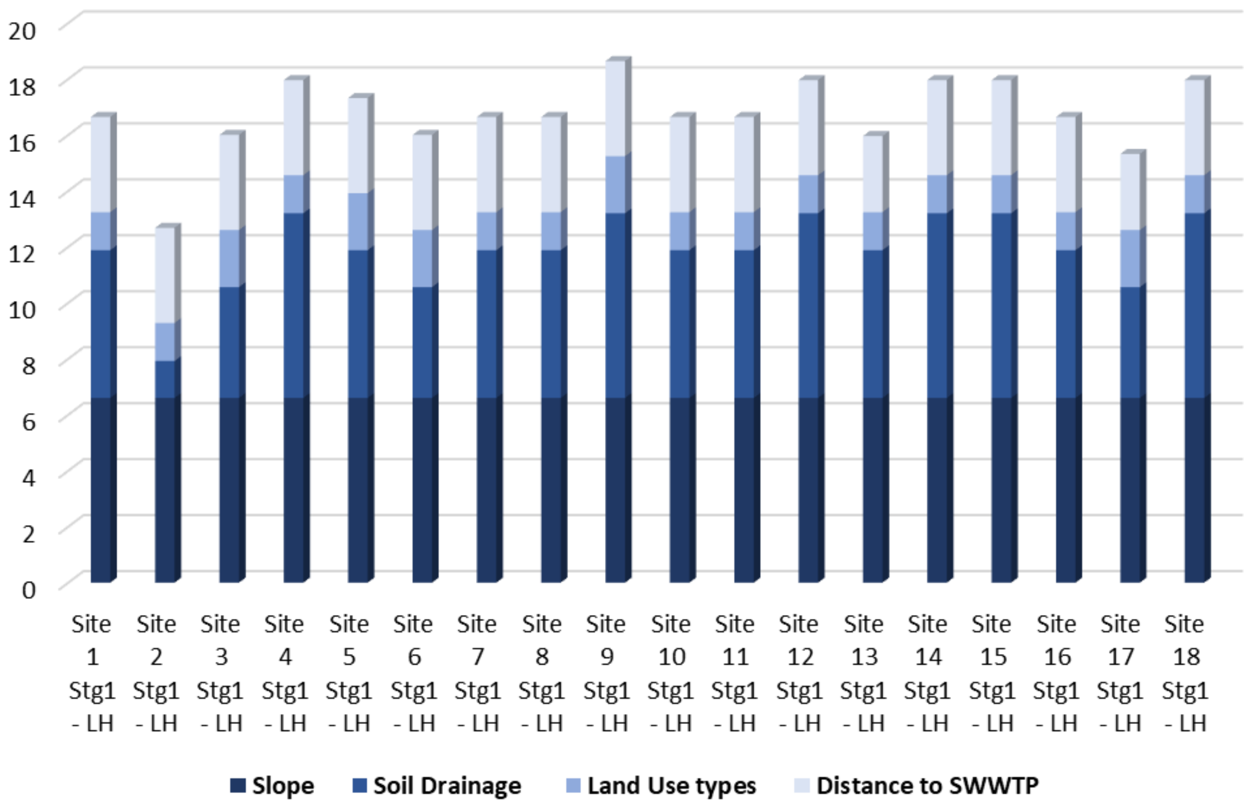


Figure 24. Stage 1 Low hydraulic loading MCA results with weighting.

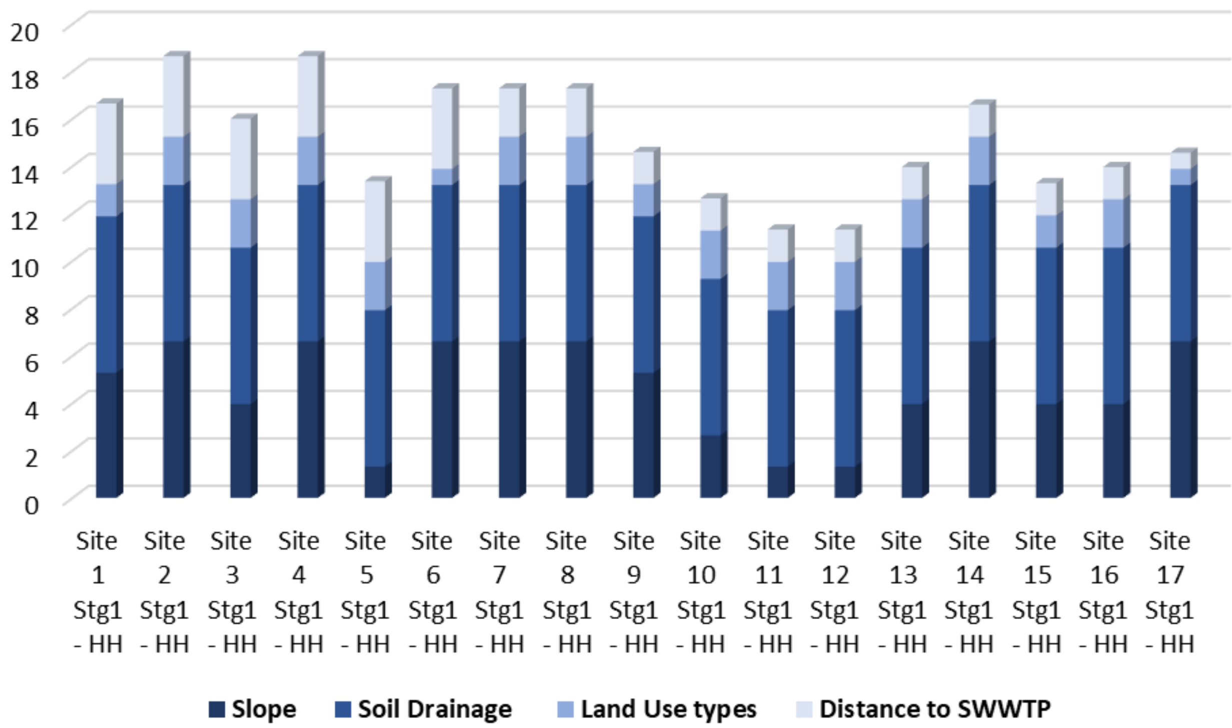


Figure 25. Stage 1 high hydraulic loading MCA results with weighting.

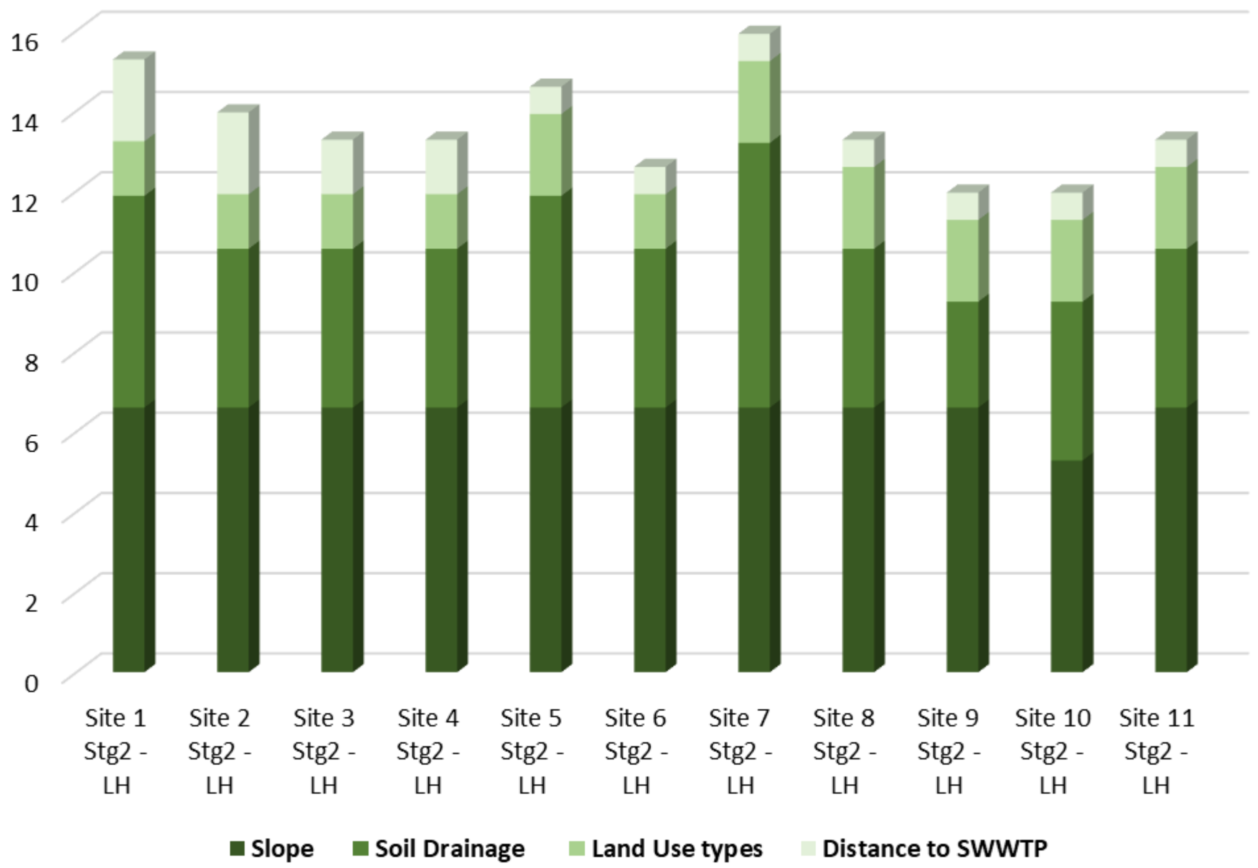


Figure 26. Stage 1 low hydraulic loading MCA results with weighting.

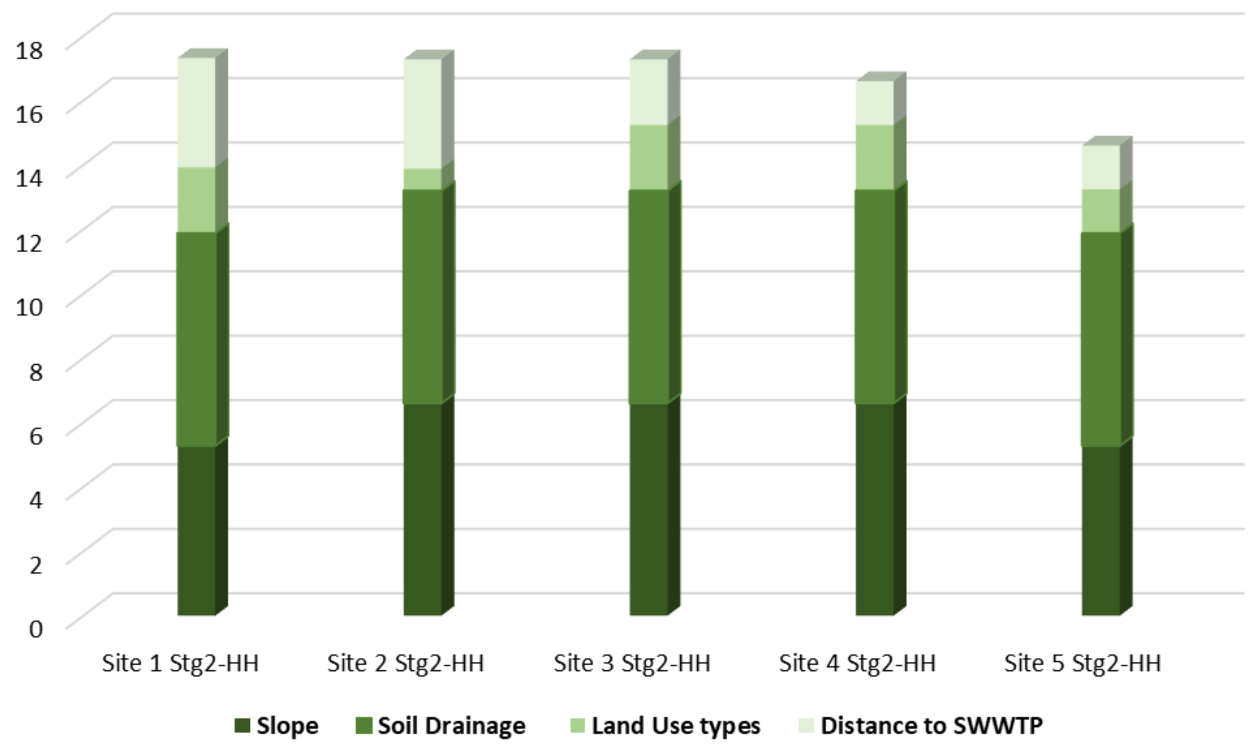


Figure 27. Stage 2 high hydraulic loading MCA results with weighting.

8.2.3 Sensitivity Analysis

A sensitivity analysis was conducted from appointing one criterion with a weighting of 40% and the other 3 criteria at 20%. The sensitivity analysis was conducted to determine whether a general trend that could support the final MCA ranking. As seen in Table 9, the sites identified in rank 1 in the weighting ranking are consistently ranked as the most feasible in the sensitivity analysis. Site 2, one of most feasible sites for Stage 1-HH has two bore, and Site 4 has one cultural site registered through ArchSite[14]. Stage 2 – LH (Site 7) has three cultural sites, and four bores within this land area. The most feasible site for Stage 2 – HH (Site 1) also has three cultural sites within the land area.

Table 9. Ranking based on the sensitivity analysis scenarios where each heading criteria is weighted 40% and the remaining three criteria at 20% each.

Scenario	Rank	Slope	Soil drainage	Land Use	Distance
Stage 1 – LH	1	Site 9	Site 9	Site 9	Site 9
	2	Site 4,5,12,14,15,18	Site 4,12,14,15,18	Site 5	Site 4,5,12,15,18
	3	Site 3,6	Site 5	Site 3,4,6,12,14,15,18	Site 1,3,6,7,8,10,16
	4	Site 1,7,8,10,11,16	Site 1,7,8,10,11,16	Site 1, 7,8,10,11,16	Site 17
	5	Site 13, 17	Site 3	Site 17	Site 13
Stage 1 – HH	1	Sites 2 and 4	Sites 2 and 4	Sites 2 and 4	Sites 2 and 4
	2	Site 6,7,8	Sites 3,6,7,8	Sites 3,7,8	Site 1,3,6
	3	Site 1,14	Site 1, 14	Site 1,14	Site 7,8
	4	Site 3, 5	Site 14, 5	Site 6, 5	Site 14, 5
	5	Site 17	Site 13,16	Site 13,16	Site 9,13,16
Stage 2 – LH	1	Site 7	Site 7	Site 7	Site 1
	2	Site 1	Site 1	Site 1,5	Site 2
	3	Site 2	Site 2	Site 8,11	Site 7
	4	Site 8,11	Site 8,11	Site 3,4,10	Site 3,4
	5	Site 3,4	Site 3,4		Site 5
Stage 2 – HH	1	Site 1,2,3	Site 1	Site 1	Site 1
	2	Site 4	Site 2,3	Site 3	Site 2
	3	Site 5	Site 4	Site 4	Site 3
	4		Site 5	Site 2	Site 4
	5			Site 5	Site 5

[14] https://archsite.eaglegis.co.nz/NZAA/Account/Login?ReturnUrl=%2FNZAA%2F

9 Summary and Recommendations

9.1 Summary

Based on this initial assessment, the sites listed below are most feasible for treated wastewater to discharge to land:

- Stg 1-LH: Site 9
- Stg 1- HH: Site 2 and 4
- Stg 2 – LH: Site 7
- Stg2 – HH: Site 1

Of all the sites reviewed, the five sites visualised in Figure 28 based on the MCA and sensitively analysis, achieved the more desireable mixture of suitable slope, soil type, land use type, and location for the discharge to land method to be technicially feasible.

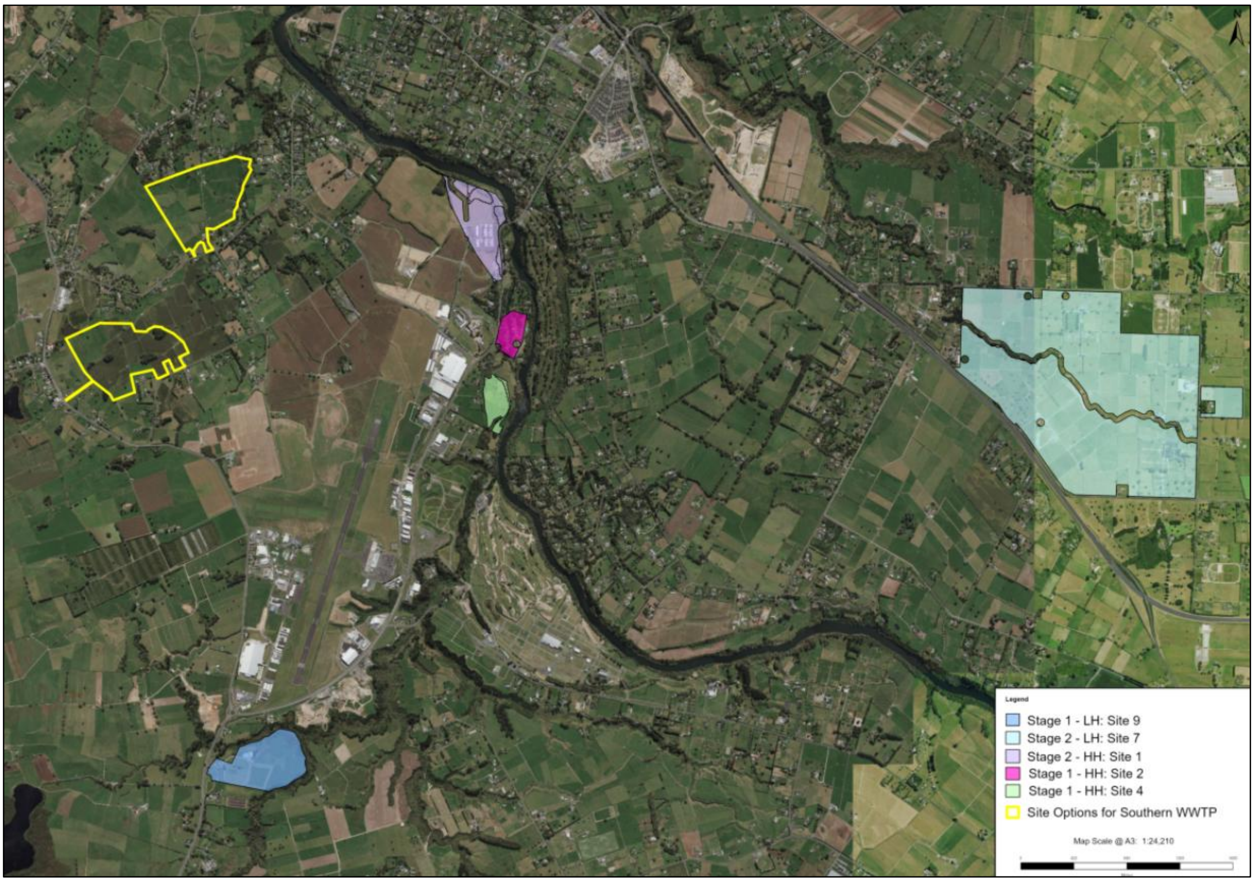


Figure 28. Most feasible land parcels for each discharge to land scenario, based on MCA criteria.

All five of these sites have a mixture of land-uses which will require further consultation with landholders, and more detailed feasibility investigations. Stage 2 sites will also require further investigation regarding the presence of documented cultural heritage site. While all sites have potential limits, irrigation to land at each of these sites is possible given the soil profile and characteristics. Further consideration may need to be given if the recommended site for Stage 2 – LH is pursued, as the site is approximately 7.5 km from the proposed SWWTP location, and on the other side of the Waikato River.

Table 10 below summarises the positive attributes, and potential concentrations relating the technical feasibility of each site. Further information specific to a given site has also been given, however, the further information and review required for all sites is summarised in Section 0.

Table 10. Summary of positive attributes, potential constraints, and further information requested for each most feasible land parcel.

Most feasible Sites	Positive Attributes	Potential Constraints	Further Information Required
Stg2–LH Site 7	• Slope and soil profile likely provides adequate drainage for discharge to land. • Significant Size allows for flexibility	• Distance to the proposed SWWTP would require piping to the other side of the Waikato River. • Known cultural sites within proximity. • Four Bores located onsite.	• Further investigation required for the presence of cultural heritage sites. • Further consultation with landowners. • Further soil and hydrogeological investigations.
Stg2–HH Site 1	• Slope and soil profile likely provides adequate drainage for discharge to land. • Proximity to SWWTP allows for easy effluent transfer.	• Known cultural sites within proximity.	• Further investigation required for the presence of cultural heritage sites. • Further consultation with landowners. • Further soil and hydrogeological investigations.
Stg1–LH Site 9	• Slope and soil profile likely provides adequate drainage for discharge to land. • Proximity to SWWTP allows for easy effluent transfer.	• SNA present on land parcel.	• Further consultation with landowners. • Further soil and hydrogeological investigations.
Stg1–HH Site 2	• Slope and soil profile likely provides adequate drainage for discharge to land.	• Two bores located onsite.	• Further consultation with landowners. • Further soil and hydrogeological investigations. • Further Inspection of bores.
Stg1–HH Site 4	• Slope and soil profile likely provides adequate drainage for discharge to land. •	• One cultural heritage site within proximity.	•

9.2 Recommendations

Further work is dependent on the decision-making process of pursuing the discharge to land option further or the exploration of other discharge options. If these options were to be moved forward, further investigations should include:

- Site-specific investigations to assess the findings from the desktop investigation (soil and hydrogeological investigations);
- Landowners should be engaged to assess the potential availability of land for treated wastewater discharge;
- Further investigation into the practically of selected sites, including, physically accessibility, cost, and suitability in term of climate change/hazards; and
- Feasibility of piping wastewater from the treatment plant to discharge location. This is particularly relevant for Stage 2 – LH, as it is located on the other side of the Waikato River.

10 Limitations

This report has been prepared by Beca Limited (Beca) solely for Hamilton City Council (the Client). Beca has been requested by the Client to provide a Land Discharge Options Assessment for the proposed Southern Wastewater Treatment Plant (SWWTP). This report is prepared solely for the purpose of presenting the findings of a desktop feasibility assessment for the discharge of treated wastewater to land from the SWWTP. The contents of this report may not be used for any purpose other than in accordance with the stated Scope.

This report is prepared solely for the Client. Beca accepts no liability to any other person for their use of or reliance on this report, and any such use or reliance will be solely at their own risk.

Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency, and sufficiency of all information provided to it by, or on behalf of, the Client or any third party, including the information listed above, and has not independently verified the information provided. Beca accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the information provided.

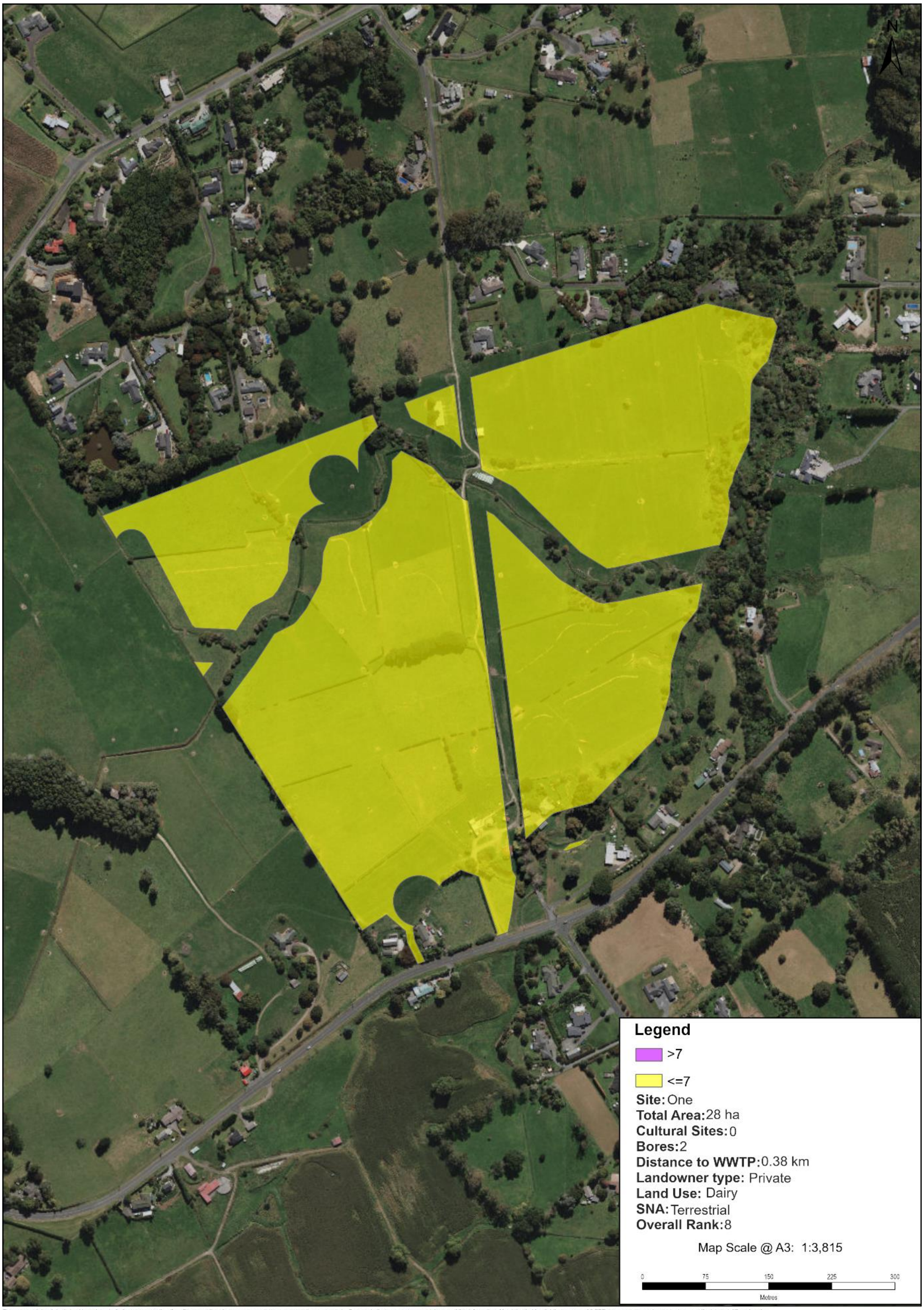
The contents of this report are based upon our understanding and interpretation of current legislation and guidelines ("Standards") as consulting professionals and should not be construed as legal opinions or advice. Unless special arrangements are made, this report will not be updated to take account of subsequent changes to any such Standards.

This report should be read in full, having regard to all stated assumptions, limitations, and disclaimers.

A

Appendix A – Candidate Sites

Stage 1 Low Hydraulic load Site Selection (Site 1 – 18)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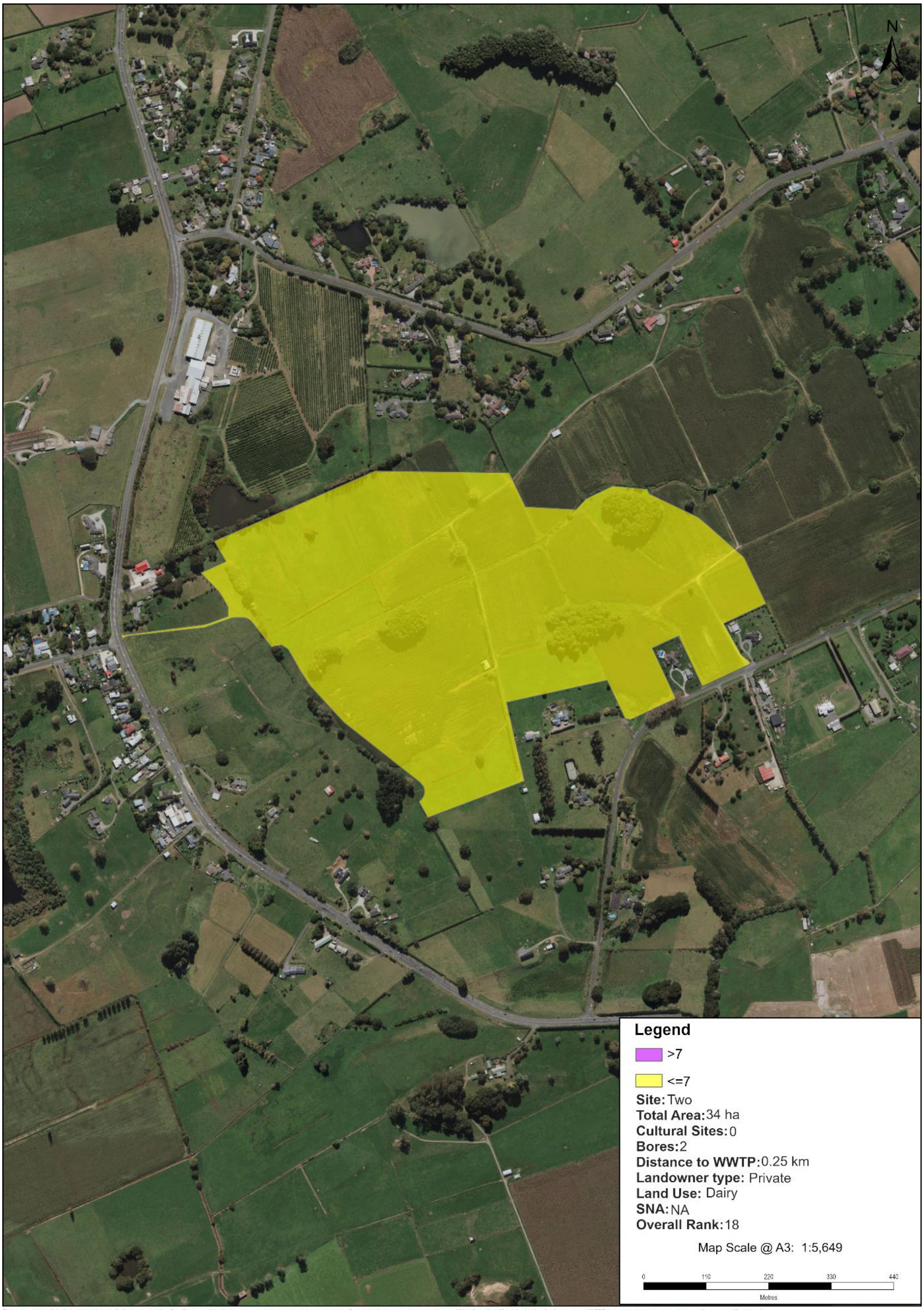
Legend
>7
<=7
Site: One
Total Area: 28 ha
Cultural Sites: 0
Bores: 2
Distance to WWTP: 0.38 km
Landowner type: Private
Land Use: Dairy
SNA: Terrestrial
Overall Rank: 8
Map Scale @ A3: 1:3,815
0
75
150
225
300
Metres



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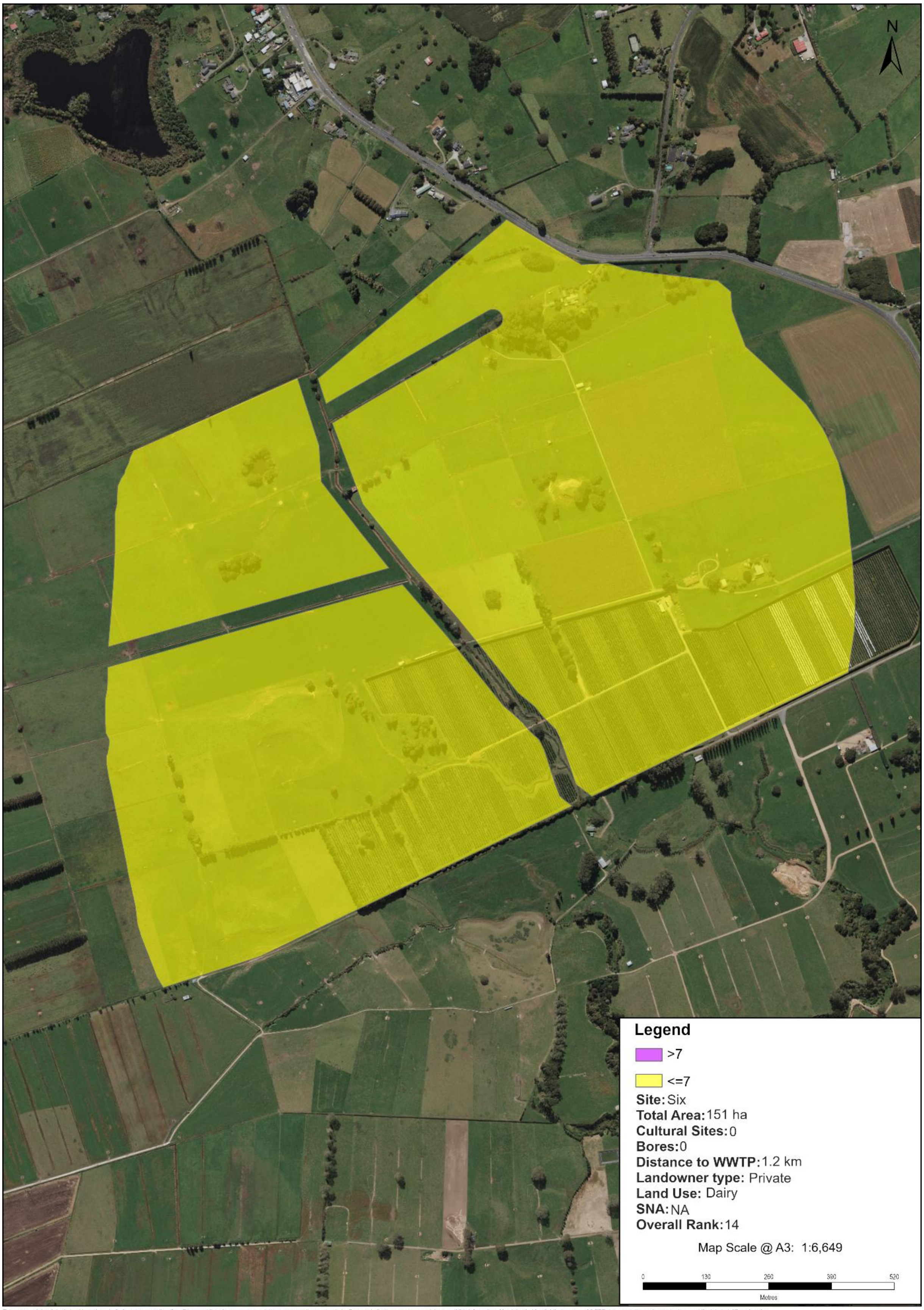
N
Legend
>7
<=7
Site: Four
Total Area: 20 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 1.25 km
Landowner type: Private
Land Use: Dairy
SNA: NA
Overall Rank: 2
Map Scale @ A3: 1:4,036
0 80 160 240 320
Metres


N
Legend
>7
<=7
Site: Five
Total Area: 84 ha
Cultural Sites: 6
Bores: 5
Distance to WWTP: 1.54 km
Landowner type: Private
Land Use: Cropland
SNA: NA
Overall Rank: 7
Map Scale @ A3: 1:5,306
0
100
200
300
400
Metres



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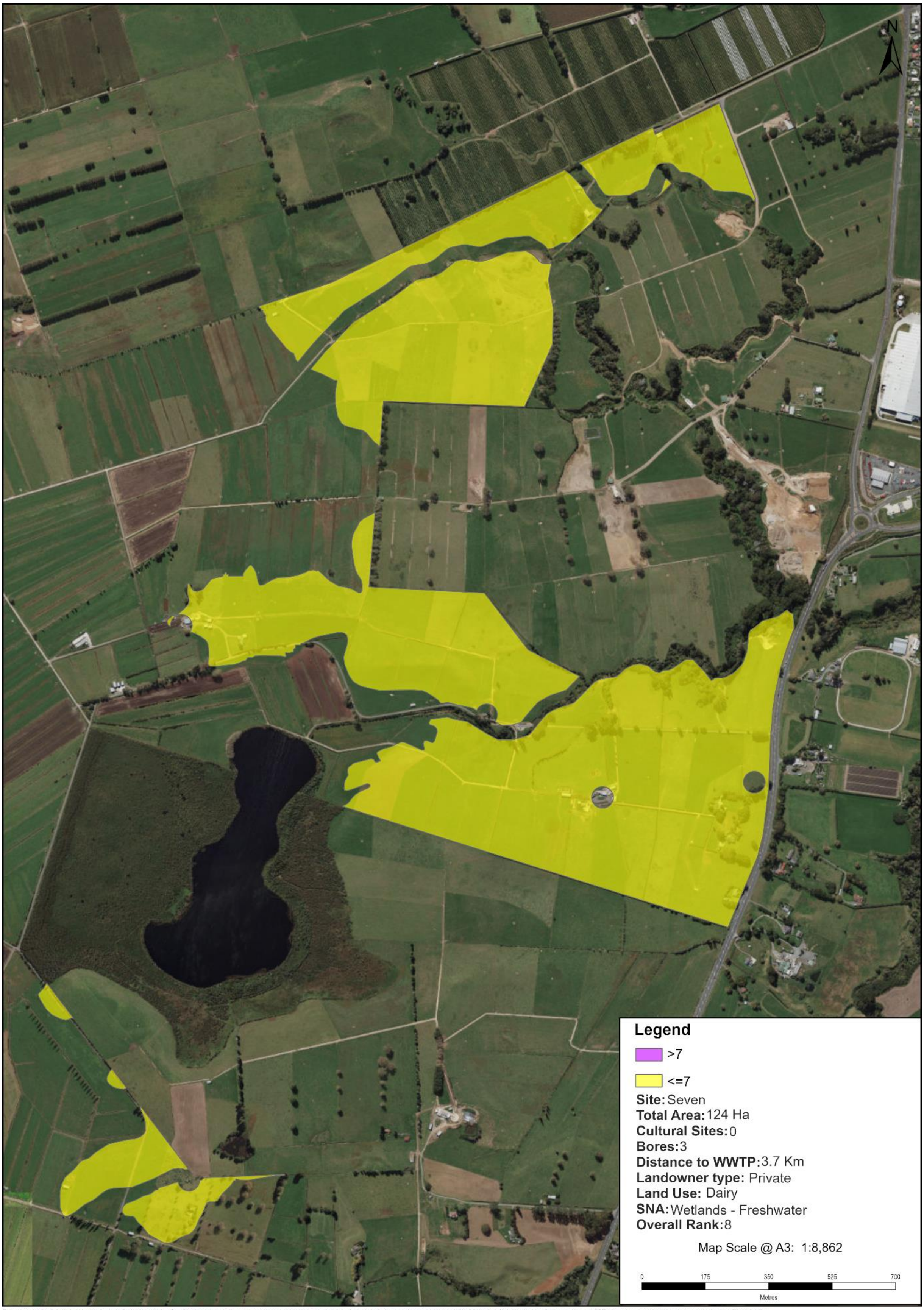
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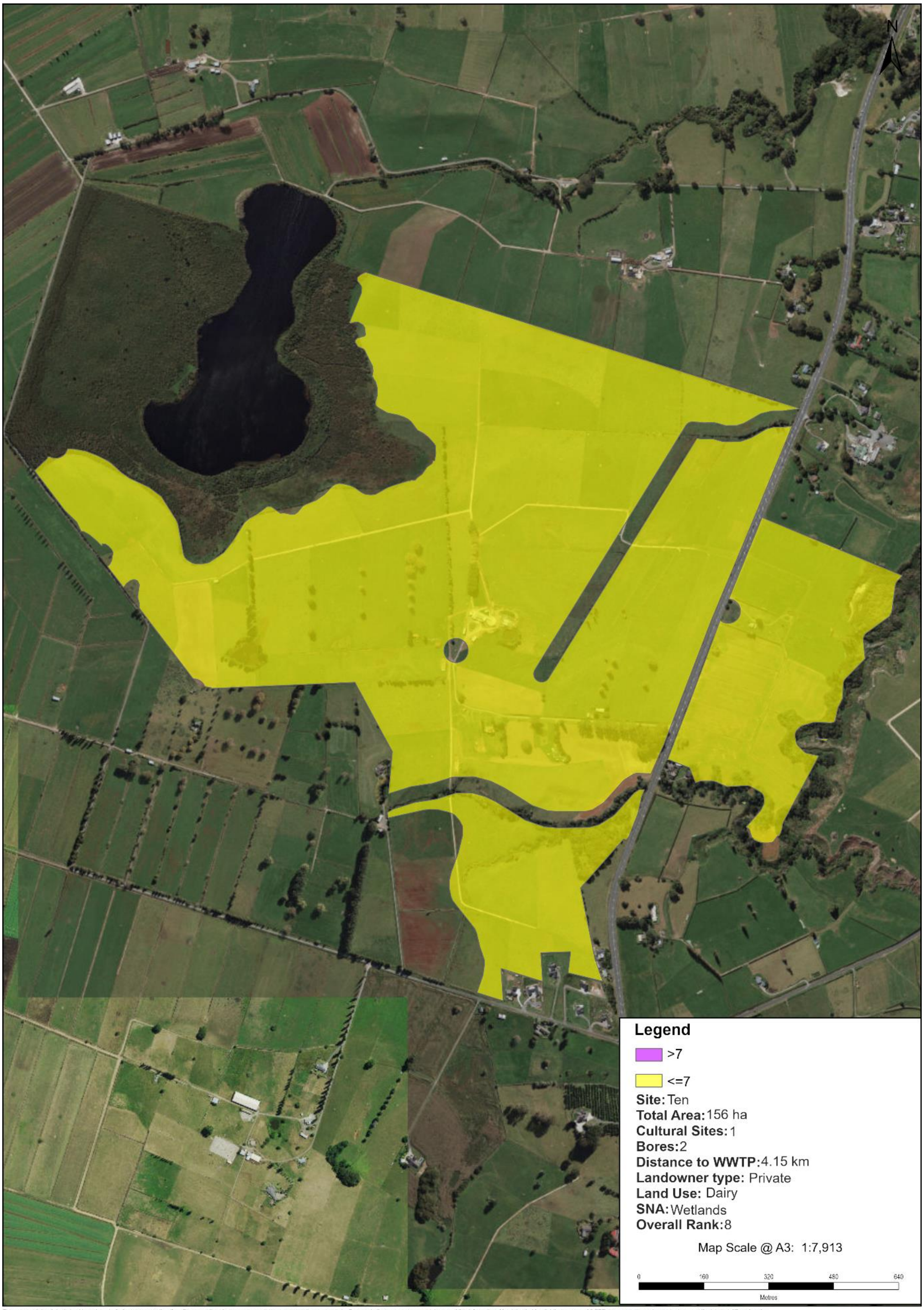
Legend
>7
<=7
Site: Seven
Total Area: 124 Ha
Cultural Sites: 0
Bores: 3
Distance to WWTP: 3.7 Km
Landowner type: Private
Land Use: Dairy
SNA: Wetlands - Freshwater
Overall Rank: 8
Map Scale @ A3: 1:8,862
0
175
350
525
700
Metres


N
Legend
>7
<=7
Site: Eight
Total Area: 110 ha
Cultural Sites: 0
Bores: 4
Distance to WWTP: 1.21 km
Landowner type: Private
Land Use: Dairy
SNA: Terrestrial, Wetlands - Freshwater
Overall Rank: 8
Map Scale @ A3: 1:7,413
0
150
300
450
600
Metres


N
Legend
>7
<=7
Site: Nine
Total Area: 24 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 3.5 km
Landowner type: Private
Land Use: Non-Dairy
SNA: Terrestrial, Wetlands - Freshwater
Overall Rank: 1
Map Scale @ A3: 1:3,036
0
60
120
180
240
Metres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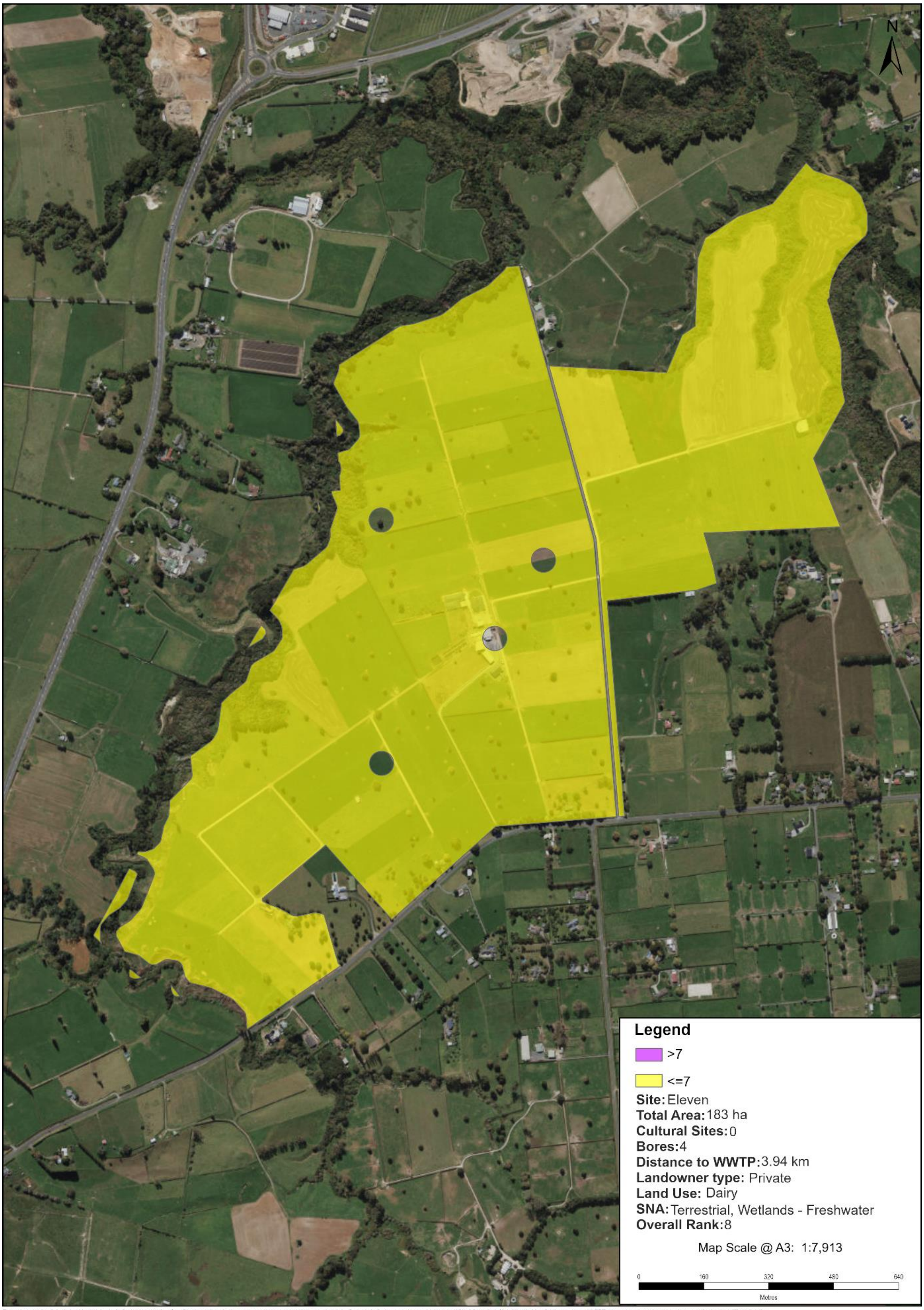
Legend
>7
<=7
Site: Ten
Total Area: 156 ha
Cultural Sites: 1
Bores: 2
Distance to WWTP: 4.15 km
Landowner type: Private
Land Use: Dairy
SNA: Wetlands
Overall Rank: 8
Map Scale @ A3: 1:7,913
0 160 320 480 640
Metres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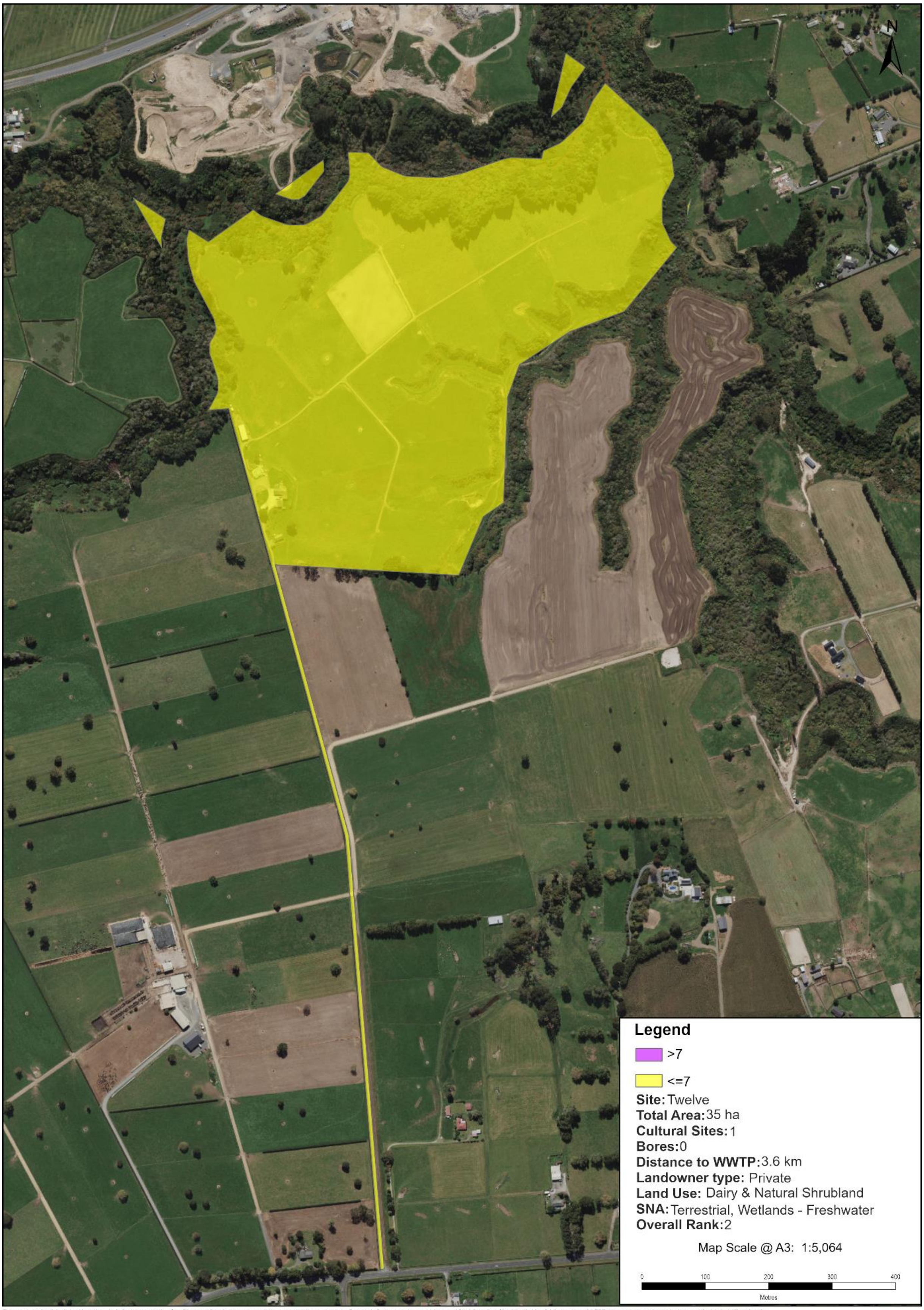
Legend
>7
<=7
Site: Eleven
Total Area: 183 ha
Cultural Sites: 0
Bores: 4
Distance to WWTP: 3.94 km
Landowner type: Private
Land Use: Dairy
SNA: Terrestrial, Wetlands - Freshwater
Overall Rank: 8
Map Scale @ A3: 1:7,913
0
160
320
480
640
Metres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Legend
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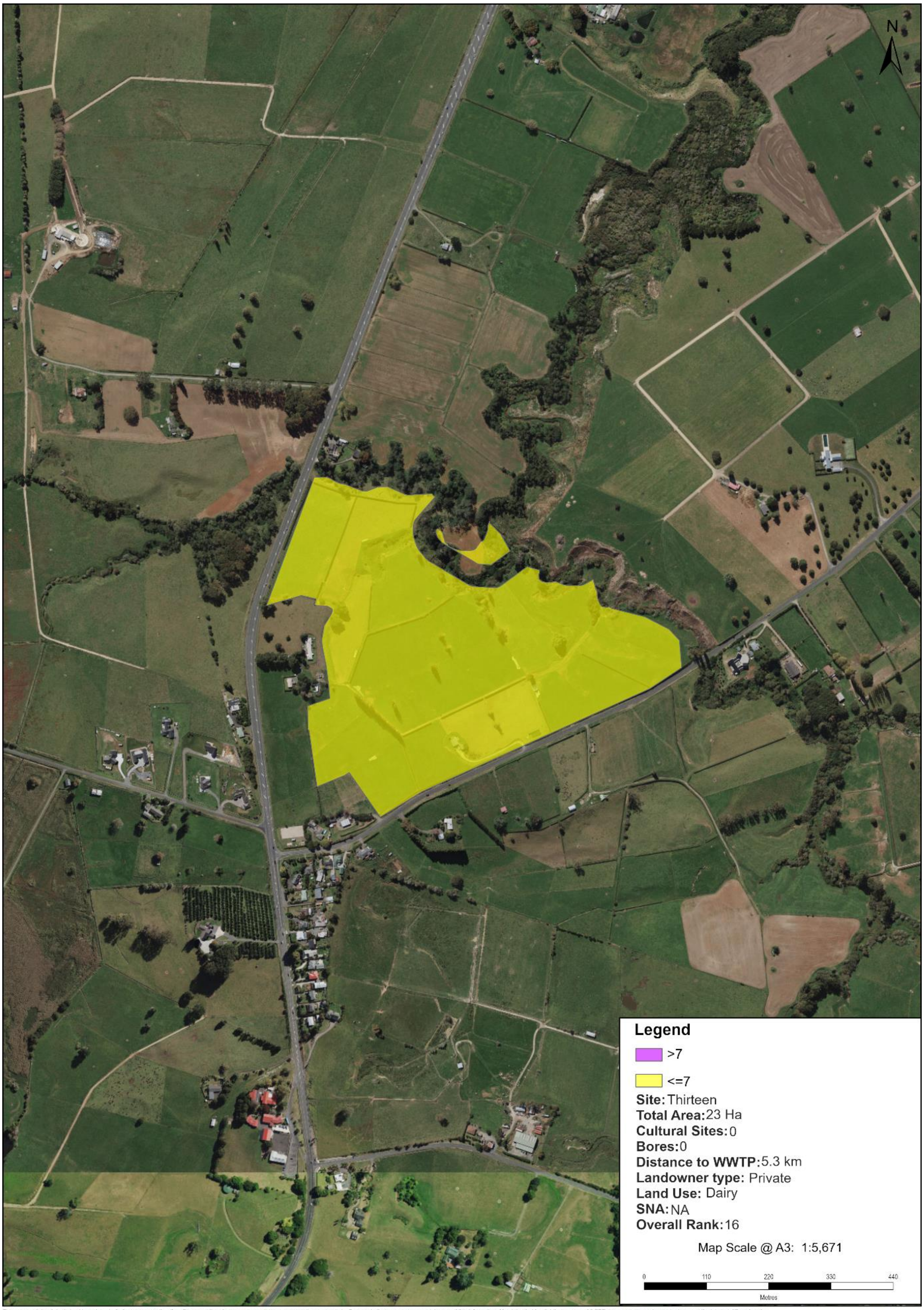
<=7
Site: Twelve
Total Area: 35 ha
Cultural Sites: 1
Bores: 0
Distance to WWTP: 3.6 km
Landowner type: Private
Land Use: Dairy & Natural Shrubland
SNA: Terrestrial, Wetlands - Freshwater
Overall Rank: 2
Map Scale @ A3: 1:5,064
0
100
200
300
400
Metres



