Manaaki Whenua
Landcare Research

# Soil information for four Hamilton southern wastewater treatment plant land treatment sites

Prepared for: Beca International Consultants Ltd

**April 2023**

# Soil information for four Hamilton southern wastewater treatment plant land treatment sites

*Contract Report: LC4260*

Malcolm McLeod

*Manaaki Whenua – Landcare Research*

| *Reviewed by:* | *Approved for release by:* |
|---|---|
| Scott Fraser | John Triantafilis |
| Scientist | Portfolio Leader – Managing Land & Water |
| Manaaki Whenua – Landcare Research | Manaaki Whenua – Landcare Research |

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# Summary


### Project and client

Beca International Consultants Ltd have requested Manaaki Whenua–Landcare Research (MWLR) undertake soil appraisal at four sites for wastewater discharge to land in the Hamilton South area.

### Objectives

- Review existing soil information.
- Make preliminary assessments on the suitability of soils at four sites (i.e., Sharpe Farm, Narrows Road, Golf Course, and Penniket Road) in the Hamilton South region for the land disposal of treated wastewater.

### Methods

- Relevant historical soil information was evaluated.
- Soil observations to about 1 metre below soil surface were undertaken using a light coring rig or by hand augering where use of the coring rig would cause crop damage during access.
- Soil descriptions placed emphasis on soil properties most relevant to irrigation of treated wastewater, i.e. colour, texture, consistence, drainage.

### Results

- Soils at Sharpe Farm were predominantly developed in imperfectly or poorly drained alluvium with a minor area developed in older clayey volcanic tephra. Imperfect and poor drainage as well as clayey textures are considered restrictions to treated wastewater application.
- Soils on low-lying land at Narrows Road are developed in poorly drained alluvium while those on elevated rolling land are developed in older clayey volcanic tephra. Poor drainage and clayey textures are considered restrictions to treated wastewater application.
- Soils at the Golf Course are developed in well-drained sandy alluvium and likely provide little renovation to applied treated wastewater.
- Wastewater application rates need to be matched to soils at Penniket Road where the upper subsoil probably adsorbs phosphorus and is a filter to bacteria and viruses.

### Conclusions

- We investigated soils at four potential Hamilton South wastewater treatment sites (Sharpe Farm, Narrows Road, the Golf Course, and Penniket Road [3N and 3S]) for land application of treated wastewater.
- Most soils at Sharpe Farm and Narrows Road have drainage restrictions and limitations for year-round application of treated wastewater, although deficit irrigation of topsoils may be feasible.

- While most soils at the Golf Course have adequate infiltration characteristics for year-round application of treated wastewater, they will probably provide little renovation of applied wastewater.
- Well-drained soils at both sites within Penniket Road (3N and 3S) have few limitations to year-round application of treated wastewater if application rates are matched to soil infiltration and permeability rates. However, some soils are likely to absorb applied phosphorus and filter out microbes.

# 1 Introduction

Beca International Consultants Ltd (Beca Ltd) have requested Manaaki Whenua–Landcare Research (MWLR) to undertake soil appraisal at selected sites for wastewater discharge to land in the Hamilton South area.

# 2 Background

Four potential sites, near Hamilton airport, have been selected by Beca Ltd for the land discharge of treated wastewater. The sites are: Sharpe Farm, Narrows Road, the Golf Course, and Penniket Road (3N and 3S).

# 3 Objectives

- Review existing soil information.
- Make preliminary assessments on the suitability of soils at four sites in Hamilton South for the land disposal of treated wastewater.

# 4 Methods

Relevant historical soil information was evaluated from: Grange et al. (1939); Joe (1986); an unpublished NZ Soil Bureau map of the Waikato district; and S-Map online, version 4.2.100 (Manaaki Whenua – Landcare Research 2023). Generally, Joe (1986) reports the mean and standard deviation of replicate hydraulic conductivity results where $n$=4.

S-Map online is a free-to-access online soil map derived from a combination of field observations supplemented with co-variate layers such as a digital elevation model and geological layers. Geographic soil names have been superseded by new family names and supported by a large database of soil data. Because S-Map online is a nationwide system it allows generation of information on soil chemical and physical properties, often involving complex relationships between soil properties, to be established.

In the field, soil observations to about 1 metre below soil surface were undertaken using a light coring rig (Figure 1) or by hand augering where use of the coring rig would cause crop damage. Appendix 1 shows observation sites at the completion of the observation in the event of claims for crop damage. Soil descriptions placed emphasis on soil properties most relevant to irrigation of treated wastewater (i.e. colour, texture, consistence, drainage). Sites were located using a hand-held Global Positioning System device (Garmin GPSMAP® 64s) and are shown in Appendix 2.

**Figure 1. A light coring rig was used to obtain an undisturbed soil core for description where crop damage was not of concern.**

# 5 Results

## 5.1 Historical data

Grange et al. (1939) undertook a soil survey in the area between 1933 and 1935 at a scale of 1:31,680. The Golf Course is not covered by Grange et al. (1939) but is covered by an unpublished, undated Soil Bureau map at scale 1:63,360. Some saturated hydraulic conductivity data has been elucidated from Joe (1986) and should be considered as a guide only. Joe (1986) also reported near-saturated hydraulic conductivity at a tension of -40 mm water ($K_{-40}$). At this tension water moves through the pores of 0.75 mm and smaller only. Thus, transient natural soil structural cracks and worm holes are not involved in the transmission of water. $K_{-40}$ is a slower hydraulic conductivity value than $K_{sat}$ and may be more appropriate for wastewater application considerations. S-Map online provides 1:50,000 scale coverage for all of the potential sites.

### 5.1.1 Sharpe Farm

Grange et al. (1939) show Sharpe Farm soils to be well-drained Horotiu sandy loam with poorly drained Te Kowhai silt loam, clay loam in the lower areas of river terrace (all from alluvium), and imperfectly drained Hamilton clay loam on land above the river terrace developed in airfall volcanic tephra. Hamilton clay loam soils are developed in 'old' (>50,000 year) airfall volcanic ash which has now mostly weathered to clay.

Grange et al. (1939) also show a minor area of an unnamed soil in an embayment in surrounding elevated land. Judging from the landscape position between the elevated land and an artificial drain shown on topographical maps, the soil is likely to be poorly or very poorly drained.

At Sharpe Farm (Figure 2), S-Map online shows two map units. The major map unit areas relate to alluvial soils on the Hinuera Formation (deposited by the ancestral Waikato River) but these are away from the levees and in a backswamp landscape position where we would expect less well-drained soils (Pukehina and Wharepunga families). The very minor map unit area pertains to volcanic tephra covered low hills (Mairoa and Te Rahu families) which are surrounded by alluvium of the Hinuera Formation. Before S-Map online the Mairoa family would have been included in Tirau soils while the Te Rahu family would have been included in Hamilton soils.

**Figure 2. Sharpe Farm is predominantly flat to undulating but with minor undulating toeslopes in the southwestern part of the site.**

### 5.1.2 Narrows Road

Grange et al. (1939) show lower-lying the land at Narrows Road to be predominantly poorly drained Te Kowhai soils with Hamilton soils on higher elevation rolling land. Te Kowhai soils are relatively fine-grained soils deposited by overbank flow in backswamp positions by the ancestral Waikato River. Hamilton soils are developed in 'old' (>50,000 year) airfall volcanic ash which has now mostly weathered to clay.

At Narrows Road S-Map online shows two map units (Figures 3–4). Major map unit areas relate to alluvial soils on the Hinuera Formation but away from the levees and in a backswamp landscape position, so we expect less well-drained soils (Pukehina and Wharepunga families). Before S-Map, the Pukehina family would have been included in Te

Kowhai soils while the Wharepunga family would have been included in the Bruntwood soils of Singleton (1991). The minor map unit relates to low hills that are volcanic tephra covered (Mairoa and Te Rahu families) which are surrounded by alluvium of the Hinuera Formation. Before S-Map online, the Mairoa family would have been included in Ohaupo soils, Te Rahu family would have been included in Hamilton soils.

**Figure 3. Low-lying land at Narrows Road is shown by S-Map online to be predominantly poorly drained Pukehina family soils developed on the alluvial Hinuera Formation.**

**Figure 4. Higher elevation rolling land is shown by S-Map online to be Mairoa and Te Rahu soil families developed in volcanic tephra.**

### 5.1.3 Golf Course

The unpublished Soil Bureau map shows the Golf Course to have Waikato soils that are developed in rhyolitic alluvium alongside the Waikato River.

S-Map online shows one map unit with two soil classes both developed on terraces formed from the Taupo Pumice alluvium from 186 AD eruption deposited by the Waikato River. The soil classes are both deep (Turangi family), but one is sandy and the other loamy over sand (Figure 5). Before S-Map, the soils were included in Waikato soils.

**Figure 5. The Golf Course site has well drained Turangi family soils developed in pumice alluvium.**

### 5.1.4 Penniket Road

There are two sites at Penniket Road (3N and 3S; Figures 6 and 7). Grange et al. (1939) show the Penniket Road sites to be Horotiu sand and coarse sandy loam with Horotiu sandy loam towards the north. At both Penniket Road sites (3N and 3S) S-Map online shows two map units both developed on the alluvial fan surface. The alluvial fan was deposited by the ancestral Waikato River and is known as the Hinuera Formation. Being an alluvial surface, the levees have better drained soils (Otorohanga family) while in lower landscape positions soils become less well-drained (Airfield family). Before S-Map, Otorohanga family soils were included in Horotiu soils while Airfield family soils were included in Whatawhata soils (Bruce 1978). The Otorohanga family developed on Hinuera Formation has volcanic tephra in the upper soil profile (>35 cm thickness) that was deposited in the last 20,000 years and which gives it high phosphorus retention.

**Figure 6. S-Map online shows Penniket Road Site 3N to have soils within Otorohanga and Airfield soil families.**

Grange et al. (1939) show the southern Site 3S at Penniket Road to be Horotiu sandy loam while S-Map online also shows Otorohanga and Airfield families present, with the potential for Pukehina family towards the south.

**Figure 7. S-Map online shows Penniket Road Site 3S to have Otorohanga, Airfield and Pukehina soil families.**

## 5.2 Current investigations

### 5.2.1 Sharpe Farm

Most of the land at Sharpe Farm is planted in pasture and two distinct landform units are evident. The majority of the land is a dissected terrace (Hinuera Formation) of the Waikato River with a combination of imperfectly drained and poorly drained soils (Figures 8 and 9). Grey colours in the subsoil of these soils indicates waterlogging for considerable periods of the year. Well-drained soils mapped by Grange et al. (1939) were not evident although now the definition of 'well drained' has been revised and formalised. 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.

Typically, the imperfectly drained soils have a dark loamy topsoil overlying a loamy yellowish brown upper subsoil. Lower subsoils are firm and grey. The grey colour indicates waterlogging for considerable periods of the year. Below about 70 cm the soils are often developed in pumice sand, but this can be waterlogged as well. Where upper subsoils are yellowish-brown, they are judged to have moderate anion retention. This means the soil has some ability to retain phosphorus.

Although Joe (1986) did not measure the hydraulic conductivity of similar soils, the upper subsoils are judged to have $K_{sat}$ of 2 $\times 10^{-5}$ m $s^{-1}$ to 1 $\times 10^{-6}$ m $s^{-1}$; whereas the firm grey lower subsoil is judged to have $K_{sat}$ of c. 2.5 $\times 10^{-6}$ m $s^{-1}$, with $K_{-40}$ of c. 3.9$\times 10^{-7}$ m $s^{-1}$.

**Figure 8. Imperfectly drained soil typical of the alluvial Hinuera surface at Sharpe Farm. Grey colours indicate waterlogged conditions for much of the year.**

The imperfectly drained nature of the soil, with indication of subsoil waterlogging, combined with restricted subsoil permeability indicates limitations to year-round application of treated wastewater. Deficit irrigation using storage within the topsoil and yellowish-brown upper subsoil is feasible. However, care must be taken not to graze stock on 'wet' topsoils.

**Figure 9. Drainage ditches in the terrace land are also a sign of imperfectly and poorly drained soils at Sharpe Farm.**

The small area of rolling land (southwestern margin) above the dissected river terrace has Hamilton soils developed in 'older' airfall volcanic tephra, Hamilton Ash beds. 'Hamilton Ash beds' is a colloquial term for volcanic tephras of between c. 50,000 and 340,000 years old. This soil material has mostly weathered to clay and also there is some movement of fine clays downwards blocking soil pores and restricting water movement. Being in a toeslope landscape position, the soils receive water from upslope and the soils show signs of periodic waterlogging, even in the topsoil.

Although Joe (1986) measured hydraulic conductivity of similar soils the ones he measured occurred in a higher landscape position where $K_{sat}$ and $K_{-40}$ were $5.5 \pm 1.0\ \ 10^{-5}$ m $s^{-1}$ and $1.8 \pm 0.2 \times 10^{-6}$ m $s^{-1}$, respectively, in the upper subsoil; and $2.9 \pm 3.7 \times 10^{-6}$ m $s^{-1}$ and $1.6 \pm 1.0 \times 10^{-6}$ m $s^{-1}$, respectively, in the lower subsoil.

The 'younger' loamy airfall volcanic tephra has probably been eroded from this site.

Topsoils showing signs of periodic waterlogging indicate the soils have limitations for year-round application of treated wastewater, but limited deficit irrigation of the topsoil may be feasible. However, care must be taken not to stock 'wet' topsoils.

*Interpretation for treated wastewater disposal*

Low-lying land at the Sharpe Farm site has drainage and permeability restrictions to year-round treated wastewater application. The small area of elevated land above the terraces has rolling slopes, restricted subsoil permeability and evidence of waterlogging in the topsoil. This indicates restrictions to year-round application of treated wastewater. Lateral flow of surface-applied treated wastewater to these slopes is likely to generate seepage zones at the base of slopes. Both the low-lying and small area of elevated land could be considered for deficit irrigation, but care must be taken to avoid stocking 'wet' topsoils.

### 5.2.2 Narrows Road

Most of the land at the Narrows Road site is planted in maize. The flat, low-lying land is predominantly poorly drained with very poorly drained soils in embayments. Deep drains are also 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 – an indication of waterlogging where vegetation does not readily decompose. Typically, poorly drained soils have loamy topsoils cultivated to about 20 cm overlying firm, greyish, loamy upper subsoils (Figure 10). Below about 70 to 80 cm in the lower subsoil, soil material is pumiceous sand. Saturated hydraulic conductivity ($K_{sat}$) in the upper subsoil of similar soils is $8.9 \pm 6.4 \times 10^{-5}$ m s-$^{1}$ with $K_{-40}$ of $1.2 \pm 0.2 \times 10^{-6}$ m $s^{-1}$ (Joe 1986).

The 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 (Figures 11 and 12). The waterlogging is a restriction to year-round application of treated wastewater. Deficit irrigation of poorly drained soils may be feasible where water storage of the topsoil only, is considered. However, care must be taken not to stock 'wet' topsoils.

The soils on elevated rolling land are well drained, developed in clayey Hamilton Ash beds. Similarly, topsoils are cultivated to about 20 cm and overlie very firm clayey subsoils (Fugure 13). In these soils, clay from upper soil layers is often translocated down the soil profile and deposited below about 50 cm. The translocated clay tends to block soil pores and reduce hydraulic conductivity. The $K_{sat}$ and $K_{-40}$ of similar soils are $5.7 \pm 1.0 \times 10^{-5}$ m $s^{-1}$ and $1.8 \pm 0.2 \times 10^{-6}$ m $s^{-1}$, respectively, in the upper subsoil; and $2.9 \pm 3.7 \times 10^{-6}$ m $s^{-1}$ and $1.6 \pm 1.0 \times 10^{-6}$ m $s^{-1}$, respectively, in the lower subsoil (Joe 1986). At the toe of slopes on the rolling land, soils tend to become less well-drained with manganese concretions in the upper subsoil which indicated waterlogging for some period of the year.

The rolling slopes and potentially restricted subsoil permeability indicate these soils have limitations for year-round treated wastewater application. The rolling land could be considered for deficit irrigation, but care must be taken to avoid stocking 'wet' topsoils and to match application rate to infiltration rate to prevent run-off.

**Figure 10. Greyish colours in the Pukehina family soil above 30 cm indicate a poorly drained soil.**

**Figure 11. Deep drains are another indication of poorly drained soils on the low-lying land.**

**Figure 12. Soft surface conditions in embayments are associated with very poorly drained soils.**

**Figure 13. On elevated rolling land at the Narrows Road site, soils are developed in clayey Hamilton Ash which is very firm.**

*Interpretation for treated wastewater disposal*

The low-lying land at the Narrows Road site has drainage and permeability restrictions which present limitations for year-round application of treated wastewater, although deficit irrigation of the topsoil may be feasible. Elevated land has rolling slopes and restricted subsoil permeability that also present limitations for year-round application of treated wastewater, although deficit irrigation of the topsoil may be feasible. Lateral flow of surface-applied treated wastewater is likely with a probability of seepage zones at the base of slopes.

### 5.2.3 Golf Course

At the Golf Course, soils are developed in well-drained rhyolitic alluvium deposited by the Waikato River. Natural river channels and the development of the golf course mean the soils show much variation and disturbance (Figure 14) but typically a dark sandy loam topsoil to about 20 cm overlies yellowish-brown sand to about 50 cm where soil weathering slows, and the sand reflects the colour of the original alluvium (Figure 15). Although Joe (1986) did not report hydraulic conductivity measurements for these soils $K_{sat}$ and $K_{-40}$ are judged to be c. 4.0 $\times 10^{-4}$ m $s^{-1}$ and 7.4 $\times 10^{-5}$ m $s^{-1}$, respectively. Rhyolitic stones and pumice are common throughout the soil. Although much of the land is disturbed, the disturbed material is generally the same rhyolitic alluvium. An exception is the lower terrace adjacent to the eastern terrace riser which can have up to 70 cm imported fill over an organic-rich buried topsoil (Figure 16).

**Figure 14. Turangi family soils at the Golf Course site often show signs of disturbance.**

**Figure 15. Typical well drained Turangi family soil at the Golf Course site.**

**Figure 16. The lower terrace adjacent to the eastern terrace riser can have up to 70 cm of imported fill.**

Below the topsoil, sandy Turangi family soils are judged to have rapid saturated hydraulic conductivity ($K_{sat}$ > 4 × $10^{-5}$ m $s^{-1}$).

*Interpretation for treated wastewater disposal*

At the Golf Course site, surface applied treated wastewater will potentially move through the soil rapidly, so this site is suitable for year-round application of treated wastewater. However, the nature of the soil material indicates little renovation is likely. The amount and nature of imported fill on the low terrace adjacent to the eastern terrace riser may need further investigation.

### 5.2.4 Penniket Road

Soils at Site 3N at Penniket Road are predominantly well-drained Otorohanga family soils developed in < 20,000 year-old volcanic tephra overlying the rhyolitic alluvium of the Hinuera Formation (Figure 17). The alluvium is older (c. 20,000 years old) than the alluvium of the Turangi family soils at the Golf Course site (c. 2,000 years old). Typically, Otorohanga family soils show a dark brown loamy topsoil over a yellowish-brown loamy

upper subsoil on a very pale brown sandy lower subsoil. Judging from soil colour and simple reactive aluminium tests done in the field indicate they have high or very high anion retention (Blakemore et al. 1987) indicating they would be able to retain large amounts of applied phosphorus with only minor phosphorus leaching. Similar soils have $K_{sat}$ and $K_{-40}$ of 4.0 ± 1.2 $\times 10^{-5}$ m $s^{-1}$ and 5.9 ± 0.7 $\times 10^{-6}$ m $s^{-1}$, respectively, in the upper subsoil; this increases to 4.0 ± 2.9 $\times 10^{-4}$ m $s^{-1}$ and 7.4 ± 3.1 $\times 10^{-5}$ m $s^{-1}$, respectively, in the lower subsoil.

Towards the very north of the site and associated with slightly lower land the soils become less well drained (imperfectly drained) with reddish brown mottles and manganese concretions in the upper subsoil. Such features are indicative of short periods of waterlogging and may be associated with rolling land to the north of the site. LiDAR images show slightly elevated land either side of Penniket Road, but the soils are similar to those on the lower land. Well-drained soils on site 3N have few limitations for year-round application of treated wastewater if wastewater application rates are matched to infiltration and permeability rates. Care must be taken to avoid stocking 'wet' topsoils.

**Figure 17. Well drained Otorohanga family soil at Penniket Road site 3N where yellowish-brown loamy upper subsoils are expected to retain phosphorus and filter microbes.**

Soils at Site 3S Penniket Road are a well-drained inclusion within the map unit showing Otorohanga family soils. They are developed in re-sorted volcanic tephra that has been combined with sandy rhyolitic alluvium of the Hinuera Formation (Figure 18). The alluvium is older than the alluvium of the Turangi family soils at the Golf Course site. Typically, the soils have a dark yellowish-brown loamy topsoil up to 30 cm thick on a brownish-yellow upper subsoil. The lower very pale brown sandy subsoil shows little soil development, reflecting the colour and structure of the unweathered sandy alluvium. Judging from soil colour and simple reactive aluminium tests undertaken in the field they have medium (Blakemore et al. 1987) anion retention in the upper subsoil indicating they would be able to retain moderate amounts of applied phosphorus with only minor phosphorus leaching. Similar soils have $K_{sat}$ and $K_{-40}$ of 4.0 ± 2.9 $\times 10^{-4}$ m $s^{-1}$ and 7.4 ± 3.1 $\times 10^{-5}$ m $s^{-1}$, respectively, in the lower subsoil. Our experience is that the loamy upper subsoil material is a good filter to bacteria and possibly viruses.

Well-drained soils on site 3S have few limitations for year-round application of treated wastewater when application rates are matched to infiltration and permeability rates. Care must be taken to avoid stocking 'wet' topsoils.

**Figure 18. Well drained soil at Penniket Road 3S.**

*Interpretation for treated wastewater disposal*

Both well-drained sites at Penniket Road will accept treated wastewater on a year-round basis if application rates match the soils' infiltration and permeability. However, stocking of 'wet' topsoils should be avoided. Some long-term removal of phosphorus and pathogens by these soils is expected where upper subsoils are loamy.

# 6 Conclusions

| Site | Notes |
|---|---|
| Sharpe Farm | Low-lying terrace land has drainage (and in some places) permeability restrictions, while land above the river terrace has rolling slopes, imperfect drainage and restricted subsoil permeability. Sharpe Farm has limitations to year-round application of treated wastewater. Deficit irrigation using storage within the topsoil and yellowish-brown upper subsoil is feasible. |
| Narrows Road | Low-lying land has drainage and permeability restrictions, while the elevated land has rolling slopes and restricted subsoil permeability. Narrows Road has limitations for year-round application of treated wastewater although deficit irrigation of the topsoil may be feasible. Lateral flow of surface-applied treated wastewater is likely, with seepage zones probable at the base of slopes. |
| Golf Course | Surface-applied treated wastewater will potentially move through the soil rapidly, but the nature of the soil material indicates little renovation is likely. At the Golf Course, surface-applied treated wastewater will potentially move through the soil rapidly and is suitable for year-round application. However, the nature of the soil material indicates little renovation is likely. The amount and nature of imported fill on the low terrace adjacent to the eastern terrace riser may need further investigation. |

| Site | Notes |
|---|---|
| Penniket Road | Match application rate to soil infiltration rate. Some long-term removal of phosphorus and pathogens is expected where upper subsoils are loamy. Both sites (3N and 3S) at Penniket Road can accept treated wastewater on a year-round basis if application rates match the soils' infiltration and permeability. |

## 7 Acknowledgements

Thanks to those who allowed access to land and colleague Isaac Osbaldiston for field assistance at Sharpe Farm as well as Andrew Miram at Sharpe Farm for showing us the location of high-voltage underground cables, fibre optic cable and water pipes.

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## Appendix 1 – Photos at waypoints

The photos below are provided to show site disturbance after soil description in the event of claims for crop damage.

**Table A1.1. Reference photos**

Waypoint 1063 Sharpe by rig in pasture

Waypoint 1064 Sharpe by hand in pasture

Waypoint 1066 Sharpe by hand in pasture

Waypoint 1067 Sharpe by hand in pasture

Waypoint 1069 Sharpe by rig in pasture

Waypoint 1070 Sharpe by hand in pasture

Waypoint 1055 Narrows. By hand in maize

Waypoint 1056 Narrows. By hand in pasture

Waypoint 1057 Narrows. By hand on edge of maize

Waypoint 1058 Narrows. By hand in maize

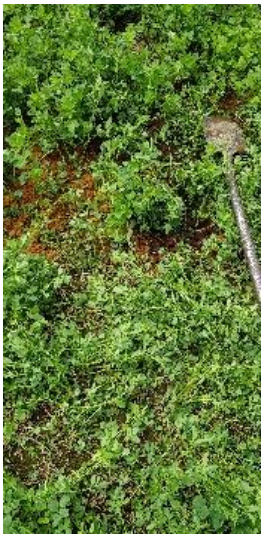
Waypoint 1061 Golf Course. By rig in pasture

Waypoint 1045 Penniket. By rig in harvested lucerne

Waypoint 1048 Penniket. By rig in harvested lucerne

Waypoint 1049 Penniket. By rig in harvested lucerne

Waypoint 1050 Penniket. By hand in pasture



Waypoint 1052 Penniket. By hand in pasture

Waypoint 1053 Penniket. By rig in pasture

Waypoint 1054 Penniket. By hand in pasture

# Appendix 2 – Location of waypoints


**Figure A2.1 Sharpe Farm.**


**Figure A2.2. Narrows Road.**


**Figure 19. Golf Course.**


**Figure A2.4. Penniket Road.**

# Multi-Criteria Assessment Workshop Record

## Southern Wastewater Treatment Plant

Prepared for Hamilton City Council
Prepared by Beca Limited

**22 August 2024**

## Revision History

| Revision Nº | Prepared By | Description | Date |
|---|---|---|---|
| 1 | Mhairi Rademaker | Draft | March 2023 |
| 2 | Garrett Hall | Final | August 2024 |
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| | | | |
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## Document Acceptance

| Action | Name | Signed | Date |
|---|---|---|---|
| Prepared by | Mhairi Rademaker |  | March 2023 |
| Reviewed by | Garrett Hall |  | August 2024 |
| Approved by | Garrett Hall |  | August 2024 |
| on behalf of | Beca Limited | | |

# 1 Introduction

The purpose of this report is to document the Southern Wastewater Treatment Plan technical MCA.

# 2 Short-list options

The Metro Wastewater Detailed Business Case - Site Selection Options Report identified three sites for further investigation:

- Old Site 2a: Waikato Regional Airport Limited, Rukuhia
- Old Site 2c: Narrows Road / Ohaupo Road (SH3), Rukuhia
- Old Site 3: Rukuhia Farm, Penniket Road, Rukuhia

Since that report was completed, the focus has shifted to sites in either Crown or council ownership.

Waka Kotahi NZ Transport Agency (Waka Kotahi) has secured a designation for the future Southern Links transportation project in the southern sub-region. The Crown has been progressively purchasing land for this future transport corridor and has identified a number of sites where land it now owns is likely to be surplus to Waka Kotahi requirements for a transport corridor.

In addition, HCC has purchased a farm between Peacockes Road and Raynes Road.

Therefore, four sites were identified for further investigation as part of a refined short-list:

- Site 1: Sharpe Farm
- Site 2: Rukuhia/Narrows Road
- Site 3: Penniket Road
- Site 4: Golf Course

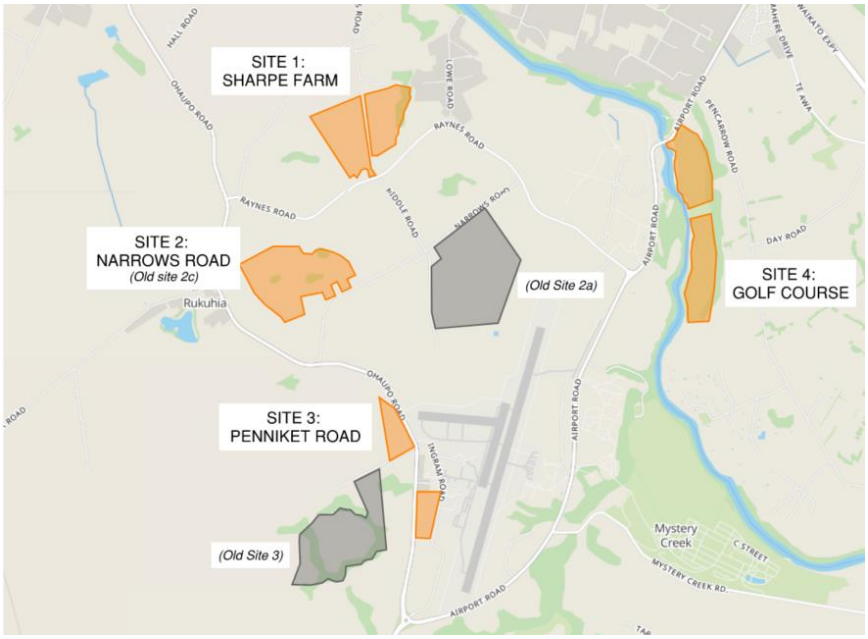


Figure 1: Short-list sites for consideration (sites identified in Metro Wastewater Detailed Business Case - Site Selection Options Report but no longer being considered shown in grey)

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# 3 Desktop review summaries

The summaries below have been developed to assist with scoring of the MCA and mana whenua assessments. Any additional information learnt through the MCA workshop and mana whenua hui will be added as relevant. More detail will be provided in the Short-List Report

## Site 1: Sharpe Farm

| | |
|---|---|
| Built environment | Rural-residential / lifestyle block clusters along the northern and southern boundaries.<br>Expect that WWTP can be accommodated with 150m buffer to site boundary, but some dwellings (no. TBC) will be within 300m of plant. |
| Archaeology | Archaeological artefacts have been found on the farm in the past and the current landowner is aware of probable borrow pits on the land (although there are no formally recorded sites). It was not possible to see them during the initial field survey as the grass was very long. It is intended to return to site in autumn to re-assess the nature and extent of the archaeological evidence. |
| Potential for discharge to land | Soils predominantly imperfectly or poorly drained alluvium with some older clayey volcanic tephra. Groundwater was encountered 57-70cm below soil surface.<br>These soils are considered restrictions to discharge to land. |
| Contaminated soils | • The stockyards and various sheds on the site may have had contaminating activities operated within or near them including sheep dip/drenching, asbestos, and storage of fuel and pesticides.<br>• No broad site contaminating activity has been identified across the paddocks used for farming. It is known that superphosphate fertilizers can result in elevated cadmium levels in agricultural land uses, however, are unlikely to result in a contaminated soil risk or require additional management. |
| Terrestrial ecology | • **Terrestrial vegetation**: Primarily pasture and exotic grass cover with scattered areas of hedges and shelterbelts. Riparian margins of the Nukuhau Stream comprised of a range of mixed native and exotic species and identified as a Significant Natural Area in Waipā District Plan.<br>• **Wetlands**: Potential wetland area adjacent the Nukuhau Stream.<br>• **Bats**: Known bat presence concentrated along the riparian corridors of the watercourses on the site, as well as in denser vegetated areas in proximity to the site.<br>• **Avifauna**: Several suitable habitat types for a range of native and introduced species.<br>• **Lizards**: Low likelihood in pasture utilised by cattle. Potential suitable habitat in unmanaged areas. |
| Aquatic ecology | • Two **tributaries of the Nukuhau Stream** traverse the site with naturally meandering channels. Some erosion of streambanks. Extensive macrophyte and weed growth in and adjacent channel with shading limited to a few taller trees. Stream substrata was unable to be confirmed due to the instream weed growth but is expected to be soft sediment.<br>• The **main channel of the Nukuhau Stream** flows alongside the eastern boundary of the site. Substrata appears to comprise of mainly sandy-silt sediment. Riparian vegetation comprises mixed native and exotic species |

| | |
|---|---|
| | with variable levels of shading. Suitable habitat for fish and macroinvertebrates – no records of fish species but nearby records indicate likely presence of a range of native species including at-risk species. |
| Groundwater | • Approximately 24 known bores/wells within 600 m of the site, with five screened at <10 m and nine of unknown screen depth.<br>• 7 household/domestic water supply wells within ~500 m of the site. |
| Planning | • **Zoning**: Site and surrounds zoned rural except Large Lot Residential to the north/northeast. No overlays except airport horizontal surface.<br>• **Features and overlays**: Adjoins Southern Links designation (District Plan reference D156, shown in purple outline on zone map), Significant Natural Area: Nukuhau Stream Margins (District Plan reference WP270, shown in green on features map), Viewshaft and SH3 Scenic Corridor to the west (shown in purple hash on features map), Not located with a District Plan potential flood area.<br>• **Watercourses**: Nukuhau Stream and unnamed tributary both surface water classification, Waikato River at Nukuhau confluence classified as indigenous fish habitat, trout habitat, and contact recreation.<br>• **Highly productive land**: Site classified as LUC 2 with some LUC 1 & 3 along the southern boundary. |

## Site 2: Narrows/Rukuhia

| | |
|---|---|
| Built environment | Rural-residential / lifestyle block clusters along the northern and southern boundaries, Rukuhia village to the west.<br>WWTP unlikely to be accommodated with 150m buffer to site boundary (because of ecological constraint), but potentially acceptable to include the Southern Links designation in this buffer area. Some dwellings (no. TBC) will be within 300m of plant. |
| Archaeology | No known sites on this land. The research has not led to the identification of sites and no archaeological sites are anticipated. |
| Potential for discharge to land | Low lying area consist of poorly drained alluvium, more elevated areas are older clayey volcanic tephra.<br>Poor drainage and clayey textures are considered restrictions to discharge to land. |
| Contaminated soils | • Sheds on the site may have had contaminating activities operated within or near them including asbestos and storage of fuel and pesticides.<br>• No broad site contaminating activity has been identified across the paddocks used for farming. It is known that superphosphate fertilizers can result in elevated cadmium levels in agricultural land uses, however, are unlikely to result in a contaminated soil risk or require additional management. |
| Terrestrial ecology | • **Terrestrial vegetation**: Primarily pasture and exotic grass cover with four small remnant native vegetation stands – one of which is identified as a Significant Natural Area in the Waipā District Plan. These remnant forest systems are expected to provide suitable habitat for a range of native avifauna and bats. These small sections are remnants of a larger section of kahikatea and pukatea forest, prior to human clearance, that was estimated to be around 103 ha in size. |

| | |
|---|---|
| | • **Wetlands**: No wetlands identified.<br>• **Bats**: Known bat presence on and around the site.<br>• **Avifauna**: Habitat within this site for avifauna is limited to the remnant indigenous forests areas and there is potential for New Zealand falcon to utilise these forest remnants for roosting and breeding habitat.<br>• **Lizards**: Low likelihood in area used for horticulture/cropping. Potential suitable habitat in unmanaged areas including the remnant forest stands. |
| Aquatic ecology | • One modified watercourse that is a **tributary of the Nukuhau Stream**. Transitions from a straightened channel in the upper reach to a naturally meandering channel as it flows through the site and confluences with a tributary of the Nukuhau Stream. Riparian vegetation coverage limited to exotic weed growth with taller ferns scattered throughout, providing little shading. |
| Groundwater | • Approximately 25 known bores/wells within 600 m of the site, with 2 screened at <10 m and 12 of unknown screen depth.<br>• One resource consent for a water permit to take water from the tributary of the Nukuhau Stream on the southwest of the site. |
| Planning | • **Zoning**: Site and surrounds zoned rural except an area of Large Lot Residential Zone/Deferred Large Lot Residential Zone to the southwest. No overlays except airport horizontal surface.<br>• **Features and overlays**: Adjoins Southern Links designation (District Plan reference D156, shown in purple outline on zone map), Significant Natural Area: Rukuhia kahikatea forest remnant (District Plan reference WP273, shown in green on features map), Viewshaft and SH3 Scenic Corridor over western half of site (shown in purple hash on features map). Not located with a District Plan potential flood area.<br>• **Watercourses**: Nukuhau Stream and unnamed tributary (both surface water classification) a short distance to the east of the site. Waikato River at Nukuhau confluence classified as indigenous fish habitat, trout habitat, and contact recreation.<br>• **Highly productive land**: Site classified as LUC 2 & 3 with some LUC 4 towards the north-western corner. |

## Site 3: Penniket

| | |
|---|---|
| Built environment | Airport industrial activities and residential area between the two sites.<br>WWTP cannot be accommodated with 150m buffer to site boundary (sites too small). 20+ dwellings will be within 300m of plant along with 15+ industrial properties. |
| Archaeology | No known sites on this land. The research has not led to the identification of sites and no archaeological sites are anticipated. |
| Potential for discharge to land | Soils are predominantly well drained Otorohanga family soils.<br>Both sites at Penniket Road are potentially suitable for discharge to land when application rates match the soils infiltration. Some long-term removal of phosphorus and pathogens is expected where upper subsoils are loamy. |
| Contaminated soils | • Historic stockyard and sheds on the southern site may have had contaminating activities operated within or near them including sheep |

| | |
|---|---|
| | dip/drenching, asbestos and storage of fuel and pesticides. In addition, there is a risk of pesticide/herbicide application on vegetation plots resulting in contaminated soils as well as a risk of PFAS contaminated groundwater from adjacent airport activities.<br>• No potential contaminating activities identified on the northern site. |
| Terrestrial ecology | • **Terrestrial vegetation**: No terrestrial vegetation on either site. However, in proximity to both properties there are tall exotic and native species that could potentially provide roost habitat for bats.<br>• **Wetlands**: No wetlands identified.<br>• **Bats**: No records within the site but bats known to frequent the wider area.<br>• **Avifauna**: The sites present no suitable permanent habitat for native avifauna. The southern site is within an actively used industrial area, therefore, experiences regular disturbance from people and noise traffic<br>• **Lizards**: Low likelihood in area used for horticulture/cropping. Potential suitable habitat in unmanaged areas along site boundaries. |
| Aquatic ecology | • No watercourses present within the sites. Approximately 350 m west and 1 km south are several tributaries of Mystery Creek, which is a significant stream system off the Waikato River |
| Groundwater | • Approximately 27 known bores/wells within 600 m of the site, with 8 screened at <10 m and 16 of unknown screen depth.<br>• There are many consented domestic-use water takes in the area around Penniket Road site, as well as two water take permits consenting extraction 85 cubic metres a day. |
| Planning | • **Zoning**: Northern parcel is zoned Rural and the southern parcel is zoned Airport Business as part of the Airport Structure Plan Area.<br>• **Features and overlays:** North: Airport (horizontal surface, outer control boundary, subsidiary strip approach, transitional slope) – not shown on maps below South: Airport (strategic noise, horizontal surface, night control boundary, outer control boundary, transitional slope) – not shown on maps below. Adjoins Southern Links designation (District Plan reference D156) and SH3 designation (District Plan reference D37), separated by SH3 from Airport designation (District Plan reference D71) shown in purple outline on zone map. Viewshaft and SH3 Scenic Corridor over northern parcel (shown in purple hash on features map), Special Amenity Area over residential properties between the two parcels (shown in red hatch on features map). Not located with a District Plan potential flood area.<br>• **Watercourses**: None present.<br>• **Highly productive land**: Both sites classified as LUC 1. |

## Site 4: Golf Course

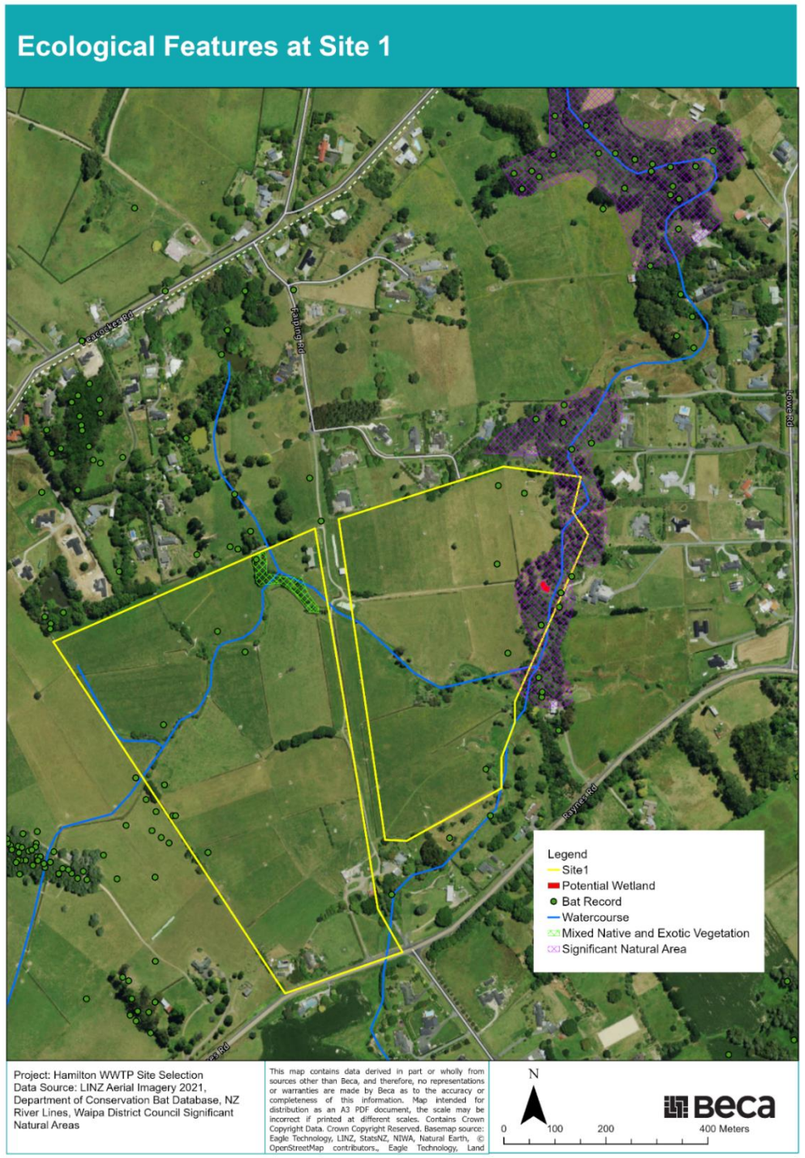
| | |
|---|---|
| Built environment | Rural-residential / lifestyle blocks along the eastern boundary overlooking the site.<br>WWTP cannot be accommodated with 150m buffer to site boundary (site too narrow). 15+ dwellings will be within 300m of plant. |
| Archaeology | Three known sites within the golf course. This includes two pa and one extensive garden site. There are likely to be additional archaeological sites present. |

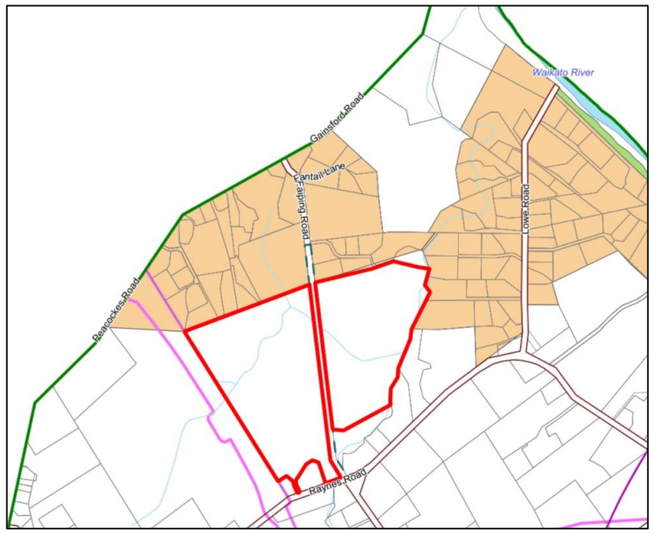
| | |
|---|---|
| Potential for discharge to land | Soils are well drained rhyolitic alluvium. Golf course development means there is much variation and disturbance. The amount and nature of imported fill on the lower terrace may need further investigation.<br>This site may be suitable for land discharge however any discharge will potentially move through the soil and into the Waikato River quickly. |
| Contaminated soils | • Site appears of WRC's Land Use Information Register (LUIR) as a potentially contaminated site.<br>• Implement sheds (greenkeepers) and the clubhouse buildings were present from pre-1963. The golf course is a registered HAIL from broad application of pesticides. From experience, these applications are concentrated on greens and tee boxes, and to a lesser degree on fairways. It cannot be ruled out that the shed and club house have had contaminating activities operated within, or near them. |
| Terrestrial ecology | • **Terrestrial vegetation**: there are numerous tall trees scattered throughout the site, comprising of mixed native and exotic species, with a dominance of pine trees.<br>• **Wetlands**: No wetlands identified. However, there are a number of artificial ponds.<br>• **Bats**: Records available confirm the presence of numerous long-tailed bats both within the site, as well as in neighbouring areas on the adjacent bank.<br>• **Avifauna**: Large amount of suitable roosting, foraging, and breeding habitat for a range of avifauna species including at-risk species.<br>• **Lizards**: ample suitable habitat for native herpetofauna species including copper skink and pacific gecko including dense ground groundcover vegetation including thick grass, which is preferred by copper skinks. Additionally, as the site is currently overgrown and unmaintained there is likely limited disturbances, which would enable populations to re-establish. Additionally, there are numerous tall trees with loose bark and crevices for pacific gecko, although they are scattered throughout. |
| Aquatic ecology | • Site is directly adjacent the Waikato River<br>• A tributary of the Waikato River flows along the eastern boundary of the site. Riparian vegetation is largely weedy with some mixed native and exotic trees providing shading in places. No barriers to fish passage were observed and it is likely that this stream provides suitable habitat for a range of freshwater species. |
| Groundwater | • Approximately 26 known bores/wells within 600 m of the site, with 10 of unknown screen depth.<br>• There are two consented domestic use bores located 250 m east of the site along Pencarrow Road. |
| Planning | • **Zoning**: Rural with adjoining land rural/rural lifestyle/open space.<br>• **Features and overlays:** Operative: Landscape Policy Area adjacent Waikato River (green shaded on operative plan map), Airport Obstacle Limitation Surface (not shown on map below) / Proposed: Outstanding Natural Landscape (green hash) and Significant Natural Area (green) along Waikato River banks, Airport Obstacle Limitation Surface (not shown on map below). Southern Links designation bisects the site (District Plan reference J22 / NZTA-11) shown in purple outline on operative plan map and blue outline on proposed plan map and Airport Road designation adjoins the site (District Plan reference NZTA-14, proposed plan only) shown in blue outline on proposed plan map. Sites and areas of significance to Maaori (red dash |

outline): 253 and 289 within the site, 271 & 272 overlooking. Areas subject to River Stability Policy.

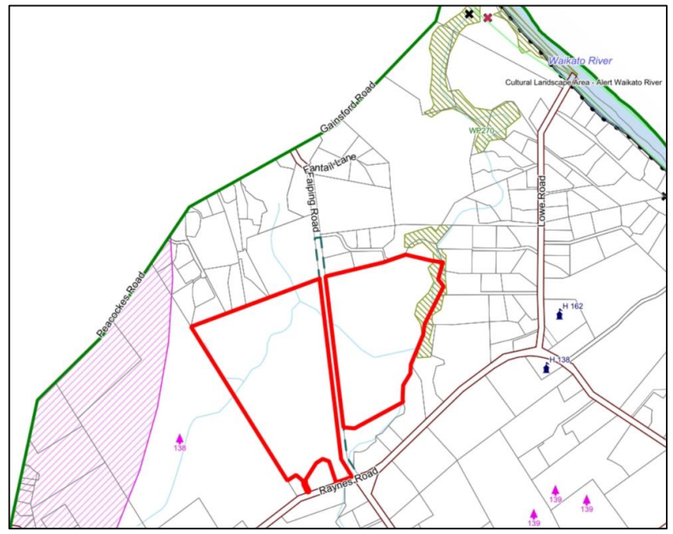
- **Watercourses**: Waikato River classified as indigenous fish habitat, trout habitat, and contact recreation.
- **Highly productive land**: Site classified as LUC 3.

## Figures Site 1: Sharpe Farm

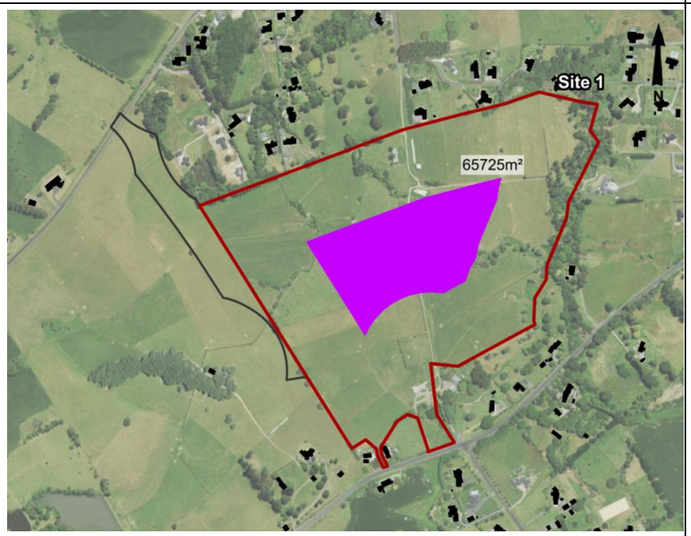


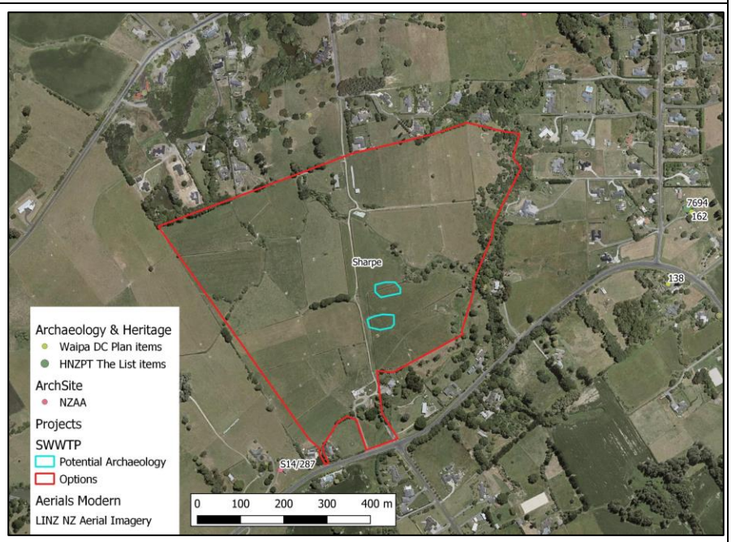

Waipā District Plan zoning (large lot residential shown in yellow)




Waipā District Plan features

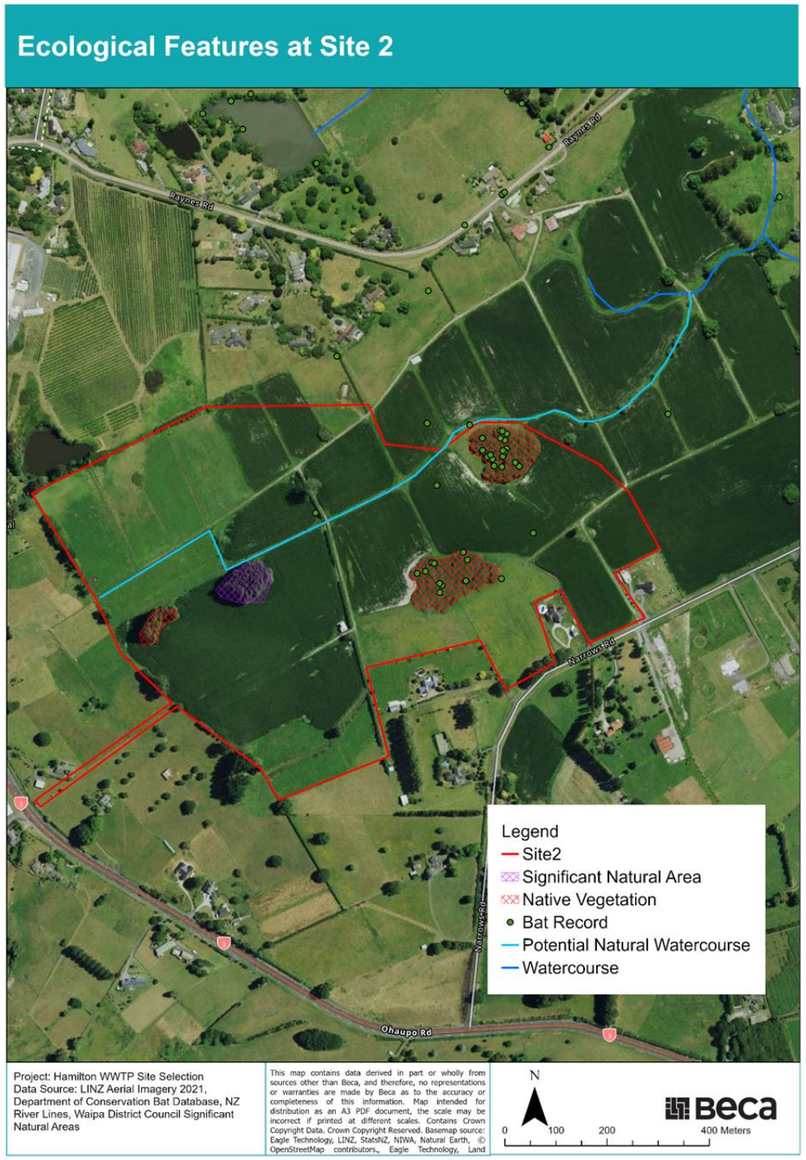


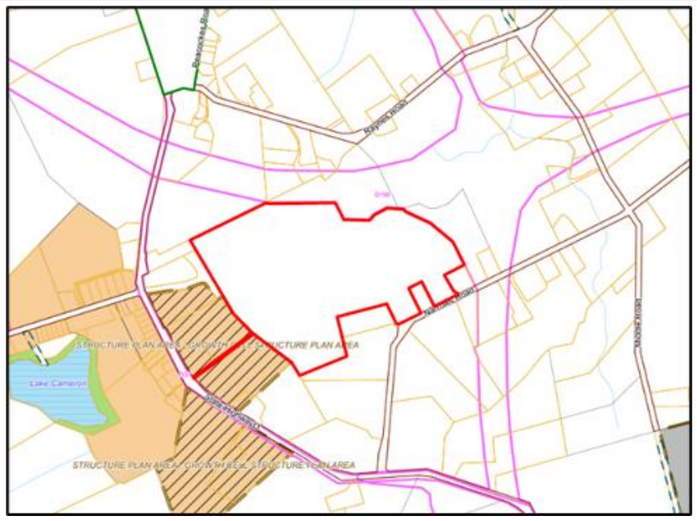

Site showing surrounding buildings. Purple area indicates 150m from site boundary.