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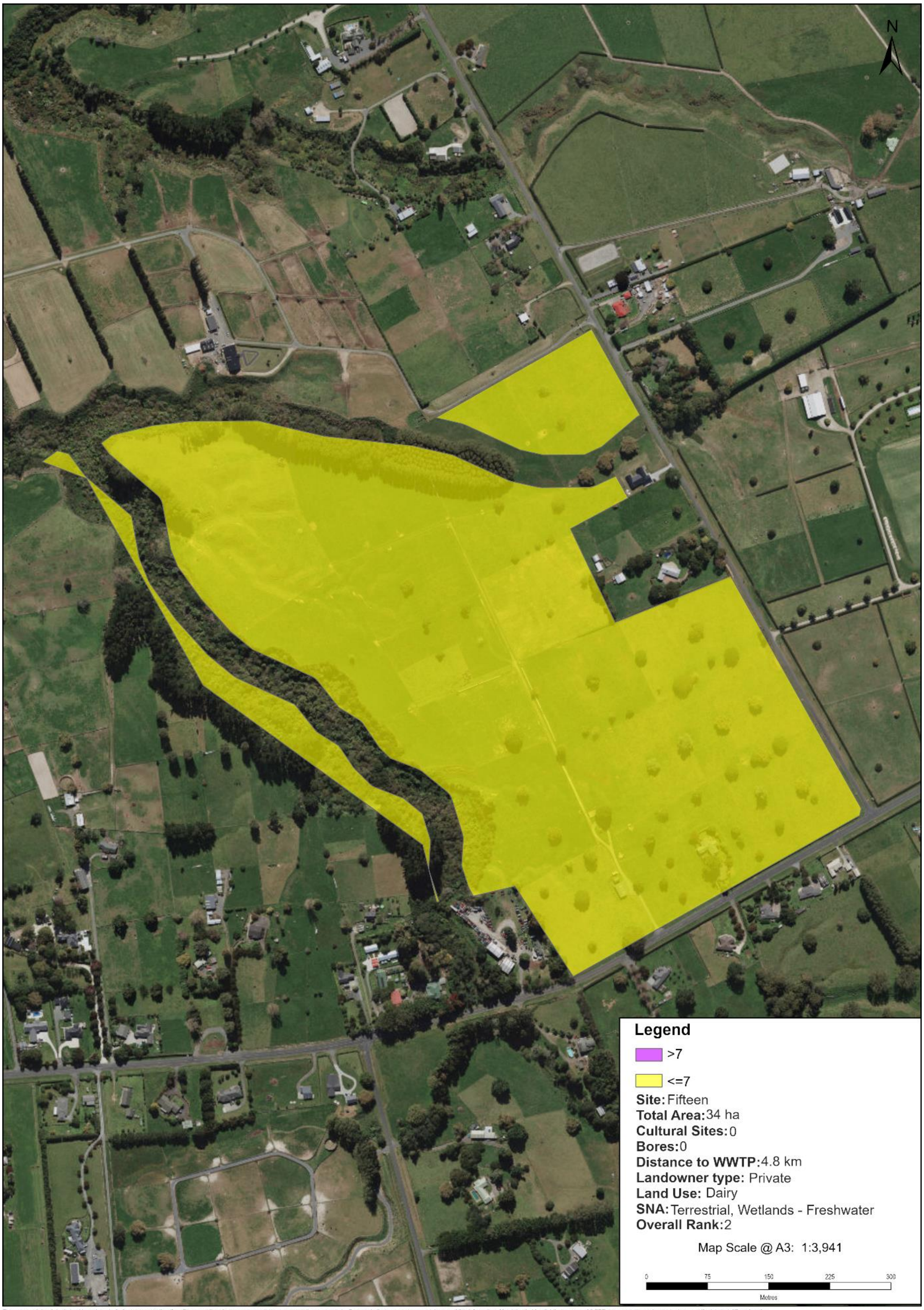
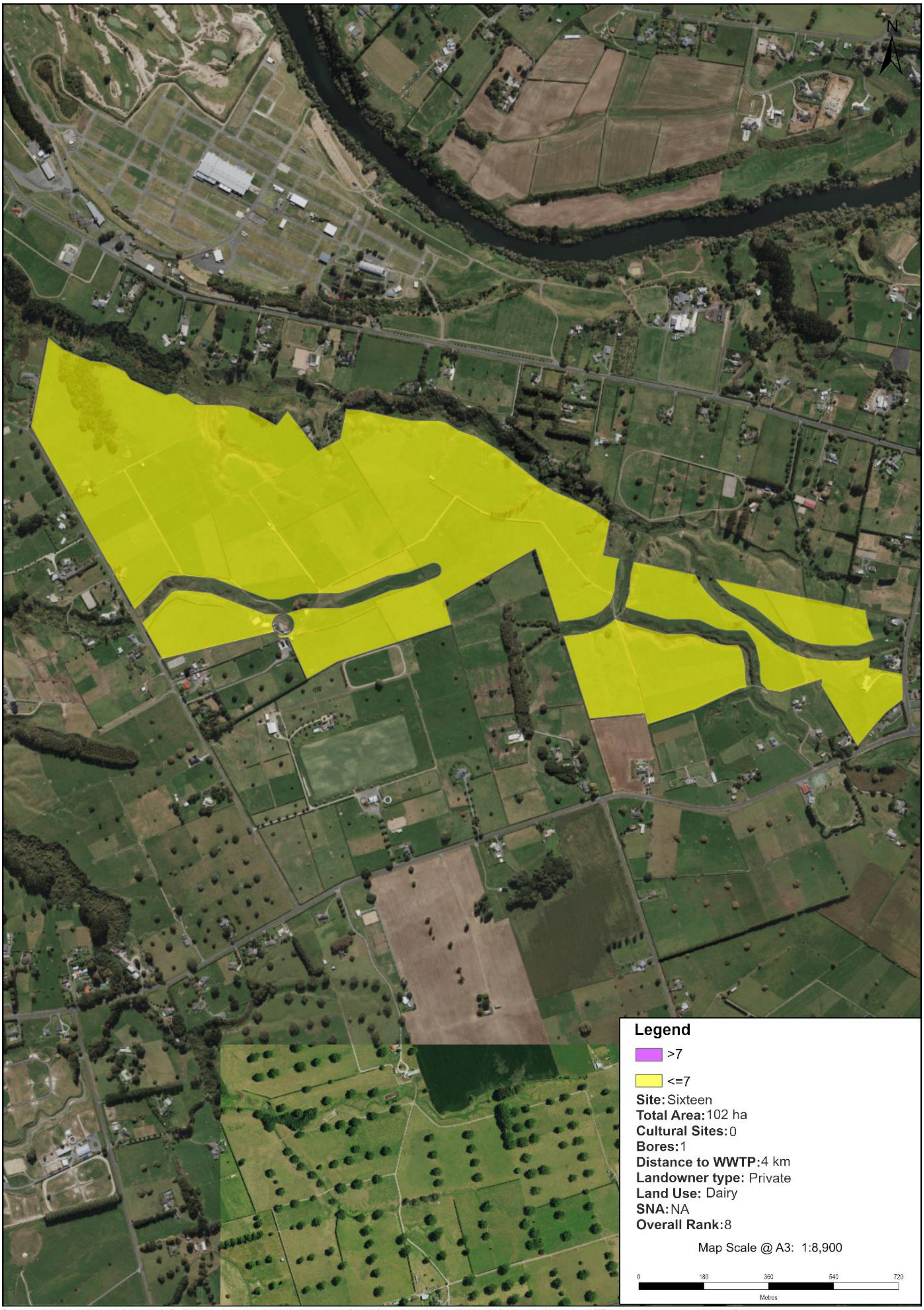
N
Legend
>7
<=7
Site: Fourteen
Total Area: 30 ha
Cultural Sites: 0
Bores: 1
Distance to WWTP: 4.2 km
Landowner type: Private
Land Use: Dairy
SNA: Terrestrial, Wetlands - Freshwater
Overall Rank: 2
Map Scale @ A3: 1:3,941
0
75
150
225
300
Metres


N
Legend
>7
<=7
Site: Fifteen
Total Area: 34 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 4.8 km
Landowner type: Private
Land Use: Dairy
SNA: Terrestrial, Wetlands - Freshwater
Overall Rank: 2
Map Scale @ A3: 1:3,941
0
75
150
225
300
Metres



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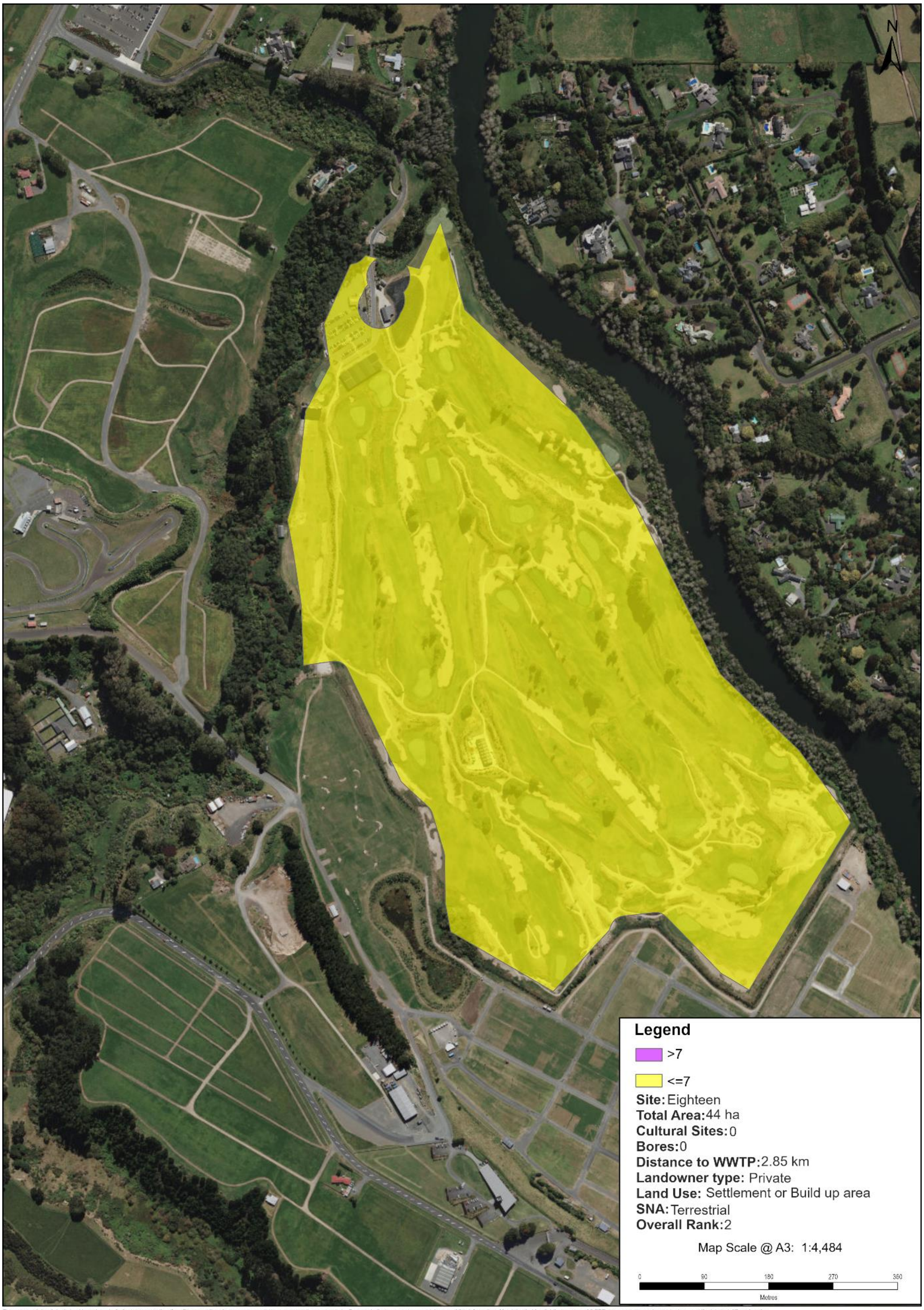
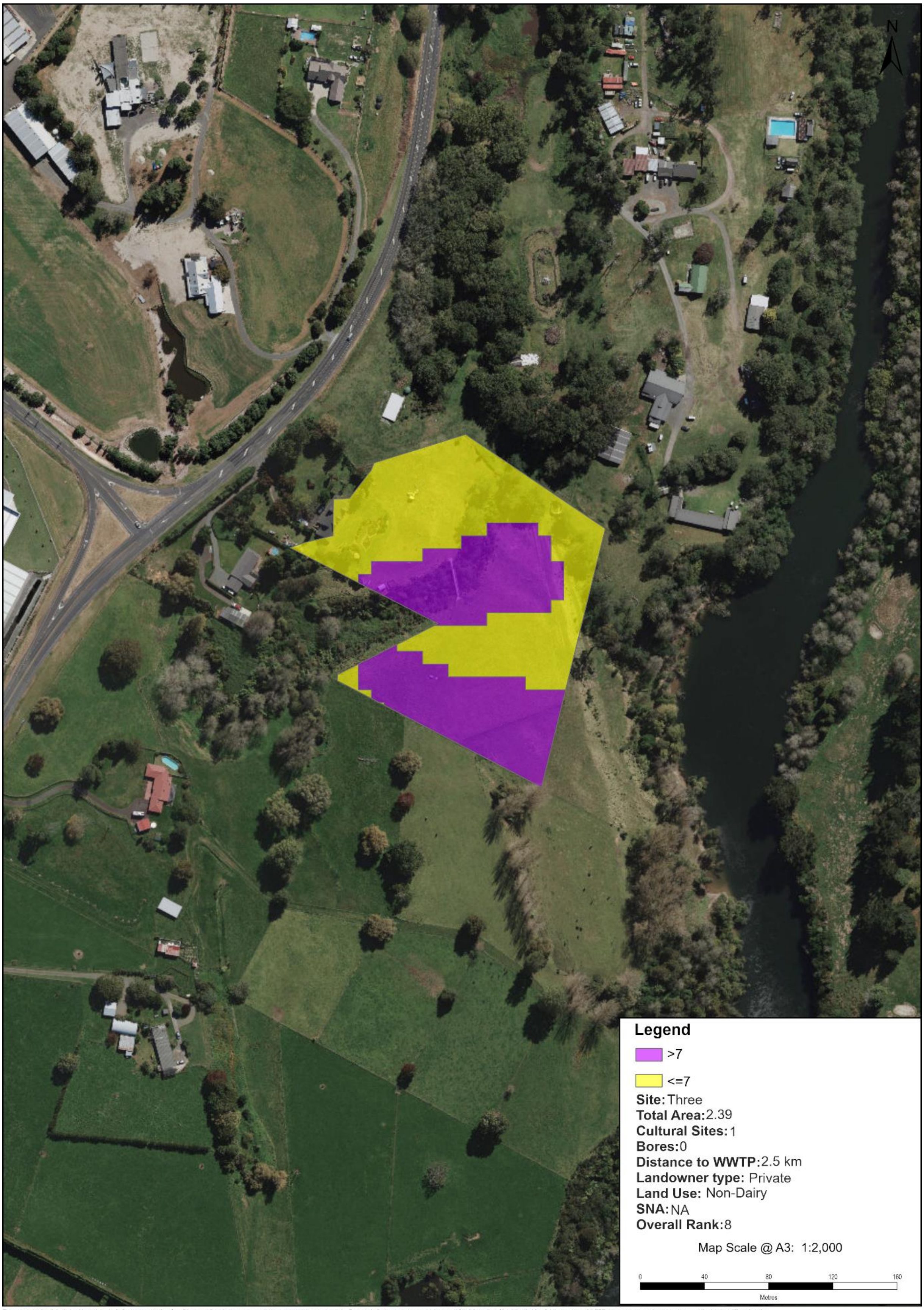

N
Legend
>7
<=7
Site: Eighteen
Total Area: 44 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 2.85 km
Landowner type: Private
Land Use: Settlement or Build up area
SNA: Terrestrial
Overall Rank: 2
Map Scale @ A3: 1:4,484
0
90
180
270
360
Metres

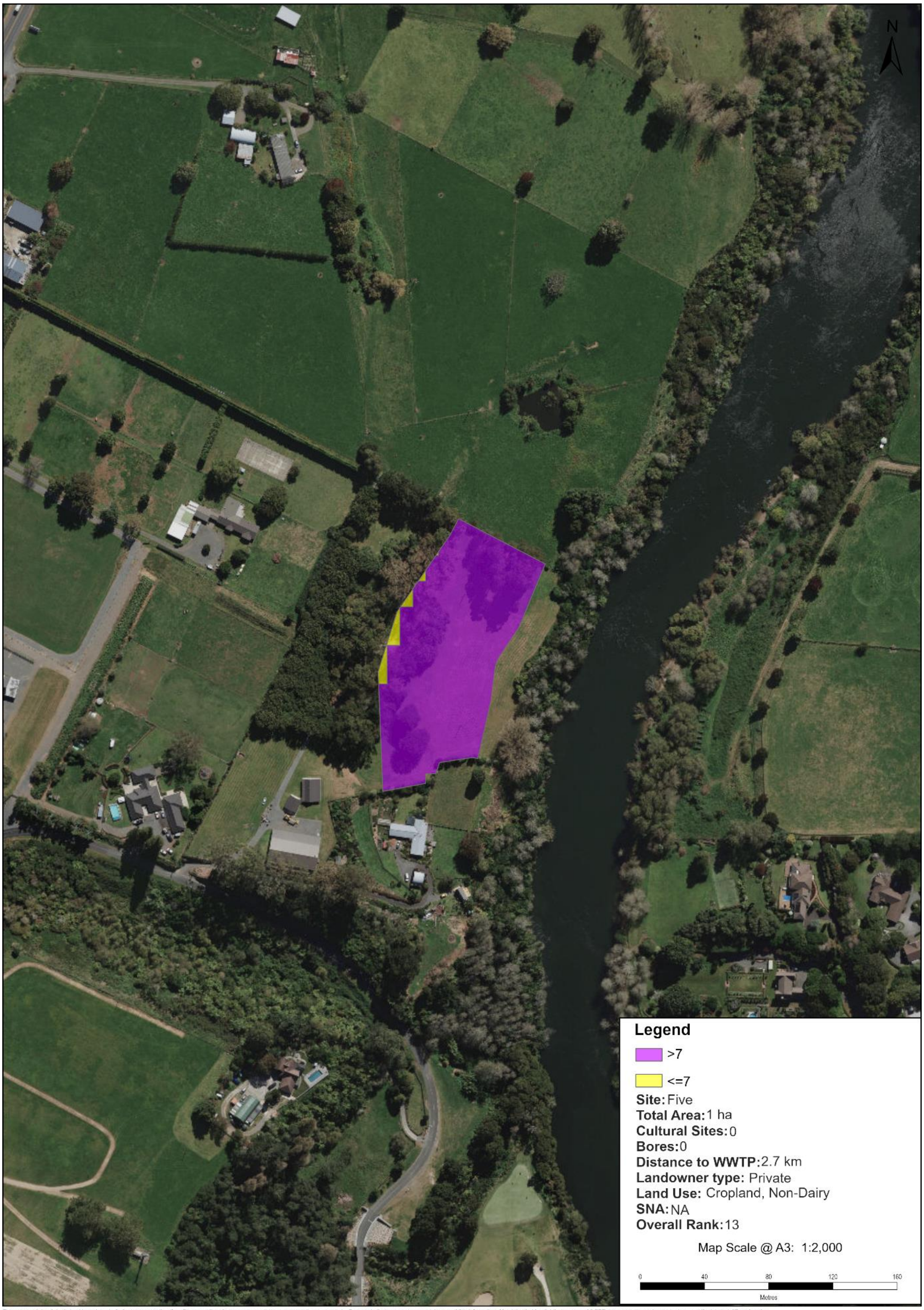
Stage 1 High Hydraulic Loading Candidate Sites (Sites 1 – 17)

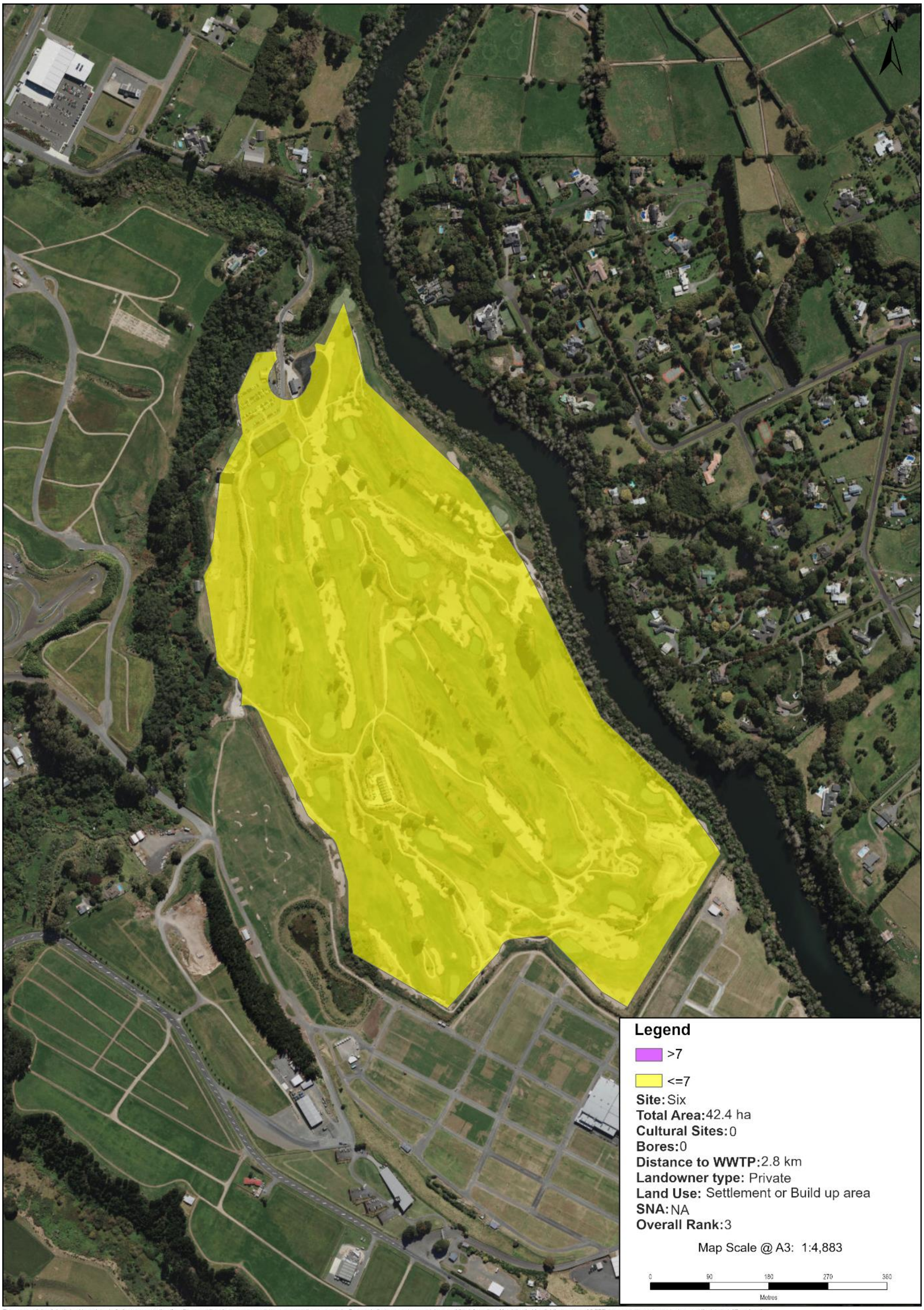

N
Legend
>7
<=7
Site: One
Total Area: 19.4 Ha
Cultural Sites: 3
Bores: 0
Distance to WWTP: 2.3 km
Landowner type: Private
Land Use: Settlement, Dairy, Cropland
SNA: NA
Overall Rank: 3
Map Scale @ A3: 1:5,556
0
110
220
330
440
Metres

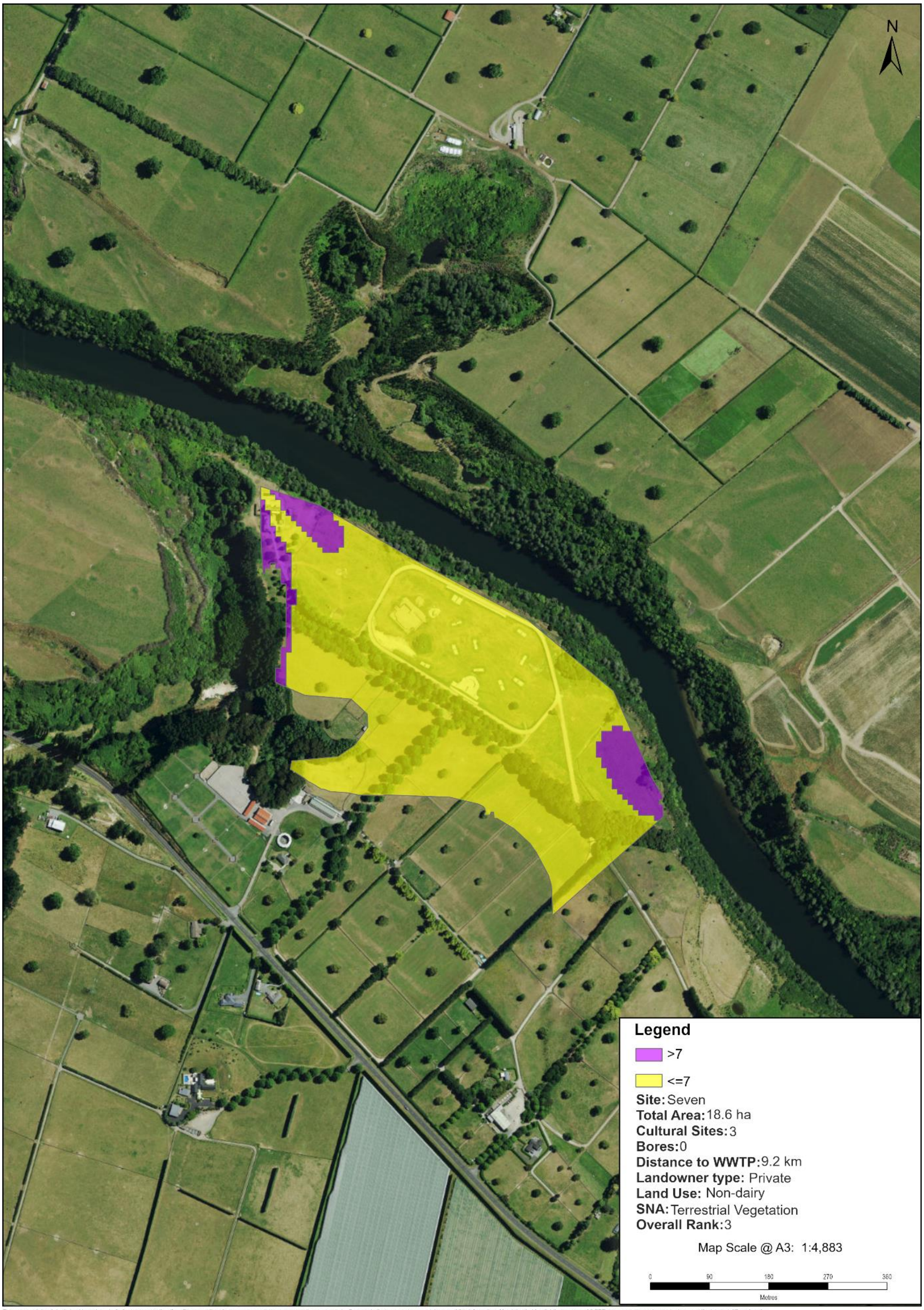

N
Legend
>7
<=7
Site: Two
Total Area: 5.83 Ha
Cultural Sites: 0
Bores: 2
Distance to WWTP: 2.6 km
Landowner type: Private
Land Use: Non-Dairy
SNA: NA
Overall Rank: 1
Map Scale @ A3: 1:1,456
0
25
50
75
100
Metres


N
Legend
>7
<=7
Site: Three
Total Area: 2.39
Cultural Sites: 1
Bores: 0
Distance to WWTP: 2.5 km
Landowner type: Private
Land Use: Non-Dairy
SNA: NA
Overall Rank: 8
Map Scale @ A3: 1:2,000
0 40 80 120 160
Metres


N
Legend
>7
<=7
Site: Four
Total Area: 7 ha
Cultural Sites: 1
Bores: 0
Distance to WWTP: 2.5 km
Landowner type: Private
Land Use: Non-Dairy
SNA: NA
Overall Rank: 1
Map Scale @ A3: 1:2,000
0
40
80
120
160
Metres


N
Legend
>7
<=7
Site: Five
Total Area: 1 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 2.7 km
Landowner type: Private
Land Use: Cropland, Non-Dairy
SNA: NA
Overall Rank: 13
Map Scale @ A3: 1:2,000
0
40
80
120
160
Metres


N
Legend
>7
<=7
Site: Six
Total Area: 42.4 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 2.8 km
Landowner type: Private
Land Use: Settlement or Build up area
SNA: NA
Overall Rank: 3
Map Scale @ A3: 1:4,883
0
90
180
270
360
Metres



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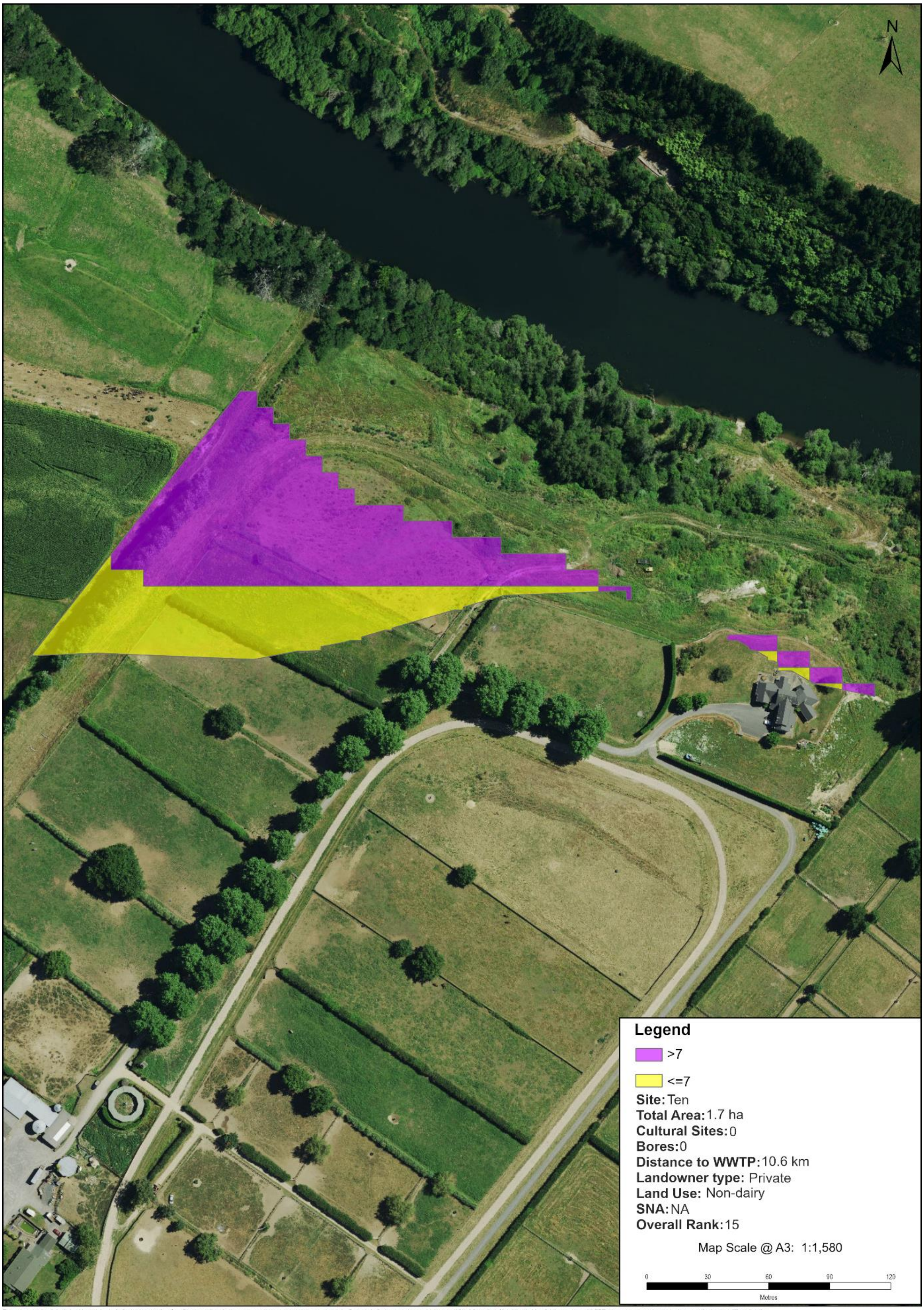
N
Legend
>7
<=7
Site: Nine
Total Area: 13.2 Ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 10.2 km
Landowner type: Private
Land Use: Dairy
SNA: NA
Overall Rank: 9
Map Scale @ A3: 1:3,556
0
70
140
210
280
Metres


N
Legend
>7
<=7
Site: Ten
Total Area: 1.7 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 10.6 km
Landowner type: Private
Land Use: Non-dairy
SNA: NA
Overall Rank: 15
Map Scale @ A3: 1:1,580
0
30
60
90
120
Metres


N
Legend
>7
<=7
Site: Eleven
Total Area: 1.3 ha
Cultural Sites: 1
Bores: 0
Distance to WWTP: 11.4 km
Landowner type: Private
Land Use: Non-dairy
SNA's: NA
Overall Rank: 16
Map Scale @ A3: 1:1,300
0
25
50
75
100
Metres

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N
Legend
>7
<=7
Site: Thirteen
Total Area: 2.8 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 11.6 km
Landowner type: Private
Land Use: Natural Forest & Non-dairy
SNA: NA
Overall Rank: 11
Map Scale @ A3: 1:2,000
0
40
80
120
160
Metres


N
Legend
>7
<=7
Site: Fourteen
Total Area: 1.4 Ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 11.5 km
Landowner type: Private
Land Use: Non-Dairy
SNA: NA
Overall Rank: 7
Map Scale @ A3: 1:2,000
0
40
80
120
160
Metres


N
Legend
>7
<=7
Site: Fifteen
Total Area: 4.5 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 11.8 km
Landowner type: Private
Land Use: Non-dairy, Settlement, & Unknown
SNA: NA
Overall Rank: 14
Map Scale @ A3: 1:1,378
0
25
50
75
100
Metres

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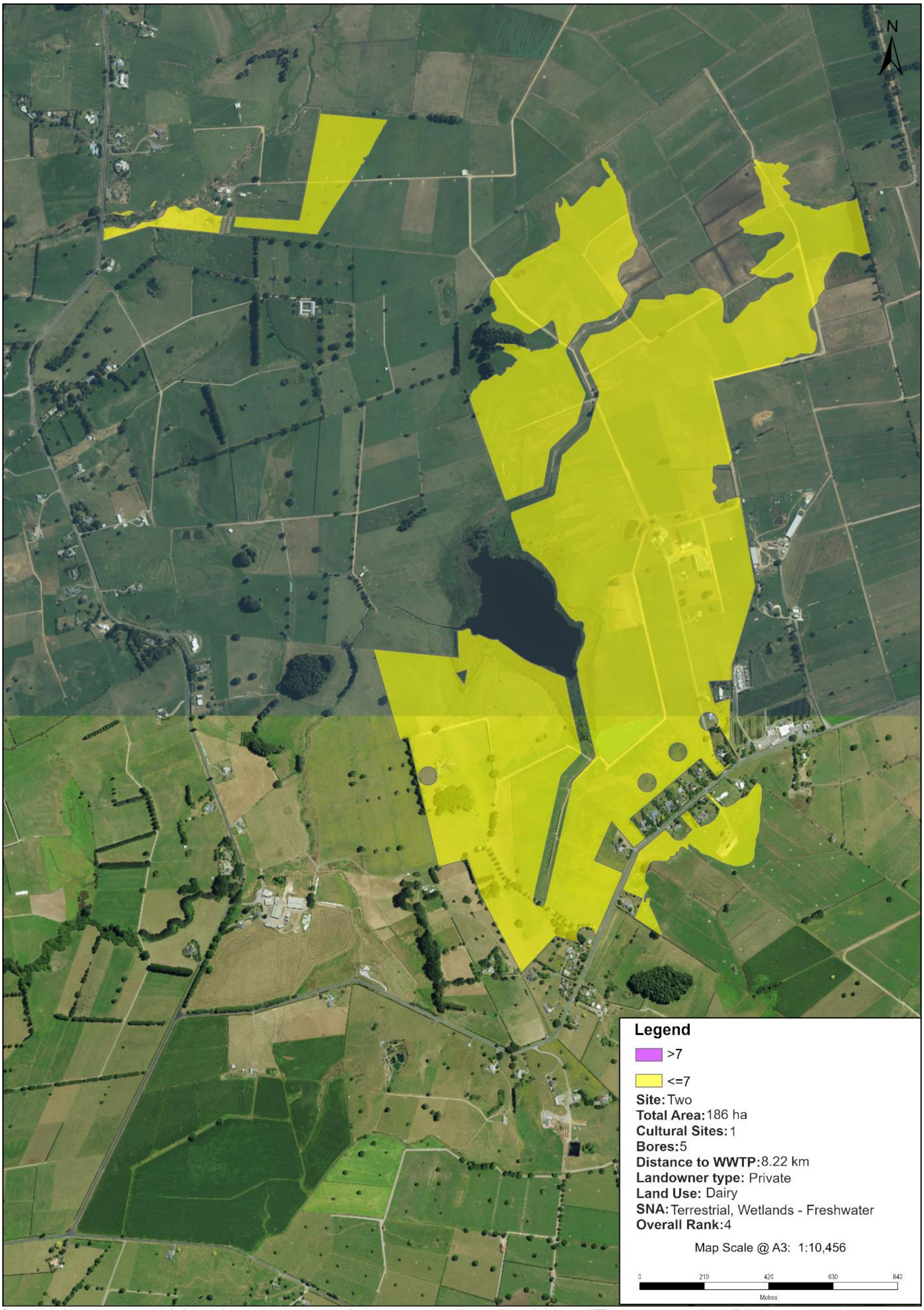
N
Legend
>7
<=7
Site: Seventeen
Total Area: 1.8 Ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 12.8 km
Landowner type: Private
Land Use: Other
SNA: NA
Overall Rank: 10
Map Scale @ A3: 1:2,000
0
40
80
120
160
Metres

Stage 2 Low Hydraulic Loading Candidate Sites (Site 1 – 11)


N
Legend
>7
<=7
Site: One
Total Area: 180 ha
Cultural Sites: 2
Bores: 3
Distance to WWTP: 8.82 km
Landowner type: Private
Land Use: Dairy and Non-dairy
SNA: Terrestrial, Wetlands - Freshwater
Overall Rank: 2
Map Scale @ A3: 1:10,947
0
220
440
660
880
Metres



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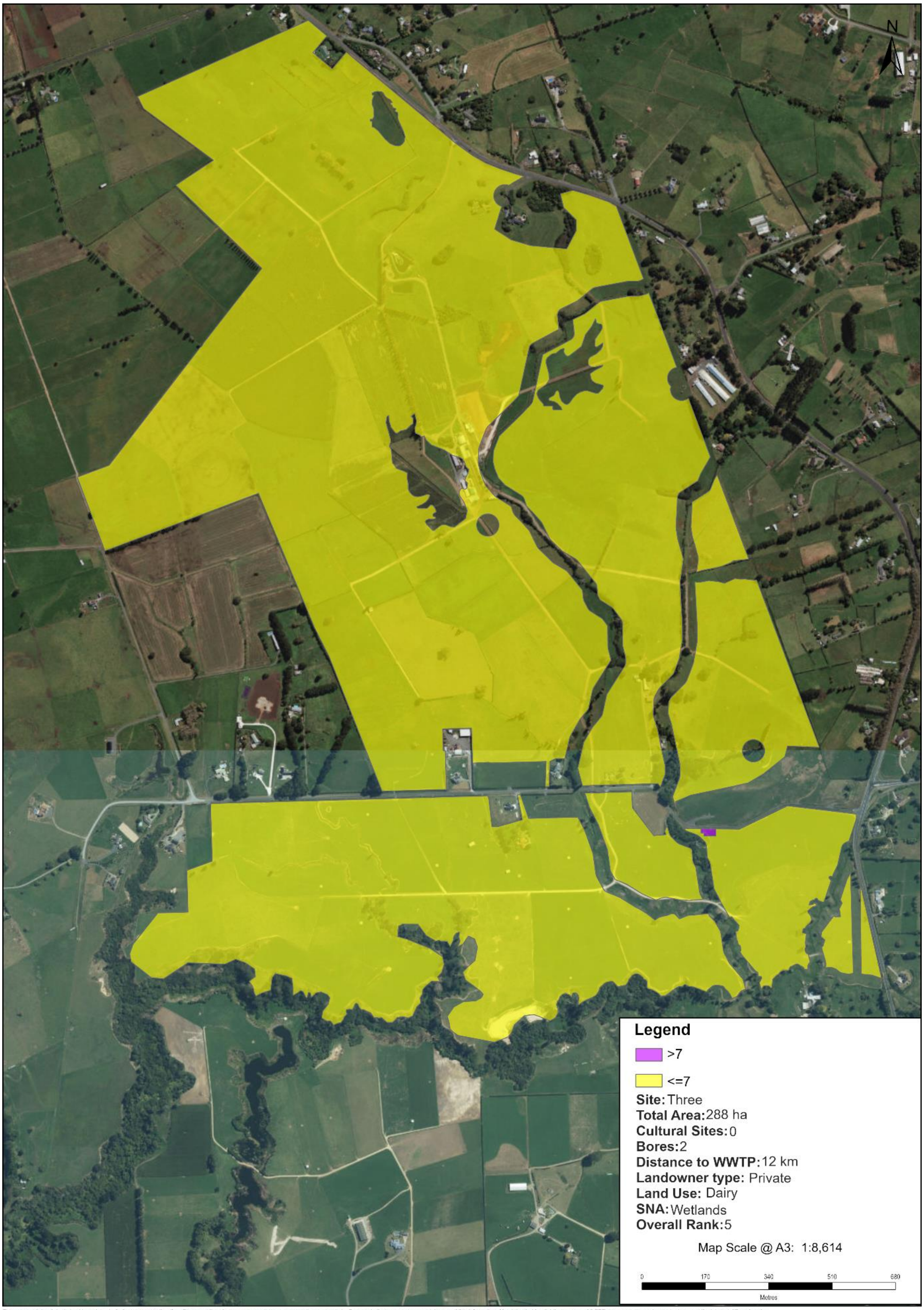

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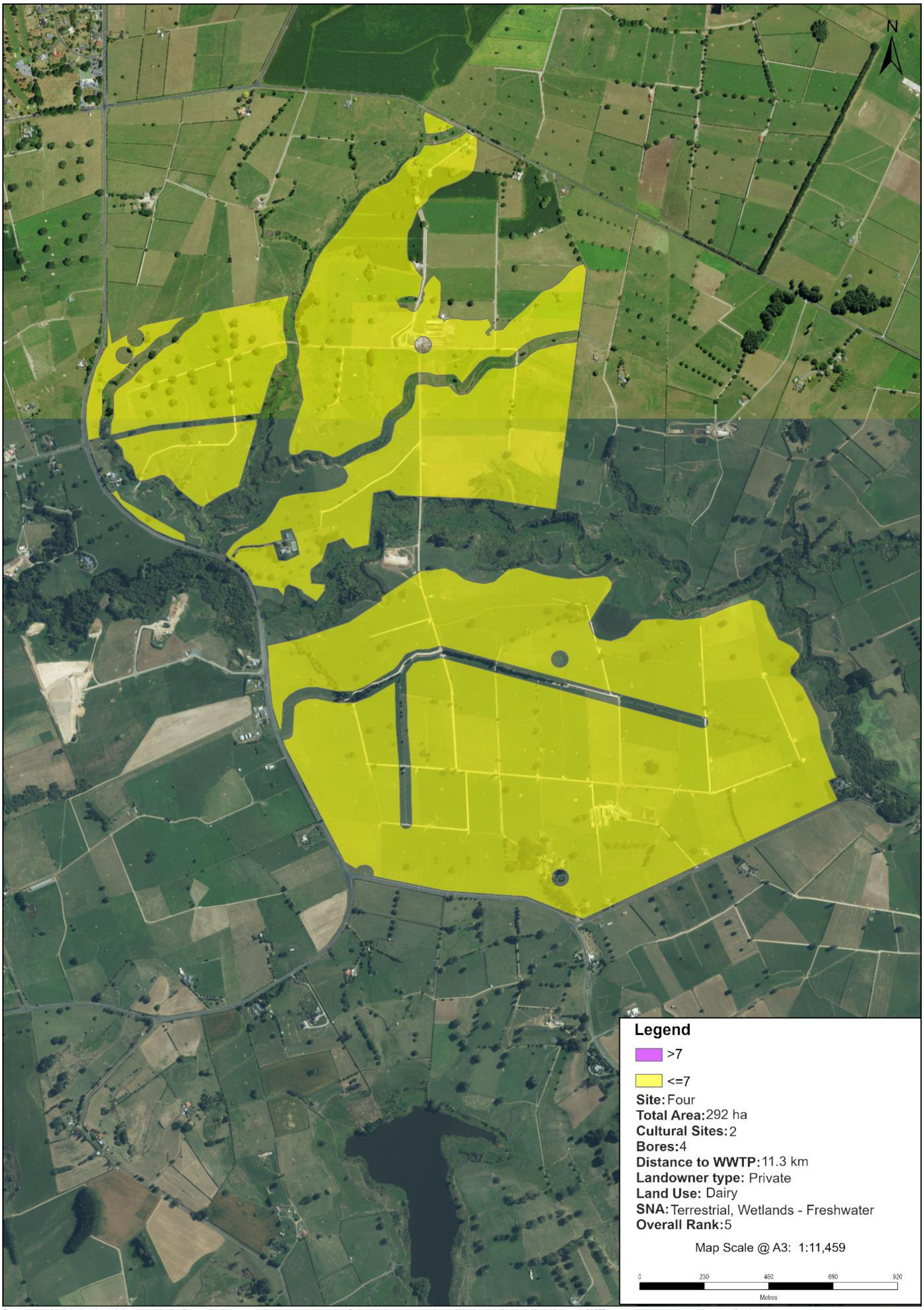
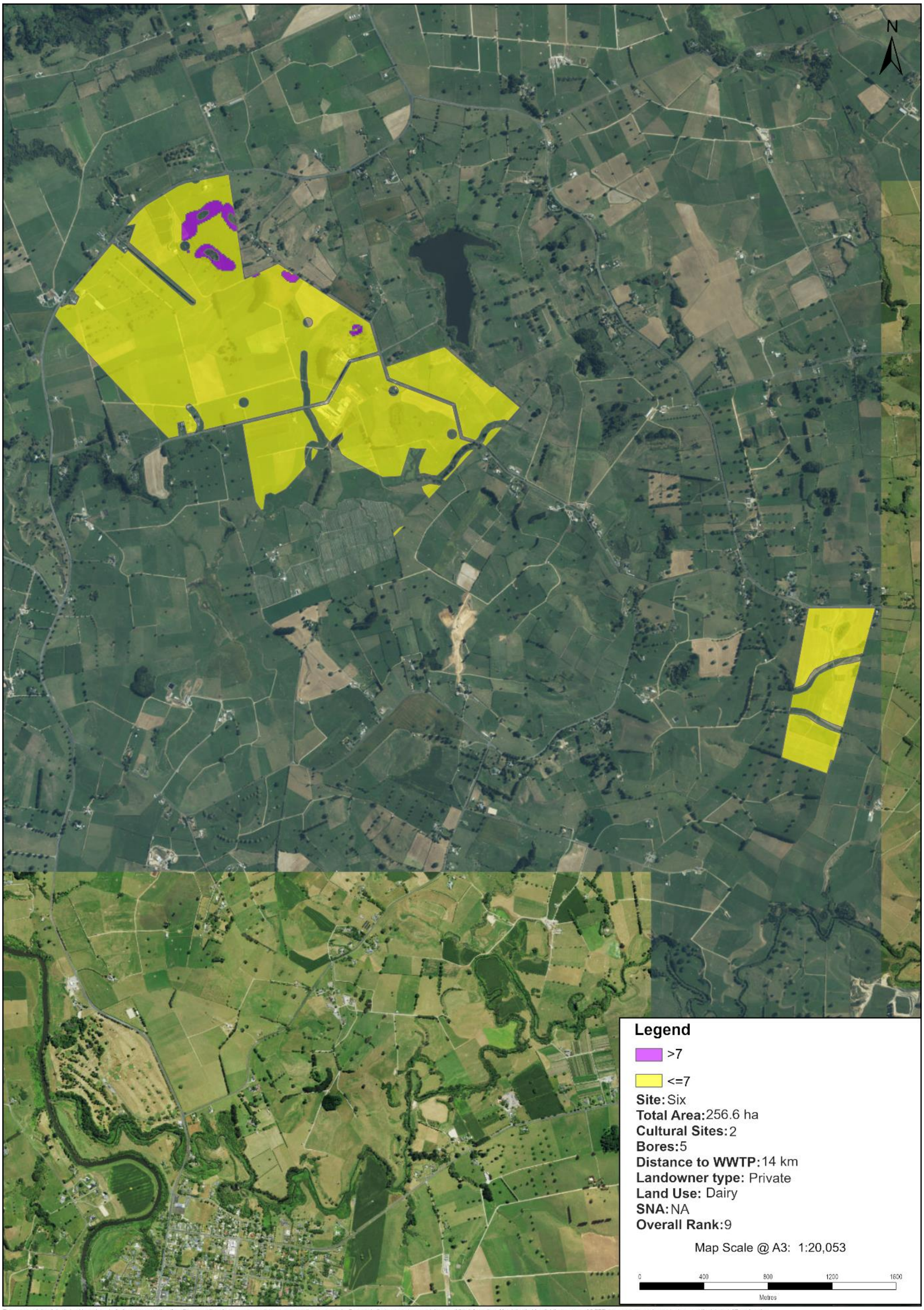
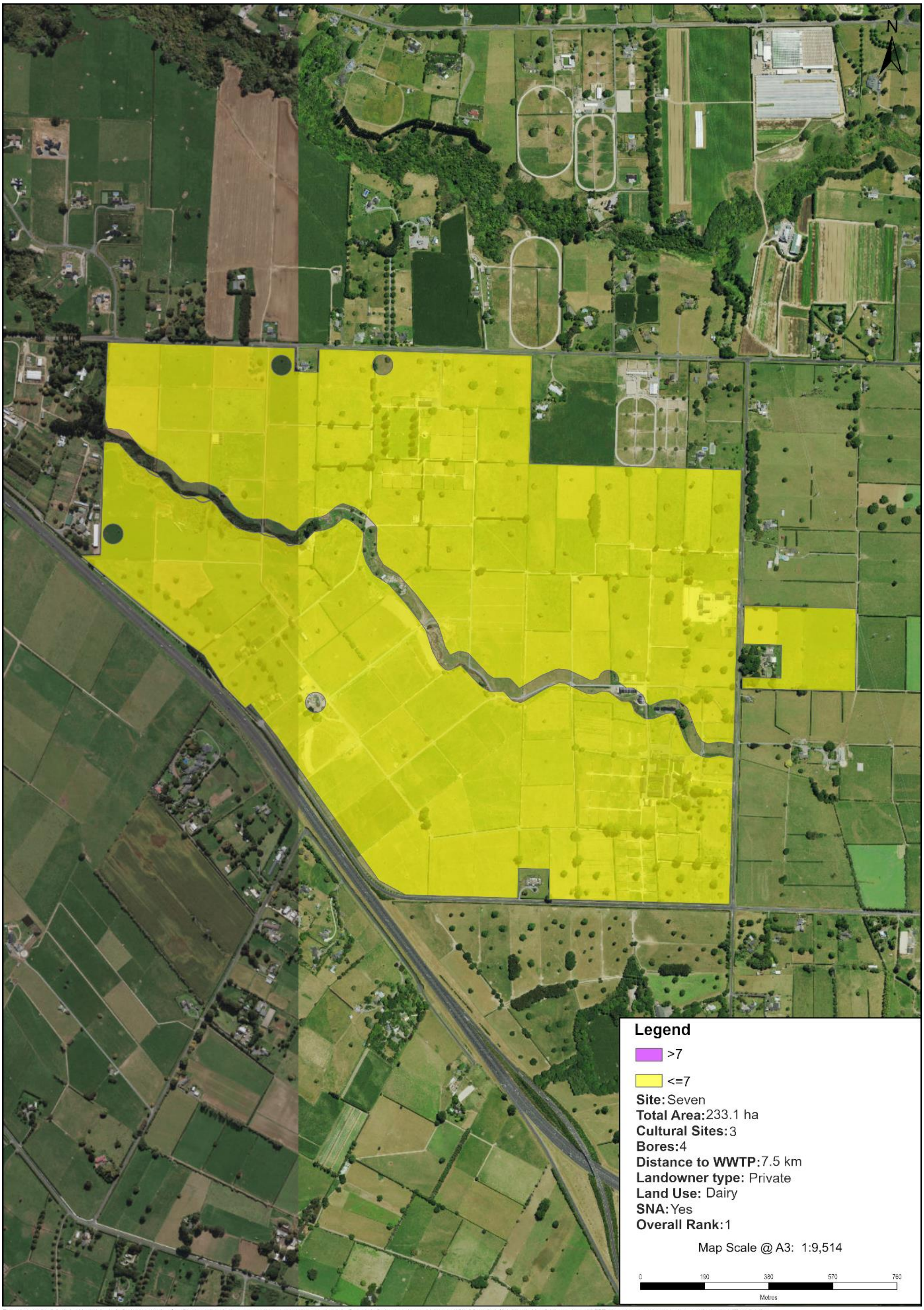
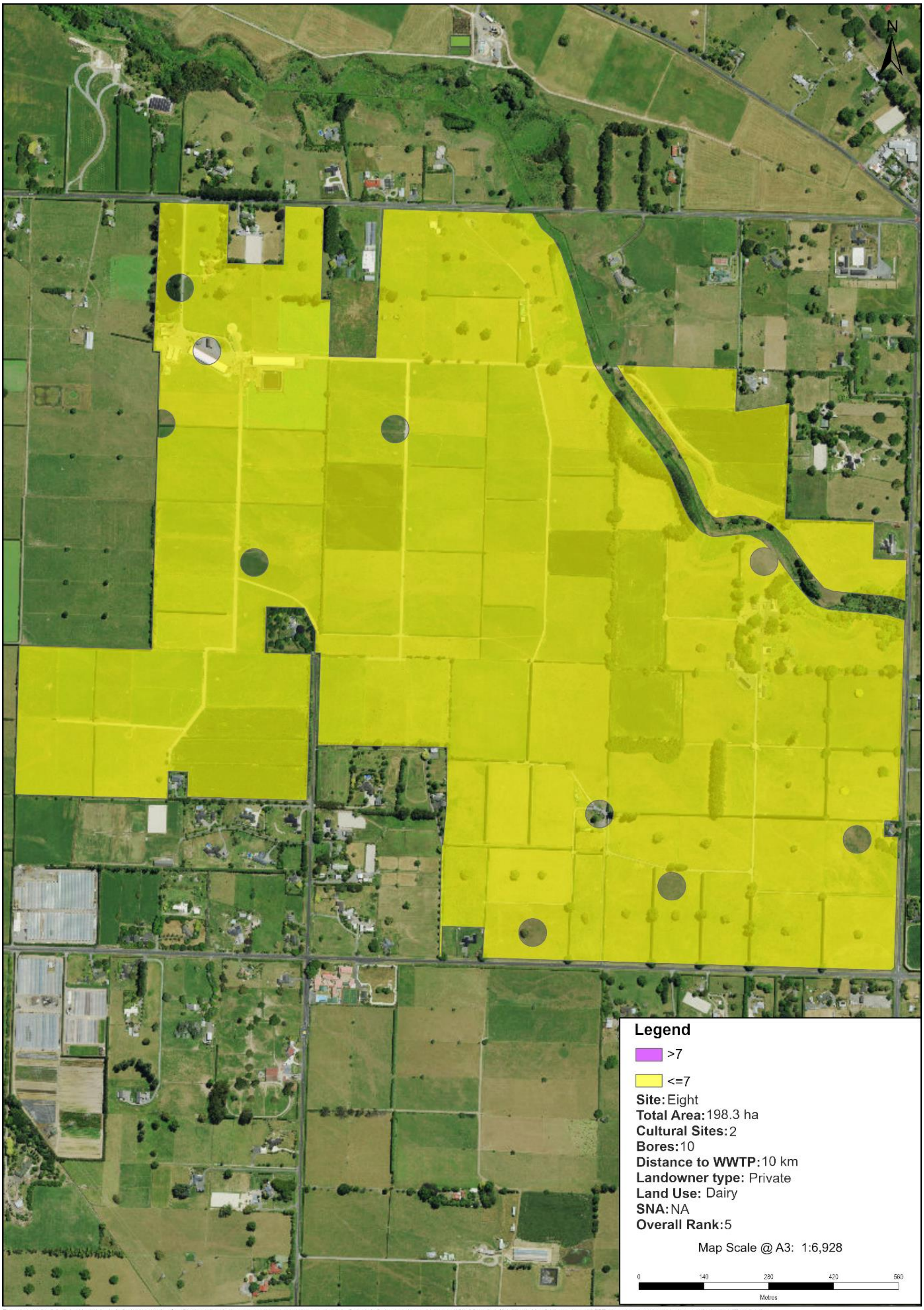

N
Legend
>7
<=7
Site: Four
Total Area: 292 ha
Cultural Sites: 2
Bores: 4
Distance to WWTP: 11.3 km
Landowner type: Private
Land Use: Dairy
SNA: Terrestrial, Wetlands - Freshwater
Overall Rank: 5
Map Scale @ A3: 1:11,459
0
230
460
690
920
Metres

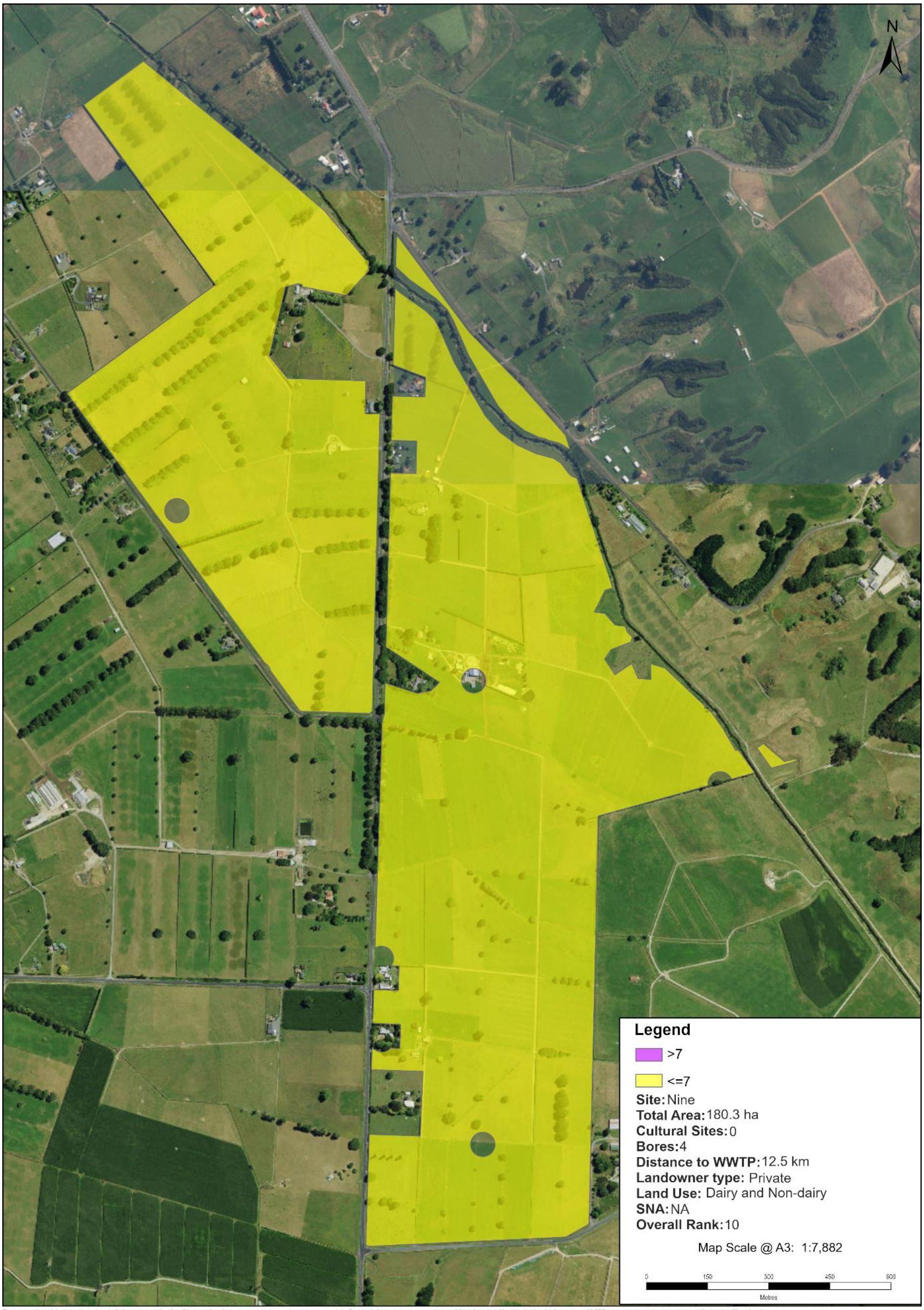

N
Legend
>7
<=7
Site: Five
Total Area: 201.3 ha
Cultural Sites: 2
Bores: 4
Distance to WWTP: 13.9 km
Landowner type: Private
Land Use: Non-dairy & Cropland
SNA: NA
Overall Rank: 3
Map Scale @ A3: 1:9,852
0
200
400
600
800
Metres

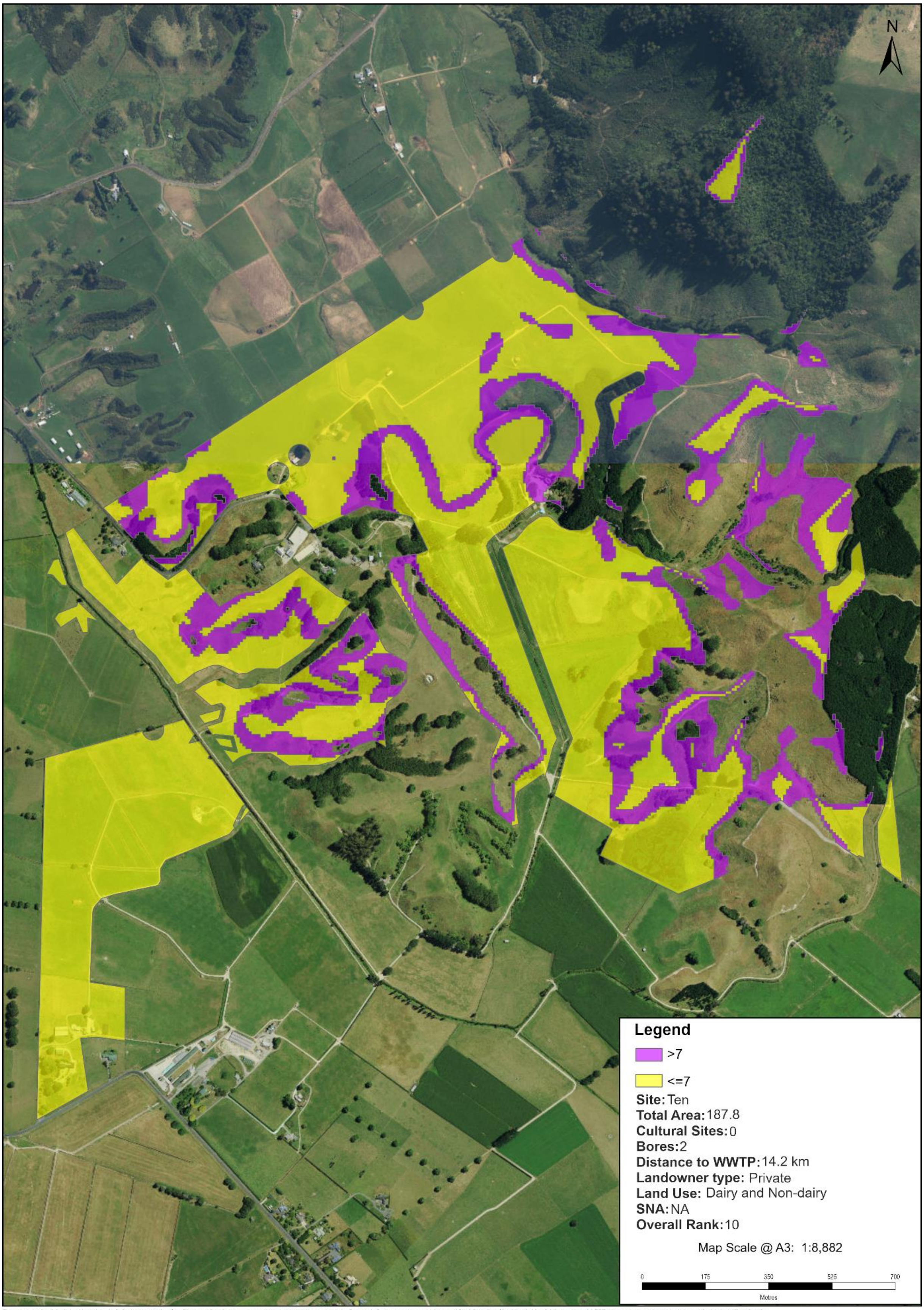

N
Legend
>7
<=7
Site: Six
Total Area: 256.6 ha
Cultural Sites: 2
Bores: 5
Distance to WWTP: 14 km
Landowner type: Private
Land Use: Dairy
SNA: NA
Overall Rank: 9
Map Scale @ A3: 1:20,053
0
400
800
1200
1600
Metres

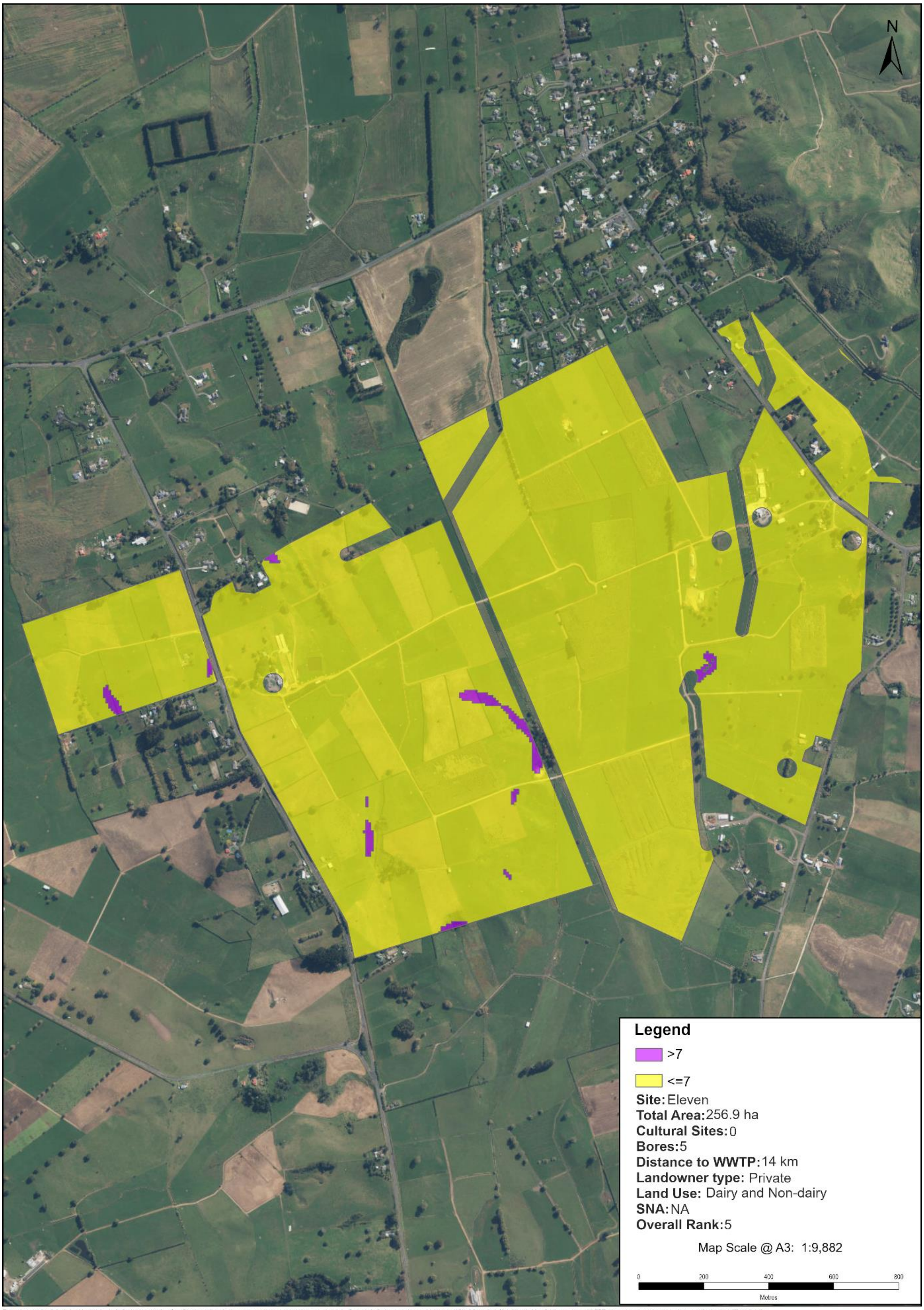


N
Legend
>7
<=7
Site: Seven
Total Area: 233.1 ha
Cultural Sites: 3
Bores: 4
Distance to WWTP: 7.5 km
Landowner type: Private
Land Use: Dairy
SNA: Yes
Overall Rank: 1
Map Scale @ A3: 1:9,514
0
190
380
570
760
Metres


N
Legend
>7
<=7
Site: Eight
Total Area: 198.3 ha
Cultural Sites: 2
Bores: 10
Distance to WWTP: 10 km
Landowner type: Private
Land Use: Dairy
SNA: NA
Overall Rank: 5
Map Scale @ A3: 1:6,928
0
140
280
420
560
Metres


N
Legend
>7
<=7
Site: Nine
Total Area: 180.3 ha
Cultural Sites: 0
Bores: 4
Distance to WWTP: 12.5 km
Landowner type: Private
Land Use: Dairy and Non-dairy
SNA: NA
Overall Rank: 10
Map Scale @ A3: 1:7,882
0
150
300
450
600
Metres


N
Legend
>7
<=7
Site: Ten
Total Area: 187.8
Cultural Sites: 0
Bores: 2
Distance to WWTP: 14.2 km
Landowner type: Private
Land Use: Dairy and Non-dairy
SNA: NA
Overall Rank: 10
Map Scale @ A3: 1:8,882
0
175
350
525
700
Metres



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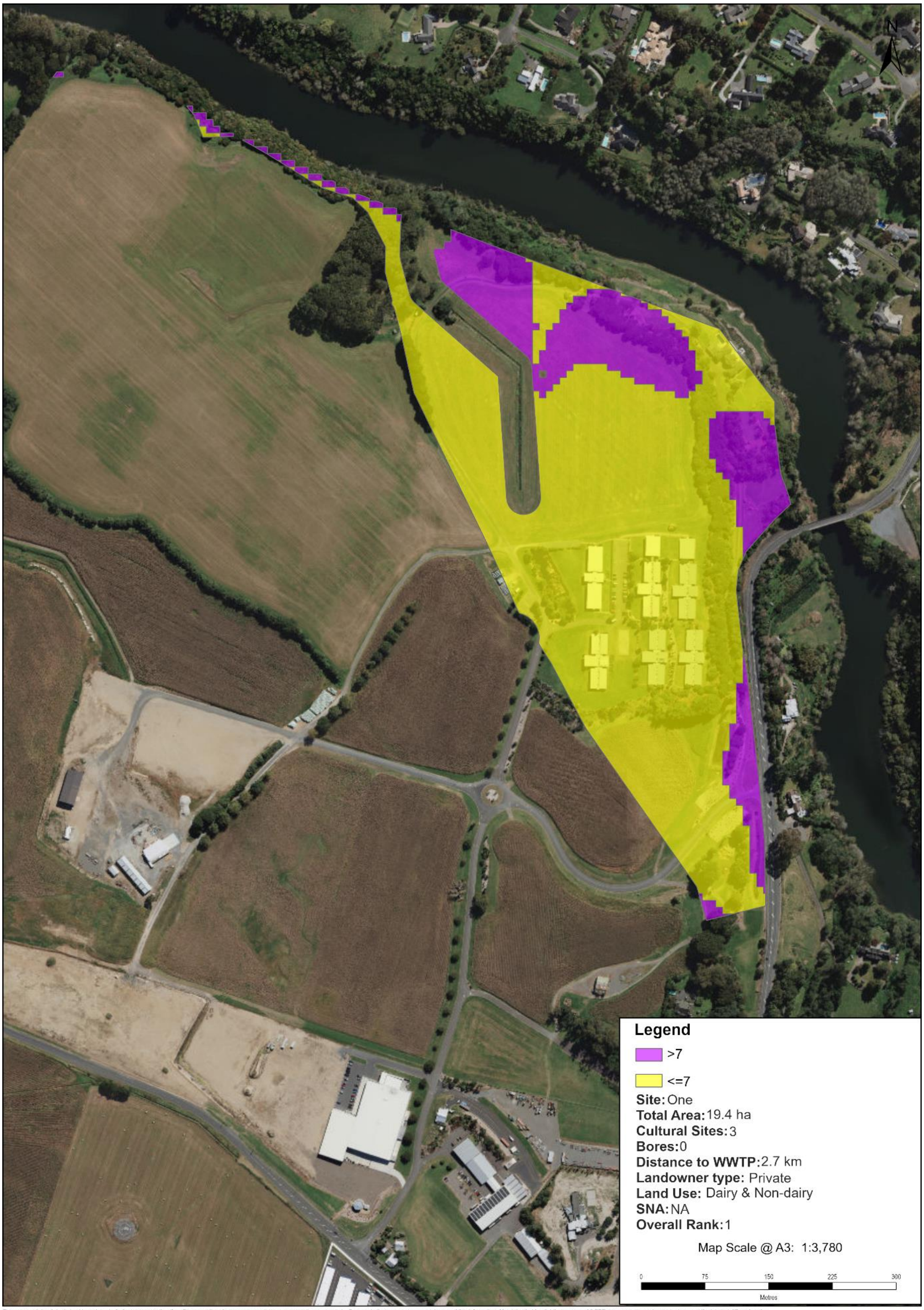
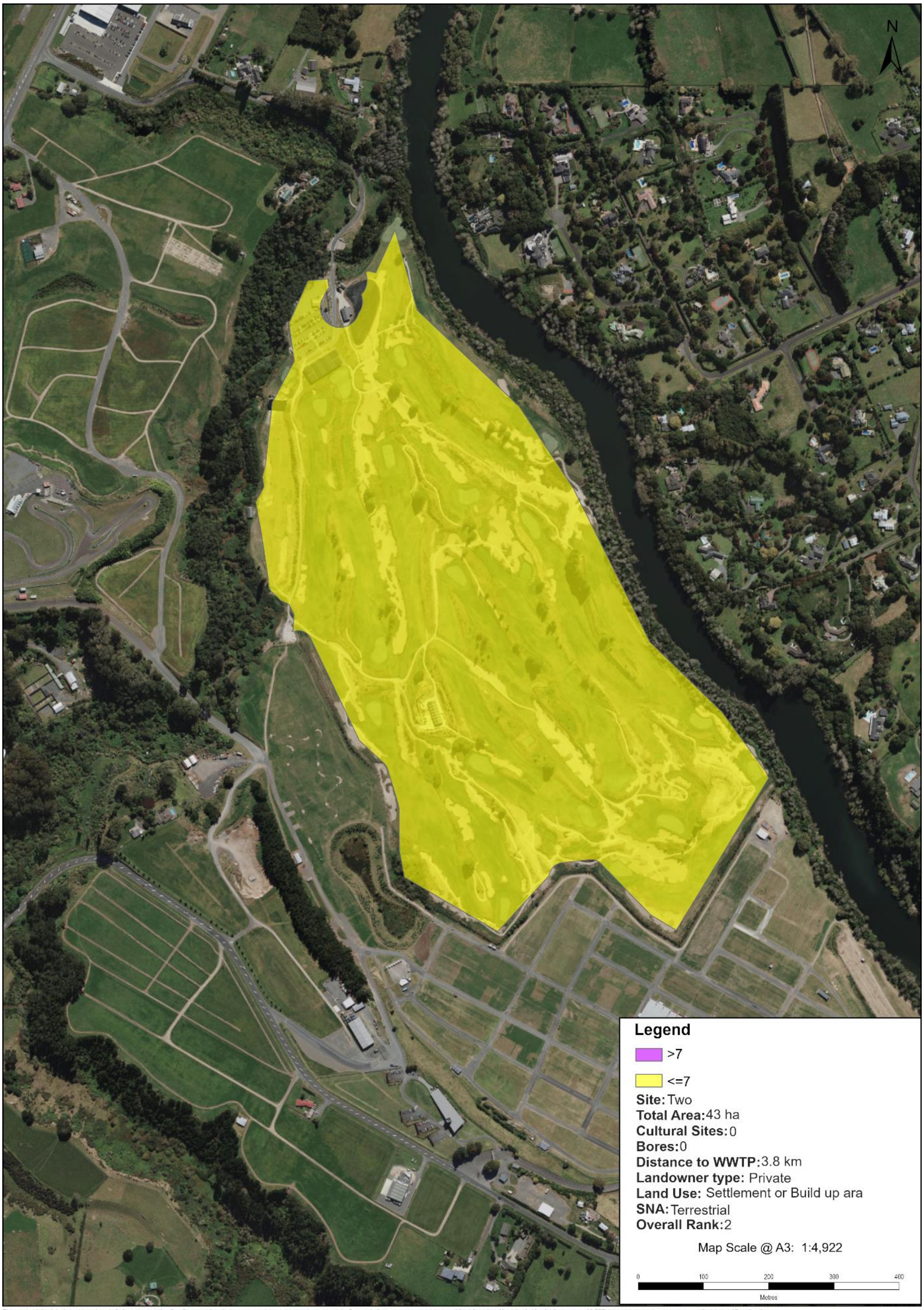
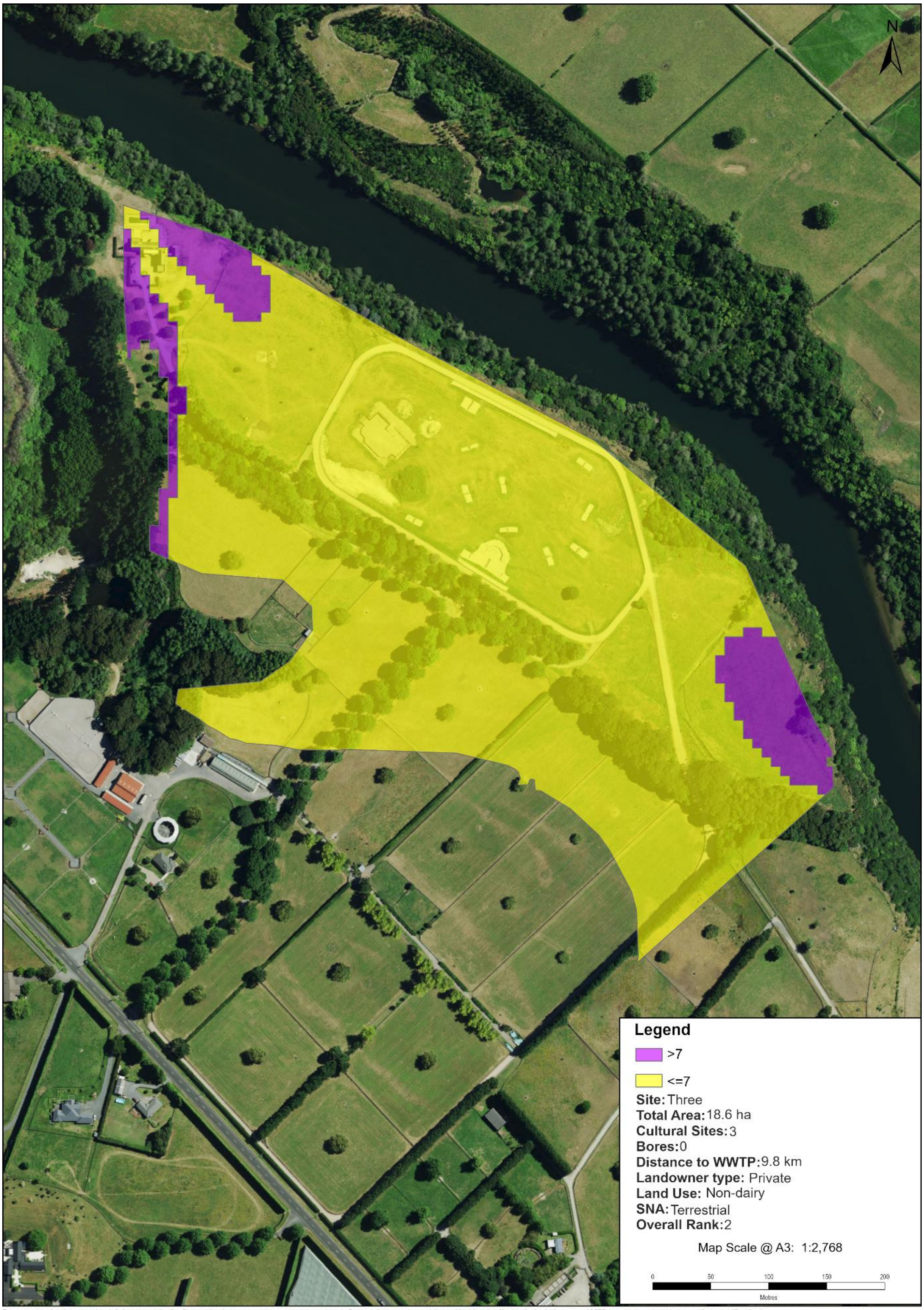
Stage 2 High Hydraulic Loading Candidate Sites (Site 1 -5)


N
Legend
>7
<=7
Site: One
Total Area: 19.4 ha
Cultural Sites: 3
Bores: 0
Distance to WWTP: 2.7 km
Landowner type: Private
Land Use: Dairy & Non-dairy
SNA: NA
Overall Rank: 1
Map Scale @ A3: 1:3,780
0 75 150 225 300
Metres


N
Legend
>7
<=7
Site: Two
Total Area: 43 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 3.8 km
Landowner type: Private
Land Use: Settlement or Build up ara
SNA: Terrestrial
Overall Rank: 2
Map Scale @ A3: 1:4,922
0
100
200
300
400
Metres


N
Legend
>7
<=7
Site: Three
Total Area: 18.6 ha
Cultural Sites: 3
Bores: 0
Distance to WWTP: 9.8 km
Landowner type: Private
Land Use: Non-dairy
SNA: Terrestrial
Overall Rank: 2
Map Scale @ A3: 1:2,768
0
50
100
150
200
Metres


N
Legend
>7
<=7
Site: Four
Total Area: 12.8 ha
Cultural Sites: 4
Bores: 0
Distance to WWTP: 10.2 km
Landowner type: Private
Land Use: Non-dairy
SNA: NA
Overall Rank: 4
Map Scale @ A3: 1:1,762
0 30 60 90 120
Metres


N
Legend
>7
<=7
Site: Five
Total Area: 13.3 ha
Cultural Sites: 0
Bores: 0
Distance to WWTP: 10.5 km
Landowner type: Private
Land Use: Dairy
SNA: NA
Overall Rank: 5
Map Scale @ A3: 1:1,962
0 30 60 90 120
Metres

B

Appendix B – MCA Scoring

Stage 1 - LH

SWWTP	MCA for a feasible land assessment for discharge options from SWWTP										
	Site 1 Stg1-LH		Site 2 Stg1 -LH		Site 3 Stg1 -LH		Site 4 Stg1 -LH		Site 5 Stg1 -LH		
Assessment Criteria	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking
Slope	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	94 % of the land area has a slope of 7 or less	5
Soil Drainage	4	61 % of the site is moderately drained to well drained	1	12 % of the site is moderately drained to well drained	3	53 % of the site is moderately drained to well drained	5	98 % of the site is moderately drained to well drained	4	62 % of the site is moderately drained to well drained	3
Land Use Compatability	2	Privately owned/ grassland with dairy land use	2	Privately owned/ grassland with dairy land use, small area of non-dairy and forest	3	Privately owned/ grassland with both dairy and non-dairy land use	2	Privately owned/ grassland with dairy land use	3	Majority anual cropland, some dairy and non-dairy grazing	3
Distance to WWTP	5	< 1 km from WWTP	5	< 1 km from WWTP	5	< 1 km from WWTP	5	1.5 km from WWTP	5	1.5 km from WWTP	5

Site 6 Stg1 -LH		Site 7 Stg1 -LH		Site 8 Stg1 -LH		Site 9 Stg1 -LH		Site 10 Stg1 -LH		Site 11 Stg1 -LH		Si
Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Ranking
100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	
56 % of the site is moderately drained to well drained	4	72 % of the site is moderately drained to well drained	4	70 % of the site is moderately drained to well drained	5	89 % of the site is moderately drained to well drained	4	70% of the site is moderately drained to well drained	4	76% of the site is moderately drained to well drained	5	
Privately owned/ grassland with dairy land use, some cropland	2	Privately owned/ grassland with dairy land use	2	Privately owned/ grassland with dairy land use	3	Privately owned/ grassland with non-dairy land use	2	Privately owned/ grassland with dairy land use	2	Privately owned/ grassland with dairy land use	2	
1.2 km from WWTP	5	3.7 km from WWTP	5	1.2 km from WWTP	5	3.5 km from WWTP	5	4.2 km from WWTP	5	4 km from WWTP	5	

te 12 Stg1 -LH	Site 13 Stg1 -LH		Site 14 Stg1 -LH		Site 15 Stg1 -LH		Site 16 Stg1 -LH		Site 17 Stg1 -LH		Site 18 S
Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking
100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5
92% of the site is moderately drained to well drained	4	79% of the site is moderately drained to well drained	5	99% of the site is moderately drained to well drained	5	96% of the site is moderately drained to well drained	4	75% of the site is moderately drained to well drained	3	56% of the site is moderately drained to well drained	5
Privately owned/ grassland with dairy land use, some forested area	2	Privately owned/ grassland with dairy land use	2	Privately owned/ grassland with dairy land use, some forested area	2	Privately owned/ grassland with dairy land use	2	Privately owned/ grassland with dairy land use	3	Privately owned/ grassland with non-dairy land use	2
3.6 km from WWTP	4	5.3 km from WWTP	5	4.2km from WWTP	5	4.8km from WWTP	5	4km from WWTP	4	5.2km from WWTP	5

Stg1 -LH
Rationale
100 % of the land area has a slope of 7 or less
99% of the site is moderately drained to well drained
privately owned golf course
2.9km from WWTP

Stage 1 - HH

SWWTP	MCA for a feasible land assessment for discharge options from SWWTP										
	Site 1 Stg1-HH		Site 2 Stg1-HH		Site 3 Stg1-HH		Site 4 Stg1-HH		Site 5 Stg1-HH		
Assessment Criteria	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking
Slope	4	78 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	3	55 % of the land area has a slope of 7 or less	5	83% of the land area has a slope of 7 or less	1	97% of the land area has a slope of 7 or less	5
Soil Drainage	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5
Land Use Compatability	2	largely privately owned dairy land and build up area	3	largely grassland with woody biomass; some area of dairy	3	non-dairy grassland	3	non-dairy grassland	3	A mixture of privately owned cropland and non-dairy grasslands	1
Distance to WWTP	5	2.3 km from WWTP	5	2.6 km from WWTP	5	2.5 km from WWTP	5	2.5 km from WWTP	5	2.7 km from WWTP	5

Site 6 Stg1-HH	Site 7 Stg1-HH		Site 8 Stg1-HH		Site 9 Stg1-HH		Site 10 Stg1-HH		Site 11 Stg1-HH		Si
Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking
100% of the land area has a slope of 7 or less	5	91% of the land area has a slope of 7 or less	5	94% of the land area has a slope of 7 or less	4	75% of the land area has a slope of 7 or less	2	37% of the land area has a slope of 7 or less	1	<1% of the site has a slope less than 7 or less.	1
100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5
Privately ownded golf course	3	privately owned non-dairy grassland	3	privately owned non-dairy grassland	1	Largely privately owned dairy land	3	privately owned non-dairy grassland	3	privately owned non-dairy grassland	3
2.8 km from WWTP	3	9.2 km from WWTP	3	9.9 km from WWTP	2	10.2 km from WWTP	2	10.6 km from WWTP	2	11.4 km from WWTP	2

te 12 Stg1-HH	Site 13 Stg1-HH		Site 14 Stg1-HH		Site 15 Stg1-HH		Site 16 Stg1-HH		Site 17 Stg1-HH	
Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale
19% of the site has a slope less than 7 or less.	3	53 % of the land area has a slope of 7 or less	5	100% of the land area has a slope of 7 or less	3	57 % of the land area has a slope of 7 or less	3	50% of the land area has a slope of 7 or less	5	82% of the land area has a slope of 7 or less
100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained	5	100 % of the site is moderately drained to well drained
privately owned non-dairy grassland	3	mixture of private forested land and non-dairy grassland	3	privately owned non-dairy grassland	2	Large build up area, and non-dairy grassland	3	privately owned non-dairy grassland	1	Quarry?
11.5 km from WWTP	2	11.6 km from WWTP	2	11.5 km from WWTP	2	11.8 km from WWTP	2	11.8 km from WWTP	1	12.8 km from WWTP

Stage 2 - LH

SWWTP	MCA for a feasible land assessment for discharge options from SWWTP										
	Site 1 Stg2-LH		Site 2 Stg2-LH		Site 3 Stg2-LH		Site 4 Stg2-LH		Site 5 Stg2-LH		
Assessment Criteria	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking
Slope	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	99 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5
Soil Drainage	4	Approx. 72% of the site has moderately well drained to well drained soils.	3	Approx. 48% of the site has moderately well drained to well drained soils.	3	Approx. 52% of the site has moderately well drained to well drained soils.	3	Approx. 42% of the site has moderately well drained to well drained soils.	4	Approx. 71% of the site has moderately well drained to well drained soils.	3
Land Use Compatability	2	Mostly dairy, some build up area and woody biomass grassland	2	Privately owned/ grassland land with dairy land use	2	Privately owned/ grassland land with dairy land use	2	Privately owned/ grassland land with dairy land use	3	Privately owned/ grassland land with both dairy and non-dairy land use	2
Distance to WWTP	3	~8.8 km	3	~8.2 km	2	~12 km	2	~11.3 km	1	~13.9 km	1

Site 6 Stg2-LH		Site 7 Stg2-LH		Site 8 Stg2-LH		Site 9 Stg2-LH		Site 10 Stg2-LH		Site 11 Stg2-LH	
Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking
98 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	4	74 % of the land area has a slope of 7 or less	5	99 % of the land area has a slope of 7 or less	
Approx. 43% of the site has moderately well drained to well drained soils.	5	Approx. 84% of the site has moderately well drained to well drained soils.	3	Approx. 56% of the site has moderately well drained to well drained soils.	2	Approx. 31% of the site has moderately well drained to well drained soils.	3	Approx. 50% of the site has moderately well drained to well drained soils.	3	Approx. 50% of the site has moderately well drained to well drained soils.	
Privately owned/ grassland land with dairy land use, small areas of cropland.	3	Privately owned/ grassland land with both dairy and non-dairy land use	3	Privately owned/ grassland land with both dairy and non-dairy land use	3	Privately owned/ grassland land with both dairy and non-dairy land use	3	Privately owned/ grassland land with both dairy and non-dairy land use	3	Privately owned/ grassland land with both dairy and non-dairy land use	
~14 km	1	~7.5 km (other side of Waikato River)	1	~10 km (other side of Waikato River)	1	~12.5 km (other side of Waikato River)	1	~14.2 km (other side of Waikato River)	1	~14 km (other side of Waikato River)	

Stage 2 - LH

SWWTP	MCA for a feasible land assessment for discharge options from SWWTP										
	Site 1 Stg2-LH		Site 2 Stg2-LH		Site 3 Stg2-LH		Site 4 Stg2-LH		Site 5 Stg2-LH		
Assessment Criteria	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking
Slope	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	99 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5
Soil Drainage	4	Approx. 72% of the site has moderately well drained to well drained soils.	3	Approx. 48% of the site has moderately well drained to well drained soils.	3	Approx. 52% of the site has moderately well drained to well drained soils.	3	Approx. 42% of the site has moderately well drained to well drained soils.	4	Approx. 71% of the site has moderately well drained to well drained soils.	3
Land Use Compatability	2	Mostly dairy, some build up area and woody biomass grassland	2	Privately owned/ grassland land with dairy land use	2	Privately owned/ grassland land with dairy land use	2	Privately owned/ grassland land with dairy land use	3	Privately owned/ grassland land with both dairy and non-dairy land use	2
Distance to WWTP	3	~8.8 km	3	~8.2 km	2	~12 km	2	~11.3 km	1	~13.9 km	1

Site 6 Stg2-LH	Site 7 Stg2-LH		Site 8 Stg2-LH		Site 9 Stg2-LH		Site 10 Stg2-LH		Site 11 Stg2-LH		
Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking
98 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	4	74 % of the land area has a slope of 7 or less	5	99 % of the land area has a slope of 7 or less	
Approx. 43% of the site has moderately well drained to well drained soils.	5	Approx. 84% of the site has moderately well drained to well drained soils.	3	Approx. 56% of the site has moderately well drained to well drained soils.	2	Approx. 31% of the site has moderately well drained to well drained soils.	3	Approx. 50% of the site has moderately well drained to well drained soils.	3	Approx. 50% of the site has moderately well drained to well drained soils.	
Privately owned/ grassland land with dairy land use, small areas of cropland.	3	Privately owned/ grassland land with both dairy and non-dairy land use	3	Privately owned/ grassland land with both dairy and non-dairy land use	3	Privately owned/ grassland land with both dairy and non-dairy land use	3	Privately owned/ grassland land with both dairy and non-dairy land use	3	Privately owned/ grassland land with both dairy and non-dairy land use	
~14 km	1	~7.5 km (other side of Waikato River)	1	~10 km (other side of Waikato River)	1	~12.5 km (other side of Waikato River)	1	~14.2 km (other side of Waikato River)	1	~14 km (other side of Waikato River)	

Stage 2 - HH

SWWTP	MCA for a feasible land assessment for discharge options from SWWTP										
	Site 1 Stg2-HH		Site 2 Stg2-HH		Site 3 Stg2-HH		Site 4 Stg2-HH		Site 5 Stg2-HH		
Assessment Criteria	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking	Rationale	Ranking
Slope	4	78 % of the land area has a slope of 7 or less	5	100 % of the land area has a slope of 7 or less	5	91 % of the land area has a slope of 7 or less	5	94 % of the land area has a slope of 7 or less	4	75 % of the land area has a slope of 7 or less	
Soil Drainage	5	100% of the site has well drained soils.	5	100% of the site has well drained soils.	5	100% of the site has well drained soils.	5	100% of the site has well drained soils.	5	100% of the site has well drained soils.	
Land Use Compatability	3	Privately owned/ grassland land with both dairy and non-dairy land use	1	Privately owned/ Settlements or built-up area	3	Privately owned/ grassland land with non-dairy land use	3	Privately owned/ grassland land with non-dairy land use	2	Privately owned/ grassland land with dairy land use	
Distance to WWTP	5	~2.7 km	5	~3.8 km	3	~9.8 km	2	~10.2 km	2	~10.51 km	

E

Appendix E – Deep Bore Injection High Level Investigation

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9 August 2024

Hamilton City Council
Private Bag 3038
Waikato Mail Centre
Hamilton 3240
New Zealand

Attention: Jackie Colliar

Dear Jackie

Southern Wastewater Treatment Plant - Deep Bore Injection High Level Investigation

1 Introduction

A new wastewater treatment plant (WWTP) is proposed in the area immediately south of Hamilton City to service future growth in the area of Waikato Regional Airport (Airport), and northern Waipā District. As part of optioneering of various disposal methods, deep bore injection (DBI) is being considered. The sections below provide a high-level feasibility review of this disposal method for the two short-listed sites identified for the WWTP (Figure 1).

make everyday better.

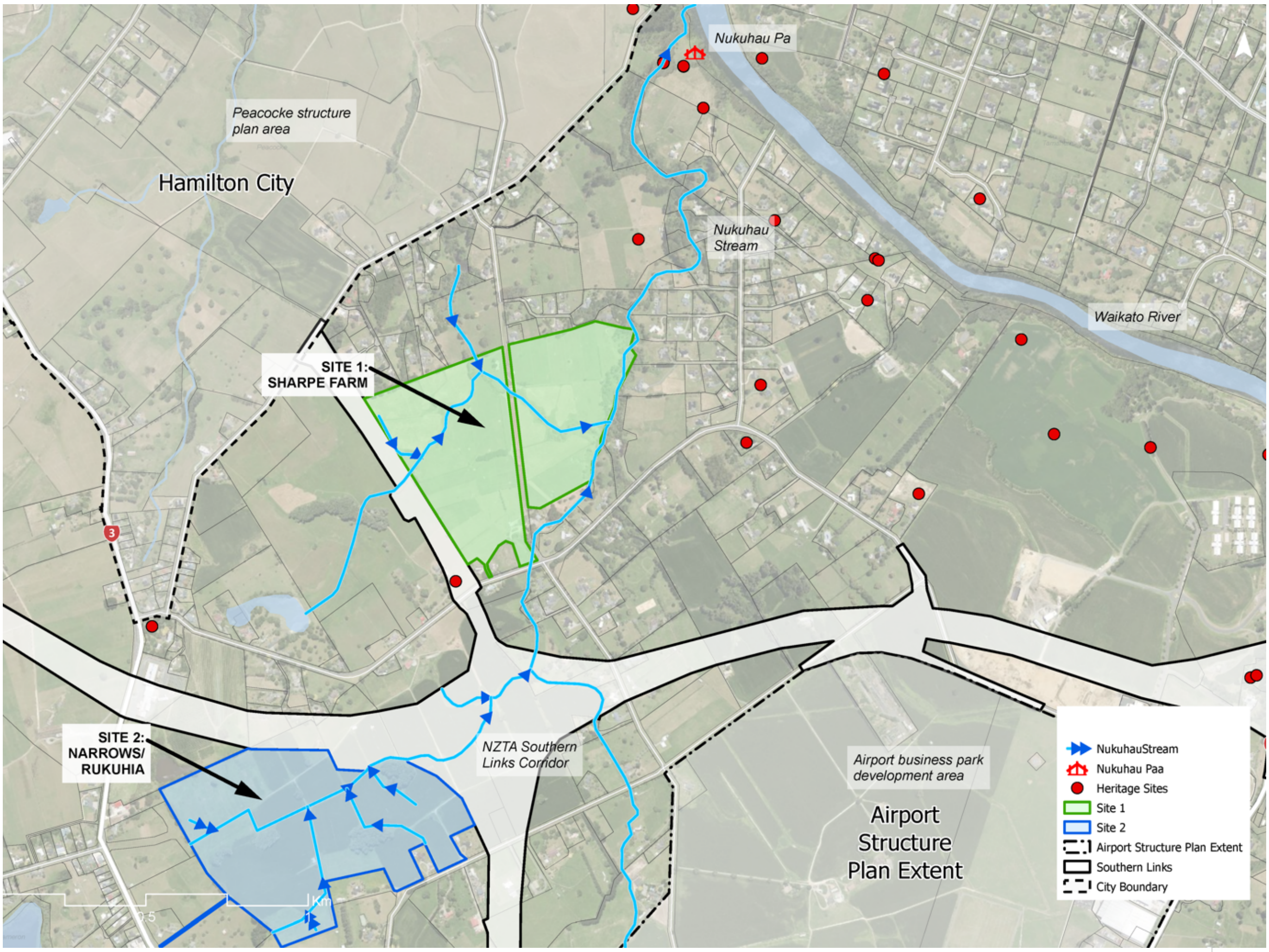

Figure 1: Shortlisted Site 1 and Site 2. Excerpt and annotated after Hamilton City Council drawing 'Southern Wastewater Shortlisted Sites', Version 1, drawn 17/11/2022

2 Deep Bore Injection

2.1 Feasibility of deep bore injection

Deep Bore Injection consists of pumping water, in this case, treated wastewater into the subsurface using bores. The feasibility of deep bore injection primarily depends on the geological environment of the sites. The term "deep" generally implies that the units that receive the discharge should be well isolated from the aquifers which are normally used for water supply. The disposal should be confined to a unit where there are aquitards underlying and overlying the unit, therefore having limited or no direct hydraulic connection between overlying and underlying units and surface water systems. As the injection normally occurs in the saturated zone, the injected treated wastewater mainly compresses or displaces the existing fluid in the units. Given the low compressibility of water, a large volume of storage space is required to accommodate the discharge, which requires the unit used for disposal to underlie a large geographic area (Shammas et al., 2016).

A larger aquifer storage can allow for a greater degree of storing and mixing of the treated wastewater with the groundwater. For a rock formation, whilst the primary porosity is generally low, the secondary porosity e.g., pore space created by fracturing, joints, solution channels, etc. can provide a greater potential for buffering the wastewater inflow, however, these features can be discrete.

In addition to the aquifer storage, the degree of mixing between the treated wastewater and ambient groundwater will also depend on aquifer hydraulic conditions and discharge operations, e.g., groundwater flow rate, discharging volume and rate, etc. The underground environment may also provide an opportunity for solutes in the treated wastewater to undergo chemical and biological reactions that can further attenuate their concentrations.

2.2 DBI Construction and operation

DBI of treated wastewater requires the construction of a Class 1 Injection Well as defined by the USEPA (2024a) for the injection of hazardous, non-hazardous and municipal wastes. The construction comprises the following stages as outlined by the Groundwater Protection Council (2021) and illustrated in Figure 2:

- **Stage 1 Drilling**: Borehole drilling to a depth below the lowermost Underground Source of Drinking Water (USDW). Steel 'surface casing' is installed to cover the full length of the borehole and cemented from the bottom to the ground surface to protect the groundwater.
- **Stage 2 Drilling & Production Casing**: A smaller diameter borehole is drilled through the surface casing down into the injection zone. The production casing is then installed from the surface to the top of or into the injection zone and cemented in place from bottom to top. The casing within the injection zone is either perforated or screened to allow injection fluids to enter the unit.
- **Injection System Setup**: A circular injection packer and injection tubing (pipe) are installed inside the production casing above the injection zone. The tubing is placed into the packer, forming a seal following its expansion. The annular space between the production casing and the injection tubing can be filled with a corrosion-inhibiting fluid (recommended but not necessary for municipal wastes).

During operation, treated wastewater is piped from storage tanks to the injection well either by pumps or through gravity, depending on the pressure required for effective injection. This pressure is governed by factors such as the depth and permeability of the geological unit, as well as the diameters of the borehole and tubing and volumes to be injected. During injection, the injected water displaces existing groundwater as it moves through porous rock (either the pore matrix or secondary flow through joints and fractures) or sediment within the unit. Depending on geological conditions, the injected water spreads radially outward from the injection point within sedimentary units or follow discrete fracture sets within the rock. Porewater pressure is expected to generally be greatest at the injection point and dissipate with distance as the treated wastewater disperses (Shammas et al., 2016); however, injection into discrete rock fractures can result in more heterogenous pressure distributions due to the variability in fracture networks and their ability to transmit fluids.