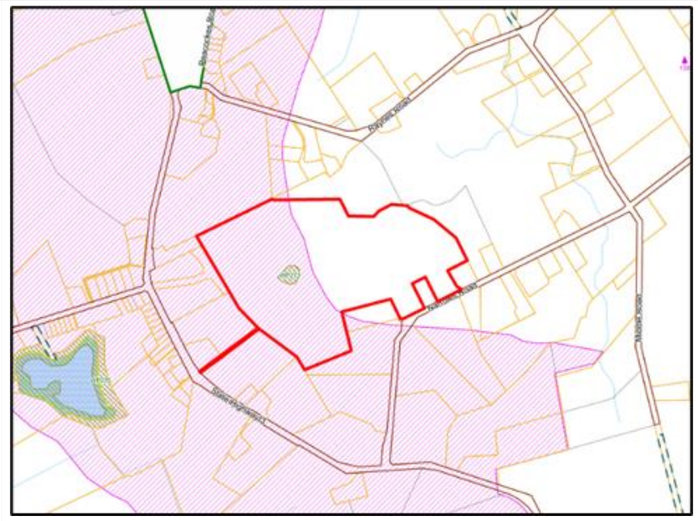

Known and potential archaeological features

## Figures Site 2: Rukuhia/Narrows

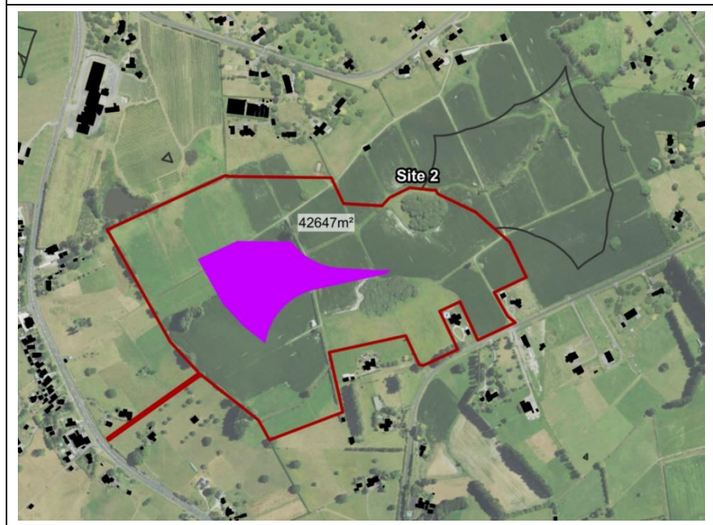


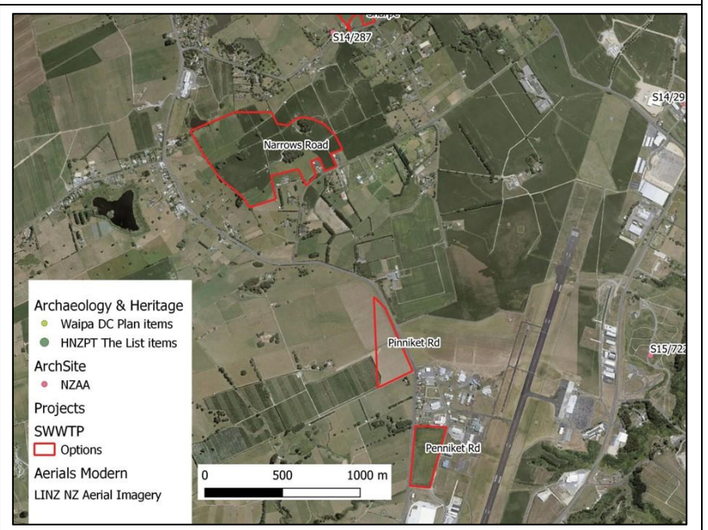

Waipā District Plan zoning (large lot residential shown in yellow, deferred with brown hash, Southern Links designation in purple))




Waipā District Plan features (SH3 viewshaft in purple, SNA in green)



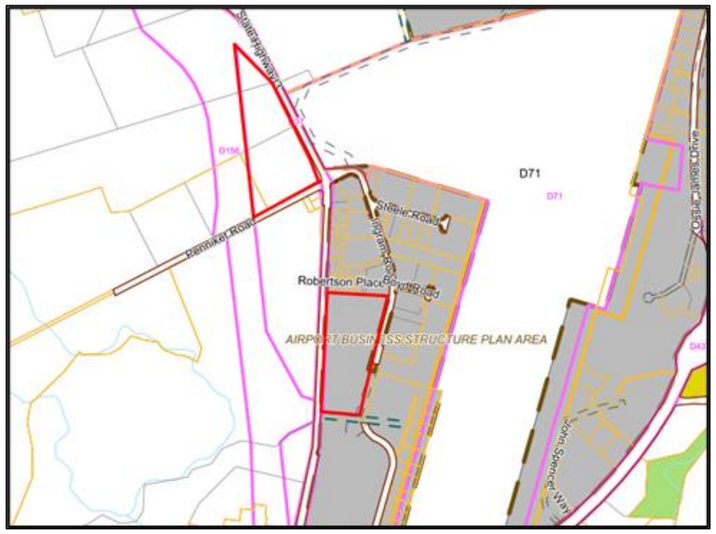

Site showing surrounding buildings. Purple area indicates 150m from site boundary.



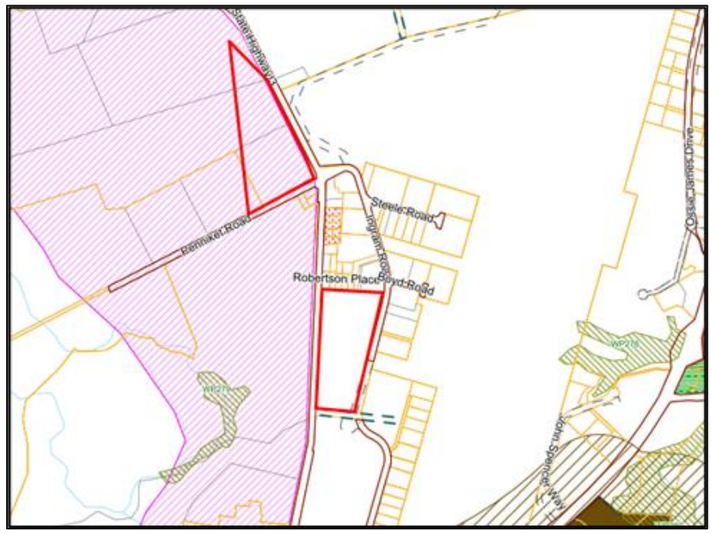

Known and potential archaeological features

## Figures Site 3: Penniket

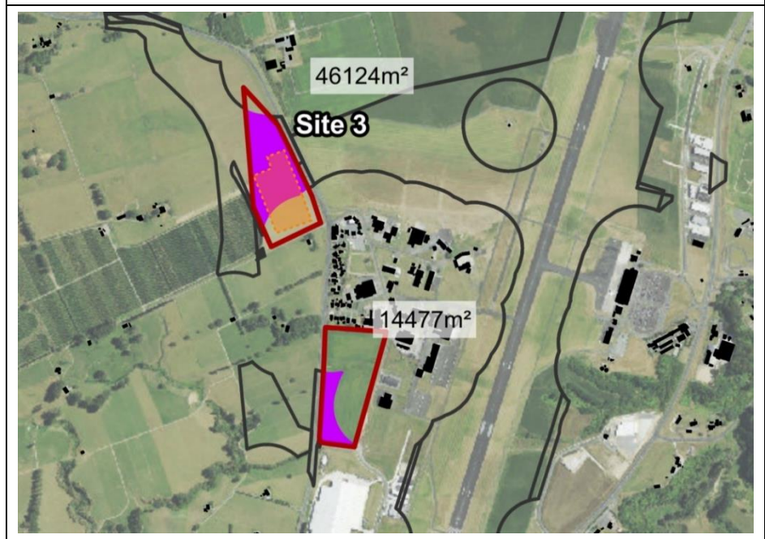
No ecological features of note



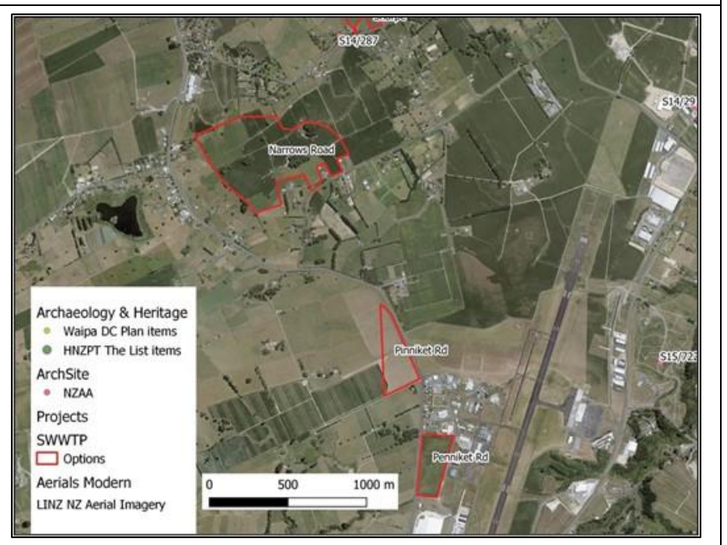

Waipā District Plan zoning (Airport Industrial zone shown in grey)




Waipā District Plan features (SH3 viewshaft shown in purple)

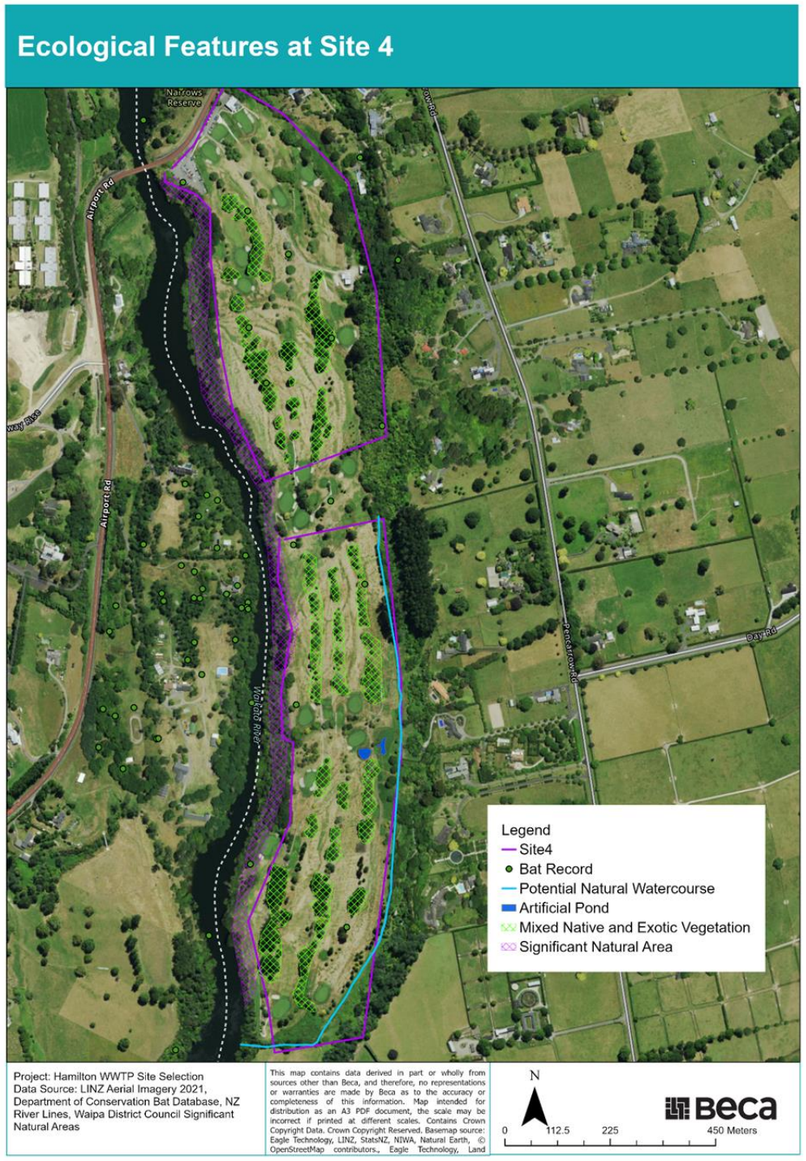



Site showing surrounding buildings. Purple area indicates 150m from nearest dwellings (site too small to achieve 150m from site boundary). Orange box to show potential scale of WWTP.

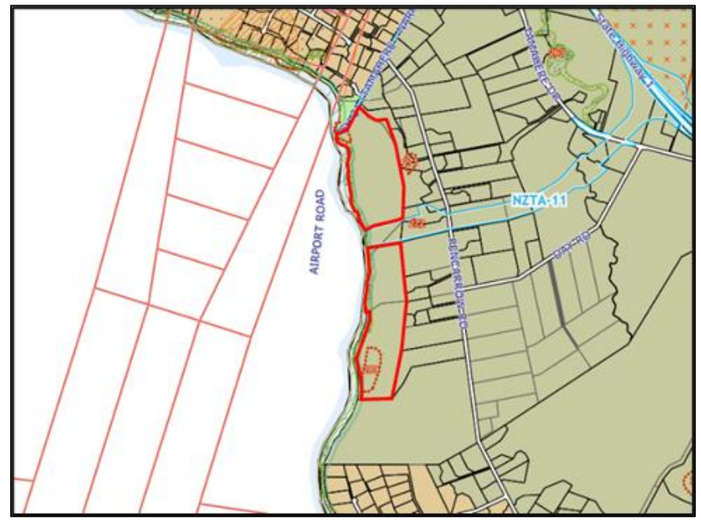



Known and potential archaeological features

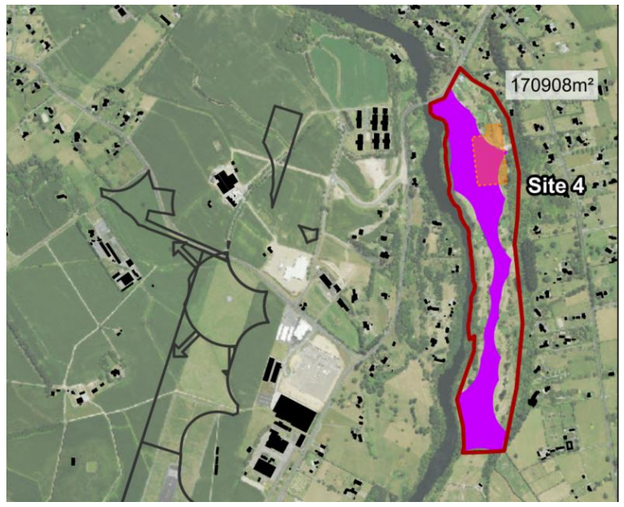
## Figures Site 4: Golf Course



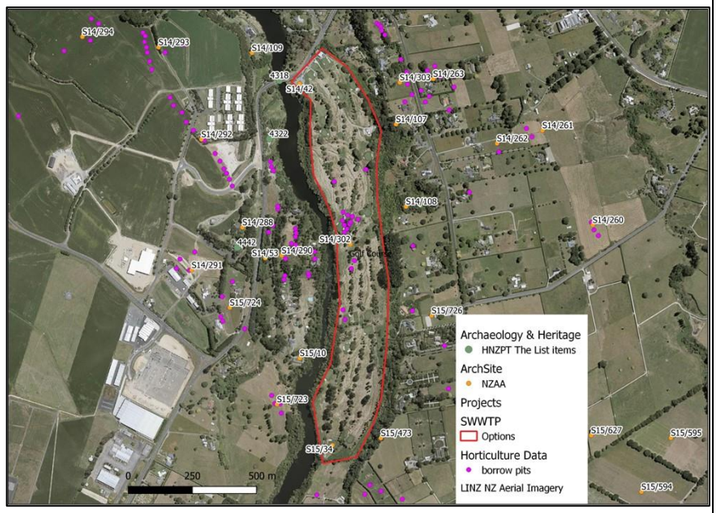

Waikato District Plan zoning




Waipā District Plan features




Site showing surrounding buildings. Purple area indicates 150m from site boundary. Orange box to show potential scale of WWTP.




Known and potential archaeological features

# 4 Technical MCA

This section records a summary of discussions at the technical MCA workshops.

The technical MCA was held over three online workshops:

- 21 March 2023 at 2:30pm
- 27 March 2023 at 3:00pm
- 28 March 2023 at 3:00pm

Attendance at the technical MCA workshops varied between the dates – not all attendees were present for all sessions or for the full duration of each session. Attendees include:

- Daniel Hishon (HCC)
- Denzil Govender (HCC)
- Isaac McIntyre (HCC)
- Jackie Colliar (HCC)
- Keith Hornby (HCC)
- Melissa Slatter (HCC)
- Nathanael Savage (HCC)
- Raewyn Simpson (HCC)
- Sven Erikson (HCC)
- Paula Hunter (Stantec)
- Garrett Hall (Beca)
- John Crawford (Beca)
- Shaun le Grange (Beca)
- Mhairi Rademaker (Beca)
- Nick Berry (Beca)
- Kimberley de Souza (Beca)
- Mathew Noonan (Beca)

## 4.1 MCA criteria scoring

MCA scoring was undertaken using an excel workbook. Criteria were pre-scored by the Beca technical team and refined at the workshops.

The table below records matters that were discussed at the workshops but does not include the full scoring rationale (which is covered in the MCA table).

Table 1: Technical MCA scoring discussion points

| Operational |
|---|
| **1a: Ability to discharge stage 1 flows to land**<br>• Site investigations are not positive in terms of potential to discharge to land year-round.<br>• Sites 1 and 2 appear to have low permeability and/or restricted subsoil permeability. Deficit irrigation may be possible.<br>• Site 3 could potentially be used for year-round irrigation depending on application rates.<br>• Site 4 appears suitable for year-round irrigation noting that the treated wastewater would move quickly through the site to the river. However, the geotechnical conditions at this site present a risk to discharge to land.<br>• Scoring based on potential ability to discharge to land (geotechnical and contaminated land concerns considered under the relevant criteria). Sites 1 and 2 scored equally. Sites 3 and 4 scored equally – score for Site 4 raised (from 5 to 7) to match Site 3 based on assumption that discharge to land would not be seeking additional treatment. |
| **1b: Accessibility from transport corridors for operation**<br>• Criteria considers operation only – refer 4d for construction access. Scoring based on existing road environment but future works (such as Southern Links or modifications to access) noted. |

- Site 1 - Access from both north and south, comes through residential area/lifestyle blocks.
- Site 2 - Site access off SH3, reasonable access. Site appears to have unformed access from SH3 which would be the preferred access (noting lower speed environment and wide median compared to SH3-Narrows Road intersection (which would be the alternative). Assumed access from Raynes Road not available long-term (Southern Links will cut off).
- Site 3 - very accessible off SH3 but note high speed environment.
- Site 4 - bad sight lines, straight off bridge, fast traffic, access ongoing basis needs better access points. Discussed whether Site 4 is scored too harshly but agreed that it is a difficult and dangerous access.
- Agreed that order should be: Site 1 -> 2 -> 3 -> 4.
- **Action**: Make sure the criteria description/assumptions are clear than this does not include construction access and that this is based on the existing road environment.

**1c: Access to utilities / power**

- Power supply available on all sites (on boundary for 1, 3 & 4, slightly further for Site 2)
- Query whether water supply is the same across all sites. Sites 3 & 4 do have reticulated supply (although capacity may be lower than ideal) which is considered enough to differentiate from Sites 1 and 2.
- Order: Site 1 & 3 similar, then Site 4, then Site 2 (which does not have reticulated water and power supply not on boundary).

**1d: Treatment plant hydraulics**

- This criterion considers the ability to use topography within the site to lower pumping requirements.
- Sites 1, 3 & 4 are relatively flat – topography doesn't hinder flows but also doesn't help
- Site 2 has some existing topography that could be used depending on the final layout of the site. Score lowered (from 9 to 7) to reflect uncertainty in layout (ie benefit remains an opportunity not a certainty).

**1e: Greenhouse gas emissions**

- There is not likely to be a notable difference in capital or operational carbon for the WWTP between sites (other than a small difference in travel carbon and maybe pumping within the site). The scores are driven by embedded carbon on pipelines and pumping carbon.
- Noted this is a qualitative comparison only. A quantitative assessment should be undertaken during the next stage of the project.
- Discussed whether this criterion should remain on the basis that it is scoring almost the same thing as 2a and 2b (the length and complexity of conveyance). Agreed that it should be scored and remain as a stand-alone criterion but that it should be given a low weighting during future weighting exercises.
- Agreed to score as 8, 6, 4, 2 for options 1 through 4 respectively.

**1f: Operability and flexibility during operation**

- New criteria added during workshop.
- Workshop attendees raised a concern that none of the existing criteria considered the ability to operate the WWTP in an efficient manner. This includes maintenance and renewals – major components can't be replaced on-line so there needs to be space to replace adjacent before taking the old process offline.
- Noted by HCC operations staff that Site 3 will be very difficult to operate with very limited space within the site to use for maintenance activities.

- Scoring agreed as Site 1: 9 (large, plenty of space with few constraints), site 2: 8 (large, plenty of space but kahikatea stands constrain the usable space), site 3: 2 (very limited space, while early layouts indicate that a WWTP could be accommodated within the site there would be constraints on operation and maintenance space and extra space on a separate parcel is less useful), site 4: 3 (more space than site 3 but constrained by split site and requirements to set back from riverbanks).
- Discussed whether this should form a fatal flaw but agreed that all sites would be operable (if not efficient). Agreed that this should be weighted heavily during future weighting exercises.

**1g: Future proofing**

- New criteria added during workshop.
- Workshop attendees raised a concern that none of the existing criteria considered the ability to expand the WWTP in the future.
- Noted that Site 3 has effectively no space or future growth without splitting the WWTP over the two sites. It is just too small.
- Scoring similar to 1f and agreed as Site 1: 9 (large, plenty of space with few constraints), site 2: 8 (large, plenty of space but kahikatea stands constrain the usable space), site 3: 1 (very limited space for growth), site 4: 7 (more space than site 3 but constrained by split site and requirements to set back from riverbanks).
- Discussed whether this should form a fatal flaw but agreed to weigh heavily during future weighting exercises instead.

## Conveyance

**2a: Distance and complexity of pipelines from contributing catchments & 2b: Distance and complexity to potential river discharge sites**

- Criteria 2a and 2b discussed together. Conveyance from contributing catchments based on recent Southern Links conveyance works. Conveyance to Waikato River based on availability and complexity of a potential route along public land (roads/paper roads), does not consider form or function of any discharge structure (which could include eg a traditional diffuser, rock-lined channel, wetland adjacent river)
- Options presented (refer *Assessment of Alternative Sites* for figures):
  - Site 1:
    - Easy connection to contributing catchments via Southern Links from north/west
    - Route to river along Raynes Road and Lowe Road or continue along Raynes Road and across SH21 via paper road
  - Site 2:
    - Easy connection to contributing catchments with slight diversion from Southern Links along Peacockes Road & SH3
    - Route to river along Raynes Road and Lowe Road or continue along Raynes Road and across SH21 via paper road
  - Site 3:
    - Longer connection to contributing catchments with longer distance of conveyance along SH3
    - Three options to river including back up SH3 to connect with the options for Site 1/2 or continue south along SH3 and back northeast on SH21 to River via paper road
  - Site 4:
    - Longest connection to contributing catchments via SH3 and SH21 with a crossing of the Waikato River on either the existing Narrows Bridge or a new structure adjacent the bridge or possibly further south. Would require additional pump station compared to other options. Noted that new pipe crossings not encouraged by mana whenua.

    - Site is adjacent river so shortest distance but challenging to access river via public land from this site (high riverbanks)
- Sites 1, 2 and 3 are expected to be gravitated (from conveyance network). Site 4 would require an additional pump station.
- All options assume a pumped discharge from the WWTP.
- Query whether there is an option to discharge to a tributary rather than directly to the Waikato. This may be a possibility during earlier stages (when flows are lower) but would need consideration of existing stream flows vs discharge flows. Options could include the Nukuhau Stream or its tributaries (for Sites 1 and 2, noting potential concerns re Nukuhau Pa downstream) or the gully complex south of the Airport (for Site 3).
- Query whether there are considerations under the NES Drinking Water in respect of distance to the Hamilton Water Treatment Plant. The high level of treatment is not expected to cause issues at the WTP however this would need to be considered further during the next stage of the project.
- Query whether the further downstream discharge points would have sufficient mixing prior to Nukuhau Pa. There will be high level of treatment but this is a matter that will need to be considered further in the next stage of the project and in consultation with mana whenua.
- Other matters that would need to be considered during selection of a discharge point (and the form of discharge) is potential for variability in mixing along this stretch of the river (are there sites that would promote quicker mixing), steepness of riverbanks and ability to get the discharge to river level, impacts on the character of the river (and whether there are areas where the discharge would have less of an impact on natural character).
- Scoring based complexity and distance:
    - 2a order is Site 1 -> 2 -> 3 -> 4. Agreed that Site 4 should score 1 due to additional pumping requirement and river crossing of untreated wastewater (noted that Site 4 is notably worse than Site 3). Sites 1 and 2 raised (from 8 to 9 and 6 to 7) to better reflect spread.
    - 2b order is 4 -> 1 -> 2 -> 3. Score for Site 4 reduced (from 8 to 7) to reflect the potential challenge getting to the river, then agreed Site 1 should be scored as a 6 (lowered from 7) to maintain spread and Sites 2 & 3 progressively lower.

## Physical

### 4a: Liquefaction and geotechnical risk

- Sites 1 & 2 have similar liquefaction and weak soil risk, slightly higher at site 2 due to high groundwater levels. Scored 6 and 5 respectively.
- Site 3 has liquefaction and weak soil risk but less so than sites 1 & 2 due to topography.
- The riverbanks at Site 4 present a risk of slope instability. Areas of weak soils expected to be prone to settlement and low bearing capacity, liquefaction risk. Risk associated with discharging to land also noted with a significant risk of piping highlighted.

### 4b: Potential impacts on contaminated land

- Sites 1 & 2 similar agricultural use, sheds have potential for contamination. Stockyard at Site 1 also a risk. Scored 8 and 9 respectively.
- Site 3 could be impacted by historic firefighting foams and subsequent PFAS contamination from the adjacent airport site – risk of groundwater contamination.
- Site 4 is a recorded HAIL site (golf course) with known pesticide use and storage.

### 4c: Flooding risk

- None of the site are subject to flood hazard overlays in the Waipā/Waikato District Plan. Sites 1, 3 and 4 lowered from 10 to 9 to reflect uncertainty (lack of site specific modelling) Site 2 scored slightly lower due to areas of ponding observed during site visit and over winter (see photo below).

### 4d: Buildability

- This criterion considers buildability/constructability with a focus on construction access, likely earthworks requirements, likely environmental controls
- Site 1 is fairly flat with few environmental constraints. Risk of discharge to Nukuhau manageable with normal controls. Expect a new culvert on the Nukuhau tributary would be required. Reasonable site access from Raynes Road for construction traffic – Raynes-SH3 intersection known to have some risks. Site lowered from 8 to 7 to reflect environmental and access constraints.
- Site 2 slopes may require higher earthworks volumes and the lower areas more likely to require excavate and replace. Site access more challenging – as per operational access, access from SH3 appears preferred but uncertain in terms of approvals.
- Site 3 flat with no environmental constraints. Site access reasonable (almost straight off SH3) but discussed that this is expected to require left-in left-out only using the RAB at the airport for turnaround.
- Site 4 likely to provide relatively well drained, all-weather working conditions. Risk of discharge to Waikato River manageable with normal controls but noted risk associated with erosion/scour/piping failure along riverbanks. Access to site provides a significant constraint for construction. Score lowered from 5 to 4 to reflect these challenges.

## Natural environment

### 5a: Natural character of waterbodies

- Criteria focussed on natural character (as opposed to effects on flora and fauna).
- Opportunities noted to enhance the natural character of existing waterbodies on sites 1 & 2 including through riparian planting of the Nukuhau and its tributaries and any wetlands identified.
- Site 4 lowered (from 6 to 5) to better reflect impact on natural character of Waikato River and expected challenges in mitigating any effect. Site 2 raised (from 4 to 6) since the only waterbody is a channelised upper tributary with lower current values and to reflect there is an opportunity to improve the character.
- Action: document assumptions (eg in terms of layout within the site)

### 5b: Aquatic and terrestrial ecology

- Criteria focussed on presence of and potential effects on aquatic and terrestrial vegetation and fauna.
- Assumes layouts as shown to avoid major features (including siting on west side of Site 1 and avoiding the remnant forest stands on site 2).
- Discussed that lights won't be required to be on all night.
- Discussed HCC's experience with bats. Noted the western banks of the Waikato opposite Site 4 are a known bat nursery area. Noted that bat management (from a construction/tree felling perspective) is almost BAU for HCC now.
- Discussion on whether site 2 is scored too harshly but ultimately agreed that the risk of impact to the remnant forest stands justifies the low score. Reiterated that any clearance of vegetation in the remnant stands is considered a no-go – the WWTP would need to be designed around the stands.
- There are a number of opportunities for restoration/mitigation of aquatic and terrestrial environments including riparian planting and management of the eastern side of the site at Site 1, enhancement of the remnant forest and riparian planting (and potentially some stream naturalisation works) at site 2, and riparian and terrestrial enhancement at site 4.

### 5c: Ground and surface water quality

- Groundwater risk based on presence (or absence) of bores down-gradient/within sphere of potential effect rather than usage (since usage is not easy to determine without talking to the landowners).
- Risk of PFAS mobilisation discussed.
- Site 4 lowered (from 9 to 5) to reflect the risk to the Waikato River (water quality) in the event of accidental discharge during construction/operation.

### 5d: Highly productive soils

- Discussed the difference between current capacity and potential capacity: The NPSHPL is based on potential capacity therefore the Golf Course needs to be considered in the same way as the other sites (even though it is not currently used for primary production).
- Agreed to score all sites the same – they are all HPL and will require the same consideration under the NPSHPL.

## Built environment

### 5a: Odour

- Discussed relative risk and ability to manage odour at length. Noted overseas WWTP examples that have residential dwellings immediately adjacent and WWTPs in NZ with limited buffers.
- A modern WWTP like that proposed should have limited odour during normal operations (ie should be able to meet the standard no objectionable or offensive odour at the boundary condition even where the boundary is close to the WWTP). However, "no offensive or objectionable" doesn't mean people won't be able to smell anything and odours can be very objective. In any event, there will be change from the existing environment.
- The biggest risk is during upset conditions and from a small number of higher risk processes (screens and grit removal, primary sedimentation, digesters, and sludge management). Where possible, these should be enclosed with extraction to odour control equipment and set back as far as practicable from the closest site boundary.
- Plans show 100, 200 and 300m buffer from the WWTP (based on early indicated layouts). Ideally the site would provide 150m buffer within the site and 300m buffer to dwellings; none of the sites provide that much buffer.
- Discussion on relativity between sites 1 and 2. While site 1 has more dwellings now, there is undeveloped land adjacent site 2 including titles with no dwellings (where a house could be constructed as a permitted activity) and identified future development areas. Agreed that there isn't much difference between these sites and Site 2 lowered (from 6 to 5).

- Sites 3 and 4 are too small to provide any useful buffer.

**5b: Noise**

- This criterion considers both buffer availability and sensitivity of the receiving environment
- Noted that site 3 (while the smallest) has a higher ambient noise due to proximity to SH and airport and therefore may have lower sensitivity.
- Discussed that the Southern Links corridor will already change the noise environment at site 1, 2 & 4 and therefore residents nears that corridor should already be anticipating a change in noise environment in the future.
- Sites 3 & 4 lowered (from 6 to 5) on the agreement that while it is expected that noise effects can be managed it is significantly more challenging when there is almost no buffer to the property boundary (where effect is typically measured).

**5c: Landscape and visual**

- Site 1 raised (from 4 to 6) to reflect fairly limited viewing audience, existing vegetation that screens many of the views, and the (expected) relative ease of screening the WWTP at this site.
- Site 2 lowered (from 6 to 5) on the basis that this site is likely to be more challenging to screen.
- Site 3 raised (from 5 to 7). While there is a large viewing catchment (including transient views from SH3), this is a lower sensitivity environment in the context of the adjacent airport and airport industrial/commercial development.
- Site 4 has a limited viewing catchment but expected to be high sensitivity based on existing environment.
- Agreed order should be Site 3 -> 1 -> 2 -> 4.
- Discussed opportunities to undertake screen planting early to allow growth prior to WWTP construction. Discussed need to keep planting outside of operational areas (or at least consider operational requirements)

**5d: Archaeology**

- Discussed recorded vs anecdotal archaeological evidence and linkage to mana whenua inputs. The archaeology scoring in based on recorded archaeological sites and anecdotal evidence from previous owner of site 1.
- Site 1 raised (from 4 to 5) on the basis that WWTP would be sited to the west of the site. Sites 2 & 3 lowered (from 10 to 9) to reflect that lack of known sites or known risk doesn't mean no risk.

**5e: Heritage**

- Noted that there is some significance in relation to farming heritage at Sharpe Farm (Site 1). Agreed this is not of a level that should impact site selection but should be considered during future phases.

**5f: Alignment with long term growth / alternative land uses**

- Beyond the additional land around the airport proposed to be enabled by Waipā District's Plan Change 20 (Airport Northern precinct extension) there are no other areas currently identified for future expansion that are strategically identified in either the local or regional growth strategies.
- The Airport is  however clearly identified in HCC growth strategies as a Strategic Industrial Node for the subregion and consequently any sites that may prevent or constrain the further consolidation of industrial activity around the airport are less than optimal from a land use perspective.
- Noted that:

- Site 1: Not in an area that is strategically identified. However HCC's submission to PC 20 (Airport Northern precinct extension) identified and strongly supported this site as the possible location for a 'future infrastructure plant'.
- Site 2: While not in an area that is strategically identified, the location of this site south of the Southern Links designation and general proximity to the airport indicates some potential for this area to be identified in a future growth strategy
- Site 3: The Southern portion of Site 3 is located within the existing Airport Business zone Southern precinct, forming part of the sub-regions limited industrial land supply. Through Plan Change 20: Airport Northern precinct extension, HCC has presented expert evidence encouraging the safeguard of Industrial land in the sub-region. HCC's appointed economic expert has identified the importance of Industrial/land adjoining Airport activities to be considered a 'scarce resource' that should be developed to its full industrial potential leveraging the strategic locational advantages the Airport and associated linkages provided.
- Site 4: Not identified in any growth strategies; however, workshop attendees noted there are probably better opportunities for this site than a WWTP given its proximity to the Waikato River and current park-like nature.

- Some concerns with this criterion as many of the matters discussed are not identified in strategic planning documents and rather the opinion of workshop attendees in terms of what might appear "sensible" based on existing land use patterns and the Southern Links roading network.
- Ultimately agreed to record discussions (as above) but score all sites the same.

| SOUTHERN WWTP - SHORT LIST | | | Short list assessment for a new wastewater treatment plant and land discharge site for the Southern WWTP | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SITE ONE: SHARPE FARM | | SITE TWO: NARROWS/RUKUHIA | | SITE THREE: PENNIKET ROAD | | SITE FOUR: GOLF COURSE | | | |
| Assessment Criteria | | | Ranking | Rationale | Ranking | Rationale | Ranking | Rationale | Ranking | Rationale | | |
| **1. Operational** | **1a** | Ability to discharge stage 1 flows to land (airport only) | 3 | Low-lying land at Sharpe Farm has drainage and permeability restrictions while the small area of land above the terraces (southwest part of site) has rolling slopes and restricted subsoil permeability.<br>Some deficit irrigation of topsoils may be feasible. | 3 | The low lying land has drainage and permeability restrictions while the elevated land has rolling slopes and restricted subsoil permeability.<br>Some deficit irrigation of topsoils may be feasible. | 7 | Both sites at Penniket Rd will accept treated wastewater when application rates match the soils infiltration. Year round discharge still unlikely because of this and further investigation would be required to confirm whether the site could take all Stage 1 flows under deficit irrigation.<br>(Risk associated with PFAS considered under groundwater criteria 5c) | 7 | Soils have adequate infiltration characteristics for year round irrigation. Surface applied treated wastewater will potentially move through the soil rapidly to the Waikato River (i.e. possible to discharge to land, not considering potential geotechnical risk associated with such a discharge). The nature of the soil material indicates little renovation is likely but scoring based on high quality discharge not requiring further land treatment to achieve required quality). | |
| | **1b** | Accessibility from transport corridors for operation | 8 | Good access available from both Faiping Road (noting "residential" nature) and Raynes Road. Assumed that Raynes Road would be utilised as the preferred. | 7 | Assumes access either via existing formed access from Narrows Road or (preferably SH3)<br>Narrows Road would be an option for ongoing access but with challenges turning on/off SH3. Property links to SH3 in Rukuhia. No existing formed access (and appears to be some encroachment from neighbouring dwelling) but remains an opportunity.<br>Current access from Raynes Road has some sightline issues and fairly sharp gradient. Raynes Road access will be cut-off with construction of Southern Links but opportunity to work with WK to seek new access. | 6 | Site access directly off SH3 is convenient. Sightlines are better than Site 4 but SH3 in this location is a high-speed environment and some safety concerns remain. | 4 | Site access directly off SH21 is convenient; however, the sightlines, proximity to the Narrows Bridge, and traffic speeds make this a dangerous access point (while this would improve post-Southern Links, the timing of those works are too uncertain to include here). Some modifications would be required to the turn in area - possibly opportunity to relocate the access and create a right-turn bay to improve safety (this has not been investigated in detail therefore has not been taken into account in scoring.) | |
| | **1c** | Access to utilities/power | 7 | Doubled ended WEL 11kV supply along the paper Faiping Rd, immediately adjacent site.<br><br>No potable water supply available. 2.9km to HCC SH3 Reservoir. Existing bore on site, no take consent. | 5 | 11kV supply available from SH3, approx. 300m / 11kV supply available on Raynes Rd to north, approx. 800m / 11kV supply available on Narrows Rd to south approx. 600m.<br><br>No potable water supply available. 2.4km to HCC SH3 Reservoir. Approx 3.5km from WDC supply adjacent SH3 industrial site at Airport.<br>Surface water take consent on site for horticulture purposes. Expires 2030 | 7 | Water and 11kV supplies on site boundary<br><br>However, the Water pipeline is 150mm PVC which appears to have been set up for the localised industrial estate and so may have a limited total capacity (potentially fire fighting supply only) | 6 | WEL and Waipā Networks both have 11kV supplies coming to adjacent the site. Both are single ended and they are not linked for any form of resilience.<br><br>There is a potable water supply to the northern end of the site. This is a Waikato District OD63mm. Existing bore on site, but no take consent. | |
| | **1d** | Greenhouse gas emissions | 8 | Shortest conveyance route from contributing catchment with relatively short distance to Waikato River for future discharge (depending on chosen discharge location) | 6 | Second shortest route from contributing catchment with moderate distance to Waikato River for future discharge (depending on chosen discharge location) | 4 | Second longest route from contributing catchment with moderate distance to Waikato River for future discharge (depending on chosen discharge location) | 2 | Furthest from contributing catchments (from Southern links), will require intermediate pump station. Close to potential discharge location. | | |
| | **1e** | Treatment plant hydraulics (ie requirement for pumping) | 5 | Relatively flat site so constrained hydraulic profile through the site. Elevated ILW + main reactors would allow a largely gravity flow through. | 7 | The sloping sites will allow a predominantly gravity flow through the treatment plant, apart from RAS and general 'site drainage returns' | 5 | Relatively flat site so constrained hydraulic profile through the site. Elevated ILW + main reactors would allow a largely gravity flow through. | 5 | Relatively flat site so constrained hydraulic profile through the site. Elevated ILW + main reactors would allow a largely gravity flow through. | | |
| | **1f** | Operability and flexibility during operation | 9 | Large site with usable space around the proposed WWTP location for operational activities | 8 | Large site with usable space around the proposed WWTP location for operation. Scores lower than site 1 as the remnant forest stands reduce the usable space. | 2 | Challenges with operating the site within a limited footprint and across two pieces of land | 3 | Challenges with operating the site across the two parcels (split by future southern links) | | |
| | **1g** | Future proofing | 9 | Large site with usable space around the proposed WWTP location | 8 | Large site with usable space around the proposed WWTP location. Scores lower than site 1 as the remnant forest stands reduce the usable space. | 1 | Limited space for future expansion / construction space for building of future stages while plant remains on line / construction of renewals and replacements (again, while plant remains on line) | 7 | Site is more space constrained due to shape, proximity to Waikato River (and the geotechnical constraints around the river bank) and southern links split. | | |
| **2. Conveyance** | **2a** | Distance and complexity of pipelines from contributing catchments | 9 | Shortest conveyance route, avoids SH3. | 7 | Short-length along SH3, second shortest conveyance route from Southern Links. | 4 | Longer length of conveyance, long distance along SH3. | 1 | Furthest from contributing catchments (from Southern links), will require intermediate pump station and Waikato River crossing (river crossing of raw wastewater). | | |
| | **2b** | Distance and complexity to potential river discharge sites | 6 | One option for route to discharge to the Waikato River, assumption to follow roads. Shorter distance than site two. | 5 | Two options for route to discharge to the Waikato River, one option will require crossing of SH21. Assumption to follow roads. | 4 | Three options for route to discharge to the Waikato River, route will have to go around the airport. Longest length of pipelines. | 7 | Close proximity to the Waikato River. Might be difficult to get to the river given incised nature of river at the Narrows. | | |
| 3. Mana whenua | | | | | | | | | | | | |
| **4. Physical** | **4a** | Liquefaction and geotechnical risk | 6 | Site likely to be susceptible to liquefaction in a moderate to large earthquake event, with lateral spreading risk (to stream). A wide range of treatments are available to manage liquefaction effects, including ground improvements and strengthened foundations.<br>Weak soils may be present across the site and require excavation and replacement or another engineering treatment below new structures | 5 | Site likely to be susceptible to liquefaction in a moderate to large earthquake event, with lateral spreading risk around drainage channels. A wide range of treatments are available to manage liquefaction effects, including ground improvements and strengthened foundations.<br>Risk of weak ground with high groundwater levels. | 7 | Liquefaction risk, risk of weak soils. | 4 | The western/riverbank edge of this site is at risk of slope instability, and will require setback distance of 20m to 30m. Localised areas underlain by weak clayey soils swampy areas would be prone to high settlement and low bearing capacity.<br>Potential for loose sandy soils that will be susceptible to liquefaction below groundwater table. | | |
| | **4b** | Potential impacts of contaminated soil | 8 | Agricultural land, several sheds and stockyards. Low risk of contaminated land issues requiring considerable risk assessment or management to enable development. | 9 | Agricultural land, only one shed observed. Low risk of contaminated land issues requiring considerable risk assessment or management to enable development. | 7 | Historical use of southern paddocks, dwelling and sheds. Elevated risk in southern portion of site due to observations of potential trials and proximity to Airport. Northern area of Site 3 is low risk. Need to consider potential PFAS in groundwater beneath Airport. | 5 | Old golf course – broad cast pesticide application and registered HAIL. Likely contains elevated levels of contaminants throughout the site that will require some form of risk assessment and management, largely dependent on the any proposed WWTP design (/earthworks). | | |
| | **4c** | Flooding risk | 9 | Not identified as flood hazard area or ponding area in District Plan | 8 | Not identified as flood hazard area or ponding area in District Plan. However, site observations indicated low lying areas of the site are subject to rainfall pooding especially during winter months | 9 | Not identified as flood hazard area or ponding area in District Plan | 9 | Not identified as flood hazard area or ponding area in District Plan | | |
| | **4d** | Buildability | 7 | Flat site unlikely to present notable construction challenges, risk of sediment discharge to Nukuhau Stream manageable with normal controls. Good bi-directional access. New culvert on Nukuhau tributary would be required.<br>Assumes access from Raynes Road. | 5 | Building on the slopes will provide good ground but higher associated earthworks volumes, more sediment control required. Access restricted compared to site 1.<br>Assumes access off Raynes Road, which is likely to require significant modification for construction purposes. Access from SH3 more suitable but would require approval from WK for a new access (as existing unformed) and would impact on neighbour. Access from Narrows also an option but has some challenges with the Narrows-SH3 intersection which would likely require left in/out only. | 8 | Both sites flat ground, easy earthworks and good, relatively safe access.<br>Construction access would likely require left in/out only. | 4 | Well drained site likely to be relatively dry, all weather working conditions. Risk of sediment discharge to Waikato River manageable with normal controls but any point source discharge would require careful management in terms of erosion/scour/outfall control.<br>Access to and from SH21 is a problem in terms of public and construction vehicle safety (sightlines, proximity to the Narrows Bridge, and traffic speeds make this a dangerous access point) | | |
| **5. Natural environment** | **5a** | Potential for impacts on the natural character of wetlands, rivers and lakes and their margins | 7 | Assume WWTP located to the west of the paper road - which is located within riparian margins of a tributary system but away from Nukuhau main stem (and the associated Significant Natural Area).<br>A potential wetland is identified within the eastern section of the site (likely be 100 m+ away from WWTP), near the Nukuhau Stream main channel. Further wetland delineation would be required.<br>Tributaries of the Nukuhau Stream traverse the site, so there is potential for moderate impacts on the natural character of these waterways.<br>Opportunities to provide mitigation that will have a positive impact on natural character through management and planting of existing waterways | 6 | One watercourse traverses the site. Assume WWTP located at western end of site where waterway is heavily modified. No wetlands identified but noted that it is highly likely there was wetland here in the past and further wetland delineation would be required.<br>Limited impact on natural character of wetlands/rivers, opportunities to provide mitigation that will have a positive impact on natural character through management and planting of existing waterways. | 10 | No wetlands, watercourses, or lakes identified within the site. | 5 | No wetlands identified within the site (further survey may be needed if site is chosen). However, one watercourse along the eastern edge of the site and several man-made ponds are present, which likely provide habitat to aquatic fauna and avifauna. Dependent on location of WWTP.<br>Potential for moderate impact on natural character of the Waikato River (and on the identified Outstanding Natural Landscape overlay that runs along the river margin) due to proximity of WWTP. | | |
| | **5b** | Potential for impacts on aquatic and terrestrial ecology including vegetation, fish, birds, bats and lizards | 7 | Assume WWTP located to the west of the paper road, some riparian vegetation clearance anticipated of tributary - minimal impacts to birds. No stream diversion expected but some potential for impact on fish. Some impacts for bats (noise, lighting, likely removal of trees in centre of site).<br>Opportunities to provide mitigation that will have a positive impact on aquatic and terrestrial ecology through stream enhancement and riparian planting of existing waterways.<br>Noting that noise (blowers at night) needs to be mitigated quite low anyway for DP requirements. While lights are provided for night vision, they do not need to be turned on as a matter of routine.<br>Restoration opportunities available along the Nukuhau Stream and tributary and well as through usage of the balance land. | 3 | SNA identified within the site as well as remnant kahikatea stands - which provide important habitat for terrestrial fauna. Assume WWTP can be located around the remnant stands - clearance of any of these trees is considered a no-go.<br>Current proposed location (at western end of site) has high risks on bat and lizard populations within SNA and kahikatea vegetation (if requiring removal). Should watercourse require diversion/damming of watercourse, this will impact any native fish. No significant impacts anticipated for avifauna, which comprise of primarily Not Threatened species. Construction risks to bats from noise and lighting during construction.<br>Opportunities to provide mitigation that will have a positive impact on aquatic and terrestrial ecology through stream enhancement and riparian planting of existing waterways abd enhancement or expansion of the remannt stands.<br>Noting that noise (blowers at night) needs to be mitigated quite low anyway for DP requirements. While lights are provided for night vision, they do not need to be turned on as a matter of routine.<br>Restoration opportunities available around the remnant bush. | 9 | Impacts on terrestrial ecology are limited to bats - from noise and lighting (tree removal not expected). Low likelihood but potential impact for lizards, which may reside in the scrubby vegetation on the edges of the site. Only Not Threatened avifauna are expected within proximity to the site. | 5 | Clearance of trees may cause injury to bats and avifauna, and clearance of grassy groundcover may injure native lizards. Potential challenges getting approval for removal of vegetation on site and associated loss of bat habitat.<br>Should WWTP placement require diversion/ damming of watercourse or removal of man-made ponds, this will likely impact native fish. Vegetation within the site is mixed native exotic and is generally scattered throughout. Removal will impact terrestrial fauna.<br>Opportunities to provide mitigation that will have a positive impact on aquatic and terrestrial ecology through stream enhancement and riparian planting of existing waterways and well an enhancement of existing planting | | |
| | **5c** | Potential for impacts on groundwater (and therefore users) and surface water quality | 6 | Some risk to wetlands and surface water bodies if land discharge progressed and would need to consider appropriate setbacks. Impacts of drawdown on potential wetlands or surface water bodies would need to be addressed, though we have assumed this could be managed to a low risk level via appropriate siting, design and construction controls.<br>Shallow wells directly down-gradient are potential receptors of land discharge or could be in zone of drawdown influence. Given the rural nature of the site the risk of consolidation settlement damaging private assets is likely to be low. The contaminated land assessment also indicates a low risk of contamination requiring significant risk assessment or controls | 5 | Some risk to surface water bodies if land discharge progressed and would need to consider appropriate setbacks.<br>Higher direct risk to waterbodies from stormwater run off and spills, would require additional management.<br>Shallow wells directly down-gradient are potential receptors of land discharge or could be in zone of drawdown influence. | 4 | Low direct risk to waterbodies.<br>Risk of discharge to land mobilising PFAS from adjacent sites and/or drawdown during construction having the same effect.<br>Groundwater gradient unclear, at least 8 shallow bores which could be receptors of any site discharge or could be in zone of drawdown influence.. | 5 | Some risk to surface water bodies if land discharge progressed and would need to consider appropriate setbacks.<br>Higher direct risk to Waikato River and watercourse along back of site from stormwater run off and spills, would require additional management.<br>No wells down gradient (geotechnical risk covered above). | | |
| | **5d** | Potential for impacts on highly productive soil | 5 | Majority of site classified as LUC2 | 5 | Area where WWTP likely to be located is split across 2, 3 & 4 | 5 | Both parcels classified as LUC 1 - southern parcel has a business/commercial zone, therefore NPSHPL will not apply to that parcel (that parcel would score 10 on its own) | 5 | Classified as LUC 3, noting that this land is not currently managed as production land so no loss of actual productive land (however, loss of capacity remains) | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **6. Built environment** | **6a** | Potential for odour effects | 5 | (Based on current possible layout)<br>High risk odour sources can likely be located more than 150m from the site boundary. Other odour sources, including the reactors, will be closer but there is a sufficient buffer to minimise these risks. Approximately 14 dwellings are located within 300m of high risk odour sources. The rural residential development which is occurring to the north of the site on private roads off Peacockes Rd and also on Faiping Rd will increase sensitivity of the area to possible odour effect in the event of a plant malfunction. May be able to locate high risk units 200m from nearest dwelling. Some consentability risk. | 5 | (Based on current possible layout)<br>High risk odour sources can likely be located more than 150m from the site boundary. Other odour sources, including the reactors will be closer but there is a sufficient buffer to minimise these risks. Approximately 8 dwellings are located within 300m of high risk odour sources (noting that two of these have been acquired by the crown for the Southern Links project). May be able to locate high risk units 200m from nearest dwellings. Overall there looks to be a lower housing density than site 1 but there are sites within 200m that could be developed as a permitted activity.<br>Commercial land use to the northwest of the plant which would have a lower odour sensitivity. Some consentability risk. | 2 | Unable to locate high risk odour sources more than 150m from the site boundary. Treatment processes will potentially located adjacent to the boundary. Therefore, the site offers no significant odour buffer. Residential and commercial receptors are located to southeast of the site. These receptors will be generally not located in the predominant downwind direction. However, at least 1 dwelling is likely to be located within 100m of the plant and potentially up to 11 dwellings within 300m of the plant. A number of commercial operators will also be located within 300m of the plant. A positive feature of the site are open fields in other directions. Although this land would not be control by the council and land use could change over time with reverse sensitivity implications. Moderately high consentability risk | 2 | Unable to locate high risk odour sources more than 150m from the site boundary. Treatment process will be located 30-50m from the site boundary. Residential receptors are located to east of the site which is in the predominant downwind direction. One dwelling may be located within 100m of the plant and potentially up to 19 dwellings could be located within 300m of the plant. A feature of the site is the river running along the site west boundary. Potentially winds and any emitted odour could be channelled along the river. Moderately high consentability risk |
| | **6b** | Potential for noise effects (including plant and traffic access) | 7 | Noise expected to be able to be mitigated to a prescribed level at the boundaries. Blowers and centrifuges are the highest noise potential. Both come in acoustic enclosures which would be housed withing concrete buildings.<br>Potentially higher sensitivity receiving environment due to lower ambient noise; however, Southern Links Designation would already have an impact on the noise environment and therefore residents are aware that there will be a change in noise environment in the future. | 7 | Noise expected to be able to be mitigated to a prescribed level at the boundaries. Blowers and centrifuges are the highest noise potential. Both come in acoustic enclosures which would be housed withing concrete buildings.<br>Potentially lower sensitivity receiving environment than Site 1 due to proximity to SH3 and the resulting higher level of existing noise. In addition, Southern Links Designation would already have an impact on the noise environment and therefore residents are aware that there will be a change in noise environment in the future. | 5 | Noise expected to be able to be mitigated to a prescribed level at the boundaries but much more challenging with very limited buffers. Blowers and centrifuges are the highest noise potential. Both come in acoustic enclosures which would be housed withing concrete buildings.<br>Potentially lower sensitivity receiving environment due to proximity to SH3 and the resulting higher level of existing noise as well as the industrial and airport land uses. | 5 | Noise expected to be able to be mitigated to a prescribed level at the boundaries but much more challenging with smaller buffers than sites 1 and 2. Blowers and centrifuges are the highest noise potential. Both come in acoustic enclosures which would be housed withing concrete buildings.<br>Potentially higher sensitivity receiving environment due to lower ambient noise even with proximity to SH21; however, Southern Links Designation would already have an impact on the noise environment and therefore residents are aware that there will be a change in noise environment in the future. |
| | **6c** | Potential for landscape and visual effects | 6 | Highly visible from residential properties to the north. Existing vegetation provides a lot of screening and remaining appear possible to screen from adjacent plant. Also visible from residential properties to the south, but easier to screen. | 5 | Highly visible including from SH3 and Raynes Road - transient viewers - but impacts on viewshaft in district plan.<br>Highly visible from residential properties to the north and east (including Rukuhia village) but opportunity to screen along edge of site (away from SH3).<br>Future southern links corridor would remove visual audience to the north. | 7 | Highly visible including from SH3 - transient viewer. Few direct neighbours overlooking site. Expected to have a lower sensitivity than other sites due to the surrounding industrial/airport land uses.<br>More challenging to screen with proximity to SH3 (maintaining vegetation harder in proximity to SH and limit on size of trees acceptable. | 3 | Smaller visual audience but elevated neighbours would be difficult to screen. Expected to be sensitive to visual effects due to significant change from existing golf course land use. This site will also impact an identified Outstanding Natural Landscape (per the proposed Waikato District Plan) |
| | **6d** | Potential for archaeological impacts | 5 | Archaeological artefacts have been found on the farm in the past and the current landowner is aware of probable borrow pits on the land. It was not possible to see them during the initial field survey as the grass was very long. It is intended to return to site in autumn to re-assess the nature and extent of the archaeological evidence.<br>Archaeological sites more likely to be present on the eastern half of the site, scoring based on WWTP on western side. | 9 | No known sites on this land. The research has not lead to the identification of sites and no archaeological sites are anticipated. | 9 | No known sites on this land. The research has not lead to the identification of sites and no archaeological sites are anticipated. | 2 | Three known sites within the golf course. This includes two pa (one at north and one at south. South end probably destroyed when existing infrastructure constructed. North end would have been impacted to some degree by the golf course construction) and one extensive garden site. |
| | **6e** | Potential for heritage impacts | 10 | There are currently no known heritage sites affected by the proposal (potential archaeological sites covered above). | 10 | There are currently no known heritage sites affected by the proposal. | 10 | There are currently no known heritage sites affected by the proposal. | 10 | There are currently no known heritage sites affected by the proposal (archaeological sites covered above). |
| | **6f** | Alignment with long term growth / alternative land uses | 6 | Not in an area that is strategically identified<br>Outside immediate development areas but in area that is already becoming rural-residential/large lot | 6 | Not in an area that is strategically identified<br>Outside immediate development area but directly adjacent large lot residential | 6 | The Southern portion of Site 3 is located within the existing Airport Business zone Southern precinct, forming part of the sub-regions limited industrial land supply. Through Plan Change 20: Airport Northern precinct extension, HCC has presented expert evidence encouraging the safeguard of Industrial land in the sub-region. HCC's appointed economic expert has identified the importance of Industrial/land adjoining Airport activities to be considered a 'scarce resource' that should be developed to its full industrial potential leveraging the strategic locational advantages the Airport and associated linkages provide. | 6 | Not in an area that is strategically identified<br>Site appears to present better uses however this is difficult to evidence |
| | | | **158** | | **144** | | **138** | | **112** | |

**Southern Wastewater Treatment Plant**

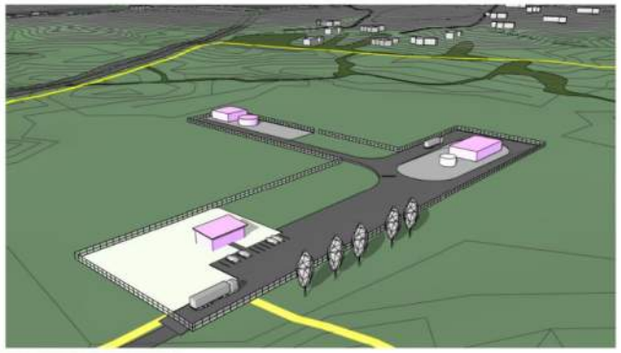
Overall site layout


NOTE: These layouts and the associated renderings have been produced to give an early indication of what a WWTP *could* look like on these two sites. No design has been completed at this stage. The layouts and rendering are based on the flows expected and size and shape of process units on other similar sites. Changes should be expected during future design processes.

**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 1 layout

2,000 PE – 5,000 PE (400-1,000 $m^3$/day)

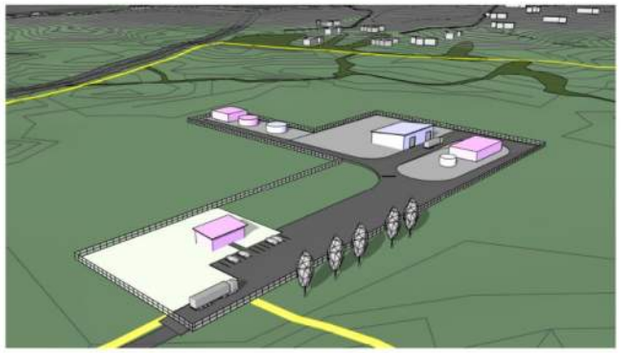



NOTE: These layouts and the associated renderings have been produced to give an early indication of what a WWTP *could* look like on these two sites. No design has been completed at this stage. The layouts and rendering are based on the flows expected and size and shape of process units on other similar sites. Changes should be expected during future design processes.

**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 2 layout

6,000 PE – 9,500 PE (1,200-1,900 $m^3$/day)

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**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 1 & 2 visual

6,000 PE – 9,500 PE (1,200-1,900 $m^3$/day)


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**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 1 & 2 visual

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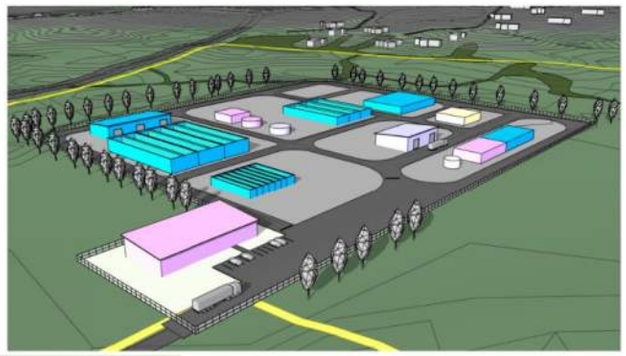
**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 3 layout

78,000 PE (15,600 $m^3$/day)

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Site 1 (Sharpe Farm) | Stage 3 visual

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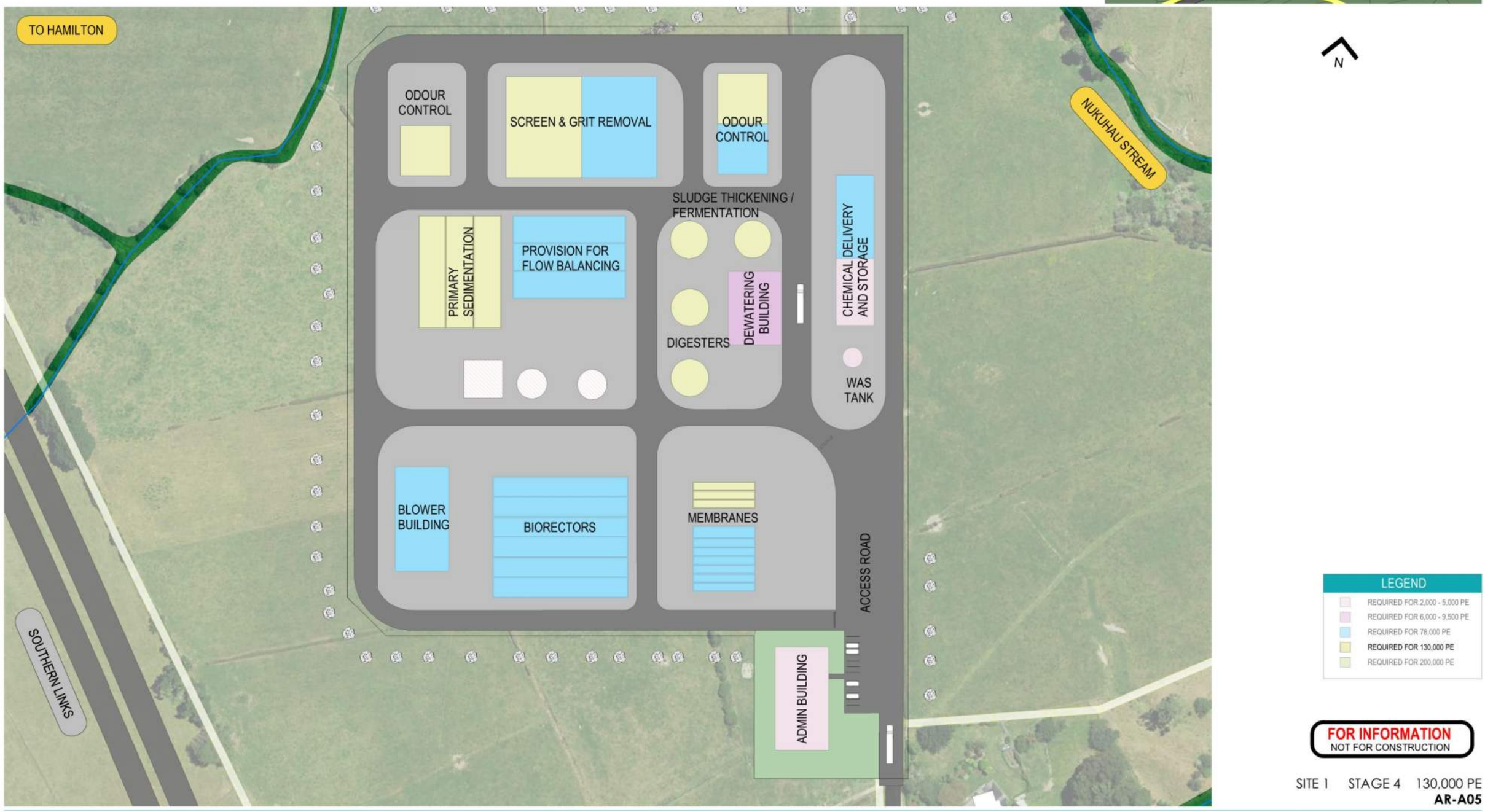
**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 4 layout

130,000 PE

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**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 4 visual

130,000 PE


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**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 4 visual

130,000 PE


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**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 4 visual

130,000 PE


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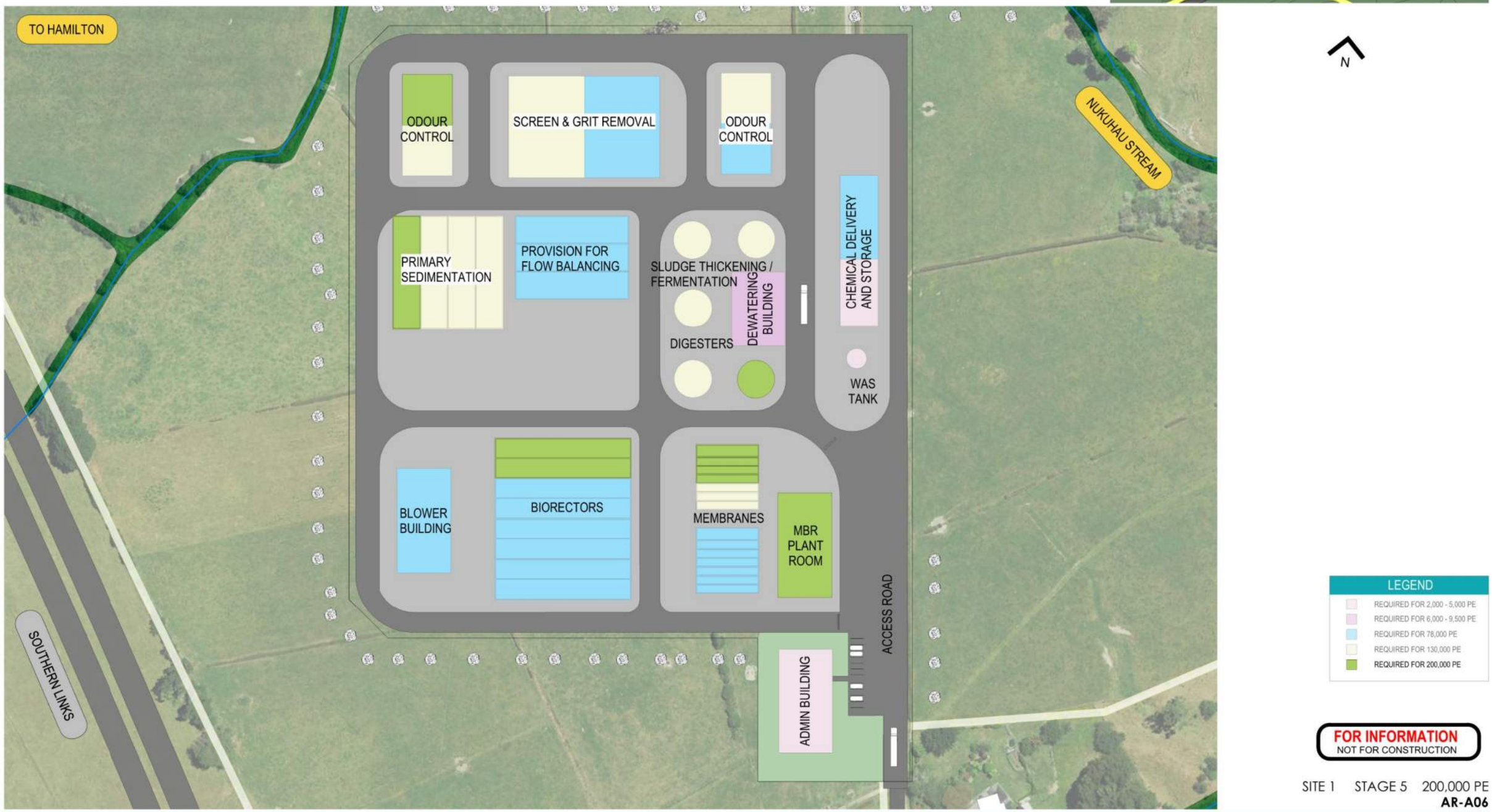
**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 5 layout

200,000 PE

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**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 5 visual

200,000 PE


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**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 5 visual

200,000 PE


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**Southern Wastewater Treatment Plant**

Site 1 (Sharpe Farm) | Stage 5 visual

200,000 PE


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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 1 layout

2,000 PE – 5,000 PE (400-1,000 $m^3$/day)


N

LEGEND

- REQUIRED FOR 2,000 - 5,000 PE
- REQUIRED FOR 6,000 - 9,500 PE
- REQUIRED FOR 78,000 PE
- REQUIRED FOR 130,000 PE
- REQUIRED FOR 200,000 PE

FOR INFORMATION
NOT FOR CONSTRUCTION

SITE 2 STAGE 1 2,000-5,000 PE

**AR-A07**

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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 2 layout

6,000 PE – 9,500 PE (1,200-1,900 $m^3$/day)


N

LEGEND

- REQUIRED FOR 2,000 - 5,000 PE
- REQUIRED FOR 6,000 - 9,500 PE
- REQUIRED FOR 78,000 PE
- REQUIRED FOR 130,000 PE
- REQUIRED FOR 200,000 PE

FOR INFORMATION
NOT FOR CONSTRUCTION

SITE 2 STAGE 2 6,000-9,500 PE

**AR-A08**

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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 1 & 2 visual

6,000 PE – 9,500 PE (1,200-1,900 $m^3$/day)


NOTE: These layouts and the associated renderings have been produced to give an early indication of what a WWTP *could* look like on these two sites. No design has been completed at this stage. The layouts and rendering are based on the flows expected and size and shape of process units on other similar sites. Changes should be expected during future design processes.

**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 1 & 2 visual

6,000 PE – 9,500 PE (1,200-1,900 $m^3$/day)


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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 1 & 2 visual

6,000 PE – 9,500 PE (1,200-1,900 $m^3$/day)


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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 3 layout

78,000 PE (15,600 $m^3$/day)


N

LEGEND

- REQUIRED FOR 2,000 - 5,000 PE
- REQUIRED FOR 6,000 - 9,500 PE
- REQUIRED FOR 78,000 PE
- REQUIRED FOR 130,000 PE
- REQUIRED FOR 200,000 PE

FOR INFORMATION
NOT FOR CONSTRUCTION

SITE 2 STAGE 3 78,000 PE
**AR-A09**

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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 3 visual

78,000 PE (15,600 $m^3$/day)


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Site 2 (Narrows/Rukuhia) | Stage 3 visual

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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 3 visual

78,000 PE (15,600 $m^3$/day)


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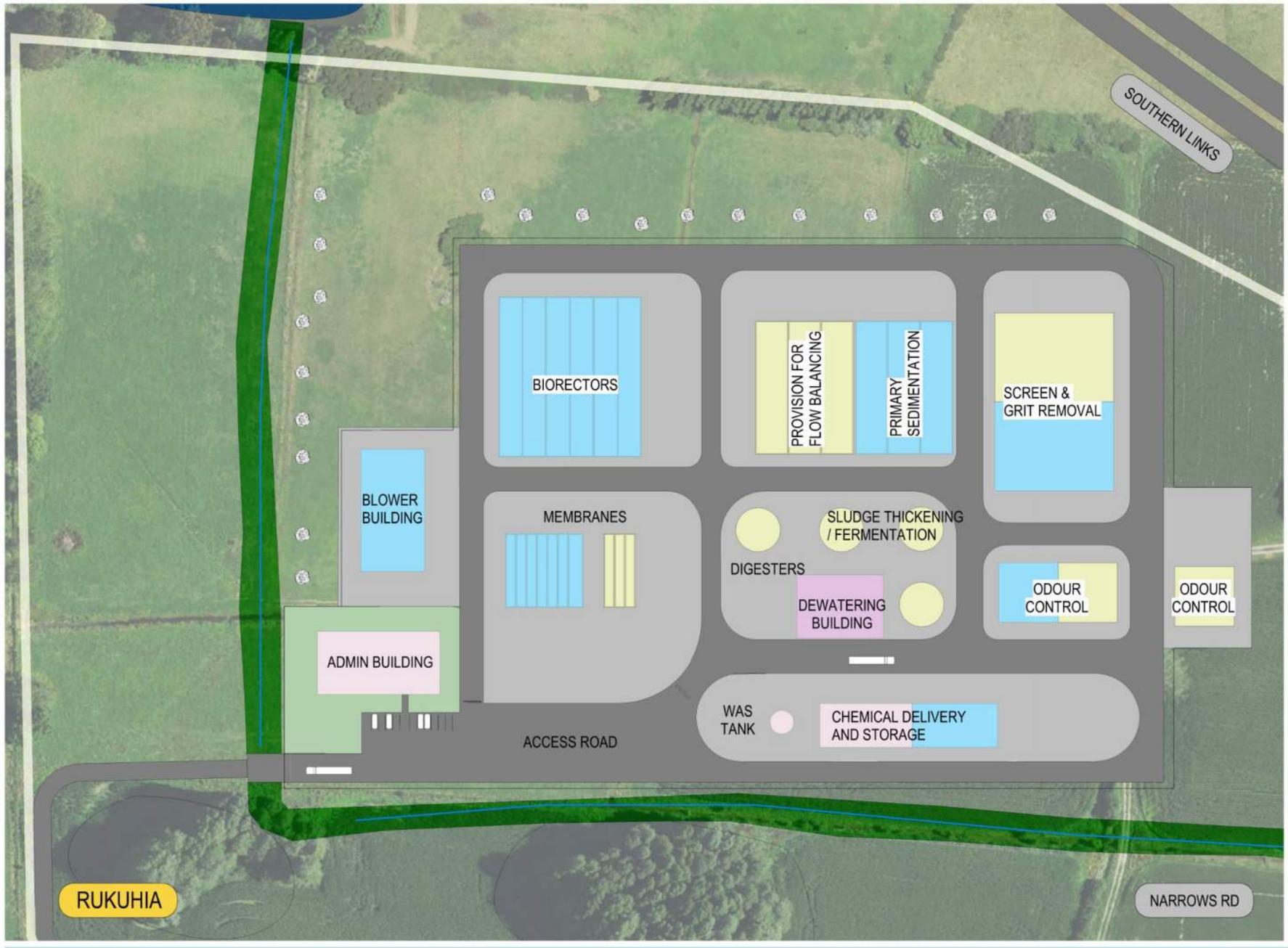
**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 4 layout

130,000 PE




N

LEGEND

- REQUIRED FOR 2,000 - 5,000 PE
- REQUIRED FOR 6,000 - 9,500 PE
- REQUIRED FOR 78,000 PE
- REQUIRED FOR 130,000 PE
- REQUIRED FOR 200,000 PE

FOR INFORMATION
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SITE 2 STAGE 4 130,000 PE

**AR-A10**

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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 4 visual

130,000 PE


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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 4 visual

130,000 PE


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130,000 PE


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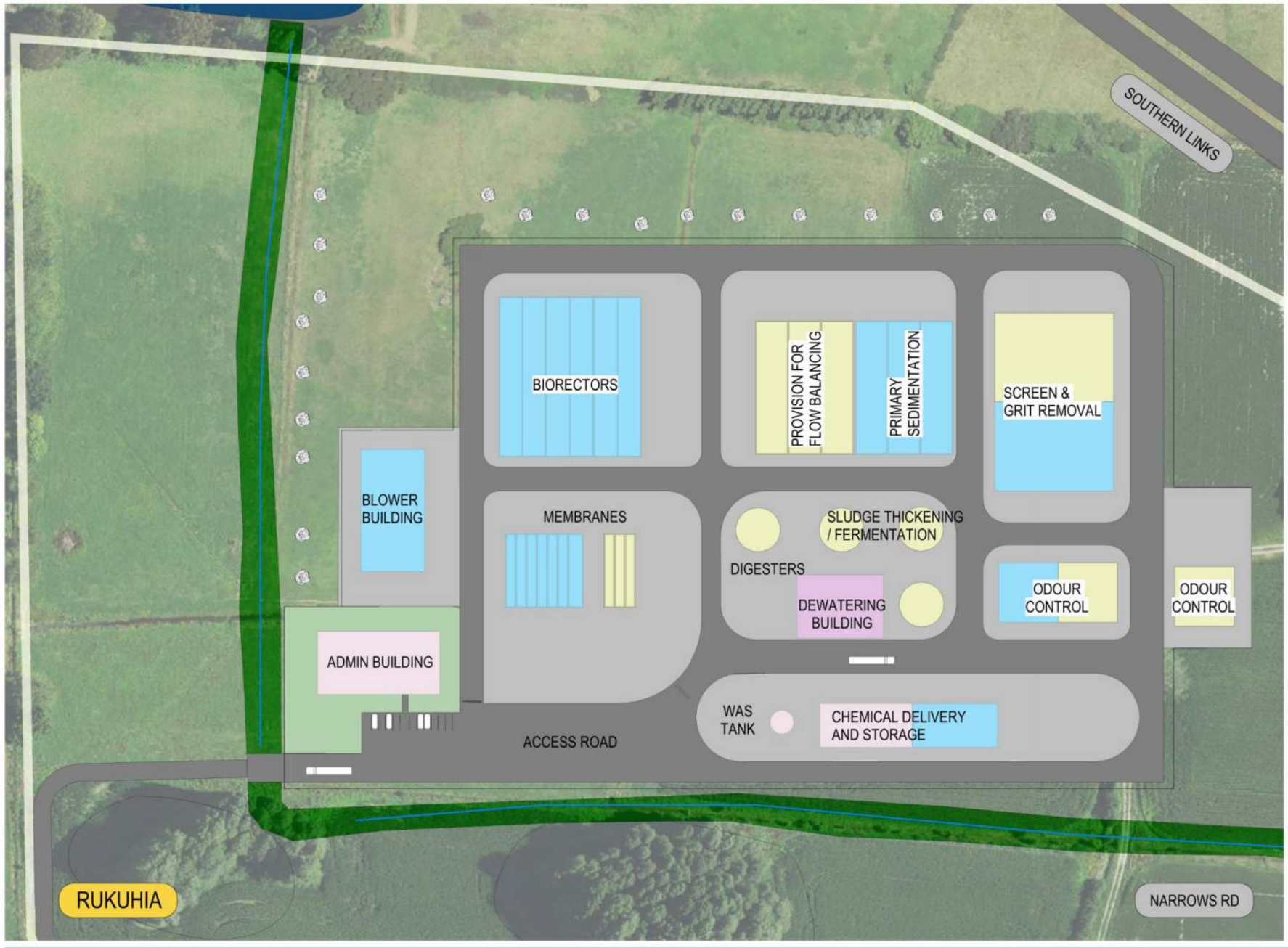
**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 5 layout

200,000 PE




N

LEGEND

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- REQUIRED FOR 6,000 - 9,500 PE
- REQUIRED FOR 78,000 PE
- REQUIRED FOR 130,000 PE
- REQUIRED FOR 200,000 PE

FOR INFORMATION
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SITE 2 STAGE 4 130,000 PE

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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 5 visual

200,000 PE


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**Southern Wastewater Treatment Plant**

Site 2 (Narrows/Rukuhia) | Stage 5 visual

200,000 PE


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200,000 PE


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# Southern Wastewater Treatment Plant

## Assessment of Alternative Sites

Prepared for Hamilton City Council
Prepared by Beca Limited

**23 August 2024**

# Contents

# Appendices

## Revision History

| Revision Nº | Prepared By | Description | Date |
|---|---|---|---|
| A | Mhairi Rademaker | Partial draft for HCC review | 17 April 2023 |
| B | Mhairi Rademaker | Draft for HCC review | 18 August 2023 |
| C | Mhairi Rademaker | Draft for HCC review | 31 October 2023 |
| D | Garrett Hall | Final | 23 October 2024 |
| | | | |

## Document Acceptance

| Action | Name | Signed | Date |
|---|---|---|---|
| Prepared by | Mhairi Rademaker |  | 31 October 2023 |
| Reviewed by | Garrett Hall |  | 23 October 2024 |
| Approved by | Garrett Hall |  | 23 October 2024 |
| on behalf of | Beca Limited | | |

# Executive Summary

The Waikato region has seen tremendous growth and development in commercial, industrial and residential areas, placing pressure on existing wastewater services and creating further demand for wastewater treatment and management services. Aging wastewater infrastructure, increasing regulatory requirements and environmental expectations, climate change impacts, and greater growth demands have created a significant investment deficit.

The Southern Metro Wastewater Detailed Business Case (Southern Metro DBC) outlines these challenges and recommends a preferred option for managing wastewater from the southern area of the Waikato-Hamilton-Waipā metro sub-region. The preferred option is made up of a programme of works, including four major projects in the southern sub-region. One of the projects is development of a new Wastewater Treatment Plant (WWTP) in the area immediately south of Hamilton to service future growth in the south of Hamilton City, the Waikato Regional Airport, and surrounding land use in the northern Waipā District.

The Southern Metro DBC process included undertaking a site selection process to identify a preferred broad location for the Southern Wastewater Treatment Plant (SWWTP) in the area immediately south of Hamilton. Since that Report was completed, Hamilton City Council (HCC) considered the project programme and timeframes associated with land acquisition, and focussed on land that could be acquired through a willing-seller/willing buyer process. In addition, HCC has purchased a farm between Peacockes Road and Raynes Road (Sharpe Farm).

This report details the further short-list site selection feasibility and assessment of alternative sites to recommend a preferred site for the SWWTP.

The four short-listed sites included within this report for assessment are shown in Figure E1 and include:

- Site 1: Sharpe Farm
- Site 2: Rukuhia
- Site 3: Penniket Road
- Site 4: Golf Course

The short-list assessment process is set out in Figure E2. The process has been characterised by collaborative decision points where project partners (including HCC and iwi and hapuu representatives) provided input into the site selection process.

Desktop studies and site investigations were undertaken of the four preferred sites alongside site visits with iwi and hapuu.

A series of technical workshops and mana whenua hui were held with relevant parties to seek input to the options assessment. The technical Multi Criteria Assessment (MCA) and Tangata Whenua Assessment (TWEA) were carried out in parallel and are given equal weighting in consideration of the preferred option.

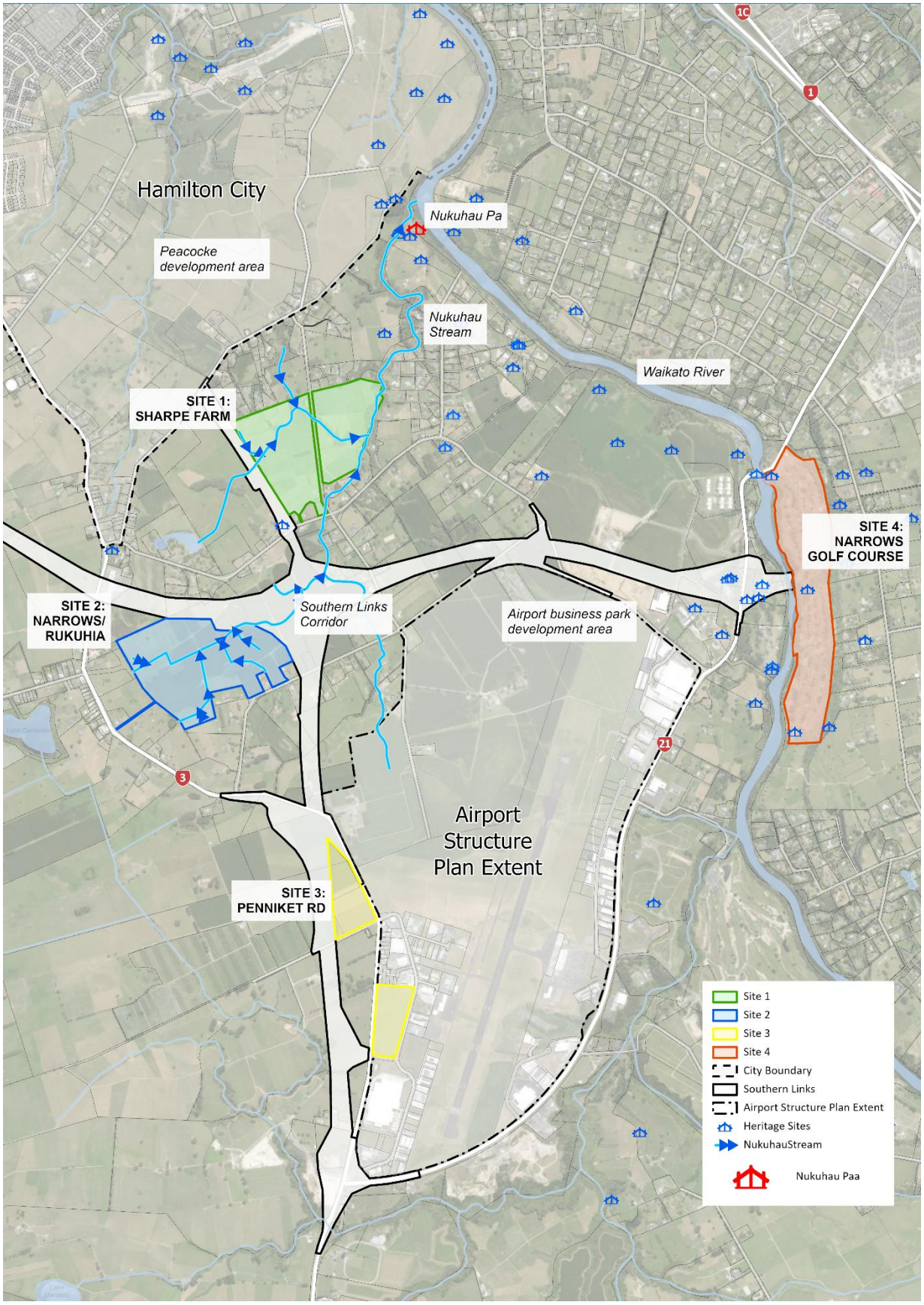


Figure E1: Four Short-Listed Sites

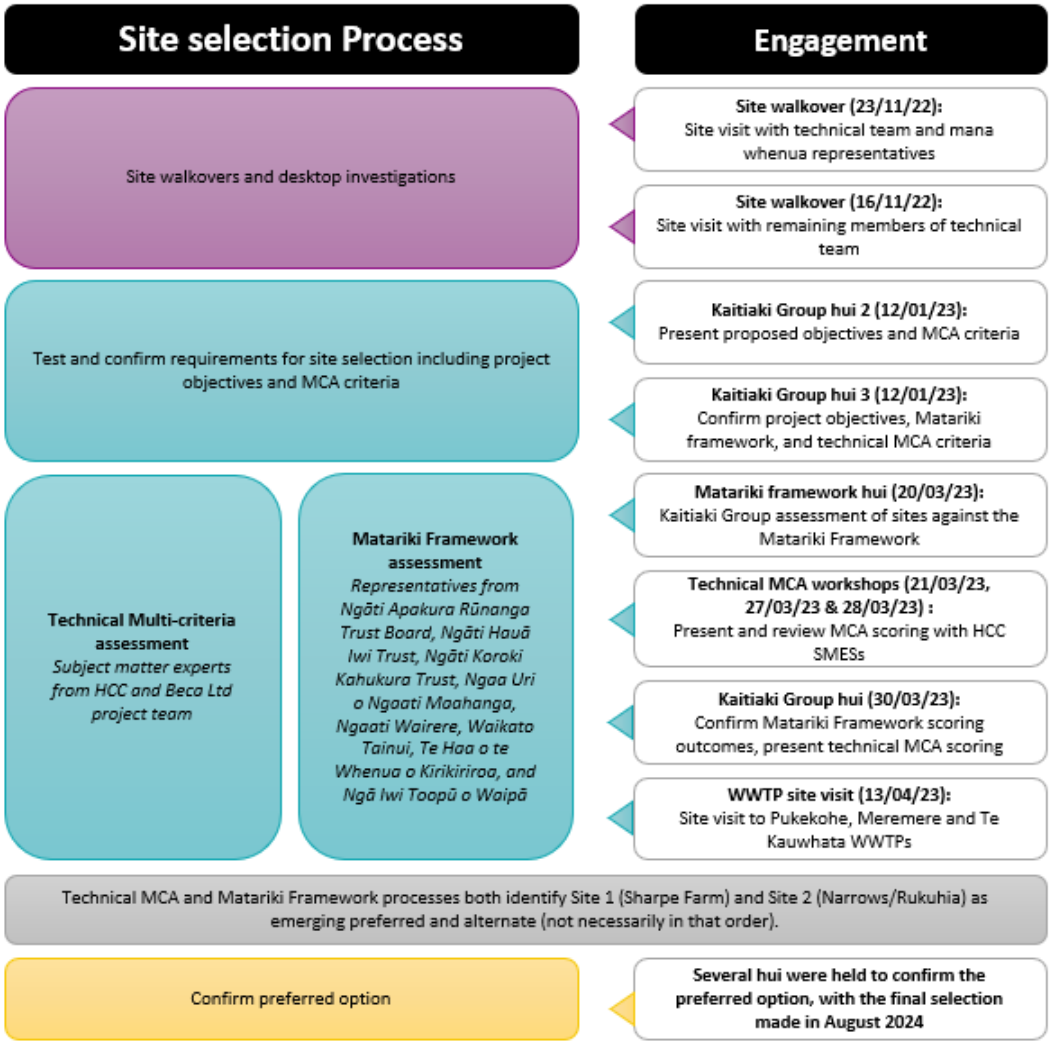


Figure E2: Site selection (short-list) process

Following the MCA process and multi-disciplinary workshops, Sites 1 and 2 scored higher, with Site 1 the highest. The experts agreed that sites 1 and 2 appeared generally appropriate for the proposed WWTP and Sites 3 and 4 should be discounted. A further weighting/sensitivity exercise was undertaken to investigate how changing the weighting of the various criteria impacted the overall scoring.

In all scenarios tested, the order remained the same as the raw scores except for scenario 4 where the higher weighting on natural environment lifts Site 3 to the same score as Site 2. The consistency in scoring strengthens the position that Site 1 was the preferred site from the technical MCA.

To assist with the selection of a preferred site, a series of layouts and renderings were developed for Sites 1 and 2. The purpose of these was to show a WWTP could develop at each of the sites over time.

Following the technical MCA process and the findings of the TWEA, Sharpe Farm has been identified at the preferred site. Sharpe Farm scored the highest in both the unweighted and weighted MCA.

The Rukuhia site has been identified as the alternative option, although at the date of finalising this report the Southern Links Project landholdings are being reassessed by NZTA. This may mean this site is no longer available.

# 1 Introduction

## 1.1 Project background

The Waikato region has seen tremendous growth and development in commercial, industrial, and residential areas, placing pressure on existing wastewater services and creating further demand for wastewater treatment and management services. Aging wastewater infrastructure, increasing regulatory requirements and environmental expectations, climate change impacts, and greater growth demands have created a significant investment deficit.

The **Southern Metro Wastewater Detailed Business Case**[1] (Southern Metro DBC) outlines these challenges and recommends a preferred option for managing wastewater from the southern area of the Waikato-Hamilton-Waipā metro sub-region. The preferred option is made up of a programme of works, including four major projects in the southern sub-region.

One of the projects is development of a new wastewater treatment plant (WWTP) in the area immediately south of Hamilton to service future growth in the south of Hamilton City, the Waikato Regional Airport (Airport), and surrounding land use in the northern Waipā District.

The Southern Metro DBC process included undertaking a site selection process to identify a preferred broad location for the Southern Wastewater Treatment Plant (SWWTP) in the area immediately south of Hamilton. The **Metro Wastewater Detailed Business Case - Site Selection Options Report** outlines the process undertaken to identify and screen potential sites, assess short-list sites, and identify an initial preferred solution in terms of the area where the SWWTP would be best located. That report makes recommendations for further analysis to refine and confirm the preferred option.

## 1.2 Purpose of this report

This report details the site selection feasibility and assessment of alternative sites to recommend a preferred site for the SWWTP in the area immediately south of Hamilton.

The purpose of this report is to:

- Describe the short-list sites considered
- Describe the assessment methodology used to assess the four short-listed sites and confirm the preferred option
- Identify potential constraints and risks within each of the four short-listed sites.
- Outline the results of that assessment
- Highlight potential risks and matters to be considered in the next project phase

This report will support a future Notice of Requirement and resource consent processes.

When considering a Notice of Requirement, section 171(1) of the Resource Management Act 1991 (RMA) requires that adequate consideration is given to alternative sites, routes, and methods and whether the work and designation are reasonably necessary for achieving the objectives of the requiring authority. This report sets out consideration of alternative sites for construction and operation of a new WWTP as well as whether discharge to land is possible at the same site as the WWTP. Further reporting will consider alternative routes, methods and whether the work and designation are reasonably necessary for achieving the objectives of the requiring authority.

[1] GHG/Beca, 2022

The next phases of the SWWTP project will also need to consider the discharge of treated wastewater to land at other sites and/or the Waikato River and terms of section 105 and the Fourth Schedule of the RMA which require that possible alternative methods of discharge, including to other receiving environments, are considered. Good resource management practice for wastewater discharges generally includes adopting the Best Practicable Option (BPO).

The RMA defines the BPO as:

> *In relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to—*
>
> *(a) The nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and*
>
> *(b) The financial implications, and the effects on the environment, of that option when compared with other options; and*
>
> *(c) The current state of technical knowledge and the likelihood that the option can be successfully applied.*

This report focusses on the assessment of alternative sites and does not specifically assess the BPO. However, it is expected that this assessment, along with the Southern Metro DBC and the detailed investigations associated with future resource consent applications, will support identification of the BPO.

## 1.3 Note on consideration of alternatives

Under the RMA, adequate consideration of alternative routes, sites, and methods must be given in circumstances relating to:

- A notice of requirement – where a requiring authority does not have interest in the land sufficient in undertaking the work, or it is likely that such work would result in significant adverse effects on the environment (s171(1)(b))
- Resource consent applications – an Assessment of Environmental Effects (AEE) must include a description of potential alternative locations or methods in undertaking the activity, if that work will result in a significant adverse effect on the environment (Schedule 4 Clause 6)
- Applications for discharge permits – in considering the nature and sensitivity of discharge and any potential alternative discharge methods, and/or other receiving environments (s105 and Schedule 4, Clause 6)
- The “best practicable option” which is to be adopted, ensures that the noise emitted from land or water does not exceed a reasonable level (s 16).

The preferred option should be selected based on a transparent, replicable, and robust process. Case law affirms that the focus of the adequacy of consideration of alternatives should be determined by the adequacy of the assessment of alternative process rather than the outcome.

An assessment of alternatives does not require a full assessment of all possible alternatives, nor is it necessary to select the “best” option based on an assessment of the relative merits of the alternative option identified. Not every viable/feasible option needs to be considered; however, the requiring authority must demonstrate that the assessment of alternatives has not been carried out in an arbitrary or cursory way.

Consideration of alternatives needs to be in proportion to the effects of the proposed designation. This calls for greater scrutiny where there is a likelihood for greater adverse effects, including both the effects on land not held by the requiring authority as well as in relation to the severity of adverse effects which may arise from an option.

The level of detail in the assessment should be proportionate to the extent of adverse effects created by the activities considered and the sensitivity of the receiving environment(s) potentially impacted. Where there is greater the potential is for adverse effects (or impacts on private land), a more robust and careful assessment of alternative sites is required.

This assessment process needs to include RMA matters, particularly those relevant to Part 2 matters. Where these matters are notably relevant to a proposal, they should be given standing during alternative assessments (for example through specific criteria or criteria weighting exercises).

This report will form part of the wider body of evidence that supports the need for a new WWTP to service the south of Hamilton City, Airport, and northern Waipā District that includes:

- *Southern Metro DBC*: Considers alternative wastewater servicing options and presents a new Southern WWTP as the preferred option
- *Metro Wastewater Detailed Business Case - Site Selection Options Report*: Supports the Southern Metro DBC and outlines the process for selecting the area around the airport as the preferred area for the new WWTP
- *This report*: Considers four sites identified by HCC including the potential to discharge to land on those sites and recommends a preferred site for the WWTP
- *Future work*: Will complete the assessment of alternative methods, sites, and routes for the WWTP infrastructure and discharge to land and/or the Waikato River including consideration of the matters set out in RMA s105 and the BPO.

## 1.4 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 WWTP sites. 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.

# PART A: Sites considered

# 2 Overview

## 2.1 Site selection process

Figure 1 below provides an overview of the site selection process to date.

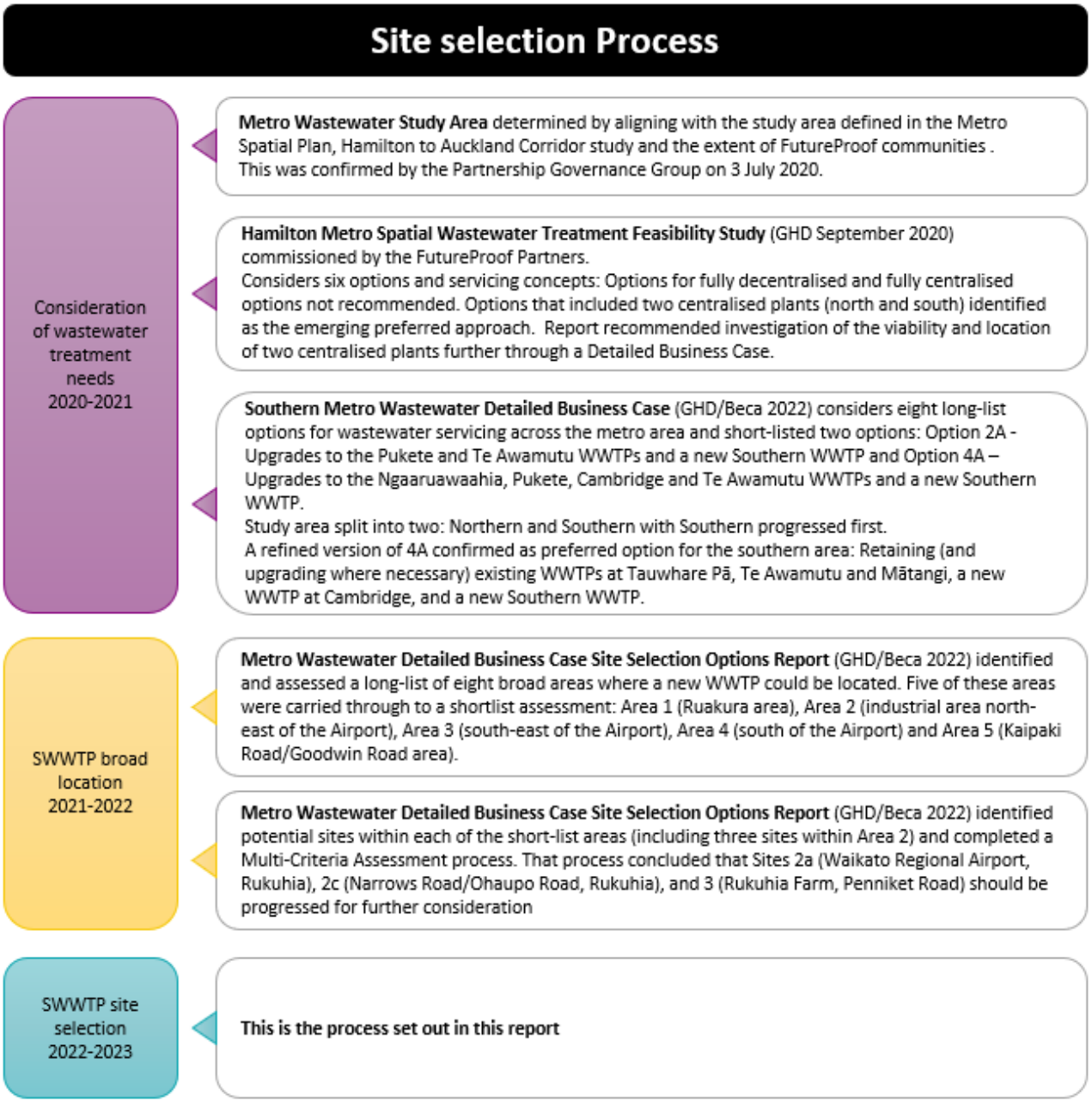


Figure 1: Site Selection Process Methodology

## 2.2 Sites considered

The **Metro Wastewater Detailed Business Case - Site Selection Options Report** was completed in March 2022 and outlined the context for the Project and included an overview of the study area, detailed the site selection methodology and included a process of constraint mapping, identification of areas to avoid and sites of cultural or archaeological significance. A long-list site identification and assessment process was

undertaken including engagement with mana whenua and Council staff. Assessment criteria were developed and used to identify and assess short-listed sites.

The Report identified three sites for further investigation being:

- Site 2a: Waikato Regional Airport Limited, Rukuhia
- Site 2c: Narrows Road / Ohaupo Road (SH3), Rukuhia
- Site 3: Rukuhia Farm, Penniket Road, Rukuhia

These sites were identified for the purpose of understanding the potential costs and impacts of different specific locations rather than being specifically preferred sites.

Since that report was completed, HCC has considered the project programme and timeframes associated with land acquisition. In order to progress the project efficiently and avoid protracted Public Works Act processes, HCC has focussed on land that can be acquired through a willing-seller process. In practice, this means sites in either Crown or council ownership. As outlined in Section 1.3, an assessment of alternatives does not require a full assessment of all possible alternatives and not every viable/feasible option needs to be considered.

Sites 2a and 3 were removed from consideration following early discussions between the landowners and Hamilton City Council (HCC) where the landowners indicated they would not be interested in entering into a willing-seller progress.

New Zealand Transport Agency Waka Kotahi (NZTA) has secured a designation for the future Southern Links transportation project in the southern sub-region. The Crown has been progressively purchasing land for this future transport corridor and has identified a number of sites where land it now owns is likely to be surplus to NZTA requirements for a transport corridor. As a result, three of these sites are now able to be considered by the partner councils for a new WWTP.

In addition, HCC has purchased a farm between Peacockes Road and Raynes Road.[2]

Therefore, HCC identified four sites for further investigation as part of a refined short-list:

- Site 1: Sharpe Farm
- Site 2: Narrows/Rukuhia
- Site 3: Penniket Road
- Site 4: Golf Course

These sites are shown in Figure 2 along with the three short-listed sites identified by the Southern metro DBC process.

[2] It should be noted that, while this property was identified and purchased as part of this project, there was no pre-supposition that the property would be the preferred site for a WWTP nor even that it would be suitable for a WWTP. The property has a number of features of interest to HCC regardless of whether it is used for a WWTP including its proximity to the Nukuhau Stream.

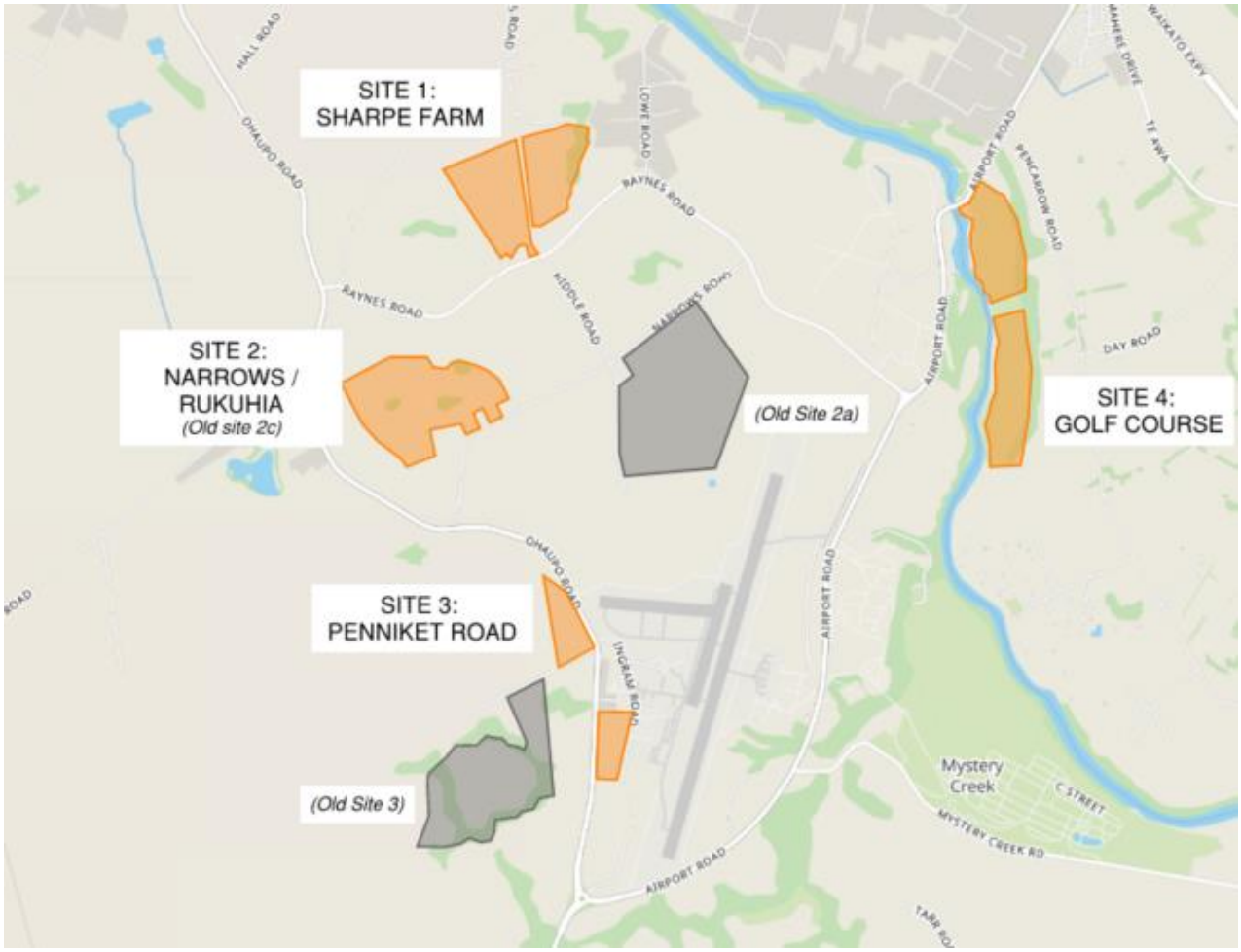


Figure 2: Short-list sites for consideration (sites identified in Metro Wastewater Detailed Business Case - Site Selection Options Report but no longer being considered shown in grey)

Figure 3 shows an overview of the four short-listed sites in further details along with the Southern Links NZTA designation, the Peacocke development area and the Hamilton Airport Structure Plan extent.

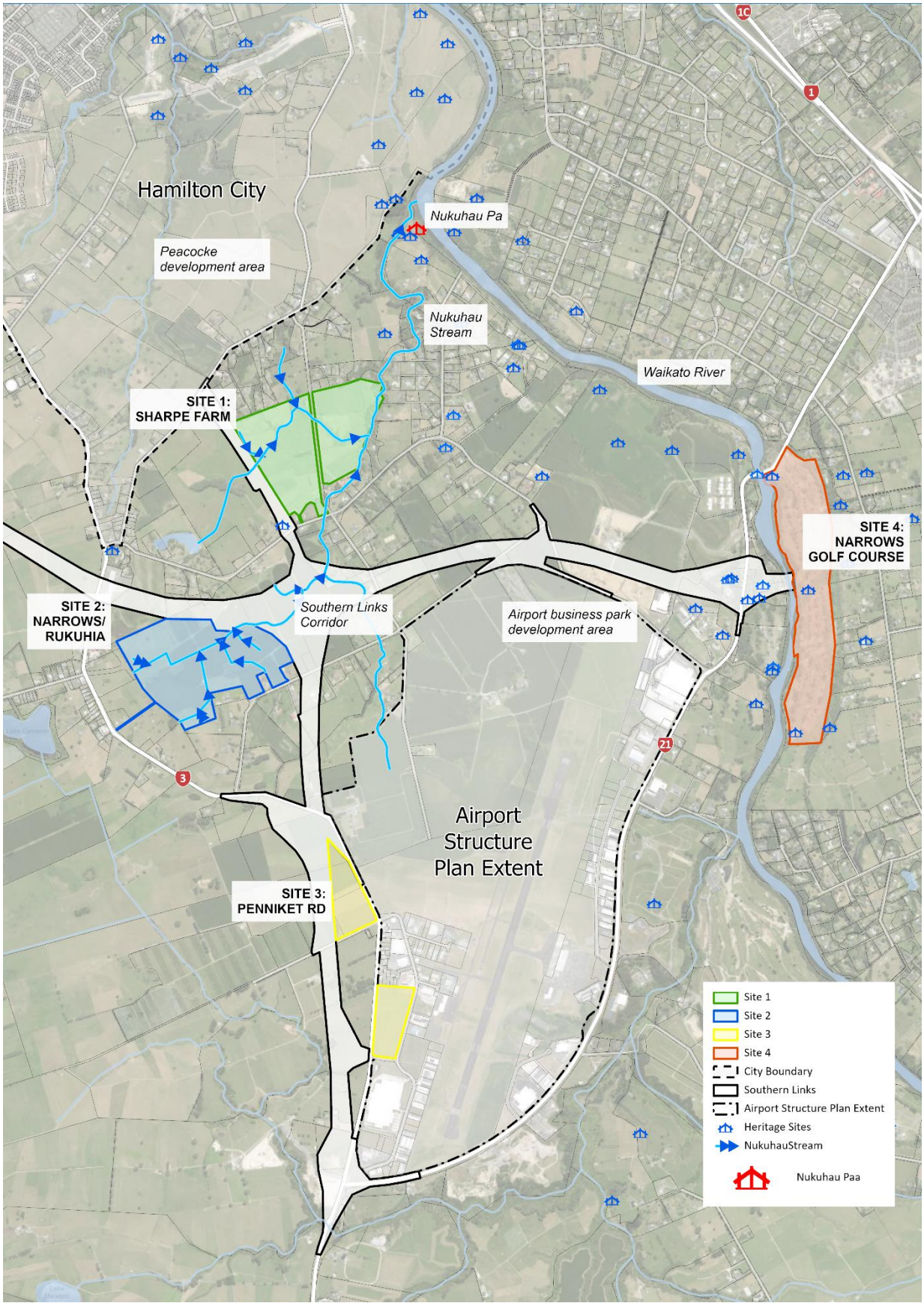


Figure 3: Short-Listed Sites Overview

## 2.3 Expected WWTP layout requirements

### 2.3.1 Footprint

The Southern Metro DBC assumed the SWWTP would be staged over time as shown in Table 1 with an ultimate population equivalent (PE) of 130,000. Since the Southern Metro DBC was completed, additional work has been undertaken by Beca[3] to investigate the area of Hamilton that could be diverted to the SWWTP. As a result of that work, the ultimate sizing has been increased to 200,00 PE for the purpose of site selection. Excluding buffers, site access requirements and based on the processes shown in Figure 4, a 200,000 PE plant is expected to require 5-6 ha. Table 1 describes the staging of the SWWTP as proposed in the Southern Metro DBC, with amendments in italics considered by the Southern Hamilton Catchment Diversion Report.