For gravity-fed injection systems, the necessary components include:

- An injection well,
- Storage tanks located at higher elevation than the injection well to allow gravity-flow,
- Piping system from tanks to the well,
- Flow control valves to regulate flow into well; and
- Continuous monitoring equipment to monitor flow rates, pressure etc.

For pumped injection systems, the following additional components are needed:

- Injection well designed to accommodate additional pressure from pumping.
- Appropriately sized injection pump(s) (typically single-stage centrifugal pumps for wellhead pressures up to about 150 psi (~1034 kPa) and multiplex piston pumps to achieve higher pressures (Shammas et al., 2016)).
- Pump control systems e.g., variable speed drive etc.

Class I injection wells are continuously electronically monitored and controlled during operation to maintain pressure in the annular space and packer, and to confirm suitable injection rates and pressures are achieved (GWPC, 2021).

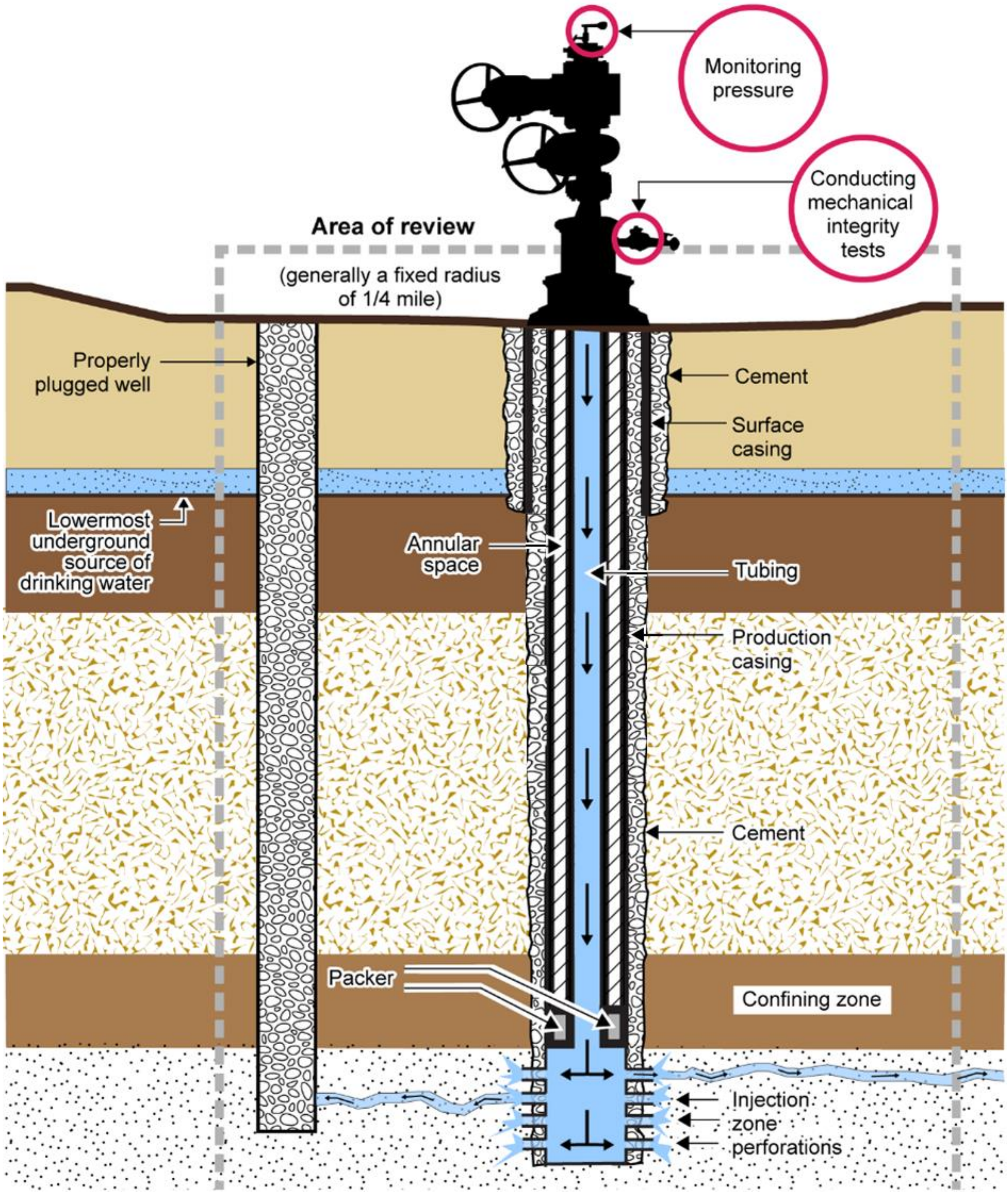

Figure 2: Typical Class I Injection well construction diagram. Modified after GAO (2014) to reflect USEPA guidance that the inner casing should generally be cemented from the surface to the top of the injection zone for Class I municipal waste wells.

3 Regional Geology

The short-listed sites for the proposed WWTP are located in the lower Waikato catchment area, within the Hamilton Basin, as shown in Figure 3Figure 3. The Hamilton Basin is a large graben or fault-bound depression, flanked by greywacke ranges (Pakaroa to the west and Hakarimata to the east). The Basin is infilled with a thick sequence of largely alluvial Tauranga Group sediments deposited by the ancestral Waikato River, which migrated back and forth within the wider river floodplain, resulting in laterally and vertically variable sand, silt and clay sequences. (Kear and Schofield, 1978, as cited by Hadfield, 2001). The geological units in the area from younger to older mainly consist of:

- **Tauranga Group**: sand, silt, gravel, and peat materials of fluvial, lacustrine and volcanogenic sediments.
- **Miocene sediments (Waitemata Group)**: clastic sedimentary rocks such as calcareous siltstone and sandstone.
- **Te Kuiti Group**: clastic and carbonate sedimentary rocks such as siltstone, sandstone and limestone.
- **Basement Greywacke**: massive to poorly bedded, fine to medium grained sandstone with thin-bedded alternating sandstone and mudstone.

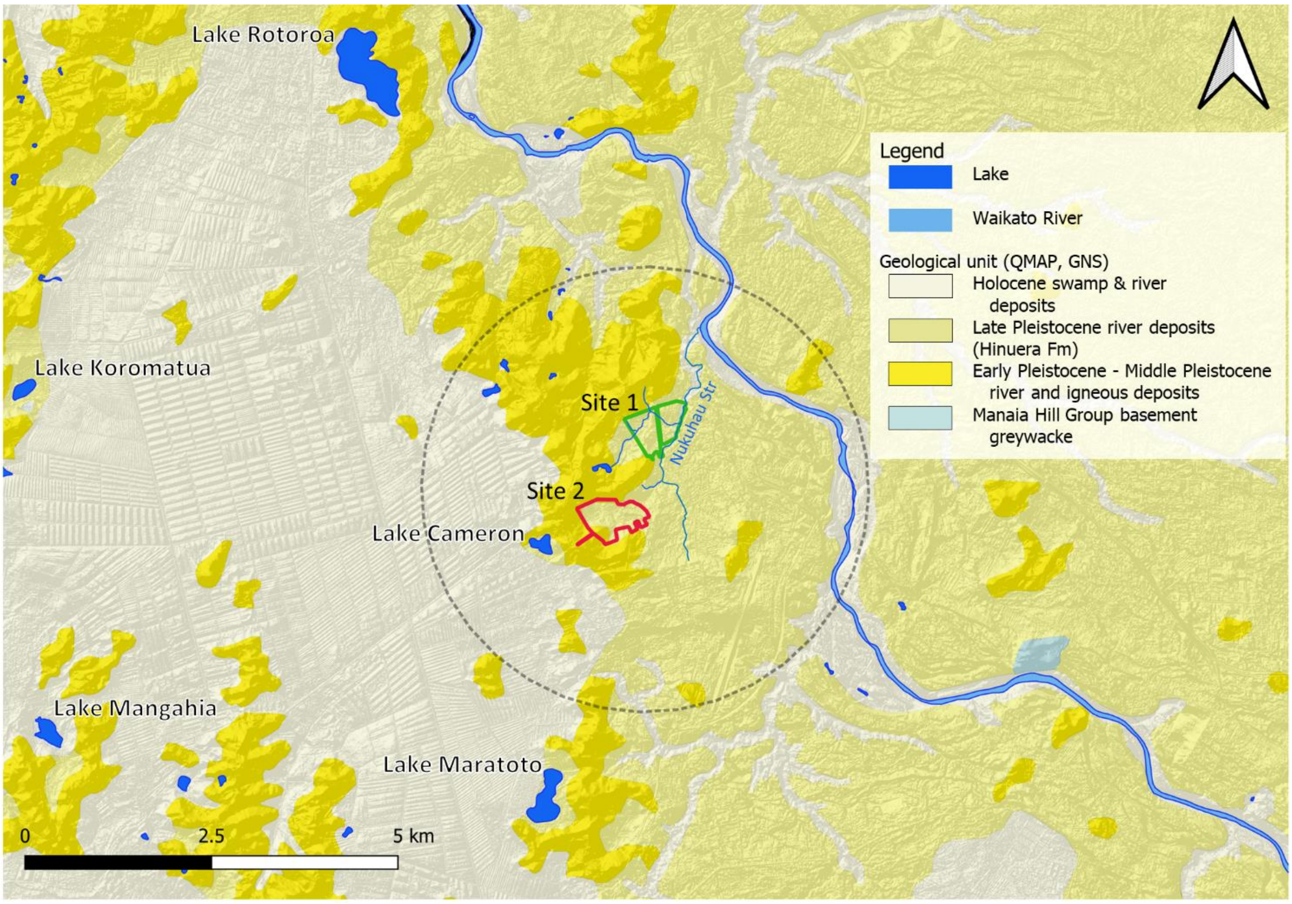

Figure 3 Geological units in the region (QMAP, GNS). Dashed outline of circle denotes 3 km radius from centre-point between Site 1 and Site 2 used for high-level bore review.

Tauranga Group sediments are quite heterogeneous, with the more permeable sand and gravel layers being the most preferable water supply aquifers in the region. The thickness of the Tauranga Group is highly variable but typically ranges between 5 m to 80 m, however, a thickness of up to 600 m is known in the Hamilton Basin (Katz, 1968, as cited in White et al., 2015).

Review of the Waikato Regional Council (WRC) bore database indicates 158 bores, reaching up to 114 m depth, have been drilled within a 3 km radius of Site 1 and Site 2 (search radius shown on Figure 2). Based on driller's logs, the lithological descriptions (where available) are broadly consistent with Tauranga Group sediments (e.g., pumiceous sand, silt, gravel, and peat materials). This suggests this group of sediments have a minimum thickness of some 114 m beneath Site 1 and Site 2.

Although not confirmed by borehole logs for the specific area of interest, it is recognised that Miocene sediments corresponding to the Waitemata Group underlie the Tauranga Group sediments elsewhere in the Hamilton Basin as proven by 8 No. historical deep exploration wells drilled between 1963 and 1972 north and west of Hamilton (Edbrooke, 2005; White et al., 2015). According to Edbrooke 2005, the subgroup comprises three formations:

- The basal Waikawau Sandstone, up to 50 m thick, characterised by calcareous, glauconitic fine- to medium-grained sandstone with common calcareous concretionary beds near the base; grading into
- The Koheroa Siltstone, up to 75 m thick, which is a moderately calcareous sandy siltstone, commonly with calcareous sandstone and tuffaceous sandstone beds up to 2 m thick; overlying
- Mercer Sandstone, found only between Glen Massey and Rotowaro in the Waikato 1:250,000 geological map area (Edbrooke, 2005).

Based on available data, geological modelling suggests that Miocene sediments are not present beneath the specific area of interest (Figure 4) (White et al. 2015). We note that Figure 4 presents additional geological units which may not apply to the specific location of interest but are mapped at the northern end of the geological section.

The Te Kuiti Group stratigraphically underlies Miocene sediments and is characterised as a predominantly transgressive sequence from basal coal measures, overlying marginal marine to outer shelf and upper bathyal calcareous mudstone, sandstone and limestone (White et al., 2015). The Te Kuiti Group is well-documented in the lower Waikato valley based on outcrops and numerous coal exploration drillholes but is not well known in the Hamilton Basin because of its depth (commonly >800 m), lack of outcrop and relatively few sufficiently deep drillholes (White et al., 2015). Available information indicates the Te Kuiti Group in the Hamilton Basin is up to 200 m thick and dominated by mudstone with some sandstone and limestone beds. The group is thickest in the west and thins to the east (White et al., 2015).

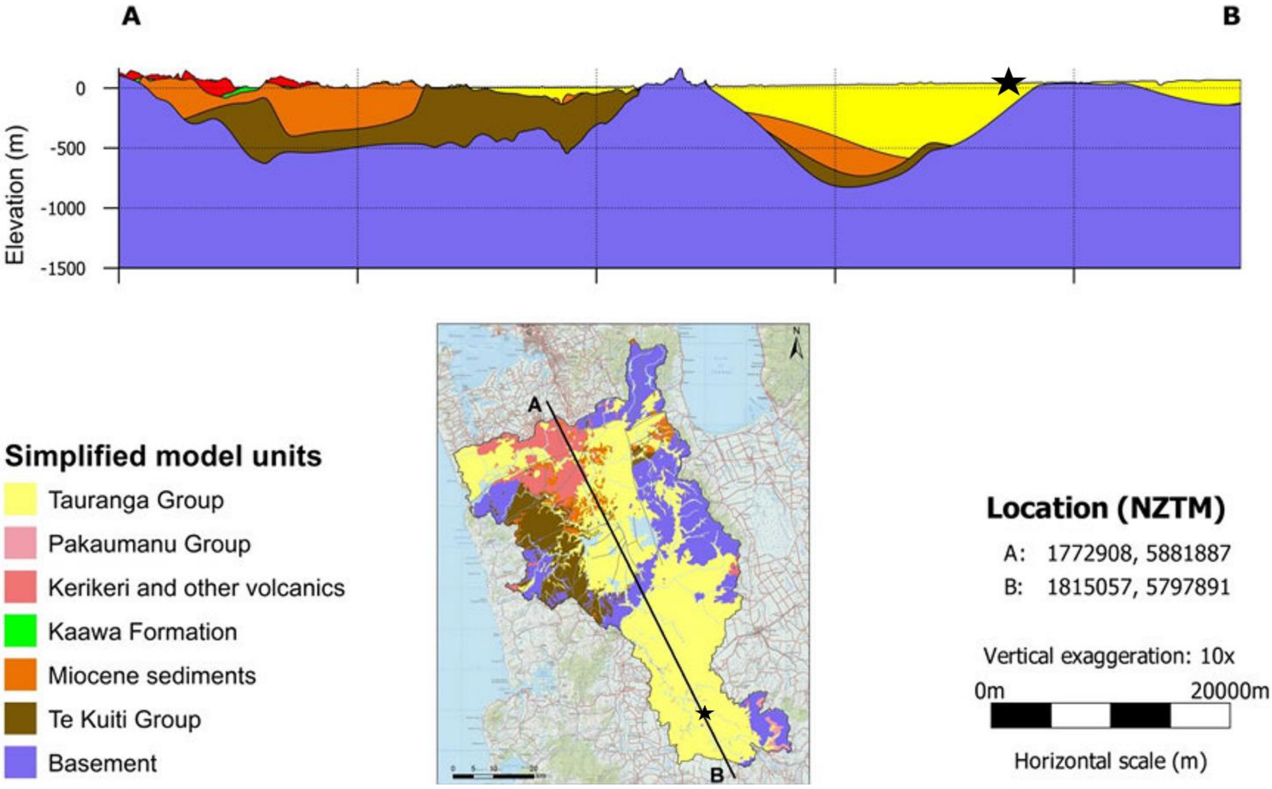

Figure 4: North-south cross-section through the Lower-Middle Waikato geological model (White et al., 2015). Location of Site 1 and Site 2 marked by black star.

Within the Te Kuiti Group, there are three units identified with aquifer potential, suggesting a potential for greater aquifer storage. These include Pukemiro Sandstone, as seepage and springs are observed where it outcrops on the landscape, the Elgood Limestone and Glen Massey Sandstone where there are crevices and solution cavities (White et al., 2015). Underlying the Te Kuiti Group is basement greywacke, which generally has low porosity and permeabilities due to the mineralisation of the intergranular space, i.e., the intergranular fluid storage is typically considered non-existent (White et al., 2015). The groundwater storage potentially provided by the secondary porosity from jointing and shearing is also considered limited.

Elevated groundwater temperatures have been recorded on Punikanae Island in Lake Waikare, which is located within the lower Waikato catchment. Geochemical analysis indicates the spring likely originates from the Te Kuiti Group (Balane, 2013). This suggests the potential for an upward flow zone and low enthalpy geothermal systems within the Te Kuiti Group, although their presence in the Hamilton Basin remains uncertain. Several hot springs are recorded approximately 32 km to 49 km northwest of Site 1 and Site 2 from fractures within Murihiku Terrane basement rocks on the east bank of Waingaro Stream and adjacent to a tributary of Waikorea Stream respectively (GNS, 2021; Edbrooke, 2005). Additionally, warm water of ~27 °C to 35 °C has been encountered in boreholes at depths from 140 m to 165 m at Horotiu, Frankton, and central Hamilton (Schofield, 1972, as cited in Edbrooke, 2005); these boreholes are presumed to draw water from Tauranga Group sediments however the bore logs have not been reviewed.

4 Considerations for Development of DBI

4.1 Suitable geological unit(s) for DBI

More permeable sand and gravel layers within the Tauranga Group can potentially provide suitable groundwater storage and can also transmit the flow more readily, however, these aquifers are also likely to be used for water supply. Given the generally variable nature of the Tauranga Group sediments due to their mixed fluvial, lacustrine and distal ignimbritic origin, it will be necessary to find a laterally extensive unit with sufficient hydraulic separation between the water supply aquifer and disposal unit. The deepest recoded bore used for water supply in the area is 114 m deep, it is likely that the disposal unit will need to be deeper than 120 m to provide sufficient separation, providing an aquitard exists to separate the targeted aquifer. Multiple investigation bores would be necessary to constrain the thickness and horizontal extent of a potential target disposal unit, as well as its potential confinement by an overlying and underlying low permeability layer.

Both Miocene sediments and older Te Kuiti Group could be a possibility for disposing treated wastewater, particularly in the calcareous sandstone units if fracturing and solution cavities are present. However, their presence would first need to be confirmed through investigation drilling. Miocene sediments were generally encountered at greater than 250 m depth north and west of Hamilton when exploration drilling was undertaken between 1963 and 1972. It is worth noting however that an exploration well drilled to 1,207 m depth between 1982 and 1984 at Ohaupo, some 6 km south of Site 2, encountered basement greywacke at 267 m depth underlying pumiceous silt (i.e., Tauranga Group). This borehole investigation suggests Miocene sediments and Te Kuiti Group may be absent beneath the selected locations of interest. As discussed above, the generally low groundwater storage within basement greywacke will limit its capacity for receiving and diluting the treated wastewater.

Based on the available geological data and pending the results of further investigation, it is likely that any proposed DBI will likely need to target the Tauranga Group sediments at depth.

4.2 Local and regional groundwater conditions

For siting the injection bores, local groundwater conditions, e.g., unconfined and confined aquifers, connection to surface water systems, etc., need to be investigated and reviewed. Understanding the regional groundwater flow direction and gradient is of value to inform assessment of the travel times of the disposed wastewater.

Groundwater flow within the Waikato area is strongly influenced by the lateral and vertical variability in geology. Regionally, groundwater flows in a north-westerly direction towards the distant Manukau Harbour and Hauraki Gulf where it discharges; however, locally, it flows mainly towards the Waikato River where it discharges with some flow towards incised streams (White et al, 2015). Research to date indicates groundwater supplies up to 85 percent of the base flow in Hamilton Basin streams and isotope analysis suggests that groundwater flux is predominantly within shallow aquifers (<5 years old) with deeper aquifers typically containing water thousands of years old (White et al., 2015; Hadfield, 2001).

Based on the results of monitoring undertaken for the WRC Healthy Rivers Project, high nitrate levels are common in shallow, unconfined aquifers with concentrations commonly higher than the pre-2021 Maximum Allowable Value (MAV) of 11.3 mg/L and commonly between 5.7 mg/L and 11.3 mg/L (White et al., 2015). Nitrate-nitrogen concentrations appeared to be increasing over time in some wells where there was sufficient data to enable trend analysis. Levels of iron are common in deeper aquifers located in peaty sediments.

It is worth noting that a series of low permeability layers may exist in the upper Tauranga Group, as seen during the Southern Gullies Pipeline and Storage Tanks project (Beca, 2022). However, investigations for this project identified these layers were not laterally extensive i.e., in the order of several hundred meters.

There is limited data on groundwater conditions at the depths likely to be targeted for DBI i.e., greater than 120 m depth. It is anticipated groundwater flow paths at those depths will be highly dependent on confining conditions beneath the site(s) but groundwater likely flows northwest and consistent with shallower regional groundwater flow directions. Further investigation, including both a more detailed desktop study and drilling, can assist in confirming groundwater conditions at the selected sites and identify downstream receptors e.g. surface water systems, groundwater users, etc. Note that injection into deep groundwater will likely have less impact on any shallow receptors compared to the discharge to land, unless there are upward flow zones down gradient.

4.3 Potential effects on receptors

As discussed above, should deep bore injection progress to short-list assessment and become the preferred disposal option, potential receptors will need to be further assessed, and the injection needs to minimise or avoid the interference to existing groundwater users, surface water systems etc.

The Waikato Regional Council bore database indicates there are 158 bores between 3.5 m and 114 m depth within 3 km of the selected locations of interest (the average bore depth is 40 m; 1 bore depth is unknown). There are also 23 consented water takes within 3 km with 8 noted to be for construction dewatering purposes. It is likely that some, if not most, of the 158 recorded bores may be taking groundwater under s14 (3) of the RMA or as a Permitted Activity, in which case there will be no publicly available data but regardless the owners are legally entitled to abstract some groundwater.

Another potential receptor is Nukuhau Stream and its tributaries which flow through and downgradient of Site 1 (Figure 1 and Figure 3). It is likely that groundwater contributes some component of baseflow to this stream based on its incised and low-lying nature relative to adjacent terraces. Previous site investigations near an adjacent tributary to the Mangakotukutuku Stream indicated a series of perched water levels beneath the terraces and a deeper regional water level at some 16 m depth, approximately equal to stream level (Southern Gullies Pipeline and Storage Tanks project, 2022). Given the likely target depth of DBI, there may be sufficient hydraulic separation or travel time to limit discharge of groundwater potentially containing contaminants associated with treated wastewater to the stream, however further investigation would be required to confirm.

The Waikato River, approximately 800 m east of Site 1, may be a potential receptor if groundwater from DBI reports to the river without sufficient travel time within the aquifer to attenuate potential contaminants. Analysis of 25 years of Waikato River water quality data at 10 sites from 1993 to 2017 indicates an increasing trend in total nitrogen (Vant, 2018). Whilst DBI of treated wastewater could directly increase nitrogen loading in the aquifer at the point of discharge, it is unlikely that groundwater enriched in nitrogen or other wastewater-related contaminants will report to the Waikato River without undergoing natural attenuation, filtration and dilution processes to enhance water quality. However, further investigation will be required to confirm this assumption.

4.4 Requirement of water treatment

The ambient groundwater will mix and therefore dilute the treated wastewater, resulting in a lower solute concentration. However, the chemical, biological and geochemical conditions in the saturated aquifers will be different from that of the shallow near-surface environment. Where favorable conditions exist, chemical and geochemical reactions can occur. Therefore, the targeted aquifer may be vulnerable to treated wastewater and vice versa, the groundwater conditions and its potential reaction with the discharge could potentially affect the operation of the injection bores, e.g., corrosion etc., which could potentially require a higher level of treatment of the wastewater.

The chemical conditions of the wastewater and the aquifers need to be thoroughly investigated to determine risks and likely level of treatment of the wastewater.

4.5 Cost of investigation and construction

Existing bores that are screened in the appropriate units could be considered as injection bores i.e., the deepest recorded bores below other groundwater users. According to Council records this is unlikely to be an option but if a borehole is identified through a more detailed desktop study, the following would need to be undertaken before confirming the existing bore(s) are a viable option:

- The borehole log and construction records need to be reviewed,
- The bore conditions need to be confirmed using downhole camera logging, particularly, the integrity of the bore casing needs to be checked to confirm no leakage,
- Hydraulic conductivity testing will need to be undertaken to confirm aquifer suitability if no recent testing has been undertaken.

If new bores are to be constructed, preliminary drilling and hydrogeological testing will need to be undertaken to identify a suitable disposal unit. Like investigation drilling for water supply, there is a risk of not finding the appropriate unit at certain locations, but this risk can be managed and reduced through a desktop study and a tailored investigation drilling programme. The bores themselves should also be properly designed and constructed, and downhole camera logging and bore casing integrity tests would need to be carried out to confirm the construction is up to the standard required of injection bores.

Additionally, there is a risk of encountering a low enthalpy geothermal system as indicated by warm groundwater from 140 m to 165 m depth within deep boreholes at Horotiu, Frankton, and central Hamilton (Section 2). This risk can be managed and reduced by a tailored investigation drilling programme.

Note: The field investigation and bore construction can have greater capital costs when compared to other disposal options, e.g., land disposal. However, any land purchase requirements will likely be less for DBI as the footprint is smaller than the land area required for subsurface disposal methods.

4.6 Public perception

There will likely be public concerns for injecting treated wastewater to an underground environment, therefore, public perception and expectations should be well managed. DBI is widely adopted overseas but in New Zealand DBI is mainly limited to the disposal of process wastewater from the oil and gas industry and stormwater (Beca and GHD, 2020). One treated wastewater bore injection system exists in New Zealand at Russell, Bay of Islands, however this is a shallow bore injection system.

It is noted that overseas variable drivers to utilise DBI for disposal of treated wastewater exist such as:

- High population density which limits the availability of land for surface or subsurface disposal methods e.g., South Florida, USA.
- High treated wastewater volumes that are not practical to dispose of via surface or subsurface disposal methods alone e.g., South Florida, USA.

- Protection of surface water and groundwater through preventing direct discharge to waterways or to the lowermost underground drinking water source e.g., South Florida, USA.
- Suitable geology which lends itself to safe disposal of treated wastewater (in conjunction with limited availability of land) e.g., South Florida, USA.
- To counteract land subsidence issues related to high rates of groundwater abstraction and aquifer compaction e.g., Virginia, USA.
- To counteract saltwater intrusion caused by high rates of groundwater abstraction by creating a hydraulic barrier e.g., Bay Park, New York, USA.
- An unsuitable (arid) climate where high evaporation and low soil infiltration rates limit the efficacy of land-based disposal methods e.g., Doha basin, Qatar.
- To replenish groundwater with recycled water (treated wastewater purified to drinking water standards) and then injected underground for additional filtration and storage e.g., Perth, Western Australia.

The drivers outlined above demonstrate that DBI is utilised in various situations to mitigate or counterbalance other potential effects.

5 Conclusions

The successful development of deep bore injection will primarily depend on:

- The geological and hydrogeological environment,
- Sufficient hydraulic separation between the disposal depth and upper units, particularly those used for water supply, and
- Sufficient aquifer storage that can accommodate the discharge.

As Miocene sediments (Waitemata Group) and Te Kuiti Group may be absent beneath the selected locations of interest, deep sandy units of the Tauranga Group, in particular those with a suitable confining layer, could be suitable for the DBI. However, the potential risks with this unit include but are not limited to:

- Not encountering a sandy unit that is confined and laterally extensive; and;
- The unit having upward flow zones and low enthalpy geothermal systems at depth.

Undertaking a more detailed desktop study that confirms the geology through site investigations and locating the bore(s) where springs and warm water have not been identified will likely reduce this risk.

Should the DBI be the preferred option to proceed, a more detailed desktop study is required to review the local and regional geological and hydrogeological conditions and identify any potential down gradient receptors. Unless there are any red flags identified, the desktop study should be followed up by site investigations to confirm suitability.

Understanding the chemical characteristics of the aquifer and wastewater will also be required to understand any potential adverse impacts on the aquifer and operation of the injection bores.

Risks in developing the DBI need to be thoroughly identified and should be reviewed and managed throughout the project.

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7 Applicability Statement

This letter has been prepared by Beca Limited (Beca) on the specific instructions of Hamilton City Council (Client). It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

Should you be in any doubt as to the applicability of this letter and/or its recommendations for the proposed development as described herein, and/or encounter materials on site that differ from those described herein, it is essential that you discuss these issues with the authors before proceeding with any work based on this document.

In preparing this report Beca has relied on key information including the following:

- Groundwater resource characterisation in the Waikato River catchment for the Healthy Rivers Project (White et al., 2015)
- Geological Maps at 1:250k-QMAP, GNS Science, available at <https://data.gns.cri.nz/geology/>, accessed 27 June 2024
- New Zealand Petroleum and Minerals Geodata Catalogue, available at <https://geodata.nzpam.govt.nz/>, accessed 2 July 2024
- Waikato Regional Council bore database, available at https://wellsnz.teurukahika.nz/, accessed 4 June 2024

Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency, and sufficiency of all information provided to it by, or on behalf of, the Client, including the information listed above, and has not sought independently to verify the information provided.

This report should be read in full, having regard to all stated assumptions, limitations and disclaimers. No part of this report shall be taken out of context, and, to the maximum extent permitted by law, no responsibility is accepted by Beca for the use of any part of this report in any context, or for any purpose, other than that stated herein.

Yours sincerely

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F

Appendix F – Southern WWTP Coastal Discharge Memorandum

Memorandum

To:	Jackie Colliar	**Date:**	16 May 2025
From:	Shaun le Grange	**Our Ref:**	4702999-501909-839
Copy:	Garrett Hall, Melissa Slatter		
Subject:	Southern WWTP Coastal Discharge Memorandum		

1.1 Introduction and Background

The Southern Wastewater Treatment Plant (SWWTP) is proposed in the area immediately south of Hamilton City to support future growth around the Waikato Regional Airport and northern Waipā District. The site selection process to identify the preferred location for the SWWTP is currently underway.

The Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) plans for the SWWTP to be developed in stages, eventually serving a Population Equivalent (PE) of 200,000. However, the Hamilton City Council (HCC) has indicated that regional resource consents will only be sought for the initial stages 1 – 2b, accommodating up to 18,000 PE or 3,600 m^3/day.

Environmental and engineering investigations are being conducted to develop and assess various options for discharging treated wastewater from the future SWWTP. Among the disposal methods being considered is a discharge to the coast (ocean outfall).

This memo presents the results of a high-level desktop assessment on the feasibility of coastal discharge for treated effluent from this plant.

1.2 Assumptions

The conveyance route assessment was based on the following assumptions:

- The sewer rising main will start in the proximity of the potential site identified north of the Hamilton airport
- The ocean outfall location is close to the existing outfall at the Raglan Harbour
- The alignment has been kept within the road corridor where possible/practical
- The planned Southern Links project has been taken into consideration
- Key alignment obstacles have been identified such as river/stream, bridge and railway crossings
- Rising main material: PE100 PN16
- Peak discharge rate is 41.7 L/s (3600 m^3/day)

Please refer to Appendix A for the assessed alignment.

1.3 Outcome

The outcome of the high-level desktop assessment on the feasibility of coastal discharge for treated effluent has been summarised below:

- Rising main diameter: OD250 PN16 equating to 1.28m/s @ 41.7L/s
- The alignment is approx. 56.7km long

- The peak static height that would need to be overcome is approx. 175m.
- Some key obstacles identified for the alignment are:
    - Railways crossing
    - Multiple stream and bridge crossings
    - The route runs along the SH23 and would require a considerable amount of traffic management
- Due to the typography and length of the rising main multiple booster pump stations would be required to convey the treated effluent to the ocean outfall

Shaun le Grange

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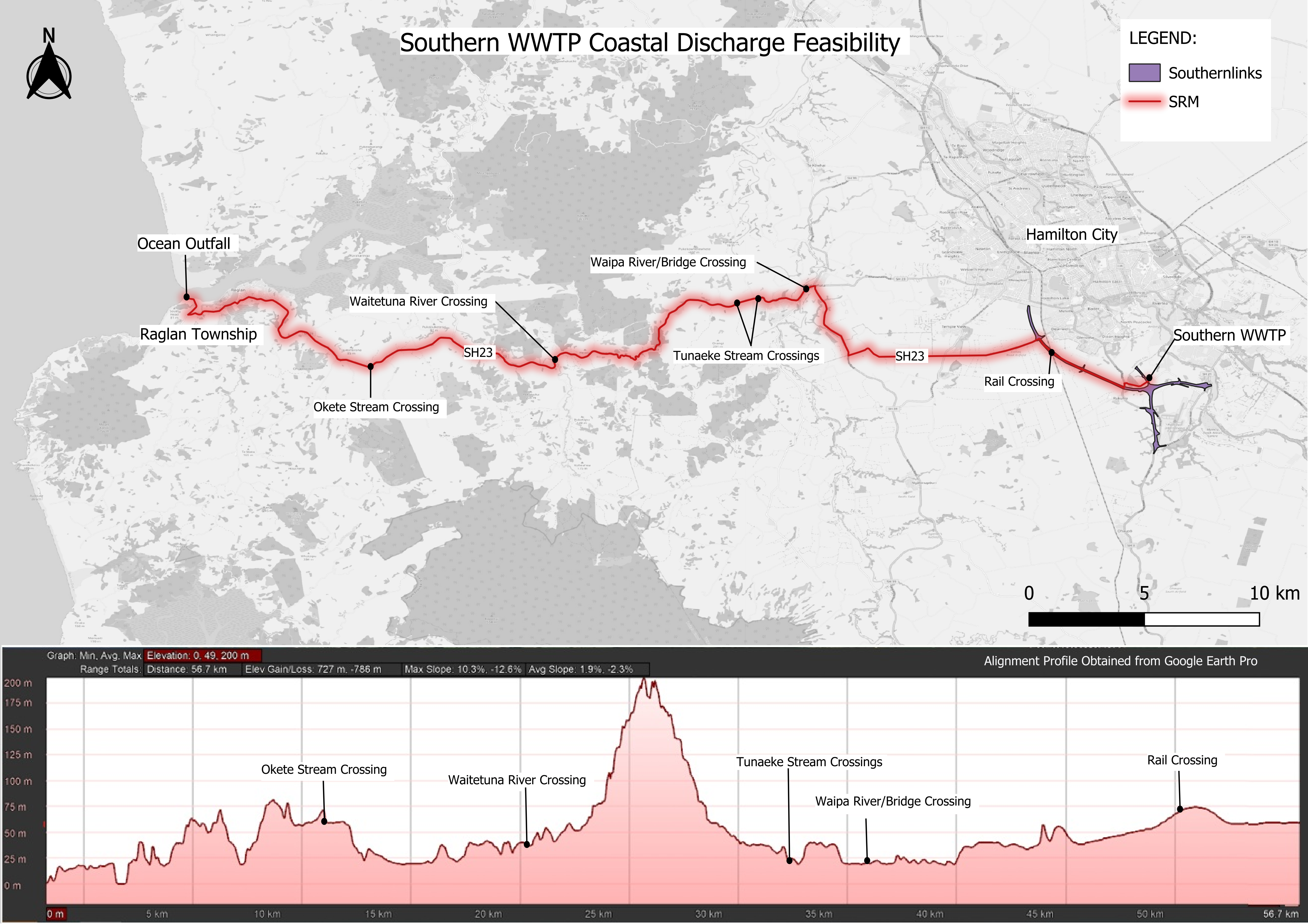
A

Appendix A – Assessed Alignment



Southern WWTP Coastal Discharge Feasibility
N
LEGEND:
Southernlinks
SRM
Ocean Outfall
Raglan Township
Okete Stream Crossing
SH23
Waitetuna River Crossing
Waipa River/Bridge Crossing
Tunaeke Stream Crossings
SH23
Hamilton City
Rail Crossing
Southern WWTP
0
5
10 km
Graph: Min, Avg, Max Elevation: 0, 49, 200 m
Range Totals: Distance: 56.7 km Elev Gain/Loss: 727 m, -786 m Max Slope: 10.3%, -12.6% Avg Slope: 1.9%, -2.3%
Alignment Profile Obtained from Google Earth Pro
200 m
175 m
150 m
125 m
100 m
75 m
50 m
25 m
0 m
Okete Stream Crossing
Waitetuna River Crossing
Tunaeke Stream Crossings
Waipa River/Bridge Crossing
Rail Crossing
0 m
5 km
10 km
15 km
20 km
25 km
30 km
35 km
40 km
45 km
50 km
56.7 km

G

Appendix G – Investigation of Feasible Options for Reuse of Treated Wastewater

Sensitivity: General

Investigation of Feasible Options for Reuse of Treated Wastewater

Southern Wastewater Treatment Plant Long List Development

Prepared for Hamilton City Council
Prepared by Beca Limited

7 August 2025

Source: New Zealand Herald, 2018

Contents

Revision History

Revision Nº	Prepared By	Description	Date
1	Brigette Priestley	Draft for Client Review	16/08/2024
2	Brigette Priestley	Final	07/08/2025

Document Acceptance

Action	Name	Signed	Date
Prepared by	Brigette Priestley		07/08/2025
Reviewed by	Garrett Hall		07/08/2025
Approved by	Garrett Hall		07/08/2025
on behalf of	Beca Limited		

Executive Summary

Hamilton City Council (HCC) commissioned Beca to conduct a desktop feasibility assessment to determine theoretically appropriate wastewater reuse options for the Southern Wastewater Treatment Plant (SWWTP). HCC would like to investigate reuse options for the SWWTP that would work in conjunction with the primary discharge method, whether that be a land or water discharge. The SWWTP is planned to be developed in stages, with Sequential Batch Reactor (SBR) treatment technology and a land discharge for Stage 1, transitioning to Membrane Bioreactor (MBR) technology and a river discharge from Stage 2 onwards, subject to further technical investigations as part of resource consent processes. It is understood that the resulting wastewater from the MBR plant will be of a significantly greater quality than the SBR plant.

Despite a lack of New Zealand specific guidelines, wastewater reuse within New Zealand is not a new or novel approach.

Irrigation to golf courses using subsurface irrigation as well as spray irrigation is one of the more common forms of wastewater reuse in New Zealand such as at Omaha wastewater treatment plant (WWTP) (North Auckland), Kinloch WWTP (Taupō), Bell Island WWTP (Tasman), Seddon Sewage Treatment Plant (Marlborough), and Mangawhai WWTP (Kaipara). Reuse of wastewater for the irrigation of public gardens, parks and sports fields is somewhat less common; however, it is being explored by some councils (including Whangārei District Council and Tauranga City Council) where there is pressure on potable water supplies. Marlborough District Council is also exploring discharge to grape vines for the Blenheim WWTP.

Other wastewater uses including industrial reuse and reuse in the construction sector are less common. Watercare has been leading potable wastewater reuse with their recycled water pilot plant at Mangere WWTP with a potable and non-potable treatment system. Whilst this plant is only investigating the potential for possible potable reuse in the future, the non-potable treated water is being used in the Central Interceptor's tunnelling activities.

In order to assess which reuse options might be feasible for both the Stage 1 SBR plant and the Stage 2, Beca reviewed the minimum treated wastewater performance standards that have been set through a Memorandum of Understanding (MoU) with partner organisations as part of the Southern Metro Detailed Business Case (DBC) against relevant wastewater reuse standards. Whilst there are no national guidelines for water recycling in New Zealand, the international guidelines most commonly employed are the Australian guidelines for wastewater reuse including the Australian Guidelines for Water Recycling (AGWR) : Managing Health and Environmental Risks (Phase1), 2006, the Victorian guideline for water recycling, Environment Protection Authority Victoria, Publication 1910.2, March 2021, and the Queensland Guideline for low-exposure recycled water schemes, 2022. These three guidelines look at the quality of the wastewater, in particular the level of pathogen removal, to apply wastewater classes, and these classes correlate to wastewater reuse types that would be plausible and would not cause a significant risk to public health. Each of the classes also correlate to different levels of controls which are required to manage public health risks.

Based on the available information for the proposed Stage 1 and 2 treatment plants, it is anticipated that the MBR plant could potentially meet the Class A treated wastewater (in accordance with the Victorian guideline for water recycling 2021 and the Queensland Guideline for low-exposure recycled water schemes 2022) provided the required pathogen log removals can be met, whilst the SBR plant is likely to meet Class C wastewater and therefore wastewater reuse is likely to require greater controls. As a result, the potential reuse options for the SBR plant are more limited than for the MBR plant.

This information was then used as part of a feasibility assessment which looked at the suitability of the treated wastewater for a selection of potential wastewater reuse options, the availability of sites within the vicinity of the proposed SWWTP for these reuse options, and the potential risks and limitations of each option. The following wastewater reuse options were investigated:

1. Reuse for golf courses, sports fields and parks
2. Agricultural Reuse (nurseries, orchards, vineyards)
3. Industrial Reuse
4. Reuse for the construction sector
5. Indirect Potable Use

For the Stage 1 SBR plant, the feasibility assessment showed that discharge to pastoral land or fodder crops is the most feasible. Irrigation to food crops is less likely to be feasible. Spray drift control, the use of subsurface irrigation, and/or the application of buffer zones may also be needed to minimise public health risks. Treated wastewater from the SBR plant could be used for irrigation to golf courses, gardens, sports fields and parks where there is no public access; and subsurface drippers will most likely be required. A thorough risk assessment should be undertaken for any proposed reuse to determine the mitigation measures needed to protect environmental sensitivities and public health.

For the Stage 2 MBR plant, the feasibility assessment showed that agricultural reuse including irrigation to pasture and non-food crops (including plant nurseries) as well reuse for golf courses, sports fields and parks may be feasible provided land conversion is possible. This includes using a sprinkler system with some restrictions including buffer zones and spray drift control although a combination of sub-surface drippers (for areas with public access) and spray irrigation (for areas without public access) may also be preferred. The level of treatment that could be provided by the MBR plant would also be important for determining the dispersal method. There are available sites within the vicinity of the proposed WWTP location that could be investigated further.

Reuse in the construction sector may also be feasible for wastewater from the MBR plant if the treated wastewater can meet the required level of disinfector to minimise construction worker risk. There are a number of future construction areas within the vicinity of the proposed SWWTP that could be investigated; however, it noted that this is not a reliable long-term option for reuse. Industrial reuse may also be possible; however, there do not appear to be any immediate options in the vicinity of the WWTP at this time.

As such the following recommendations were made regarding the reuse options to take forward to the next stage of the SWWTP discharge options assessment.

Stage	Reuse options	Recommendation
Stage 1 SBR Plant	Reuse for golf courses, sports fields and parks, Hamilton airport runway apron	This reuse option should be investigated further.
	Agricultural Reuse (nurseries, orchards, vineyards)	This reuse option should be investigated further.
	Industrial Reuse	This option may be feasible and a thorough risk and consentability assessment should be undertaken at the next stage if there is appetite to further consider this option.
	Reuse for the construction sector	This option may be feasible, and further investigations are recommended if there is appetite for this option.
	Indirect Potable Use	It is not recommended to investigate this option further as a discharge to the Waikato is already being considered for the primary discharge method.

Stage	Reuse options	Recommendation
Stage 2 MBR Plant	Reuse for golf courses, sports fields and parks, Hamilton airport runway apron	This reuse option should be investigated further.
	Agricultural Reuse (nurseries, orchards, vineyards)	This reuse option should be investigated further.
	Industrial Reuse	This option may be feasible and a thorough risk and consentability assessment should be undertaken at the next stage if there is appetite to further consider this option.
	Reuse for the construction sector	This option may be feasible, and further investigations are recommended if there is appetite for this option.
	Indirect Potable Use	It is not recommended to investigate this option further as a discharge to the Waikato is already being considered for the primary discharge method.

In order to consent any of the reuse options considered in this assessment, including agricultural reuse and reuse for golf courses, sports fields and parks, additional site investigations would be required to determine the feasibility of the option. Such investigations were outside the scope of this document but would be significant in confirming whether an option should be taken forward for further consideration.

1 Introduction

1.1 Background

The Waikato region is undergoing significant urban, industrial, and commercial growth, resulting in increasing demand on existing wastewater infrastructure. To address this, the Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) was developed, tasked with identifying a preferred option to manage wastewater from the southern part of the Waikato-Hamilton-Waipā metro area. A key component of this plan is the construction of a new Southern Wastewater Treatment Plant (SWWTP), which would service future development in southern Hamilton, the Waikato Regional Airport, and northern Waipā.

The Southern Metro DBC process included a site selection process to identify a preferred broad location for the SWWTP in the area immediately to the south of Hamilton. This short-list and site feasibility investigation concluded in August 2024 and recommended the preferred site for the SWWTP as land that is owned by Hamilton City Council (HCC) between Peacockes Road and Raynes Road (Sharpe Farm).

The SWWTP is planned to be developed in stages, eventually serving a Population Equivalent (PE) of up to 200,000. The Southern Metro DBC assumed a land discharge for Stage 1, transitioning to a river discharge from Stage 2 onwards, subject to further technical investigations as part of resource consent processes. HCC will seek consents for Stages 1 to 2b, covering up to 18,000 (PE) and an average daily flow of 3,600 m^3/day at the end of stage 2b. Commencement flows at stage 1 are estimated to be 400 m^3/day increasing to 1,900 m^3/day at the end of stage 2a.

Beca Ltd (Beca), on behalf of HCC, has conducted various investigations into alternative discharge options for the SWWTP, building on previous work, to assess the long-list options for the SWWTP which will inform the resource consent process. This work will reassess the broad assumptions made by the Southern Metro DBC with regards to discharge options.

Environmental and engineering investigations are being conducted to develop and assess various options for discharging treated wastewater from the future SWWTP. Among the disposal methods being considered is a discharge to surface water (main stem of the Waikato River, surface waterways, restored/constructed wetlands), deep bore injection, discharge to coastal waters (ocean outfall) and a discharge to land. In addition to these options, HCC is considering other possible options for the treated wastewater including reuse (non-potable reuse and potable reuse).

1.2 Purpose and Scope

HCC have commissioned Beca to undertake a high-level desktop feasibility assessment of wastewater reuse options for the SWWTP. This report will set out the following:

- A summary of the SWWTP including wastewater quality, and comparison against the relevant guidelines.
- Guidelines available for wastewater reuse.
- A summary of wastewater reuse in New Zealand including operational and proposed examples.
- A high-level assessment of reuse options including:
    - Discharge to golf courses, sports fields, parks and public spaces/green belts,
    - Agricultural reuse including irrigation to fodder crops, forestry, pasture, vineyards and orchards,
    - Industrial reuse (e.g. cleaning/wash-down and processes),

- Reuse in construction activities (e.g. dust suppression), and
- Indirect potable reuse

- Recommendations for reuse including plausible areas for consideration.
- Further work required to determine feasibility of possible reuse options.

The assessment of reuse options including irrigation to golf courses, sports fields, parks and public spaces/green belts as well as agricultural reuse corresponds with the work being undertaken to assess discharge to land options undertaken through GIS analysis of land parcels within 15km of the SWWTP site. As such, this report will refer to the 'Land Feasibility Assessment'[1] report.

It is noted that both the 'Land Feasibility Assessment' report and this report do not account for the willingness of landowners to receive treated wastewater for reuse on their site, nor do they address land use policy changes that may be required.

[1] Southern Wastewater Treatment Plan Land Discharge Options Assessment: Land Feasibility Assessment, Prepared by Beca for Hamilton City Council, July 2024

2 Southern Wastewater Treatment Plant

The Hamilton-Waikato Metropolitan area stretches from the northern town of Ngāruawāhia, down to Cambridge and Te Awamutu in the south. In response to the rapid growth in this region, the Southern Metro DBC was developed to select the preferred options to provide wastewater services for the southern sub-region of the Hamilton-Metro Area (Southern Metro Area). The Southern Metro Area encompasses several small communities and industrial areas, including: Peacocke, Rukuhia, Mātangi, Tauwhare Pā, Airport industrial area, Ōhaupō, Cambridge, Te Awamutu. In the Southern Metro Area, three small to medium wastewater treatment plants (WWTPs) are currently located in Te Awamutu, Cambridge, and Mātangi. Based on the Southern Metro DBC, the development of the SWWTP is the preferred option to address the growing wastewater needs of the Southern Metro Area, with the Cambridge and Te Awamutu WWTPs remaining in place to service those current and future development areas.

2.1 Southern Wastewater Treatment Plant

The development of the SWWTP is proposed to be staged over time. At this stage, regional resource consents will only be sought for Stages 1 to 2b (up to 18,000 PE or 3,600 m³/day). According to Table 1, the Southern Metro DBC assumed that Stage 1 would employ Sequential Batch Reactor (SBR) treatment technology with land discharge, while Stage 2 would utilise Membrane Bioreactor (MBR) technology with discharge into the Waikato River. However, this long-list discharge options assessment is currently reassessing these assumptions regarding the staging and final discharge environments for each phase.

As part of this long-list assessment work, this report will include a reuse feasibility assessment for both Stage 1 and Stage 2.

Table 1. Southern Metro DBC SWWTP Concept Staging.

Description		Serviced area	Starting demand	Cumulative Capacity
Stage 1	SBR* with discharge to land	Airport precinct	400 m³/day (2,000 PE)	1,000 m³/day (5,000 PE)
Stage 2a	MBR** with discharge to Waikato River	Airport precinct and Mātangi / Tamahere commercial areas	1,200 m³/day (6,000 PE)	1,900 m³/day (9,500 PE)
Stage 2b	MBR with discharge to Waikato River (additional reactors and membrane equipment)	Airport precinct, wet industry and Mātangi /Tamahere commercial areas	3,600 m³/day (18,000 PE)	3,600 m³/day (18,000 PE)

* SBR treatment technology with land disposal is proposed for the first stage. This technology provides enormous flexibility in terms of flows and load and will provide effluent quality that is suitable for application into or onto land. SBR is able to stop solids to reduce organic matter found in wastewater, which is done over a number of cycles, depending on the size of the tank.

** MBR treatment technology with discharge to water is proposed for the second stage. MBR systems are aerobic activated sludge biological reactors, which combine the biological degradation process, known as "activated sludge", with solid-liquid separation by membrane filtration. This process results in high-quality effluent with low levels of suspended solids, pathogens, and nutrients

2.2 Preferred Locations for the Wastewater Treatment Plant

The Southern Metro DBC site location process involved exploring the area immediately south of Hamilton to identify a preferred location for the SWWTP. The 2024 Assessment of Alternative Sites report[2] undertaken by Beca further refined the locations identified by Southern Metro DBC, narrowing them down to four shortlisted sites. Through a multi-criteria analysis (MCA), Site 1 (Sharpe Farm) and Site 2 (Narrows/Rukuhia) emerged as the preferred locations for the SWWTP. These preferred sites are detailed in Table 2 and are shown in Figure 1. Following the technical MCA process and the findings of the Tangata Whenua Effects Assessment (TWEA), Sharpe Farm has been identified at the preferred site. Sharpe Farm scored the highest in both the unweighted and weighted MCA.

Table 2. Description of the shortlisted sites for the SWWTP.

Site Name	Site Address	Site Owner	Area of Site	Title	Legal Description
Sharpe Farm (Site 1)	Raynes Road, Rukuhia	HCC	34.2 ha (two blocks which have an area of 19.35 ha and 14.85 ha).	SA72C/450	Lot 5-6 DPS 91837
Narrows/ Rukuhia (Site 2)	71 Narrows Road/Ōhaupō Road	The site is owned by the Crown and administered by Waka Kotahi	35 ha	RT 534321	Lot 1 DP 420545

[2]Southern Wastewater Treatment Plant Assessment of Alternative Sites, Beca, 2024.