Table 1: Southern Metro DBC SWWTP concept staging

| | Description | Serviced area | Starting demand | Total capacity |
|---|---|---|---|---|
| Stage 1 | Sequential Batch Reactor (SBR) with discharge to land | Airport precinct | 400 $m^3$/day (2,000 PE) | 1,000 $m^3$/day (5,000 PE) |
| Stage 2a | Membrane Bioreactor (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) |
| Stage 3 | MBR with energy recovery | Airport precinct, wet industry, Mātangi / Tamahere commercial areas, and southern Hamilton | 15,600 $m^3$/day (78,000 PE) | 15,600 $m^3$/day (78,000 PE) |
| Ultimate (DBC) | To consider the site capacity and layout that may be required within the next 50 years | As above | 130,000 PE | |
| *Ultimate (Southern Diversion)* | *To consider future proofing of the site to a realistic maximum* | *As above* | *200,000 PE* | |

[3] South Hamilton Catchment Diversion Report (Beca), January 2023.

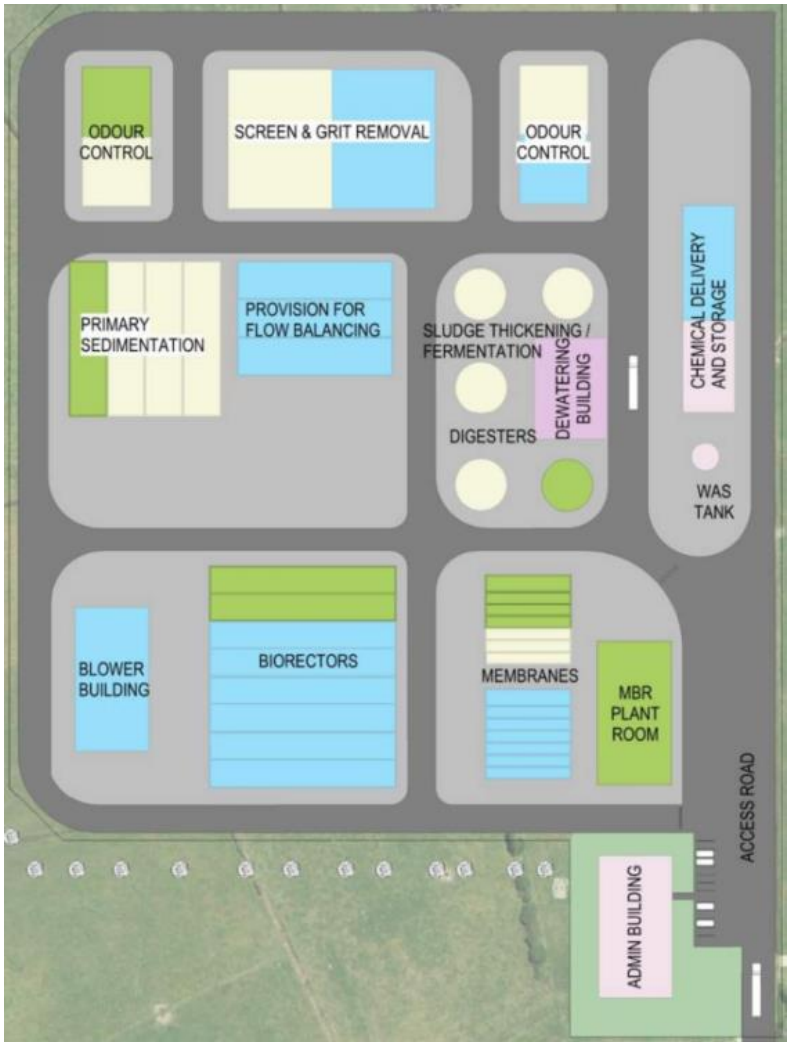


Figure 4: SWWTP ultimate footprint (200,000 PE) indicative process requirements and layout

### 2.3.2 Buffer distances

Buffers (or setbacks) are commonly used to reduce the risk of adverse effects including odour, noise and visual effects. For WWTPs, the potential for odour effects is usually of particular concern to neighbours and it is the odour effects that typically drive the required buffers.

The general requirement for discharges to air is that the discharge shall not result in odour that is objectionable to the extent that it causes an adverse effect at or beyond the boundary of the subject property.

While odour is subjective, a modern, well designed, operated and maintained WWTP should produce very little odour. Many of the higher risk processes can (and should) be enclosed and vented to odour control units (such as biofilters) to reduce odour discharge. However, there remains a risk of odour discharge during times when the WWTP is operating in ‘upset’ or contingency situations for example as a result of changes to influent quality or following equipment or power failure. In such situations, providing a buffer between the WWTP and neighbours is important to minimise the risk of adverse effects.

There are two buffers that should be considered:

- The internal buffer – how far can the WWTP (and in particular the higher risk processes[4]) be set back from the property boundary?
- The buffer to existing dwellings – how far is the WWTP (and in particular the higher risk processes) from existing dwellings?

There are no New Zealand standards that set required or recommended buffer distances from WWTPs. Water New Zealand has provided recommended separation distances for waste stabilisation ponds (e.g. anaerobic, facultative, and maturation ponds) but not for a tank based WWTP. The recommended separation distances of 150m to the nearest isolated dwelling and 300m to any residential area.

A number of Australia regulatory authorities have published recommended separation distances for industrial and municipal emission sources, including WWTPs, which are designed to avoid air quality adverse amenity effects from incompatible land uses. The Victorian Environmental Protection Agency (EPA) separation distances are often referred to in NZ when consenting projects. The Victorian EPA recommends a buffer of around 340m from a 40,000 PE MBR WWTP, and 580m a 200,000 PE MBR WWTP. However, these buffer distances are considered overly conservative, particularly for a modern MBR plant.

Other Australian state EPA EPA's typically do not specify recommended separation distances for WWTP with capacities greater than 15,000 PE. The maximum separation distance for a WWTP of 15,000 PE is commonly defined by EPA's to be 300m.

However, it is important to note that the separation distances recommended by the EPAs are not regulatory standards.

Less conservative guidelines are published by the Ontario Ministry for the Environment. For WWTPs with a treatment capacity of between 500 to 25,000 $m^3$/day the ministry specifies a minimum separation 100 metres to sensitive land uses but recommends this separation distance should be at least 150 metres. A minimum separation distance of 150m is specified for WWTP with a treatment capacity greater than 25,000 $m^3$/day. However, the Ontario guidelines note that the specified separation distances are not appropriate for dealing with the effects of major treatment plant upsets such as overloading or equipment breakdown.

For the purpose of this site selection process, a buffer of 150m to the site boundary is recommended as a starting point. However, this separation distance may not be sufficient to mitigate adverse odour effect during upset conditions. The separation distance also assumes odour emissions have been minimised through the implementation and maintenance of good odour control system and management procedures. Mapping of the indicated site layouts with 100m, 200m, and 300m buffers has been used to show the number of dwellings close to the site and to assess the potential risk of odour effects.

Odour dispersion modelling should be undertaken in the next stages of the project to help inform the buffer requirements, and odour control requirements for normal operation conditions.

## 2.4 Form of discharge

A key issue for the Project is the assessment of the suitability of the sites for land-based discharge which may form part of the Stage 1 discharge. Malcolm McLeod (Manaaki Whenua Landcare Research) undertook field investigations to ascertain the site specific nature of soils to inform a preliminary assessment on the suitability of the sites for land disposal of treated wastewater. This report is attached as **Appendix A**. Should discharge to land be considered through the next phases of this project, additional work will be required to ascertain potential application rates, storage requirements, effects on the receiving environment (soils,

[4] Higher risk processes include the screens and grit removal, primary sedimentation, digesters, and sludge thickening/fermenting/management.

groundwater and surface water) and the volume of any balance flow that may still need to be discharged to water.

The Southern Metro DBC assumes an ultimate discharge from the SWWTP to the Waikato River (from Stage 2 onwards). This report includes consideration of potential conveyancing routes to the river for each site but does not consider the practicality or feasibility of constructing a discharge structure to the river.

Access to the river may be via private land and could have particular cultural, geotechnical or environmental constraints that are beyond this scope of this report (and are likely to be consistent across all WWTP site options). However, the accessibility of a river discharge option will impact the long-term viability of the WWTP and should be considered as soon as practicable.

While a range of matters will need to be considered as part of the form and location of any future river discharge, a number were specifically raised by the project team, HCC specialists and mana whenua during preparation of this report. Those matters include:

- Mana whenua have given strong direction that, in general, new structures in the bed of the Waikato River should be avoided.
- Mana whenua have given strong direction that some form of land contact is preferred prior to discharge of treated wastewater to the river, this would require additional space near the river.
- Options to discharge the treated wastewater to a tributary rather than the river should be considered. This would require detained consideration of flows and potential for erosion and scour.
- Any discharge to the river is likely to be upstream of Nukuhau Pa and the Hamilton Wastewater Treatment Plant. The proximity to and potential for effects on these sites should be considered in detail.

## 2.5 Conveyance

The following conveyance scenarios and respective routes have been assessed for the new WWTP:

- Conveying incoming flows from the catchments to the WWTP
- Conveying outgoing treated effluent from the WWTP to the Waikato River

The following criteria were used to identify potential conveyance routes:

- Sizing of pump stations and pipelines were not completed for this study
- Conveyance of incoming flows from the catchments were based on the South Hamilton Catchment Report[5] and should be read in conjunction with this report
- Routes have assessed assuming they follow existing/ paper road corridors. No routes through private property have been considered.
- All flows from the WWTP are being conveyed to the Waikato River (i.e. this assessment of conveyance routes does not consider potential conveyance to other discharge to land or stream sites)
- High level typographical data were used

## 2.6 Regional geology and hydrogeology

### 2.6.1 Geology

The four sites under consideration are located within the Hamilton Basin, a depression formed by faulting and uplift of surrounding ranges. The soil and rock types in the area are largely the result of sedimentary infilling of the depression.

[5] South Hamilton Catchment Diversion Report, Beca, January 2023.

The Hamilton Basin has two distinctive terranes: the Hamilton Hills and the Lowlands (Figure 5). All four sites are located in the Lowlands terrane.

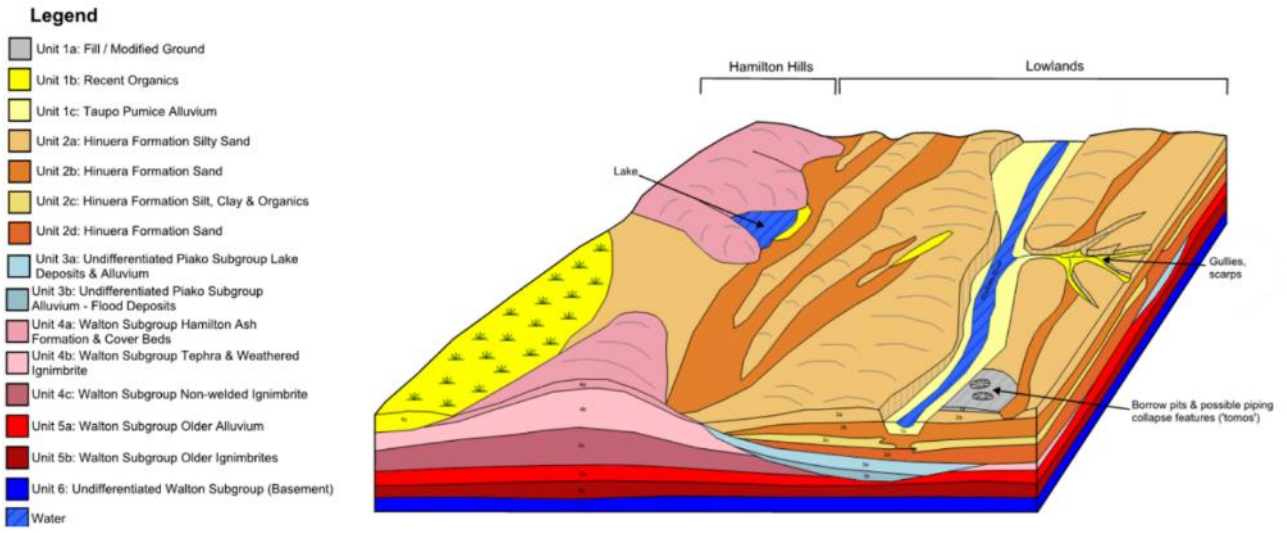


Figure 5: Schematic diagram showing the Hamilton Basin geology (Source: after Lowe, 2010)

The Hamilton Hills are composed of Walton Subgroup deposits that include volcanic ash beds (explosive eruption deposits) and ignimbrites (pyroclastic deposits) from the Taupo Volcanic Zone (2.4 million years to 60,000 years ago). After its formation, the Walton Subgroup underwent uplift and faulting. These deposits were then eroded by the Waikato River channel which redeposited silt and sands between the hills, creating the Lowland areas.

The Lowlands are the valleys between the Hamilton Hills that have been infilled with younger alluvial sediments of the Piako Subgroup, including the Hinuera Formation (late Pleistocene, last 24,000 to 14,000 years). These materials were deposited by the ancestral Waikato River which migrated backwards and forwards within the wider river floodplain, and therefore the lithology of these deposits vary both laterally and vertically and include bedded pumiceous sands, silts, and gravels interbedded with peats. In some areas peat swamps developed on top of the Hinuera Formation.

Within the project area, the Hinuera Formation forms a broad flat surface at approximately 50m RL to 60m RL and is primarily composed of sediments made of low energy alluvial deposits comprising interbedded silt and sand with peat / organic silt lenses (QMap, GNS Science 2014).

### 2.6.2 Hydrogeology

Groundwater flow within the Waikato area is strongly influenced by the depositional history, which has created lateral and vertical variability in grain size (a mixture of pumiceous sand, silts, and gravels interbedded with clay/peats).

The Lowland areas are typically characterised by highly permeable coarse sand and gravels interlayered with low permeability silty soils, which creates a series of perched groundwater tables above the much deeper regional water table that is connected to the Waikato River.

In general, regional groundwater follows the topography, flowing in a north-westerly direction (Figure 6) towards the confluence of the Waikato and Waipā Rivers.

The shallower perched groundwater tables are more closely connected to smaller creeks and streams. Local flow gradients are towards topographic low points, where groundwater discharges, providing a significant component of stream base-flow.

Recharge to the regional aquifer occurs primarily through rainfall to the surrounding higher elevation hills and ranges and from up-gradient aquifers. In the low-lying areas, rainfall recharge will be captured by the perched water tables before slowly infiltrating into the deeper aquifers. The flow rate is likely to be very slow both horizontally and vertically due to the flat topography and presence of low permeability horizons.

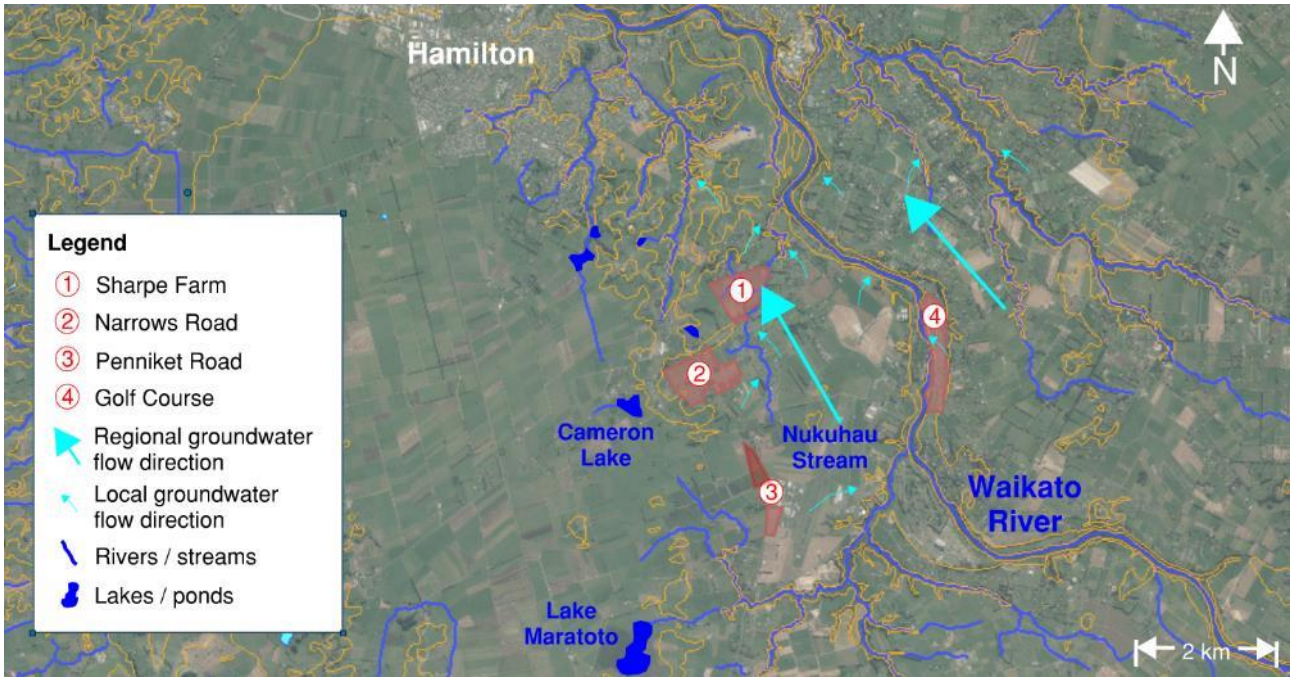


Figure 6: Overall flow and direction of groundwater in Southern Hamilton area

## 2.7 Ecological Context

### 2.7.1 Vegetation

All four sites fall within the Hamilton Ecological District (ED) and the Waikato Ecological Region (ER). An ED is defined as an area where the topographical, geological, climatic, soil, and biological features produce a characteristic landscape and range of biological communities. An ER is an aggregation of EDs with closely related characteristics. Indigenous vegetation within this ED has been severely depleted, with less than 2% of all original indigenous ecosystem remaining. Prior to human settlement and modification, vegetation within this ED mainly comprised of large bogs, scrub, and fernland with smaller areas of swamp forests. Human modification has led to only remnant areas of kahikatea - dominated forests scattered throughout this ED. Clearance of vegetation has occurred primarily for farming practices as well as urbanisation (Hamilton City).

### 2.7.2 Wetlands

There are numerous wetlands across the Hamilton ED and Waikato ER that are associated within the Waikato River and ranges from low nutrient peat areas, sedge dominated wetlands, raupō reedlands and flax swamps, and riverine wetlands along the riparian margins. Collectively, these wetlands provide numerous ecological benefits, including providing habitat to a variety of plants and animals, enhancing water quality through filtering nutrients and suspended sediment, and storing floodwaters. Within the Waikato River catchment a majority of wetland environments have been drained for farmland or other activities and have reduced in extent by over 75% over the last 160 years.

### 2.7.3 Avifauna

Within the Waikato ER there are over 124 native species of birds, however, the majority of these species are commonly found *Not Threatened* species, especially within more highly modified and regularly disturbed areas.

The desktop review identified the presence of approximately 57 native avifauna species within an 8 km radius of the sites. Most of these species have a conservation status of Not Threatened, however, there are several At Risk and Threatened species identified (Table 2).

Table 2. Native avifauna species identified in an 8 km radius of the sites (New Zealand Birds Online, 2013; Robertson et al., 2021)

| Common name | Scientific Name | Conservation Status |
|---|---|---|
| African Collared-Dove | *Streptopelia roseogrisea* | Not Threatened |
| Australasian Swamphen | *Porphyrio melanotus* | Not Threatened |
| Australian Shoveler | *Spatula rhynchotis* | Not Threatened |
| Black Swan | *Cygnus atratus* | Not Threatened |
| Grey warbler | *Gerygone igata* | Not Threatened |
| Gray Teal | *Anas gracilis* | Not Threatened |
| Southern black-backed gull | *Larus dominicanus* | Not Threatened |
| Spurwing plover | *Vanellus miles* | Not Threatened |
| Morepork | *Ninox novaeseelandiae* | Not Threatened |
| New Zealand Bellbird | *Anthornis melanura* | Not Threatened |
| New Zealand Fantail | *Rhipidura fuliginosa* | Not Threatened |
| New Zealand Pigeon | *Hemiphaga novaeseelandiae* | Not Threatened |
| Paradise Shelduck | *Tadorna variegata* | Not Threatened |
| Pied Stilt | *Himantopus leucocephalus* | Not Threatened |
| Sacred Kingfisher | *Todiramphus sanctus* | Not Threatened |
| Shining Bronze-Cuckoo | *Chrysococcyx lucidus* | Not Threatened |
| Silvereye | *Zosterops lateralis* | Not Threatened |
| Spotted Dove | *Streptopelia chinensis* | Not Threatened |
| Swamp Harrier | *Circus approximans* | Not Threatened |
| Tomtit | *Petroica macrocephala* | Not Threatened |
| Tui | *Prosthemadera novaeseelandiae* | Not Threatened |
| Welcome Swallow | *Hirundo neoxena* | Not Threatened |
| White-faced Heron | *Egretta novaehollandiae* | Not Threatened |
| Whitehead | *Mohoua albicilla* | Not Threatened |
| Spotless Crake | *Zapornia tabuensis* | At Risk - Declining |
| Eurasian Coot | *Fulica atra* | At Risk - Naturally Uncommon |
| Little Black Cormorant | *Phalacrocorax sulcirostris* | At Risk - Naturally Uncommon |
| New Zealand Pipit | *Anthus novaeseelandiae* | At Risk - Declining |
| New Zealand Falcon | *Falco novaeseelandiae* | At Risk - Recovering |
| Black shag | *Phalacrocorax carbo* | At Risk - Relict |
| Little shag | *Microcarbo melanoleucos* | At Risk - Relict |

| Common name | Scientific Name | Conservation Status |
|---|---|---|
| Australasian Bittern | *Botaurus poiciloptilus* | Threatened – Nationally Critical |
| New Zealand Dabchick | *Poliocephalus rufopectus* | Threatened – Nationally Increasing |

Of the species with an At-Risk and Threatened conservation status (Table 2), the following species have a higher likelihood of utilising habitat within and within proximity to the four sites, based on their habitat preferences (New Zealand Birds Online, 2013):

- Australasian pipits - often present in remnant pine forests, open habitats grasslands, and around remaining wetlands.
- Eurasian coots – are an entirely aquatic species, often found within freshwater lakes and ponds with submerged vegetation or grassy edges.
- Little black cormorant – have a range of habitats, however, is known to occur within lakes and ponds.
- New Zealand falcon – often breed in areas of suitable bush remnants include podocarp and pine forests, as well as forage along grassland areas.
- Great cormorant and little pied cormorant – both are found in a variety of habitats include rivers, streams, and ponds.
- Australasian bittern – can often be found foraging in drains and wetland/farmland edges, as well as areas of rank-grasses and paddocks.

The potential presence of these species within and within proximity of the four sites are discussed in detail in later sections of this Report with respect to each of the sites.

### 2.7.4 Herpetofauna

There are currently numerous records of native herpetofauna within the Hamilton ED, as well as the wider Waikato ER. Native species within the Hamilton ED include pacific gecko (Not Threatened), elegant gecko (At Risk - Declining), and copper skink (At Risk - Declining) (Bell & Wiles, 2015). Copper skinks are found throughout the North Island in a variety of environments including garden debris/rubbish, thick-rank grass, rocks, logs, and other organic debris (New Zealand Herpetological Society, n.d.-a). Similarly, the elegant geckos are an arboreal species with a wide distribution in the Northland to central North Island area, they are primarily found in forested habitats including swaps, scrubland, and mature forests, although they appear to favour scrubby and re-generating habitats (New Zealand Herpetological Society, n.d.-b). Pacific geckos can be found through north-western North Island and are both arboreal and terrestrial and as such, inhabit a range of environments including swamps, scrublands, mature forests, rocky coastlines, and back-dunes (New Zealand Herpetological Society, n.d.-c).

### 2.7.5 Bats

There are two species of native bats identified within the Waikato Region, the long-tailed bat (*Chalinolobus tuberculatus*) (Threatened – Nationally Critical) and the central lesser short-tailed bat (*Mystacina tuberculatus rhyacobia*) (At Risk - Declining). The latter species primarily resides within the Pureora Forest; however, long-tailed bats are widely distributed within the Hamilton ED and Waikato ER.

### 2.7.6 The Waikato River

The Waikato River is the longest river in New Zealand at 425 km long with catchment area of 14,260 km$^2$. Human population pressures have led to the degradation of streams and tributaries of the Waikato River, although, within the Hamilton region there are still sections of good riparian coverage. Ongoing land use changes and modifications has led to an increase in stormwater discharge into streams and tributaries, which eventually flush into the Waikato River, impacting water quality.

Water quality within the Waikato River and tributaries varies across the catchment, however, land use pressures including the clearance of vegetation and intensive farming practices have led to increased inputs

of nitrogen and phosphorus into the river system through groundwater infiltration as well as surface water runoff directly into waterways. An exceedance of nutrients within freshwater systems can often lead to the excessive growth of algae which can impact the survival of native species. Other water quality parameters including pH and dissolved oxygen varies across the river system, however, water temperature is noted to be elevated.

### 2.7.7 Freshwater Fauna

Due to its size, the Waikato River supports a variety of aquatic species. The river provides temporary and permanent habitat for a diverse range of freshwater fish, with over 19 native species recorded (Waikato Regional Council, n.d.) (Table 3). The river channel provides a significant migratory pathway for diadromous native freshwater fish species (e.g., whitebait), providing suitable feeding and spawning habitat for species during their various life stages. However, in some areas, instream modifications including dams, perched culverts, and floodgates are potentially restricting fish passage.

Table 3. Native fish species identified within the Waikato River channel (Dunn et al., 2018; Waikato Regional Council, n.d.).

| Common Name | Scientific Name | Conservation Status |
|---|---|---|
| Yellow-eyed mullet (aua) | *Aldrichetta forsteri* | Not Threatened |
| Shortfin eel (hao) | *Anguilla australis* | Not Threatened |
| Common bully (pako) | *Gobiomorphus cotidianus* | Not Threatened |
| Redfin bully | *Gobiomorphus huttoni* | Not Threatened |
| Cran's bully | *Gobiomorphus basalis* | Not Threatened |
| Grey mullet | *Mugil cephalus* | Not Threatened |
| Common smelt (ngaoire) | *Retropinna retropinna* | Not Threatened |
| Black flounder (patiki) | *Rhombosolea retiaria* | Not Threatened |
| Freshwater crayfish (koura) | *Paranephrops planifrons* | Not Threatened |
| Shrimp (kouraura) | *Paratya curvirostris* | Not Threatened |
| Banded kokopu (para) | *Galaxias fasciatus* | Not Threatened |
| Torrentfish (papamoko) | *Cheimarrichthys fosteri* | At Risk – Declining |
| Giant kokopu (kokopu) | *Galaxias argenteus* | At Risk – Declining |
| Koaro | *Galaxias brevipinnis* | At Risk – Declining |
| Black mudfish | *Neochanna diversus* | At Risk – Declining |
| Inanga | *Galaxias maculatus* | At Risk – Declining |
| Longfin eel (Kuwharuwharu) | *Anguilla dieffenbachii* | At Risk – Declining |
| Giant bully | *Gobiomorphus gobiodes* | At Risk – Naturally Uncommon |
| Lamprey (pirahau) | *Geotria australis* | Threatened Nationally Vulnerable |
| Short-jawed kokopu | *Galaxias postvectis* | Threatened – Nationally Vulnerable |
| Australian longfin eel | *Anguilla reinhardti* | Introduced |

In addition to native fish, the Waikato River and tributaries provide a range of suitable habitat for a large diversity of freshwater macroinvertebrates including kākahi and koura. The shallow shorelines of the river which, in some areas, are covered by macrophytes provide suitable breeding habitat for the larval and adult stages of a range of sensitive macroinvertebrate species. However, there are also numerous exotic and pest species of plants and animals that have been introduced to the system, altering its natural functioning. This includes catfish, koi carp, trout, and *Gambusia,* all of which can impact the survival of native fish and plant species within these freshwater systems.

# 3 Site 1: Sharpe Farm

## 3.1 Overview

| | |
|---|---|
| Owner | Hamilton City Council |
| Address | Raynes Road, Rukuhia |
| Title & legal description | SA72C/450, Lot 5-6 DPS 91837 |
| Area | 34.2 ha (comprised of two blocks at 19.35 ha and 14.85 ha) |

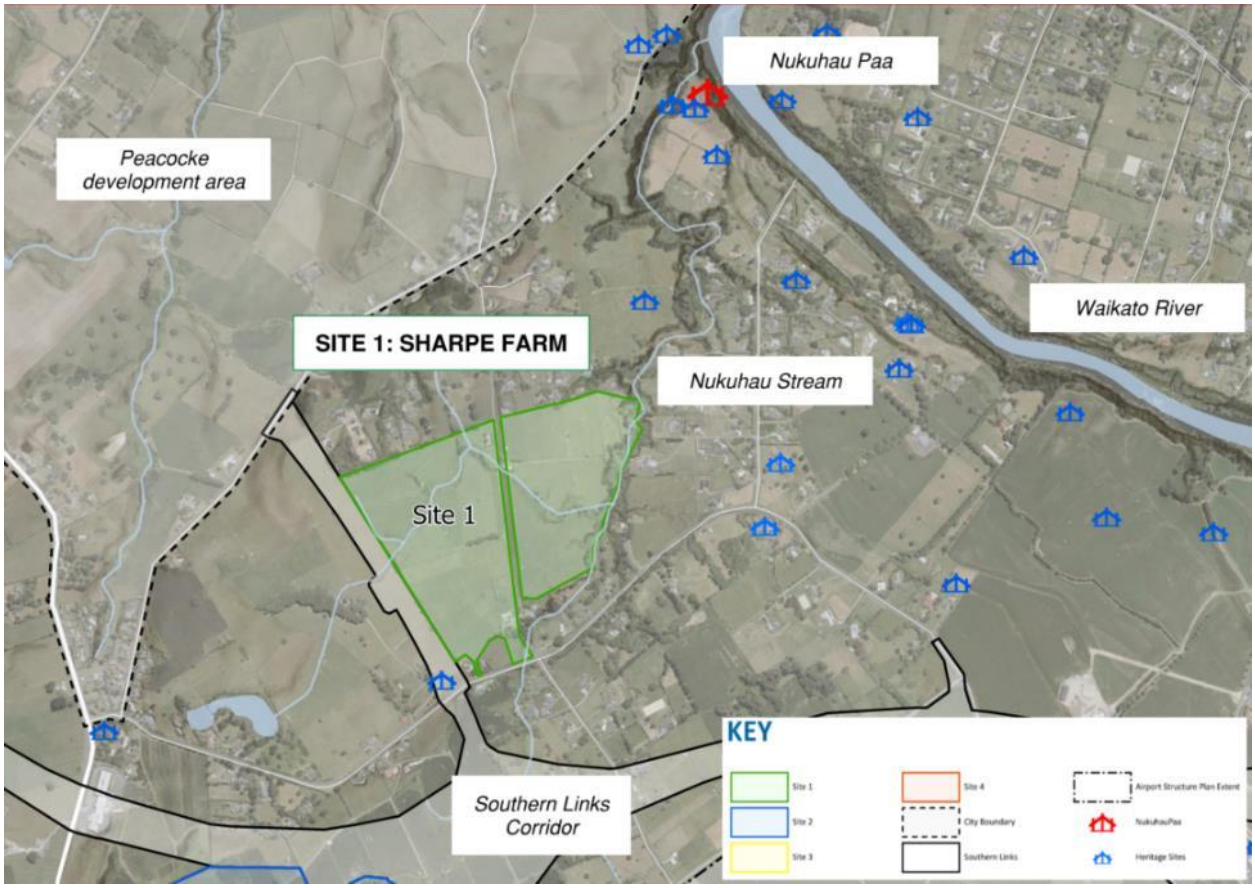


Figure 7: Site 1 location. Note Hamilton City boundary to the north/west, Southern Links Road designation to the west, and Waikato River to the east.

## 3.2 Site layout

Figure 8 shows an early conceptual layout for Site 1 based on the space expected to be required for the "ultimate" design (i.e. 200,000 PE).

The layout seeks to:

- Maximise the setback from the Nukuhau Stream based on feedback from mana whenua on the cultural significance of the Nukuhau
- Avoid requiring diversion of tributaries of the Nukuhau Stream to lower cultural/ecological impacts and maintain opportunity for riparian planting allow all watercourses within the site

- Avoid existing vegetation. Removal of a row of large exotic trees will likely be required; however, this is balanced against avoiding a stream diversion or inefficiencies in plant layout.
- Maximise buffer distance to dwellings to the north and south to minimise potential odour and noise effects on existing neighbours
- Recognise future land use associated with the Southern Links Road designation to the west (as the land is designated for roading purposes it is unlikely that residential development will occur)

It is expected that the main access to the site will be from the south (off Raynes Road) as the alternative access from the north passes through a rural-residential area. The access from the south requires a crossing of the Nukuhau Stream and access improvements (such as localised widening) which will require further detailed consideration.

A double ended 11kV power supply is available on the paper road running through the site. A utility buffer runs along the paper road and this will need to be considered in future design stages should this site proceed.

There is a paper road running through the site connecting the end of Faiping Road to Raynes Road. The recent decision on Proposed Private Plan Change 20: Airport Norther Precinct Extension requires construction of a new walking and cycling shared path connecting Peacocke Road to the Northern Precinct via Middle Road and Faiping Road, or a suitable alternative, prior to any development of the Northern Precinct.[6] There is a significant risk of conflict between users of such a shared path and the construction and operational traffic that would be associated with a WWTP at this site. This risk could potentially be managed by routing the pathway closer to the Nukuhau Stream and ensuring that any WWTP traffic accessed the site from Raynes Road (i.e. no WWTP traffic to use the existing section of Faiping Road).

Figure 9 shows the Site 1 waterways and contours while Figure 10 shows the early concept layout for key process units for a 200,000 PE WWTP.

[6] Proposed Private Plan Change 20: Airport Norther Precinct Extension, Decisions of Hearings Panel and Section 32AA Evaluation Report (June 2023). Refer Rule 10.4.2.20.

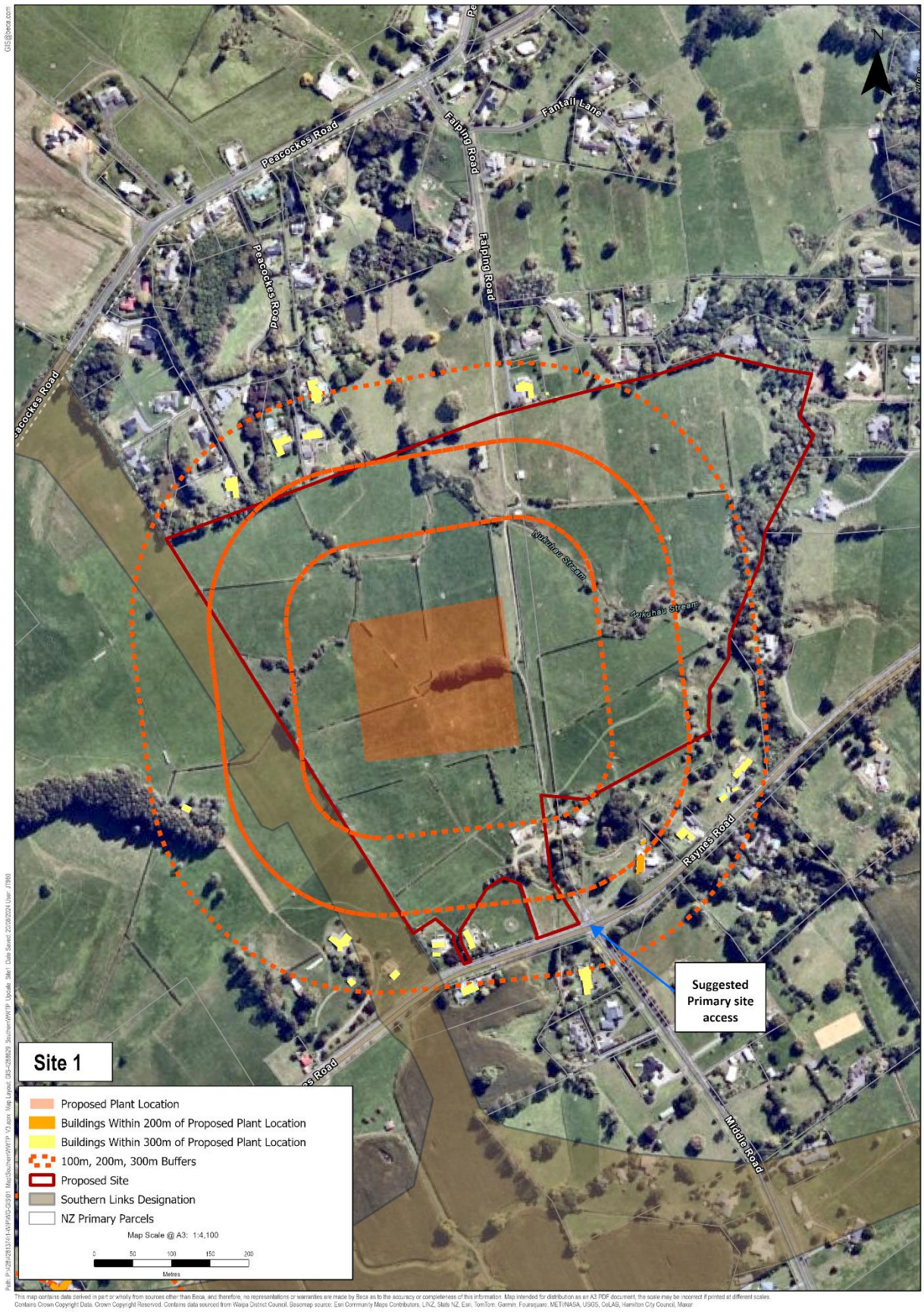


Figure 8: Proposed placement of WWTP within Site 1 showing 100m, 200m and 300m buffers and highlighting the properties within those buffers. Site boundary in red.


Figure 9: Site 1 waterways and contours


Figure 10: Early concept layout for Site 1 showing key process units for a 200,000PE plant. Processes colours orange not required until post-Stage 3.

## 3.3 Potential conveyance

Based on the above, the following potential conveyance routes have been identified:

- Catchment Conveyance
  - 1km long sewer rising main (SRM - No.1) from the N12 sewage pump station (SPS)
  - 1km long Gravity Sewer (GS - No.1) from SRM – No.1 to the WWTP
  - 1.6km long Gravity Sewer (GS – No.2) to the WWTP
- Treated Effluent Conveyance
  - 2.2km long Rising main (RS- No.1) from the WWTP to the Waikato River

The potential discharge point to the Waikato River will need to consider:

- The form of the discharge. Mana Whenua have given strong direction that, in general, new structures in the bed of the Waikato River are not appropriate and that some form of land contact is preferred prior to discharge to wastewater to the river. This requires space adjacent the river.
- Proximity to the Nukuhau Paa and whether this location is far enough to minimise effects.
- Proximity to the Hamilton Water Treatment Plant and confirmation that the discharge would not give rise to issues with potable water supply (with reference to the National Environmental Standards for Sources of Human Drinking Water 2007 and the proposed amended outlined by Ministry for the Environment in 2022). This assessment should also consider the indirect potable re-use enabled by discharging highly-treated wastewater upstream of a large part of its contributing catchment.

If this discharge point is not appropriate or achievable, the upstream discharge point (and conveyance route) identified in Section 5.3 could be considered.

Discharge of treated wastewater to the Nukuhau Stream could be an option for lower flows. Consideration of this as an option would require detailed investigation of flow capacity of the Nukuhau Stream and potential effects associated with changes in flow rate and water quality. A discharge to the Nukuhau Stream would also require careful consideration of potential cultural effects.

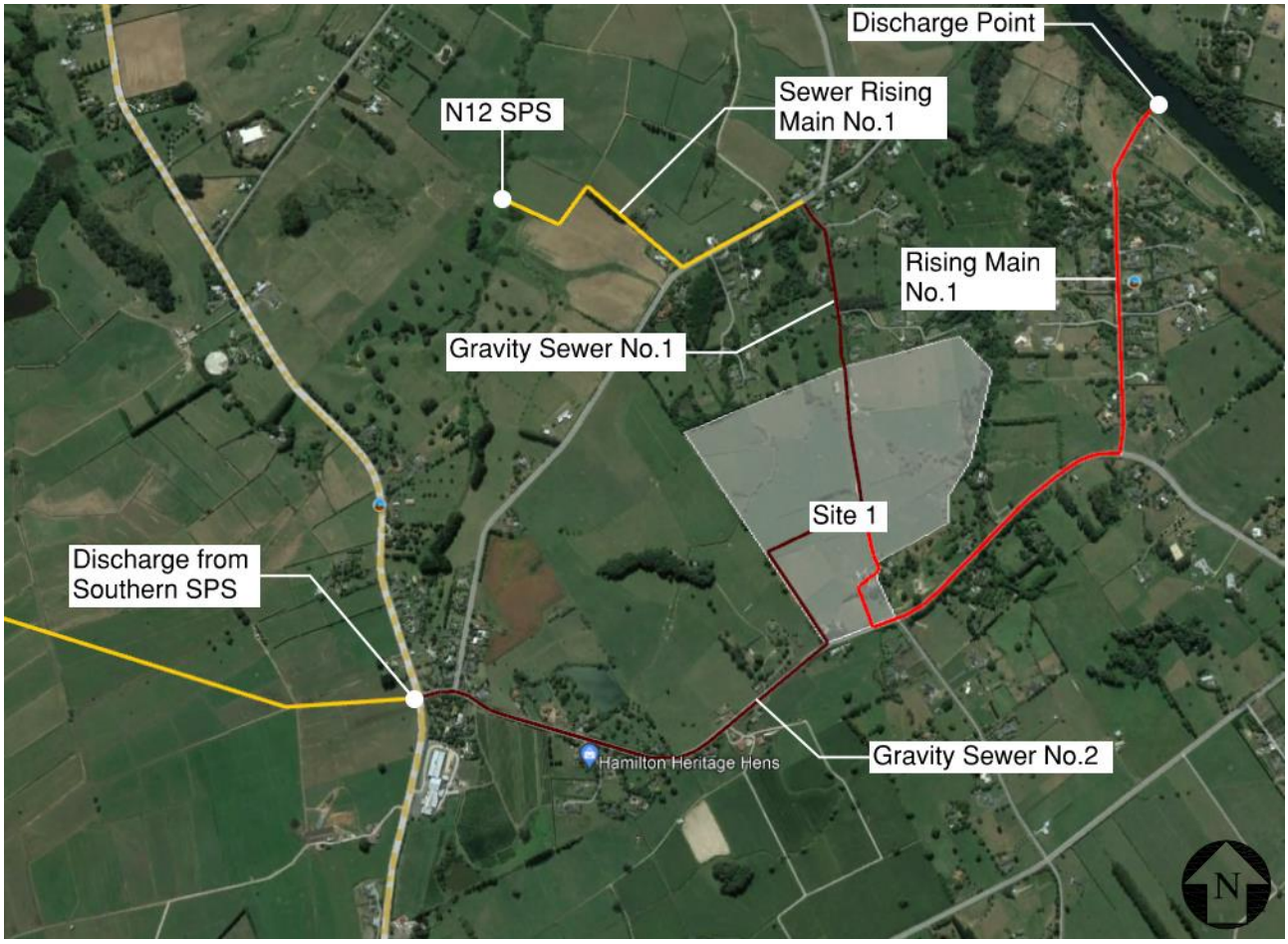


Figure 11: Site 1 Potential Conveyance Routes (conveyance of incoming flows from the catchments – i.e. N12 and Southern SPS were based on the South Hamilton Catchment Report[7] and should be read in conjunction with this report)

## 3.4 Locality and topography

The Sharpe Farm site is located approximately 800 m west of the Waikato River.

Ground elevation contours from WRC LiDAR (1 m interval) indicate the site is relatively flat, typically ranging from 47m RL to 49m RL across the bulk of the site.

The relatively steeply incised Nukuhau Stream runs along the eastern boundary at an elevation of approximately 42m RL (5 m bgl). There is also an unnamed tributary of the Nukuhau Stream which cuts through the site from west to east. This tributary stream sits at approximately 47 mRL (~1 m bgl) at the western boundary becoming more incised towards the east where it meets the Nukuhau Stream.

## 3.5 Geotechnical

### 3.5.1 Geology and Ground Conditions

The published geological maps (Edbrooke, 2005[8] and GNS Science Q Map 2020) indicate that most of the site is underlain by sand, silt, gravel, peat, and pumice of the Hinuera Formation. Along the eastern edge of

[7] South Hamilton Catchment Diversion Report, Beca, 2023

[8] Edbrooke, S.W. (compiler) 2005. Geology of the Waikato area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 4. 1 sheet + 68 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited. ISBN 0-478-09877-4

the property is a north-south orientated lens of Holocene alluvium associated with the Nukuhau Stream. The elevated ground along the northern boundary is underlain by older soils of the Walton Subgroup, typically comprising weathered airfall ash soils over weathered Ignimbrites.

Review of WRC bore records (location of bores shown in Figure 12) indicates the geology is dominated by silts and sands to a depth of at least 20m. Gravelly soils were also identified within the upper 10m in some bores located to the west and south (bores records 72_3204, 70_978, 72_4080 and 70_1195).

### 3.5.2 Geotechnical Investigations

Following the preliminary MCA scoring process this site was selected for geotechnical investigations to develop a better understanding of the ground conditions and geohazards.

Site investigations were undertaken at the proposed development area on 17 January 2024. Field testing comprised five test pits to depths of up to 5m, and nine Cone Penetration Tests (CPTs) to depths of up to 25m.

The investigations found the area proposed to be developed is underlain by Hinuera Formation deposits consisting of loose to medium dense sand interbedded with firm silt lenses to the depth of these tests.

Groundwater was encountered at depths ranging between 1.6m and 3.75m across the site. Groundwater levels will fluctuate seasonally. Full saturation of the site area could occur in an extreme rainfall event.

### 3.5.3 Geotechnical Considerations

Construction of buildings and tanks is expected to induce static settlements within the firm silt layers. This risk is to be managed through localised excavation and replacement, pre-loading, or another engineering treatment below new structures. Such treatments are commonly adopted in these ground conditions and do not preclude development.

It is noted that the variable nature of these layers across the site could potentially lead to differential settlements.

The near surface loose to medium dense sands are expected to provide suitable static bearing capacity for expected foundation pressures. Foundations may be governed by seismic loads and liquefaction effects, as discussed below.

The future design of buried structures will need to consider buoyancy from groundwater and potential liquefied soils.

Preliminary analyses indicate that the sands are expected to liquefy in a moderate to large earthquake event. Liquefaction effects may include uplift pressures on buried structures, reduced bearing capacities and vertical settlements of the order of 200mm to 500mm across the site. Ground improvements may potentially be needed if the effects are not acceptable, noting HCC require a 1000 year earthquake event to be considered for operation continuity. These treatments will increase the construction cost of the civil-structural works for the proposed development.

The nearby gullies pose a potential risk of lateral spreading during earthquake loading in the northern part of development area. This hazard may be reduced by siting new structures in the southern portion of the site, away from the gully slopes. A detailed liquefaction analysis and slope design would be needed to confirm liquefaction and lateral spreading effects.

### 3.5.4 Hydrogeological Considerations

#### Approach to Evaluation

To provide an initial screening of the four sites, the following potential groundwater effects due to construction and / or operation of a wastewater plant were considered:

- Migration of treated wastewater into down-gradient bores, where land-based disposal or treatment is used
- Drawdown from dewatering (or drainage) causing:
  - Interference effects in bores in the surrounding area
  - Reducing the groundwater component of baseflow to surface water bodies and / or lowering the water level in wetlands.
  - Migration of contaminants from adjacent sites.
  - Consolidation settlement of assets in the surrounding area

WRC bore and consent records were reviewed to identity if there are bores that could be down or along - gradient from the site, and thus could be a potential receptor for any irrigated wastewater, or which might experience drawdown from any site dewatering activities. Bore details were filtered, and the following bore types were excluded from further assessment:

- Bores with hole diameter less than 90 mm or casing diameter less 50 mm; these are likely to be geotechnical piezometers with no associated water take.
- Bores deeper than 25 m; these are likely to be screened in a much deeper aquifer with slow vertical travel time and some degree of hydraulic disconnect from the surface.
- Bores located on the subject sites; these are assumed to be abandoned / decommissioned as part of the project.

Of the remaining bores, bores screened within the upper 10 m are considered most likely to be potential receptors as they are more likely to be abstracting water from the same shallow aquifer into which the discharge would occur.

The location of consented water takes have also been reviewed to identify if any are specifically identified for potable supply, our could be ignored (e.g., short term diversion consents, or consents located on the site which are assumed to be surrendered as part of project works) however as bores can abstract water as a Permitted Activity or under s14b of the RMA, for the purpose of this assessment all bores (even those without an associated take permits) are assumed to be potentially abstracting water for domestic or potable use.

#### Groundwater flow direction

The site is located within the Nukuhau Stream catchment, so shallow groundwater is inferred to flow towards this stream and its tributaries (Figure 12).

Two tributaries enter and converge in the northern area of the site, flowing east to join Nukuhau Stream which flows to the northeast. Upstream of one of these tributaries, approximately ~500 m from the site, is a dammed pond. The inferred direction of shallow groundwater flow is shown in Figure 12 below.

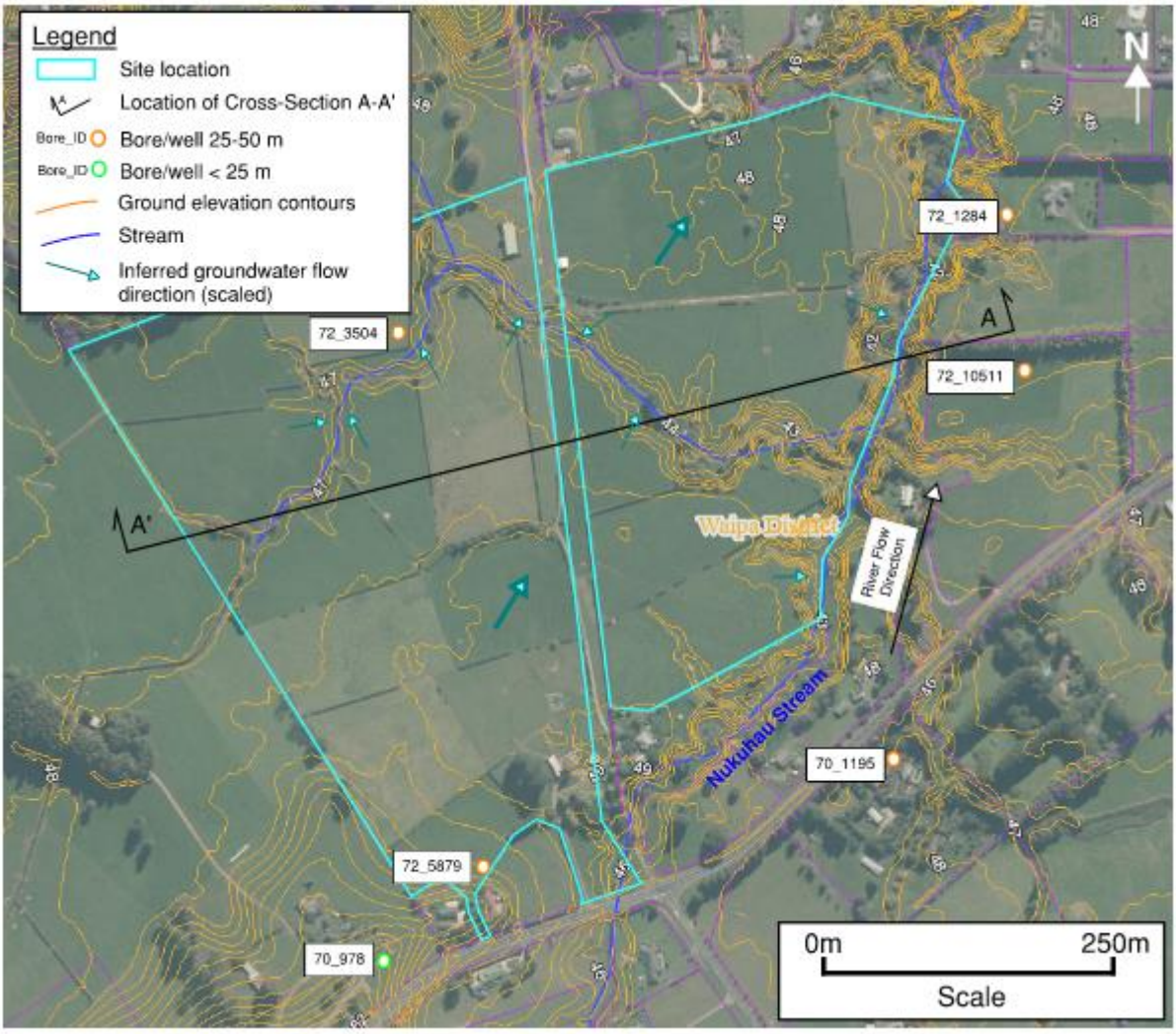


Figure 12: Inferred groundwater flow direction and location of nearest potential groundwater receptors

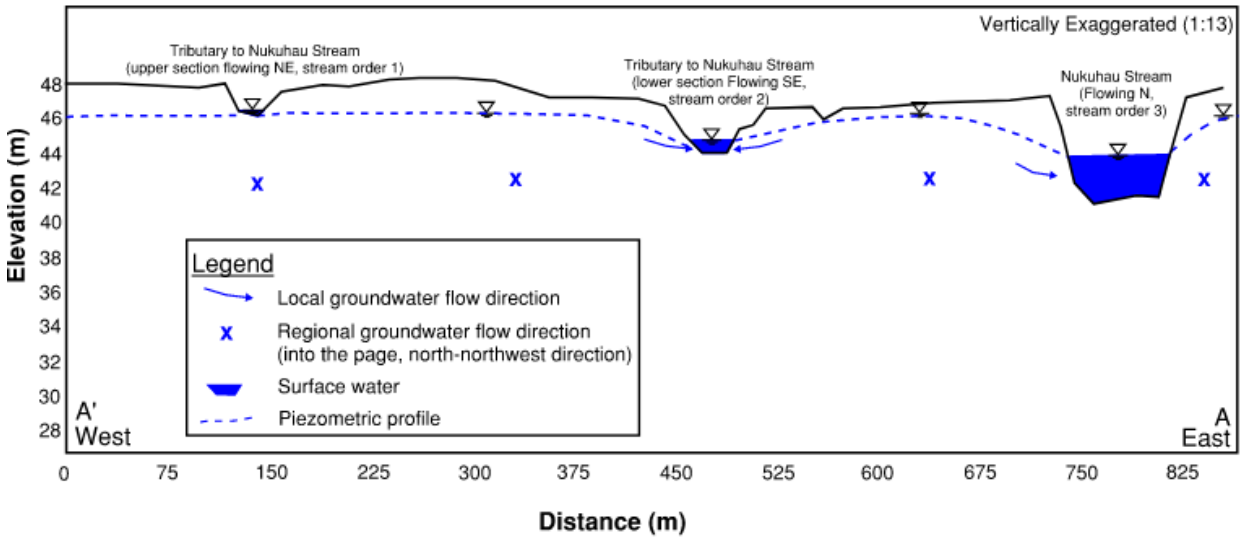


Figure 13: Schematic west-east cross section through site showing inferred groundwater-surface water interaction

### Consents and groundwater bores

There are approximately twenty-four known bores/wells within 600 m of the site; five are screened at <10 m and a further nine are of unknown depth (and so are considered potential receptors). The locations of the closest bores to the site are shown in Figure 12. The bores which are potentially located down hydraulic gradient are on the far side of the incised Nukuhau Stream; so overall, the risk of treated wastewater or drawdown reaching these is likely to be low.

There is one water take permit (WRC AUTH126827.01.01) located directly downgradient of the site, associated with a bore (WRC Bore ID 72-8905) of unknown depth. This bore is located 400 m to the north of the northern site boundary.

### Assessment

Possible groundwater receptors are streams and nearby groundwater users. As noted above one (potentially) shallow bore is located directly downgradient. Ultimately infiltration rates, level of treatment, soil permeability, and travel time will need to be assessed to determine the actual risk and number of bores potentially affected.

Similarly, depths, construction methods, soil permeability and distances from site works would be required to quantitatively assess drawdown impacts. Given the rural nature of the site the risk of consolidation settlement damaging private assets is likely to be low. The contaminated land assessment also indicates a low risk of contamination requiring significant risk assessment or controls. Impacts of drawdown on potential wetlands or surface water bodies would need to be addressed, though we have assumed this could be managed to a low risk level via appropriate siting, design and construction controls.

## 3.6 Potential for land discharge

Manaaki Whenua Landcare Research undertook a soil investigation at the site to determine the potential suitability to discharge treated wastewater to land (Appendix A). Their site investigation is summarised in Table 4.

Table 4: Site 1 Summary of Suitability to Discharge to Land

| Soils | Constraints | Potential Ability to Discharge Year Round | Implications for Site Selection |
|---|---|---|---|
| The majority of the land is a dissected terrace (Hinuera Formation) of the Waikato River with a combination of imperfectly drained and poorly drained soils. | Grey colours in the sub-soil indicates waterlogging for considerable period of the year. The imperfectly drained nature of the soil, with indication of subsoil waterlogging, combined with restricted subsoil permeability indicates limitations to year-round application of treated wastewater.<br><br>Deficit irrigation using storage within the topsoil and yellowish-brown upper subsoil is feasible. However, care must be | No. | Parts of the site may be able to be used for land discharge, but only during soil moisture deficit periods (generally between December to March), although this would vary seasonally. The Nukuhau Stream is a sensitive receptor at the eastern end of the site and there would need to be sufficient buffer areas to the stream.<br><br>An assessment of soil infiltration rates and confirmation of available land areas would be |

| Soils | Constraints | Potential Ability to Discharge Year Round | Implications for Site Selection |
|---|---|---|---|
| | taken not to graze stock on 'wet' topsoils. | | required to determine whether stage 1 flows could be discharged within the site, even during the soil moisture deficit period.<br><br>An alternative discharge method/site is likely required for stage 1 flows, noting that part flows may be discharged to areas but only during soil moisture deficit periods. |

## 3.7 Contaminated land risk

### 3.7.1 Approach

The purpose of this assessment is to provide an indication of potential areas of contaminated land within the four WWTP site options and inform any potential implications these may present to developing the site. The scope of this assessment was limited to a review of the Waikato Regional Council's (WRC) Land Use Information Register (LUIR) and historical aerial imagery. No site walkover was conducted.

### 3.7.2 Historical Aerial Review

Historical aerial photos were reviewed and determined the following historic land uses:

- 1953 (Retrolenz) – farm land, some undulating. No structures appear to be present except stockyard in southern area. Some drainage channels present.
- 1963 (Retrolenz) – farmland developed with farm lane and more paddocks separated. Same infrastructure.
- 1979 (Retrolenz) – appears to be current land uses, no significant different land uses identified.
- 1990 (Retrolenz) – appears to be current land uses, no significant different land uses identified.
- 2006 – current (Google Earth): no significant changes. Sheds have had some minor changes + stockyards present. Land use remained agricultural.
- Currently - active dairy farm currently, with several sheds.

### 3.7.3 Assessment

The site is currently agricultural and has been used as such since as early as 1953 (likely much earlier). No other land uses have been identified through a review of historical aerials. Waikato Regional Council confirmed the site does not appear on their LUIR as a potentially contaminated site.

An area of stockyards is present in the southern area of the site which was present as early as 1953. Several other sheds are also present that have been erected over different periods. It cannot be ruled out that these sheds and stockyards have had contaminating activities operated within, or near them, including:

- Sheep dip / drenching site (stockyard only)
- Asbestos (in sheds and structures)
- Hazardous substance storages (including fuel, pesticides etc).

No broad-site contaminating activity has been identified across the paddocks used for farming. It is known that superphosphate fertilizers can result in elevated cadmium levels in agricultural land uses, however, are unlikely to result in a contaminated soil risk or require additional management.

This site will require a Preliminary Site Investigation (PSI), involving a site walkover, to inform the potential risk of land uses and materials surrounding the shed and stockyards. Depending on the findings of the PSI, targeted sampling may be required in these areas to inform potential contamination risk and management requirements.

## 3.8 Archaeology

Survey plan, the records of the NZZ, and aerial photography has been reviewed. There are currently no recorded archaeological sites affected by the proposal.

However, archaeological artefacts have been found on the farm in the past by the landowner and the current landowner is aware of probable borrow pits on the land (although there are no formally recorded sites). It was not possible to see them during the initial field survey in 2022 as the grass was very long. A follow up survey in May 2024 observed no evidence for borrow pits and the undulations on the site were thought to be as a result of the braided river system.

The presence of the Nukuhau Paa, some 1km to the north, may increase the risk of archaeological sites being present on this property. The cultural effects associated with the Nukuhau Paa are covered in the separate Tangata Whenua Effects Assessment (TWEA) for this Project.

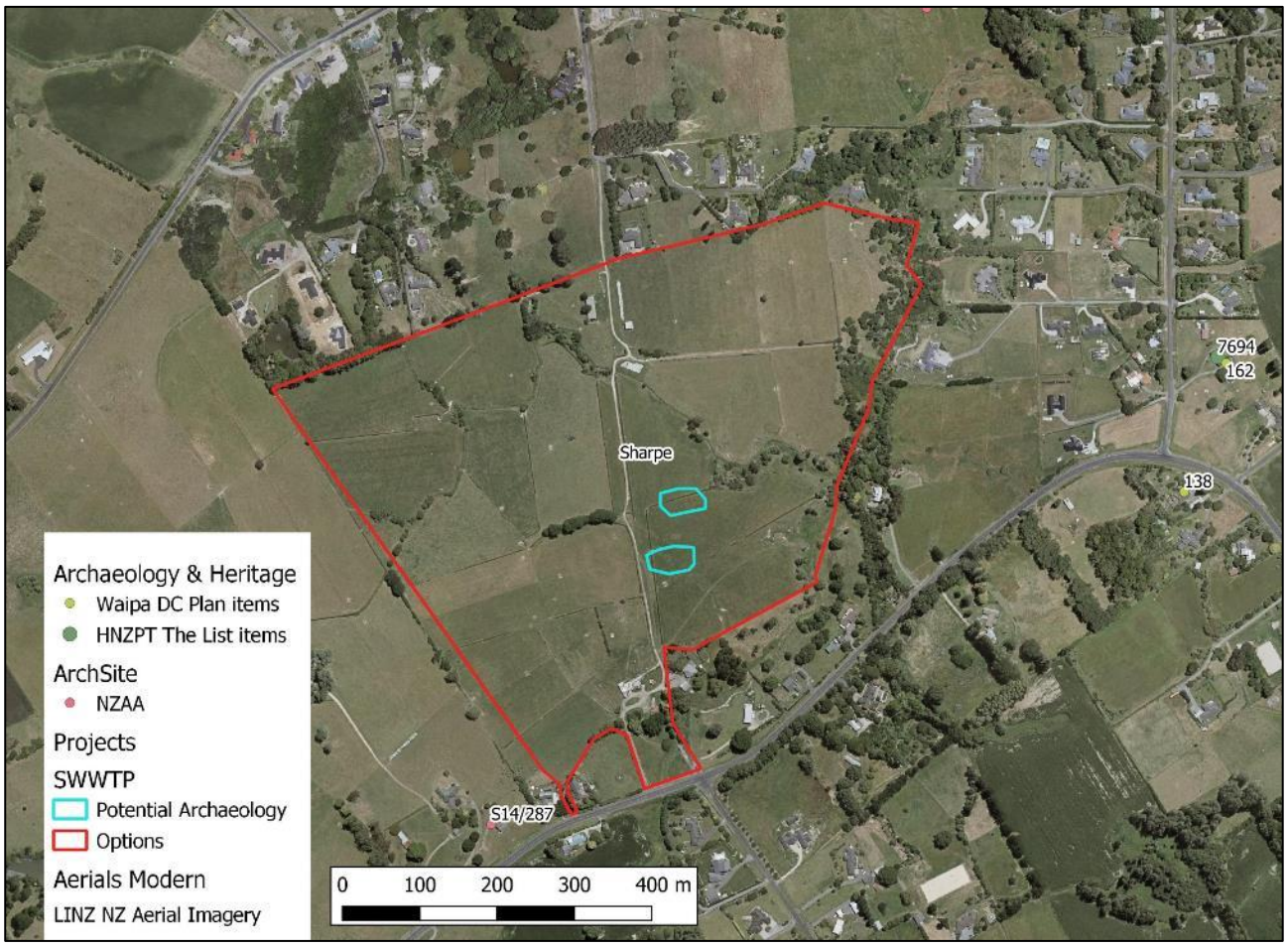


Figure 14: Sharpe Farm Heritage Landscape. Blue polygons adapted from aerial imagery/LiDAR. A follow up survey in May 2024 determined no evidence for borrow pits on site.

## 3.9 Built Environment

### 3.9.1 Sensitive receptors and buffer distances

There are clusters of rural-residential / lifestyle blocks along the northern and southern boundaries and further to the east of the Nukuhau Stream. Due to the topography of the site, properties from both the north and south overlook parts of Site 1.

The future Southern Links Road Designation runs along the western boundary of the site. This both reduces the likelihood for residential development along that boundary and will result in a change to the receiving environment during construction and operation of that road corridor.

The WWTP could be placed within Site 1 with 150m buffer from the WWTP footprint to the edge of HCC-owned land with the exception of the western boundary where there is only 100m (however this area is part of the Southern Links Road designation).

### 3.9.2 Odour

The rural-residential development which is occurring to the north of the site on private roads off Peacockes Road and on Faiping Road will increase sensitivity of the area to possible odour effect in the event of a plant malfunction. Approximately 14 dwellings are located within 300m of the potential WWTP footprint, but, with careful placement of processes within the WWTP footprint, it appears possible to locate all high-risk odour producing processes 200m from the nearest dwellings.

### 3.9.3 Noise

Based on a minimum setback distance of 150m to the site boundary, it is expected that the WWTP can be designed to achieve prescribed levels at the boundary. Blowers and centrifuges have the highest noise potential, this equipment comes in acoustic enclosures which would be housed withing concrete buildings to minimise noise.

This area is considered a higher sensitivity receiving environment due to low ambient noise levels. There would be a change to the noise environment and those residents overlooking the site are likely to raise concerns about noise. However, this should be considered within the context of the future Southern Links Road network which would also result in a change in noise environment so such changes should not be completely unexpected to residents.

### 3.9.4 Traffic and Access

Good access is available from both Faiping Road and Raynes Road. Waka Kotahi has been investigating a new roundabout at the intersection of SH3 and Raynes Road, which would lower impacts associated with traffic turning on and off SH3.

It is recommended that site access is restricted to Raynes Road to lower traffic impacts on Faiping Road (which has characteristics closer to a shared access road/driveway) and the intersection of Faiping Road and Peacockes Road.

While a level of traffic impact should be expected during construction, operational traffic is expected to be low within the context of existing traffic flows on Raynes Road.

There is a paper road running through the site connecting the end of Faiping Road to Raynes Road. The recent decision on Proposed Private Plan Change 20: Airport Norther Precinct Extension requires construction of a new walking and cycling shared path connecting Peacocke Road to the Northern Precinct via Middle Road and Faiping Road, or a suitable alternative, prior to any development of the Northern

Precinct.[9] There is a significant risk of conflict between users of such a shared path and the construction and operational traffic that would be associated with a WWTP at this site. This risk could potentially be managed by routing the pathway closer to the Nukuhau Stream and ensuring that any WWTP traffic accessed the site from Raynes Road (i.e. no WWTP traffic to use the existing section of Faiping Road).

The future Southern Links is unlikely to change access to this site. The new road will run to the west of this site, with Raynes Road being bridged over Southern Links.

### 3.9.5 Visual

The proposed WWTP location is highly visible from a number of residential properties to the north (and south). Existing vegetation provides some screening, especially to dwellings further up the hill. The site is also visible from residential properties to the south where there is less existing vegetation.

Figure 15: Views from proposed WWTP site looking north towards neighbouring dwellings

Figure 16: Views from proposed WWTP site looking south towards neighbouring dwellings

[9] Proposed Private Plan Change 20: Airport Norther Precinct Extension, Decisions of Hearings Panel and Section 32AA Evaluation Report (June 2023). Refer Rule 10.4.2.20.

## 3.10 Ecology

The ecological features identified at Site 1 can be found in Figure 17 and described in detail below.

### 3.10.1 Terrestrial Vegetation

Vegetation within this site has been cleared for cattle as well as other agricultural purposes and as such, comprises of primarily pasture and exotic grass cover with scattered areas of hedges and shelterbelts within some of the paddocks, which comprised of predominantly exotic species including ash (*Fraxinus excelsior*). Within and adjacent to the site are several Significant Natural Areas, as identified by the Waipā District Council. This includes the riparian margins of the Nukuhau Stream along the eastern boundary of the site and is comprised of a range of mixed native and exotic species including (but not limited to) ferns, willows (*Salix* sp.), pine (*Pinus radiata*), flax (*Phormium tenax*), mānuka (*Leptospermum scoparium*), and cabbage trees (*Cordyline australis*).

Aside from the riparian margins, there are no other areas of native vegetation within the site. However, an initial desktop survey identified several remnants of native forest areas outside of the site boundary. This includes an indigenous forest mapped as deciduous hardwoods, broadleaved indigenous hardwood, and pine forest in the northern gully system of the Nukuhau Stream which extends along the riparian margin of the upper section of the Nukuhau Stream and the eastern tributary which sits along the border of the site. These areas are expected to provide habitat to long-tailed bats and native avifauna.

### 3.10.2 Wetlands

During the initial ecology site walkover, which was conducted on 21st December 2022, several potential inland wetlands were identified within the eastern section of the site. This putative wetland is adjacent to the Nukuhau Stream in a lower lying area, with potentially hydrophytic plant species, and water ponding observed. However, there was approximately 28 mm of rain within the previous four days across the Hamilton region, although no rain on the day of the site visit (Met Service, 2022). This has likely caused some rain derived pooling within the site, making wetland hydrology features difficult to ascertain.

Currently, this area is mapped as a potential wetland (Figure 17, Figure 18), however, a wetland delineation site survey is required to confirm this initial assessment and identify if the area meets the definition of a *natural inland wetlands* in accordance with the recently amended National Policy Statement for Freshwater Management (2020 – Amended January 2024).

In addition to this area, the margins of the Nukuhau Stream may display riverine margin characteristics due to the identified presence of creeping buttercup (*Ranunculus repens*), soft rush (*Juncus effusus*), and *Carex* sp. This riverine wetland is expected to be restricted to the margins of the stream and hydrologically linked to stream flows; however, the full extent is not confirmed at this time.

### 3.10.3 Bats

Records available from the Department of Conservation (DOC) database indicate the presence of numerous long-tailed bats (*Chalinolobus tuberculatus*) (Threatened – Nationally Critical) within the site (see Figure 17), as well as in neighbouring areas. These findings were recorded in 2019 for a NZTA project. The records of long-tailed bats appear to be concentrated along the riparian corridors of the watercourses on the site, as well as in denser vegetated areas in proximity to the site.

Long-tailed bats are known to forage within riparian corridors with less-dense vegetation and more open space, which can both physically impede them whilst flying and also impact their echolocation reception. Furthermore, there is some research which indicates the that long-tailed bats prefer deeper and calmer water, which reduces the potential for collisions with features protruding from a waterway as well as the noise of turbulent water influencing echolocation and prey detection.

### 3.10.4 Avifauna

There are several suitable habitat types for a range of native and introduced species. Open grassland, surrounding forest, and treeland areas often support a range of common native and introduced passerine species as well as wetland waders while the nearby stream provides habitat for waterfowl. Native species identified (through desktop review) within the riparian margins and vegetation corridor of the watercourse includes grey teal (*Anas gracilis*), tūī (*Prosthemadera novaeseelandiae*), grey warbler (*Gerygone ignata*), spur-winged plover (*Vanellus miles*), fantail (*Rhipidura fuliginosa*), pied stilt (*Himantopus himantopus*), pūkeko (*Porphyrio melanotus*), and swamp harrier (*Circus approximans*), all of which are Not Threatened. During the site walkover the only native species observed were tūī and pūkeko, however, passerine birds were heard within the trees.

### 3.10.5 Herpetofauna

Currently, a majority of the site is still utilised for cattle, thereby resulting in ongoing disturbance. As such, there is a low likelihood for these actively managed areas to provide adequate habitat to ground-dwelling herpetofauna species. However, within the site there does appear to be areas that are currently unmanaged including the thick grassy environment in the eastern section of the site (see Figure 18, Figure 19) within proximity to the Nukuhau Stream. This could potentially provide some suitable habitat for herpetofauna including copper skink. Additionally, there are areas of shelterbelts, hedges, and dumped logs, which are known to be utilised by copper skink.

### 3.10.6 Watercourses

Two tributaries of the Nukuhau Stream traverse the site with naturally meandering channels, and some erosion along the streambanks. Extensive macrophyte and weed growth was observed included water lily within the channels. This overgrowth is expected to slow water flow, which was observed during the site visit. Riparian vegetation coverage across the tributaries was limited to weedy groundcover vegetation and few taller trees providing little shade to the channel. The type of stream substrata was unable to be confirmed due to the instream weed growth but is expected to be soft sediment.

In addition to the tributaries, the main channel of the Nukuhau Stream flows alongside the eastern boundary of the site. The stream channel had a maximum wetted width of approximately 1.5 m and substrata appeared to comprise of mainly sandy-silt sediment. The stream had moderate depth and slow flow, with vegetation including *Carex* sp., sedges, and exotic weeds growing within and alongside the channel. Instream habitat mainly consisted of pool habit and some woody debris and macrophyte growth, which would provide suitable habitat for fish and macroinvertebrates. Riparian vegetation comprised of mixed native and exotic species that provide variable levels of shading across the channel. Instream obstructions (both natural and man-made) were not observed (within this section of the channel), and there is potential for fish passage into the upstream reaches. Erosive features along the streambanks were not observed.

### 3.10.7 Freshwater Fish

Data on the New Zealand Freshwater Fish Database (NZFFD) indicate there are no records of fish species within the watercourse channels at the site. However, records from nearby tributaries indicate the presence of giant kōkopu (*Galaxias argenteus*), kōaro (*Galaxias brevipinnis*), shortfin eel (*Anguilla australis*), longfin eel (*Anguilla dieffenbachii*), common bully (*Gobiomorphus cotidianus*), and banded kōkopu (*Galaxias fasciatus*), of those three are classified as “At Risk – Declining.” As the Nukuhau Stream and the watercourses within the site are a tributary of the Waikato River, which provides habitat and a migration pathway for a diverse range of freshwater fauna, it is expected that these channels also would provide temporary and permanent habitat for freshwater fish.

### 3.10.8 Restoration potential

There are a number of opportunities for ecological restoration at this site including opportunities for stream enhancement and riparian planting along the Nukuhau Stream and its tributaries.

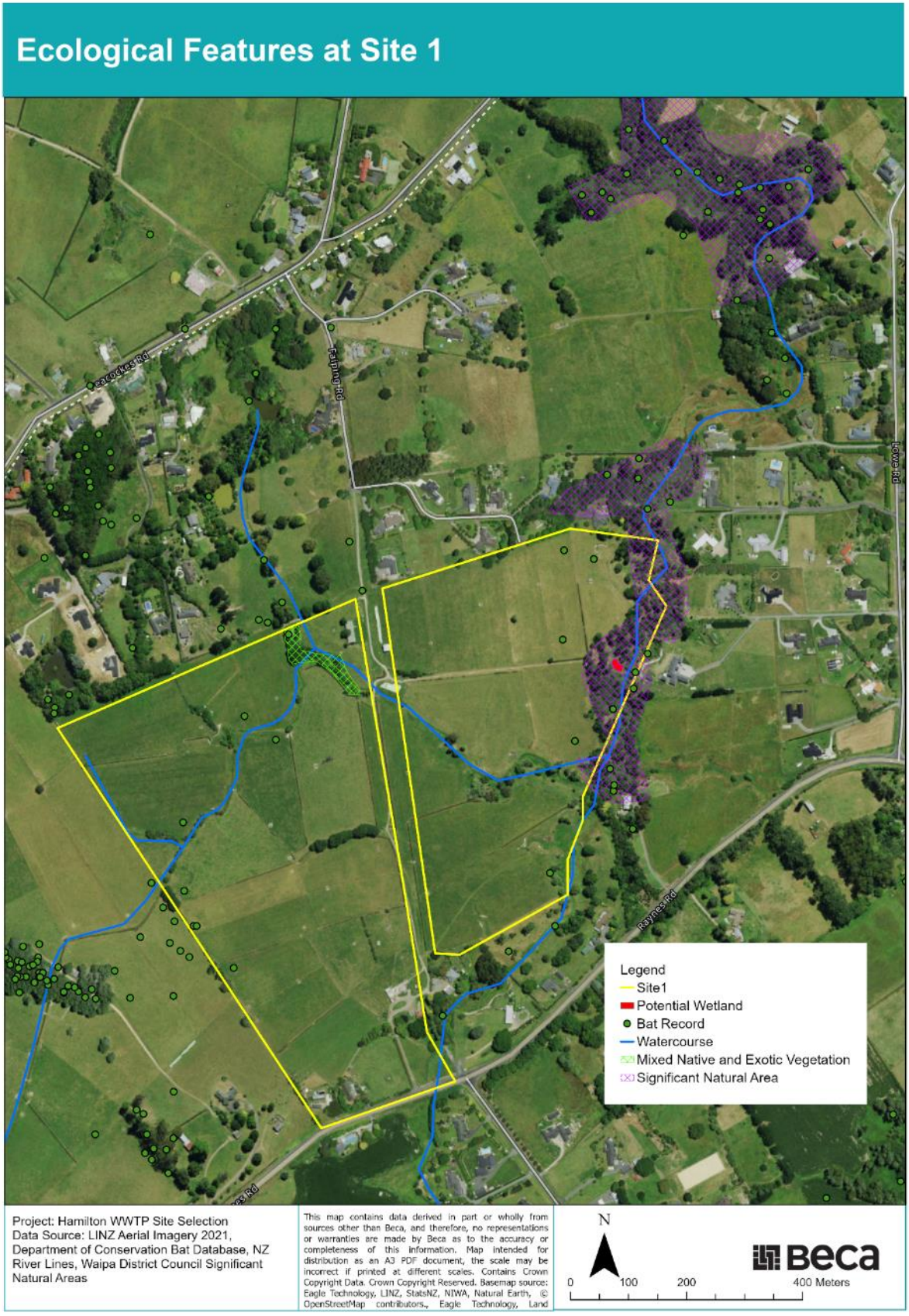


Figure 17: Ecological features identified through desktop surveying and the initial site walkover at Site 1

Figure 18: General overview of Site 1 (top) and the potential wetland area identified in the eastern section of the site (bottom).

Figure 19: Tributaries observed within Site 1 (top) and the section of the Nukuhau Stream observable from the eastern boundary of the site (bottom).

There are several ecological matters that will need to be taken into consideration should Site 1 be further considered for the location of the WWTP. Further investigations will be required at this site. As such, the following recommendations have been made:

1. No fish/aquatic surveys have been carried out at the site, and there is no available data for native fish presence/absence within the watercourse identified at the site. Due to the connectedness of the watercourse with the Waikato River, there is a high likelihood of At-Risk and/or Threatened species residing here. As such, eDNA, MCI, and fish surveying will provide further information on species presence.
2. Due to the confirmed presence of long-tailed bats within and within proximity to the site, bat management will be required prior to the clearance of any suitable roosting trees. In addition to this, operational disturbances to bats from noise and lighting (during the construction phase) may need to be considered.
3. Due to the ideal habitat within the site for herpetofauna, lizard management will be required prior to the clearance of any vegetation.
4. Wetland delineation surveys will need to be undertaken within the area of the identified potential natural wetland and along the Nukuhau stream margins.
5. Avifauna within the site is primarily limited to Not Threatened and Introduced species, however, as most native birds are protected under the Wildlife Act (1953), management will be required prior to the clearance of vegetation.

## 3.11 Planning

Site 1 is located within Waipā District and is therefore subject to the Waipā District Plan.

The site and surrounds are zoned Rural with an area of Large Lot Residential Zone to the north/northeast. The Southern Links designation runs along the site's western boundary and a paper road bisects the site. There are no features or overlays within the site except the Airport Horizontal Surface overlay (which is not expected to impact potential development of this site) and a Significant Natural Area (SNA) overlaying the Nukuhau Stream Corridor.

It is expected that the WWTP and land discharge area would be designated and therefore not subject to the rules of the Waipā District Plan; however, all works should be set back from the Nukuhau Stream SNA to reduce ecological effects. Resource consents are expected to be required from WRC for discharge to air (odour), discharge to land/water (land disposal/discharge to Waikato River), and earthworks within a High Risk Erosion Area (for construction/installation of the disposal field) as an overall discretionary activity under the Waikato Regional Plan. In addition, consent may be required under the NES-FW for construction and operation of specified infrastructure if works or discharges are required within 100m of any identified wetland and under the NESCS if soil disturbance is required around the stockyards or sheds.

The National Policy Statement for Highly Productive Land (NPSHPL) will apply to this site.

Table 5: Key district and regional plan characteristics

| District Plan | |
|---|---|
| Zone | Rural |
| Adjoining zone | South and west: Rural<br>North and northeast: Large Lot Residential |
| Zone overlay | Airport (horizontal surface) |
| Designation | Adjoins Southern Links designation (District Plan reference D156, shown in purple outline on zone map) |

| | |
|---|---|
| **District Plan** | |
| Features | Significant Natural Area: Nukuhau Stream Margins (District Plan reference WP270, shown in green on features map)<br>Viewshaft and SH3 Scenic Corridor to the west (shown in purple hash on features map) |
| Natural hazards | Not located with a District Plan potential flood area |
| **Regional Plan** | |
| Water courses | Nukuhau Stream and unnamed tributary both surface water classification – land adjacent these waterbodies will be classified as High Risk Erosion Area<br>Waikato River at Nukuhau confluence classified as indigenous fish habitat, trout habitat, and contact recreation. |
| Bores | Two recorded bores on the site and a number of bores and bore consents in the surrounding area |
| **Other planning considerations** | |
| NES Freshwater | A potential wetland has been identified near the Nukuhau Stream |
| NPS Highly Productive Land | Largely classified as LUC 2 with some LUC 1 & 3 along the southern boundary[10] |
| NES Contaminated Soils | The stockyards and various sheds on the site may have had contaminating activities operated within or near them including sheep dip/drenching, asbestos, and storage of fuel and pesticides which could trigger the NESCS. |

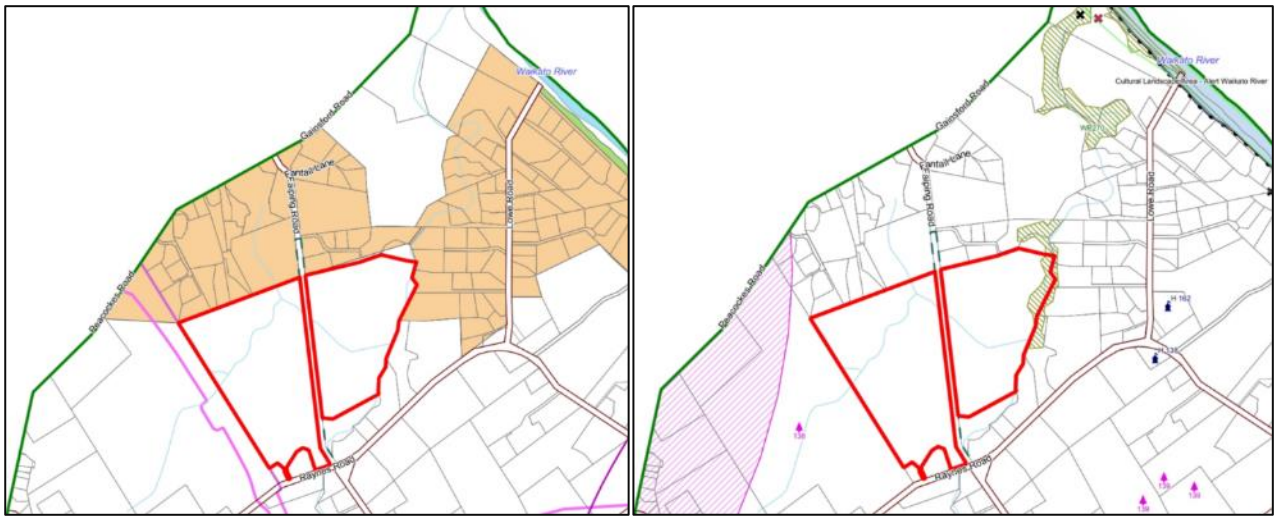


Figure 20: Waipā District Plan maps - zoning (left) and features (right)

[10] Land Use Capability 2021 from New Zealand Land Resource Inventory (accessed via LRIS portal December 2022)

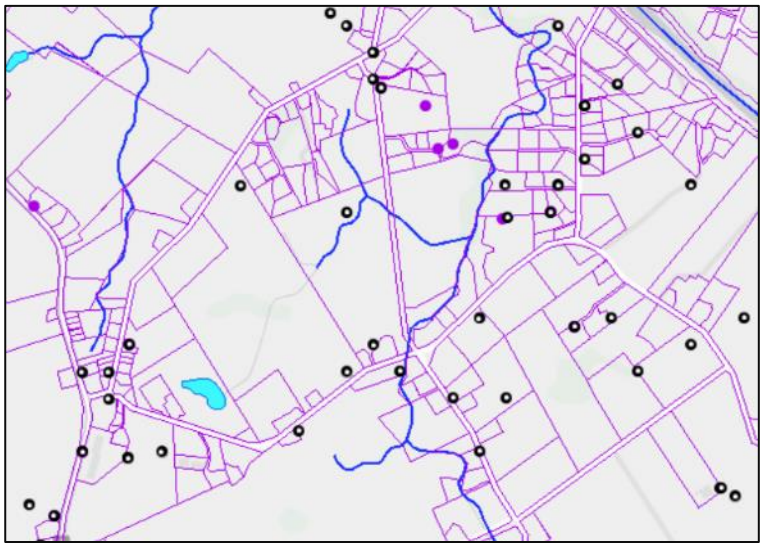

Figure 21: Bores (black) and bore consents (purple) from WRC Groundwater Maps (accessed December 2022)

# 4 Site 2: Narrows/Rukuhia

## 4.1 Overview

| | |
|---|---|
| Owner | Crown (administered by Waka Kotahi) |
| Address | 71 Narrows Road/Ohaupo Road (SH3) |
| Title & legal description | RT 534321, Lot 1 DP 420545 |
| Area | 35 ha (area outside Southern Links designation) |

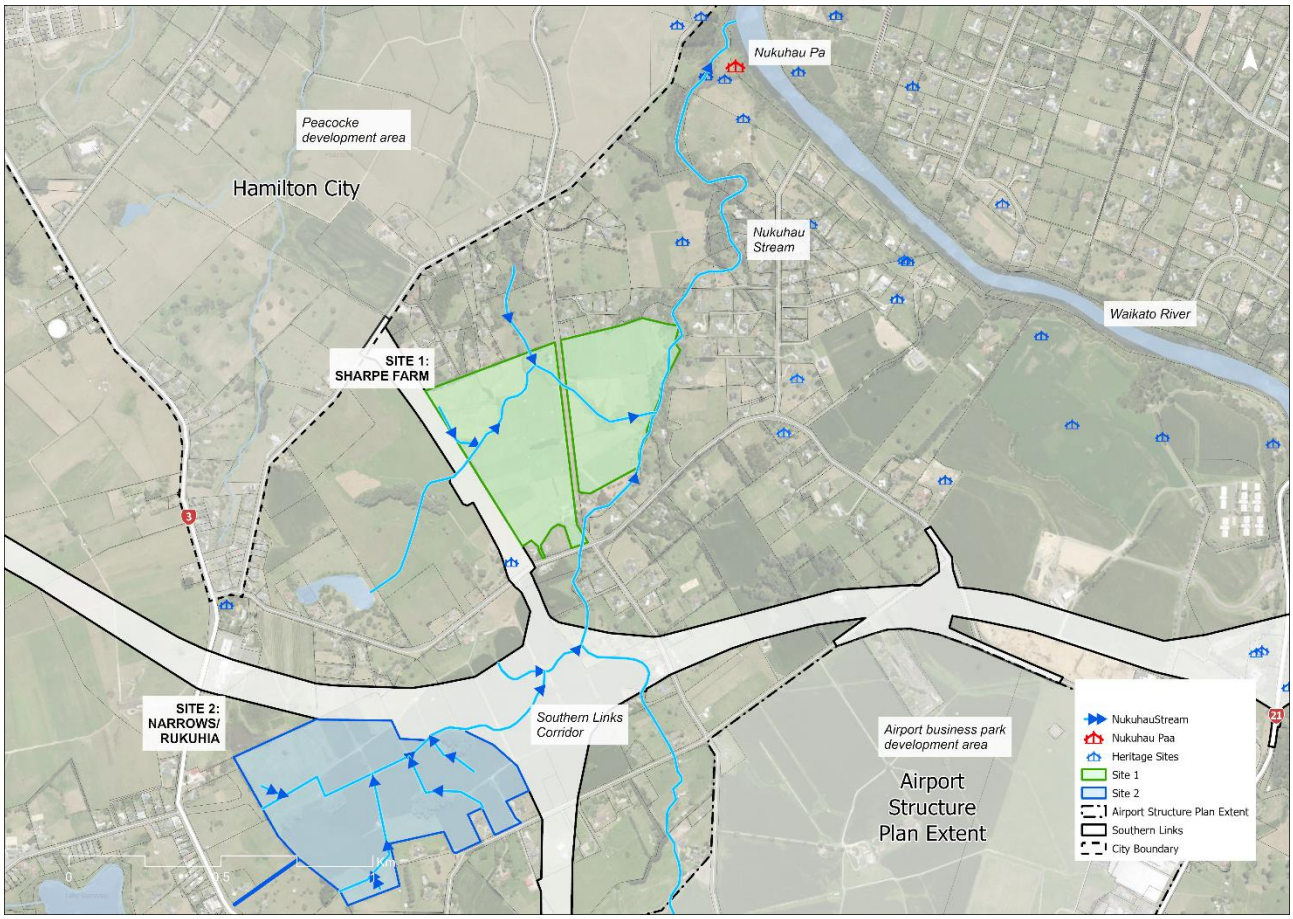


Figure 22: Site 2 location. Note Hamilton City boundary to the north, Southern Links Road designation to the north/east, airport to the east and Waikato River to the northeast/east.

## 4.2 Site layout

Figure 23 shows an early conceptual layout for Site 2 based on the space expected to be required for the "ultimate" design (i.e. 200,000 PE).

The layout seeks to:

- Avoid existing native vegetation. In particular, the remnant kahikatea stands are considered to be particularly sensitive.
- Make use of site topography to improve hydraulics through the WWTP and minimise pumping requirements

- Maximise buffer distance to dwellings to the north, west and south to minimise potential odour and noise effects on existing neighbours, including consideration of undeveloped land on the western boundary)
- Recognise future land use associated with the Southern Links Road designation to the north (as the land is designated for roading purposes it is unlikely that further residential development will occur, and a number of existing dwellings will be removed)

Ideally, the main access to the site would be from the west (off SH3/Ohaupo Road). The property boundary extends through to SH3; however, there is no formed access point (road crossing) and it appears that a neighbouring dwelling is encroaching very close to the access. Formation of this access way would require approval from Waka Kotahi (as road controlling authority) and engagement with the neighbour).

Traffic volumes on the existing SH3 would be expected to reduce post-Southern Links, which will improve this access point from a safety and efficient perspective.

There are two alternative (existing) access points:

- Narrows Road to the south
- Raynes Road to the north though the area designated for Southern Links – this access would only be available with Waka Kotahi approval and only until such time as construction of Southern Links commenced

There are several 11kV power supplies available near the site including on SH3 (300m), Raynes Road (800m), and Narrows Road (600m).

Figure 24 shows the Site 2 waterways and contours while Figure 25 shows the early concept layout for key process units for a 200,000 PE WWTP.

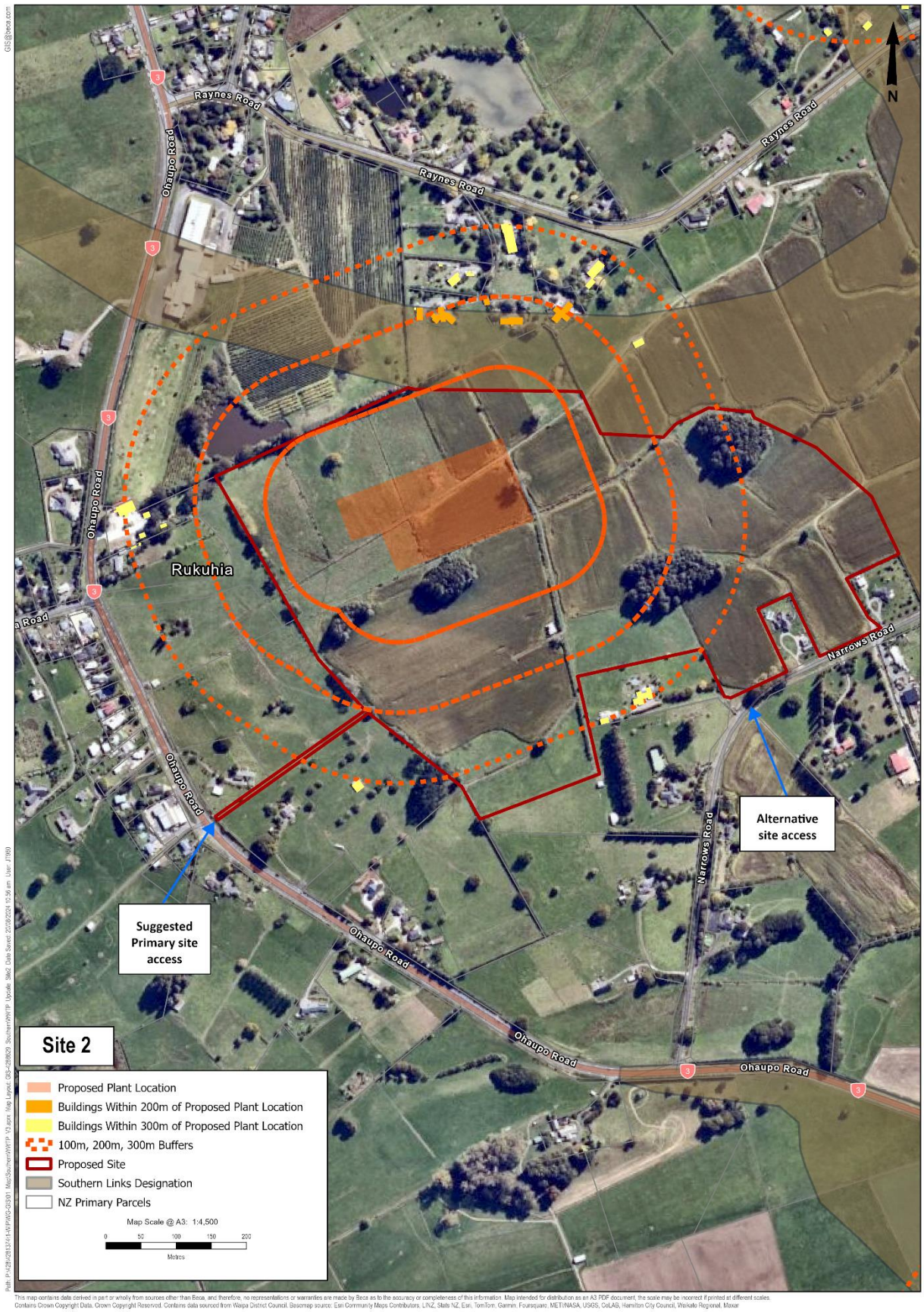


Figure 23: Proposed placement of WWTP within Site 2 showing 100m, 200m and 300m buffers.

Figure 24: Site 2 waterways and contours


Figure 25: Early concept layout for Site 2 showing key process units. Processes colours orange not required until post-Stage 3.

## 4.3 Potential conveyance

Based on the above, the following potential conveyance routes have been identified:

- Catchment Conveyance
  - 0.7km long sewer rising main (SRM - No.1) from the N12 sewage pump station (SPS)
  - 1.3km long Gravity Sewer (GS - No.1) from SRM – No.1 to the head of GS – No.2
  - 1.6km long Gravity Sewer (GS – No.2) to the WWTP
- Treated Effluent Conveyance
  - Route Option 1: 2.7km long Rising main (RS- No.1) from the WWTP to the Waikato River
  - Route Option 2: 4km long Rising main (RS- No.2) from the WWTP to the Waikato River

The potential discharge point to the Waikato River will need to consider:

- The form of the discharge. Mana Whenua have given strong direction that, in general, new structures in the bed of the Waikato River are not appropriate and that some form of land contact is preferred prior to discharge to wastewater to the river. This requires space adjacent the river.
- Proximity to the Nukuhau Paa and whether the downstream discharge point shown below is far enough to minimise effects.
- Proximity to the Hamilton Water Treatment Plan and confirmation that the discharge would not give rise to issues with potable water supply (with reference to the National Environmental Standards for Sources of Human Drinking Water 2007 and the proposed amended outlined by Ministry for the Environment in 2022). This assessment should also consider the indirect potable re-use enabled by discharging highly-treated wastewater upstream of a large part of its contributing catchment.

Discharge of treated wastewater to the Nukuhau Stream via the tributary on Site 2 could be an option for lower flows. Consideration of this as an option would require detailed investigation of flow capacity of the Nukuhau Stream and tributary and potential effects associated with changes in flow rate and water quality. A discharge to the Nukuhau Stream would also require careful consideration of potential cultural effects.

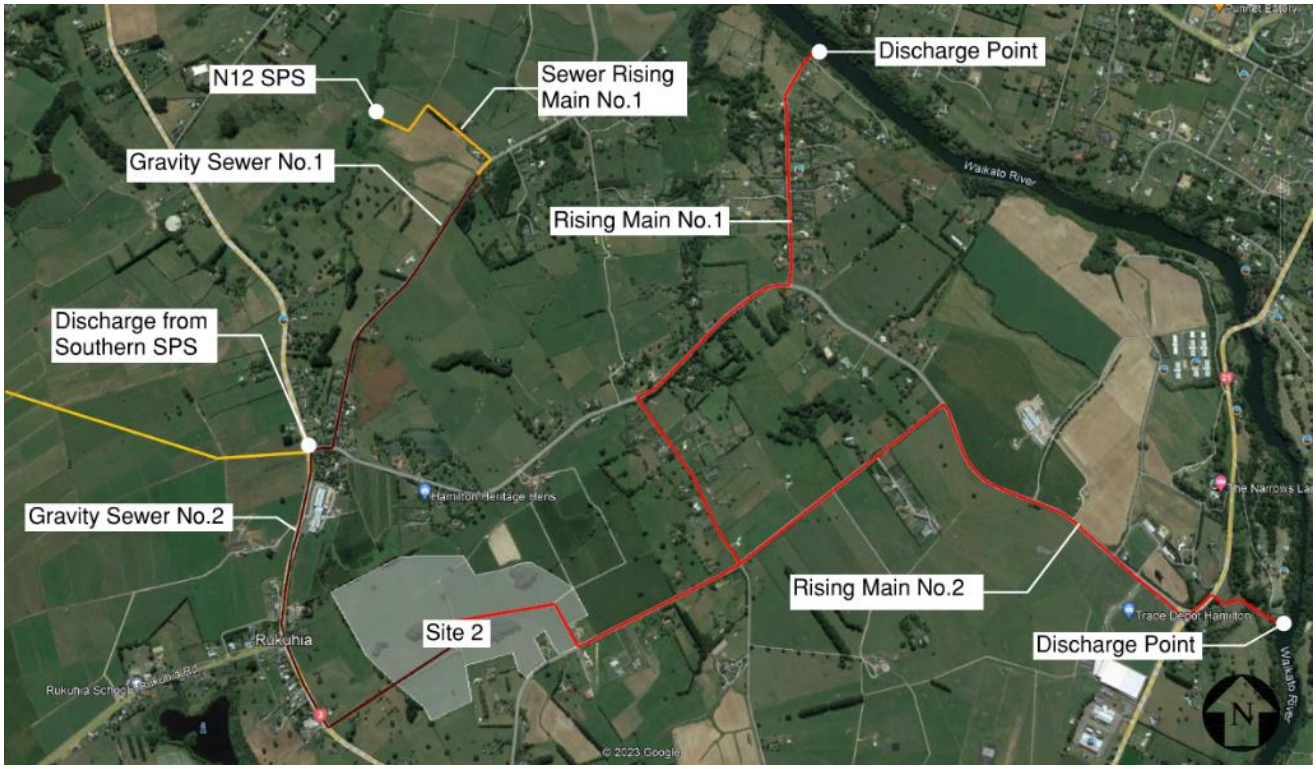


Figure 26: Site 2 Potential Conveyance Routes

## 4.4 Locality and topography

The Narrows Road site is located approximately 1.75 km southeast of the Waikato River.

Review of ground elevation contours (WRC LiDAR 1 m interval) indicate the site is relatively flat (48 to 49 mRL), with an overall very gentle incline towards the east. To the north, west and south, the topography rises more steeply with the site encircled by low rolling hills at 62 m RL to 72 m RL.

The Nukuhau Stream runs along the eastern boundary and is incised to an elevation of approximately 46 m RL (2 m depth). There is also an unnamed tributary of the Nukuhau Stream which runs through the middle of the site transitioning from a modified (straightened), shallow channel in the upper (western) reach to a more naturalised, and slightly deeper channel to the east where it joins Nukuhau Stream at 46 mRL.

Within the site there appears to be one modified watercourse that is a tributary of the Nukuhau Stream. The watercourse channel flows in an easterly direction and transitions from a straightened channel in the upper reach to a naturally meandering channel as it flows through the site and confluences with a tributary of the Nukuhau Stream.

While this site isn't subject to any flood hazard overlays, field drainage suggests a high groundwater table and surface ponding has been observed during the winter months. This would require careful design consideration. Surface flooding has been observed at the site as shown in Figure 27.

Figure 27: Photo Showing Observed Surface Flooding at Site 2

## 4.5 Geotechnical

### 4.5.1 Geology and Ground Conditions

The published geological map (Edbrooke, 2005[11]) indicates the site is predominantly underlain interbedded sand, silt, gravel, peat, and pumice of the Hinuera Formation (forming the flat interior of the site, and with soils of the Walton Subgroup forming the low rolling hills around the site.

[11] Edbrooke, S.W. (compiler) 2005. Geology of the Waikato area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 4. 1 sheet + 68 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited. ISBN 0-478-09877-4

The GNS Science Q Map (2020) shows the western half of the low-lying land to be underlain by late Pleistocene lake sediments of the Piako sub-group. These are described as locally derived lacustrine mud, silt, gravel, and peat.

Review of WRC bore logs in the eastern areas of the site indicates that the stratigraphy is dominated by interbedded silts and sands to a depth of at least 15m, with some clay in the upper 5m.

### 4.5.2 Geotechnical Investigations

Following the preliminary MCA scoring process this site was selected for geotechnical investigations to develop a better understanding of the ground conditions and geohazards.

Site investigations were undertaken at the proposed development area on 16 January 2024, comprising five test pits to depths of up to 5m and nine CPTs to depths of up to 15m. At the time of investigation, the eastern part of the development was planted in crops so test locations were moved to the closest suitable locations.

The investigations found the area proposed to be developed is underlain by Piako Subgroup lake sediments. The ground profile across the site generally comprised near surface soft to firm peat and organic silts to depths of 2m to 3.5m underlain by an interbedded sequence of loose sands and soft to firm clayey silts. Medium dense to dense sands were encountered at depths ranging between 9.0m and 13.5m and extended to the depth of penetration. These deeper sands may represent the older Walton Subgroup however the investigation was not conclusive at all locations.

On site measurements and observations of the farm drains indicate that the water table during summer conditions 0.7m to 1.5m depth. During winter this is expected to rise close to the ground surface.

### 4.5.3 Geotechnical Considerations

The soft to firm peat and silts are expected to induce significant static and long term creep settlements that require preloading or other deep ground improvement below new structures. Such treatments are commonly adopted in these ground conditions. These do not preclude development, however these will increase construction costs at this site.

The low strength near surface soils are not expected to provide suitable bearing capacities for new structures and if selected this site would likely require the construction of an engineered fill platform as part of ground improvements as noted above. The elevated hills in the western part of the site may provide a suitable fill source, however sensitive ash soils can create difficulties for bulk earthworks. Imported granular fill may be more suitable for this site.

The future design of buried structures will need to consider buoyancy from groundwater and potential liquefied soils.

Preliminary analyses indicate that the loose to medium dense sands of the Piako Subgroup are expected to liquefy in a moderate to large earthquake event. Liquefaction effects may include uplift pressures on buried structures, reduced bearing capacities and vertical settlements of the order of 100mm to 250mm across the site. A wide range of treatments are available to manage liquefaction effects, including ground improvements and strengthened foundations. These can significantly increase the construction cost of the civil-structural works for development.

The shallow farm drains present a low risk of lateral spreading during earthquake loading. This hazard can be eliminated by infilling of the farm drains during development of the site.

### 4.5.4 Hydrogeological Considerations

#### Approach to Evaluation

To provide an initial screening of the four sites, the following potential groundwater effects due to construction and / or operation of a wastewater plant were considered:

- Migration of treated wastewater into down-gradient bores, where land-based disposal or treatment is used
- Drawdown from dewatering (or drainage) causing:
  - Interference effects in bores in the surrounding area
  - Reducing the groundwater component of baseflow to surface water bodies and / or lowering the water level in wetlands.
  - Migration of contaminants from adjacent sites.
  - Consolidation settlement of assets in the surrounding area

WRC bore and consent records were reviewed to identity if there are bores that could be down or along - gradient from the site, and thus could be a potential receptor for any irrigated wastewater, or which might experience drawdown from any site dewatering activities. Bore details were filtered, and the following bore types were excluded from further assessment:

- Bores with hole diameter less than 90 mm or casing diameter less 50 mm; these are likely to be geotechnical piezometers with no associated water take.
- Bores deeper than 25 m; these are likely to be screened in a much deeper aquifer with slow vertical travel time and some degree of hydraulic disconnect from the surface.
- Bores located on the subject sites; these are assumed to be abandoned / decommissioned as part of the project.

Of the remaining bores, bores screened within the upper 10 m are considered most likely to be potential receptors as they are more likely to be abstracting water from the same shallow aquifer into which the discharge would occur.

The location of consented water takes have also been reviewed to identify if any are specifically identified for potable supply, our could be ignored (e.g., short term diversion consents, or consents located on the site which are assumed to be surrendered as part of project works) however as bores can abstract water as a Permitted Activity or under s14b of the RMA, for the purpose of this assessment all bores (even those without an associated take permits) are assumed to be potentially abstracting water for domestic or potable use.

#### Groundwater Flow Direction

This site is located within the Nukuhau Stream catchment, so shallow groundwater likely flows towards this stream and its tributaries in an overall north-east direction. The inferred direction of groundwater flow is shown in Figure 28.