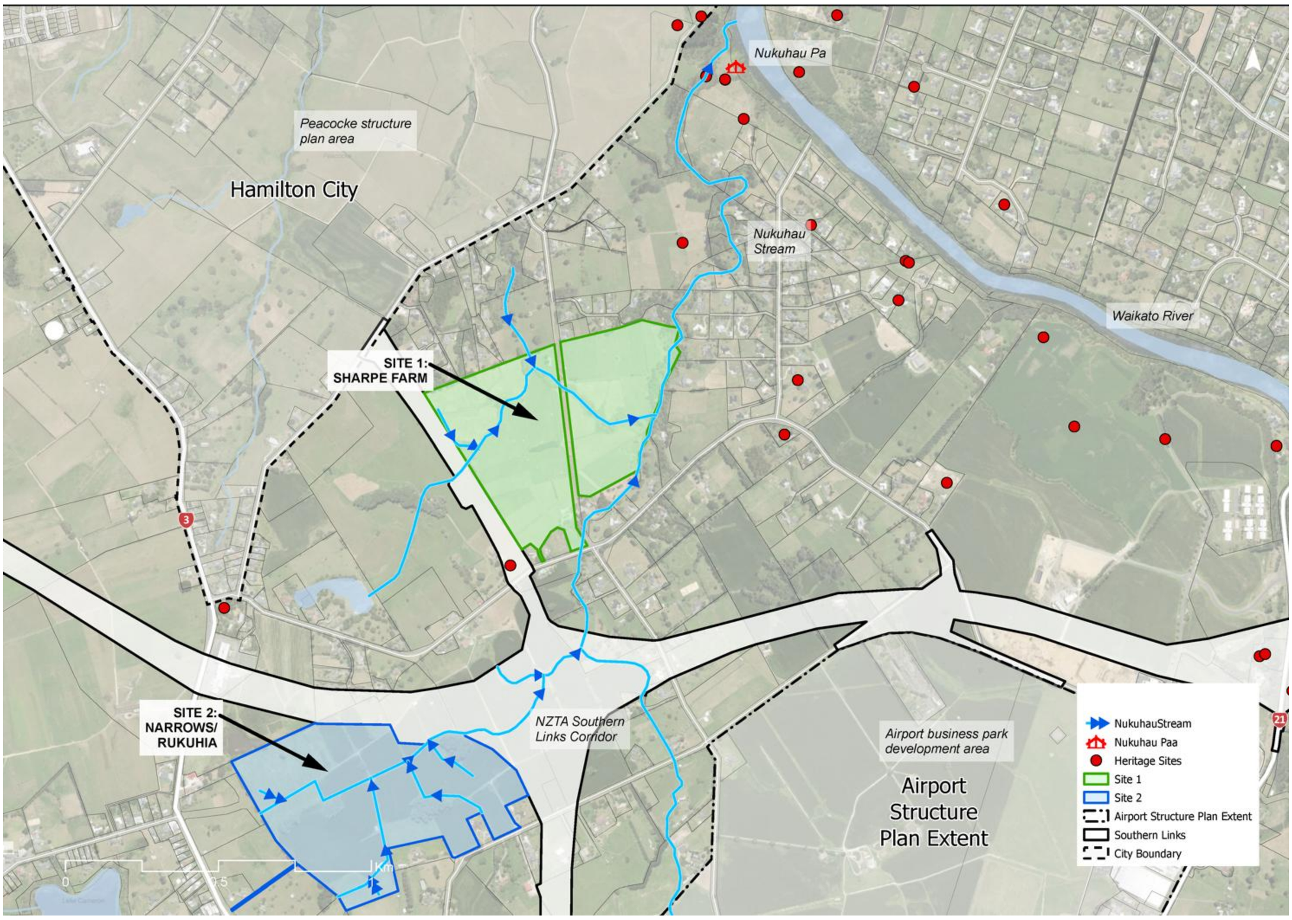


Figure 1.The preferred sites for the Southern WWTP (Site 1 and Site 2).

2.3 Proposed Treated Wastewater Quality

The key contaminants of concern that have a known impact on public health and the Waikato River environment are pathogens (e.g. bacteria and viruses) and nutrients (nitrogen and phosphorus). As part of the Southern Metro DBC, minimum treated wastewater performance standards have been set through a Memorandum of Understanding (MoU) with partner organisations and these are presented below in Table 3.

Table 3. Minimum performance standards for discharge to land and discharge to water.

Parameter		Minimum Performance Standards for Discharge to Land (SBR)	Minimum Performance Standards for Discharge to Water (MBR)
Total Nitrogen (mg/L)	Annual Mean	<20	<4.0
Total Phosphorus (mg/L)	Annual Mean	No specific limit	<1.0
E. coli (cfu/100mL)	95th Percentile or Median	<500 (as a median)*	<14 (as a 95th Percentile)

**No specific limit, unless there is a risk of bypass discharge, in which case, UV disinfection would be employed to reduce E. Coli to c.500 cfu/100ml as a median.*

Further design work is required to determine appropriate consent limits for other typical contaminants such as Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS), although both these contaminants will be very low in the final treated wastewater discharged from an MBR treatment process, due to the membrane filtration process proposed. Concentrations of BOD and TSS will be moderately higher in the SBR process, however it is assumed these concentrations would be at a suitable level for discharge to land, where effects on BOD and TSS are less of a concern.

3 Guidelines for Water Recycling and Application

Worldwide technologies and management systems for water recycling have advanced significantly over the years, ensuring safe and successful operations across a wide range of schemes. However, the absence of national guidelines for water recycling in New Zealand has resulted in relying on voluntary adoption of international standards which has led to inconsistencies and increased challenges in implementing water recycling practices effectively.

Disposal of wastewater to land is relatively common practice in New Zealand, but this is not currently classified as recycling or reuse of water. Discharges to land are managed as part of the consenting process under the Resource Management Act 1991 and it falls to Regional Councils to determine what limits should be placed on uses of recycled water. This is often undertaken on a case-by-case basis as applications for the use (discharge) of water are made, rather than there being standard rules or guidelines for the use of recycled water.

In the absence of guidelines specific to New Zealand, this document has looked at the Australian guidelines for wastewater reuse that have been commonly applied by applicants when seeking wastewater reuse consents in New Zealand.

Note: Reference to 'logarithmic' or 'log' reductions refers to the decrease in number of pathogens (pathogen count) following a level of treatment. One-log reduction is a 90% reduction (for example, a reduction from 1000 to 100). A two log reduction is a 99% reduction (for example, a reduction from 1000 to 10).

3.1 Available Guidelines for Water Recycling

3.1.1 Australian Guidelines for Water Recycling[1]

In 2004, the Australian Academy of Technological Sciences and Engineering (AATSE) released a report advocating for the re-evaluation of wastewater as a valuable water resource. They recommended wider usage of wastewater, especially in non-drinking water applications, and highlighted the need for updated national guidelines due to existing limitations. In response, the Environment Protection and Heritage Council and the Natural Resource Management Ministerial Council developed new national guidelines on water recycling[3]. Documentation in the field of water recycling in Australia includes the Australian Guidelines for Water Recycling (AGWR), the Victorian Guideline for water recycling, and the Queensland Guideline for low-exposure recycled water schemes. These guidelines are described below and used in the assessment of the proposed treatment and irrigation methods in this report.

AGWR offers comprehensive guidance on safely and sustainably recycling wastewater. They specifically address various applications including agriculture, fire control, municipal, residential and commercial properties, as well as industrial uses. In the absence of a regulatory framework for wastewater reuse in New Zealand, the AGWR can be used as the basis to determine appropriate wastewater quality requirements, treatment plant upgrade options and the potential risks associated with proposals. Internationally, the AGWR has been recognized as significantly advanced and aligned with the recommendations outlined in the World Health Organisation's guidelines[4].

Table 3.8 in the AGWR outlines various applications of recycled water, along with suggested treatment methods, achievable reductions in contaminants, on-site precautions, exposure mitigation, and water quality goals, aligning with the fit-for-purpose approach (see Appendix A of this report).

[3] Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase1), 2006.

[4] European Commission JRC Science and Policy Reports. Water Reuse in Europe: Relevant guidelines, needs for and barriers to innovation, Sanz and Gawlik, 2014.

Table 3.4 of the AGWR provides a summary of the potential reduction in hazard concentrations through different treatment processes. These processes can be used individually or in combination to reduce microbial hazards. The table shows a range of possible reductions in pathogens, which can vary due to factors like design features of the treatment processes. Table 4 is derived from Table 3.4 of the AGWR, detailing the logarithmic reductions of enteric pathogens and indicator organisms that are typically achieved. Whilst this data is valuable to support planning, it is important to note that validation of log removals is required through challenge testing of the treatment plant and sampling and analysis for bacteria (e.g. campylobacter), viruses (e.g. adenovirus) and protozoa (e.g. Giardia, Cryptosporidium).

Table 4.Indicative logarithmic reductions of enteric pathogens and indicator organisms (Derived from Table 3.4 of the AGWR).

Treatment	*E. coli*	Bacterial pathogens (including Campylobacter)	Viruses (including adenoviruses, rotaviruses and enteroviruses)	Giardia	Cryptosporidium
Primary treatment	0-0.5	0-0.5	0-0.1	0.5-1	0-0.5
Secondary treatment	1-3	1-3	0.5-2	0.5-1.5	0.5-1
Dual media filtration with coagulation	0-1	0-1	0.5-3	1-3	1.5-2.5
Membrane filtration	3.5->6	3.5->6	2.5->6	>6	>6
Reverse osmosis	>6	>6	>6	>6	>6
Lagoon storage	1-5	1-5	1-4	3-4	1-3.5
Chlorination	2-6	2-6	1-3	0.5–1.5	0–0.5
Ozonation	2-6	2-6	3-6	N/A	N/A
UV light	2->4	2->4	>1.0 adenovirus, >3.0 enterovirus, hepatitis A	>3.0	>3.0
Wetlands – surface flow	1.5-2.5	1	N/A	0.5-1.5	0.5-1
Wetlands – subsurface flow	0.5-3	1-3	N/A	1.5-2	0.5-1

N/A = not available; UV = ultraviolet

Note: Reductions depend on specific features of the process, including detention times, pore size, filter depths, disinfectant.

3.1.2 Victorian Guidelines for Water Recycling[5]

The Victorian guideline for water recycling by Environment Protection Authority Victoria (Victoria guideline) aims to ensure the sustainable and safe use of recycled water in Victoria by minimizing risks and protecting soil ecosystems, productivity, water resources, and human health. Table 1 of the Victoria guideline for water recycling outlines the classification criteria for recycled water, categorising it into three classes (A−C). Table 5shows the Victorian guideline Class A, Class B and Class C requirements which allows for unrestricted reuse and restricted reuse options.

Table 5. Class of recycled water and corresponding standards for biological treatment and pathogen reduction derived from the Victoria guideline).

Class	Water quality objectives – medians[1, 2] unless specified	Treatment process	Range of uses – uses include all lower class uses
A	Microbiological objectives expressed as microbial log reduction target based on QMRA and based on AGWR (Phase 1) and with attainment demonstrated in accordance with the Guidelines for validating treatment processes for pathogen reduction: Supporting class A recycled water schemes in Victoria (DH Victoria, 2013) • Turbidity < 2 NTU • < 10 / 5 mg/L BOD / SS[5] • pH 6 – 9[3]	The treatment processes should be designed to achieve the required Logarithmic Reduction Value (LRV). For Class A recycled water schemes, specific pathogen logarithmic reduction values (or 'log' reductions) must be defined and attained for bacteria, viruses, and protozoa, for which logarithmic removal targets are dependent upon the intended recycled water use as outlined in Table 3.8 of the AGWR (see Appendix A). These values must align with the microbial water quality objectives outlined in the current version of AGWR and any subsequent updates. Further details are provided Table 6 sets out the Fit-for-purpose Logarithmic Reduction Values (LRVs) for Class A unrestricted municipal use.	Irrigation of public open spaces, such as parks and sports fields, where public access is unrestricted, and any irrigation method is used. Agricultural food production, i.e. foods consumed raw. Domestic garden watering, including vegetable gardens. Toilet flushing. Washing machine use. General outdoor uses such as car washing, dust suppression, construction and wash-down. Filling water features and ponds that are not used for swimming. Use in cooling towers. Firefighting and fire protection systems, including hydrants and sprinkler systems. (other uses can also be considered on a case by case basis)
B	• < 100 *E. coli* org/100 mL • pH 6 – 9[3] • < 20 / 30 mg/L BOD / SS[5]	Secondary and pathogen reduction[4]	Agricultural: for example, dairy cattle grazing. Industrial: for example, washdown water.
C	• < 1,000 *E. coli* org/100 mL • pH 6 – 9[3] • < 20 / 30 mg/L BOD / SS[5]	Secondary and pathogen reduction[4]	Urban (non- potable) with controlled public access. Agricultural: for example, human food crops cooked/processed, grazing/fodder for livestock. Industrial: systems with no potential worker exposure.

[5] Victorian guideline for water recycling, Environment Protection Authority Victoria, Publication 1910.2, March 2021.

Class	Water quality objectives – medians[1, 2] unless specified	Treatment process	Range of uses – uses include all lower class uses

Notes:

[1] Medians to be determined over a rolling 12- month period.

[2] Refer also to Technical Information for the Victorian Guideline for Water Recycling (publication 1911) and Guidelines for wastewater irrigation, (publication 168) (EPA Victoria, 1991) for additional guidance on water quality criteria and controls for salts, nutrients and toxicants.

[3] pH range is 90th percentile. A higher upper pH limit for lagoon-based systems with algal growth may be appropriate, provided it will not be detrimental to receiving soils and disinfection efficacy is maintained.

[4] Guidance on pathogen reduction measures and required pre-treatment levels for individual disinfection processes are described in Disinfection of recycled water- Guidelines for environmental management (publication 730) (EPA Victoria, 2002).

[5] Helminth reduction requirements are up to 4 log10 and can include lagoon detention of primary treated effluent for ≥ 50 days or secondary treated effluent for ≥ 25 days, or some other equivalent Chief Veterinary Officer (CVO) and EPA approved process, such as media or membrane filtration. Alternatively, a risk-based assessment and derivation of the level of reduction required can be separately agreed with the CVO and EPA. Note that where the objective is to protect human health directly (for example no livestock involved in the transmission process) the treatment requirements for helminths can potentially be different to, and potentially less stringent than, where the recycled water will supply livestock. Therefore, risks associated with direct human exposures and the related health impacts on humans can be assessed separately from risks associated with exposures of livestock.

SS = Suspended solids; BOD = biological oxygen demand

For Class A recycled water schemes, specific pathogen logarithmic reduction values (or 'log' reductions) must be defined and attained for bacteria, viruses, and protozoa, for which logarithmic removal targets are dependent upon the intended recycled water use as outlined in Table 3.8 of the AGWR (see Appendix A). These values must align with the microbial water quality objectives outlined in the current version of AGWR and any subsequent updates. Further details are provided Table 6 sets out the Fit-for-purpose Logarithmic Reduction Values (LRVs) for Class A unrestricted municipal use.

Table 6. Class A recycled water pathogen log reduction value objectives– municipal use (unrestricted) (derived from the Victoria guideline)

Group	Total pathogen log reduction value objective[1]
Bacteria	4-log reduction (99.99% reduction)
Viruses	5-log reduction (99.999% reduction)
Protozoa	3.5-log reduction (99.95% reduction)

Notes:

[1]Fit-for-purpose LRVs.

The Victoria guideline also set out the relevant considerations when employing commercial / industrial / municipal uses for Class A recycled water. See Table 7below.

Table 7. Considerations for acceptable[1] uses of class A recycled water (derived from Victoria guideline)

Potential Use	Environmental[2]	Plumbing/ communication[3]	Other
Irrigation	Risk assessment	Controls required	-
Construction	Avoid run-off to stormwater system	Controls required	-
Wash-down	Avoid run-off to stormwater system	Controls required	-
Dust suppression	Avoid run-off to stormwater system	Controls required	-
Cooling towers	-	Controls required	Legionella control[4]
Toilet/urinal flushing	-	Controls required	Aesthetics
Hydrants (external & internal) and hose reels	-	Controls required	-

Notes:

[1]Uses are considered acceptable from a human health perspective.

[2]Environmental considerations and controls are discussed in Technical Information for the Victorian Guidelines for Water Recycling (publication 1911).

[3]Plumbing and communication controls are discussed in Technical Information for the Victorian Guidelines for Water Recycling (publication 1911).

[4]Under the Public Health and Wellbeing Act 2009 a specific risk management plan is required to control the risk of Legionella from cooling tower systems. Contact DHHS for further information. https://www2.health.vic.gov.au/publichealth/water/legionella-risk-management-guidelines.

EPA Victoria also has the '*Technical Information for the Victorian Guidelines for Water Recycling*' (publication 1911.2) which suggests some best-practice technical approaches and methods that can be used to comply with the Victorian Guideline for Water Recycling (publication 1910.2).

3.1.3 Queensland Guidelines for Low-Exposure Recycled Water Schemes[6]

The Queensland Guidelines for Low-Exposure Recycled Water Schemes (Queensland guideline) are designed for recycled water providers and users who exclusively utilise recycled water for low-exposure purposes. Recycled water in Queensland is commonly used for various low-exposure purposes, such as:

- Irrigation of public open spaces like playing fields and parks.
- Irrigation of pasture and fodder crops.
- Irrigation of heavily processed food crops like sugar cane.
- Irrigation of non-food crops such as cotton.
- Utilization for dust suppression on construction sites

Table 2 of the Queensland guideline lists *E. Coli* guideline values for recycled water for low exposure uses (refer to Table 8). These values have been suggested as part of verification monitoring of the treated wastewater and are based on the class of wastewater.

[6] Queensland Guideline for low-exposure recycled water schemes, 2022.

Table 8. Guideline values for recycled water (for low exposure uses) (Table 2 of Queensland Guideline).

Class of recycled water	Guideline values
Class A+	Less than 1 E. coli cfu/100mL or less than 1 E. coli MPN / 100mL in at least 95% of samples taken in the previous 12 months*
Class A	Less than 10 E. coli cfu/100mL or less than 10 E. coli MPN / 100mL in at least 95% of samples taken in the previous 12 months
Class B	Less than 100 E. coli cfu/100mL or less than 100 E. coli MPN / 100mL in at least 95% of samples taken in the previous 12 months
Class C	Less than 1,000 E. coli cfu/100mL or less than 1,000 E. coli MPN / 100mL in at least 95% of samples taken in the previous 12 months
Class D	Less than 10,000 E. coli cfu/100mL or less than 10,000 E. coli MPN / 100mL in at least 95% of samples taken in the previous 12 months

Note:

* When Class A+ recycled water is being supplied to households as part of a dual reticulation scheme, and when it is used to irrigate minimally processed crops, there are additional microbiological criteria that must be met (see Public Health Regulation Section 58). However, it can be provided for low-exposure uses without testing for anything other than E. coli.

According to the Queensland guideline, for every use of recycled water, specific controls must be implemented based on the relevant class of wastewater quality. These controls are necessary because recycled water, with the exception of purified recycled water (which undergoes extensive treatment and can be used to replenish drinking water sources), is not safe for human consumption. These controls are set out in Appendix B of this report. It is noted that not all classes of wastewater quality are applicable for each of the listed uses and as such controls are not included for every class under every use.

3.2 Application of Guidelines to the SWWTP

3.2.1 Comparison to recommended water quality specifications for recycled water

As noted in Table 3, performance standards for the proposed Stage 1 and 2 treatment plants have only been determined for total nitrogen (TN), total phosphorus (TP) and *E. Coli*. BOD, TSS. The pH and turbidity standards are not required for current purposes because to achieve the three nominated standards, BOD, TSS and turbidity will already be low and pH around neutral. However, consideration can be given to the E.coli specifications.

The proposed SBR plant will have a UV disinfection unit for treating bypasses. The UV specification for *E. Coli* is around 500 cfu/100ml as a median. Under this situation, the wastewater produced would only meet Class C of the Victoria and the Queensland guideline values.

Whilst the proposed MBR plant has an *E. Coli* specification of <14 cfu/100mL (as a 95^{th} percentile), it is anticipated that the actual performance of the MBR treatment plant with UV disinfection will provide a greater level of disinfection. As such, the Stage 2 WWTP may be able to meet the Class A requirements of the Victoria guideline in terms of *E.coli*.

3.2.2 Expected Logarithmic Reduction Values from Proposed Process Treatment Stages

Table 9 and Table 10 provide a practical overview of the expected performance for each unit operation at the proposed SBR plant and the proposed MBR plant respectively.

This is a high-level assessment only and is based on the early concept design for the treatment process as described in the Southern DBC Preferred Option Report[7] as well as the indicative logarithmic reduction values of enteric pathogens and indicator organisms from Table 3.4 of the AGWR[8].

Table 9. Expected LRVs for the proposed SBR plant

Treatment	LRV E.coli	LRV for Bacterial pathogens (including Campylobacter)	LRV for Viruses (including adenoviruses, rotaviruses and enteroviruses)	LRV for Protozoa*	Comment
Secondary treatment	1.0 – 3.0	1.0 – 3.0	0.5 – 2.0	0.5 – 1.0	
UV Disinfection	2.0 -> 4.0	2.0 -> 4.0	>1.0 adenovirus, >3.0 enterovirus, hepatitis A	>3.0	
Indicative log removals in the final treated wastewater	3.0	3.0	1.5	3.5	Minimum values have been considered for each LRV

* The range for Cryptosporidium has been included to be more conservative as the LRVs for Giardia are higher in the AGWR.

Table 10. Expected LRVs for the proposed MBR plant

Treatment	LRV E.coli	LRV for Bacterial pathogens (including Campylobacter)	LRV for Viruses (including adenoviruses, rotaviruses and enteroviruses)	LRV Protozoa*	Comment
Secondary treatment	1.0 – 3.0	1.0 – 3.0	0.5 – 2.0	0.5 – 1.0	
Membrane filtration	3.5 - >6	3.5 - >6	2.5 - >6	>6	
UV Disinfection	2.0 -> 4.0	2.0 -> 4.0	>1.0 adenovirus, >3.0 enterovirus, hepatitis A	>3.0	
Indicative log removals in the final treated wastewater	6.5	6.5	4.0	9.5	Minimum values have been considered for each LRV

* The range for Cryptosporidium has been included to be more conservative as the LRVs for Giardia are higher in the AGWR.

Based on this assessment, the MBR plant could potentially meet the Victoria guideline Class A recycled water pathogen LRV objectives for unrestricted municipal use (as presented in Table 7), however further refinement of the design is required to confirm if this is achievable. The SBR plant could also potentially meet the Victoria guideline Class A pathogen log removals if it is designed to meet the higher log removals. Note that other uses will need to have the fit-for-purpose LRVs determined prior to assessing feasibility.

[7] GHD, Beca. The Hamilton – Waikato Southern Metropolitan Area Wastewater Detailed Business case – Preferred Option Report. Metro Wastewater Project Partners. May 2022.

[8] Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase1), 2006.

Consideration could also be given to the AGWR and the log removals recommended for different uses. Based on Table 9 and Table 10, the MBR plant wastewater is likely to meet the LRV for the majority of the reuse options whilst the SBR plant in less likely to be able to meet the log reductions and would therefore be suitable for options such as municipal use with enhanced restrictions on access and application, landscape irrigation, and non-food crops.

3.2.3 Application of the Guidelines and Classes

Based on the above assessment, the following classifications have been made for the proposed SWWTP stages. The possible uses are based on the water quality objectives and pathogen log removals set out in the AGWR, Victorian guideline, and the Queensland Guideline only. Further clarification is required as part of the WWTP design to confirm that the treatment plant can meet the guidelines values for Class A, B or C wastewater.

Table 11. Recycled wastewater options and classes applicable to the SWWTP

WWTP Upgrade	Applicable Class	Possible uses
SBR (Stage 1)	Class C*/**	• Municipal open space and golf course irrigation (e.g. parks and sports fields) with enhanced restrictions on access and application. • Landscape irrigation — trees, shrubs, public gardens, etc. • Irrigation to non-food crops, with restrictions. Limited food crops may be possible. • Irrigation of pasture and fodder crops, with restrictions. • Industrial reuse where there is no potential worker exposure.
MBR (Stage 2)	Class B*/**	• Municipal open space and golf course irrigation (e.g. parks and sports fields) with restricted access and application. • Landscape irrigation — trees, shrubs, public gardens, etc. • Irrigation of non-food crops, with restrictions. Some food crops may be possible with restrictions. • Irrigation of pasture and fodder crops, with restrictions. • Industrial reuse e.g., washdown water. • Dust suppression with restrictions.
MBR (Stage 2)	Class A*/**	• Municipal open space and golf course irrigation (e.g. parks and sports fields) with minimal or no restrictions. • Landscape irrigation — trees, shrubs, public gardens, etc. • Irrigation of commercial food crops and non-food crops, with restrictions (greater variety of crops for Class A than for Class B) • Irrigation of pasture and fodder crops, with minimal restrictions. • General outdoor uses such as car washing, dust suppression, construction and wash-down. • Use in cooling towers.

*Victorian guideline for water recycling (2021)

** Queensland Guideline for low-exposure recycled water schemes (2022)

3.3 Risks and Limitations of Applying Australian Guidelines

Implementing the Australian guidelines requires technical skills within a regulator to interpret and apply them appropriately to each reuse scheme. As water reuse is still a growing field in New Zealand, many of the regional authorities may not yet have the inhouse expertise to review applications and apply standards that are context specific. The lack of New Zealand specific guidelines makes this especially hard and there is no ‘one size fits all’ approach that can be applied. New Zealand specific cultural sensitivities, in particular around potable reuse, are also not incorporated into the Australian guidelines but are essential considerations within the New Zealand context.

Water Services Authority - Taumata Arowai are in the process of reviewing the available international guidelines from Australia, the United States and Singapore in order to develop New Zealand specific guidelines that regional authorities can implement. Until such time that New Zealand guidelines are available, it is likely that the application of the Australian guidelines will continue to be used on an ad hoc basis. However, this should be undertaken with caution as there is not a consistent approach taken across New Zealand.

4 Wastewater Reuse in New Zealand

This section summarises the status of wastewater reuse in New Zealand as well as some of the limitations to reuse.

Despite a lack of New Zealand specific guidelines, wastewater reuse within New Zealand is not a new or novel approach. Common approaches to wastewater reuse overlap with the shift towards the discharge of treated wastewater to land, such as the reuse of wastewater for irrigation purposes (e.g. irrigation to pasture). Disposal of wastewater to land is relatively common practice in New Zealand to address iwi concerns about discharge of human sewage to water, with standards existing for treated wastewater disposal to land (Standards New Zealand & Australia, 2012)[9]. Less common options include re-use within the construction industry as well as indirect potable reuse.

However, the approach to reuse in New Zealand is centred around the disposal of wastewater, rather than utilising treated wastewater as a resource in situations where potable water may have been used before for non-potable purposes (such as irrigation of crops or sports parks), thereby reducing the pressure on potable water supplies. Recycled water standards may provide greater clarity around the requirements for using treated wastewater, and thereby encourage it's use for these purposes.

4.1 Examples of wastewater reuse

There are a number of current or potential non-potable recycled water use examples in New Zealand and these are described in more detail in the following sections.

4.1.1 Golf Course Reuse

Irrigation to golf courses using subsurface irrigation as well as spray irrigation is one of the more common forms of wastewater reuse in New Zealand. This section provides examples of these schemes.

4.1.1.1 Omaha Beach Golf Course, Auckland

Omaha Beach is a popular recreational beach and coastal residential settlement which is located north of Auckland and situated on environmentally sensitive coastal sand dunes. In conjunction with the development of a new residential area in Omaha, the existing 9-hole golf course was developed to a full 18-hole course. As extensive local irrigation of Omaha Beach Golf Course (OBGC) was limited due to groundwater depletion, different irrigation alternatives were evaluated and irrigation of treated wastewater from the Omaha WWTP was implemented.

The Omaha WWTP is located on Jones Road, Omaha Flats. Wastewater from Omaha, Point Wells and Matakana is treated and discharged to land at forestry blocks within the Omaha WWTP site itself, and to the OBGC. There is no direct discharge to water however, the WWTP site and the OBGC are in close proximity to Whangateau Harbour.

The Omaha WWTP was first operated in 1982, and then expanded in 2000, 2004 and 2009. Further expansions were due to the residential development by Omaha Beach. Wastewater in the Omaha WWTP is treated through a multi-stage process which includes an inlet screen, aerated lagoon, oxidation pond, storage dam, tertiary filters and UV disinfection.

[9] A review of international wastewater reuse standards and guidelines. Environmental Science and Research (ESR), Leonard, M., Russell, K., & Cressey, P. ((n.d.)).

A spray irrigation system was initially proposed for the OBGC during the summer months. However, a subsurface drip system was chosen for irrigation as it was superior to the sprinkler alternative due to technical, economic and environmental advantages[10].

The discharged wastewater has been used for the irrigation of fairways and fringes during summer and autumn by subsurface drip irrigation systems since 2002. The system consists of buried drip irrigation, drip emitters and antimicrobial lined tubing and has been operating successfully. In the subsurface drip irrigation system, rows of drip equipment were installed at a shallow depth below the soil surface, leading to maximised adsorption via the unsaturated soil zone and root zone of plants. This has greatly decreased usage of fresh water and fertiliser in the OBGC. Two main areas are irrigated in OBGC: 5.7 ha of fairways, plus some trees, green fringes, and rough within the OBGC Fairways block; and 0.6 ha of dunes within the OBGC Dunes block. The OBGC Fairways block is irrigated during summer and irrigation flow rate is not expected to rise over time. However, the OBGC Dunes block, with a high infiltration capacity, is irrigated during winter. Discharge of treated wastewater to the OBGC Dunes during very wet winters has made this block crucial to the irrigation system[11].

Figure 2.Omaha Golf Course – Subsurface drip irrigation of fairway vs. un-irrigated fairway[12]

4.1.1.2 Kinloch Golf Course, Taupō District

The Kinloch Public Golf Club (Figure 3) is located on the western shores of Lake Taupo, in the lakeside village of Kinloch and occupies 88 and 93 Kinloch Road. The Kinloch WWTP is sited at 46 & 48 Island Drive in Kinloch, Taupō District and services around 1050 residential lots in the Kinloch area. The WWTP is located in the centre of the site which is grassed and has some trees across the site. Wastewater is collected from a conventional

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[10] Gearing, P. Subsurface drip irrigation of Omaha golf course fairways with treated effluent.

[11] Omaha WWTP – Land discharge consent & beneficial re-use outcomes, Stuart, A, 2017.

[12] Gearing, P. Subsurface drip irrigation of Omaha golf course fairways with treated effluent.

gravity network and is sent to the Kinloch WWTP. The Kinloch WWTP comprises an inlet screen, a grit removal system and two sequencing batch reactors.

An upgrade strategy for the Kinloch WWTP was developed by Taupō District Council consisting of a two-stage treatment plant upgrade and the construction of a new subsurface drip irrigation system for treated wastewater discharge. Installation of a new sludge tank (2019) and a wastewater storage tank (2020) in stage 1 and a new dripper irrigation system at Kinloch Golf Course in stage 2 (2020) were completed. In stage 3, new inlet works, pump station and emergency storage tanks, biofilter for odour management, retrofitting the existing SBR into Activated Sludge Reactors and the installation of a new membrane filtration systems was completed in 2022.

The treated wastewater used to be pumped to the herringbone disposal trenches as the primary form of treated wastewater disposal. After installation of a new dripper irrigation system, herringbone trenches were replaced and the subsurface drip irrigation system distributed the treated wastewater over a much larger area, at lower application rates. The irrigation system has been operating successfully since installation in 2020. The relevant consent conditions for the implementation of the golf course irrigation system are set out in Table 12 below.

Figure 3. Kinloch golf course[13]

Table 12. Consent conditions pertaining to practice and application of wastewater at Kinloch golf course

Condition Number	Consent Condition
6	In accordance with the staged improvements as set out in Taupō District Council Kinloch WWTP Upgrade Strategy. Harrison Grierson document number R002v2.0 – AK145643-01, August 2020 (DM#17095791), from a time that commences three months post the commissioning of the dripper irrigation system, the consent holder shall ensure the discharge complies with the following limits:

[13] https://www.kinlochgolf.co.nz

Condition Number	Consent Condition
	i. the annual average total nitrogen (TN) concentration shall not exceed **8** grams per cubic metre and the 90th percentile shall not exceed **20** grams per cubic metre, ii. the median weekly total nitrogen (TN) load over a calendar month, shall not exceed **28** kilograms per week, iii. the annual total nitrogen (TN) load shall not exceed **1314** kilograms per year for the year commencing 1 July and ending 30 June, iv. The annual total phosphorus (TP) load shall not exceed **900** kilograms per year for the year commencing 1 July and ending 30 June. **Note:** For the purposes of conditions (4), (5) and (6), the period of compliance is 1 July to 30 June annually. Note: For the purposed of Condition (6ii) the weekly TN load shall be calculated by multiplying the daily mass load, as calculated on the day the TN sample was taken, by 7.
7	The loading rate of effluent to land by way of any new dripper irrigation lines, traditional absorption trenches and beds or methods of rapid infiltration, shall be consistent with: i. the loading rates for these methods as set down in either the 'Australian and New Zealand Standard for On-site Domestic Wastewater Management' (AS/NZS1547:2012), or ii. Auckland Councils Technical Publication No. 58 (TP58) 'On-site Wastewater Systems: Design and Management Manual, Third edition, 2004; or iii. In accordance with the methodology outlined in the Kinloch Wastewater Treatment Plan Upgrade, Section 127 Consent Variation and Assessment of Environmental Effects, Taupo District Council. Harrison Grierson document number R002v4- AK137370-axs, November 2015" (DM3616458), whereby: a) Dripper-line irrigation shall be loaded to a maximum of 17mm/day, b) Dripper-line irrigation shall be the primary disposal method under normal operation with rapid infiltration being utilized only in high flow events when the dripper-lines are already fully loaded, or iv. an alternative NZ standard or technical publication that is agreed to in writing by the Waikato Regional Council.
8	Where any new effluent discharge systems are to be installed and the standards, technical publications or alternative publications that were previously applied in accordance with condition (7) have become obsolete, an alternative replacement New Zealand standard or technical publication that is agreed to in writing by the Waikato Regional Council can be applied.
9	At all times the loading rate of effluent to land shall not exceed the hydraulic absorptive capacity of the soils.
10	There shall be no overland discharge of effluent (i.e. leakage to the ground surface) from any part of the wastewater treatment plant or the effluent land application system
11	Dripper irrigation lines shall be laid in the ground at a consistent depth that is between 150 millimetres and 300 millimetres below the ground surface.

4.1.1.3 Greenacres Golf Club, Tasman District

The Nelson Regional Sewerage Business Unit (NRSBU) have added a pseudo-water recycling plant at the end of the Bell Island WWTP. The recycling plant treats part of the wastewater stream and consists of tertiary membrane treatment using membranes recycled from the Nelson WTP. NRSBU makes the treated wastewater (recycled water) available to users, but the user must get their own consent to discharge and may need to provide additional treatment depending on the end use.

Greenacres Golf Club (Figure 4) is located on Best Island which, like Bell Island, is an island within the Waimea Inlet of Tasman Bay. There is a causeway that connects the island to the mainland on the south-west side and to Bell Island on the north-east side. Greenacres Golf Club has two existing freshwater bores which are consented and used for irrigation purposes.

The Waimea Inlet is a popular location for recreational boating and fishing and culturally important to Te Tau Ihu iwi. The Te Tau Ihu iwi have previously expressed concerns about the discharge of treated wastewater into the Waimea Estuary and the discharge of treated wastewater to land for irrigation purposes held significantly less concern for iwi, and indeed, was a preferred option to minimise impacts on the Waimea inlet.

In February 2023, Tasman District Council (TDC) granted a consent for the discharge of treated wastewater from the Bell Island WWTP to the Greenacres Golf Club (Consent RM211275)[14]. The treated wastewater will be stored in 15 x 30,000 litre above ground storage tanks and the wastewater within each tank would be diluted with freshwater from one of the golf club's existing bores and will be further treated with ultra-violet lamps prior to discharge through the golf club's existing irrigation network. The irrigation system comprises a combination of in-ground pipes and hydraulically operated sprinklers. Irrigation of treated wastewater via sprinklers centrally located within the fairways and within greens was proposed which will help reduce the amount of irrigation water required from their two existing freshwater bores.

The decision by TDC referenced the Victoria guideline and the water pathogen log reductions required. The report concluded that the level of treatment proposed is expected to meet the log removal standards for Class A wastewater. However, it is noted that the limit set out in the consent was <10 E. coli cfu/100mL (c.f. <1 E. coli cfu/100mL as a median in the Victoria guideline). The relevant conditions for the implementation of the golf course irrigation system are set out in Table 13.

Figure 4. Greenacres Colf Club[15]

Table 13. Consent conditions pertaining to practice and application of wastewater at Greenacres Golf Club.

Condition Number	Consent Condition
5	The Consent Holder shall, at all times, have an Operations and Maintenance Manual and an Odour Management Plan in place and make these plans available to the Council's Team Leader - Monitoring and Enforcement upon request…

[14] Decision of Tasmin District Council, Resource Consent RM211275 & RM211278, 1 February 2023.

[15] https://www.greenacresgolfclub.co.nz/

Condition Number	Consent Condition
7	There shall be no surface ponding as a result of the treated wastewater discharge, nor any direct discharge or run-off into any waterbody.
9	The maximum daily rate of application shall not exceed 15mm nor shall the application exceed 35mm in any consecutive 7-day period.
11	The water shall be ultrafiltered via a membrane plant and shall meet the following standards: a) Turbidity <2NTU b) CBOD <10 mg/L c) Suspended Solids <5 mg/L d) pH 6-9, 90th percentile Post the UV treatment the water shall meet the following standards: e) <10 E. coli cfu/ 100mL f) <10 faecal coliforms 100mL
14	The Consent Holder shall discharge treated wastewater to land only when weather conditions are such that it does not result in spray drift and/or an offensive or objectionable odour discernible beyond the property boundary.
15	Wastewater irrigation shall not occur within 24 hours of a 20mm or greater rainfall event occurring. A fit-for purpose weather station shall be established on site for the purpose of giving effect to this condition. Information required to assess compliance with this condition shall be recorded and included in the Annual Report required by Condition 4.
16	There shall be no surface water ponding, direct discharge, or run-off into any water body as a result of the irrigation.
18	Soil pH shall be maintained at pH 5 or greater at all times for the duration that treated wastewater is applied to the land under this consent.
20	The Consent Holder shall provide and maintain adequate signage at the perimeter of irrigation areas warning the general public that treated wastewater has been applied for irrigation purposes.

4.1.1.4 Awatere Golf Course, Marlborough District

Marlborough District Council (MDC), a Unitary Authority, operate the Seddon Sewage Treatment Plant (STP) which receives and treats wastewater from the township of Seddon, before discharging treated wastewater into Starborough Creek, a tributary of the Awatere River.

MDC proposed to upgrade the Seddon STP to achieve tertiary level treatment to ensure the plant can meet Class A quality wastewater under the Victoria Guideline[16]. It was proposed that the treated wastewater from the STP would be irrigated to a new land-based application system. The primary land application area was the Awatere Golf Course (refer to Figure 5) which was to be irrigated via pop up sprinklers. NZ Transport Agency Waka Kotahi owned land located between the railway track and SH1 (2.6ha) that was also to be used for the land application scheme and was to be irrigated via sub-surface dripper lines. Due to site constraints, it was also proposed that treated wastewater be discharged to Starborough Creek at times when the capacity of the storage pond was exceeded, and soil conditions were not suitable for irrigation.

In March 2024, MDC approved a 20-year consent for the discharge (expiring March 2044). Relevant conditions are set out in Table 14.

[16] Decision of Marlborough District Council, Resource Consent U230097, 26 March 2024

Figure 5. Awatere golf course[17]

Table 14. Consent conditions pertaining to practice and application of wastewater at Awatere golf course

Condition Number	Consent Condition
3	Three months prior to irrigation commencing, the consent holder shall provide an Operation and Management Plan (OMP), prepared by a suitably qualified and experienced person, to the Compliance Manager, Marlborough District Council…
5	The discharge shall not result in any detectable wastewater within any of the following setbacks: a) 20 metres any surface watercourse (including any drain) or wetland; or b) 50 metres of any residential dwelling.
6	The irrigation of wastewater shall not result in: a) Spray drift crossing the boundaries of the irrigation area identified in Condition 2; or b) An odour which, in the opinion of a warranted Marlborough District Council officer, is offensive or objectionable beyond the boundary of the irrigation area identified in Condition 2.
12	The consent holder shall install and maintain soil moisture probes at locations that are most representative of the wastewater irrigation areas, as approved by the Compliance Manager, Marlborough District Council. The soil moisture probes are to be installed and operational before the discharge first occurs. Real time soil moisture records shall be kept by the consent holder online and access made available to the Compliance Manager, Marlborough District Council.
14	The discharge to the land application areas must cease in the event that they are inundated with flood waters. Discharge shall not be applied to areas where ponding of rainwater or river water is present. Following subsidence of flood waters on the land application area, the consent holder shall not apply wastewater to the land until there is a soil moisture deficit.

[17] http://www.awateregolfclub.co.nz/

Condition Number	Consent Condition
15	The Total Nitrogen loading on each land application area shall not exceed a nett of 150 kilograms of nitrogen per hectare per year.
17/18	The treatment plant shall produce a wastewater quality that complies with the following: a) BOD < 10 mg/l b) TSS < 5 mg/l c) E. coli <1 per 100 ml If the rolling annual medians specified in above are exceeded, then the consent holder shall take best practicable measures to reduce exceedances. Best practicable measures may include, but shall not be limited to, the measures identified in the Council's Operation and Management Plan required under condition 3. The consent holder shall provide the readings to the Compliance Manager, Marlborough District Council, upon request.
19	Irrigation of wastewater across the land application area must be managed as far as practicable to only occur when a soil moisture deficit is present within the rooting zone of the disposal area as determined by the soil moisture probe. Soil moisture deficit will be determined by a method specified in the OMP as required by Condition 3. Application depth may vary but must take into account antecedent soil moisture conditions and any forecast rainfall. Monitoring during the first 12 months after this consent is first exercised will be used to develop soil moisture triggers to determine the most practicable irrigation management rules. These will be incorporated into the OMP and revised on an annual basis, through updates to the OMP, as more monitoring data is gathered.
24/25	Soil sampling results for areas that receive wastewater shall not exceed the following levels: a) Total nitrogen 0.70% W/W b) Total phosphorus 50 µg/cubic centimetre (mg/L) as Olsen P c) Sodium 6% Base saturation (Exchangeable Sodium Percentage) d) Potassium 20% Base saturation (Ex. Pott.%) If the limits in above are exceeded, the consent holder shall prepare and submit a mitigation plan that includes commentary on existing soil results, any new potential soil sampling and analysis, reasons for increase as well as recommendations and an action plan that identifies remedial works to undertake to reduce exceedances and then retest the soil in the same location(s). The discharge should cease to such sites until remedial action is completed. If the cessation of discharge is not possible ahead of remedial works, the consent holder shall advise the Compliance Manager, Marlborough District Council.

4.1.1.5 Mangawhai Golf Course, Kaipara District

Kaipara District Council (KDC) has been investigating a new land discharge system for treated wastewater from the Mangawhai WWTP, which may involve discharge to land at the Mangawhai Golf Course using a subsurface drip irrigation system to certain areas and spray irrigation to the majority of the golf course. The existing land application system at the Council's farm off Brown Road is approaching full capacity and with an increasing population at Mangawhai an alternative discharge system is required.

KDC is planning to upgrade the Mangawhai WWTP to meet Class A of the Victoria Guideline, to allow for unrestricted irrigation of the local golf course. The existing WWTP includes a cyclic activated sludge (CASS) process followed by filtration and chlorine disinfection. Sludge produced from the plant is dewatered on site[18]. Options for upgrading the WWTP are still being investigated, however the preferred option is expanding the existing CASS process with a downstream Class A system including ultrafiltration, UV and chlorination disinfection. This is currently under investigated with a consent application for the discharge to land scheme

[18] Mangawhai CWWTP Options Report Peer Review, Beca Hunter H2O

at the golf course to be submitted to Northland Regional Council in 2025/2026 pending a decision by KDC to implement the scheme.

4.1.2 Reuse for public gardens, parks and sports fields

Reuse of wastewater for the irrigation of public gardens, parks and sports fields is somewhat less common in New Zealand; however, it is being explored by some councils where there is pressure on potable water supplies.

4.1.2.1 Whangārei District Council Case Study

In 2020, Whangārei District Council (WDC) acquired resource consent from Northland Regional Council (NRC) to discharge tertiary treated wastewater to land (consent number AUT.041644.01.01). This discharge to land was confined to the irrigation of garden beds, trees, and sports fields. A three-year consent was granted to WDC, with the consent being accepted on the 4th of March 2020 and expiring on the 28th of February 2023 (WDC have applied to NRC for a renewal of this consent). The impetus for this consent was a longlist stakeholders workshop run at the Whangārei WWTP. During this workshop, options for reuse were expanded to include parks, gardens, and industrial and plantation applications, as opposed to the originally suggested 100 ha land treatment. This irrigation method is not to be actioned continually, only applied when the WDC or NRC are under pressure for potable water. Because of the large number of unknown factors associated with this practice, the resource consent decision stipulates some stringent and specific conditions around this activity. As well as being asked to provide a Wastewater Irrigation Management Plan, Table 15 details the conditions provided on this practice pertaining to application and practice.

Table 15. Consent conditions pertaining to practice and application.

Consent Number	Consent Condition
5	These consents shall only be exercised during periods when water restrictions are implemented by Whangārei District Council.
6	As a minimum, all wastewater shall receive tertiary (UV) treatment and additional chlorination to provide additional treatment prior to it being used for irrigation purposes.
7	The concentration of faecal coliforms in the treated wastewater, as measured in any sample collected prior to it being used for irrigation purposes, shall not exceed 1000 cfu per 100 millilitres.
8	The irrigation of sports fields with treated wastewater shall only occur on closed sports fields for the purpose of re-establishing vegetation on the fields.
9	The public shall be restricted from sports fields during irrigation activities authorised by these consents and the fields shall remain closed until the surface of the irrigated area is dry. As a minimum, prominent signage shall be placed prior to the commencement of irrigation
10	No treated wastewater shall by discharged to sports fields within: • 20 metres of any property boundary (not owned by the consent holder); or • 12 metres of the coastal marine area; or • 15 metres of a river, lake, stream, pond or natural wetland; or • 5 metres of any identified stormwater flow paths.
11	Garden beds and trees shall only be irrigated with treated wastewater using a hose with a trigger nozzle. The hose shall not be left unattended during irrigation.
12	Treated wastewater shall not be discharged to land during rain events or when the soils within the irrigation areas are saturated.
13	There shall be no ponding of treated wastewater within, or surface runoff of any contaminants from the irrigated areas as a result of the exercise of these consents

Consent Number	Consent Condition
14	The exercise of these consents shall not result in the discharge of treated wastewater into any watercourse, including any identified overland flow path.

For the method of treatment, water tankers are filled at the WWTP post UV treatment. During filling, chlorine is added in the form of 12.5% bleach at the rate of 40 mL per 1000L to provide additional disinfection to the reuse water. A sample is taken to check faecal coliform counts are <1,000 cfu/100 mL and to check if future chlorine levels require adjustment. Once filled, the irrigation water is applied to land via one of two methods:

- **By hose with a trigger nozzle**: This method is used for trees and annual planting. Allows for a highly localised water application.
- **By rear spray bar**: This method is used for grass and sports fields. The tanker will be driven in a pattern to water desired area with an appropriate amount of water. The application area is either roped off, and/or signs are put up to inform the public.

Prior to return, tankers are fully disinfected. This WDC reuse initiative lacked an A Class classification for treated wastewater, necessitating these measurements.

4.1.2.2 Tauranga City Council Case Study

In 2005, the Tauranga City Council (TCC) was granted resource consent (consent number 62886) for the irrigation of treated wastewater from the Chapel Street WWTP. This water, which is secondary treated and UV disinfected, was intended for spray irrigation at eight road reserve sites within the Tauranga District. However, the consent has not been fully utilized due to the consent conditions being overly restrictive and not practical for TCC to implement. As a result, no reclaimed wastewater from Chapel Street WWTP has been used for irrigation since 2010.

TCC is now seeking to re-explore the option of using treated wastewater from either Chapel Street WWTP or Te Maunga WWTP for the irrigation of newly planted juvenile trees rather than the eight road reserve sites specified in consent 62886. This requires a re-evaluation due to the change of application area(s), and technological developments since the last consent was lodged.

Beca has recommended that in order to implement this revised scheme, TCC should explore treatment process upgrades to enable unrestricted public access, achieving compliance with AGWR municipal – unrestricted, Victorian Guideline Class A, or Queensland Guideline Class A+/A standards. Testing and validation will be crucial to ensure water quality targets meet intended uses and health and environmental criteria.

4.1.3 Agricultural Reuse

Agricultural reuse is commonly referred to as discharge to land. Below are a few examples of differing kinds of agricultural reuse in New Zealand.

4.1.3.1 Taupō WWTP wastewater discharge to pasture[19]

The surface waters of the Taupo district are of high quality and are sensitive to nitrogen inputs. To reduce nitrogen discharge into these waters, the Taupo District Council employed a land treatment scheme in 1995, in which treated municipal wastewater from the Taupo WWTP is irrigated onto ryegrass pasture. Previous to this scheme, the wastewater effluent was discharged into the Waikato River. The movement from direct disposal into water to application onto land was seen as a big improvement both culturally and environmentally.

[19] Taupo District Land Treatment Scheme - Revisited. Water New Zealand (Sunich, S), 2016.

In 2008, the scheme was expanded to accommodate projected population increases and connection to two additional sites, Acacia Bay and Rakaunui Road. Lucerne was added to the irrigated crop. The current consent allows for the irrigation of up to 15,000 m^3 per day of treated wastewater effluent across nearly 500 hectares of farmland. The haylage crop produced through this irrigation is baled and sold to dry stock farmers, helping to fund the scheme which at the time was the largest municipal wastewater irrigation scheme in New Zealand.

4.1.3.2 Central Hawkes Bay wastewater discharge to pasture

Central Hawke's Bay District Council (CHBDC) has been implementing a major infrastructure project to secure the future of the district's wastewater network. This focuses on the areas of Waipawa, Waipukurau, and Ōtāne; Pōrangahau and Te Paerahi; and Takapau. The Te Paerahi and Pōrangahau WWTPs currently discharge to sand dunes (Te Paerahi) and the Pōrangahau River (Pōrangahau) and it is CHBDC's intention to transition these to a discharge to pastoral grazing (low intensity rotational cropping) land within nine years.

Since 2018, CHBDC has been consulting with the community and Mana Whenua on a preferred discharge solution. This has culminated in a staged plan to remove the existing discharges from the present locations and to discharge 100% of future flows to private land. Currently, the preferred land discharge sites have been consented for Takapau WWTP and consent conditions are being finalised for the combined Te Paerahi/Pōrangahau WWTPs (for discharge to land).

The consent for Takapau WWTP includes a consent to discharge effluent onto or into a wetland (consent number AUTH-127077-01) as well as onto land (consent number AUTH-127078-01). The discharge to land consent includes irrigation to pasture with a High Rate Land Passage (HRLP) option to be employed when the field capacity has been reached. HRLP is an alternative to a direct discharge of treated wastewater into a waterway and involves passing the treated wastewater through the land (for example, a series of earth basins separated by gravel berms and planted with suitable species) before discharging to water[20]. The consent sets effluent quality standards for BOD, TSS, ammoniacal nitrogen, Dissolved Inorganic Nitrogen, Dissolved Reactive Phosphorus and *E. Coli* for the discharge to land. The consent also includes maximum Nitrogen and Phosphorus loads (kg/ha/year) and set back distances from sensitive receptors. Animals cannot be grazed on the land for at least 48 hours after irrigation (or while the pasture is wet with irrigated wastewater, whichever is longer).

4.1.3.3 Blenheim WWTP discharge to vines

Two significant grape growers on the outskirts of Blenheim town have requested to receive recycled wastewater from Marlborough District Council (MDC to provide irrigation water to facilitate significant expansion to their grape growing areas. They wish to receive wastewater treated to the same standard as used in the Willunga Basin Scheme in South Australia. That is, Class C recycled water in accordance the Victoria Guideline.

Apart from these two, there is a very large expansion of grape growing proposed by various wine companies around Blenheim and there is only very limited availability of water resources to support such expansion in this very dry region.

The Blenheim WWTP is situated in areas (land and estuary) of very high cultural significance to Te Rūnanga o Ngāti Rārua, and discharges treated wastewater into the Wairau Estuary. Te Rūnanga o Ngāti Rārua have expressed deep concern with the effects of the WWTP discharge on the awa, moana and mahinga kai.

MDC aims to limit wastewater discharge into local awa and moana. As one mitigation measure, MDC is currently investigating and considering the 'irrigation to grapes' proposal and initiating a consent process to

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[20] High Rate Land Passage Structures For Attenuation At High Risk Land Application Periods, prepared by Lowe Environmental Impact Limited (Lowe, H. and Cass, S), 2015. Accessed from: https://flrc.massey.ac.nz/workshops/15/Manuscripts/Paper_Lowe_2015.pdf

allow that to happen. This consenting would be informed by the Victoria Guideline. Irrigation of vines (as with most crops) would not be viable all year round.

4.1.4 Industrial Use

Beca is not aware of any industrial reuses of municipal wastewater currently in place within New Zealand, although industrial reuse of treated wastewater was previously investigated at the NZ Oil Refinery at Marsden Point and NZ Steel in Glenbrook. Reuse of industrial wastewaters for washdown are more common. The dairy industry, for example, commonly reuses ‘Green Water’ (water containing dairy effluent) for initial washdown of dairy sheds.

4.1.5 Potable Reuse

Given public opinion on the use treated wastewater as potable water, direct potable reuse of treated wastewater in the short to medium term would be difficult. Legislative changes to the New Zealand Drinking Water Standards would be required in order to facilitate direct potable reuse of treated wastewater.

4.1.5.1 Watercare Indirect Potable Reuse, Auckland

New Zealand effectively already has unplanned indirect potable reuse of treated wastewater occurring in the Waikato. Watercare takes a large potable water volume from the Waikato River at Tuakau for supply to Auckland City. Upstream of that, discharges of treated wastewater effluent to the Waikato River occur at Hamilton, Meremere, Huntly, Ngāruawāhia, Huntly, Cambridge, Tokoroa and other places.

Watercare is also considering recycled water from their Mangere WWTP for potable use.

4.1.5.2 Watercare Citizens Assembly, Auckland

The Watercare Citizens Assembly Project (Citizens Assembly) engaged with 37 community members to deliberate on Auckland’s next major potable water source beyond 2040. The final recommendation of the Citizens Assembly was direct potable reuse for Auckland’s next source of water (while still investigating the feasibility of desalination)[21]. The group was representative of Auckland residents based on age, gender, ethnicity, education, and varying home ownership. Independent experts provided information, discussion and answered questions so the Citizens Assembly could understand the complexity of this issue and the different source waters. Mana whenua were also engaged to ensure the views of Māori were considered and the principals of Te Mana o te Wai were understood. The Citizens Assembly was held over four sessions throughout August and September 2022, exploring potential water supply options and undergoing a deliberative democracy process.