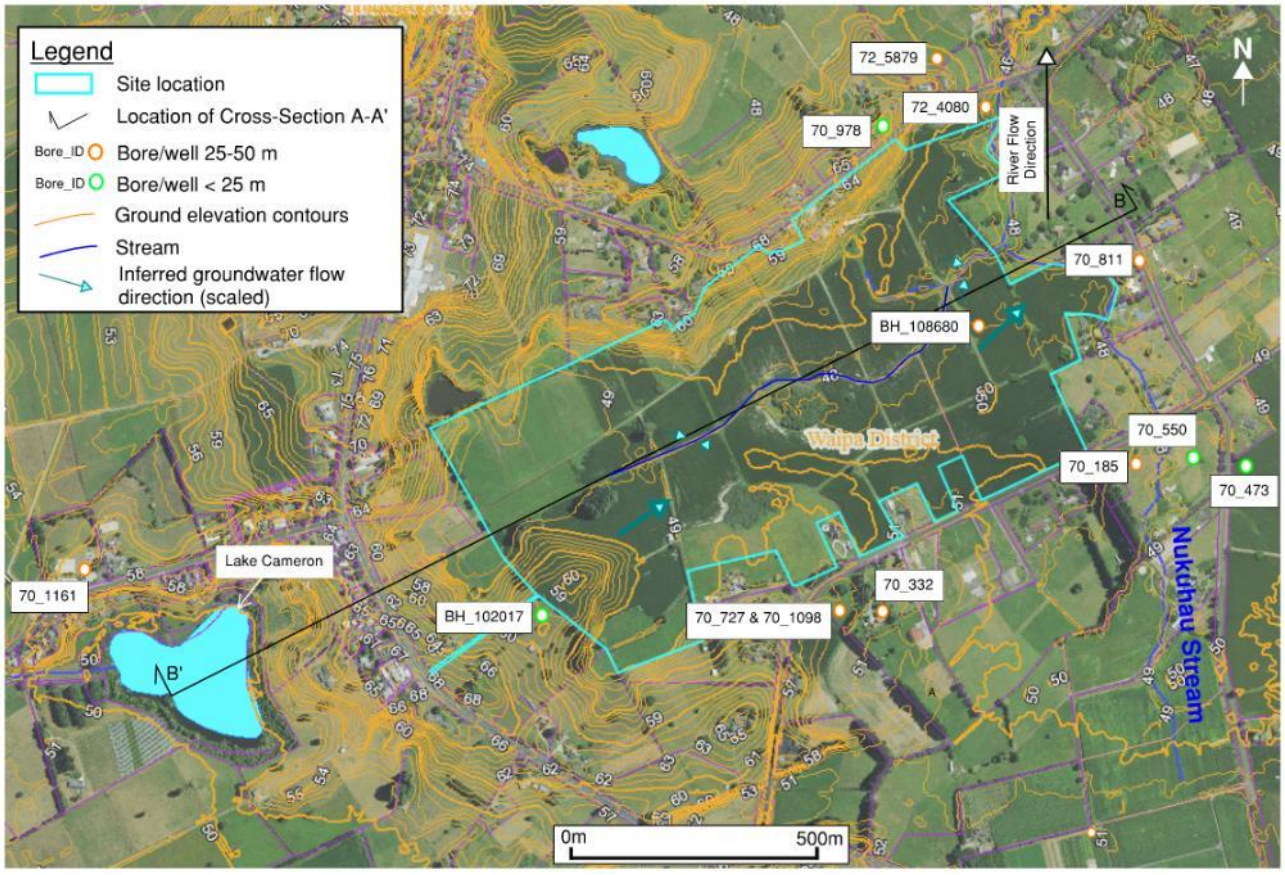


Figure 28: Inferred groundwater flow direction and location of nearest potential groundwater receptors

Some localised shallow groundwater flow towards the tributary could also be expected but overall, it is anticipated that the channel would drain a locally high groundwater level, discharging it to the northeast. A schematic cross-section for the site is shown in Figure 29.

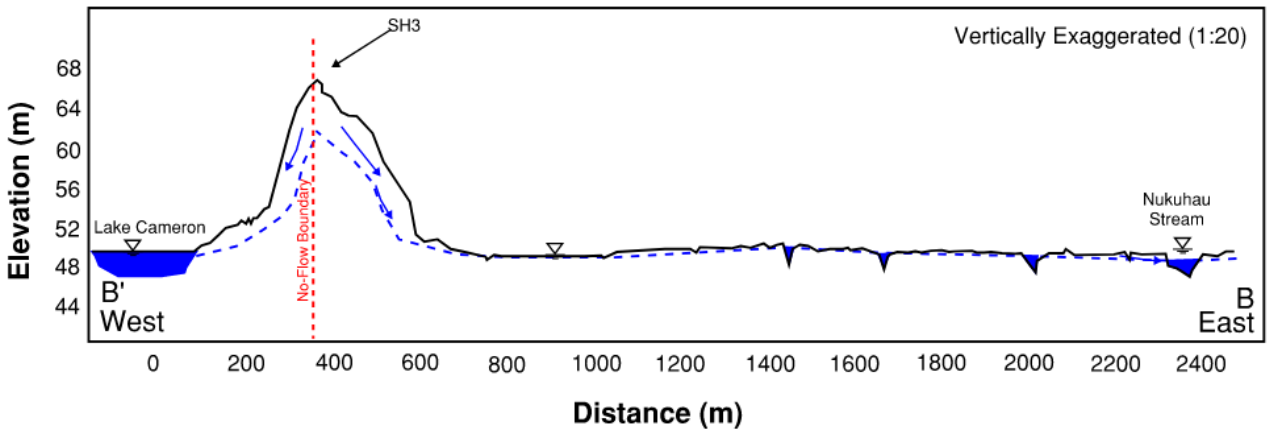


Figure 29: Schematic west-east cross section through site showing inferred groundwater-surface water interaction.

### Consents and groundwater bores

There are approximately 25 known bores/wells within 600 m of the site; two are reported to be screened at <10 m and a further 12 are of unknown depth (and so are considered potential receptors). The location of the closest bores to the site is shown in Figure 28. There are three shallow bores (WRC Bore ID 70_908, 70_553 and 70_473) located down hydraulic gradient, which could be potential receptors.

There are two groundwater take permits (WRC AUTH133419.01.01 and AUTH140249.01.01) located downgradient of the site. Neither are specifically associated with a known bore, so it is not possible to

accurately assess separation distance, but the distance between the respective site boundaries is at least 400 m in both cases. Additionally, both takes are located on the far side of the Nukuhau Stream, so if they are associated with shallow bores the risk of any direct hydraulic connection with the Narrows Road site may be low.

#### Assessment

Possible groundwater receptors are streams and nearby groundwater users. There are three shallow bores, and two groundwater takes located downgradient. Ultimately infiltration rates, level of treatment, soil permeability, and travel time will need to be assessed to determine the actual risk and number of bores potentially affected.

Similarly, depths, construction methods, soil permeability and distances from site works would be required to quantitatively assess drawdown impacts. Given the rural nature of the site the risk of consolidation settlement damaging private assets is low. The contaminated land assessment also indicates a low risk of contamination requiring significant risk assessment or controls. Impacts of drawdown on surface water bodies and any associated groundwater dependent eco-systems would need to be addressed, though we have assumed this could be managed to a low risk level via appropriate siting, design, and construction controls.

## 4.6 Potential for land discharge

Manaaki Whenua Landcare Research undertook a soil investigation at the site to determine the potential suitability to discharge treated wastewater to land (Appendix A). Their site investigation is summarised in Table 6.

Table 6: Site 2 Summary of Suitability to Discharge to Land

| Soils | Constraints | Potential Ability to Discharge Year Round | Implications for Site Selection |
|---|---|---|---|
| The flat, low-lying land is predominantly poorly drained, with some areas of very poorly drained soils. The soils on elevated rolling land are well drained developed in clayey Hamilton Ash. | The poorly and very poorly drained soils have indications of waterlogging which is a restriction to year round application of wastewater. The rolling slope areas and potentially restricted subsoil permeability indicates these soils have limitations for year-round discharge, but could be used for deficit discharge. | No. | The rolling slope areas (to the western end of the site) are better suited to a deficit irrigation scheme, whereas the lower part of the site is very poorly drained and generally unsuitable. The WWTP indicative location is at the end of the site with better soils, so these areas would not be available for discharge.<br><br>An alternative discharge method/site is likely required for stage 1 flows. |

## 4.7 Contaminated Land Risk

### 4.7.1 Historical Aerial Review

Historical aerial photos were reviewed and determined the following historic land uses:

- 1943 (Retrolenz) – all farm land, no infrastructure present within site.
- 1953 (Retrolenz) – all farm land, no infrastructure present within site.
- 1963 (Retrolenz) – all farm land, shed constructed (in location observed today)

- 1974 (Retrolenz) – no changes.
- 1986 (Retrolenz) – no changes. Some minor earthworks outside northern boundary – looks to be associated with a silage storage pit.
- 1995 (Retrolenz) – no changes.
- 2006 – current (Google Earth): no significant changes. One shed present over that time. Land use remained agricultural / cropping (ag).
- Currently - active dairy farm currently, with seasonal cropping (maize and lucerne)

### 4.7.2 Assessment

The site is currently agricultural and has been used as such since as early as 1943 (likely earlier). No other land uses have been identified through a review of historical aerials. Waikato Regional Council confirmed the site does not appear on their LUIR as a potentially contaminated site.

One shed was observed to be present from as early as 1963 to present day. It cannot be ruled out that this shed has had contaminating activities operated within, or near them, including:

- Potential asbestos
- Hazardous substance storages (including fuel, pesticides etc).

No broad-site contaminating activity has been identified across the paddocks used for farming. It is known that superphosphate fertilizers can result in elevated cadmium levels in agricultural land uses, however are unlikely to result in a contaminated soil risk or require additional management.

This site will require a PSI, involving a site walkover, to inform the potential risk of land uses and materials surrounding the shed. Depending on the findings of the PSI, there may be the requirement to undertake targeted sampling in this area to inform potential contamination risk and management requirements.

## 4.8 Archaeology

Survey plan, the records of the NZZ, and aerial photography has been reviewed. There are currently no recorded archaeological sites affected by the proposal. Based on the location of these land parcels, no archaeological sites are anticipated (as shown in Figure 30).

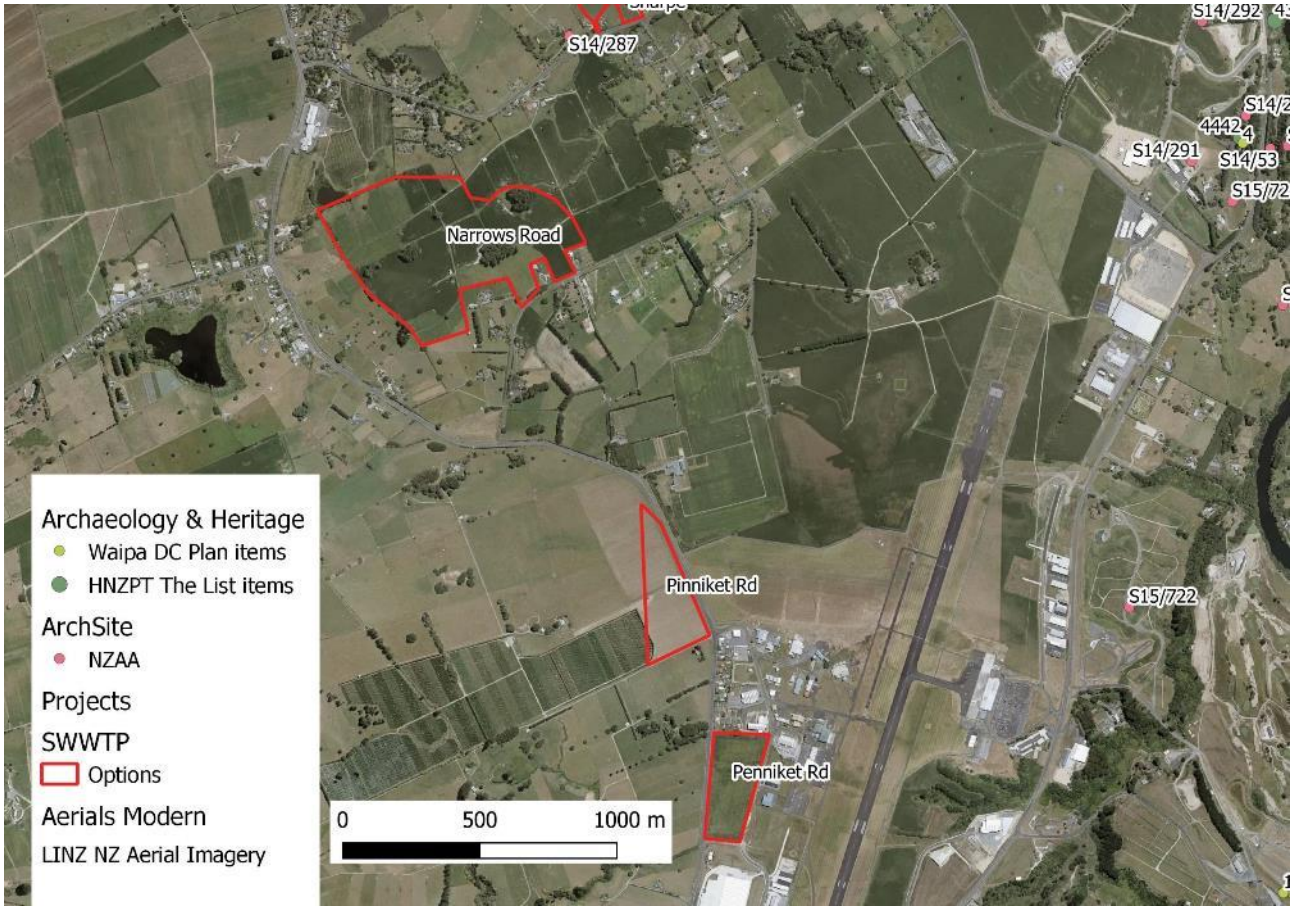


Figure 30: Penniket Road & Narrows/Rukuhia Heritage Landscape

## 4.9 Built Environment

### 4.9.1 Sensitive receptors and buffer distances

The site is located to the east of Rukuhia village. Existing dwellings are concentrated to the west of SH3, with reasonable setback from the proposed site. Due to the topography of the land surrounding the site, a cluster of dwellings to the north and scattered dwellings to the west/south overlook Site 2.

The future Southern Links Road Designation runs along the northern and easter boundaries of the site. This both reduces the likelihood for residential development along those boundaries and will result in a change to the receiving environment during construction and operation of that road corridor. A number of dwellings within this area have already been acquired by NZTA for roading purposes.

The land between SH3 and the site boundary is zoned as Deferred Large Lot Residential (as a Structure Plan Area). Notably, new dwellings could be constructed as a permitted activity on the three of these land parcels that do not have existing dwellings.

### 4.9.2 Odour

The WWTP could be placed within Site 2 with 100m buffer from the WWTP footprint to the edge of the site and at least 150m from the closest dwellings (as shown in Figure 23).

The cluster of rural-residential properties to the north of the site and Rukuhia village (although largely outside the 300m buffer) will increase sensitivity of the area to possible odour effect in the event of a plant malfunction. Approximately 8 dwellings are located within 300m of high risk odour sources (noting that two of these have been acquired by the crown for the Southern Links project), but, with careful placement of

processes within the WWTP footprint, it appears possible to locate all high-risk odour producing processes 200m from the nearest dwellings. However, that 200m buffer could be threatened by permitted activity development on the land parcels to the west without current dwellings.

### 4.9.3 Noise

Based on a minimum setback distance of 100m to the site boundary, it is expected that the WWTP can be designed to achieve prescribed levels at the boundary. Blowers and centrifuges have the highest noise potential, this equipment comes in acoustic enclosures which would be housed withing concrete buildings to minimise noise.

This area is considered a moderate sensitivity receiving environment due to ambient noise levels associated with SH3. There would be some change to the noise environment and those residents overlooking the site may raise concerns about noise. However, this should be considered within the context of SH3 and the future Southern Links Road network which would also result in a change in noise environment so such changes should not be completely unexpected to residents.

### 4.9.4 Traffic and Access

Existing access is available from both Raynes Road and Narrows Road; however, the Raynes Road access crosses through the Southern Links Road designation so would only be an option with Waka Kotahi approval and until such time as construction started on Southern Links.

The property appears to have a legal access through to SH3 which would be preferred over the existing access points although this is currently unformed without a road crossing. It appears that a neighbouring dwelling is encroaching very close to the access strip. Formation of this access way would require approval from Waka Kotahi (as road controlling authority) and engagement with the neighbour).

If access can be obtained from SH3, traffic impact during both construction and operation is expected to be low within the context of existing traffic flows on SH3. If the SH3 access cannot be progressed, Raynes Road may be the preferred during construction - Waka Kotahi has been investigating a new roundabout at the intersection of SH3 and Raynes Road, which would lower impacts associated with traffic turning on and off SH3 and the equivalent intersection at Narrows Road has poor sightlines and a higher speed environment.

Narrows Road could reasonably be used for operational access.

### 4.9.5 Visual

The proposed WWTP location is highly visible from a small number of residential properties to the northeast. Existing vegetation provides a lot of screening, especially to dwellings further up the hill. The site is also highly visible from SH3 and site screening will be required from this location.

## 4.10 Ecology

All ecological features identified during desktop studies and the initial site walkover are outlined in Figure 31.

### 4.10.1 Terrestrial Vegetation

A majority of the site has been previously cleared and is currently utilised as horticultural land with four smaller areas of remnant native vegetation stands. One of these stands is classified as a SNA called "*Rukuhia kahikatea forest remnant.*" This area has been protected for its biodiversity values and is assessed as regionally significant and is considered an under-represented vegetation type in this area.

These remnant forest systems are expected to provide suitable habitat for a range of native avifauna and bats. These small sections are remnants of a larger section of kahikatea and pukatea forest, prior to human clearance, that was estimated to be around 103 ha in size.

### 4.10.2 Bats

Records available from the Department of Conservation (DOC) database indicate the presence of numerous long-tailed bats within the site, as well as in neighbouring areas, which were recorded in 2019. The records of long-tailed bats appear to be concentrated to mainly two areas of denser vegetation on the property, on the northern boundary and near the southern boundary.

### 4.10.3 Avifauna

Habitat within this site for avifauna is limited to the remnant indigenous forests areas and there is potential for New Zealand falcon to utilise these forest remnants for roosting and breeding habitat. Due to the horticultural use of the land, it is likely the area is regularly disturbed, therefore limiting species composition to mainly introduced and Not Threatened species. No other At Risk or Threatened species are expected to frequent the site.

### 4.10.4 Herpetofauna

As a large majority of the site is currently used for horticulture it is regularly maintained, and as such, there is a low likelihood of native herpetofauna species residing within the cleared areas. However, there is potential for native herpetofauna to shelter within the remnant forest stands, prior to human clearance, would have supported a diverse range of native fauna.

### 4.10.5 Wetlands

The initial site walkover identified no *inland natural wetlands* as described under the NPSFM (2022) within Site 2.

### 4.10.6 Watercourses

Within the site there appears to be one modified watercourse that is a tributary of the Nukuhau Stream. The watercourse channel flows in an easterly direction and transitions from a straightened channel in the upper reach to a naturally meandering channel as it flows through the site and towards the confluence with a tributary of the Nukuhau Stream. The stream had adequate water depth and slow flow, riparian vegetation coverage was limited to exotic weed growth with taller ferns scattered throughout, providing little shading to the stream. Substrate within the stream appeared to be mainly soft sediment and instream habitat was limited to slower flowing pool sections.

In addition to this permanent stream system, several artificial drainage channels also cross the site.

### 4.10.7 Freshwater fish

There are no records of freshwater fish identified within the watercourses onsite, as well as within the Nukuhau Stream channel and tributaries. However, the Nukuhau Stream is a moderately sized stream, extending approximately 4 km inland, and is expected to provide a suitable migration pathway and habitat for a range of native freshwater fish, which are known to be present within the Waikato River. For this reason, there is a high likelihood of native freshwater fish being present within the permanent stream channel within the site, as well as within any artificial channels with adequate connectivity.

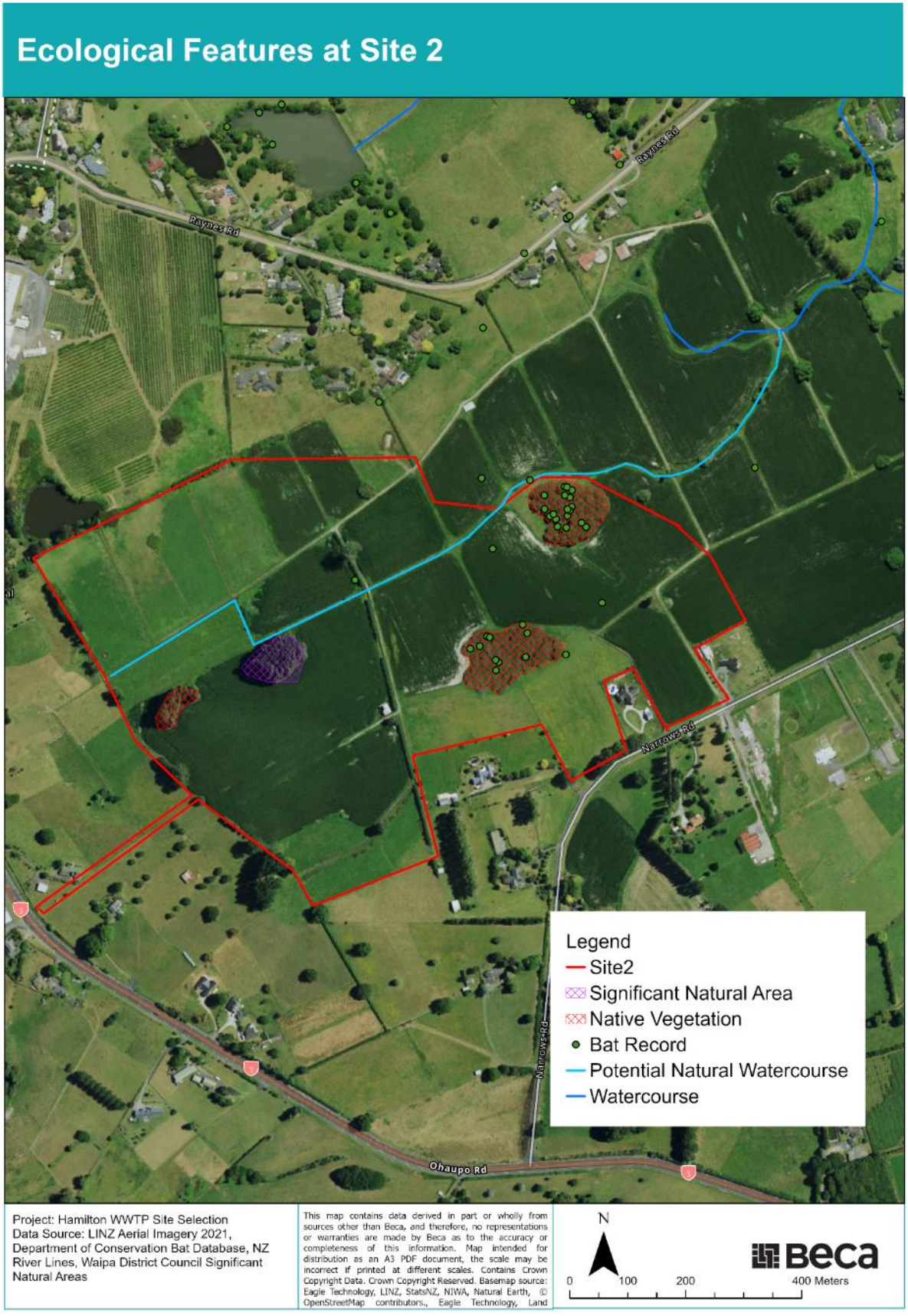


Figure 31: Ecological features identified at Site 2 from desktop mapping and an initial site walkover.

Site 2 presents several ecological constraints to consider should this site be chosen for the WWTP. As such, the following recommendations are made.

1. The areas of remnant indigenous vegetation should be retained onsite.
2. The watercourse likely provides suitable habitat for native freshwater fish. As such, eDNA survey and/or fish survey is recommended to identify species residing within this system. As the NPS:FM (2022) requires consideration be given to both the current and potential ecological value of freshwater systems, the proposed works should avoid direct impacts (reclamation, diversion) of these systems.
3. A watercourse delineation and classification survey will need to be conducted across the potential natural watercourse as well as any other identified watercourse within the site.
4. While no wetlands were identified during the initial site walkover, should Site 2 be selected, an in-depth wetland survey and delineation should be conducted within 100 m of the proposed location of the WWTP.
5. There are numerous opportunities for restoration and ecological enhancement including the restoration of indigenous vegetation across the site as well as along the riparian margins of the watercourse.
6. Due to the ideal habitat within the site for herpetofauna, lizard management will be required prior to the clearance of any vegetation.
7. Due to the confirmed presence of long-tailed bats within and within proximity to the site, bat management will be required prior to the clearance of any suitable roosting trees. In addition to this, operational disturbances to bats from noise and lighting (during the construction phase) will need to be considered. There is the potential for adverse effects on bats from both the construction and operational phases of the WWTP at this site.
8. Avifauna within the site is primarily limited Not Threatened and Introduced species, however, as most native birds are protected under the Wildlife Act (1953), management will be required prior to the clearance of vegetation.

### 4.10.8 Restoration potential

There are a number of opportunities for ecological restoration at this site including opportunities for stream enhancement and riparian planting along the tributaries of the Nukuhau Stream and expansion/ enhancement of the forest remnant areas.

## 4.11 Planning

Site 2 is located within Waipā District and is therefore subject to the Waipā District Plan.

The site and surrounds are zoned Rural with an area of Large Lot Residential Zone/Deferred Large Lot Residential Zone to the southwest. The Southern Links designation runs along the site's northern and eastern boundaries. Key features and overlays within the sites include the Airport Horizontal Surface overlay (which is not expected to impact potential development of this site), a small SNA overlaying a remnant kahikatea stand, and a Viewshaft and SH3 Scenic Corridor which overlays the western half of the site.

It is expected that the WWTP and land discharge area would be designated and therefore not subject to the rules of the Waipā District Plan; however, all works should be set back from the kahikatea stand (and other areas on remnant bush not classified as SNA) to reduce ecological effects and consideration would need to be given to visual effects on the SH3 corridor. Resource consents are expected to be required from WRC for discharge to air (odour), discharge to land/water (land disposal), and potentially earthworks not meeting permitted activity standards (for construction/installation of the disposal field) as an overall discretionary activity under the Waikato Regional Plan.

The National Policy Statement for Highly Productive Land (NPSHPL) will apply to this site.

Table 7: Site 2 - key district and regional plan characteristics

| | |
|---|---|
| **District Plan** | |
| Zone | Rural |
| Adjoining zone | Rural and Southern Links designation<br>Southwest: Large Lot Residential and Deferred Large Lot Residential (Structure Plan Area) |
| Zone overlay | Airport (horizontal surface) |
| Designation | Adjoins Southern Links designation (District Plan reference D156, shown in purple outline on zone map) |
| Features | Significant Natural Area: Rukuhia kahikatea forest remnant (District Plan reference WP273, shown in green on features map)<br>Viewshaft and SH3 Scenic Corridor over western half of site (shown in purple hash on features map) |
| Natural hazards | Not located with a District Plan potential flood area |
| **Regional Plan** | |
| Water courses | Nukuhau Stream and unnamed tributary (both surface water classification) a short distance to the east of the site.<br>Waikato River at Nukuhau confluence classified as indigenous fish habitat, trout habitat, and contact recreation. |
| Bores | One recorded bore on the site and a number of bores and bore consents in the surrounding area |
| **Other planning considerations** | |
| NES Freshwater | No wetlands were identified during the site walkover; however, there were a number of wet area and further delineation should be undertaken |
| NPS Highly Productive Land | Largely classified as LUC 2 & 3 with some LUC 4 towards the north western corner[12] |
| NES Contaminated Soils | The various sheds on the site may have had contaminating activities operated within or near them including asbestos and storage of fuel and pesticides which could trigger the NESCS. |

[12] Land Use Capability 2021 from New Zealand Land Resource Inventory (accessed via LRIS portal December 2022)

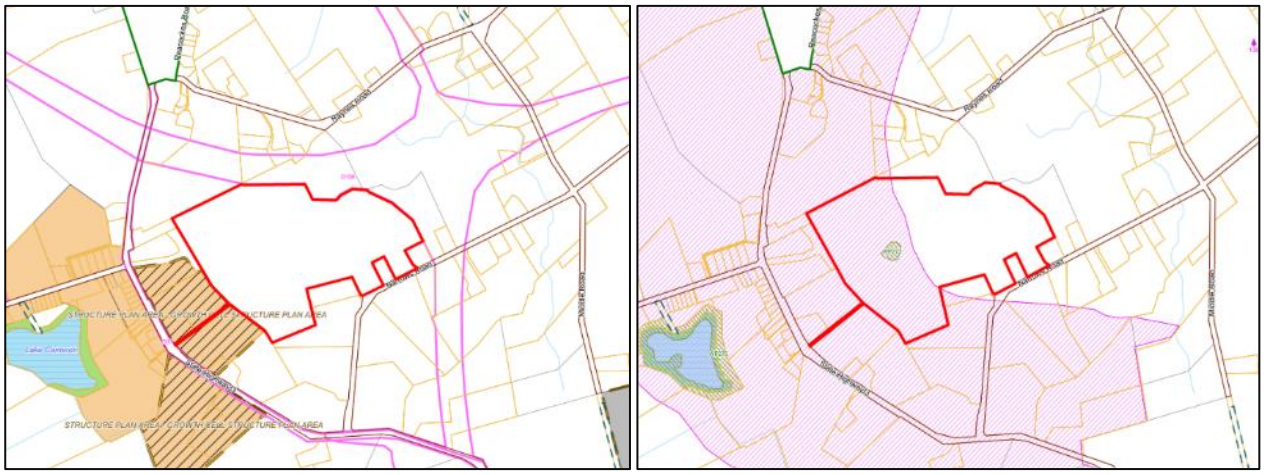

Figure 32: Waipā District Plan maps - zoning (left) and features (right)

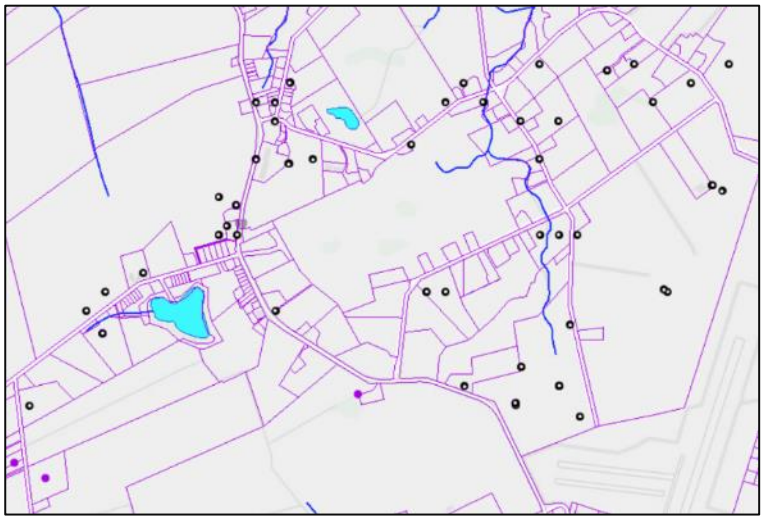

Figure 33: Bores (black) and bore consents (purple) from WRC Groundwater Maps (accessed December 2022)

# 5 Site 3: Penniket Road

## 5.1 Overview

| | North | South |
|---|---|---|
| Owner | Crown (administered by Waka Kotahi) | Tainui Group Holdings |
| Address | 3454 & 3502 Ohaupo Road | Ohaupo Road / Ingram Road |
| Title & legal description | SA328/42, Part Lot 3 DP 7672<br>SA72D/474, Lot 2 DPS 92133<br>SA13A/148, Lot 1 DPS 15142<br>SA13A/149, Lot 2 DPS 15142 | 292114, Lot 2 DP 372243 |
| Area | 7.5 ha | 6.5 ha |

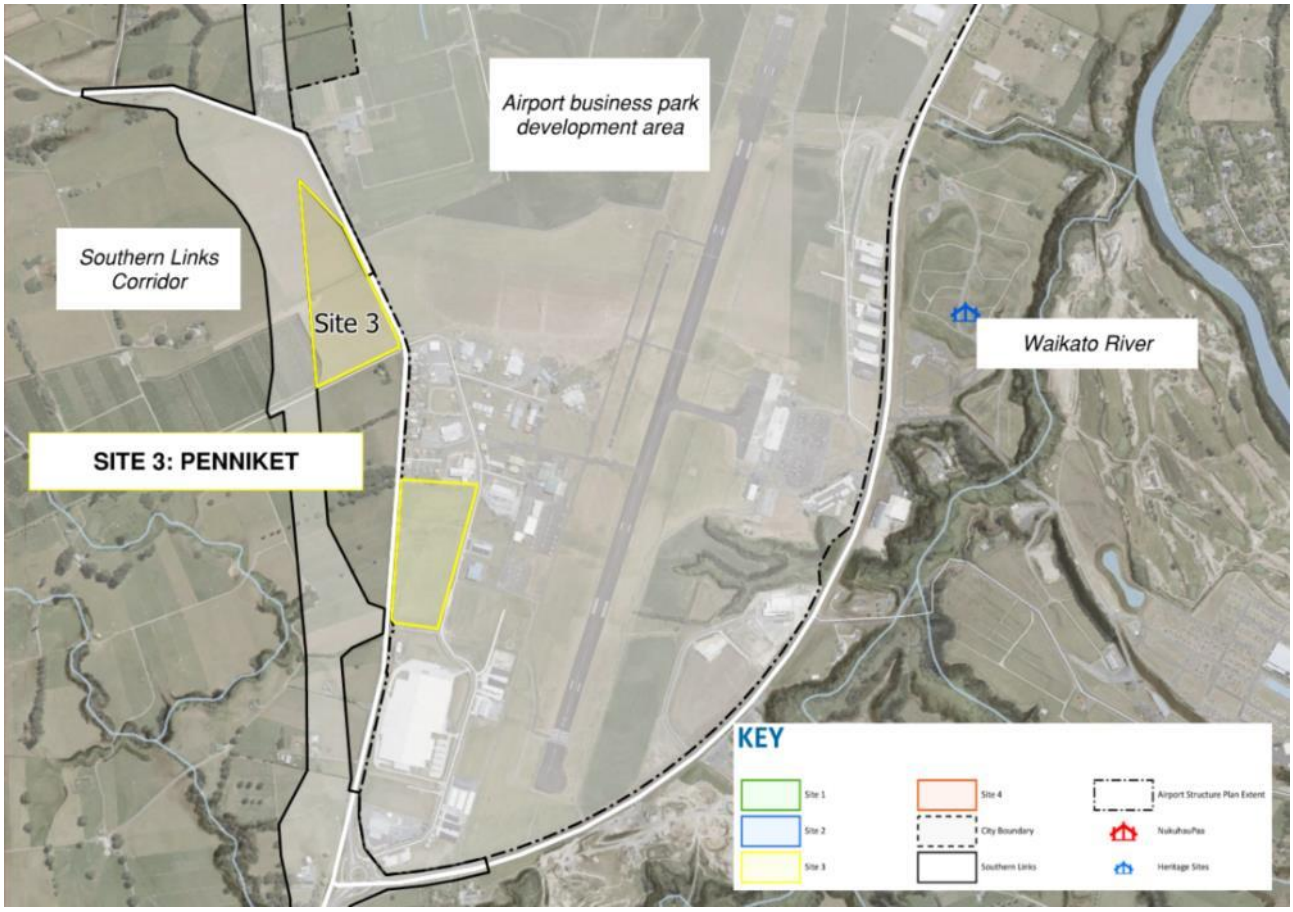


Figure 34: Site 3 location. Note Southern Links Road designation to the north/west, airport to the east and Waikato River to the east.

## 5.2 Site layout

Figure 35 shows an early conceptual layout for Site 3 based on the space expected to be required for the “ultimate” design (i.e. 200,000 PE). The layout could also be arranged with the inlet at the northern end.

The operational main access to the site could either be from Penniket Road or (potentially) directly off SH3 via an existing access point (however, this may require consultation with Waka Kotahi and would require consideration of how the road environment might change following construction of Southern Links.

Turning in and out of Penniket Road can be challenging due to speed environment and a tight turning radius (especially from the south). The more northern site access direct from SH3 may be easier to upgrade for construction traffic. Construction access to this site may need to be limited to left-in left-out for safety.

The southern site as an existing formed access of SH3/Ohaupo Road or could alternatively be accessed off Ingram Road. The intersection of SH3 and Ingram Road appears to be suitable for larger vehicles; however, similar to the northern site, construction access may need to be limited to left-in left-out.

Southern Links passes to the east of the site and will not impact on the site access location but would be expected to reduce traffic volumes and therefore reduce safety concerns (noting that the timing of Southern Links remains uncertain).

Water (southern site only) and 11kV supplies available at the site boundary, although water main capacity is uncertain.

Figure 36 shows the Site 3 waterways and contours while Figure 37 shows the early concept layout for key process units for a 200,000 PE WWTP.

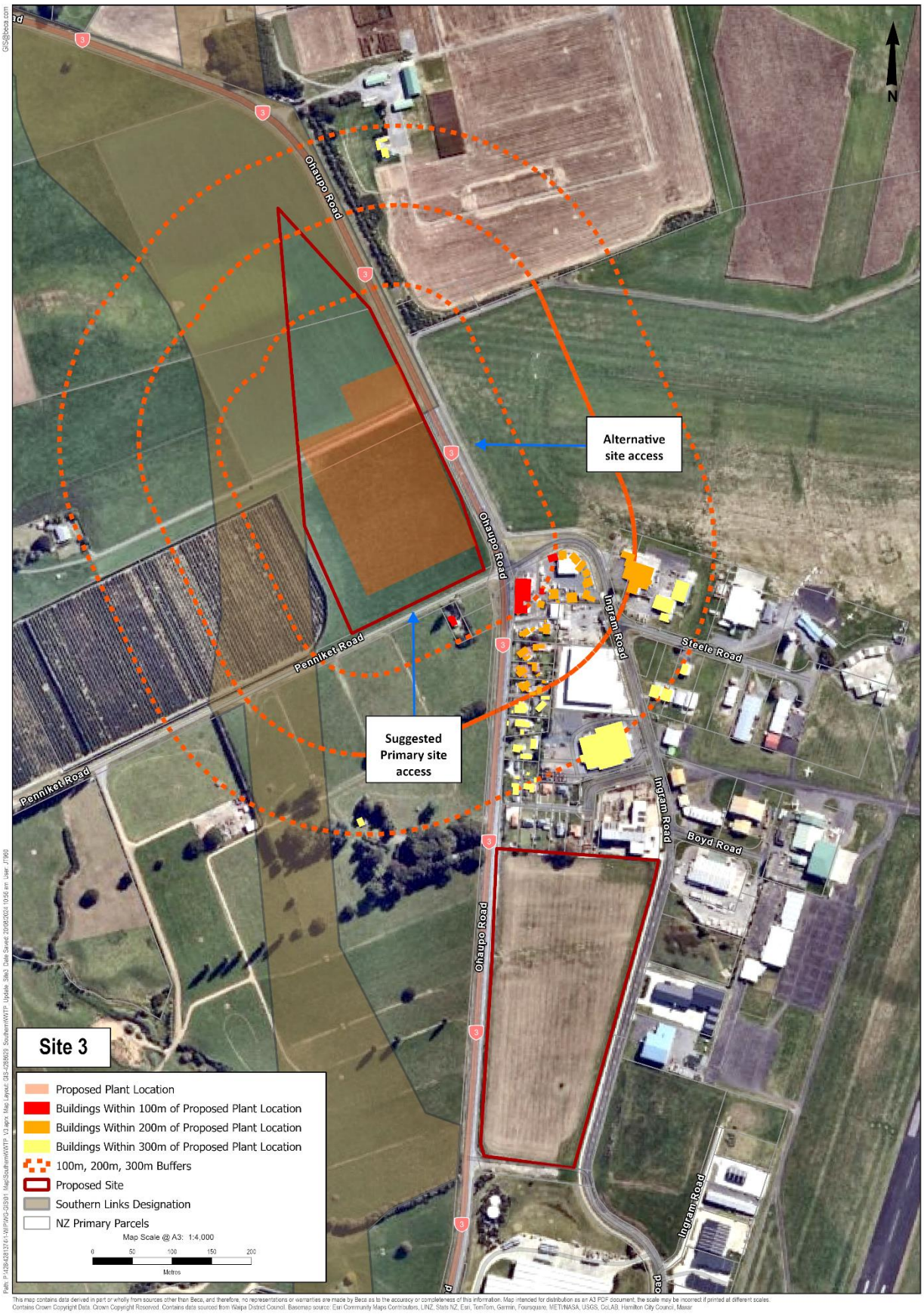


Figure 35: Proposed placement of WWTP within Site 3 showing 100m, 200m and 300m buffers.

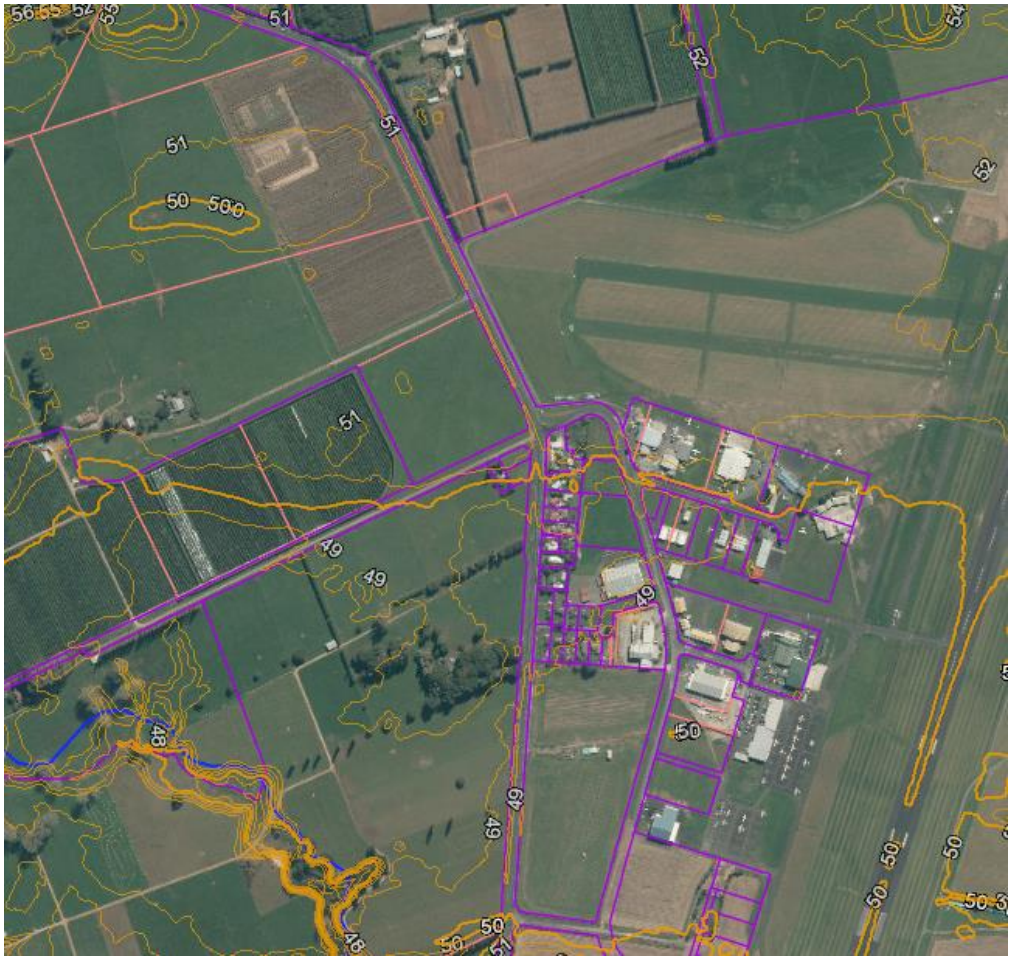


Figure 36: Site 3 watercourses and contours


Figure 37: Early concept layout for Site 3 showing key process units. Processes colours orange not required until post-Stage 3.

## 5.3 Potential conveyance

Based on the above, the following potential conveyance routes have been identified:

- Catchment Conveyance
  - 0.7km long sewer rising main (SRM - No.1) from the N12 sewage pump station (SPS)
  - 1.3km long Gravity Sewer (GS - No.1) from SRM – No.1 to the head of GS – No.2
  - 3.8km long Gravity Sewer (GS – No.2) to the WWTP
- Treated Effluent Conveyance
  - Route Option 1: 5.1km long Rising main (RS- No.1) from the WWTP to the Waikato River
  - Route Option 2: 5.4km long Rising main (RS- No.2) from the WWTP to the Waikato River
  - Route Option 3: 5km long Rising main (RS- No.3) from the WWTP to the Waikato River

The potential discharge point to the Waikato River will need to consider:

- The form of the discharge. Mana Whenua have given strong direction that, in general, new structures in the bed of the Waikato River are not appropriate and that some form of land contact is preferred prior to discharge to wastewater to the river. This requires space adjacent the river.
- Proximity to the Nukuhau Paa and whether the downstream discharge point shown below is far enough to minimise effects.
- Proximity to the Hamilton Water Treatment Plant and confirmation that the discharge would not give rise to issues with potable water supply (with reference to the National Environmental Standards for Sources of Human Drinking Water 2007 and the proposed amended outlined by Ministry for the Environment in 2022). This assessment should also consider the indirect potable re-use enabled by discharging highly-treated wastewater upstream of a large part of its contributing catchment.

Discharge of treated wastewater to the gully system adjacent SH21 (i.e. next to Rising Main No. 3) could be an option for lower flows. Consideration of this as an option would require detailed investigation of flow capacity of the gully and potential effects associated with changes in flow rate and water quality.

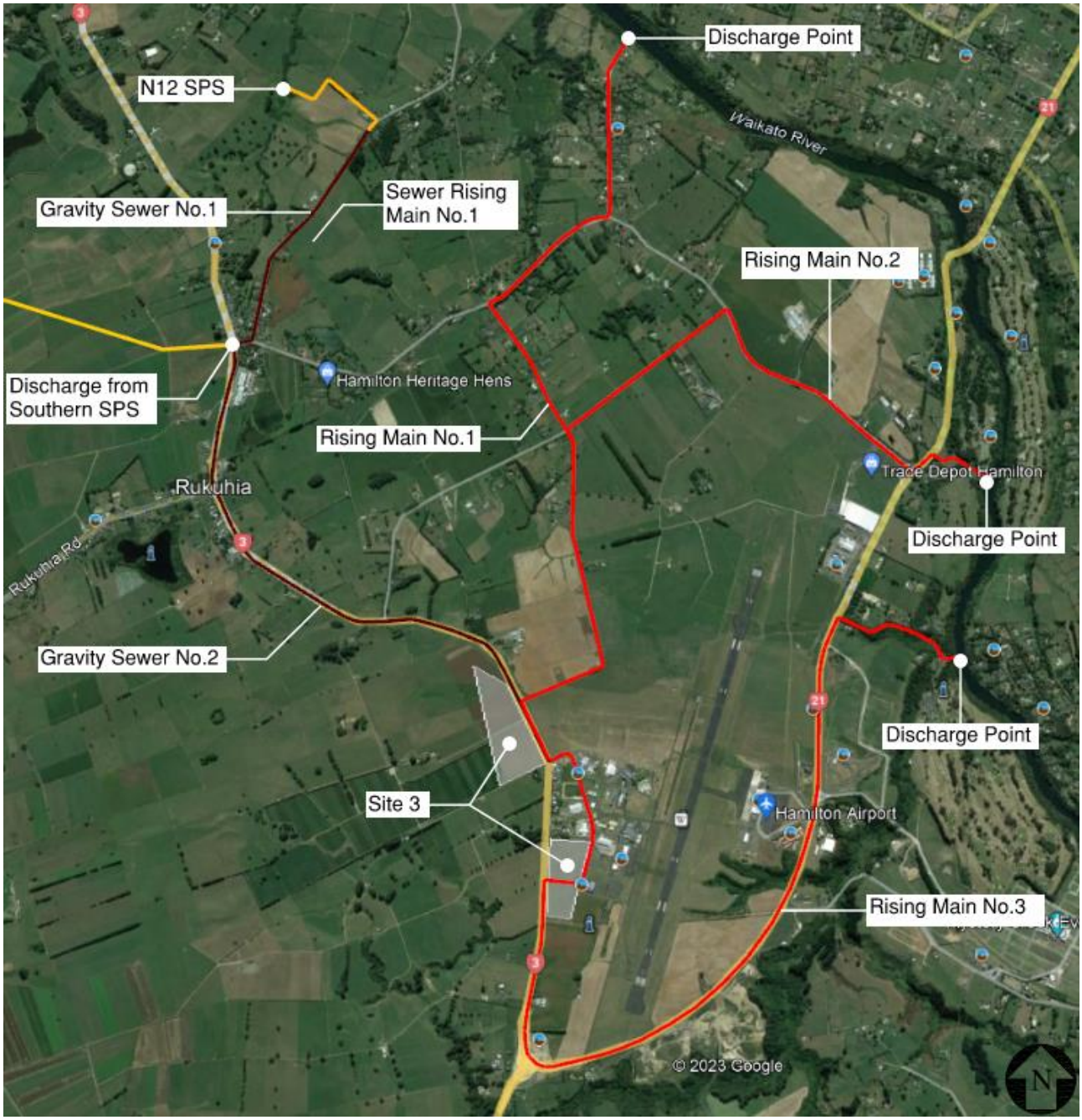


Figure 38: Site 3 Potential Conveyance Routes

## 5.4 Locality and topography

The Penniket Road site is located approximately 2km southwest of the Waikato River, and west of Hamilton Airport.

Review of ground elevation contours (WRC LiDAR 1m interval) indicates that the site and the surrounding area is essentially flat, ranging from 49m RL to 52m RL. A tributary of the Waikato River is located approximately 250m southwest of the site, and the topography in this area drops steeply to the tributary river level at a lowest level of ~40m RL.

## 5.5 Geotechnical

### 5.5.1 Geology and Ground Conditions

The published geological maps (Edbrooke, 2005[13], GNS Science QMap 2020) indicate that the site is underlain by sand, silt, gravel, peat, and pumice of the Hinuera formation.

WRC well logs indicate the lithology is dominated by silts and sands to a depth of at least 20m. Clays are identified in the upper 5m, with occasional interbeds of peat in at least one bore log. Surficial soils where water bore logs are available are generally indicated to be silts and sands.

### 5.5.2 Geotechnical Considerations

The potential site area, underlain by soils of the Hinuera Formation, will likely be susceptible to liquefaction in a moderate to large earthquake event. Liquefaction occurs when loose saturated sand lose strength under earthquake loads. Liquefaction effects include lateral spreading near slopes, post-earthquake settlement, low seismic bearing capacity and uplift pressures on buried structures.

This effect of this hazard can be lessened by siting new structures away from slopes, including the existing drainage channels. The actual hazard at any location is variable and would require geotechnical testing and analysis to assess. A wide range of treatments are available to manage liquefaction effects, including ground improvements and strengthened foundations. These can significantly increase the construction cost of the civil-structural works for development.

Weak soils, including soft to firm clays and peat layers, may be present across the site. Where present, these soils would likely require excavation and replacement, preloading, or another engineering treatment below new structures. Such treatments are commonly adopted in these ground conditions and do not preclude development where the associated costs are acceptable.

### 5.5.3 Hydrogeological Considerations

#### Approach to Evaluation

To provide an initial screening of the four sites, the following potential groundwater effects due to construction and / or operation of a wastewater plant were considered:

- Migration of treated wastewater into down-gradient bores, where land-based disposal or treatment is used
- Drawdown from dewatering (or drainage) causing:
  - interference effects in bores in the surrounding area
  - Reducing the groundwater component of baseflow to surface water bodies and / or lowering the water level in wetlands.
  - Migration of contaminants from adjacent sites.
  - Consolidation settlement of assets in the surrounding area

WRC bore and consent records were reviewed to identity if there are bores that could be down or along - gradient from the site, and thus could be a potential receptor for any irrigated wastewater, or which might experience drawdown from any site dewatering activities. Bore details were filtered, and the following bore types were excluded from further assessment:

[13] Edbrooke, S.W. (compiler) 2005. Geology of the Waikato area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 4. 1 sheet + 68 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited. ISBN 0-478-09877-4

- Bores with hole diameter less than 90 mm or casing diameter less 50 mm; these are likely to be geotechnical piezometers with no associated water take.
- Bores deeper than 25 m; these are likely to be screened in a much deeper aquifer with slow vertical travel time and some degree of hydraulic disconnect from the surface.
- Bores located on the subject sites; these are assumed to be abandoned / decommissioned as part of the project.

Of the remaining bores, bores screened within the upper 10 m are considered most likely to be potential receptors as they are more likely to be abstracting water from the same shallow aquifer into which the discharge would occur.

The location of consented water takes have also been reviewed to identify if any are specifically identified for potable supply, our could be ignored (e.g., short term diversion consents, or consents located on the site which are assumed to be surrendered as part of project works) however as bores can abstract water as a Permitted Activity or under s14b of the RMA, for the purpose of this assessment all bores (even those without an associated take permits) are assumed to be potentially abstracting water for domestic or potable use.

### Groundwater Flow Direction

In the absence of any site-specific data, the direction of shallow groundwater flow is difficult to assess. Deeper regional groundwater flow will be to the north and east towards the Waikato River, but some local component of flow, particularly at shallow depths towards Mystery Creek to the south and an unnamed tributary to the west could be expected. As there is no clear direction of flow, bores and in all directions are considered to be potentially downgradient.

### Consents and groundwater bores

There are approximately 27 known bores/wells within 600 m of the site; eight are reported to be screened at a depth <10 m and a further 16 are of unknown depth (and so are considered potentially in hydraulic connection with the site). The location of the closest bores to the site is shown in Figure 39**.** All eight shallow bores are considered potentially down hydraulic gradient, and all are located with within 200 – 300 m of the site boundary.

There is one water take permit (WRC AUTH138851.01.01) located within 200 – 300 m of the site boundary. It does not appear to be associated with a known bore and there is no other information with which to assess its purpose.

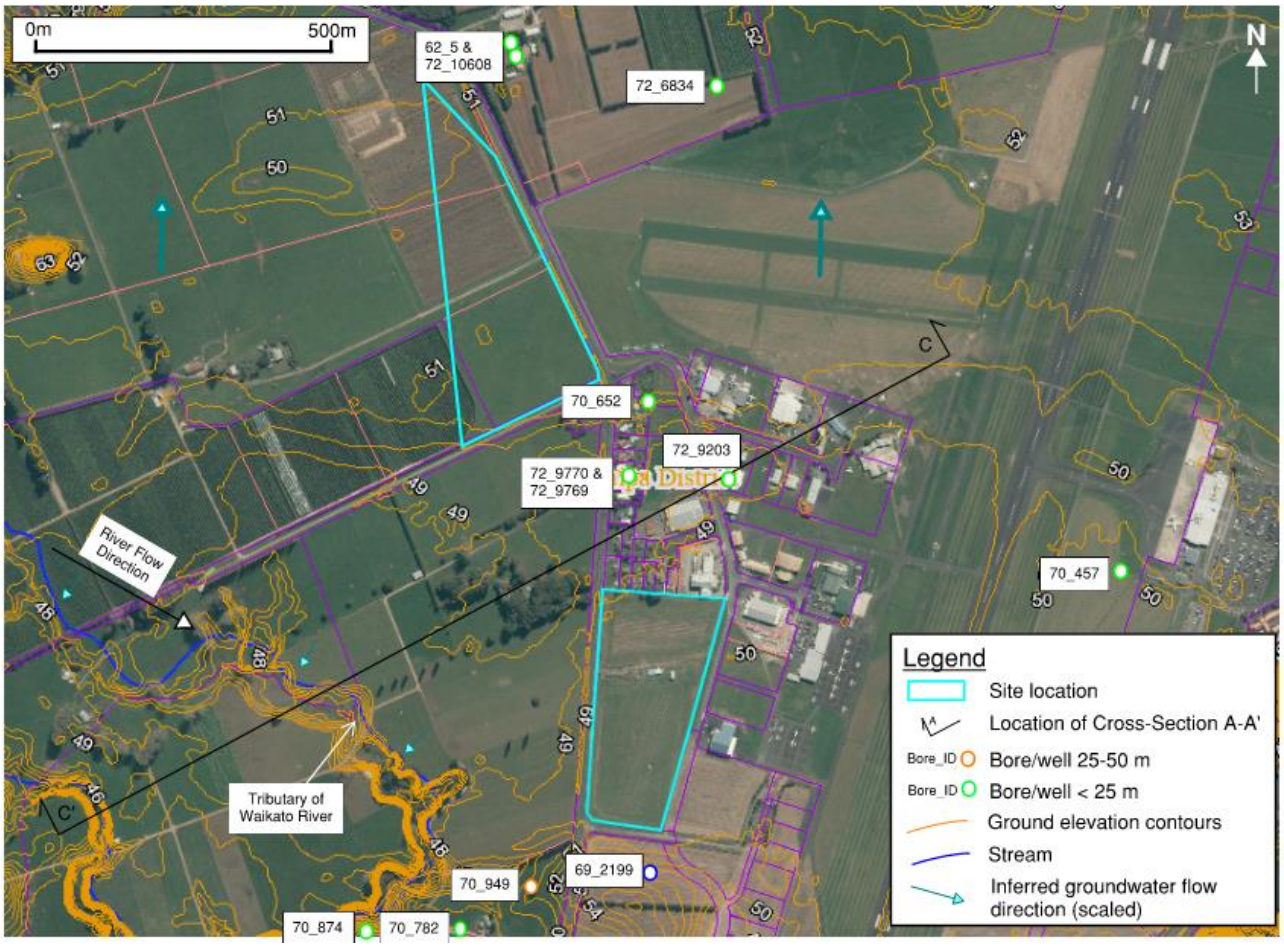


Figure 39: Inferred groundwater flow direction and location of nearest potential groundwater receptors

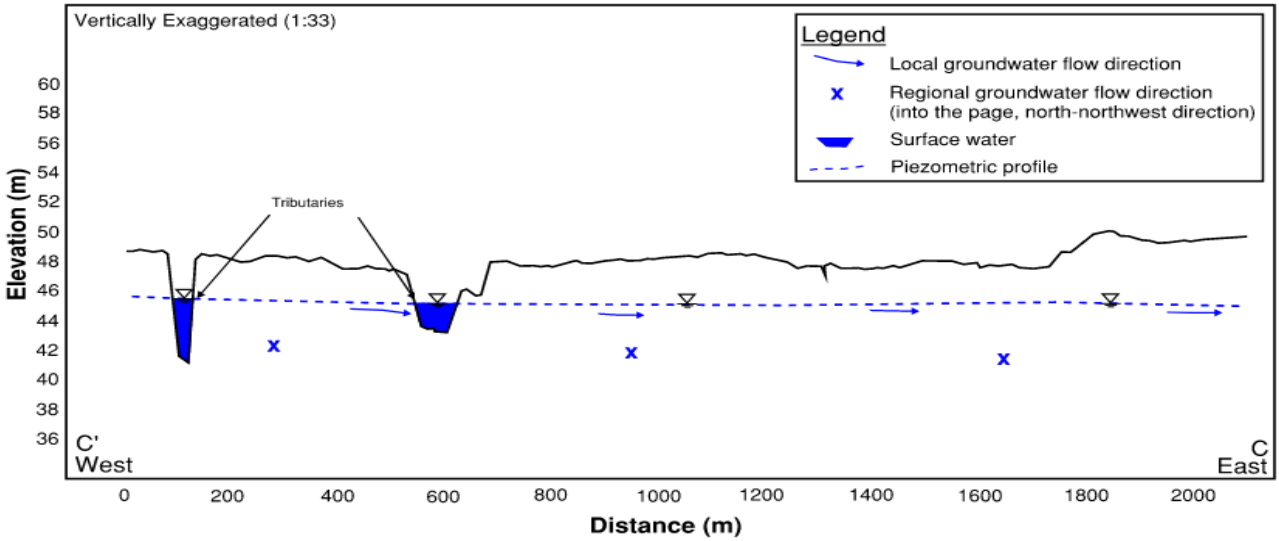


Figure 40: Schematic west-east cross section through site showing inferred groundwater-surface water interaction

***Assessment***

Possible groundwater receptors of treated wastewater are streams and nearby groundwater users. There are at least eight known shallow bores, and one groundwater take located within 200 – 300 m of the site boundary, all of which could be a potential receptor. Ultimately infiltration rates, level of treatment, soil permeability, and travel time will need to be assessed to determine the actual risk and number of bores potentially affected.

Similarly, depths, construction methods, soil permeability and distances from site works would be required to quantitatively assess drawdown impacts. There are no surface water bodies on the site, and the nearest is the tributary creek to the southwest so overall the risk of impacts on surface water bodies is likely to be low, or easily managed. This site has had some industrial development, including the airport and so the risk of consolidation settlement damaging private assets, or draw-in of contaminants from adjacent sites, will be greater than that assessed for sites 1 and 2; though it may be possible to manage these to a low risk level via appropriate siting, design and construction controls.

## 5.6 Potential for land discharge

Manaaki Whenua Landcare Research undertook a soil investigation at the site to determine the potential suitability to discharge treated wastewater to land (Appendix A). Their site investigation is summarised in Table 8.

Table 8: Site 3 Summary of Suitability to Discharge to Land

| Soils | Constraints | Potential Ability to Discharge Year Round | Implications for Site Selection |
|---|---|---|---|
| Predominantly well-drained Otorohanga family soils. | Both well-drained sites at Penniket Road will accept treated wastewater on a year-round basis if application rates match the soils' infiltration and permeability. However, stocking of 'wet' topsoils should be avoided. Some long-term removal of phosphorus and pathogens by these soils is expected where upper subsoils are loamy. | Yes. | An assessment of soil infiltration rates and confirmation of available land areas would be required to determine whether all stage 1 flows could be discharged within the sites, however the soils are generally well suited. |

## 5.7 Contaminated land risk

### Historical Aerial Review

Historical aerial photos were reviewed and determined the following historic land uses:

- 1953 (Retrolenz) – north site - farm land, no structures present. South site – appears agricultural but some storage of material present along northern boundary.
- 1963 (Retrolenz) – north site – farmland, no structures present. South site – appears agricultural with shed and/or dwelling constructed near centre of the site. Small paddocks/plots could be a crop trial area?
- 1974 (Retrolenz) – No significant changes. Dwelling/shed still present in south site.
- 1986(Retrolenz) – No significant changes. Dwelling/shed still present in south site.
- 2006 – current (Google Earth): no significant changes. Both sites have been cropped at different times (appears to be maize/ corn or similar ag crop). No other structures present other than the southern site dwelling/shed previously observed, remaining.
- Currently - active farmland currently, sheds present on southern site in current aerials but observed to have been removed on site visit

### Assessment

North site area – The site is currently agricultural and has been used as such since as early as 1953 (likely earlier). No structures or differing land uses have been identified in this northern site.

South site area – The site is currently agricultural with two sheds, a stockyard area and silage storage near its centre having been removed in recent years. Site appears to have had smaller paddocks/ plots which could have been a pastoral or cropping trial.

Waikato Regional Council confirmed the site does not appear on their LUIR as a potentially contaminated site.

It cannot be ruled out that land uses in the south site have had contaminating activities operated within, or near them, including:

- Sheep dip / drenching site (stockyard only)
- Potential asbestos (in sheds and structures)
- Hazardous substance storages (including fuel, pesticides etc)
- Pesticide/herbicide application on vegetation plots.

No potential contaminating activity has been identified across the paddocks in the northern site.

It is known that superphosphate fertilizers can result in elevated cadmium levels in agricultural land uses, however, are unlikely to result in a contaminated soil risk or require additional management.

This site will require a Preliminary Site Investigation (PSI), involving a site walkover, to inform the potential risk of land uses and materials surrounding the old sheds, stockyards and historical use of the paddocks in the southern site. Depending on the findings of the PSI, there may be the requirement to undertake targeted sampling in these areas to inform potential contamination risk and management requirements.

This site also needs to consider the neighbouring airport land use and potential PFAS in groundwater contamination issues. While it is unlikely, any discharges to ground and potential effects to groundwater movements would need to consider PFAS and the wider contamination context.

## 5.8 Archaeology

Survey plan, the records of the NZZ, and aerial photography has been reviewed. There are currently no recorded archaeological sites affected by the proposal. Based on the location of these land parcels, no archaeological sites are anticipated.

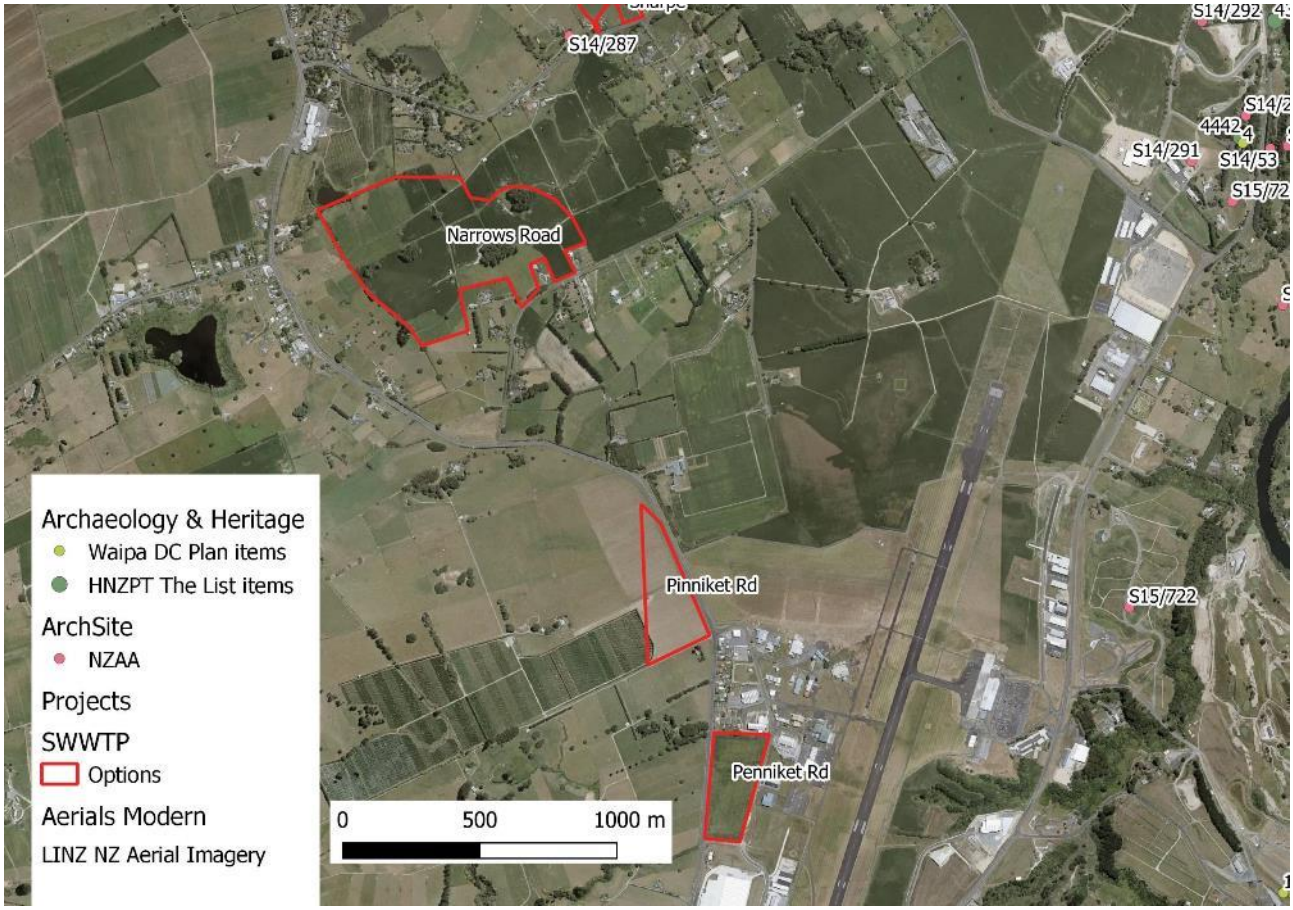


Figure 41: Penniket Road & Narrows/Rukuhia Heritage Landscape

## 5.9 Built Environment

### 5.9.1 Sensitive receptors and buffer distances

The site is located in/adjacent to the Airport Industrial/Commercial area. There are scattered rural residences in the area around the site along with a number of residential dwellings along SH3 within the Airport Industrial/Commercial area. There is very little space available for buffers within the two parts of this site and sensitive receptors are present very close to the site boundaries.

### 5.9.2 Odour

The WWTP could be placed on either the northern or southern site; however, very limited buffers could be provided and there would be residential dwellings within 100m of the WWTP footprint in either case.

It is likely that treatment processes would be located within 5-10m of the site boundary providing no significant odour buffer. While the residential and commercial receptors to the southeast are generally not located within the predominant downwind direction, at least one dwelling is likely to be located within 100m of the WWTP with appropriately another ten dwellings and approximately seven commercial/industrial premises within 300m of the footprint.

There are few other dwellings in the area and the ongoing expansion of Titanium Park (the Airport commercial/industrial development) and the Southern Links Road corridor (to the west of the northern site), the risk of future urban development is lower than other sites.

### 5.9.3 Noise

With very limited ability to create setbacks within the site boundary, achieving prescribed levels at the boundary will be more challenging. Blowers and centrifuges have the highest noise potential, this equipment comes in acoustic enclosures which would be housed withing concrete buildings to minimise noise.

This area is likely to have a lower sensitivity to noise due to ambient noise levels associated with SH3 and airport operations. There would be some change to the noise environment and residents may raise concerns about noise. However, this should be considered within the context of SH3 and the future Southern Links Road network which would also result in a change in noise environment so such changes should not be completely unexpected to residents.

### 5.9.4 Traffic and Access

Access to the northern site is available from Penniket Road as well as an existing access direct to SH3/Ohaupo Road.

Turning in and out of Penniket Road can be challenging due to speed environment and a tight turning radius (especially from the south). The more northern site access direct from SH3 may be easier to upgrade for construction traffic. Construction access to this site may need to be limited to left-in left-out for safety.

The southern site as an existing formed access of SH3/Ohaupo Road or could alternatively be accessed off Ingram Road. The intersection of SH3 and Ingram Road appears to be suitable for larger vehicles; however, similar to the northern site, construction access may need to be limited to left-in left-out.

While there will be increased traffic during construction, both construction and operational traffic impacts are expected to be low within the context of existing traffic flows on SH3.

Southern Links passes to the east of the site and will not impact on the site access location but would be expected to reduce traffic volumes and therefore reduce safety concerns (noting that the timing of Southern Links remains uncertain).

### 5.9.5 Visual

The area around Site 3 is largely flat and few properties have direct views into the sites. However, the site is highly visible from SH3. The visual impact is likely to be lessened by other commercial/industrial premises in the area.

## 5.10 Ecology

### 5.10.1 Vegetation

During the initial site walkover there were no terrestrial vegetation observed within the site boundary. However, in proximity to both properties there are tall exotic and native species that could potentially provide roost habitat for bats.

On the southern site there is a boundary of scrubby exotic vegetation along the edge of the site. The site itself has been cleared of all vegetation and is currently used for cropping.

### 5.10.2 Bats

There are currently no records of bats within the site, however, there are numerous records of long-tailed bats within the riparian corridor of the watercourse located south of the site, which is a tributary of Mystery Creek. Within the site itself there are no tall trees with a DBH of greater than 15 cm, which is considered the minimum DBH for bat roosting trees. Additionally, there are no watercourses identified within the site. As such, there is low potential of bat roosting within the site itself. However, as long-tailed bats have a home

range of 100 km, there is potential of them passing through the site in search of more suitable foraging and roosting habitats.

### 5.10.3 Herpetofauna

There are currently no records of native herpetofauna present within or within proximity to Site 3. As the site appears to be regularly mowed and maintained, there is a low likelihood of lizard presence within the site. However, the scrubby vegetation along the boundary of the southern site can potentially act as habitat for copper skink (*Oligosoma aeneum*) (At Risk – Declining), a secretive species, which occur in a variety of habitats across the North Island including thick rank grass/vegetation, under rocks, logs, and under debris (New Zealand Herpetological Society, n.d.-a).

### 5.10.4 Avifauna

The site presents no suitable permanent habitat for native avifauna species, which is regularly mowed. Additionally, the site is located within an actively used industrial area, therefore, experiences regular disturbance from people and noise traffic.

### 5.10.5 Wetlands

The initial site visit identified no *natural inland wetlands* under the NPS-FM (2022).

### 5.10.6 Freshwater Features

Desktop mapping indicates that there are no watercourses present within the site, which was confirmed during the site visit. However, approximately 350 m west and 1 km south are several tributaries of Mystery Creek, which is a significant stream system off the Waikato River.

Figure 42: Shelterbelt along the edge of the northern site (left) and scrub along the edge of the southern site (right)

From an ecological perspective, Site 3 is considered to have the lowest risk for the placement of a WWTP as there are no moderate or high-risk ecological features identified within the site. As such, the following recommendations are made for Site 3:

1. Due to the confirmed presence of long-tailed bats within proximity to the site, operational disturbances to bats from noise and lighting (during the construction phase) may need to be considered.
2. Due to the ideal habitat within the margins of the site for herpetofauna, lizard management will be required prior to the clearance of any vegetation.

As part of the project, there are numerous opportunities to increase indigenous vegetation as part of restoration/ecological enhancement efforts.

### 5.10.7 Restoration potential

There are limited opportunities for ecological restoration at either site.

## 5.11 Planning

Site 3 is located within Waipā District and is therefore subject to the Waipā District Plan.

The northern parcel is zoned Rural and the southern parcel is zoned Airport Business as part of the Airport Structure Plan Area. The surrounds are Rural and Airport Business Zone. The Southern Links designation runs along the northern parcels site's western boundary.

Key features and overlays within the sites include a series of airport overlays (which are not expected to impact potential development of the sites), and a Viewshaft and SH3 Scenic Corridor which overlays the northern parcel.

It is expected that the WWTP and land discharge area would be designated and therefore not subject to the rules of the Waipā District Plan; however, consideration would need to be given to visual effects on the SH3 corridor. Resource consents are expected to be required from WRC for discharge to air (odour), discharge to land/water (land disposal), and potentially earthworks not meeting permitted activity standards (for construction/installation of the disposal field) as an overall discretionary activity under the Waikato Regional Plan.

The National Policy Statement for Highly Productive Land (NPSHPL) will apply to the northern parcel (southern parcel has a business/commercial zoning, therefore NPSHPL will not apply).

Table 9: Key district and regional plan characteristics

| District Plan | |
|---|---|
| Zone | North: Rural; South: Airport Business Zone (Structure Plan Area) |
| Adjoining zone | Rural, Airport Business Zone, SH3 and Southern Links designations Road corridor adjoins south of southern parcel |
| Zone overlay | North: Airport (horizontal surface, outer control boundary, subsidiary strip approach, transitional slope) – not shown on maps below<br>South: Airport (strategic noise, horizontal surface, night control boundary, outer control boundary, transitional slope) – not shown on maps below |
| Designation | Adjoins Southern Links designation (District Plan reference D156) and SH3 designation (District Plan reference D37), and separated by SH3 from Airport designation (District Plan reference D71) shown in purple outline on zone map |
| Features | Viewshaft and SH3 Scenic Corridor over northern parcel (shown in purple hash on features map)<br>Special Amenity Area over residential properties between the two parcels (shown in red hatch on features map) |

| | |
|---|---|
| Natural hazards | Not located with a District Plan potential flood area |
| **Regional Plan** | |
| Water courses | No watercourses on either site, unnamed tributary to the south connects to Mystery Creek and then the Waikato River |
| Bores | No bores recorded on either parcel but a number of bores and bore consents in the surrounding area |
| **Other planning considerations** | |
| NES Freshwater | No potential wetlands identified |
| NPS Highly Productive Land | Both parcels classified as LUC 1[14] - southern parcel has a business/commercial zoning, therefore NPSHPL will not apply. |
| NES Contaminated Soils | Sheds previously present on the site may have had contaminating activities operated within or near them including asbestos and storage of fuel and pesticides which could trigger the NESCS. |

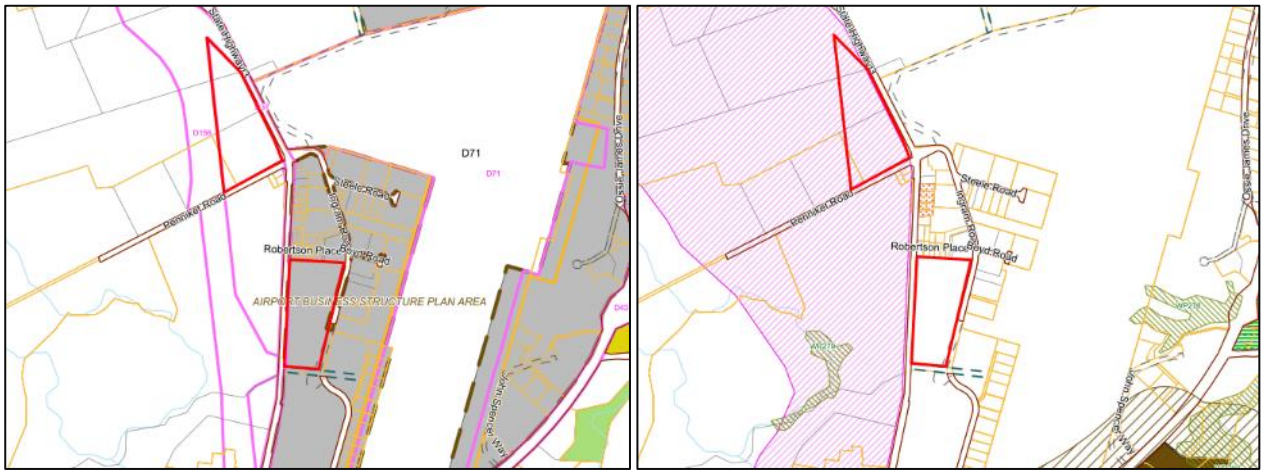


Figure 43: Waipā District Plan maps - zoning (left) and features (right)

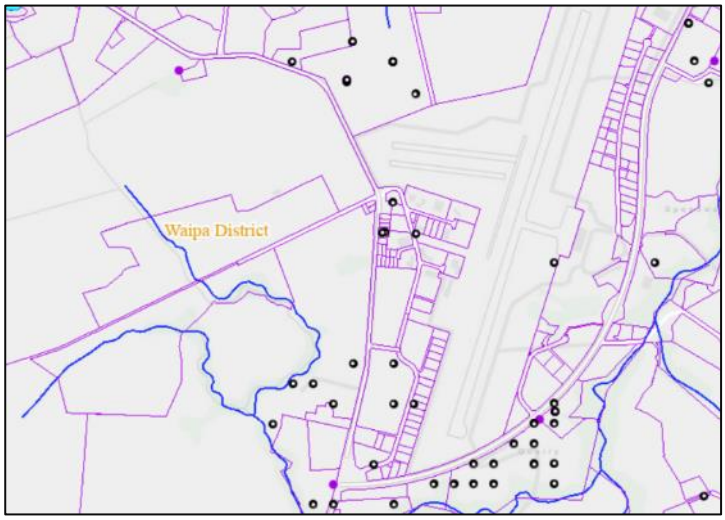


Figure 44: Bores (black) and bore consents (purple) from WRC Groundwater Maps (accessed December 2022)

[14] Land Use Capability 2021 from New Zealand Land Resource Inventory (accessed via LRIS portal December 2022)

# 6 Site 4: Golf Course

## 6.1 Overview

| | |
|---|---|
| Owner | Crown (administered by Waka Kotahi) |
| Address | Airport Road, Tamahere |
| Title & legal description | RT SA25D/881, Lot 2 DPS 27782, part Lot 9 DP 9747, part Lot 1 DPS 11859, Lot 2 DPS 14668 |
| Area | 31 ha |

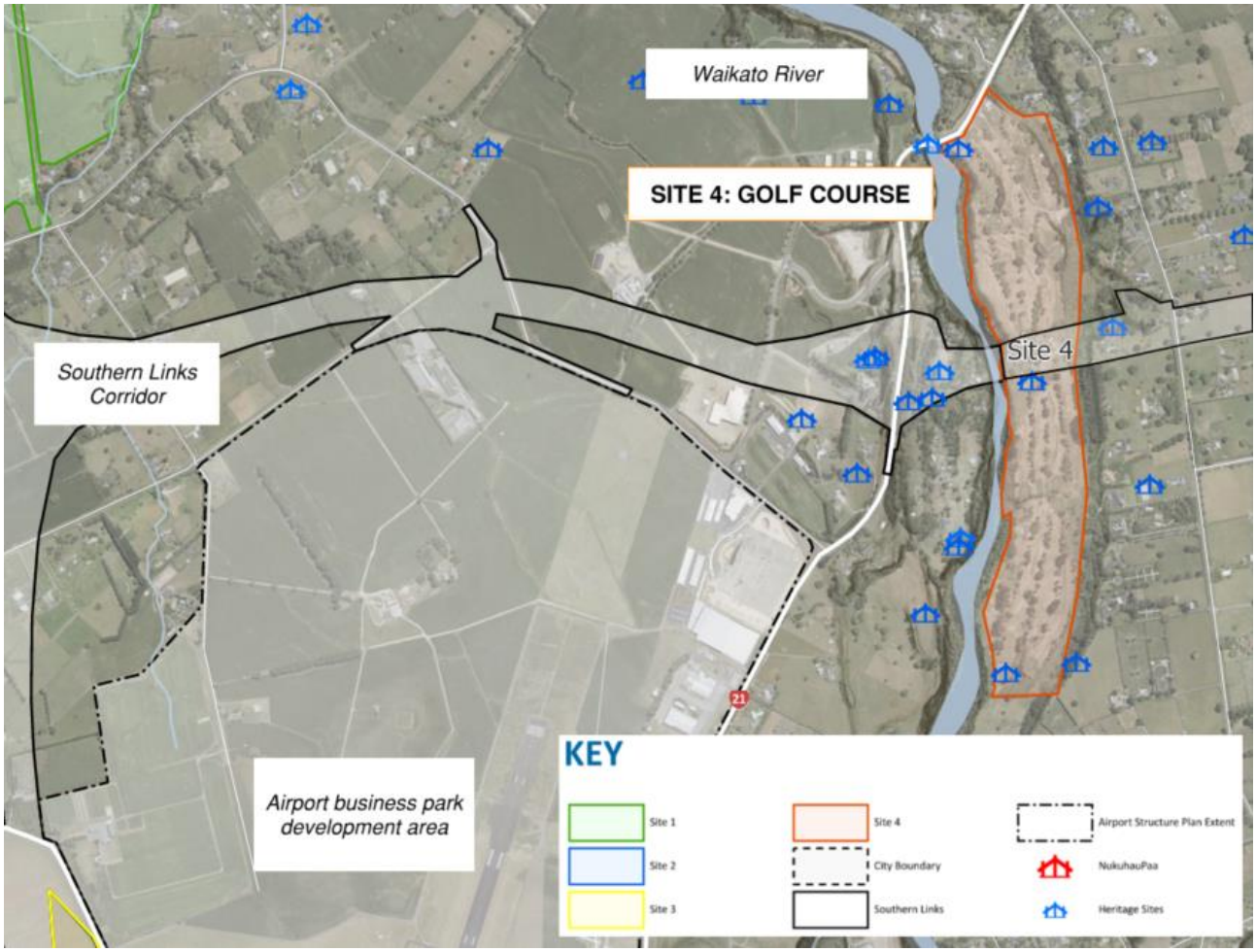


Figure 45: Site 4 location. Note Southern Links Road designation passes though the site and Waikato River runs directly adjacent site

## 6.2 Site layout

Figure 46 shows an early conceptual layout for Site 4 based on the space expected to be required for the "ultimate" design (i.e. 200,000 PE).

The layout seeks to:

- Avoid the known paa site at the southern end of the site
- Maintain access post-Southern Links – the road will bisect the site and may create challenges accessing the southern portion of the site

- Maximise setback from the banks of the Waikato River to minimise geotechnical hazard

Access to the site is from SH21/Airport Road. The speed environment, limited sightlines, and proximity to Narrows Bridge make this a challenging and potentially dangerous access location. While this would improve post-Southern Links, the timing of those works is uncertain. There appears to be space within road reserve (the property boundary runs through the old golf club carpark) that could potentially allow for the access to be moved slightly further north with a righthand turning bay added during construction. However, this would add cost and complexity.

Both WEL and Waipa Networks have 11kV power supplies running past the site. There is a potable water supply to the north end of the site and an existing bore on site (but no current water take consent).

Figure 47 shows the Site 3 waterways and contours while Figure 48 shows the early concept layout for key process units for a 200,000 PE WWTP.

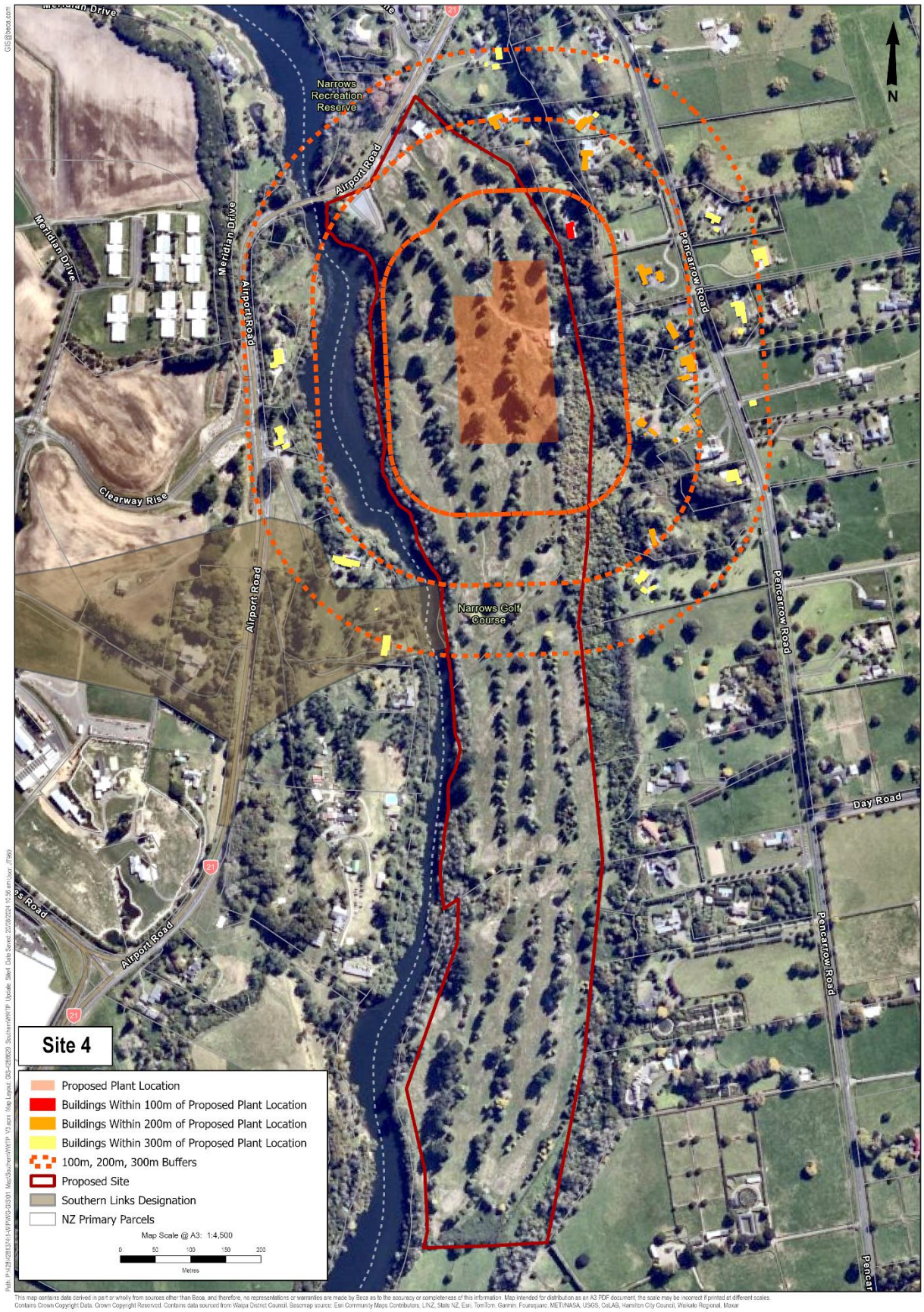


Figure 46: Proposed placement of WWTP within Site 4 showing 100m, 200m and 300m buffers. Site boundary in red.

Figure 47: Site 4 watercourses and contours


Figure 48: Early concept layout for Site 4 showing key process units. Processes colours orange not required until post-Stage 3.

## 6.3 Potential conveyance

Based on the above, the following potential conveyance routes have been identified:

- Catchment Conveyance
  - 1km long sewer rising main (SRM - No.1) from the N12 sewage pump station (SPS)
  - 1.2km long Gravity Sewer (GS - No.1) from SRM – No.1 to a New SPS (SPS – No.1)
  - 1.3km long Gravity Sewer (GS – No.2) to a new SPS (SPS – No.1)
  - 3.4km long sewer rising main (SRM – No.2) from a new SPS (SPS – No.1) to the WWTP via a new pipe bridge
- Treated Effluent Conveyance
  - 1.7km long Rising main (RS- No.1) from the WWTP to the Waikato River

Conveyance to the WWTP will require a crossing of the Waikato River. Using the existing SH21 bridge is not recommended due to the poor structural condition of that bridge; therefore, the proposed route identified includes a new pipe bridge (which is likely to present a consenting challenge). Depending on timing of the Southern Links construction, it would be better to use the Southern Links corridor and new state highway bridge; however, given the uncertainty in timing, the current alternative is proposed.

The potential discharge point to the Waikato River will need to consider:

- The form of the discharge. Mana Whenua have given strong direction that, in general, new structures in the bed of the Waikato River are not appropriate and that some form of land contact is preferred prior to discharge to wastewater to the river. This requires space adjacent the river. The river in this location is narrow with high banks which is likely to present additional challenges.
- Proximity to the Hamilton Water Treatment Plan and confirmation that the discharge would not give rise to issues with potable water supply (with reference to the National Environmental Standards for Sources of Human Drinking Water 2007 and the proposed amended outlined by Ministry for the Environment in 2022). This assessment should also consider the indirect potable re-use enabled by discharging highly-treated wastewater upstream of a large part of its contributing catchment.

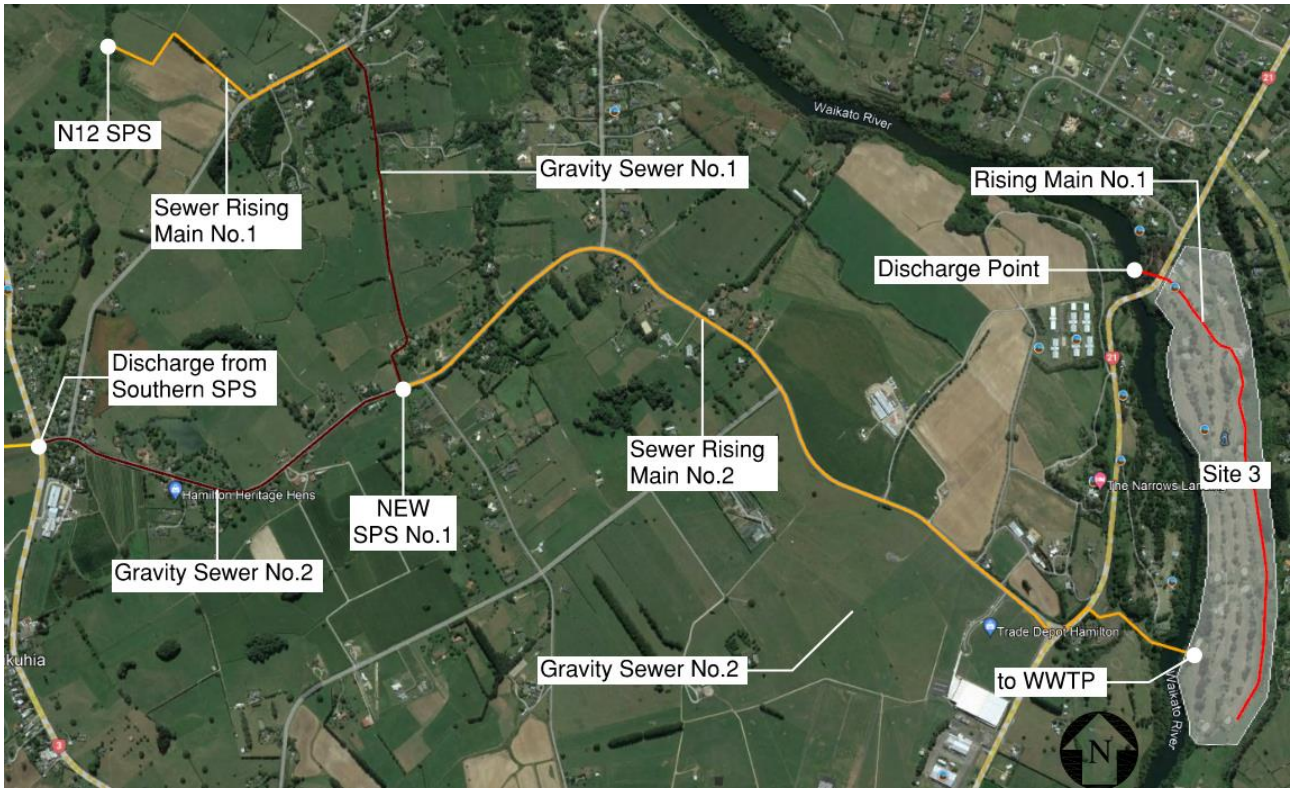


Figure 49: Site 4 Potential Conveyance Routes

## 6.4 Locality and topography

The Golf Course site is located directly adjacent to the Waikato River.

Review of ground elevation contours (WRC LiDAR 1m interval) indicate that the site is at an elevation of 28m RL to 33m RL, likely a down cut river terrace. The land directly to the east of the site is at elevation of 49m RL to 52m RL. The Waikato River flows northward, along the western boundary of the site at a much lower elevation of ~19m RL.

## 6.5 Geotechnical

### 6.5.1 Geology and Ground Conditions

The published geological maps (Edbrooke, 2005[15] and GNS Science QMap, 2020) indicates the site underlain by fluvially deposited pumice sand, silt and gravel alluvium with some charcoal fragments. of the Taupo Formation. This is underlain by older alluvial and volcanic derived materials (e.g. variably weathered Ignimbrite) of the Puketoka Formation.

Review of WRC water bore logs indicates the lithology of the site is likely to be dominated by sands, silts, and gravels to a depth of at least 20m.

[15] Edbrooke, S.W. (compiler) 2005. Geology of the Waikato area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 4. 1 sheet + 68 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited. ISBN 0-478-09877-4

### 6.5.2 Geotechnical Considerations

The western edge of this site is at risk of slope instability, and will require development to be setback from the current slope crest to allow for ongoing shallow losses of the river bank and to meet typical engineering design standards for slope instability.

The lower part of the riverbank is likely to be formed from weakly cemented Ignimbrite of the Puketoka Formation that are somewhat resistant to erosion (hence the narrowing of the river channel at this location). A setback distance of 20m to 30m of the current riverbank crest is suggested for initial siting considerations and will require confirmation by design.

The site area is an old terrace of the Waikato River with evidence of past river channels. Localised areas underlain by weak clayey soils and swampy areas may be encountered across the site. These areas would be prone to high settlement and low bearing capacity.

The Taupo Formation materials include loose sandy soils that will be susceptible to liquefaction where below the ground water table. Liquefaction occurs when loose saturated sand lose strength under earthquake loads. Liquefaction effects include lateral spreading near slopes, post earthquake settlement, low seismic bearing capacity and uplift pressures on buried structures.

Groundwater levels, (as discussed below) are likely to be generally near the base of Taupo Formation, though may be locally perched above silty layers. As such, this hazard may be variable across the extent of the site and will require site specific geotechnical investigations and assessment. Liquefaction induced lateral spreading, if found to occur, may be difficult to manage for this site due to the proximity to the riverbank and potential for large seismic movements to occur.

The high pumice content and generally loose nature of the sands within the Taupo Formation also makes these soils susceptible to piping erosion and the formation of tomos (tunnel like voids). These can pose a risk to structures and infrastructure if not detected and remediated during development. Care is also required to prevent creation of tomos when designing drainage measures. The piping risk is considered a potential fatal flaw for discharge of treated wastewater to land at this site, i.e., land-based discharge may not be feasible.

### 6.5.3 Hydrogeological Considerations

#### Approach to Evaluation

To provide an initial screening of the four sites, the following potential groundwater effects due to construction and / or operation of a wastewater plant were considered:

- Migration of treated wastewater into down-gradient bores, where land-based disposal or treatment is used
- Drawdown from dewatering (or drainage) causing:
  - interference effects in bores in the surrounding area
  - Reducing the groundwater component of baseflow to surface water bodies and / or lowering the water level in wetlands.
  - Migration of contaminants from adjacent sites.
  - Consolidation settlement of assets in the surrounding area

WRC bore and consent records were reviewed to identity if there are bores that could be down or along - gradient from the site, and thus could be a potential receptor for any irrigated wastewater, or which might experience drawdown from any site dewatering activities. Bore details were filtered, and the following bore types were excluded from further assessment:

- Bores with hole diameter less than 90 mm or casing diameter less 50 mm; these are likely to be geotechnical piezometers with no associated water take.

- Bores deeper than 25 m; these are likely to be screened in a much deeper aquifer with slow vertical travel time and some degree of hydraulic disconnect from the surface.
- Bores located on the subject sites; these are assumed to be abandoned / decommissioned as part of the project.

Of the remaining bores, bores screened within the upper 10 m are considered most likely to be potential receptors as they are more likely to be abstracting water from the same shallow aquifer into which the discharge would occur.

The location of consented water takes have also been reviewed to identify if any are specifically identified for potable supply, our could be ignored (e.g., short term diversion consents, or consents located on the site which are assumed to be surrendered as part of project works) however as bores can abstract water as a Permitted Activity or under s14b of the RMA, for the purpose of this assessment all bores (even those without an associated take permits) are assumed to be potentially abstracting water for domestic or potable use.

### Groundwater Flow Direction

This site is located directly adjacent to the Waikato River, and regional groundwater flow will be to the north with some local component discharging to the river. Elsewhere in the Waikato, in similar topographic conditions multiple perched groundwater levels are encountered and should be expected at shallow depths at this site also as a result of vertical layering of soils. These perched water tables often result in seepage in slope breaks and into the riverbanks i.e., shallow groundwater is likely to flow west, directly towards the Waikato River. Shallow groundwater may also flow locally towards constructed ponds on the site (if they are unlined).

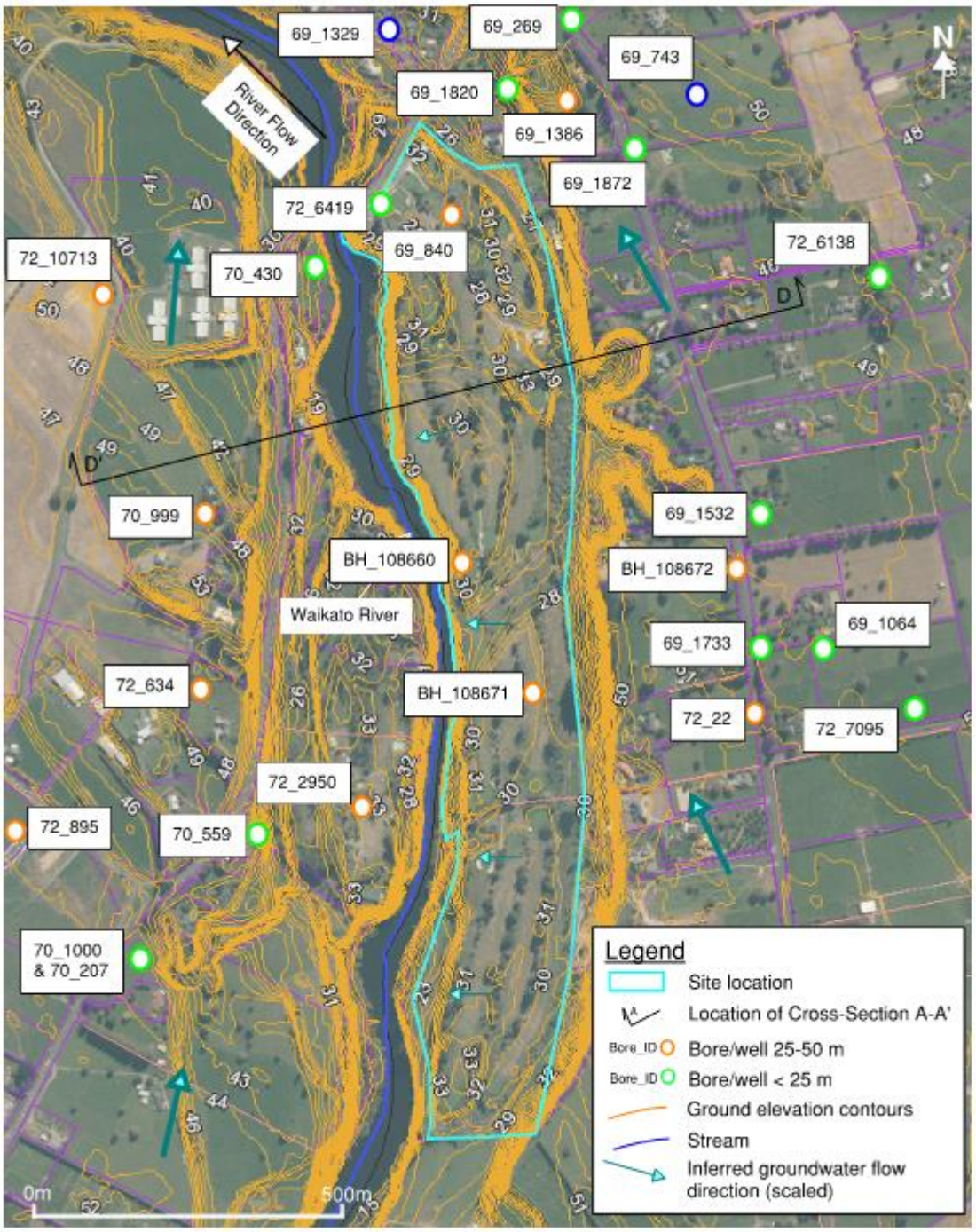


Figure 50: Inferred groundwater flow direction and location of nearest potential groundwater receptors

### Consents and groundwater bores

There are 26 known bores/wells within 600 m of the site, excluding the those located on the opposite side of the Waikato River (Figure 50). Ten are screened at an unknown depth (presumed to be shallow for this assessment) but the remainder are >25 m in depth.

There are no wells or groundwater take consents located directly downgradient of the site.

### Assessment

There is not considered to be any potential groundwater receptors that might be downgradient of any treated wastewater discharge.

As noted in the geotechnical section, given the pumiceous nature of the soils and the likely presence of perched water tables, there would be a risk of site discharges to land reducing the stability of the adjacent riverbanks and / or a risk of piping / tomos developing in the subsurface (as has occurred at Cambridge). This could be a significant site limitation to any discharge and would require specific design checks if the site were to be considered further.

Depths, construction methods, soil permeability and distances from site works would be required to quantitatively assess drawdown impacts. However, given the works would occur on a distinct terrace the risk of drawdown and associated adverse effects extending to higher ground to the east, or the Waikato River to the west, is very low.

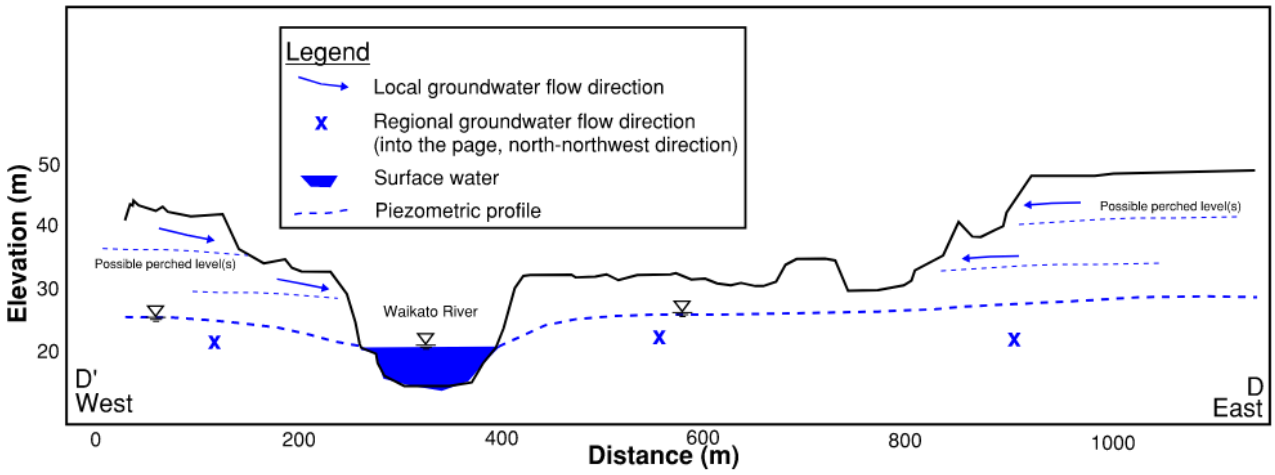


Figure 51: Schematic west-east cross section through site showing inferred groundwater-surface water interaction

## 6.6 Potential for land discharge

Manaaki Whenua Landcare Research undertook a soil investigation at the site to determine the potential suitability to discharge treated wastewater to land (Appendix A). Their site investigation is summarised in Table 10.

Table 10: Site 4 Summary of Suitability to Discharge to Land

| Soils | Constraints | Potential Ability to Discharge Year Round | Implications for Site Selection |
|---|---|---|---|
| Soils are developed in well-drained rhyolitic alluvium deposited by the Waikato River | Surface applied wastewater will potentially move through the soil rapidly, so this site is suitable for year round application of treated wastewater, However, the nature of the soil material indicates little renovation is likely. | Yes. | Hydraulically, the soils at this site could accept wastewater year round, however due to the rapid movement through the soil and close proximity to the Waikato River, little treatment will occur through the land. |

## 6.7 Contaminated land risk

### Historical Aerial Review

Historical aerial photos were reviewed and determined the following historic land uses:

- 1939 (Retrolenz) – farm land, no infrastructure.

- 1943 (Retrolenz) – Narrows Bridge is now constructed, farmland remains with no other notable infrastructure.
- 1953 (Retrolenz) – The very early form of a golf course can be observed with no major infrastructure present.
- 1963 (Retrolenz) – golf course is visible with club house and green keepers shed (in present day position) now visible.
- 1963 – present day (Retrolenz and Google Earth): no significant changes to golf course till present day.
- Currently – retired golf course

### Assessment

The site appeared to be agricultural land until circa 1953 when it was developed into a golf course. Since this time, no other land uses have been identified through a review of historical aerials and the site has been occupied as the Narrows Golf Course.

Waikato Regional Council confirmed the site does appear on their Land Use Information Register (LUIR) as a potentially contaminated site, listed as "*LUI03530 with a classification of 'Unverified HAIL' due to past land use for HAIL activities 'A10. Persistent pesticide use and or storage' and 'A17. Storage tanks for fuel' associated with Narrows Golf Club.*"

Implement sheds (greenkeepers) and the clubhouse buildings were present from pre-1963. The golf course is a registered HAIL from broad application of pesticides. From experience, these applications are concentrated on greens and tee boxes, and to a lesser degree on fairways. It cannot be ruled out that the shed and club house have had contaminating activities operated within, or near them, including:

- Potential asbestos (in sheds and structures)
- Hazardous substance storages (including fuel, pesticides etc).

This site will require a PSI involving a site walkover, to inform the potential risk of land uses and materials surrounding the site. Depending on the findings of the PSI, there is likely the requirement to undertake sampling across the site in the form of Detailed Site Investigation (DSI) to inform contamination risk and management requirements

## 6.8 Archaeology

Survey plan, the records of the NZZ, and aerial photography has been reviewed.

There are three known heritage sites possibly affected by the proposal: two pa and one extensive garden site. There are likely to be additional archaeological sites/ evidence within the proposal. The land is modified by the golf course infrastructure and recontouring. The pa to the north has likely been completely removed.