A copy of the Citizens Assembly report was circulated to all iwi across Tāmaki Makaurau (Auckland) with the opportunity to provide feedback. Several iwi supplied feedback showing the desire to be involved in decision making and that any recycled water projects need to be developed in a way that accords with tikanga.

4.1.5.3 Watercare Recycled Water Pilot Plant, Auckland[22]

Following the Citizens Assembly, Watercare constructed a small scale advanced water treatment plant to pilot recycled water technologies. This included a 500kL per day non-potable recycled water treatment train as well as a small advanced recycled water treatment train for producing drinking water quality purified recycled water at their Mangere WWTP. In the absence of New Zealand guidelines and regulations, the pilot plant was designed using international guidelines, including the AGWR, which were used as a reference.

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[21] Citizens' assembly project. ((n.d.)). (Watercare) Retrieved June 17, 2024, from Watercare Auckland: https://www.watercare.co.nz/About-us/Information-Hub/Community-engagement-hub/citizensassembly-project

[22] Turning the Tap: The first steps towards water reuse, Water Journal, Watercare Services Limited, May/June 2024

The potable and non-potable treatment trains are linked. However, for the smaller potable train, the wastewater is taken after the ultrafiltration step and passes through reverse osmosis membranes as well as an advanced oxidation treatment process combining high-intensity UV light and peroxide, and granular activated carbon filtration to remove remaining peroxide, before being dosed with chlorine for residual disinfection (see Figure 6).

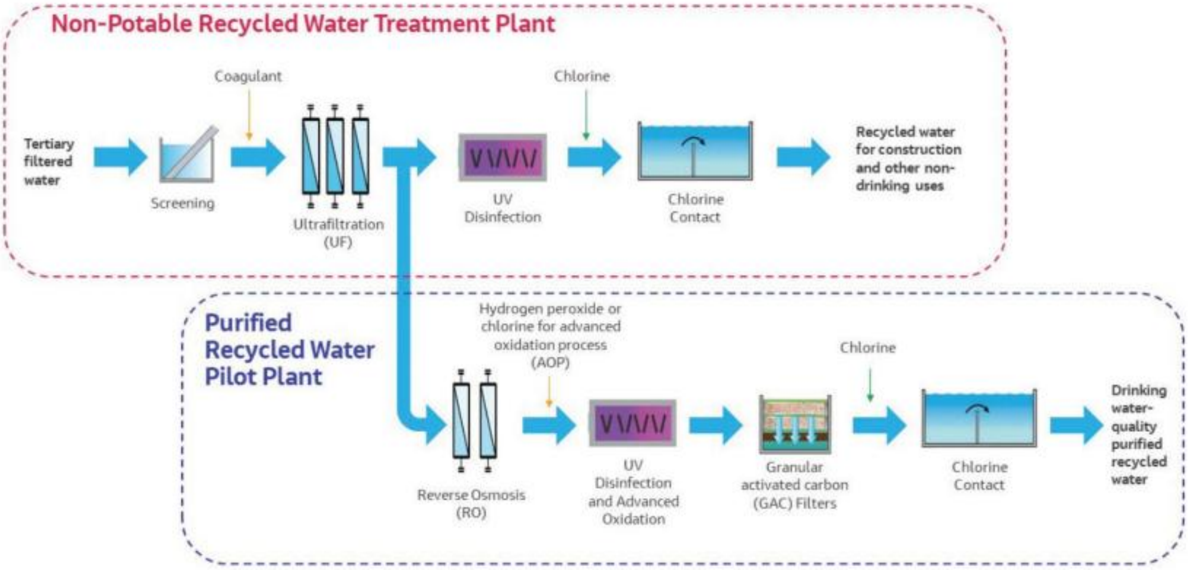

Figure 6. Watercare reuse treatment trains (source: Water Journal May/June 2024)

Commissioning of the plant is still ongoing, however since October 2023 Watercare has been testing the potable water train and tracking it against the New Zealand Drinking Water Standards in order to understand the plausible future use of wastewater for potable reuse.

4.1.6 Reuse during Construction

Reuse of wastewater for construction involves replacing potable water used for concrete production with treated wastewater. It may also involve use of water for dust suppression.

4.1.6.1 Watercare Central Interceptor, Auckland

The Central Interceptor will, once construction is complete in 2026, be a 16.2km long wastewater tunnel that runs underground from Grey Lynn to Watercare's Māngere WWTP[23]. Sustainability was a key driver for this project and one of the sustainability innovations employed was the reuse of wastewater for construction water, reducing the demand on potable water supplies[24].

As outlined above, Watercare has developed a recycled wastewater treatment plant at their Mangere WWTP with a potable and non-potable treatment system. The 500kL per day non potable treatment system was designed and built for use in the Central Interceptor's tunnelling activities[25]. The treated wastewater has subsequently been used by Watercare for construction water.

[23] https://www.watercare.co.nz/home/projects-and-updates/projects-around-auckland/central-interceptor

[24] From Concept to Reality: The Central Interceptor Sustainability Journey, Watercare Services Limited (Philpott, O. and Cunis, S).

[25] Turning the Tap: The first steps towards water reuse, Water Journal, Watercare Services Limited, May/June 2024

Construction water includes non-potable water used to washdown trucks, dust depression, cooling the tunnel boring machines (TBMs) and conditioning the earth at the face of the TBMs.

4.2 Important Matters for Consideration

4.2.1 Cultural Considerations

Mātauranga understandings of water quality are quite different to western scientific understandings of water quality[26]. Freshwater or Wai-Māori is ordinary water with no sacred associations, but it has its own purpose and its own mauri or life force. Polluted water, or Wai-kino, on the other hand, is a body of water that has its mauri altered through pollution or corruption. Wai-mate (dead water) is water that has lost its mauri and is dead in the sense that it has lost its power to rejuvenate either itself or other living things. Like wai-kino, wai-mate is dangerous to humans because it can cause illness or misfortune.

Furthermore, mixing the mauri of two different sources can be seen as a disruption to the natural order, potentially diluting the sacred qualities. This practice holds significant implications for Māori and others who adopt a traditional approach to ecosystem or environmental management[27].

Whilst there is a lack of specific iwi and hapū perspectives on recycled water use per say, drawing from these understandings of water will help in understanding some of the benefits and limitations of reusing wastewater including the feasibility of any approach. Consultation with local iwi and hapū on the effect that a reuse scheme will have on the mauri of the receiving environment is critical.

Specific to the Southern Metro DBC, the following objectives have been identified including 'implement and operate a wastewater treatment and discharge solution for the south of Hamilton City, Airport, and northern Waipā District that contributes to the restoration and protection of the health and wellbeing of the river' and to 'maximise efficient use of resources and resource recovery to contribute to net zero greenhouse gas related emissions from the wider Metro wastewater network'. As such, implementing a wastewater reuse option in conjunction to the primary discharge method would help reduce the total discharge to the Waikato River and help meet the objectives of the Southern Metro DBC.

4.2.2 Wastewater Contaminants

The Australian Guidelines focus on water-related pathogens (including viruses, bacteria, protozoa), BOD and TSS. Pathogen removal is key to managing public health risk. However, there are other contaminants that need to be accounted for in the reuse of wastewater including heavy metals and emerging contaminants.

4.2.2.1 Heavy Metals

Wastewater can contain an array of toxic chemicals, particularly through heavy metal contaminants such as copper, lead or zinc. Heavy metals can accumulate in the surface soil by irrigation of land with wastewater and then they can leach into the ground water or the soil solution when soil capacity for retaining heavy metals is reduced. Irrigation of land with treated wastewater can have adverse public health effects due to contamination of soils and ground water with heavy metals. Therefore, for safe irrigation of land with treated wastewater, environmental risk assessments of nutrients and chemical contaminants should be carried out. As with nutrients and other inorganic contaminants, other reuse options such as reuse for construction will also need to give due consideration to heavy metal concentrations and mitigation measures for reducing the risk of the recycled water entering stormwater will need to be considered. A full contaminant analysis is therefore recommended at the next stage of selection and design of the reuse option.

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[26] Wai Māori - Māori values in Water, Greater Wellington Regional Council (Grace,M), 2010.

[27] Sustainable Wastewater Management: A handbook for smaller communities, Ministry for the Environment, 2003

4.2.2.2 Emerging Contaminants

Emerging contaminants are a diverse group of chemicals that are not commonly monitored but have potential to cause adverse environmental or human health effects. Several chemicals found in wastewater, including pharmaceuticals, endocrine disrupting chemicals (EDCs), microplastics and per- and poly-fluorinated alkyl substances (PFAS), are of emerging concern with respect to municipal discharges. In assessing the risk of wastewater reuse options, emerging contaminants should be taken into account, especially for which there is insufficient toxicological information.

However, many of these emerging contaminants are not routinely included in effluent or receiving water monitoring programmes, with data collection and monitoring of emerging contaminants very inconsistent across regions in New Zealand. For many emerging contaminants, data is still lacking on the occurrence, environmental fate and ecotoxicity. Some emerging contaminants are required to be monitored in specific wastewater discharges as a result of the associated discharge consent conditions (based on the original assessment of effects). At a national level, the variation in monitoring frequency, testing methods and interpretation makes comparison of the piece-meal emerging contaminant data very difficult. More research is needed on potential effects of emerging contaminants and on human health impacts of EDCs, their presence in treated wastewater, and their elimination by treatment processes. At present, Watercare is monitoring emerging contaminants as part of their recycled water pilot study in order to collect information about what contaminants are in the catchment and how effective their treatment processes are at removing contaminants of emerging concern.

WWTPs have been found to be a major source of micro-plastics to the environment[28]. However, there is limited data available on the concentration and types of microplastics being discharged from WWTPs in New Zealand, as testing for microplastics is costly and time consuming.

[28] *in Wastewater in New Zealand: Current Data and Knowledge Gaps*, Water New Zealand conference paper (Ruffell, H., Gaw, S., Pantos, O., and Northcott, G), 2022.

5 Assessment of Reuse Opportunities for SWWTP

The purpose of this section is to explore possible reuse options for the SWWTP and make recommendations on the options that should be further considered in the next stage of the project. It is understood that these reuse options would supplement the primary discharge method currently being investigated.

This section explores the feasibility of reusing treated wastewater from the SWWTP for the following uses:

1. Reuse for golf courses, sports fields and parks

2. Agricultural Reuse

3. Industrial Reuse

4. Reuse for the construction sector

5. Indirect Potable Use

This feasibility assessment is based on the quality of the wastewater and the associated public health risks, using the Australian Guidelines as a reference, and is not an exhaustive feasibility assessment. Local plans, rules and policies have not been considered and a planning and consenting strategy should be undertaken for any option being considered further.

The assessment of possible sites for reuse is based on a desktop review and no discussions with landowners or operators has been undertaken at this stage. These discussions will be required to determine whether a reuse option is plausible.

5.1 Reuse for golf courses, sports fields and parks

This section looks at the suitability of the wastewater as irrigation water for places with public access, including: golf courses, public gardens, sports fields and parks. There is a cross over here with the discharge to land assessment currently being undertaken for the SWWTP, however this report is looking at the reuse of treated wastewater as irrigation water and would be supplementary to the primary discharge method.

5.1.1 Suitability of the Reuse Option

Based on the assessment of possible reuse options set out in Table 11 of this report, it is considered that the treated wastewater from both the Stage 1 SBR plant and the Stage 2 MBR plant would be suitable for reuse as irrigation water for municipal open spaces and for landscape irrigation.

Based on the current approach of applying the Australian guidelines to reuse options assessments, wastewater from the SBR plant could be used for irrigation to golf courses, gardens, sports fields and parks when there is no public access. Subsurface drippers will most likely be required. Other irrigation options could be considered if the enhanced restrictions on access and application as set out in the Australian guidelines are applied. However, given the SBR plant will be temporary and will be paired with a discharge to land scheme, the option of irrigating wastewater from the WWTP to golf courses, gardens, sports fields and parks may not be financially feasible.

The MBR plant, on the other hand, will have a higher quality of wastewater and may meet Class A wastewater quality for municipal use (based on the Victoria guidelines). Irrigation to golf courses, gardens, sports fields and parks using a sprinkler system with some restrictions including buffer zones and spray drift control may therefore be plausible. Other similar applications of Class A treated wastewater (see Section 4.1.1 above) use a combination of sub-surface drippers (for areas with public access) and spray irrigation (for areas without public access).

5.1.2 Availability of Sites for Reuse

The closest golf course is Tieke Golf Course, located c. 3km from Site 1 and c. 2.5km from Site 2 (refer to Figure 7). This would be the most convenient in terms of conveyance, however it is noted that this golf course already has fairway watering[29] and as such the course operators may only seek to employ wastewater reuse if there are future water allocation/availability issues with their current irrigation system.

Narrows Golf Course, located east of Sites 1 and 2, on the eastern bank of the Waikato River, was excluded from this assessment as it is understood that the golf course has closed, and the future use of the site is unknown.

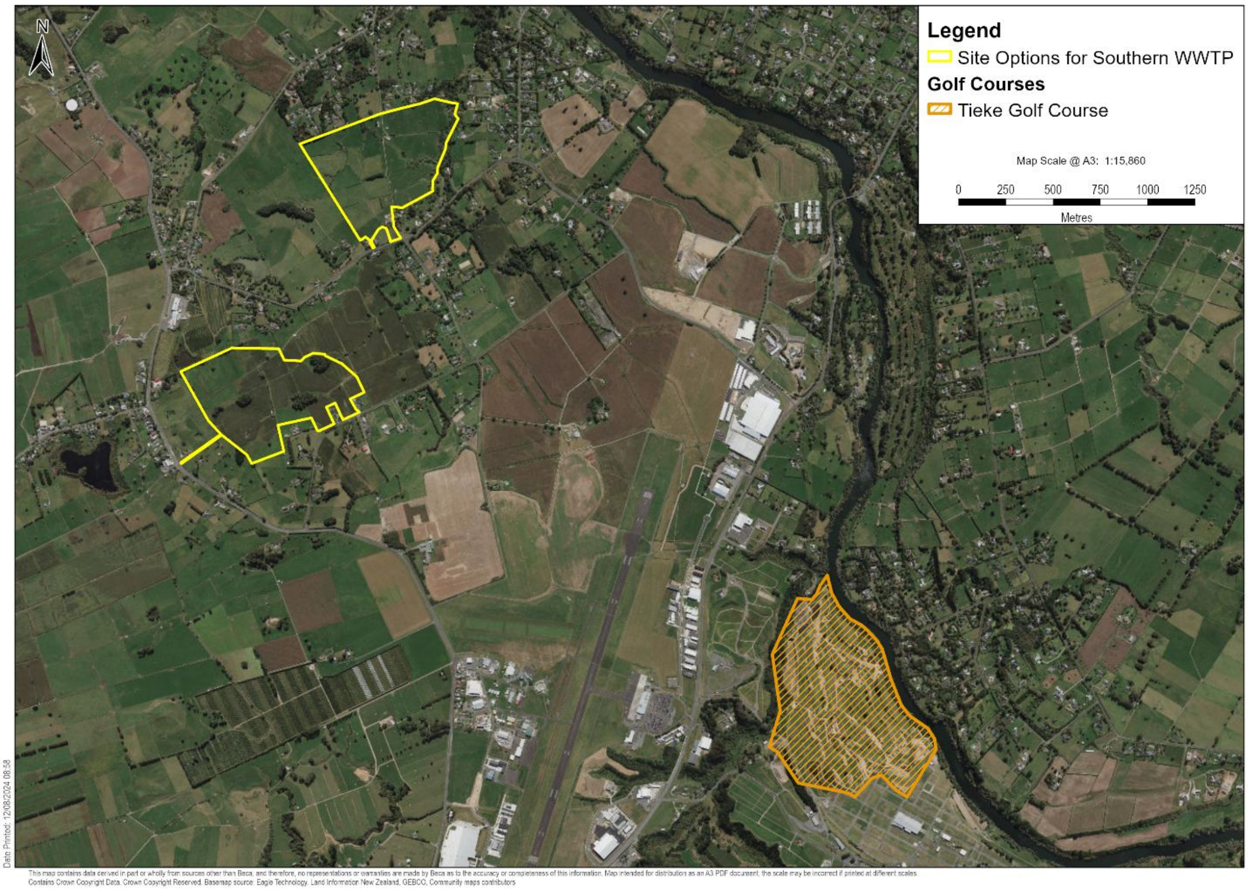


Figure 7. Location of golf courses in relation to the proposed SWWTP sites

The Hamilton Gardens consists of 18 enclosed themed gardens, connected by planted courtyards and walkways. Three more gardens are under development and a further 17 are planned before the collection is complete[30]. The Hamilton Gardens are located c. 4km from Site 1 and c. 5km from Site 2 (see Figure 8). Due to the size of this garden complex, there may be an option to explore reuse at this site provided adequate public access controls could be put in place.

[29] https://tournamentteem.co.nz/easter-golfing-holiday-2022/

[30] https://hamiltongardens.co.nz/about-us

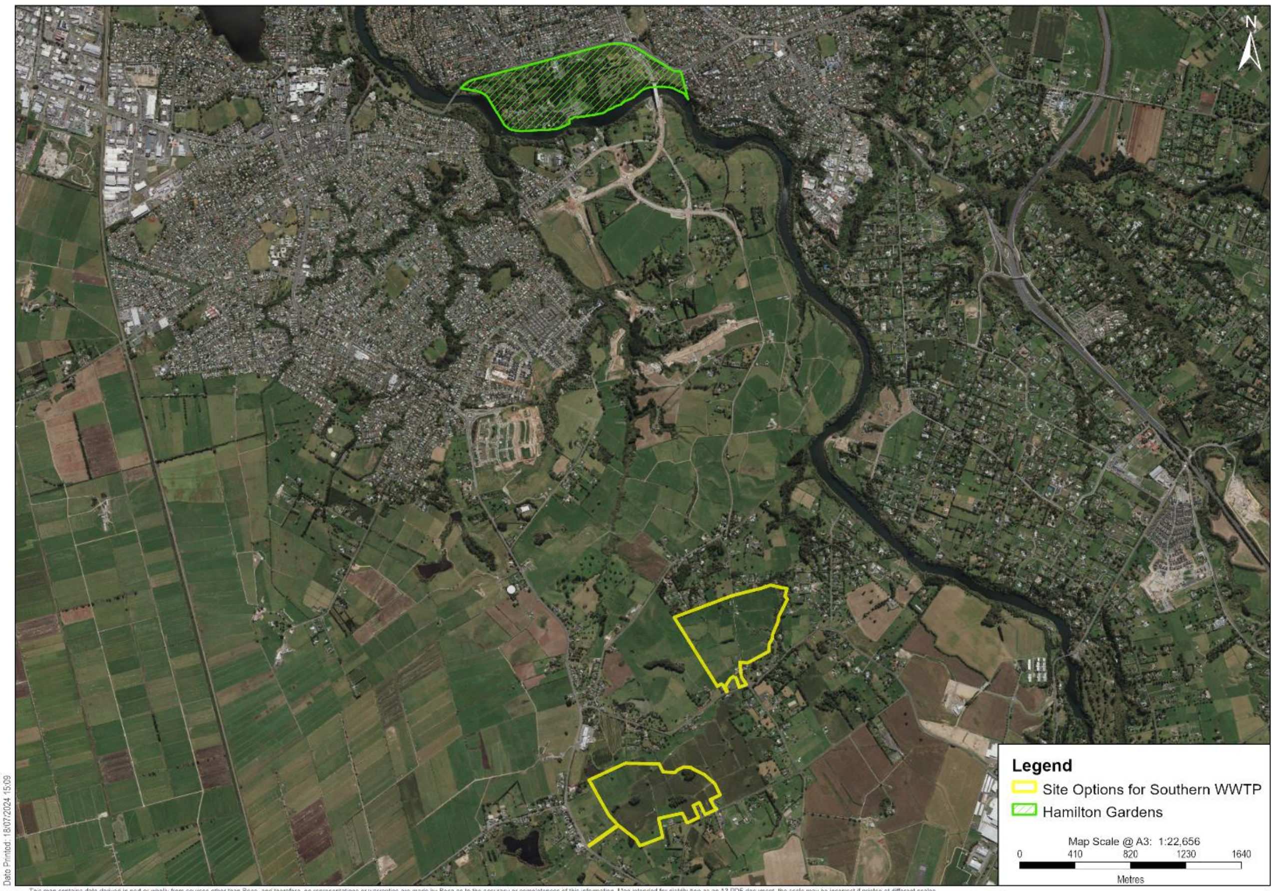


Figure 8. Location of Hamilton Gardens (green) in relation to the proposed SWWTP sites (yellow)

Furthermore, Hamilton Airport (location shown on Figure 11) is in close proximity to both Site 1 and Site 2, and contains grassed areas, such as the runway apron, that may require irrigation over the summer months. Reuse of treated wastewater for irrigation of these areas through either spray irrigation or subsurface irrigation could be explored for this site provided adequate access controls could be put in place.

In addition to these locations, there are a large number of smaller local parks and sports fields within the South Hamilton area (refer to Figure 9). These include Resthills Park (including Waikato Softball Club), Te Anau Park, Glenview Park, Fitzroy Park (including soccer fields), Mahoe Park (including baseball fields), Melville Park, Gower Park (including the Melville United AFC club grounds) and Deanwell Park plus Melville Rugby Football Club grounds. In order to manage the daily volumes of wastewater that will be produced, it may be necessary to provide irrigation to multiple parks within close proximity of each other.

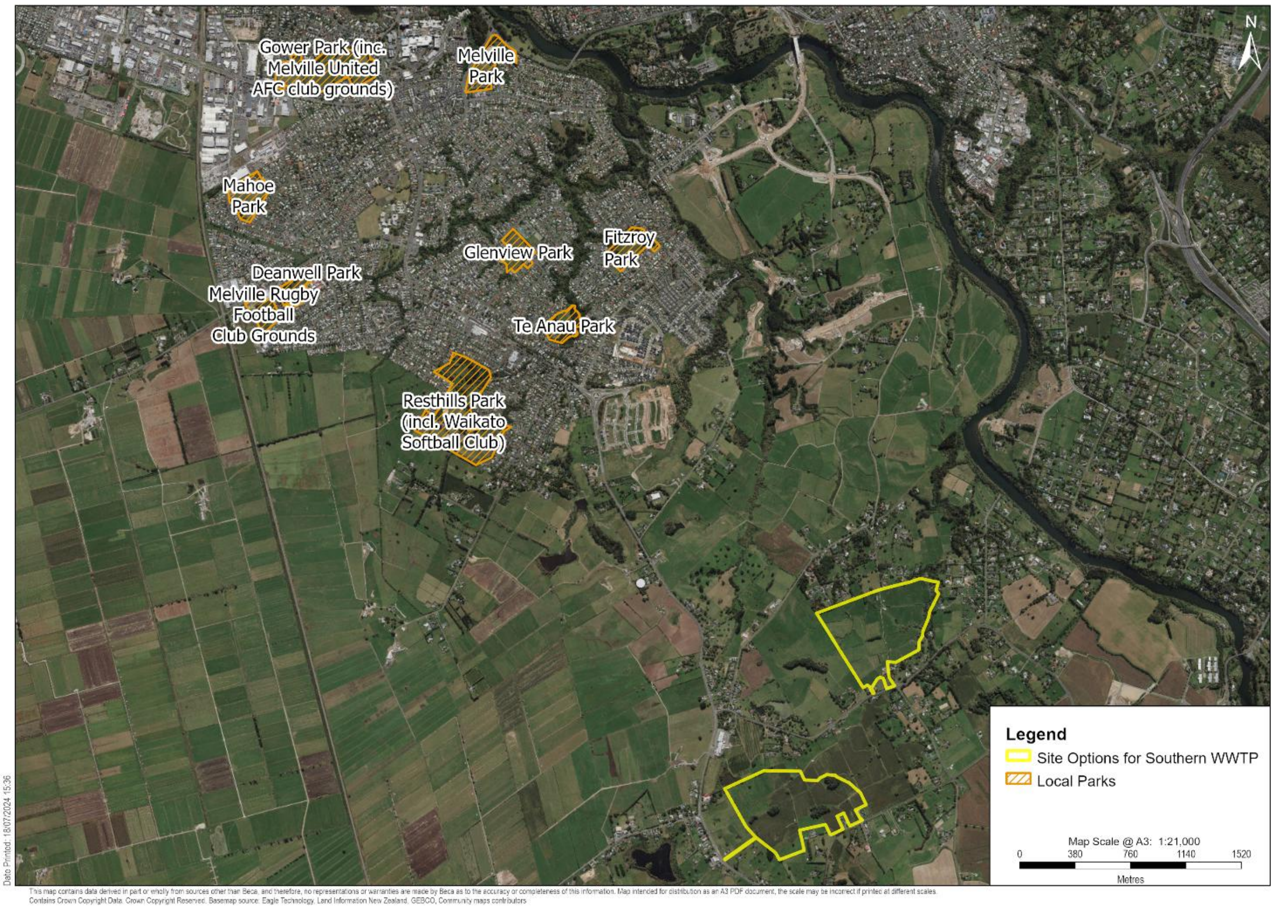


Figure 9. Sports fields and local parks within the South Hamilton area

5.1.3 Potential risks and limitations

As these places are mainly located in urban areas, human contact with water irrigation is more probable. Irrigation with treated wastewater may generate unpleasant odours which are discharged to the atmosphere and cause public annoyance. However, subsurface irrigation systems do not produce odours or aerosols. An assessment of the potential odour impacts may also be required to ensure there is no objectionable odour at or beyond the irrigation area boundary.

Airborne transport of microorganisms within aerosols during irrigation of land with treated wastewater is the key public health risk. However, the level of potential risk is dependent upon the level of treatment and wastewater quality. Controls including spray drift control, buffer zones, and / or reduced access after irrigation may be required to manage public health risks.

As with discharge to land options, additional studies into the impact on local soils, surface water bodies and groundwater would need to be completed to ensure this option is feasible from an environmental perspective. However, it is anticipated that due to the high quality of the treated wastewater from a MBR treatment system there will be an imperceptible impact on sensitive waterbodies within the vicinity of the discharge.

5.2 Agricultural Reuse

The reuse of treated wastewater can be considered an important asset for agricultural purposes. If there are agricultural lands within the vicinity of the SWWTP sites, reuse of treated wastewater for agricultural irrigation should be investigated; in particular, during times when the river is most sensitive to adverse effects at low river flows (assuming a discharge to water is the primary discharge method chosen).

It is noted that a feasibility assessment is being prepared by Beca to determine theoretically appropriate land parcels for the SWWTP to discharge to land. Three discharge to land methods have been considered in this assessment: Rapid Infiltration (RI), Slow Rate Irrigation (SRI) – Surface, and SRI – Subsurface. The assessment has focused on looking at rural land parcels within 15km of the proposed WWTP locations, with exclusion zones applied to find appropriate land parcels.

As such, this report is not looking at agricultural lands suitable for a discharge to land scheme. Rather, this section will assess alternative reuse options for the following kinds of agricultural reuse:

- Irrigation to nurseries
- Irrigation to orchards
- Irrigation to vineyards

It is assumed that agricultural reuse to nurseries, orchards or vineyards would be considered in conjunction with other options including other discharge methods.

5.2.1 Suitability of the Reuse Option

Based on the assessment of possible reuse options set out in Table 11 of this report, it is considered that the treated wastewater from the Stage 2 MBR plant would be suitable for agricultural reuse including irrigation to non-food crops. It may also be possible to irrigate to food crops, depending on the level of treatment the MBR plant can achieve. Regulatory approval from the horticultural industry, such as from Horticulture New Zealand, will likely also be required.

Based on the AGWR, the treated wastewater from the Stage 2 MBR plant may be suitable for crops with limited or no ground contact and/or where the skins are removed before consumption. Crops with no ground contact and that are heavily processed, such as vineyard grapes, should also be considered. The level of treatment that could be provided by the MBR plant would also be important for determining the dispersal method, whether that be spray irrigation or sub-surface drippers. Spray drift control and buffer zones would also be required to protect public health.

Irrigation of wastewater from the Stage 2 MBR plant to salad crops or ground berries is less likely to be plausible unless the level of treatment from the MBR plant is sufficient enough to reach the fit-for-purpose log removals for that use. Public perception around irrigation of wastewater to raw food crops may also make this option unfeasible and operators may be unwilling to consider this use. As such, raw food crop sites have not been considered further at this stage.

Irrigation to non-food crops such as trees, turf, woodlots, and flowers is likely to be feasible for the treated wastewater from the Stage 2 MBR plant when considering the quality of the wastewater in reference to the Australian guidelines. Depending on the level of treatment the MBR plant can achieve, spray drift control, the use of subsurface irrigation, and/or the application of buffer zones may also be needed to minimise public health risks.

Based on the assessment of possible reuse options set out in Table 11 of this report, it is considered that the treated wastewater from the Stage 1 SBR plant would be suitable for agricultural reuse including irrigation to non-food crops. Irrigation to food crops is less likely to be feasible; and due to the short-term nature of the SBR plant, it is not advisable to pursue food crop irrigation future due to site restrictions. Irrigation to pasture or fodder crops, or to commercial nurseries, could be considered further for the treated wastewater from the SBR plant.

5.2.2 Availability of Sites for Reuse

There are a number of plant nurseries to the south-east of the proposed WWTP sites including: Genesis Nurseries, Riverton Nurseries, Burwood Nurseries, Annton Nursery, Johns Nursery and Kaipaki Nursery.

Genesis Nurseries provides cultivars of apple, cherry, pear and stone fruits[31]. Full Bloom Nursery is located north-east of the proposed WWTP sites next to Newstead Orchard.

There are also a number of fruit orchards within the South Hamilton area. These include: Kaipaki Nursery & Orchard, Bruntwood Apple Orchard, Mātangi Persimmons Orchard, Nashi Pear Farm, Newstead Orchard, and Glenview Orchard (48 McGregor Road). There are other unnamed orchards within the district that may be part of larger conglomerates.

Covered crops producers in the vicinity of the SWWTP include T&G Covered Crops (OHA Site) which is understood to be a hydroponics greenhouse for tomatoes. Johns Nursery is adjacent to this site as well.

Ōhaupō Olives grove is located c. 6.5km south of Site 1 and c. 5.5km south of Site 2, however this is a small facility and is used also for a homestead.

Vilagrad Winery and Vineyard has a small vineyard to the south-west of the proposed sites located along Rukuhia Road (c. 8km from Site 1, c. 7km from Site 2). This is close to the Glenview Orchard site at 48 McGregor Road, and as such a combined supply could be considered.

The location of these sites in shown on Figure 10. It would be more efficient to consider supply to multiple sites within close proximity to each other to reduce conveyance costs and maximise supply to the reuse sites.

It is also noted that this is not an exhaustive list of available facilities.

[31] https://gnl.nz/our-story/

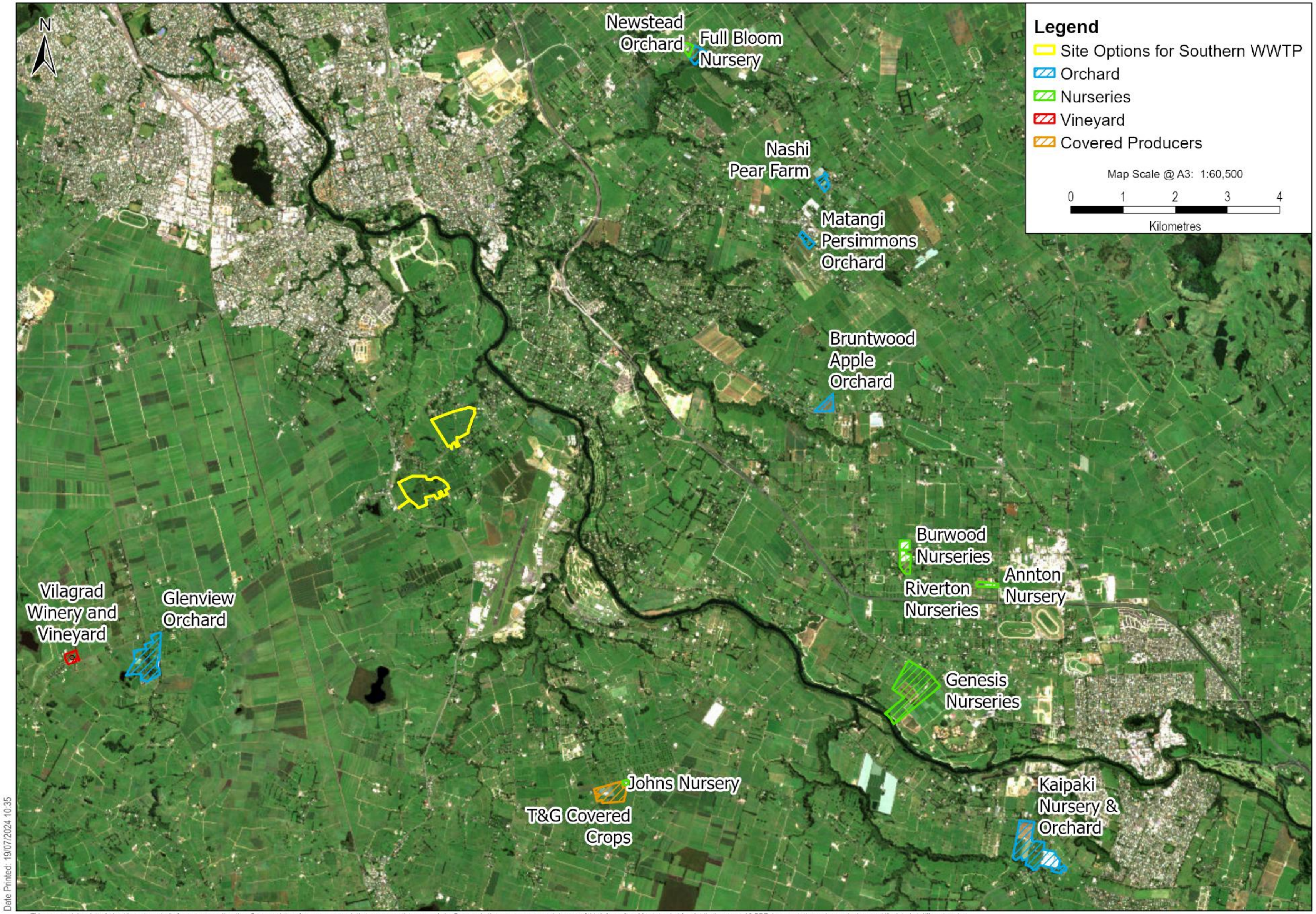


Figure 10. Location of known orchards, vineyards, plant nurseries and other agricultural sites

5.2.3 Potential risks and limitations

The selection of application method will be essential. Spray irrigation could pose a public health risk for those working in the orchards, vineyards, or plant nurseries; especially if Class A treated wastewater cannot be achieved. Controls including spray drift control, buffer zones, and/or reduced access after irrigation may be required to manage public health risks. Subsurface irrigation may also be preferable to minimise risk, depending on the quality of the wastewater. Irrigation of food crops is highly unlikely to be plausible for Class B or C wastewater due to public health risks.

There might be some risks with reusing the treated wastewater in agriculture, such as increase in the soil salinity, as well as the existence of microbial microorganisms and pollutants that could pose several health and environmental risks. Some countries have developed guidelines and quality criteria for treated wastewater reuse in agriculture to mitigate environmental and health risks.

An assessment of the potential odour impacts may also be required to ensure there is no objectionable odour at or beyond the irrigation area boundary.

It is noted that discharge to agricultural sites in New Zealand has typically included discharge to pasture (see Section 4.1.3). However, examples of reuse to other agricultural sites such as vineyards is less common and there is limited precedent (MDC are only investigating irrigation to vineyards at this stage).

5.3 Industrial Reuse

There may be opportunities for industrial reuse if there are existing wet industrial facilities within the vicinity of the site. It is also useful to consider any future wet industry that is planned within the vicinity of the site.

Wet industry is industry that uses high volumes of water and generates manufacturing or process wastewater that is difficult to treat (this is typically discharged to trade waste). An example would be shipping container washing facilities. Other industrial uses could include those that have cooling towers.

It is anticipated that an industrial reuse would be used in conjunction with one or more of the other discharge options proposed.

5.3.1 Suitability of the Reuse Option

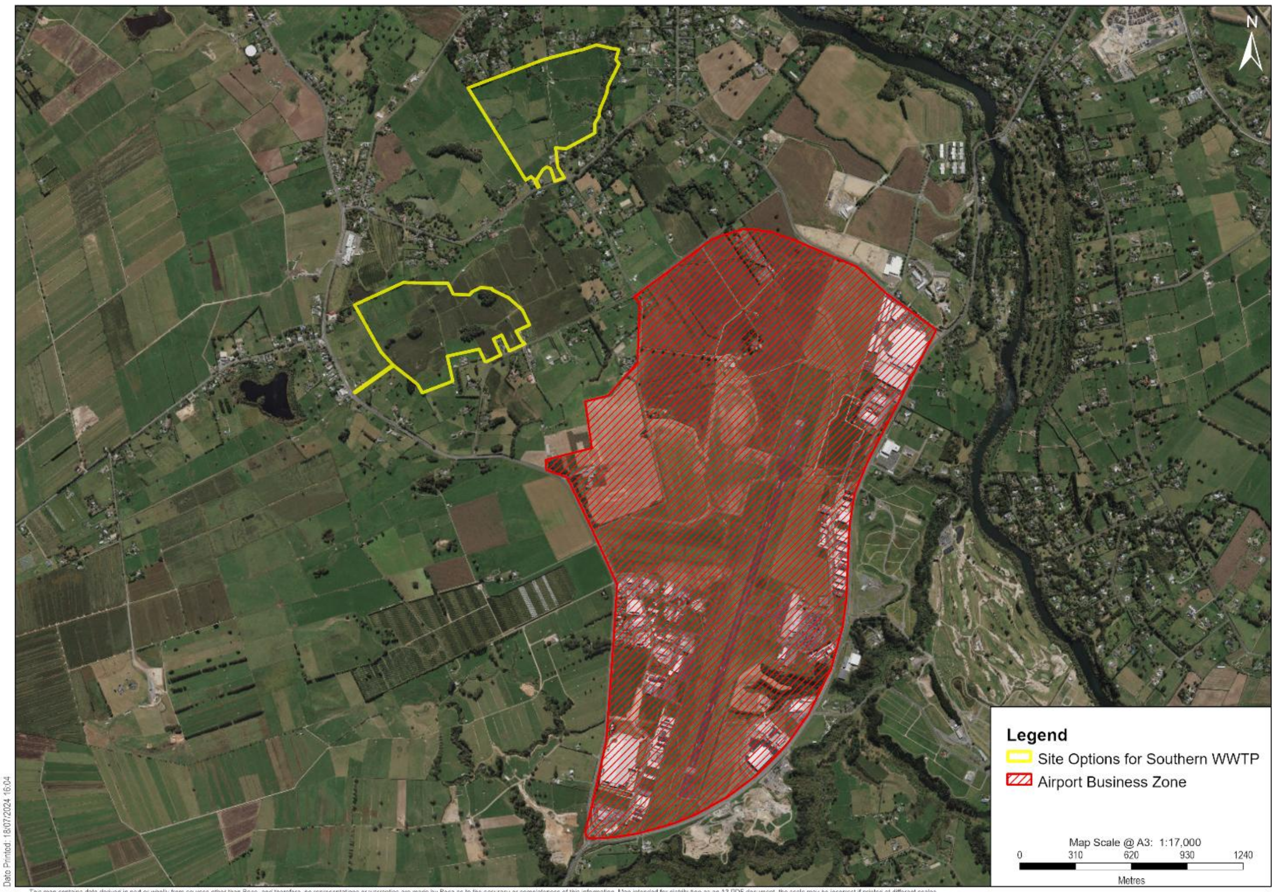
Based on the Australian guidelines and assessment prepared in Table 11 of this report, the Stage 1 SBR plant should produce wastewater suitable for wet industry provided there is no worker exposure and a thorough risk assessment had been undertaken to address any public health risks.

The Stage 2 MBR plant would produce wastewater more suitable for wet industry and should therefore be explored. If the MBR effluent is to be used for cooling tower water, then a Class A level of treatment will likely be required and other considerations will need to be included in the risk assessment including legionella risks.

The driver for using recycled water over potable water for these industries will be dependent on affordability of the treated wastewater (versus potable water) and regional and district policies encouraging sustainable solutions. Availability of water sources, or lack thereof, will also be a key driver.

5.3.2 Availability of Sites for Reuse

The closest industrial area to the proposed WWTP sites is the Airport Business Zone (see Figure 11). Zoning around the airport precinct allows for wet industry developments however the extent to which these may eventuate is not currently clear.



This map contains data derived in part or wholly from sources other than Beca, and therefore, no representations or warranties are made by Beca as to the accuracy or completeness of this information. Map intended for distribution as an A3 PDF document, the scale may be incorrect if printed at different scales.

Figure 11. Location of the Airport Business Zone in relation to the proposed sites for the SWWTP

At present the Airport Business Zone appears to only have light industry. Whilst heavy industry is not prohibited by the zone, it could be restricted in the developer agreement with Waipā District Council as there is limited water supply available currently. As such, there is potential that wet industries could be developed within the Airport Business Zone should a recycled water option be made available, minimising the pressure on potable water supply.

5.3.3 Potential risks and limitations

Consideration should be given to the final discharge of the treated wastewater. Where wastewater is proposed for use in industrial purposes, the final destination of the wastewater from that activity should be considered. Reuse in industry should only be considered where it will not cause a cumulative negative impact on the receiving environment. Given the proximity to the SWWTP it is likely that the reused wastewater will end up in trade waste and subsequently back in the WWTP, concentrating some of the more concerning contaminants such as heavy metals and emerging contaminants. However, due to the anticipated high quality of the wastewater due to the proposed MBR technology, reuse of treated wastewater in the Stage 2 SWWTP should not pose a higher level of risk to the environment than the use of potable water for wet industry.

However, depending on the reuse type, there might be some risks to human health posed by trace concentrations of chemical and microbial contaminants through pathways of skin contact and ingestion. Therefore, human health risk assessment on reuse of treated wastewater would help in protecting public health and support better planning.

5.4 Reuse for the construction sector

Reuse of treated wastewater for dust suppression and construction activities is relatively novel. Watercare have used this approach during the construction of the Central Interceptor to reduce the volume of potable water required.

5.4.1 Suitability of the Reuse Option

The EPA Victoria guidelines note that Class A recycled water is appropriate for general outdoor uses including dust suppression, construction and washdown. Class B recycled water may also be suitable, with restrictions.

Based on the assessment of wastewater quality in Table 11, with reference to the Australian Guidelines, it is feasible that the treated wastewater from the Stage 2 MBR plant could be used for construction activities. The level of disinfection provided by the MBR plant during detailed design will be key to determining whether the use is appropriate as worker exposure is highly likely. A context specific risk assessment would be recommended to ensure that the public health risks associated with any construction project employing recycled water have been adequately addressed and mitigated.

In theory, this reuse option will improve the sustainability of construction projects and reduce water wastage. However, the motivation for this reuse will be dependent on affordability of the treated wastewater (versus potable water) and regional and district policies encouraging sustainable solutions for new construction. Availability of water sources, or the lack of available water supply, will also be a key driver.

5.4.2 Availability of Sites for Reuse

There are a number of known areas of future construction within the vicinity of the proposed SWWTP including:

- **Ruakura growth cell**: this is an area on the eastern side of Hamilton that has been zoned to deliver more than 100 ha of residential development and more than 400 hectares of employment land. The area is also the site for Tainui Group Holdings' Ruakura Inland Port[32].
- **Peacocke growth cell**: this is a 720 ha area to the south of Hamilton City that is currently undergoing major construuction with the expected development of over 8,000 houses[33].
- **Southern Links Road:** This is a transport route development delivered by NZ Transport Agency Waka Kotahi to connect the southern areas of Hamilton City to the wider Hamilton area and the Waikato roading network[34]. This includes connecting SH1 with the Waikato Expressway, as well as establishing a key transport network in Peacocke.
- **Hamilton Airport industrial growth cells:** Waipa District Council have identified a number of growth cells within the Airport Business Zone for anticipated growth between now to 2035. These include Titanium Park, Meridian 37 and Montgomery Block[35]. Development within these areas has already begun, with further development anticipated.

The locations of these areas are shown on Figure 12.

[32] https://hamilton.govt.nz/your-council/news/growing-hamilton/16-8m-provincial-growth-fund-major-boost-for-ruakura-growth-cell

[33] https://hamilton.govt.nz/your-council/news/growing-hamilton/whats-the-plan-for-peacocke

[34] https://hamilton.govt.nz/strategies-plans-and-projects/projects/peacocke/southern-links/

[35] https://www.waipadc.govt.nz/our-council/strategy-and-planning/districtgrowthstrategy

Whilst the nature of reuse in construction has not been considered in this prelimiary assessment, it is possible that treated wastewater could be used for washdown of trucks and other equuipment, dust supression, and cooling of equipment as these uses have been employed for the construction of the Central Interceptor in Auckland. Supply of the wastewater to construction sites would need to be further fleshed out including whether trucking treated wastewater from the SWWTP to construction sites is a viable option.

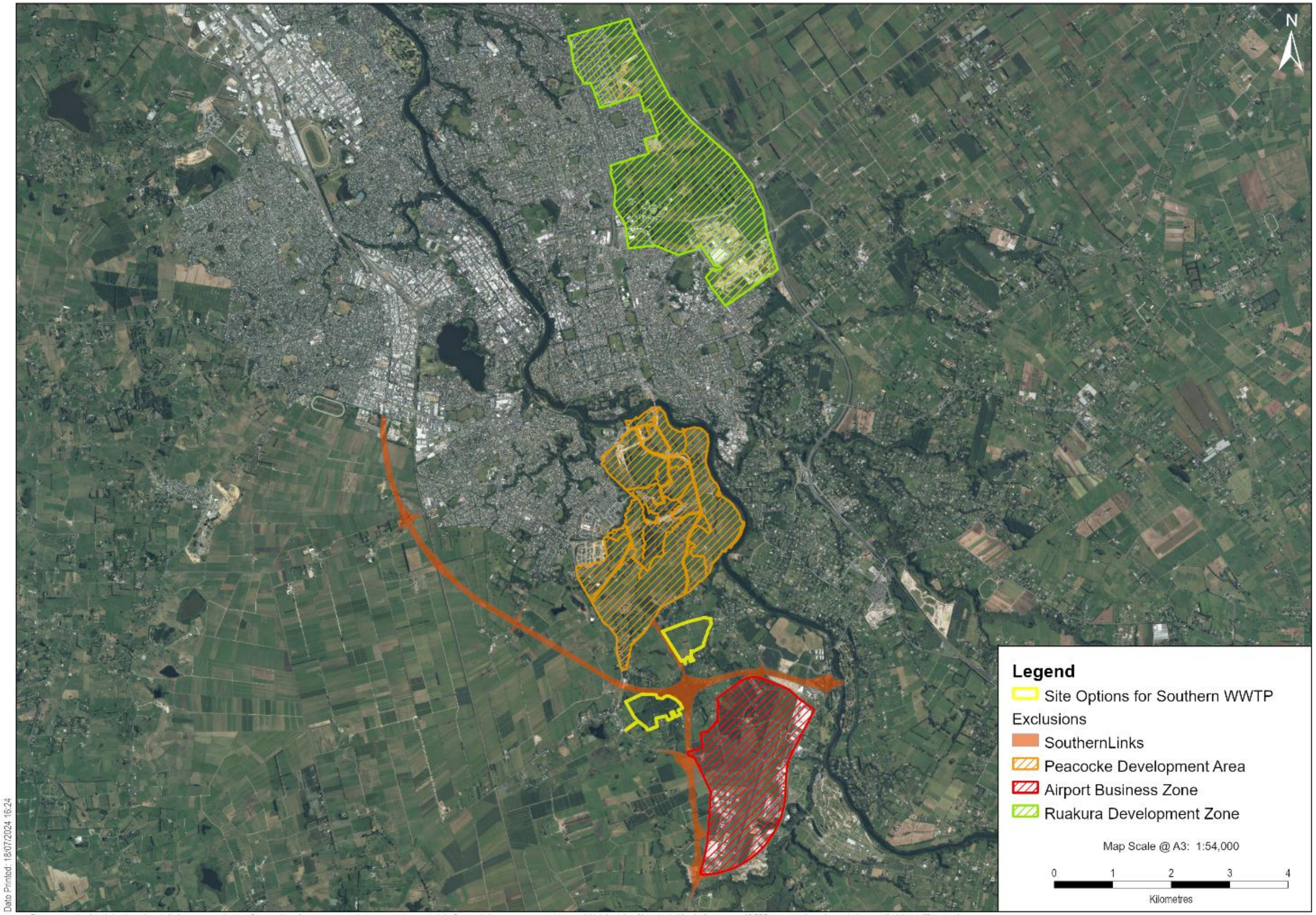


Figure 12. Location of known areas of future construction in relation to the proposed sites for the SWWTP

5.4.3 Potential risks and limitations

In terms of environmental risks, consideration should be given to the final location of the treated wastewater. If used for dust suppression, the implementation will need to ensure run-off to the stormwater system is avoided. However, it is anticipated that due to the high quality of the treated wastewater from a MBR treatment system there will be an imperceptible impact on sensitive waterbodies within the vicinity of the discharge.

The selection of application method will therefore be essential. Whilst tanker spray irrigation would provide a more efficient means of irrigation, the potential splash back, and risks associated with odour, and runoff into stormwater drains creates potential risks is using class B or C wastewater. These risks would be significantly minimised significantly if the treated wastewater is deemed to be class A in quality.

If the treated wastewater is unable to reach a class A classification, mitigations will need to be made through a management plan (clear methods for application rate, pressure of spray system, timing of application, and restriction of access would need to be considered). Exposure of workers to the treated wastewater is highest in this method of reuse and as such a thorough risk assessment would be required for any reuse activity.

Consideration of public health risks is also required if wastewater is trucked from the SWWTP to the construction sites, including as assessment of risks in transit.

5.5 Indirect Potable Reuse

Indirect potable reuse of treated wastewater might be possible by discharging the treated wastewater upstream of an existing water intake.

5.5.1 Suitability of the Reuse Option

Unlike with the other reuse options considered above, the Australian guidelines do not offer much guidance with regards to indirect potable reuse. However, indirect potable reuse already exists within New Zealand and within the Waikato River itself. The suitability of this option will need to be further investigated using dispersion modelling to determine the level of impact any discharge would have on the downstream Hamilton water treatment plant. However, it is possible that the highly treated wastewater from the Stage 2 MBR plant may be suitable for this use (discharge to water is already being considered for the MBR plant as part of the long-term options assessment).

Key to determining suitability is whether such a discharge align with the Vision and Strategy for the Waikato River (Te Ture Whaimana o te Awa o Waikato) and with Tai Tumu Tai Pari Tai Ao, the Waikato-Tainui Environmental Plan as these are both legal requirements.

5.5.2 Availability of Sites for Reuse

The Hamilton Water Treatment Plant is located c. 3.5km north of Site 1 and c. 4.5km north of Site 2 and is located downstream of the proposed SWWTP sites (see Figure 13). The Hamilton Water Treatment Plant was built in 1971 and has been upgraded over the years resulting in the plant now being able to produce 106 ML/day[36]. The treatment process includes abstraction and screening to remove debris, coagulation and sedimentation to further remove sediments, filtration through sand filters to remove any ‘straggler’ floc, Granular Activated Carbon Filtration to remove organic chemicals, UV disinfection, chlorine disinfection, and fluoridation.

[36] https://www.waikatoregion.govt.nz/assets/WRC/HR/5/94-3131306.pdf

The Cambridge WWTP already discharges (indirectly) to the Waikato River upstream of the Hamilton Water Treatment Plant. This plant has a planned upgrade to a new MBR plant that is currently under construction[37] and is expected to be operational by 1 December 2026[38].

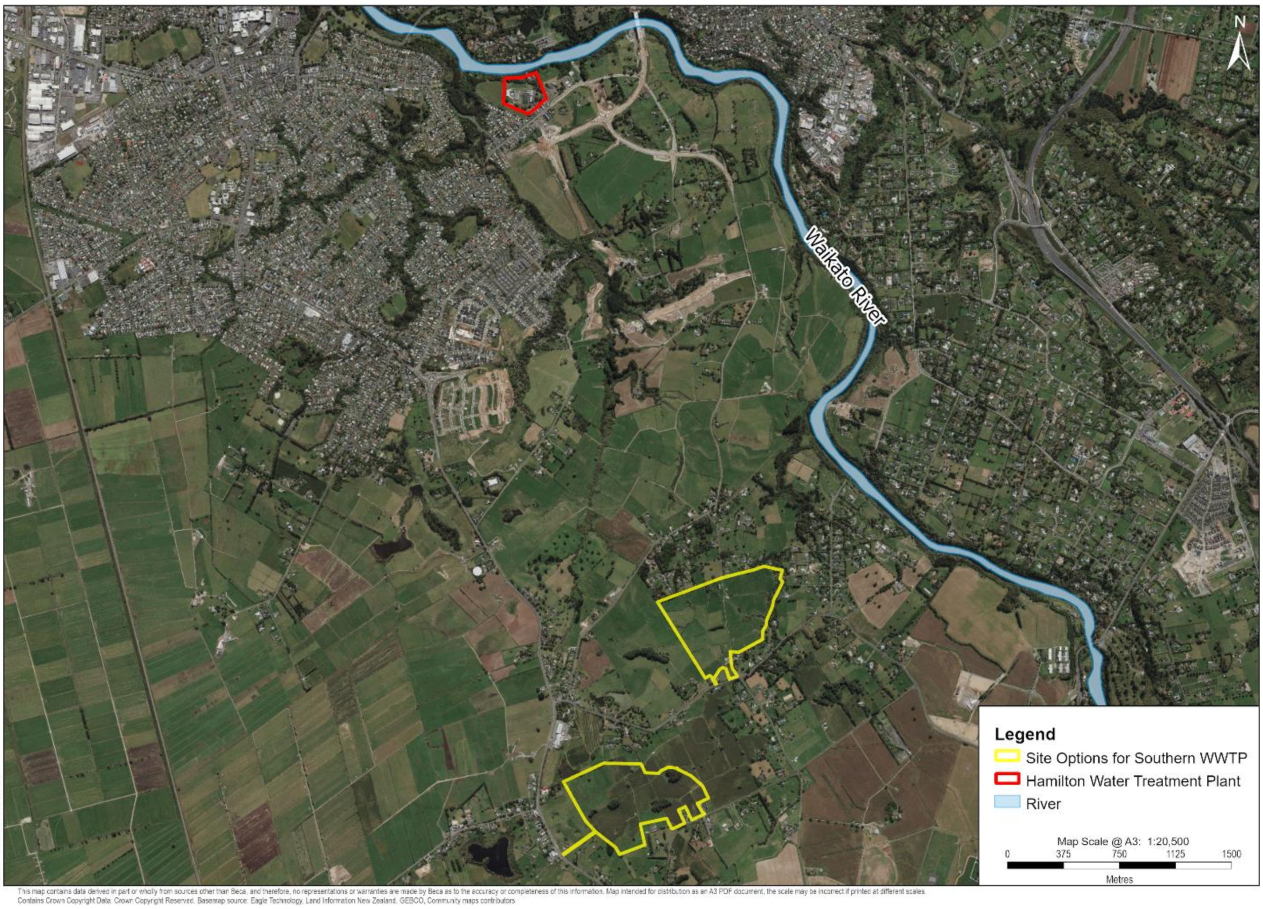


Figure 13. Location of the Hamilton Water Treatment Plant in relation to the proposed sites for the SWWTP

5.5.3 Potential risks and limitations

The discharge of MBR treated wastewater from the Stage 2 treatment plant into the Waikato River and subsequent uptake by the Hamilton Water Treatment Plant would require a thorough assessment of the public health risks including an assessment of the treatment capacity of the water treatment plant. Dispersion modelling would also be required to determine the contaminant concentrations anticipated at the point of the water take.

As with any discharge of treated wastewater to water, the potential adverse effects of the discharge on the receiving water quality and the ecology of the Waikato River and other surrounding sensitive environments should be assessed. Consideration needs to be given to near field effects (on ammonia, BOD, TSS) and far field nutrient effects (on TN and TP). Future assessment should include near-field studies on river mixing and also potential effects on macrophyte growth. Human health implications such as impacts on bathing water quality, recreational use of the river, and kai gathering also need to be considered.

A further limitation is the cultural concerns around the reuse of wastewater for drinking water. Although this is already happening within the Waikato River, it is understood to be highly offensive to Māori and goes against

[37] https://www.waipadc.govt.nz/our-council/news?item=id:2sec5olk91cxbyr41qat

[38] https://www.waipadc.govt.nz/your-waipa/majorprojects/cambridge-wastewater-treatment-plant

mātauranga ideas of water purity. Wastewater is Wai-mate (dead water) or Wai-kino (dangerous/polluted water), whilst drinking water is Wai-māori[39]. Mixing human waste with a water body disrupts the mana or purpose of the river including its purpose for drinking water. Drinking water that contains treated wastewater, even if highly treated, is typically abhorrent to Māori.

[39] '*Restoring the Mauri of the Wai - Using Co-Management to Determine Wastewater Treatment and Disposal'*, Water NZ Conference Paper (Priestley, B. and Hall, G), October 2023.

6 Summary and Recommendations

6.1 Summary of Reuse Options and Feasibility

Based on the detail provided in Section 5 of this report, the following feasibility assessment has been completed for the Stage 1 SBR plant (Table 16) and the Stage 2 MBR plant (Table 16).

This assessment is based on the quality of the treated wastewater, as compared to the Australian standards for reuse, as well as the availability of possible sites that could be further investigated for each use. Land use restrictions, consenting requires, and the costs to implement such schemes have not been considered in this high-level assessment which seeks to determine whether reuse should be further investigated for the SWWTP.

Table 16. Feasibility assessment of discharge methods for the SWWTP – Stage 1 (SBR)

Reuse options	Feasibility Assessment
Reuse for golf courses, sports fields and parks, Hamilton airport runway apron	Treated wastewater from the SBR plant could be used for irrigation to golf courses, gardens, sports fields and parks where there is no public access. Subsurface drippers will most likely be required. Other irrigation options could be considered if the enhanced restrictions on access and application set out in the Australian guidelines are applied. However, given the SBR plant will be temporary and will be paired with a discharge to land scheme, the option of irrigating wastewater from the WWTP to golf courses, gardens, sports fields and parks may not be financially feasible. **Recommendation: Unlikely to be feasible for the long term; recommendation is to not progress further.**
Agricultural Reuse	Irrigation of treated wastewater from the Stage 1 SBR plant would be suitable for agricultural reuse including irrigation to non-food crops. Irrigation to food crops is less likely to be feasible; and due to the short-term nature of the SBR plant, it is not advisable to pursue food crop irrigation further due to site restrictions. Spray drift control, the use of subsurface irrigation, and/or the application of buffer zones may also be needed to minimise public health risks. A thorough risk assessment should be undertaken for any proposed reuse to determine the mitigation measures needed to protect environmental sensitivities and public health. The SBR treatment plant, however, is already proposed to have a discharge to land system so consideration of other discharge to land systems is not required. **Recommendation: Unlikely to be feasible for the long term; recommendation is to not progress further.**
Industrial Reuse	Treated wastewater may be suitable for wet industry provided there is no worker exposure and a thorough risk assessment had been undertaken to address any public health risks. It is considered that due to the limited available of known wet industry within the vicinity of the proposed treatment plant sites, that this reuse option is unlikely to be feasible for the SBR plant. **Recommendation: Do not progress further.**
Reuse for the construction sector	Due to the level of disinfection set out in the specifications for the SBR plant, it is unlikely that the treated wastewater can be used for the construction sector. **Recommendation: Do not progress further.**

Reuse options	Feasibility Assessment
Indirect Potable Use	The SBR system has not been designed for a discharge to water scheme. The plant will have a discharge to land scheme as its primary discharge method. No further consideration has been given to a discharge to water scheme for indirect potable reuse. **Recommendation: Do not progress further.**

Based on the assessment undertaken in this report, it is not recommended to further investigate reuse options for the Stage 1 SBR plant due to the short-term nature of the plant and the restrictions on reuse due to the wastewater quality.

Table 17. Feasibility assessment of discharge methods for the SWWTP – Stage 2 (MBR)

Reuse options	Feasibility Assessment
Reuse for golf courses, sports fields and parks, Hamilton airport runway apron	Irrigation of treated wastewater to golf courses, public gardens, sports fields and parks using a sprinkler system with some restrictions including buffer zones and spray drift control likely to be feasible. A combination of subsurface drippers (for areas with public access) and spray irrigation (for areas without public access) may also be preferred. There are a number of golf course options and local parks that could be explored for this reuse. The Hamilton airport runway apron is also an option that could be explored. A thorough risk assessment should be undertaken for any proposed reuse to determine the mitigation measures needed to protect environmental sensitivities and public health. The reuse of treated wastewater for the irrigation of golf courses is well established in New Zealand as outlined in Section 4.1.1. Irrigation to parks, public gardens and road reserves are becoming more common as outlined in Section 4.1.2. As such, there is precedent for this reuse option. **Recommendation: This reuse option should be investigated further.**
Agricultural Reuse	Treated wastewater would be suitable for agricultural reuse including irrigation to non-food crops (including plant nurseries). It may also be possible to irrigate to food crops (i.e. fruits with limited or no ground contact and/or where the skins are removed before consumption; vineyard grapes), depending on the level of treatment the MBR plant can achieve. The level of treatment that could be provided by the MBR plant would also be important for determining the dispersal method, whether that be spray irrigation or sub-surface drippers. Spray drift control and buffer zones would also be required to protect public health. There are a number of plant nurseries and fruit orchards within the vicinity (less than 15km) of the proposed SWWTP sites. There is also a vineyard to the southwest of the proposed sites. Irrigation to these sites could be further explored. A thorough risk assessment should be undertaken for any proposed reuse to determine the mitigation measures needed to protect environmental sensitivities and public health. In New Zealand, the use of treated wastewater on agricultural lands has been part of a discharge to land scheme. There is less precedent for reuse in vineyards, orchards and plant nurseries. However, this option is starting to receive traction in places such as Marlborough. **Recommendation: This reuse option should be investigated further.**

Reuse options	Feasibility Assessment
Industrial Reuse	Treated wastewater would be of a high quality and could be suitable for wet industry. If the MBR effluent is to be used for cooling tower water, then a Class A level of treatment will likely be required, and other considerations will need to be included in the risk assessment including legionella risks. There may be a future option to reuse wastewater for wet industry in the Airport Business Zone; however, at present the Airport Business Zone appears to only have light industry. Whilst heavy industry is not prohibited by the zone but could be restricted in the developer agreement with Waipa District Council as there is limited water supply available currently. Providing a non-potable water supply may therefore encourage the development of wet industries in this area. However, this option is novel in New Zealand and there is no precedent for this type of reuse. As such, a thorough assessment of the risks and contestability of this option would be needed before determining whether to process with investigating this option. **Recommendation: This option may be feasible and a thorough risk and consentability assessment should be undertaken at the next stage if there is appetite to further consider this option.**
Reuse for the construction sector	Treated wastewater would be of a high quality and could be suitable for construction activities. The level of disinfection provided by the MBR plant during detailed design will be key to determining whether the use is appropriate as worker exposure is highly likely. There are a number of future construction areas within the vicinity of the proposed SWWTP that could be investigated. A context specific risk assessment would be recommended to ensure that the public health risks associated with any construction project employing recycled water have been adequately addressed and mitigated. As with industrial reuse, this option is novel in New Zealand and there is limited precedent (only known example is the Central Interceptor in Auckland). However, this option could be beneficial to the wider south Hamilton area where non-potable water sources are required. **Recommendation: This option may be feasible, and further investigations are recommended if there is appetite for this option.**
Indirect Potable Use	It is possible that the highly treated wastewater from the MBR plant may be suitable for this use (discharge to water is already being considered for the MBR plant as part of the long-term options assessment). There is a water take for potable use downstream of the proposed SWWTP sites (the Hamilton Water Treatment Plant). As such, indirect potable reuse may, unintentionally, form part of the discharge scheme if the discharge is into the Waikato River at a point near the SWWTP. However, public perception and cultural sensitivities may make this option controversial. **Recommendation: It is not recommended to investigate this option further as a discharge to the Waikato is already being considered for the primary discharge method.**

6.2 Recommendations

The feasibility assessment showed that agricultural reuse and reuse for golf courses, sports fields and parks is likely to be feasible for the Stage 2 MBR plant. Further investigation into reuse for these purposes should be undertaken in the next stage of the project. The feasibility of reuse for these options significantly improves if Class A wastewater can be achieved and therefore the level of treatment should be confirmed prior to or in parallel to reuse investigations.

Reuse in the construction sector may also be somewhat feasible if the treated wastewater can meet the required level of disinfection to minimise construction worker risk. However, availability of construction sites within the vicinity of the SWWTP may limit the potential of this reuse option. As such, further investigations may be considered but only after Class A treated wastewater has been confirmed.

Industrial reuse is unlikely to the feasible within the near future; however, further investigation into this option could be undertaken once a thorough risk and consentability assessment has been completed.

Potable reuse is highly unlikely to be feasible within the near future and as such it is not recommended to further investigate the option at this stage.

6.3 Further Work Required

6.3.1 All Resue Options

The following should be completed prior to commencing investigations into any reuse option:

- Confirm the quality of the treated wastewater including whether this will be Class A or B.
- Assess the risk of other contaminants in the treated wastewater such as heavy metals, emerging contaminants and PFAS.
- Undertake tāngata whenua engagement to determine cultural preferences and / or restrictions.

6.3.2 Agricultural Reuse and Reuse as Irrigation Water for Parks, Sports Fields, Gardens or Golf Courses

In order to further progress investigations into reuse of the treated wastewater from the Stage 2 MBR plant (and the Stage 1 SBR plant if required), the following should be completed:

- Investigation of possible discharge locations including an assessment soil type and slope, receiving environment quality (surface water, groundwater, terrestrial ecology), current land use, surrounding land uses and restrictions, flood zones, cultural heritage. This may be a desktop assessment followed by site investigations.
- Planning assessment to determine any land use restrictions and consentability risks and determine the types of consents and authorisations that would be required for the reuse. This will then determine the types of assessments that will be required.
- Landowner engagement to determine the appetite for wastewater reuse on the preferred sites.
- High level concept design for the reuse option including the method of disposal/reuse.

6.3.3 Industrial Reuse and Reuse for Construction Sector

In order to further progress investigations into reuse of the treated wastewater from the Stage 2 MBR plant, the following should be completed:

- A thorough risk and consentability assessment of reuse in the construction sector, outlining the public health risks, environmental risks, and legislative / policy restrictions. This is needed to further assess the feasibility of this option.
- Engagement with construction companies to determine the appetite for wastewater reuse on the preferred sites. This includes discussions with construction partners for the aforementioned construction areas (see Section 5.4).
- Engagement with developers as well as Waipa District Council to gauge the appetite for wastewater reuse in wet industry within the Airport Business Zone.
- Should there be interest in progressing reuse in the construction sector or in wet industry, an outline plan should be prepared highlighting how treated wastewater could be provided, the authorisations that would be required, and the risks and mitigation measures required.

7 Limitations

This report has been prepared by Beca Limited (Beca) solely for Hamilton City Council (the Client). Beca has been requested by the Client to investigate feasible options for reuse of treated wastewater for the proposed SWWTP. This report is prepared solely for the purpose of undertaking a high-level desk top feasibility assessment of wastewater reuse options for the SWWTP. The contents of this report may not be used for any purpose other than in accordance with the stated Scope.

This report is prepared solely for the Client. Beca accepts no liability to any other person for their use of or reliance on this report, and any such use or reliance will be solely at their own risk.

Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency, and sufficiency of all information provided to it by, or on behalf of, the Client or any third party, including the information listed above, and has not independently verified the information provided. Beca accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the information provided.

The contents of this report are based upon our understanding and interpretation of current legislation and guidelines ("Standards") as consulting professionals and should not be construed as legal opinions or advice. Unless special arrangements are made, this report will not be updated to take account of subsequent changes to any such Standards.

This report should be read in full, having regard to all stated assumptions, limitations, and disclaimers.

A

Appendix A – Australian Guidelines for Water Recycling (2006): Treatment processes and on-site controls

Table A1. Treatment processes and on-site controls for designated uses of recycled water from treated sewage (derived from Table 3.8 of the AGWR).

Log reduction Targets (V, P, B)[a]	Indicative treatment process	Log reductions Achievable by treatment (V, P, B)	On-site preventive measures	Exposure reduction[b]	Water quality objectives[c]
Municipal use — open spaces, sports grounds, golf courses, dust suppression, etc or unrestricted access and application					
5.0 3.5 4.0	Advanced treatment required; for example: • secondary, coagulation, filtration and disinfection • secondary, membrane filtration, UV light	5.0 3.5 4.0	No specific measures	No specific measures	• To be determined on case-by-case basis depending on technologies • Could include turbidity criteria for filtration, disinfectant Ct (chlorine residual × detention time) or dose (UV) • *E. coli* <1 per 100 mL
Municipal use, with restricted access and application					
-	Secondary treatment with disinfection	2.0 – 3.0 1.0 > 6.0	Restrict public access during irrigation and one of the following: • no access after irrigation, until dry (1–hours) • minimum 25–30 m buffer to nearest point of public access • spray drift control; for example, through low-throw sprinklers (180° inward throw), vegetation screening, or anemometer switching	2.0 1.0 1.0 1.0	• BOD <20 mg/L[d] • SS <30 mg/L[d] • Disinfectant residual (e.g. minimum chlorine residual) or UV dose • *E. coli* <100 cfu/100 mL
Municipal use, with enhanced restrictions on access and application					
-	Secondary treatment with >25 days lagoon detention or primary treatment with >50 days lagoon detention	1.0 – 3.0 1.0 – 3.0 3.0 – 4.0 0.5 – 2.0	Restrict public access during irrigation and combinations of: • no access after irrigation, until dry (1– 4 hours) • minimum 25–30m buffer to nearest point of public access • spray drift control, e.g. through low throw	2.0 1.0 1.0 1.0	• BOD <20 mg/L[d] • SS <30 mg/L[d] • Disinfectant residual (e.g. minimum chlorine residual) or UV dose • *E. coli* <1,000 cfu/100mL (disinfection may be

Log reduction Targets (V, P, B)[a]	Indicative treatment process	Log reductions Achievable by treatment (V, P, B)	On-site preventive measures	Exposure reduction[b]	Water quality objectives[c]
	• Secondary treatment	0.5 – 1.0 1.0 – 3.0	sprinklers (180° inward throw), vegetation screening, or anemometer switching		required to achieve this concentration)
Landscape irrigation — trees, shrubs, public gardens, etc					
5.0 3.5 4.0	Secondary treatment or primary treatment with lagoon detention	0.5–2.0 0.5–2.0 1.0–3.0	Combinations of: • microspray • drip irrigation • no public access	2.0 4.0 3.0	• BOD <20 mg/L[d] • SS <30 mg/L[d] • *E. coli* <1000 cfu/100mL (if not disinfected)
Commercial food crops consumed raw or unprocessed					
6.0 5.0 5.0	Advanced treatment to achieve total pathogen removal required (e.g. secondary, filtration and disinfection)	6.0 5.0 5.0	• None required, although pathogen reduction will occur between harvesting and sale • The recycled water can be used for all crop applications, including spray irrigation of salad crops	0.5 V, B	• To be determined on case-by-case basis, depending on technologies • Could include turbidity criteria for filtration, disinfectant Ct or dose (UV) • E. coli <1 per 100 mL
Commercial Food Crops					
6.0 5.0 5.0	Secondary treatment with >25 days lagoon detention and disinfection	3.0-4.0 2.0-4.0 >6.0	Consumers: • Crops with limited or no ground contact and eaten raw (e.g. tomatoes, capsicums) — drip irrigation and no harvest of wet or dropped produce • Crops with ground contact with skins removed before consumption (e.g. watermelons) — if spray irrigation, minimum 2 days between final irrigation and harvest • Pathogen reduction between harvesting and sale *Public in vicinity of irrigation area*[5] • No access and drip or subsurface irrigation	3.0 3.0-4.0 0.5/day V, B 6.0 4.0	• BOD <20 mg/L[d] • SS <30 mg/L[d] • Disinfectant residual (e.g. minimum chlorine residual) or UV dose[e] • *E. coli* <100 cfu/100mL

Log reduction Targets (V, P, B)[a]	Indicative treatment process	Log reductions Achievable by treatment (V, P, B)	On-site preventive measures	Exposure reduction[b]	Water quality objectives[c]
			• No access during irrigation and if spray irrigation, minimum 25–30 m buffer distance between irrigation area and nearest public access point		
Commercial food crops					
6.0 5.0 5.0	Secondary treatment with disinfection	2.0-3.0 1.0 >6.0	Consumers • Above-ground crops with subsurface irrigation • Crops with no ground contact and skins removed before consumption (e.g. citrus, nuts) – no harvest of wet or dropped produce – if spray irrigation, minimum 2 days between final irrigation and harvest • Pathogen reduction between harvesting and sale *Public in vicinity of irrigation area* [f] • No access and drip or subsurface irrigation No access during irrigation and if spray irrigation, minimum 25–30 m buffer distance between irrigation area and nearest public access point	4.0 4.0 0.5/day V,B 6.0 4.0	• BOD <20 mg/L[d] • SS <30 mg/L[d] • Disinfectant residual (e.g. minimum chlorine residual) or UV dose[e] • E. coli <100 cfu/100mL
Commercial food crops					
6.0 5.0 5.0	Secondary treatment or primary treatment with lagoon detention	0.5–1.0 0.5–2.0 1.0–3.0	Consumers • Crops with no ground contact and heavily processed (e.g. grapes for wine production, cereals) • Crops cooked/processed before consumption (e.g. potatoes, beetroot) • no harvest of wet or dropped produce	5.0–6.0 5.0–6.0	• BOD <20 mg/Ld • SS <30 mg/Ld • E. coli <1000 cfu/100mL

Log reduction Targets (V, P, B)[a]	Indicative treatment process	Log reductions Achievable by treatment (V, P, B)	On-site preventive measures	Exposure reduction[b]	Water quality objectives[c]
			consumption (e.g. citrus, nuts) – no spray irrigation • Crops with no ground contact and skin removed before • Raised crops (e.g. apples, apricots, grapes) – drip irrigation and no harvest of wet, dropped produce • Pathogen reduction between harvesting and sale Public in vicinity of irrigation area[e] • No access and drip irrigation • No access during irrigation and, if spray irrigation, minimum 25–30 m buffer distance between irrigation area and nearest public access point, and spray drift control (e.g. through part circle sprinklers with 180° inward throw, vegetation screening, or anemometer switching) or • Extended buffer distances to > 50m	6.0 5.0 0.5/day V,B 6.0 5.0	
Nonfood crops – trees, turf, woodlots, flowers					
5.0 3.5 4.0	Secondary treatment or primary treatment with lagoon detention	0.5-1.0 0.5-2.0 1.0-3.0	Public in vicinity of irrigation area • No access and drip irrigation • No access during irrigation and, if spray irrigation, minimum 25–30 m buffer distance between irrigation area and nearest point of public access, and spray drift control (e.g. through part cycle sprinklers with 180° inward	6.0 5.0	• E. coli <10 000 cfu/100mL

Log reduction Targets (V, P, B)[a]	Indicative treatment process	Log reductions Achievable by treatment (V, P, B)	On-site preventive measures	Exposure reduction[b]	Water quality objectives[c]
			throw, vegetation screening, or anemometer switching **or** • Extended buffer distances to >50m		

B = enteric bacteria; BOD = biochemical oxygen demand; cfu = colony forming unit; Ct = disinfectant concentration × time; P = enteric protozoa; SS =suspended solids; V = enteric virus; UV = ultraviolet

[a] Log reduction targets are minimum reductions required from raw sewage based on 95th percentiles from Table 3.7 of AGWR.

[b] Exposure reductions are those achievable by on-site measures as listed in Table 3.3 of AGWR.

[c] Water quality objectives represent medians for numbers of *E. coli* and means for other parameters.

[d] BOD and SS are an indication of secondary treatment effectiveness.

[e] Aim is to demonstrate reliability of disinfection and ability to consistently achieve microbial quality

[f] Log reductions for public in the vicinity of commercial food crop irrigation areas should comply with total log reductions required for municipal use.

B

Appendix B – Queensland Guidelines for Low-Exposure Recycled Water Schemes (2022): On-site controls

Table B1. Municipal open space irrigation (e.g. parks and sports fields) (Table 3 of Queensland Guidelines for Low-Exposure Recycled Water Schemes, 2022).

Class of recycled water	On-site controls required
Class A+	• Minimum on-site controls
Class A	• Minimum on-site controls and • A spray drift control
Class B	• Minimum on-site controls • Restricted access during irrigation and for four hours after use or until dry, and • A spray drift control or a buffer zone of at least 25 metres
Class C	• Minimum on-site controls • Restricted access during irrigation and for four hours after use or until dry • A spray drift control, and • A buffer zone of at least 25 metres

Table B2. Golf course irrigation (Table 4 of Queensland Guidelines for Low-Exposure Recycled Water Schemes, 2022).

Class of recycled water	On-site controls required
Class A+	• Minimum on-site controls
Class A	• Minimum on-site controls and • A spray drift control
Class B	• Minimum on-site controls • Restricted access during irrigation, and • A spray drift control or a buffer zone of at least 25 metres
Class C	• Minimum on-site controls • Restricted access during irrigation • A spray drift control, and • A buffer zone of at least 25 metres

Table B3. Irrigation of pasture and fodder crops for beef and dairy cattle* (Table 5 of Queensland Guidelines for Low-Exposure Recycled Water Schemes, 2022).

Class of recycled water	On-site controls required
Class A+	• Minimum on-site controls • Exclude lactating dairy cattle during irrigation and until pasture is dry • Fodder must be allowed to dry before being supplied as feed
Class A	• Minimum on-site controls • Exclude lactating dairy cattle during irrigation and until pasture is dry • Fodder must be allowed to dry before being supplied as feed If members of the public may be in the vicinity of the irrigation area: • A spray drift control
Class B	• Minimum on-site controls • Exclude lactating dairy cattle during irrigation and until pasture is dry • Fodder must be allowed to dry before being supplied as feed

Class of recycled water	On-site controls required
	If members of the public may be in the vicinity of the irrigation area: • Restricted access and • A spray drift control or a buffer zone of at least 25 metres
Class C	• Minimum on-site controls • Exclude lactating dairy cattle during irrigation and for five days following irrigation • Fodder must be allowed to dry before being supplied as feed If members of the public may be in the vicinity of the irrigation area: • Restricted access, a spray drift control and a buffer zone of at least 25 metres or • Restricted access and an extended buffer zone of at least 50 metres

*According to the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1), recycled water schemes that supply recycled water for the irrigation of pasture and fodder crops should be capable of removing or inactivating helminths. The AGWR lists secondary treatment, disinfection and greater than 25 days of lagoon detention as an acceptable treatment train for inactivating helminths. Alternative treatment trains may be employed provided it can be demonstrated that the treatment train is capable of removing helminths. N.B. Recycled water of any class should not be used for the irrigation of fodder crops for pigs or provided to pigs for drinking water.

Table B4. Irrigation of highly-processed food crops and non-food crops (Table 6 of Queensland Guidelines for Low-Exposure Recycled Water Schemes, 2022).

Class of recycled water	On-site controls required
Class A+	• Minimum on-site controls
Class A	• Minimum on-site controls If members of the public may be in the vicinity of the irrigation area: • A spray drift control or drip irrigation
Class B	• Minimum on-site controls If members of the public may be in the vicinity of the irrigation area: • Restricted access and one of the following: ○ A spray drift control ○ Drip irrigation ○ A buffer zone of at least 25 metres
Class C	• Minimum on-site controls • Highly-processed food crops must be allowed to dry before harvesting If members of the public may be in the vicinity of the irrigation area: • Restricted access and two of the following on-site controls: ○ A spray drift control ○ Drip irrigation ○ A buffer zone of at least 25 metres OR

Class of recycled water	On-site controls required
	• Restricted access and an extended buffer zone of at least 50 metres
Class D	To be used for non-food crops only • Minimum on-site controls If members of the public may be in the vicinity of the irrigation area: • No public access and drip irrigation, or • Restricted access, a spray drift control, and a buffer zone of at least 50 metres

Table B5. Dust suppressions (Table 7 of Queensland Guidelines for Low-Exposure Recycled Water Schemes, 2022).

Class of recycled water	On-site controls required
Class A+	• Minimum on-site controls
Class A	• Minimum on-site controls and • Low pressure dispersion of recycled water (e.g. gravity-fed ‘dribble bar’)
Class B	• Minimum on-site controls • Low pressure dispersion of recycled water (e.g. gravity-fed ‘dribble bar’) • Restricted access during dust suppression activities until dry

H

Appendix H – Waikato Baseline Water Quality Assessment

Sensitivity: General

Waikato Baseline Water Quality Assessment

Southern Wastewater Treatment Plant

Prepared for Hamilton City Council
Prepared by Beca Limited

7 August 2025

Contents

Revision History

Revision N°	Prepared By	Description	Date
1	Enfys Radley	Draft report for client review	02/08/2024
2	Enfys Radley	Final	07/08/2025

Document Acceptance

Action	Name	Signed	Date
Prepared by	Enfys Radley		07/08/2025
Reviewed by	Farza Feizi		07/08/2025
Approved by	Garrett Hall		07/08/2025
on behalf of	Beca Limited		

Executive Summary

The Waikato region is undergoing significant urban, industrial, and commercial growth, increasing demand on existing wastewater infrastructure. To address this, the Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) was developed, identifying a preferred option to manage wastewater from the southern part of the Waikato-Hamilton-Waipā metro area. A key component of this plan is the construction of a new Southern Wastewater Treatment Plant (SWWTP), which would service future development in southern Hamilton, the Waikato Regional Airport, and northern Waipā.

The Southern Metro DBC process included a site selection process to identify a preferred broad location for the SWWTP in the area immediately to the south of Hamilton. This short-list and site feasibility investigation concluded in August 2024 and recommended the preferred site for the SWWTP as a site that is owned by Hamilton City Council (HCC) between Peacockes Road and Raynes Road (Sharpe Farm).

The SWWTP is planned to be developed in stages, eventually serving a Population Equivalent (PE) of up to 200,000. The Southern Metro DBC assumed a land discharge for Stage 1, transitioning to river discharge from Stage 2 onwards, subject to further technical investigations as part of resource consent processes. HCC will seek consents for Stages 1 to 2b, covering up to 18,000 (PE) and an average daily flow of 3,600 m^3/day at the end of stage 2b. Commencement flows at stage 1 are estimated to be 400 m^3/day increasing to 1,900 m^3/day at the end of stage 2a.

Environmental and engineering investigations are underway to develop and evaluate various options for discharging treated wastewater from the future SWWTP. One of the disposal methods being considered is a discharge to water, into the main stem of the Waikato River.

Beca has been commissioned by HCC to conduct a baseline water quality assessment of the Waikato River to evaluate the sensitivity of the receiving environment for the proposed discharge and addressing issues such as the required level of treatment for contaminants of concern.

The policies and guidelines used in this assessment include requirements from the Operative Waikato Regional Plan (WRP), Proposed Plan Change 1 (PC1) of the WRP, the Vision and Strategy for the Waikato River (Te Ture Whaimana o te Awa o Waikato), Section 107 of the Resource Management Act (RMA), National Policy Statement for Freshwater Management 2020 (NPS-FM) and Waikato Regional Council Water Quality Guidelines. The WRP, RMA, and Te Ture Whaimana for the Waikato River are all aimed at improving water quality and mitigating activities that contribute to degradation.

A review of the existing water quality data for the Waikato River for the reach of the river where a potential discharge to water could occur from the new SWWTP (monitoring location Hamilton-Narrows (7) and Narrows Boat Ramp (P3) (upstream of the potential discharge), and Flagstaff Park (P4, downstream of the potential discharge)) showed that:

- Both the downstream (Hamilton-Narrows (7)) and upstream (Narrows Boat Ramp (P3)) monitoring locations exceeded their relative PC1 short-term and 80-year median attribute states for the following:
    - Nutrients (including total nitrogen (TN), total phosphorus (TP)) and
    - microbiology (*Escherichia coli (E. coli)).*
- The recent three months monitoring (February 2024 to May 2024) found the following:
    - There was no difference in phosphorus (Dissolved reactive phosphorus (DRP) and TP) concentrations between the upstream (P3) and downstream (P4) monitoring locations.
    - *E. coli* concentrations were higher at the downstream when compared to the upstream monitoring location.

- Toxicant (NH_4-N) concentrations were slightly higher at the upstream (P3) when compared to the downstream (P4) monitoring location.

Contaminant concentrations downstream of the future SWWTP discharge are predicted using mass balance calculations. According to the mass balance calculations, considering the low discharge volume at stage 2b (3,600 m^3/day with a 18,000 PE equivalent) and high dilution factor in Waikato River, there was a negligible percentage increase (<1.5%) in contaminants concentrations under both average river flow and low river flow conditions. Therefore, the overall effects of the potential discharge on contaminant concentrations are considered to be negligible for Stage 1 and Stage 2b.

Estimations of mass load contributions were undertaken to understand the relative contribution of nutrients from the SWWTP to the wider Waikato River. The predicted nutrient loads to the Waikato River from the future SWWTP are relatively low and will contribute <1% of the nutrient loads in Waikato River for both Stage 1 and Stage 2b. Merging the SWWTP consent process with the Pukete WWTP or implementing offsetting strategies are potential approaches to prevent nutrient loads from exceeding the baseline by reducing contaminants elsewhere in the catchment. The specific offsetting activities would need to be assessed, which could include planting on erosion-prone land and restoring riparian areas, in alignment with the goals of Te Ture Whaimana o te Awa o Waikato.

Additional investigation is recommended to confirm the exact discharge location (including establishing the most appropriate methodology). In addition, if surface water discharge is chosen as the preferred discharge location, undertaking ecological and further water quality investigations will be necessary to understand the impacts of treated wastewater discharge on the Waikato River.

Introduction

1.1 Background

The Waikato region is undergoing significant urban, industrial, and commercial growth, resulting in increasing demand on existing wastewater infrastructure. To address this, the Southern Metropolitan Wastewater Detailed Business Case (Southern Metro DBC) was developed, identifying a preferred option to manage wastewater from the southern part of the Waikato-Hamilton-Waipā metro area. A key component of this plan is the construction of a new Southern Wastewater Treatment Plant (SWWTP), which would service future development in southern Hamilton, the Waikato Regional Airport, and northern Waipā.

The Southern Metro DBC process included a site selection process to identify a preferred broad location for the SWWTP in the area immediately to the south of Hamilton. This short-list and site feasibility investigation concluded in August 2024, and recommended the preferred site for the SWWTP as a site that is owned by Hamilton City Council (HCC) between Peacockes Road and Raynes Road (Sharpe Farm).

The SWWTP is planned to be developed in stages, eventually serving a Population Equivalent (PE) of up to 200,000. The Southern Metro DBC assumed a land discharge for Stage 1, transitioning to river discharge from Stage 2 onwards, subject to further technical investigations as part of resource consent processes. HCC will seek consents for Stages 1 to 2b, covering up to 18,000 (PE) and an average daily flow of 3,600 m^3/day at the end of stage 2b. Commencement flows at stage 1 are estimated to be 400 m^3/day increasing to 1,900 m^3/day at the end of stage 2a.

Beca Ltd (Beca), on behalf of HCC, has conducted various investigations into alternative discharge options for the SWWTP, building on previous work, to assess the long-list options for the SWWTP which will inform the resource consent process. This work will reassess the broad assumptions made at the Southern Metro DBC with regards to discharge options.

Environmental and engineering investigations are being conducted to develop and assess various options for discharging treated wastewater from the future SWWTP. Among the discharge methods being considered is a discharge to the main stem of the Waikato River.

1.2 Scope and Objectives

Given that one of the potential discharge options is to the main stem of the Waikato River, Beca has been commissioned by HCC to conduct a baseline water quality assessment of the river and an ecological assessment of the Waikato River Tributaries (given there is no available ecological data for the main stem). This assessment aims to evaluate the sensitivity of the receiving environment for the proposed discharge and addressing issues such as the required level of treatment for contaminants of concern. This water quality assessment will also inform the evaluation of options for the long-term discharge of treated wastewater from the SWWTP (and to support the reconsenting of Pukete WWTP), particularly for assessing options that involve a direct discharge into the Waikato River. The scope and objective of the water quality assessment are to:

- Review existing available water quality data for the Waikato River for the reach of the river where a potential discharge to water could occur:
  - Describing the water quality of the existing environment.
  - Assessing the characteristics of the predicted discharge with respect to key water quality parameters and flow rate.
- Providing an indicative assessment of the effect on water quality of the Waikato River that would result from a potential discharge from the SWWTP.

- Providing recommendations for further work that would be required if a Waikato River discharge was considered to be progressed to the next phase of optioneering.

The assessment focusses on the baseline water quality of Waikato River and indicative effects on concentrations of selected key water quality indicators based on estimated flows and concentrations of contaminants that would enter the river. This assessment does not include mixing studies or more detailed modelling.

1.3 Information Reviewed

- The Hamilton-Waikato Southern Metropolitan Area Wastewater Detailed Business Case Preferred Option Report, Metro Wastewater Project Partners, April 2022.
- Baseline Water Quality Assessment, Pukete Wastewater Resource Consent Project, Beca, March 2024.
- Baseline Water Quality Assessment, Pukete Wastewater Resource Consent Project, June 2024.
- Southern Wastewater Treatment Plant Assessment of Alternative Sites, Beca, 2024.

2 Description of the Proposed Southern Wastewater Treatment Plant

2.1 Southern Wastewater Treatment Plant

Considering that regional resource consents will only be sought for stages 1 – 2b (up to 18,000 PE or 3,600 m^3/day), the predicted discharge flows for stages 1 and 2b will be used for the calculations in the following sections. As shown in Table 1, the Southern Metro DBC assumed that Stage 1 will involve using sequencing batch reactor (SBR) treatment technology with discharge to land and Stage 2 will use Membrane Bioreactor (MBR) and discharge to the Waikato River in terms of treatment and discharge options. However, it is important to note that this Project is reassessing the assumptions related to the staging and final discharge environment for each phase. If investigations find discharge to land is not a feasible discharge option for Stage 1, MBR treatment technology will be necessary to achieve the required level of wastewater treatment for discharge to water. Therefore, this investigation will consider the treatment technology for both stages as MBR.

Table 1. SWWTP Concept Staging.

Description		Serviced area	Starting demand	Cumulative Capacity
Stage 1	SBR* with discharge to land	Airport precinct	400 m^3/day (2,000 PE)	1,000 m^3/day (5,000 PE)
Stage 2a	MBR** with discharge to Waikato River	Airport precinct and Mātangi / Tamahere commercial areas	1,200 m^3/day (6,000 PE)	1,900 m^3/day (9,500 PE)
Stage 2b	MBR with discharge to Waikato River (additional reactors and membrane equipment)	Airport precinct, wet industry and Mātangi /Tamahere commercial areas	3,600 m^3/day (18,000 PE)	3,600 m^3/day (18,000 PE)

* SBR treatment technology with land disposal is proposed for the first stage. This technology provides enormous flexibility in terms of flows and load and will provide effluent quality that is suitable for application into or onto land. SBR is able to stop solids to reduce organic matter found in wastewater, which is done over a number of cycles, depending on the size of the tank.

** MBR treatment technology with discharge to water is proposed for the second stage. MBR systems are aerobic activated sludge biological reactors, which combine the biological degradation process, known as "activated sludge", with solid-liquid separation by membrane filtration. This process results in high-quality effluent with low levels of suspended solids, pathogens, and nutrients

2.2 Preferred Locations for the Wastewater Treatment Plant

The Southern Metro DBC process included investigating the area immediately south of Hamilton to identify a general preferred location for the SWWTP. The 2024 Assessment of Alternative Sites undertaken by Beca further refined the locations identified in the Southern Metro DBC to four shortlisted sites. Using a multi criteria analysis (MCA), Site 1 (Sharpe Farm) and Site 2 (Narrows/ Rukuhia) were identified as the preferred locations for the Southern WWTP. The preferred sites (Site 1 and Site 2) are described in Table 2 and are shown in Figure 1. Following the technical MCA process and the findings of the Tangata Whenua Effects Assessment

(TWEA), Sharpe Farm has been identified at the preferred site. Sharpe Farm scored the highest in both the unweighted and weighted MCA[1].

Table 2. Description of the preferred sites for the SWWTP.

Site Name	Site Address	Site Owner	Area of Site	Title	Legal Description
Sharpe Farm (Site 1)	Raynes Road, Rukuhia	HCC	34.2 ha (two blocks which have an area of 19.35 ha and 14.85 ha).	SA72C/450	Lot 5-6 DPS 91837
Narrows/ Rukuhia (Site 2)	71 Narrows Road/Ōhaupō Road	The site is owned by the Crown and administered by Waka Kotahi	35 ha	RT 534321	Lot 1 DP 420545

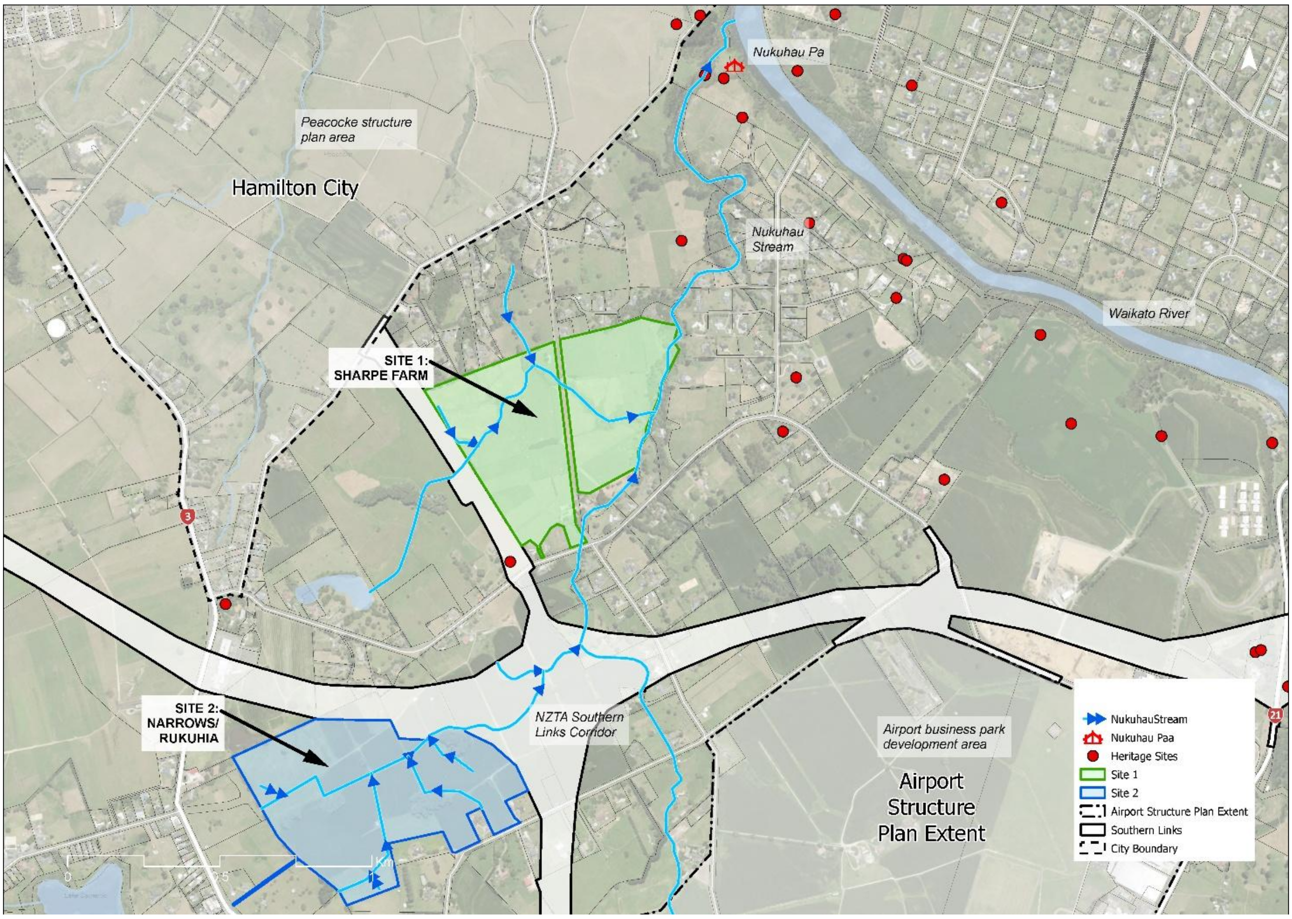


Figure 1. The preferred sites for the SWWTP (Site 1 and Site 2) (Source: Southern Wastewater Treatment Plant Assessment of Alternative Sites, Beca, 2024).

2.3 Proposed Treated Wastewater Quality

Currently, there is a wide variety of standards for treated wastewater discharge quality in the Region due to the use of different technologies. A Memorandum of Understanding (MoU) was signed by the DBC Project Partnership Group in April 23 which established the minimum performance standards to be achieved by the

[1] Southern Wastewater Treatment Plant, Assessment of Alternative Sites, Beca, August 2024.

projects in the Metro WW DBC (Northern/Southern). The agreement recommends adopting a consistent standard of treated wastewater quality for all WWTP discharges to water. These uniform standards which have been informed by the Vision and Strategy for the Waikato River (Te Ture Whaimana o te Awa o Waikato), should be implemented by 2031[2] or when the existing resource consents for discharge expire. As mentioned above, the proposed treatment technology for both Stage 1 and Stage 2b is considered MBR for discharge to water, which will provide a high level of wastewater treatment.

According to the Southern Metro DBC MoU[3], the minimum Performance Standards considered for discharge to water are listed in Table 3. These standards are utilised in Section 0 of this report where a high-level assessment of effect of the discharge on water quality of the Waikato River is provided.

Table 3. Agreed Southern Metro DBC MoU[2] minimum performance standards for discharge to water.

Parameter	Minimum Performance Standards for Discharge to Water	
Total Nitrogen (TN) (mg/L)	Annual Mean	<4.0
Total Phosphorus (TP) (mg/L)	Annual Mean	<1.0
E. coli (cfu/100mL)	95th Percentile	<14

[2] These standards have been agreed as part of the Southern Metro DBC, which gives consideration to Te Ture Whaimana.

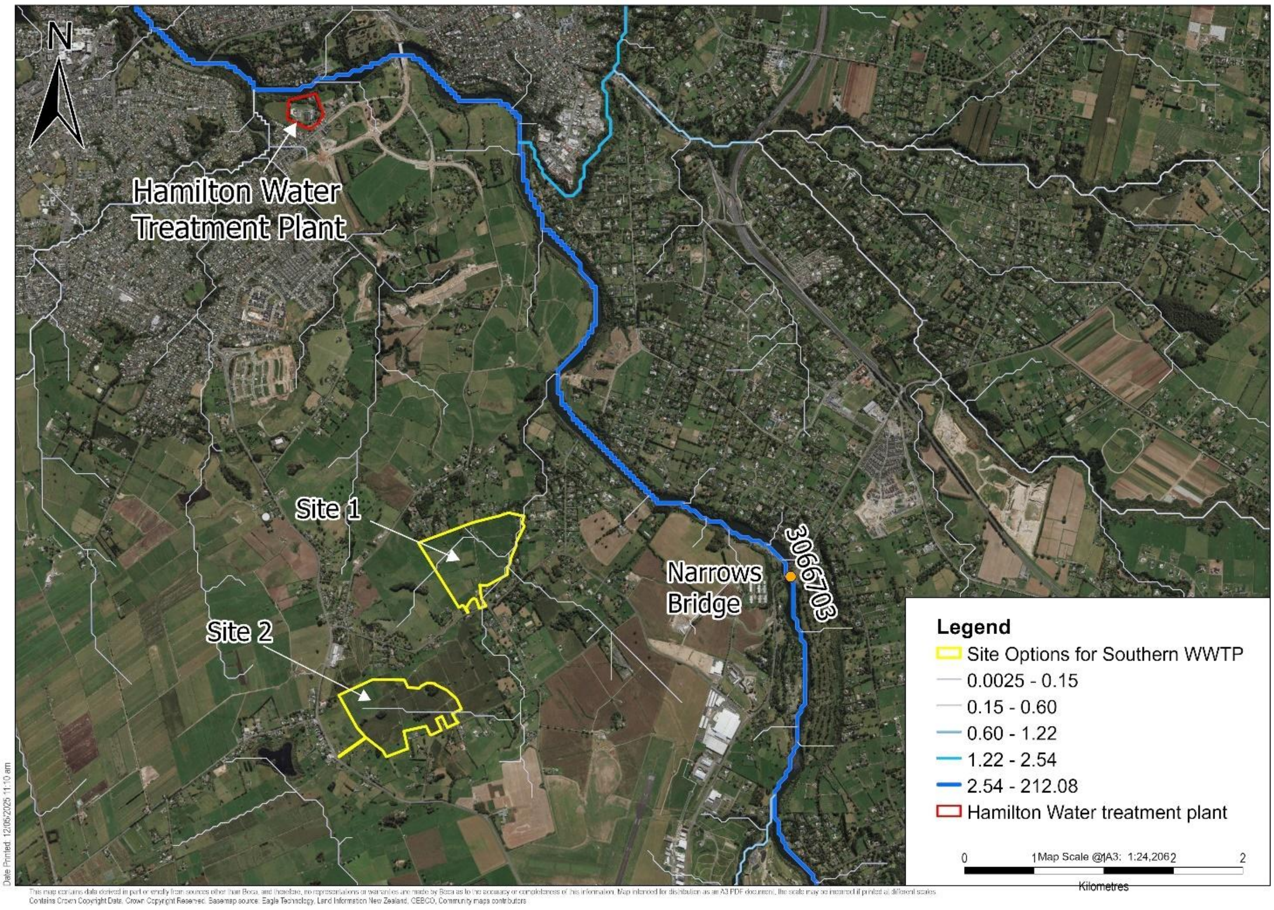
[3] The Hamilton-Waikato Southern Metropolitan Area Wastewater Detailed Business Case Preferred Option Report, Metro Wastewater Project Partners, May 2022.

3 Description of the Receiving Environment

One of the potential discharge options for the treated wastewater from the new SWWTP is into the main stem of the Waikato River. The Waikato River is the longest river in New Zealand (425 km) and has a catchment of 12,260 m2 (12% of the North Island). The Waikato River flows north from Lake Taupō across Huka Falls, Cambridge, Hamilton, Ngāruawāhia and Huntly, before flowing into the Tasman Sea at Port Waikato. The catchment is mostly pasture with some indigenous and plantation forests, with the river flowing through the volcanic plateau, passing through eight hydro dams (which have an electricity generation capacity of 1450MW), and across lowlands4. In addition to electricity generation, the river provides drinking water to the Waikato and Auckland regions, with the Hamilton Water Treatment Plant at being the closet downstream water intake from the proposed locations for the SWWTP (as shown in Figure 2).

3.1 Hydrology

Considering the proposed locations for the SWWTP (Site 1 and Site 2 as shown in Figure 1), the proposed discharge location has been assumed to be upstream of Hamilton and downstream of Cambridge. However, further investigations are required to confirm a potential discharge location for the SWWTP. According to the New Zealand River Maps5, flow estimations for the Waikato River upstream of the proposed discharge point of treated wastewater from the SWWTP are provided in Table 4 below. The upstream of the proposed discharge location is in segment nzsegment: 3066703 in the mapping tool (as shown in



[4] See: https://www.waikatoregion.govt.nz/environment/water/rivers/waikato-river/

[5] New Zealand River Maps: https://shiny.niwa.co.nz/nzrivermaps/

Figure 2).

Table 4. Flow (m^3/s) in the Waikato River at the discharge location (nzsegment: 3066703).

Mean Annual Low Flow (MALF)	Mean Flow	Median Flow
88.94	211	161

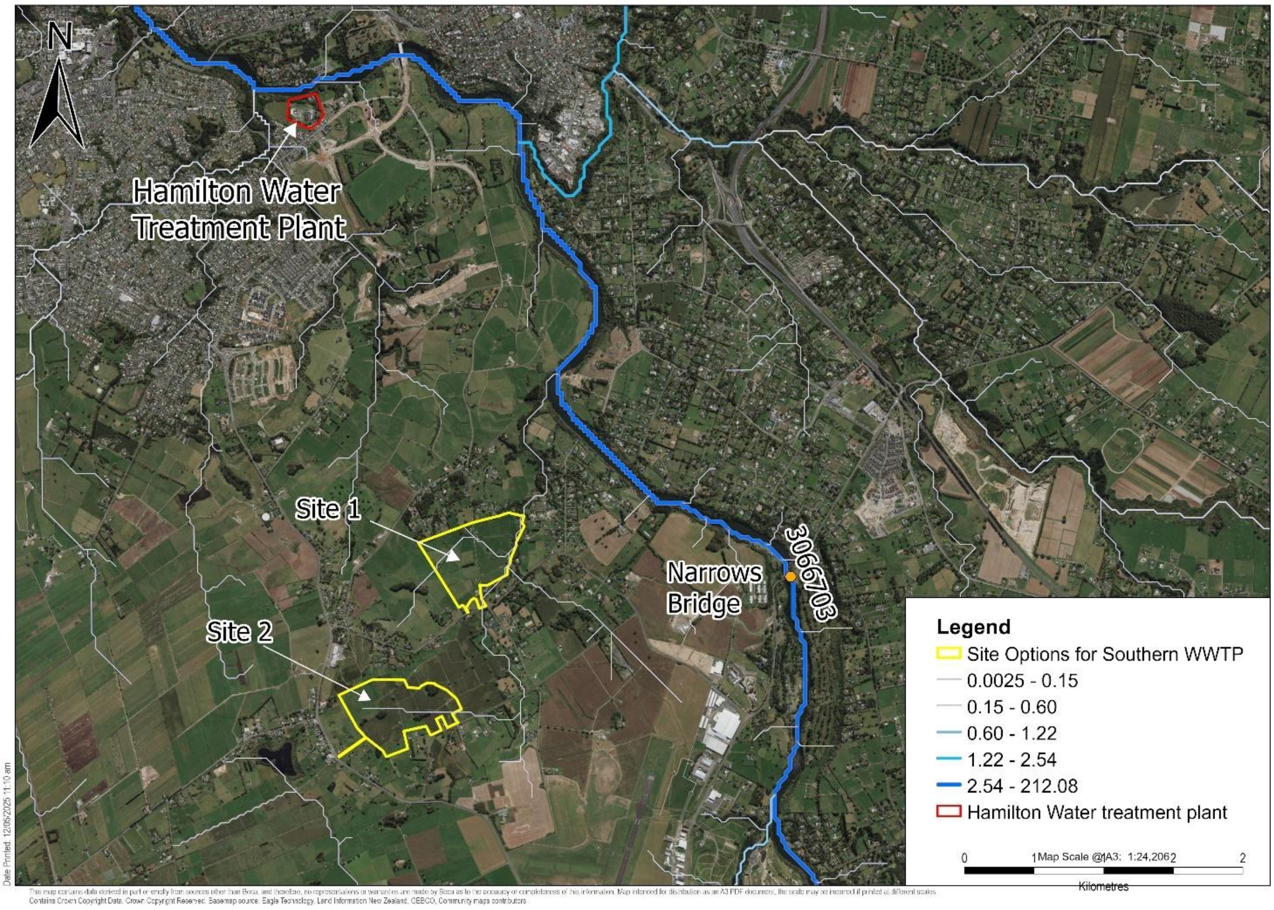


Figure 2. River segment and flow data (m^3/s) from the New Zealand River Maps tool[6].

3.2 Water Quality Monitoring Locations

3.2.1 Existing Locations Monitored by Waikato Regional Council

Long term monitoring of the Waikato River is undertaken by Waikato Regional Council (WRC). WRC routinely monitors the water quality of the Waikato River at 12 locations (long term monitoring sites) monthly. WRC provided 10-year data (2013 to 2023) for the 12 locations listed below and shown in Figure 3.

- Taupō (1)
- Ohaaki (2)
- Ohakuri (3)
- Whakamaru (4)
- Waipapa (5)

[6] New Zealand River Maps: https://shiny.niwa.co.nz/nzrivermaps/

- Karapiro Tailrace (6)
- Hamilton-Narrows (7)
- Horotiu (8)
- Huntly (Tainui Bridge) (9)
- Rangiriri (10)
- Mercer (11)
- Tuakau (12)

Additional microbiological surveys are carried out from December to March by WRC at B2, B3, and B5 (listed below and shown in Figure 3).

- Lake Karapiro (B2)
- Hamilton (Wellington St) (B3)
- Ngāruawāhia Bridge (B5)

3.2.2 New Locations Monitored by Beca

The 2024 Baseline Water Quality and Ecology Assessment undertaken by Beca[7] identified an additional eight monitoring locations along the Waikato River for a summer monitoring programme (sites P1 to P8). The eight new monitoring locations (P1 to P8) are listed below and shown in Figure 4.

- Pukerimu Water Intake (P1)
- Mystery Creek Jetty (P2)
- Narrows Boat Ramp (P3)
- Flagstaff Park (P4)
- Pukete Boat Ramp (P5)
- Horotiu Bridge (P6)
- Ngāruawāhia Bridge (P7)
- Huntly Bridge (P8)

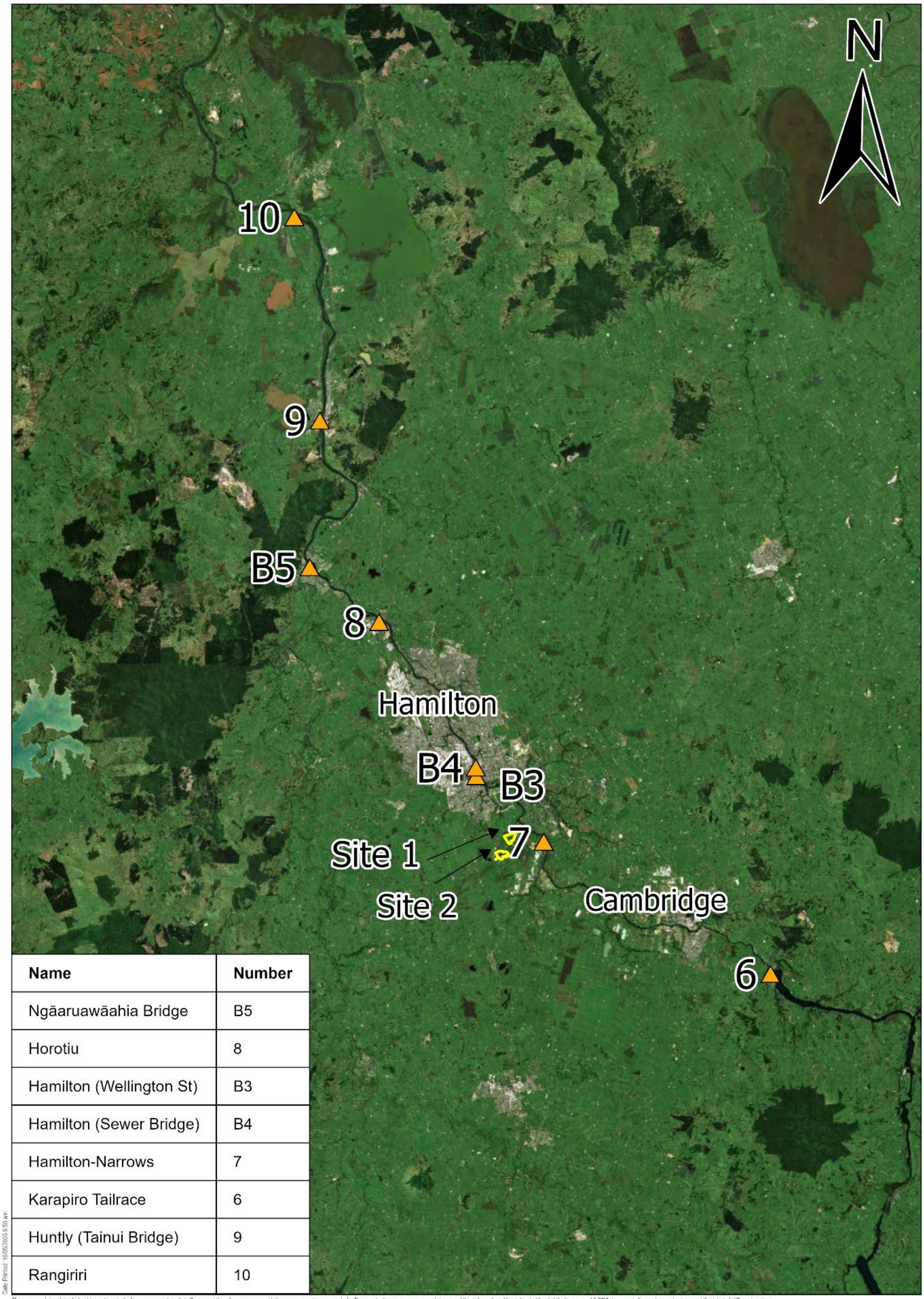
The new water quality sites are shown in Figure 4 below and were identified based on the following factors:

- The proposed sampling locations were identified to fill the spatial gaps identified between Horotiu Bridge and Huntly and also between Karapiro and Hamilton Narrows,
- Locations P4 and P5 are located upstream and downstream of the Pukete discharge,
- Locations P1, P2 and P3 were proposed to fill the gaps related to the Southern WW project,
- Locations P3, P6, P7 and P8 are close to the long-term WRC monitoring sites (Locations 7, 8, B5, 9, respectively).

The eight proposed sampling locations were monitored every two weeks and for three months (from 20 February 2024 to 19 May 2024, six sampling rounds). Monthly sampling of the eight new monitoring locations is currently underway. The first sampling round was conducted on 17 July 2024, and will continue for a period of 12 months. A report has now been prepared for the initial three-month monitoring programme[8]. On completion of the 12-month sampling programme, a subsequent report will be prepared. All of the available data will be used in any future baseline water quality report.

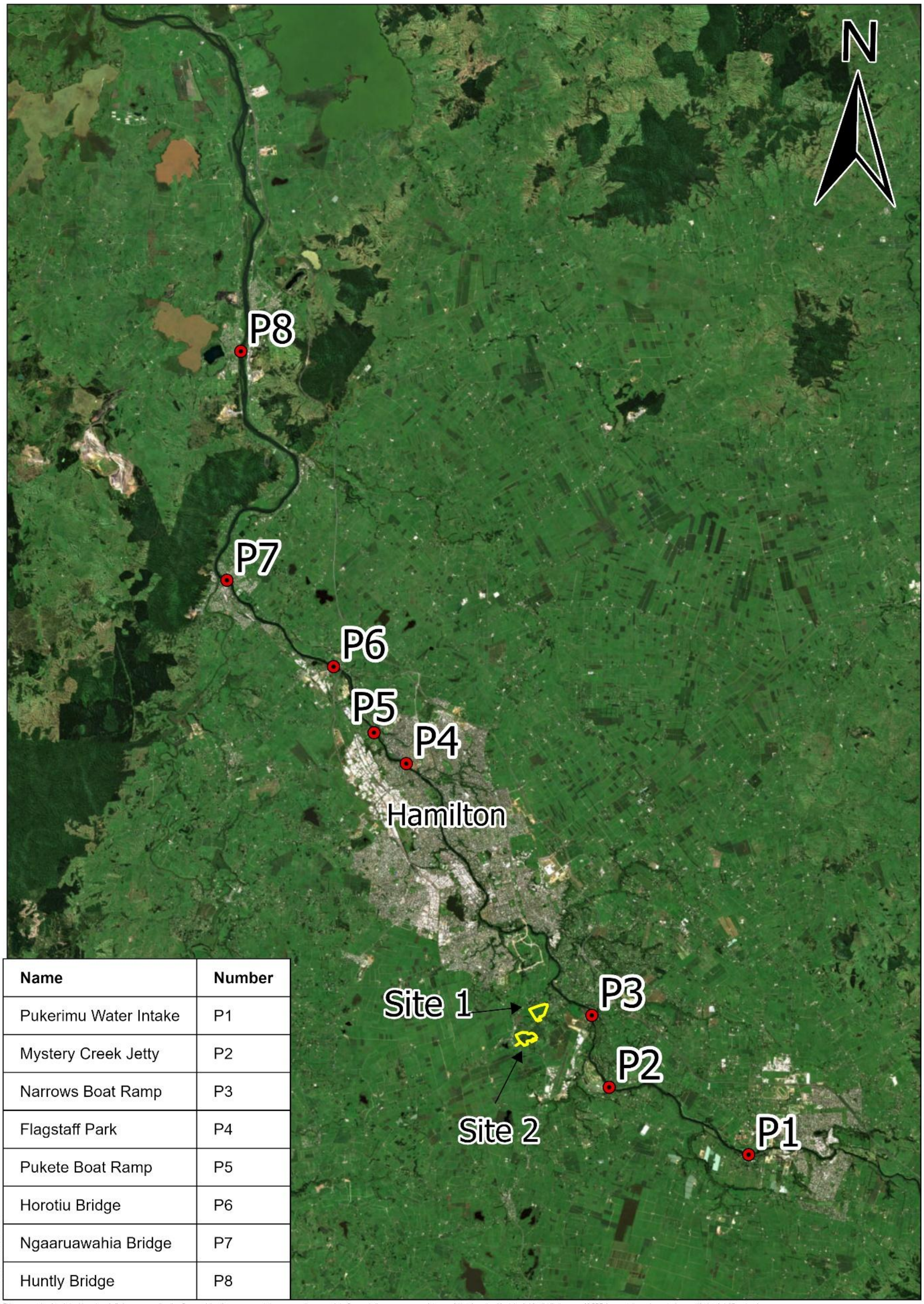
[7] Baseline Water Quality and Ecology – Pukete Wastewater Resource Consent Project, Beca, February 2024.

[8] Baseline Water Quality Assessment, Pukete Wastewater Resource Consent Project, Beca, July 2024.



Name	Number
Ngāaruawāahia Bridge	B5
Horotiu	8
Hamilton (Wellington St)	B3
Hamilton (Sewer Bridge)	B4
Hamilton-Narrows	7
Karapiro Tailrace	6
Huntly (Tainui Bridge)	9
Rangiriri	10

Figure 3. Proposed sites for the SWWTP and WRC long-term water quality monitoring locations.



Name	Number
Pukerimu Water Intake	P1
Mystery Creek Jetty	P2
Narrows Boat Ramp	P3
Flagstaff Park	P4
Pukete Boat Ramp	P5
Horotiu Bridge	P6
Ngaaruawahia Bridge	P7
Huntly Bridge	P8

Figure 4.Proposed sites for the SWWTP and water quality locations monitored by Beca.

3.3 Ecology Monitoring Locations

WRC have gathered ecological information from several tributary streams along the Waikato River under their Regional Ecological Monitoring in Streams (REMS) program[9]. This data includes details on fish populations, the composition of aquatic invertebrate communities, and the conditions within the streams themselves. WRC has conducted surveys on macroinvertebrates and physical stream characteristics at seven different locations along the river, spanning from Lake Arapuni to Port Waikato. Additionally, they have conducted detailed fish population studies at three of these sites at three-year intervals. WRC provided 10-years of ecological data, Table 5 listed the available data and Figure 5 shows the surveying sites.

Table 5. Ecological Surveys undertaken by WRC in tributary streams of the Waikato River.

Site Code	Tributary Name	Location	Survey	Survey Year
1132_67	Waikato River Trib	Port Waikato	REMS	2013 – 2023
1132_92	Unnamed Trib	Huntly	REMS	2013, 2016, 2019, 2022
			Fish population	2013, 2016, 2019, 2022
1132_105	Unnamed Trib	Ngāruawāhia	REMS	2020, 2023
			Fish population	2020, 2023
1132_69	Unnamed Trib	Lake Road, Hamilton	REMS	2013 2016 – 2023
1132_70	Unnamed Trib	River Rd Sth, Hamilton	REMS	2013, 2014, 2016 – 2023
1132_68	Unnamed Trib	River Rd, Hamilton	REMS	2014, 2015, 2017 – 2023
1132_91	Unnamed Trib	Arapuni	REMs	2015, 2018, 2021
			Fish population	2012, 2015, 2018

[9] Catlin, A., Collier, K., Pingram, M., & Hamer, M. (2005). Regional Guidelines for Ecological Assessments of Freshwater Environments Macroinvertebrate Sampling in Wadeable Streams. In Waikato Regional Council Technical Report 2016/23. www.ew.govt.nz

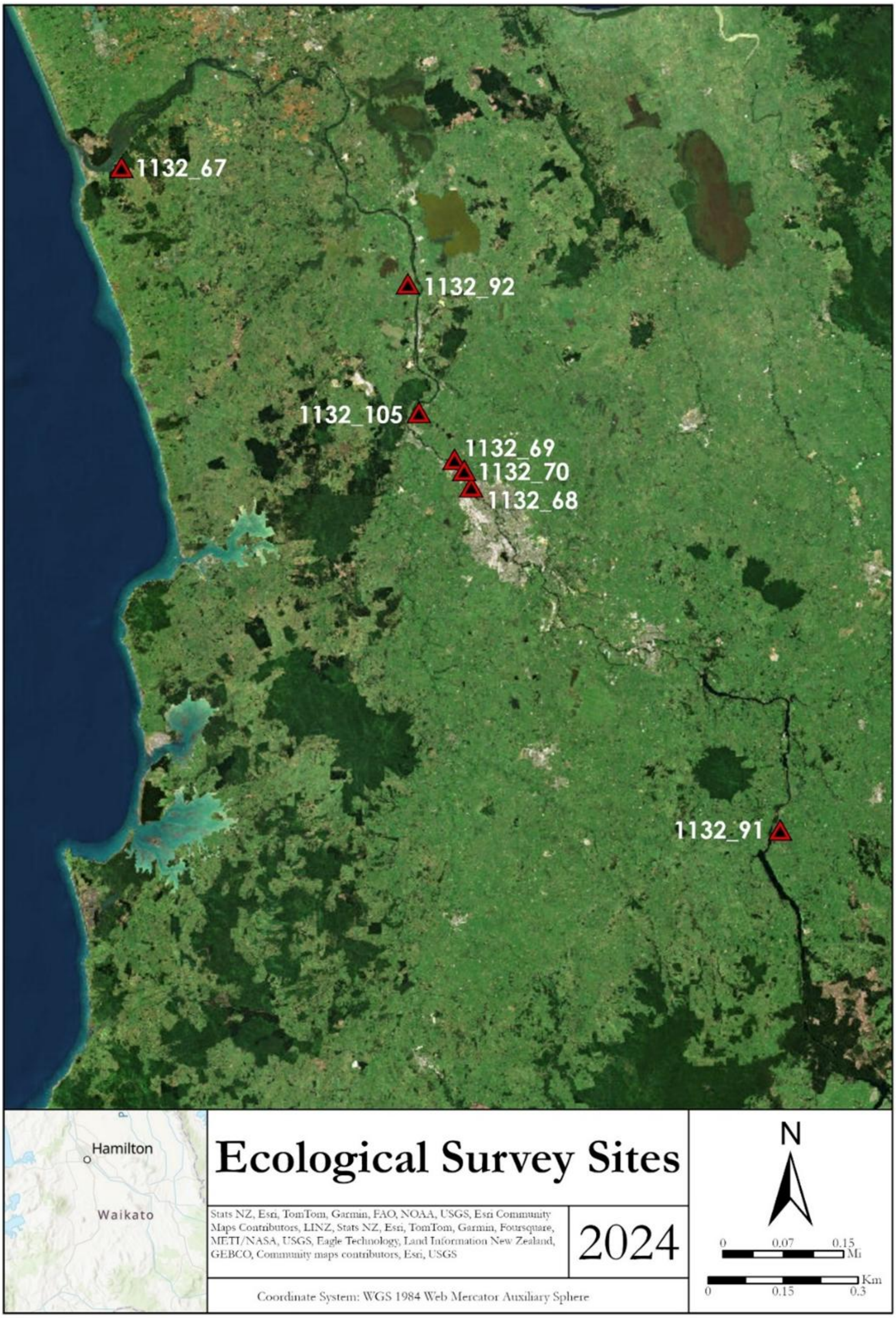


Figure 5. Ecological survey sites within tributary streams of the Waikato River.

4 Methodology

4.1 Assessment Criteria

The following sub-sections outline specific policies, guidelines, and information requirements relevant to water quality effects that must be considered if a river discharge option is pursued. These include the Operative Waikato Regional Plan (WRP), Proposed Plan Change 1 (PC1) of the WRP, Te Ture Whaimana o te Awa o Waikato, Section 107 of the Resource Management Act (RMA), National Policy Statement for Freshwater Management 2020 (NPS-FM) and Waikato Regional Council Water Quality Guidelines[10]. It should be noted that the NPS-FM and Te Ture Whaimana o te Awa o Waikato are currently under review.

4.1.1 Te Ture Whaimana o te Awa o Waikato

The key objectives of Te Ture Whaimana o te Awa o Waikato, relevant to this assessment, are as follows:

- Objective A: The restoration and protection of the health and wellbeing of the Waikato River.
- Objective H: The recognition that the Waikato River is degraded and should not be required to absorb further degradation as a result of human activities.
- Objective K: The restoration of water quality within the Waikato River so that it is safe for people to swim in and take food from over its entire length.

4.1.2 Operative Waikato Regional Plan

4.1.2.1 Information requirements: Discharges

When applying for a resource consent to discharge, section 8.1.2.5i of the WRP states that the effect the discharge will have on the receiving environment must be assessed, including the effect on the purpose(s) of relevant water management classes as set out in section 3.2.3 of the Plan.

4.1.1.2 Policies: Water Management Classes

The Waikato River at Rangiriri is classified for (identified using Waikato Regional Council GeoMaps);

- Contact recreation;
- Trout habitat; and
- Indigenous fish habitat.

Section 3.2.3 of the WRP, Policy 4 – 'Waikato Region Surface Water Class', states:

- The use of surface water bodies in the Region is enabled provided that;
  - Any significant adverse effects on existing aquatic ecosystems are avoided, remedied, or mitigated;
  - Any conspicuous change in visual colour or clarity is avoided, remedied or mitigated; and
  - The water body is not contaminated to the extent that it is unusable for irrigation or stock watering, or human consumption after treatment.

Policy 6 – 'Contact Recreation Water Class', states:

- Water bodies with significant contact recreation uses must maintain a safe water quality environment by;
  - Avoiding reductions in clarity;
  - Avoiding contamination to levels that represent a risk to human health;
  - Avoid the visible development of bacterial and fungal growths; and Avoid the development of periphyton growth or mats.

[10] See: See: https://www.waikatoregion.govt.nz/environment/water/rivers/healthyrivers/

Policy 7 – 'Fishery Class', states:

- Reaches of the Waikato River (main stem) that support a diverse range of fish species and fish habitats, or which support significant recreational, traditional, or commercial fisheries must maintain (or enhance) existing water quality and aquatic habitat by;
  - Minimise adverse effects of sediment loads and other contaminants on fish or their habitat;
  - Maintain water temperatures and dissolved oxygen levels that are suitable for aquatic habitat;
  - Ensure fish living in these waters are not rendered unsuitable for human consumption by the presence of contaminants; and
  - Minimise the adverse effects of physical disturbance to aquatic habitat.

4.1.3 Proposed Plan Change 1

The Waikato Regional Policy Statement and Regional Plan sets out the objectives, policies and rules for decision making for consent applications for discharges of treated wastewater. The PC1 to the Waikato Regional Plan includes short and long-term water quality targets for the Waikato River, with a focus on nitrogen, phosphorus, sediment, and microbial pathogen loads. Point source discharges need to demonstrate a proportional contribution to the restoration of water quality of the Waikato River to achieve the objectives of PC1. It is important to note that PC1 seeks to give effect to some objectives of Te Ture Whaimana (related to water quality of the Waikato River) and does not in itself fulfil all obligations set out in Te Ture Whaimana o te Awa o Waikato. It is also important to note that PC1 is currently under appeal and is subject to ongoing Environment Court proceedings, therefore all references here are to the Hearing Recommendations of PC1.

Te Ture Whaimana o te Awa o Waikato states the following vision(s):

- Tooōku awa koiora me ōnaoonaa pikonga he kura tangihia o te maaātaaāmuri. The river of life, each curve more beautiful than the last; and

- Our vision is for a future where a healthy Waikato River sustains life and prosperous communities who, in turn, are all responsible for restoring and protecting the health and well-being of the Waikato River, and all it embraces, for generations to come.

4.1.4 Resource Management Act Section 107 – Zone of Reasonable Mixing

The RMA requires that any standards imposed through classification of waters or under section 107 of the RMA should be met "after reasonable mixing". This implies the existence of a zone in which the underlying standards need not be met. The RMA however stops short of giving clear guidance about what constitutes reasonable mixing. It may be inferred that the area of water required for "reasonable mixing" should be minimised and any adverse effects within the "reasonable mixing zone" should not frustrate the management objectives for the waters[11].

Policy 8 in section 3.2.3 of the WRP states that:

"The zone of reasonable mixing is the area within which a discharge into water (including any discharge that occurs subsequent to a discharge onto or into land) does not need to achieve the standards specified in the water management class for the receiving water body. The size of the mixing zone must be minimised as far as is practicable and will be determined on a case-by-case basis, including consideration of the following matters:

a. The nature of the effluent, including its flow rate, composition and contaminant concentrations.

[11] It is noted that the recommendations version of PC1 (subject to environmental court of appeal) has indicated that the zone of reasonable mixing may be a transitional measure.

b. River flow rate and flow characteristics.

c. The design of the outfall.

d. The depth, velocity and rate of the mixing in the receiving water body.

e. Existing contaminant concentrations in the receiving water body both upstream and downstream of the discharge point and the assimilative capacity of the water body.

f. The frequency of the discharge.

g. The speed with which any contaminants will be diluted.

h. The ability of the discharger to alter the location of the discharge and the mixing characteristics of the outfall so as to ensure that adverse effects of the discharge beyond the zone of non-compliance are not inconsistent with the purpose for which the water body is to be managed.

i. Whether the discharger has taken all practicable steps to minimise the concentration and volume of contaminants at source.

j. Any effects of the mixing zone on other users of the water body.

k. The extent of the adverse effects within the mixing zone."

Due to the complexity of flow within the Waikato River, it is not possible to categorically state a distance of full mixing within the Waikato River downstream of the point of discharge. Further work to determine this requires the use of a hydrodynamic model.

4.1.5 National Policy Statement for Freshwater Management 2020 (NPS-FM)

The NPS-FM provides local authorities with direction on how they should manage freshwater under the RMA 1991. The NPS-FM requires to ensure that freshwater is managed in a way that gives effect to the concept of Te Mana o te Wai and prioritises[12]:

- First, the health and well-being of water bodies and freshwater ecosystems.
- Second, the health needs of people (such as drinking water).
- Third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.

4.1.6 Waikato Regional Council Water Quality Guidelines

WRC guideline[13] lists the different aspects of water quality monitored by WRC. The water quality measures are divided into two groups:

- Ecological health – those measuring whether water quality is suitable for plants and animals living in a river.
- Human use – those that measure whether water quality is suitable for human use and activities such as swimming. This is also called swimmability.

[12] Note: The Resource Management Amendment Bill proposes the exclusion of the hierarchy of obligations in the NPS-FM, the bill has now been sent to the Primary Production Selection Committee for consideration.

[13] See: https://www.waikatoregion.govt.nz/environment/water/rivers/healthyrivers/

4.2 Mass Balance Methodology

Contaminant concentrations downstream of the proposed SWWTP discharge has been predicted using mass balance calculations. The mass balance calculation is based on inputs from:

- The contaminant concentrations of the proposed discharge (based on values in Table 3);
- The median background water quality in the Waikato River upstream of the proposed discharge. For this purpose, the available water quality data at Hamilton (Narrows) (location 7, from WRC long-term water quality monitoring location) and at P3 (Narrows Boat Ramp, the new monitoring location identified in the 2024 Baseline Water Quality and Ecology Report, from the three-month water quality monitoring in 2024) were used; and
- Dilutions are calculated based on proposed discharge volumes and the flow records of the Waikato River.

The predicted water contaminant concentration (C_x) at the receiving water downstream of discharge is given by Equation 1:

Equation 1. The mass balance equation used to calculate predicted contaminant concentrations in the Waikato River downstream of the proposed SWWTP discharge.

$$C_x = \frac{(C_d - C_b)}{TD+1} + C_b$$

Where C_d is the contaminant concentration of treated wastewater; C_b is the background contaminant concentration in the receiving environment; and TD[14] is the total dilution.

The total dilution factor assumes full mixing when the discharge plume is evenly mixed across the full width of the receiving waters. Higher contaminant concentrations will occur within the discharge plume close to the point of discharge. The mass balance calculations for the predicted water quality downstream of the discharge in the Waikato River are run under an average flow scenario and a worst-case low-flow scenario. The first scenario is a normal flow condition that would be expected most of the time. The second assessment simulates a 'worst-case', low-flow scenario (the Mean Annual Low Flow (MALF) of the Waikato River) while still assuming an average flow discharge of treated wastewater from the SWWTP.

4.3 Nutrient Loads Assessment

In line with the Waikato Regional Policy Statement and Regional Plan, all discharges from the WWTPs will need to contribute towards a net improvement in water quality in the Waikato River. Therefore, estimations of mass load contributions were undertaken to understand the relative contribution of nutrients from the SWWTP to the wider Waikato River. This assessment compares the nutrient load discharged directly to the river from the SWWTP to the nearest water quality monitoring locations (Hamilton-Narrows (7) and Narrows Boat Ramp (P3), both locations are situated nearly in the same place. A qualitative discussion on other treated wastewater discharges to the Waikato River is presented.

[14] TD = (Stream flow / Wastewater flow) + 1

5 Review of Existing Water Quality Results

This section of the report provides a review of the existing water quality data for the Waikato River for the reach of the river where a potential discharge to water could occur from the new SWWTP.

5.1 Monitoring undertaken by Waikato Regional Council

WRC monitors the water quality of the Waikato River at twelve long-term monitoring locations monthly and at an additional three locations during the summer for an intensive microbial water quality survey. Water quality is assessed through the analysis of up to 40 parameters, with 27 routine parameters, undertaken either in the field or laboratory. Figure 3 shows the long-term WRC water quality monitoring location. A Baseline Water Quality and Ecology Assessment[15] was undertaken by Beca based on existing 10-year water quality results (2013 to 2023) and ecological data collected from wadable tributaries of the Waikato River. A summary of the ecological assessment is provided in Section 5.2 5-year water quality data (2018 to 2023) from the 12 long-term monitoring sites were compared against PC1 attribute targets and where no applicable attribute target was available the data was compared against the WRC and NPS-FM guidelines.

Overall, the review of the existing water quality data showed that water quality gradually declined from monitoring locations Taupo Gates (1) to Tuakau (12). Additionally, spatial gaps in relation to the anticipated discharge location of the new SWWTP were identified and a 3-month water quality programme for eight newly identified monitoring locations was recommended. In response to the recommendation, a 3-month water quality programme was undertaken by Beca, with the data collected being used in this report.

Given that Hamilton-Narrows (7) is the nearest monitoring location to the river reach where a potential SWWTP discharge could occur, the water quality assessment results for Hamilton-Narrows (7) is provided in Table 6.

Table 6. 5-year WRC monitoring results (2018 to 2023) for Hamilton-Narrows (7) (Sub-catchment 33).

Hamilton-Narrows (7) Monitoring Results					
E. coli (cfu/100ml)	Median	55	NH_4 (mg/L)	median	0.017
	95%ile	375		Maximum	0.042
	> 540 (% exceedances)	3.4	CHLa (mg/L)	Median	0.004
	>260 (% exceedances)	11.9		Maximum	0.019
DRP (mg/L)	Median	0.014	TP (mg/L)	Median	0.03
NO_3 (mg/L)	Median	0.35	TN (mg/L)	Median	0.54
	95%ile	0.55	Clarity (m)	10%ile	1.14

Note: Green highlight indicates all PC1 have been met, orange highlight indicates the 80-year (long-term) is not met, and red highlight indicates both the short-term and long-term is not met. There are not any PC1 limits (short-term and long-term) for the monitoring locations with data with no colour.

[15] Baseline Water Quality and Ecology Assessment, Pukete Wastewater Resource Consent Project, Beca, March 2024.

The 5-year WRC monitoring results are summarised below:

- Concentrations of *E. coli* exceeded all the applicable PC1 short-term and long-term targets.
- Both the short-term and long-term PC1 targets for clarity were not met.
- Concentrations of dissolved reactive phosphorus (DRP) and chlorophyll a (CHLa) did not exceed their applicable PC1 short-term or long-term targets.
- Concentrations of TN, TP, nitrate (NO_3-N), and total ammoniacal nitrogen (NH_4-N) exceeded all applicable PC1 short-term or long-term targets.
- pH levels, dissolved oxygen (DO) (%), DO concentration, and turbidity did not exceed their relevant WRC and NPS-FM (2020) guideline values.

5.2 New Monitoring Locations

The Baseline Water Quality and Ecology Assessment[11] of the Waikato River identified eight new monitoring locations and an initial 3-month summer water quality monitoring programme (February 2024 to May 2024) and a baseline water quality report were completed. The monitoring locations located near the approximate location for the SWWTP discharge include P3 and P4 (Figure 4). The results of the 3-month monitoring are provided in Table 7.

Table 7. The 3-month monitoring results for P3 and P4.

Parameter		P3	P4
Sub-Catchment #		33	25
Turbidity (NTU)	Average	1.16	1.35
	Min	0.66	1.17
	Max	1.61	1.64
TN (mg/L)	Average	0.45	0.47
	Min	0.34	0.39
	Max	0.51	0.52
NH_4-N (mg/L)	Average	0.019	0.013
	Min	0.012	0.005
	Max	0.026	0.024
NO_2-N (mg/L)	Average	0.004	0.003
	Min	0.002	0.001
	Max	0.005	0.005
NO_3-N (mg/L)	Average	0.32	0.34
	Min	0.22	0.26
	Max	0.37	0.4
NO_2-N+NO_3-N (mg/L)	Average	0.32	0.34
	Min	0.22	0.26
	Max	0.37	0.40
TKN (mg/L)	Average	0.12	0.13
	Min	0.05	0.1
	Max	0.15	0.15
DRP (mg/L)	Average	0.016	0.016

Parameter		P3	P4
	Min	0.008	0.01
	Max	0.02	0.018
TP (mg/L)	Average	0.026	0.027
	Min	0.023	0.024
	Max	0.03	0.03
E. coli (MPN/100mL)	Average	74	117
	Min	27	101
	Max	209	130
CHLa (mg/L)	Average	0.002	0.002
	Min	0.0015	0.0015
	Max	0.005	0.004
Temperature (°C)	Average	19.27	19.08
	Min	16.5	16.9
	Max	21.5	21
DO (%)	Average	80.70	75.33
	Min	74.8	67.9
	Max	96.8	81.3
DO (mg/L)	Average	7.43	6.98
	Min	6.63	6.37
	Max	9.15	7.7
pH	Average	7.1	7.1
	Min	6.6	6.4
	Max	7.4	7.4
Conductivity (µS/cm)	Average	152.2	155.4
	Min	147.8	148.8
	Max	161.1	171.3

In summary, the water quality assessment results at P3 and P4 indicated that:

- NH_4-N concentration was lower during the last three sampling (5/04/2024 to 2/05/2024) rounds when compared to the first three sampling rounds (20/02/2024 to 19/03/2024) at sampling locations P3 and P4. The average NH_4-N concentration for the period of sampling was 0.019 mg/L and 0.013 mg/L at monitoring locations P3 and P4, respectively.
- CHLa concentrations were recorded at the detection limit (0.0015 mg/L) during most sampling rounds at monitoring locations P3 and P4.
- *E. coli* concentration was elevated at monitoring location P4 (with an average concentration of 117 MPN/100 mL) compared to monitoring location P3 (with an average concentration of 74MPN/ 100mL)
- NO_3-N and NO_2-N+NO_3-N concentrations gradually increased throughout the monitoring period at both monitoring locations (P3 and P4)
- There is no notable difference in concentrations of nitrite (NO_2-N), DRP, TP, total Kjeldahl nitrogen (TKN), TN, DO saturation, conductivity, or pH levels between monitoring locations P3 and P4.
- Temperature gradually decreased at monitoring locations P3 and P4 throughout the monitoring period, which coincides with seasonal variation.

Additional sampling (a minimum of 12 monthly samples) at locations P1 to P8 is currently underway to account for seasonal variation and to be able to compare the monitoring results to the long-term WRC water quality sites, noting that the PC1 values are determined from a 5-year dataset to account for seasonal variations. In response to the recommendation, a 12-month monitoring programme is now being undertaken by Beca. Upon completion of the monitoring programme, a sequent report will be prepared. All of the available data will be used in any future baseline water quality report.

5.3 Monitoring Locations Upstream of the Southern Wastewater Treatment Plant

These 5-year median values at monitoring locations Hamilton-Narrows (7) and Narrows Boat Ramp (P3) (considered upstream of the SWWTP discharge location, both locations are situated nearly in the same place) are presented here in order to be utilised in Section 0, where a high-level assessment of effect of the discharge on water quality of the Waikato River is provided. The median values were calculated using the long-term monitoring data provided by WRC (May 2019 to January 2024) and the data collected during Beca's 3-month monitoring programme (February 2024 to May 2024).

As shown in Table 8, TN, TP, and *E. coli* 5-year medians exceeded both their relevant PC1 short-term and 80-year attribute states.

Table 8. 5-year median values at Hamilton (Narrows) (Locations 7 and P3, considered as upstream) and PC1 short-term and 80-year attribute states.

Parameter	Unit	PC1 Short-term (Sub-catchment 33)	PC1 80-year (Sub-catchment 33)	5-year Median
TN	mg/L	0.410	0.410	0.54
TP	mg/L	0.027	0.025	0.030
E. coli	cfu/100mL	39	39	54

6 Predicted Water Quality Downstream of Discharge from Southern Wastewater Treatment Plant

Predicted water quality affects were assessed using a standard mass-balance approach as described below. This approach utilises measured data and existing flow records to inform the potential concentrations of water quality parameters following reasonable mixing. The mass-balance method was carried out for two scenarios: normal flow conditions and the low-flow scenario (MALF).

6.1 Potential Effects During Average Stream Flow Conditions

This section of the report assesses the effects of the predicted discharge from the SWWTP during average River flow conditions. The assessment of predicted changes in key contaminant concentrations in the Waikato River downstream of the treated wastewater discharge are summarised in Table 9 below.

The predicted effects of the wastewater discharge are based on a number of assumptions including:

- Mean river flow of 211 m^3/s in the Waikato River upstream of the discharge (According to the New Zealand River Maps[16]).
- The proposed treated wastewater discharge flow for Stage 1 and Stage 2b, which is 400 m^3/day and 3,600 m^3/day, respectively.
- The proposed treated wastewater contaminant concentrations, which are the minimum standards for treated wastewater (annual means (for TN and TP) and 95th percentile (for *E. coli*)) are shown in Table 3.
- Waikato River background contaminant concentrations are 5-year medians calculated from monitoring data collected from monitoring locations Hamilton-Narrows (7) and Narrows Boat Ramp (P3) which are upstream of the proposed SWWTP discharge location (from 2019 to 2024). The 5-year data set includes the long-term data collected by WRC (from May 2019 to January 2024) and the 3-month sampling undertaken by Beca (from February 2024 to May 2024).
- Dilution is estimated to be 19204 and 2135-fold under average flow conditions for Stage 1 and Stage 2b, respectively.

Table 9. Predicted downstream water quality contaminant concentrations in the Waikato River under average stream flow conditions.

Parameters	Background Water Quality*	Downstream Concentrations		Downstream Water Quality Change (%)	
		Stage 1	Stage 2b	Stage 1	Stage 2b
TN (mg/L)	0.5400	0.5401	0.5407	0.014	0.13
TP (mg/L)	0.03000	0.03002	0.03019	0.071	0.64
E. coli (cfu/100mL)	54	53.9991	53.992	0.002	0.015

Note: yellow highlight indicated that the PC1 short-term attribute state has been exceeded and orange highlight indicated that both the PC1 short-term and 80-year attribute states have been exceeded.

[16] New Zealand River Maps: https://shiny.niwa.co.nz/nzrivermaps/

Parameters	Background Water Quality*	Downstream Concentrations		Downstream Water Quality Change (%)	
		Stage 1	Stage 2b	Stage 1	Stage 2b

*5-year median concentration at monitoring location Hamilton (Narrows) using data from the long-term monitoring location Hamilton-Narrows (7) and the new location (P3) monitored by Beca.

The assessment indicates that, under average river flow conditions:

- A negligible percentage increase (<1%) in the concentration of TN, TP, and *E. coli* is predicted in the Waikato River downstream of the discharge under mean river flow conditions for both Stage 1 and Stage 2b.

- TN, TP and *E. coli* concentrations are above PC1 short-term and 80-year attribute states, both upstream and downstream for existing flows and for both Stage 1 and Stage 2b. Therefore, the overall effect of these parameter is considered to be negligible for both Stage 1 and Stage 2b.

6.2 Potential Effects During Low River Flow Conditions

Worst case effects for WWTP discharges typically occur in summer when a combination of higher stream water temperatures and low stream flow results in lower contaminant dilutions. This section of report assesses the effects of the proposed discharge from SWWTP on the MALF conditions.

According to the New Zealand River Maps[17], the Waikato River MALF is assumed as 88.9 m^3/s. Other assumptions (contaminant concentrations and wastewater average daily discharge volume) remain the same as in Section 6.1 . The results of the predicted changes in water quality during low stream flow conditions are provided in Table 10. The assessment found that the estimated total dilution is high, with a dilution factor of 45,577-fold under low flow conditions for Stage 1, and 5,065-fold for Stage 2b. A high dilution factor results in greater dilution of the discharged treated wastewater.

Table 10. Existing and predicted downstream water quality contaminant concentrations in the Waikato River under low stream flow conditions.

Parameters	Background Water Quality*	Downstream Concentrations		Downstream Water Quality Change (%)	
		Stage 1	Stage 2b	Stage 1	Stage 2b
TN (mg/L)	0.5400	0.5402	0.5416	0.033	0.30
TP (mg/L)	0.0300	0.0301	0.0305	0.17	1.51
E. coli (cfu/100mL)	54	54.00	53.98	0.004	0.035

Note: yellow highlight indicated that the PC1 short-term attribute state has been exceeded and orange highlight indicated that both the PC1 short-term and 80-year attribute states have been exceeded.

*5-year median concentration at monitoring location Hamilton (Narrows) using data from the long-term monitoring location Hamilton-Narrows (7) and the new location (P3) monitored by Beca.

The assessment indicates that, under low river flow conditions:

- There is a slightly higher percentage increase in concentration of TN, TP, and *E. coli* predicted in the Waikato River downstream of the discharge under MALF conditions, when compared to average flow

[17] New Zealand River Maps: https://shiny.niwa.co.nz/nzrivermaps/

conditions (as shown in Table 9). However, the increase is negligible (<1%) in the concentration of TN, TP, and *E. coli* for both Stage 1 and Stage 2b and an 1.51% increase for TP during Stage 2b.

- Considering that the existing and predicted TN, TP, and *E. coli* concentrations are above PC1 short-term and 80-year attribute states both upstream and downstream for existing flows and for both Stage 1 and Stage 2b, the overall effect of these parameter is considered to be negligible for both Stage 1 and Stage 2b.

As shown in the Table 9 and Table 10, the mass balance assessment found that there would be a negligible increase in contaminants concentrations in the Waikato River during both Stage 1 (<0.17 %) and Stage 2b (<1.51 %). However, the negligible increase in contaminant concentrations does not contribute towards the achievement of the water quality targets set out in PC1. Therefore, if treated wastewater discharge to the Waikato is to be considered, offsetting activities would need to be investigated in order to remain consistent with the policy direction of PC1 (as described in Section 4.1.3).

6.3 Nutrient Loads Assessment

The objectives, policies and rules for decision making for consent applications for discharges of treated wastewater are set out in the Waikato Regional Policy Statement and Regional Plan. Policy 12 of the Waikato Regional Policy Statement and Regional Plan states that when considering resource applications for the discharge of nitrogen, phosphorus, sediment, or microbial pathogens to the Waikato and Waipa catchments, there is a requirement to demonstrate that the discharge is the best practicable option. Additionally, Policy 13 requires consideration to the impact of the discharge on the PC1 short and long-term attribute states and enables the offset of effects to point source discharges to occur at a different location if adverse nutrient effects to freshwater cannot be avoided or mitigated.

The minimum standards for treated wastewater quality that are presented in Table 3 are to be introduced by 2031 or when the existing discharge resource consent for each wastewater treatment plant expires. Therefore, considering the resource consent for Pukete WWTP is set to expire on 18 September 2027, the future discharge will need to meet the minimum standards presented in Table 3, reducing the nutrient loads from Pukete WWTP to the Waikato River. Additionally, Cambridge WWTP will also undergo improvements in the near future to meet the minimum standards further reducing the nutrient loads to the Waikato River.

As it can be seen from the Table 11 below, the predicted nutrient loads to the Waikato River from the future SWWTP are relatively low and will contribute only <1% of the nutrient loads for both Stage 1 and Stage 2b.

Table 11. SWWTP nutrient loads assessment.

Parameter	Unit	WWTP Discharge to River	% of River Mass Load
Stage 1			
TN Load	kg/day	1.6	0.02
	T/yr	0.58	
TP Load	kg/day	0.4	0.07
	T/yr	0.15	
Stage 2b			
TN Load	kg/day	14.4	0.15
	T/yr	5.26	
TP Load	kg/day	3.6	0.66
	T/yr	1.31	

In summary, the planned improvements at Pukete and Cambridge WWTPs will decrease nutrient discharges, helping to improve the water quality of the Waikato River. This aligns with Objective K of Te Ture Whaimana, aiming to ensure the river is safe for swimming and food gathering along its entire length.

One approach to manage nutrient discharge to the Waikato River could be to link the consent processes for Pukete WWTP with Southern WWTP discharges. This strategy would likely align with policies and legal requirements in Te Ture Whaimana that are aimed at enhancing water quality. However, if it is not possible to link the consent processes, offsetting may be required as a strategy that could prevent an increase in nutrient loads beyond the baseline by reducing nutrients in other parts of the catchment. This might involve actions like planting erosion-prone land, removing land from active farming or agricultural production and restoring riparian areas, aligning with goals to achieve Te Ture Whaimana.

The graphs below illustrate the predicted future nutrient loads associated with these treatment standards for the entire Metro Area (including: Pukete, Cambridge, Te Awamutu, Ngaruawahia, Matangi, Tauwhare Pa and Te Kowhai), accounting for increased wastewater flows driven by growth. Since a 1 mg/L TP treatment standard leads to an exceedance of baseline TP loads for the wider metro area, an alternative 0.5 mg/L TP treatment standard has also been evaluated. When all WWTP discharges are considered collectively, the future nutrient loads are projected to be lower than current levels, even with a 1 mg/L TP concentration. This indicates an overall improvement in the water quality of the Waikato River.

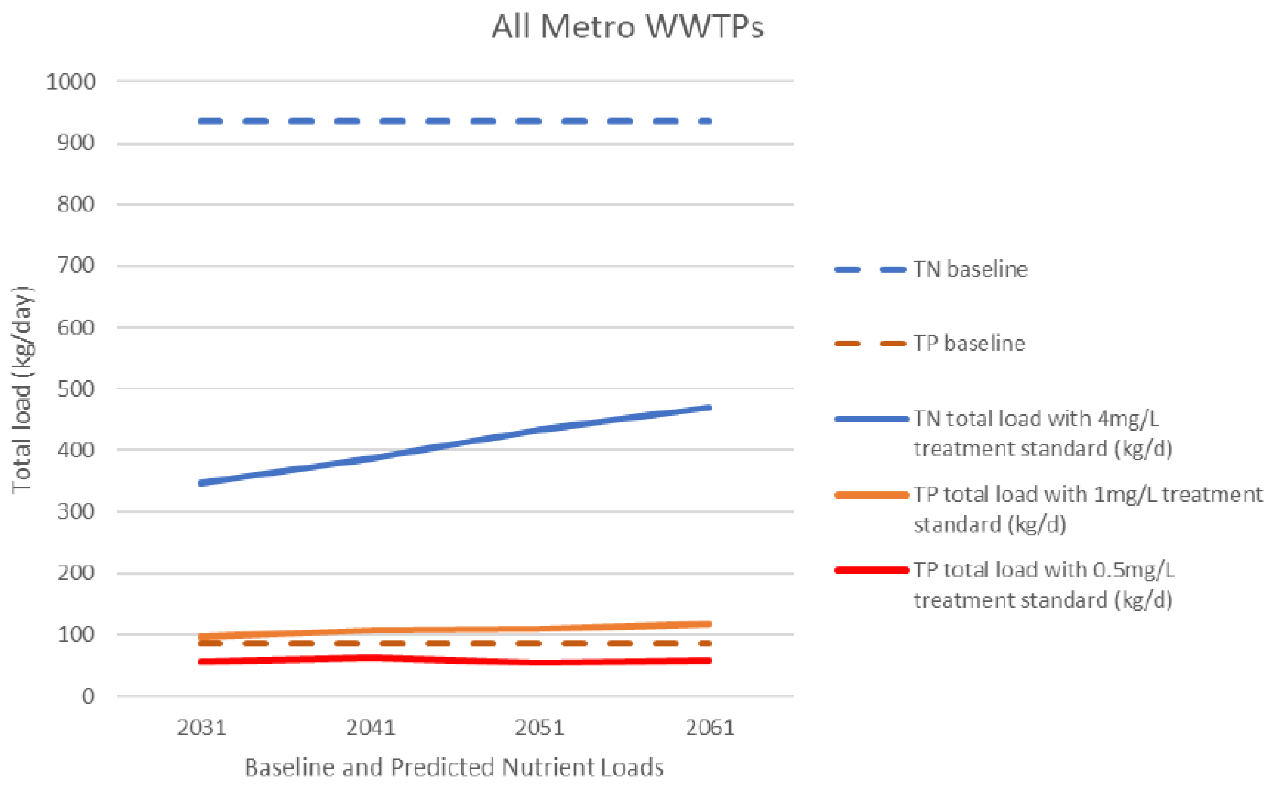


Figure 6. Baseline and Predicted Nutrient Loads for the entire Metro Area (excluding large independent industrials)[18].

[18] The Hamilton-Waikato Southern Metropolitan Area Wastewater Detailed Business Case Preferred Option Report, Metro Wastewater Project Partners, May 2022.

7 Summary and Conclusions

Review of the existing water quality data:

• The review of the existing water quality data showed that water quality gradually declined from monitoring locations Taupo Gates (1) to Tuakau (12). Additionally, the data analysis of monitoring location Hamilton-Narrows (7), which is considered upstream of the anticipated discharge from the SWWTP, showed the following:

- Concentrations of *E. coli* exceeded all of the applicable PC1 short-term and long-term targets.
- Both the short-term and long-term PC1 targets for clarity were not met.
- Concentrations of DRP and CHLa did not exceed their applicable PC1 short-term or long-term targets.
- Concentrations of TP, TN, NO_3-N, and NH_4-N exceeded all applicable PC1 short-term or long-term targets.
- pH levels, DO (%), DO concentration, and turbidity did not exceed their relevant WRC and NPS-FM (2020) guideline values.

Based on the recent 3-month water quality programme to fill the spatial gaps, the monitoring locations located near the approximate location for the SWWTP discharge include Narrows Boat Ramp (P3) and Flagstaff Park (P4). In summary, the water quality assessment results at P3 and P4 indicated that:

- There was no notable different in concentrations of CHLa, NO_2-N, DRP, TP, TKN, TN, DO saturation, conductivity, or pH levels between monitoring locations P3 and P4.
- The average NH_4-N concentration was slightly elevated at monitoring locations P3 when compared to P4. NO_3-N and NO_2-N+NO_3-N concentrations gradually increased throughout the monitoring period at both locations (P3 and P4).
- *E. coli* concentration was elevated at monitoring location P4 when compared to monitoring location P3.
- Temperature gradually decreased at both monitoring locations (P3 and P4) throughout the monitoring period.
- Additional sampling (a minimum of 12 monthly samples) at locations P1 to P8 was recommended to account for seasonal variation, with the results to be reported in a subsequent report that includes a comparison of the monitoring results to applicable guideline values All of the available data will be used in any future baseline water quality report.

Effects of the Discharge from the SWWTP on the Waikato River:

The mass balance assessment of predicted changes in key contaminant concentrations in the Waikato River downstream of the treated wastewater discharge found the following:

- Under average river flow conditions, a negligible percentage increase (<1%) in the concentration of TN, TP, and *E. coli* is predicted in the Waikato River downstream of the discharge under mean river flow conditions for both Stage 1 and Stage 2b. Additionally, TN, TP and *E. coli* concentrations are elevated above PC1 short-term and 80-year attribute states, both upstream and downstream for existing flows and for both Stage 1 and Stage 2b. Therefore, given the significant dilution that occurs, the overall effects of these parameters are considered to be **Negligible** for both Stage 1 and Stage 2b.

- Under low river flow conditions, there is a slightly higher percentage increase in the concentrations of TN, TP, and *E. coli* in the Waikato River downstream of the discharge compared to average flow conditions. However, the increase is negligible (<1%) for TN, TP, and *E. coli* concentrations in both Stage 1 and Stage 2b, except for a 1.51% increase in TP during Stage 2b. Considering that the existing and predicted TN, TP, and *E. coli* concentrations are above PC1 short-term and 80-year attribute states, both upstream and downstream for existing flows and for both Stage 1 and Stage 2b, the overall effect of these parameter is considered to be **Negligible** for both Stage 1 and Stage 2b.

Nutrient loads assessment:

In summary, the predicted nutrient loads to the Waikato River from the future SWWTP are relatively low and will contribute <1 % of the nutrient loads for both Stage 1 and Stage 2b. In addition, the planned improvements at Pukete and Cambridge WWTPs will decrease nutrient discharges, helping to improve the water quality of the Waikato River. Considering that the consent application for Cambridge WWTP has already been submitted and the WWTP is currently being upgraded, linking the consent processes for the Pukete WWTP and the SWWTP may align with policies and legal requirements in Te Ture Whaimana that are aimed at enhancing water quality. If it is not possible to merge the consent processes for Pukete WWT and SWWTP, offsetting is a strategy that could be implemented to prevent an increase in nutrient loads beyond the baseline by reducing nutrients in other parts of the catchment. This might involve actions like planting erosion-prone land and restoring riparian areas, aligning with goals to achieve Te Ture Whaimana..

Based on the predicted future nutrient loads associated with the proposed minimum performance treatment standards for the entire Metro Area, when all WWTP discharges are considered collectively, future nutrient loads are expected to be lower than current levels, suggesting an overall improvement in the water quality of the Waikato River.

Recommendations:

- In this report, the discharge point is currently assumed to be located upstream of Hamilton and downstream of Narrows Bridge. Additional investigation is needed to confirm the exact discharge location.
- If surface water discharge is chosen as the preferred discharge location, undertaking ecological and further water quality investigations will be necessary to understand the impacts of treated wastewater discharge on the Waikato River.