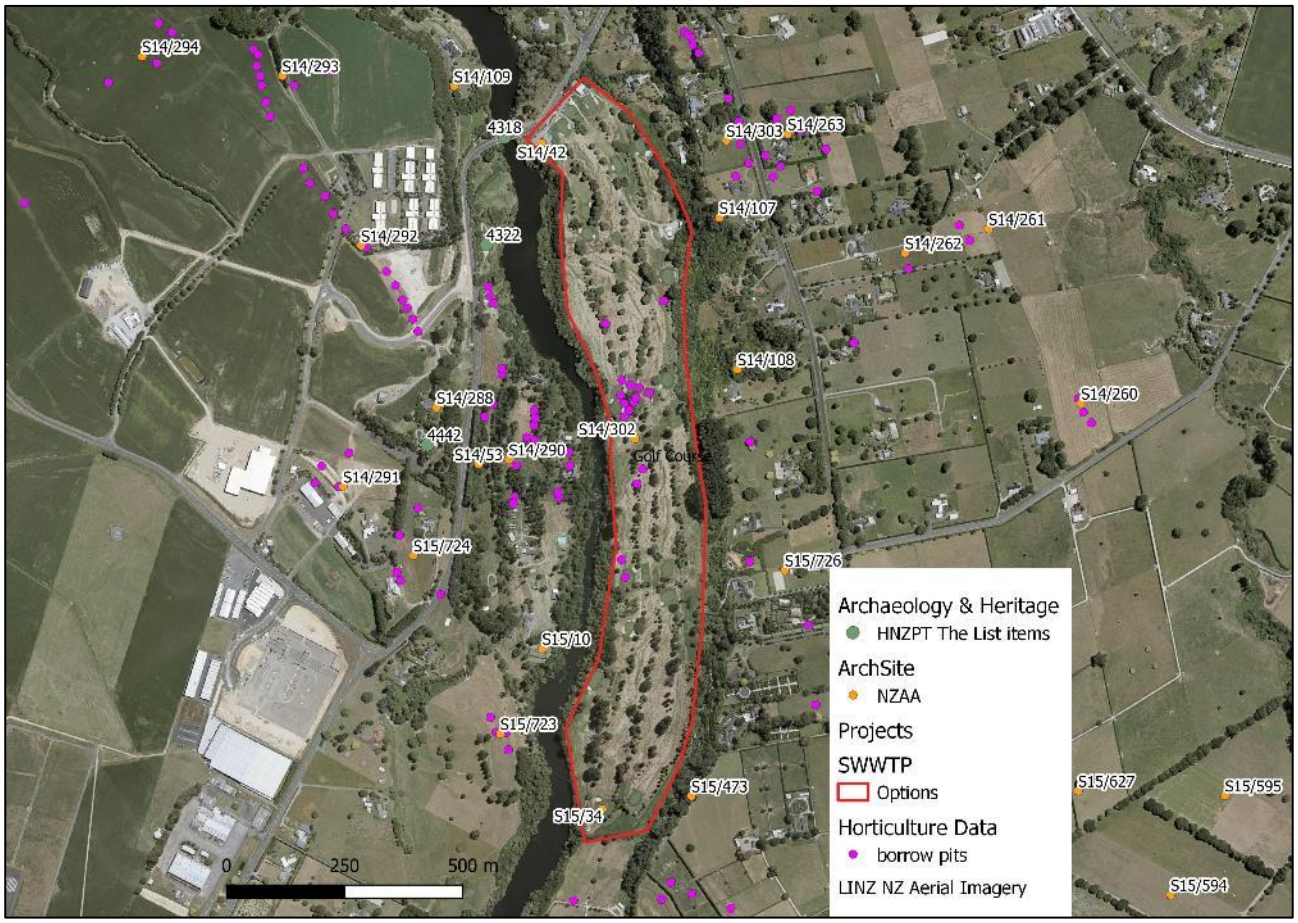


Figure 52: Golf Course Heritage Landscape

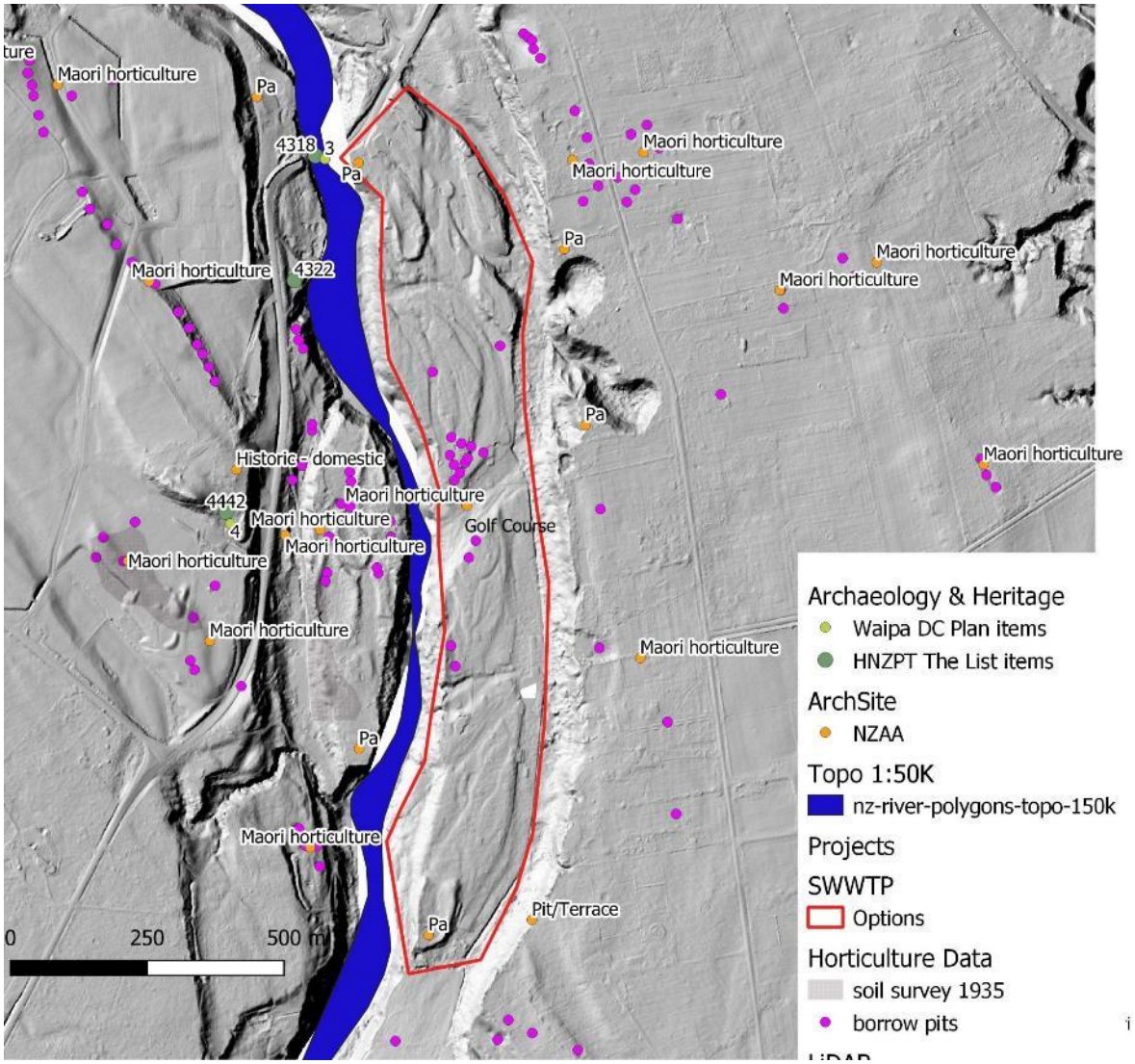


Figure 53: Gold Course LiDAR

## 6.9 Built Environment

### 6.9.1 Sensitive receptors and buffer distances

A number of rural-residential / lifestyle blocks overlook the site from the eastern boundary. These properties typically have a dwelling on the higher terrace overlooking the site with gardens extending to the site boundary.

The future Southern Links Road Designation bisects the site. This will result in a change to the receiving environment during construction and operation of that road corridor.

### 6.9.2 Odour

Due to the need to set back infrastructure from the riverbank, it is difficult to place the WWTP within Site 4 in a way that provides for even a 100m buffer to the site boundary.

Rural-residential and lifestyle block properties sitting on the terrace above the golf course will increase sensitivity of the area to possible odour effect in the event of a plant malfunction. Approximately 19 dwellings would be located within 300m of the WWTP footprint including one within 100m. Most of these dwellings are located to the east of the site, which is in the predominant downwind direction, increasing risk.

A feature of the site is the river running along the site west boundary. There is the potential for winds and any emitted odour to be channelled along the river.

### 6.9.3 Noise

With limited ability to create setbacks within the site boundary, achieving prescribed levels at the boundary will be more challenging. Blowers and centrifuges have the highest noise potential, this equipment comes in acoustic enclosures which would be housed withing concrete buildings to minimise noise.

This area is likely to have a higher sensitivity to noise due to generally low ambient noise. There would be some change to the noise environment and residents may raise concerns about noise. However, this should be considered within the context of the future Southern Links Road network which would also result in a change in noise environment so such changes should not be completely unexpected to residents.

### 6.9.4 Traffic and Access

Access to the site is from SH21/Airport Road. While convenient, the speed environment, limited sightlines, and proximity to Narrows Bridge make this a challenging and potentially dangerous access location.

Although traffic volumes would reduce post-Southern Links construction, the timing of those works is uncertain. There appears to be space within road reserve (the property boundary runs through the old golf club carpark) that could potentially allow for the access to be moved slightly further north with a righthand turning bay added during construction. However, this would add cost and complexity.

While there will be increased traffic during construction, both construction and operational traffic impacts are expected to be low within the context of existing traffic flows on SH21.

### 6.9.5 Visual

Neighbouring dwellings are elevated with direct views into the site. These properties are likely to be sensitive to visual effects due to the significant change from the existing golf course land use.

## 6.10 Ecology

The ecological features identified through a high-level site survey and desktop mapping are displayed in Figure 55.

### 6.10.1 Vegetation

As the site has been historical used as a golf course, a majority of the site has been cleared of original indigenous vegetation. The initial site walkover confirmed that there are numerous tall trees scattered throughout the site, comprising of mixed native and exotic species, with a dominance of pine trees. The rest of the site was covered in long grasses of various species, which has overgrown largely due to the site being unmaintained.

### 6.10.2 Bats

Records available confirm the presence of numerous long-tailed bats both within the site, as well as in neighbouring areas on the adjacent bank (Narrows Camping ground).

A majority of the tall trees are pines, as well as other species, most with a greater than 15 cm DBH. As long-tailed bats predominantly roost within larger, older canopy trees beneath flaking bark or in cavities, there is a high likelihood of this species roosting within trees on the site, as well as utilising the Waikato River, adjacent to the site, as foraging habitat.

### 6.10.3 Herpetofauna

Within Site 4 there appears to be ample suitable habitat for native herpetofauna species including copper skink and pacific gecko including dense ground groundcover vegetation including thick grass, which is preferred by copper skinks. Additionally, as the site is currently overgrown and unmaintained there is likely limited disturbances, which would enable populations to re-establish. Additionally, there are numerous tall trees with loose bark and crevices for pacific gecko, although they are scattered throughout.

### 6.10.4 Wetlands

During the initial site visit no *natural inland wetlands* were identified.

### 6.10.5 Avifauna

Within the site, there is a large amount of suitable roosting, foraging, and breeding habitat for a range of avifauna species. This includes the clusters of tall trees, the riparian margin vegetation, the ponds and watercourse, as well as the unmaintained rank grass that covers the entire site. A majority of species expected within and within proximity to the site would be Not Threatened and Introduced species, however, the rank grass and constructed ponds are expected to provide habitat for some At Risk species too including Australasian pipit, New Zealand falcon, and potentially several shag species which may utilise the ponds. During the site visit, no At Risk or Threatened species were observed, and some passerine species were heard in the trees.

### 6.10.6 Watercourses

This site is located on the eastern boundary of the main Waikato River channel.

During the site visit an (unmapped) watercourse was identified along the eastern boundary of the site and is a tributary of the Waikato River. The watercourse channel comprised of a wetted width ranging from 0.3 – 1.5 m, and wider in some areas. The stream bank also varied from being incised with low connectivity to the floodplain closer to less incised with good connectivity to the floodplain. Riparian coverage was limited to exotic weed growth including *Tradescantia* sp., however, in some areas there were taller trees comprising of mixed native and exotic species, providing suitable shading for the stream. Water depth ranges from 0.2 – 0.5 m and flow was slow. Instream habitat comprised of a mix of pool and run habitats, with areas of large macrophyte growth, which was mainly limited to exotic weeds. Leaf litter and woody debris was noted in some areas, which would provide adequate habitat for macroinvertebrates and fish. Stream substrate comprised of mainly sandy-silt sediment and larger cobbles, or rocks were not observed. Within the site no barriers to fish passage were observed and it is highly likely this watercourse would provide a suitable migration pathway for diadromous native freshwater fish.

### 6.10.7 Freshwater Fauna

As the watercourse identified within the site is a tributary of the Waikato River, there is a high potential for a range of freshwater fauna species to inhabit this freshwater system.

### 6.10.8 Ponds

The property includes several constructed ponds, with some having hydrophytic vegetation along the margins including *Persicaria* sp. According to the NPS:FM (2022) "*a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body*" is not considered a *natural inland wetland*. Historical aerial imagery from 1939 indicates no presence of the ponds, which supports the artificial creation of these ponds. Although not naturally occurring these ponds may provide habitat for waterbirds and/or eels.

Figure 54: Aerial imagery from 1939 of Site 4 (red boundary), no natural or constructed ponds are evident within the site during this time.

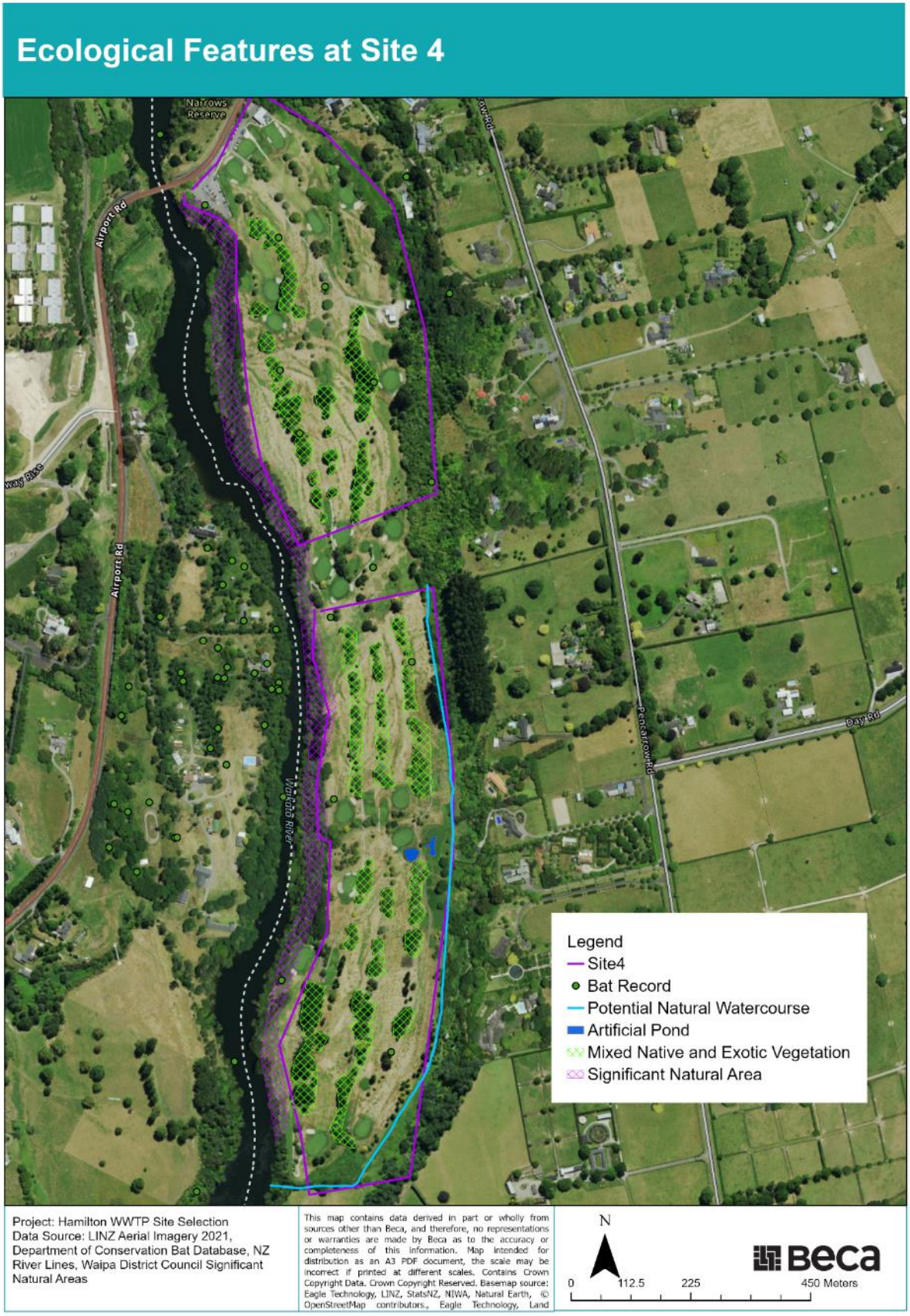


Figure 55: Ecological features identified from desktop mapping and an initial site walkover at Site 4. The mapping of the Significant Natural Area is an approximate only, made from the proposed Waikato District Pla0000000000n map.

Figure 56: Watercourse identified on the eastern boundary of Site 4 (top) and typical vegetation types and distribution across the site (bottom).

There are numerous ecological features identified within Site 4 which will need to be taken into consideration for the placement and proposed works for the WWTP. As such, recommendations at this site include:

1. No fish/aquatic surveys have been carried out at the site, and there is no available data for native fish presence/absence within the watercourse identified at the site. Due to the connectedness of the watercourse with the Waikato River, there is a high likelihood of At-Risk and/or Threatened species residing here. As such, eDNA, MCI, and fish surveying will provide further information on species presence.
2. Due to the confirmed presence of long-tailed bats within and within proximity to the site, bat management will be required prior to the clearance of any suitable roosting trees. In addition to this, operational disturbances to bats from noise and lighting (during the construction phase) may need to be considered.
3. Due to the ideal habitat within the site for herpetofauna, lizard management will be required prior to the clearance of any vegetation.
4. While no wetlands were identified during the initial site walkover, should Site 4 be selected, a wetland survey and delineation should be conducted within 100 m of the proposed location of the WWTP.
5. Avifauna within the site is primarily limited to Introduced and Not Threatened species, however, there is potential for habitat to be suitable to several At Risk species. As most native birds are protected under the Wildlife Act (1953), management will be required prior to the clearance of vegetation.
6. There are numerous opportunities for restoration and ecological enhancement including the restoration of indigenous vegetation across the site as well as along the riparian margins of the watercourse. These efforts will increase the ecological value of the site, as well as manage any adverse effects.

### 6.10.9 Restoration potential

There are a number of opportunities for ecological restoration at this site including enhancement of the unnamed tributary of the Waikato River, increased riparian planting along the Waikato River banks, and enhancement of existing planting to create additional habitat.

## 6.11 Planning

Site 4 is located within Waikato District and is therefore subject to the Waikato District Plan.

The site is zoned Rural under the operative Plan and General Rural under the Proposed Plan. The surrounds are Rural/Country Living (Operative Plan) and Rural/Rural Lifestyle/Open Space (Proposed Plan). The Southern Links designation bisects the site.

Key features and overlays within the site include areas of Outstanding Natural Landscape and Significant Natural Area along with sections of Riverbank Stability Policy Area along the river banks and an Airport Obstacle Limitation Surface (associated with the Hamilton Airport but not expected to impact any WWTP development). There are also a number of identified Sites and Areas of Significance to Maaori.

It is expected that the WWTP and land discharge area would be designated and therefore not subject to the rules of the Waikato District Plan; however, consideration would need to be given to landscape and ecological effects. Resource consents are expected to be required from WRC for discharge to air (odour), discharge to land/water (land disposal), and potentially earthworks not meeting permitted activity standards (for construction/installation of the disposal field) as an overall discretionary activity under the Waikato Regional Plan.

The NPSHPL will apply to the site as will the NESCS.

Table 11: Key District and Regional Plan characteristics

| | |
|---|---|
| **District Plan** | |
| Zone | Operative: Rural; Proposed: General Rural |
| Adjoining zone | Operative: Rural/Country Living; Proposed: Rural/Rural Lifestyle/Open Space |
| Zone overlay | Operative: Landscape Policy Area adjacent Waikato River (green shaded on operative plan map), Airport Obstacle Limitation Surface (not shown on map below)<br>Proposed: Outstanding Natural Landscape (green hash) and Significant Natural Area (green) along Waikato River banks, Airport Obstacle Limitation Surface (not shown on map below) |
| Designation | Southern Links designation bisects the site (District Plan reference J22 / NZTA-11) shown in purple outline on operative plan map and blue outline on proposed plan map<br>Airport Road designation adjoins the site (District Plan reference NZTA-14, proposed plan only) shown in blue outline on proposed plan map |
| Features | Sites and areas of significance to Maaori (red dash outline): 253 and 289 within the site, 271 & 272 overlooking |
| Natural hazards | Areas of the riverbank are identified as River Stability Policy Area |
| **Regional Plan** | |
| Water courses | Waikato River classified as indigenous fish habitat, trout habitat, and contact recreation. |
| Bores | Four recorded bores on the site and a number of bore and bore consents in the surrounding area |
| **Other planning considerations** | |
| NES Freshwater | No potential wetlands identified |
| NPS Highly Productive Land | Classified as LUC 3[16] |
| NES Contaminated Soils | The site appears on WRC's Land Use Information Register (LUIR) as a potentially contaminated site which will trigger the NESCS. |


Figure 57: Waikato District Plan maps - operative (left) and proposed (right)

[16] Land Use Capability 2021 from New Zealand Land Resource Inventory (accessed via LRIS portal December 2022)


Figure 58: Bores (black) and bore consents (purple) from WRC Groundwater Maps (accessed December 2022

# PART B: Short-list assessment

# 7 Site selection methodology

The site selection (short-list) process is set out in Figure 59 and each step explored further in the following sections. The process has been characterised by collaborative decision points where project partners (including HCC and iwi and hapuu representatives) provided input into the site selection process.

The options development and assessment process has been a collaborative effort between the project team and project partners (including HCC and iwi and hapuu representatives). A series of technical workshops and mana whenua hui were held with relevant parties to seek input to the options assessment. The technical MCA and mana whenua assessments were carried out in parallel and are given equal weighting in consideration of the preferred option.

The outputs of these meetings were an assessment process and a preferred option and are described below.

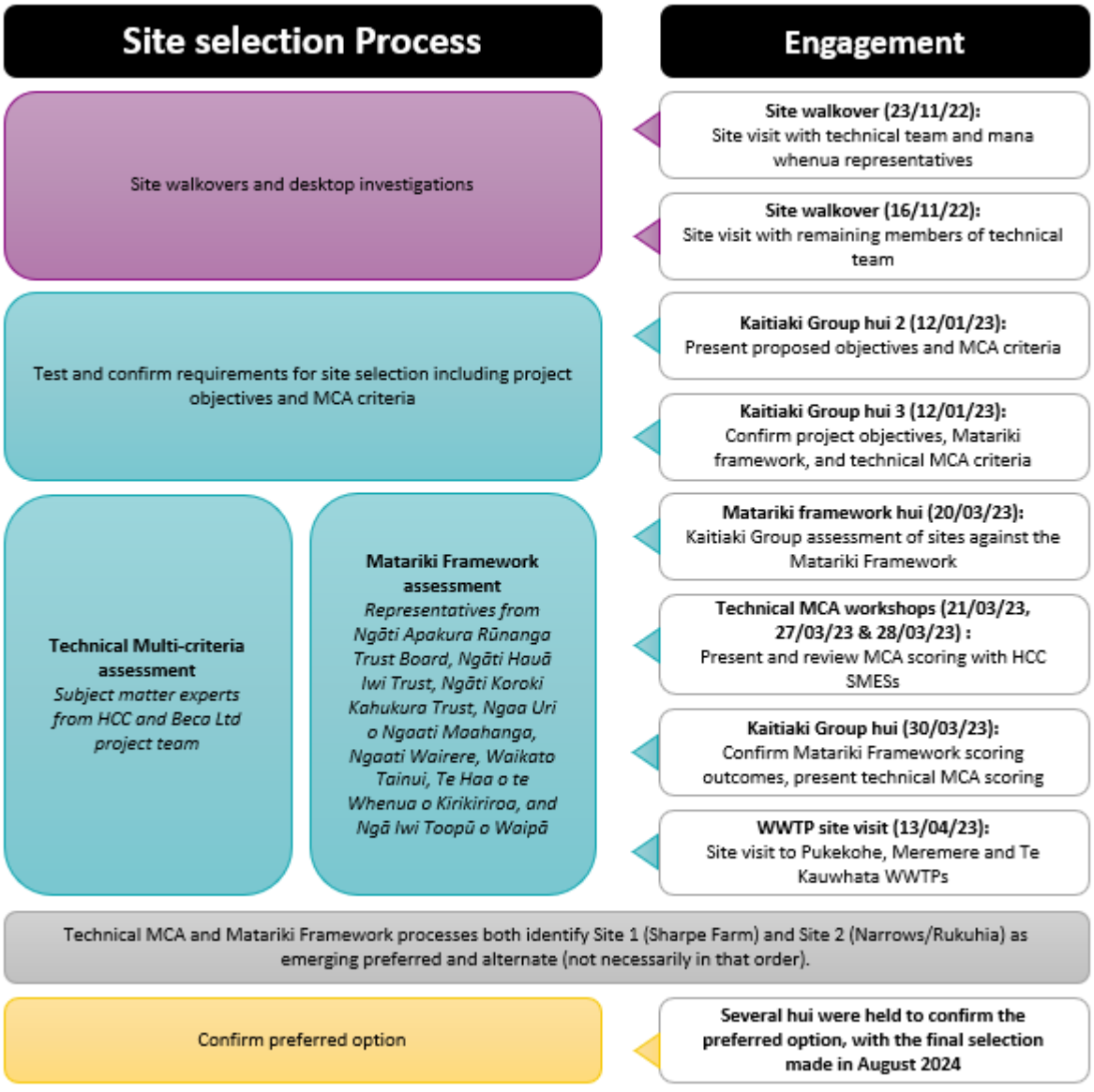


Figure 59: Site selection (short-list) process

# 8 Tangata Whenua Effects Assessment

The SWWTP Kaitiaki Group undertook an assessment against a Matariki Framework developed for the Project.

The sections below have been extracted from the minutes of a hui held on 20 March 2023 for the purposes of scoring the Matariki Framework.

## 8.1 Te Kāhui o Matariki

Matariki atua ka eke ki te rangi e
Te kaiwhakahaere o te kāhui
Haria mai rā te oranga o te tangata
E tū e, te paki o Matariki

Matariki rising in the sky
The conductor of the cluster
Bestow health on all people
Stand bright, Matariki, a sign of wellbeing

Matariki signals what has become known as the 'Māori New Year', is linked to the well-being of the people and is a time of rest and renewal. 'Te paki o Matariki' means 'the bright star of Matariki' and is a herald of wellbeing and peace. Te Paki o Matariki is the coat of arms of the Kīngitanga. The Matariki cluster of stars have been adopted into a Mātauranga Matariki framework with the Matariki atua personifying the themes and ordering mana whenua issues and solutions. The Matariki Atua are:

- Matariki: is the central star and mother of the other stars. She ensures they rise together to mark the new year. Matariki is associated with wellbeing.
- Pōhutukawa: is connected to those who have passed since Matariki the previous year. Pōhutukawa prompts us to reflect on the past year.
- Tupuānuku: 'Tupu' means 'new shoot' or 'grow'. Tupuānuku is connected to food grown in the ground.
- Tupuārangi: is connected to everything that grows above the earth or from the sky such as birds and berries.
- Waitī: is connected to freshwater and all living things that inhabit rivers, lakes, streams, and wetlands.
- Waitā: is associated with the ocean and represents the many types of food we gather from the sea.
- Waipunarangi: is connected to rain. Her name means 'water that pools in the sky'.
- Ururangi: is connected to the winds. His appearance predicts the winds for the year.
- Hiwa-i-te-rangi: signals the promise of the new season. She is the youngest (pōtiki) of the cluster.

Many of the issues and solutions are applicable across several atua (domains) but, to prevent duplication, the issue and solution is placed in the dominant atua. Given the distance of the activity from the sea, Waitī and Waitā are combined into a single theme as any impact on Waitī has the potential to impact on Waitā. There are no specific issues and mitigation measures associated with the Waipunarangi atua but that is combined with Ururangi.

The Tangata Whenua Effects Assessment (TWEA) is a separate document which refers to the engagement process for engaging with Tangata Whenua and the process of deciding upon the preferred site.

# 9 Multi-criteria assessment

## 9.1 MCA methodology

The short-list options were assessed using a Multi-Criteria Assessment (MCA) framework. An MCA process goes beyond assessing monetised or quantifiable benefits and allows for a subjective assessment of a range of environmental and social benefits. The MCA uses a scoring system to assess each option against project-specific criteria.

The short-list assessment criteria are set out in Table 12. For the short-list assessment, a rating scale was implemented to determine compliance with the criteria on a gradual scale ranging from 10 being the 'best' to 1 being 'worst'. A scoring rationale was prepared with input from each of the technical experts to guide consistent decision making from the technical experts (Table 13). The measures, key considerations, assumptions, and exclusions for each criteria were developed prior to scoring and updated as scoring progressed to clearly outline what was and wasn't considered and help drive consistency in scoring.

Table 12: MCA criteria

| Ref | Criteria | | |
|---|---|---|---|
| **Operational** | | **Natural environment** | |
| 1a | Ability to discharge stage 1 flows to land | 5a | Potential for impacts on the natural character of wetlands, rivers and lakes and their margins |
| 1b | Accessibility from transport corridors for operation | 5b | Potential for impacts on aquatic and terrestrial ecology including vegetation, fish, birds, bats and lizards |
| 1c | Access to utilities/power | 5c | Potential for impacts on groundwater users and surface water quality |
| 1d | Greenhouse gas emissions | 5d | Potential for impacts on highly productive soil |
| 1e | Treatment plant hydraulics (ie requirement for pumping) | | |
| 1f | Operability and flexibility during operation | | |
| 1g | Future proofing | | |
| **Conveyance** | | **Built environment** | |
| 2a | Distance and complexity of pipelines from contributing catchments | 6a | Potential for odour effects |
| 2b | Distance and complexity to potential river discharge sites | 6b | Potential for noise effects |
| **Mana whenua** | | 6c | Potential for landscape and visual effects |
| Not assessed. Mana whenua have undertaken a parallel assessment. | | 6d | Potential for archaeological impacts |
| **Physical** | | 6e | Potential for heritage impacts |
| 4a | Liquefaction and geotechnical risk | 6f | Alignment with long term growth / alternative land uses |
| 4b | Potential impacts of contaminated soil | | |
| 4c | Flooding risk | | |
| 4e | Buildability | | |

Initially, Beca technical experts were asked to score the criteria in their field of expertise using professional judgement and provide justification for the scoring, including any assumptions. This scoring is based on the desktop reviews undertaken and the site walkovers. Experts were asked to comment on the level of certainty of their assessment and note where further information may be required and what additional assessments will be necessary.

These scores were then presented and challenged in an interdisciplinary MCA workshop with representatives, including subject matter experts, from HCC. Subsequently, a number of the initial scores were changed. New criteria 1f and 1g were added during discussions with HCC experts to capture the importance of operability of the site and the ability to support on-going development of the site while the WWTP remains operational. A record of the technical MCA workshop is included in **Appendix B**.

In the first instance, scoring of the criteria was undertaken on an ‘equal-weighting’ basis as if each of the criteria had the same level of importance.

Once scoring was confirmed, a weighting/sensitivity exercise was undertaken to review whether changing the weight assigned to criteria changed the preferred option. This acknowledges that some criterion may have more weight (importance) than others.

Table 13: Assessment criteria for the short list MCA.

| Number | Criteria | Measures, key considerations, assumptions, and exclusions | Score = 1 (very low) | Score = 2 - 4 (low) | Score = 5 - 7 (medium) | Score = 8 - 10 (high) |
|---|---|---|---|---|---|---|
| **Operational** | | | | | | |
| 1a | Ability to discharge stage 1 flows to land | Based on Manaaki Whenua Report "Soil information for four Hamilton Southern WWTP land treatment sites".<br>Considers soil type, drainage, ability of land to take required flows. Assumes discharge to land is via sub-surface drip (avoiding odour and spray drift considerations). Assumes purpose of discharge to land is for disposal only (ie no further treatment is required).<br>Does not include geotechnical risk or groundwater quality effects (covered in 4a and 5c below) | Very limited ability for discharge (i.e. due to poor soils, steep slopes, or waterway buffer exclusions) and/or very impractical layout. | Limited ability for discharge (i.e. due to poor soils, steep slopes, waterway buffer exclusions, inability to discharge in winter/shoulder seasons) and/or impractical layout. | Moderate ability for discharge, however with some limitations (e.g. limited treatment potential through soils, high soil moisture in winter preventing discharge). | Well suited soils to land discharge with only minor limitations |
| 1b | Accessibility from transport corridors for operation | Based on desktop review.<br>Considers access to/from roads suitable for on-going operational access (construction access considered under 4d). Assessment based on current road network but notes where there may be changes in access post-Southern Links (opportunities and limitations). Highlights potential opportunities to improve access.<br>Assumes access available off any point where property boundary meets road reserve but notes where there is a risk (especially on SH). | Very poor proximity to roads and/or inappropriate sightlines and/or significant safety concerns with no options to improve (when compared to other sites) | Relatively low proximity to roads and/or poor accessibility/sightlines (when compared to other sites) | Moderate proximity to roads and average accessibility with reasonable sightlines (when compared to other sites) | Relatively high proximity to roads and good accessibility (when compared to other sites) |
| 1c | Access to utilities/power | Based on desktop review.<br>Proximity to High Voltage power supply and water supply. Further investigation may be required to determine water supply capacity. | Very poor proximity to power supply and/or very poor level of existing services (when compared to other sites) | Relatively low proximity power supply and/or poor level of existing services (when compared to other sites) | Moderate proximity to power supply and average level of existing services (when compared to other sites) | Relatively high proximity to power supply and high level of existing services (when compared to other sites) |
| 1d | Greenhouse gas emissions | Based on high-level consideration of likely pipe and pump requirements.<br>Considers greenhouse gas emissions from conveyance, network power and total emissions. Assumes the imbedded carbon and operational carbon emissions from the WWTP itself will be largely consistent across sites - while there may be a small difference in travel carbon, the key differentiator is conveyance.<br>Noted that this scores a very similar effect to 2a and 2b (which should be recognised in any weighting exercise) | Very high level of greenhouse gas emissions (when compared to other sites) | High level of greenhouse gas emissions (when compared to other sites) | Moderate level of greenhouse gas emissions (when compared to other sites) | Low level of greenhouse gas emissions (when compared to other sites) |
| 1e | Treatment plant hydraulics (ie requirement for pumping) | Based on site topography.<br>Considers treatment plant hydraulic operability and likely pumping requirements based on topography. | NA | Existing slopes likely to result in additional pumping requirements | Limited potential to use existing slopes to minimise pumping through WWTP. | High potential to utilise existing slopes to minimise pumping through WWTP. |
| 1f | Operability and flexibility during operation | Based on site size, shape, and any confining features.<br>Considers ease of operation of the WWTP including consideration of space around processes for operations and maintenance (including parking, deliveries, typical maintenance activities) | Site does not provide sufficient space for operation of the WWTP. | Limited space for operations and maintenance and/or site shape or features expected to present some challenges. | Some restrictions expected due to size/shape/features but not expected to present any significant impediment to operations. | Site large enough and provides plenty of usable space for operations with few restrictions. |
| 1g | Future proofing | Based on site size, shape, and any confining features.<br>Considers the ability to grow the site in future including consideration of space for future expansion and construction of future stages | Site does not have sufficient space for future upgrades. | Limited space for future upgrades/renewals and/or site shape or features expected to present some challenges. | Some restrictions expected due to size/shape/features but not expected to present any significant impediment to operations. | Site large enough to accommodate future expansion including renewals and replacement with few restrictions. |

| Number | Criteria | Measures, key considerations, assumptions, and exclusions | Score = 1 (very low) | Score = 2 - 4 (low) | Score = 5 - 7 (medium) | Score = 8 - 10 (high) |
|---|---|---|---|---|---|---|
| | | beyond 200,000 PE (noting that existing processes need to remain on-line while new processes are constructed) as well as renewals and replacement (again noting that existing plant needs to remain operational while replacements are constructed). | | | | |
| **Conveyance** | | | | | | |
| 2a | Distance and complexity of pipelines from contributing catchments | Ability to and complexity of connecting the site to contributing catchments, based on connecting to network as per Southern Link works. | Very long pipelines and greater pump station requirements (when compared to other sites) | Longer pipelines and greater pump station requirements (when compared to other sites) | Moderate length pipelines and moderate pump station requirements (when compared to other sites) | Shorter pipelines and lesser pump station requirements (when compared to other sites) |
| 2b | Distance and complexity to potential river discharge sites | Potential options to link the site to the Waikato River for a future river discharge. Considers only the length and potential complexity of routes along roads/paper roads as a high-level feasibility consideration. Does not include consideration of the form of discharge structure or any land or engineering requirements associated with such a structure.<br>Assumes that there would be a pump station on the WWTP discharge for all options (ie not gravitating) | Very poor proximity/ease of access to potential discharge sites (when compared to other sites) | Relatively low proximity/ease of access to potential discharge sites (when compared to other sites) | Moderate proximity/ease of access to potential discharge sites (when compared to other sites) | Relatively high proximity/ease of access to potential discharge sites (when compared to other sites) |
| **Mana whenua** | | | | | | |
| Not assessed. Mana whenua have undertaken a parallel assessment. | | | | | | |
| **Physical** | | | | | | |
| 4a | Liquefaction and geotechnical risk | Based on desktop review and site walkover. Considers complexity and risk of construction (e.g. suitability of ground conditions, ability to meet requirements of programme and staging), on-going operational stability and earthquake risk, land stability risk associated with discharge to land. | High construction risk/risk of liquefaction when compared to other sites. | Moderate to high construction risk/risk of liquefaction risk when compared to other sites. | Moderate to low construction risk/risk of liquefaction compared to other sites. | Very low construction risk/risk of liquefaction compared to other sites. |
| 4b | Potential impacts of contaminated soil | Based on desktop review of historic land use. Considers risk of human health effects during construction and risk of continued discharge to the environment as a result of land discharge. | Adverse effects of soil contamination are likely to be significantly adverse. | Adverse effects of soil contamination will take considerable effort to mitigate. | Minor adverse effects of soil contamination are relatively simple to mitigate. | Very minor effects of soil contamination (if any) can be avoided. |
| 4c | Flooding risk | Based on District Plan flood mapping and site observations.<br>Considers flooding risk during construction and operation, . | Use of this land would result in a very high probability of flooding during construction or operation | Use of this land would result in a high to moderate probability of flooding during construction or operation | Use of this land would result in a moderate to low probability of flooding during construction or operation | Use of this land would result in a low probability of flooding during construction or operation |
| 4e | Buildability | Consideration of access to the site for construction, likely earthworks/ground preparation requirements, level of environmental controls expected (e.g. erosion and sediment management) | Site topography very poor/ challenging compared to other sites and/or significant construction challenges identified.<br>Very poor proximity to roads and/or very poor internal access (when compared to other sites) | Site topography poor/ challenging compared to other sites or moderate construction challenges identified.<br>Relatively low proximity to roads and/or poor internal access (when compared to other sites) | Site topography generally flat compared to other sites and only minor construction challenges or additional requirements identified.<br>Moderate proximity to roads and average internal access (when compared to other sites) | Site topography generally flat compared to other sites and no notable construction challenges or additional requirements identified.<br>Relatively high proximity to roads and good internal access (when compared to other sites) |
| **Natural environment** | | | | | | |
| 5a | Potential for impacts on the natural character of wetlands, | Based on desktop reviews and site walkover. Considers proximity to natural wetlands, streams, rivers and their margins and potential for impact on character. Considers the potential for restoration | Adverse effects on natural character are likely to be significantly adverse. | Adverse effects on natural character will take considerable effort to mitigate. | Minor adverse effects on the natural character that are relatively simple to mitigate/good mitigation options exist. | Very minor effects on natural character (if any) can be avoided and good mitigation options exist. |

| Number | Criteria | Measures, key considerations, assumptions, and exclusions | Score = 1 (very low) | Score = 2 - 4 (low) | Score = 5 - 7 (medium) | Score = 8 - 10 (high) |
|---|---|---|---|---|---|---|
| | rivers and lakes and their margins | activities to have a positive impact on natural character. | | | | |
| 5b | Potential for impacts on aquatic and terrestrial ecology including vegetation, fish, birds, bats and lizards | Based on desktop reviews and site walkover. Considers potential for effects on aquatic and terrestrial ecology, flora and fauna and their habitats. Considers the potential for restoration activities to have a positive impact on aquatic and terrestrial ecology. | Adverse effects on aquatic and terrestrial ecology are likely to be significantly adverse. | Adverse effects on aquatic and terrestrial ecology will take considerable effort to mitigate. | Minor adverse effects on aquatic and terrestrial ecology that are relatively simple to mitigate. | Very minor effects on aquatic and terrestrial ecology (if any) can be avoided. |
| 5c | Potential for impacts on groundwater users and surface water quality | Based on desktop review.<br>Considers potential impacts associated with migration of treated wastewater or accidental spills to down gradient bores during operation of the WWTP and/or discharge to land as well as drawdown if dewatering required during construction (including consideration of interference effects, reducing groundwater flow to surface water or wetlands, migration of contaminants, and settlement). Based on presence of downgradient bores rather than use (which cannot always be easily determined. | Adverse effects of ground and surface water contamination are likely to be significantly adverse. | Adverse effects of ground and surface water contamination will take considerable effort to mitigate. | Minor adverse effects of ground and surface water contamination are relatively simple to mitigate. | Very minor effects of ground and surface water contamination (if any) can be avoided. |
| 5d | Potential for impacts on highly productive soil | Based on desktop review.<br>Considers presence of LUC 1-3 soils and change in land use that would result in loss of potential productive capacity (noting that the NPSHPL is based on potential capacity not current capacity). Assumes site is designated therefore there is a pathway through the NPSHPL. | Adverse effects on or loss of highly productive soil are likely to be significantly adverse. | Adverse effects on or loss of highly productive soil will take considerable effort to mitigate. | Minor adverse effects on or loss of highly productive soil are relatively simple to mitigate. | Very minor effects or loss of on highly productive soil (if any) can be avoided. |
| **Built environment** | | | | | | |
| 6a | Potential for odour effects | Based on desktop review, aerial photography, and potential site layouts as outlined in the Site Selection Report.<br>Considers the ability to provide for a 150m odour buffer within the site and number of sensitive receptors beyond 150m, but within 300m of the proposed site. Considers in particular the ability to site high risk treatment processes (inlet works, primary sedimentation, sludge thickening, digestors) more than 150m from site boundary and/or existing dwellings. Assumes dewatering is closed and vented to odour control. Consideration of potential development adjacent site that could increase number of sensitive receptions. Based on potential siting of WWTP within the site with consideration of how shifting the location may change the number of impacted parties. | Minimum 150m odour buffer cannot be provided between nearest dwellings and high risk treatment processes and unable to practicably mitigate potential odour risk leading to very high consentability constraints. | Minimum 150m odour buffer cannot be provided within the site for the proposed high risk treatment processes but there is at least 150m to the nearest existing dwelling.<br>High potential consentability constraints as a result of odour risk (actual or perceived) | Minimum odour buffer of 150m can be provided within the site, but some dwellings located within 300m of the proposed high-risk treatment processes.<br>Moderate potential consentability constraints as a result of odour risk (actual or perceived) | Minimum odour buffer of 150m can be provided within the site, and no dwellings are located within 300m of the proposed high-risk treatment processes.<br>Low potential consentability constraints as a result of odour risk (actual or perceived) |
| 6b | Potential for noise effects | Based on desktop review and potential site layouts as outlined in the Site Selection Report.<br>Considers noise effects on people during operation and construction including noise from the WWTP operation and traffic noise. Qualitative assessment based on proximity of site to sensitive receptors and experience at other WWTPs. Includes consideration of how the future Southern | Adverse effects on noise receptors are likely to be significantly adverse. | Adverse effects on noise receptors will take considerable effort to mitigate. | Minor adverse effects on noise receptors that are relatively simple to mitigate. | Very minor effects on noise receptors (if any) can be avoided. |

| Number | Criteria | Measures, key considerations, assumptions, and exclusions | Score = 1 (very low) | Score = 2 - 4 (low) | Score = 5 - 7 (medium) | Score = 8 - 10 (high) |
|---|---|---|---|---|---|---|
| | | Links Road may impact on the receiving environment. | | | | |
| 6c | Potential for landscape and visual effects | Impact on landscapes and visual amenity. Based on topography and observations during site walkovers. Takes into consideration potential for screening. | Adverse effects on landscape and visual receptors are likely to be significantly adverse. | Adverse effects on landscape and visual receptors will take considerable effort to mitigate. | Minor adverse effects on landscape and visual receptors that are relatively simple to mitigate. | Very minor effects on landscape and visual receptors (if any) can be avoided. |
| 6d | Potential for archaeological impacts | Based on archaeologist review of recorded sites and discussion with landowner | Significant archaeological site(s) expected to be impacted, with significant impacts expected, unlikely to be able to mitigate effects beyond an authority to modify/destroy. | Archaeological site(s) within proximity of the site and effects on archaeological values will take considerable effort to mitigate. | Archaeological site(s) expected to be impacted but effects are relatively simple to mitigate. | Archaeological site(s) present but effects on archaeological values can be easily avoided, or no archaeological site(s). |
| 6e | Potential for heritage impacts | Considers listed heritage buildings and places not covered under archaeology above. | Some heritage sites within proximity of the site and effects on heritage values are likely to be significantly adverse. | Some heritage sites within proximity of the site and effects on heritage values will take considerable effort to mitigate. | Some heritage sites within proximity of the site. Effects on heritage values are relatively simple to mitigate. | Some heritage sites within proximity of the site but effects on heritage values can be avoided; or no heritage sites within proximity of the site. |
| 6f | Alignment with long term growth / alternative land uses | Consideration of whether the site aligns with expected longer term development of the area and whether there are other potentially better uses of the site. | Site significantly impacts on potential long term growth aspirations of Waipā and HCC and/or development inconsistent with growth strategies | Site potentially impacts (to a moderate extent) on potential long term growth aspirations of Waipā and HCC and/or development has some inconsistency with growth strategies | Site potentially impacts (to a low extent) on potential long term growth aspirations of Waipā and HCC and can be managed within growth strategies and/or other potential site uses identified | Site does not impact on potential long term growth of Waipā or HCC and fits within growth strategies and limited other uses of the site available |

## 9.2 MCA scoring

### 9.2.1 Raw scores

Full detail of the MCA scoring, including rationale, is included in **Appendix C**. The raw scores are summarised in Table 14.

Sites 1 and 2 score medium-high against all criteria except for two criteria each:

- Site 1 scores low against ability to discharge to land (both score low) and potential archaeological impacts
- Site 2 scores low against ability to discharge to land (both score low) and potential ecological impacts

The potential adverse effects on archaeology and ecology respectively are expected to be manageable with effects able to be minimised or mitigated with good design and construction practices. This includes an assumption that the kahikatea stands on site 2 can be avoided and that effects on bats and other species using those remnant stands can be either avoided (though design) or mitigated/offset through restoration planting. However, the ecological risk remains high for site 2 (as reflected in the scoring) and further work would be required if this site is chosen.

Site 3 scores highly in areas relating to potential ecological and archaeological effects and buildability and has the highest potential for discharge to land. However, this site scores very low against operability criteria and potential for odour impacts and low on a number of other criteria. In particular, MCA attendees highlighted that this site is too small to provide for security of operation and maintenance activities, especially with the split site.

Site 4 scores very low in relation to conveyance from contributing catchments (due to distance and the need for a river crossing) and scores low on a range of other criteria.

The Beca technical experts and the HCC experts agreed that, overall, Sites 1 and 2 appear generally appropriate for the proposed WWTP (albeit with some risks and challenges outlined in Part C of this report) and that Sites 3 and 4 should be discounted.

Table 14: MCA scoring summary (raw scores). Colour code: black - very low, red - low, amber - medium, green - high

| | Assessment Criteria | Site 1 Sharpe Farm | Site 2 Narrows / Rukuhia | Site 3 Penniket | Site 4 Golf Course |
|---|---|---|---|---|---|
| **Operational** | | | | | |
| 1a | Ability to discharge stage 1 flows to land | 3 | 3 | 7 | 5 |
| 1b | Accessibility from transport corridors for operation | 8 | 7 | 6 | 4 |
| 1c | Access to utilities/power | 7 | 5 | 7 | 6 |
| 1d | Greenhouse gas emissions | 8 | 6 | 4 | 2 |
| 1e | Treatment plant hydraulics (ie requirement for pumping) | 5 | 7 | 5 | 5 |
| 1f | Operability and flexibility during operation | 9 | 8 | 2 | 3 |
| 1g | Future proofing | 9 | 8 | 1 | 7 |
| **Conveyance** | | | | | |
| 2a | Distance and complexity of pipelines from contributing catchments | 9 | 7 | 4 | 1 |
| 2b | Distance and complexity to potential river discharge sites | 6 | 5 | 4 | 7 |
| Mana whenua | | | | | |
| 3a | NA | | | | |
| **Physical** | | | | | |

| | Assessment Criteria | Site 1 Sharpe Farm | Site 2 Narrows / Rukuhia | Site 3 Penniket | Site 4 Golf Course |
|---|---|---|---|---|---|
| 4a | Liquefaction and geotechnical risk | 6 | 5 | 7 | 4 |
| 4b | Potential impacts of contaminated soil | 8 | 9 | 7 | 5 |
| 4c | Flooding risk | 9 | 8 | 9 | 9 |
| 4d | Buildability | 7 | 5 | 8 | 4 |
| **Natural environment** | | | | | |
| 5a | Potential for impacts on the natural character of wetlands, rivers and lakes and their margins | 7 | 6 | 10 | 5 |
| 5b | Potential for impacts on aquatic and terrestrial ecology including vegetation, fish, birds, bats and lizards | 7 | 3 | 9 | 5 |
| 5c | Potential for impacts on groundwater (and therefore users) and surface water quality | 6 | 5 | 4 | 5 |
| 5d | Potential for impacts on highly productive soil | 5 | 5 | 5 | 5 |
| **Built environment** | | | | | |
| 6a | Potential for odour effects | 5 | 5 | 2 | 2 |
| 6b | Potential for noise effects (including plant and traffic access) | 7 | 7 | 5 | 5 |
| 6c | Potential for landscape and visual effects | 6 | 5 | 7 | 3 |
| 6d | Potential for archaeological impacts | 5 | 9 | 9 | 2 |
| 6e | Potential for heritage impacts | 10 | 10 | 10 | 10 |
| 6f | Alignment with long term growth / alternative land uses | 6 | 6 | 6 | 6 |
| | **TOTAL** | **158** | **144** | **138** | **112** |

### 9.2.2 Weighting

Following completion of the initial MCA scoring, a weighting/sensitivity exercise was undertaken to investigate how changing the weighting of the various criteria impacts the overall scoring.

The outcomes are included on Table 15. In all scenarios tested, the order remains the same as the raw scores except for scenario 4 where the higher weighting on natural environment lifts Site 3 to the same score as Site 2. The consistency in scoring strengthens the position that Site 1 is the preferred site.

Table 15: MCA scoring summary (weighting). Colour code: green-amber-orange-red - highest to lowest rank.

| | Weighting scenario | Weighted score (out of 100) Site 1 Sharpe Farm | Site 2 Narrows / Rukuhia | Site 3 Penniket | Site 4 Golf Course |
|---|---|---|---|---|---|
| 1 | Equal weighting<br>(All criteria weighted at 4.3%) | 69 | 63 | 60 | 49 |
| 2 | Each “section” assigned equal weighting<br>(ie each operational criteria weighted at 2.9% giving an overall operational weighting of 20%) | 70 | 62 | 60 | 48 |
| 3 | Constructability and operability more important<br>(operational / conveyance / physical criteria weighted at 5.6%, others at 2.8%) | 70 | 63 | 58 | 49 |
| 4 | Natural and built environment more important<br>(Natural / built environment criteria weighted at 6%, others at 3%) | 67 | 62 | 62 | 48 |

| | Weighting scenario | Weighted score (out of 100) | | | |
|---|---|---|---|---|---|
| | | Site 1 Sharpe Farm | Site 2 Narrows / Rukuhia | Site 3 Penniket | Site 4 Golf Course |
| 5 | Weighting based on “importance” of criteria (See below – weighted at 2.5%, 5%, 7.5% and 10% based on low/moderate/moderate-high/high importance) | 67 | 59 | 59 | 43 |

Table 16: Criteria “importance” for weighting

| | Assessment Criteria | Weighting |
|---|---|---|
| **Operational** | | |
| 1a | Ability to discharge stage 1 flows to land | Moderate importance - would reduce the amount of river discharge in the first stage |
| 1b | Accessibility from transport corridors for operation | Moderate importance - key part of operability |
| 1c | Access to utilities/power | Lower importance - able to be designed around |
| 1d | Greenhouse gas emissions | Scores same effects as 2a and 2b so weighted zero |
| 1e | Treatment plant hydraulics (i.e. requirement for pumping) | Lower importance - able to be designed around |
| 1f | Operability and flexibility during operation | High importance - operability of the treatment plant is critical to HCC |
| 1g | Future proofing | Moderate importance - future proofing is less critical than immediate operations but still of moderate importance |
| **Conveyance** | | |
| 2a | Distance and complexity of pipelines from contributing catchments | Lower importance - increases design complexity and operational cost (including carbon cost) but considered lower importance than other criteria |
| 2b | Distance and complexity to potential river discharge sites | |
| **Mana whenua** | | |
| 3a | NA | |
| **Physical** | | |
| 4a | Liquefaction and geotechnical risk | Moderate importance - potential for significant impact on cost |
| 4b | Potential impacts of contaminated soil | Lower importance - risks similar to many construction projects and considered to be generally able to be managed |
| 4c | Flooding risk | Lower importance - none of the sites identified as having notable risk and able to be designed around |
| 4d | Buildability | High importance - being able to construct the WWTP is critical |
| **Natural environment** | | |
| 5a | Potential for impacts on the natural character of wetlands, rivers and lakes and their margins | High-moderate importance - potential impacts on waterbodies and ecology considered of high importance (note some overlap between 5a and 5b so 7.5% weighting proposed to reflect this) |
| 5b | Potential for impacts on aquatic and terrestrial ecology including vegetation, fish, birds, bats and lizards | |
| 5c | Potential for impacts on groundwater (and therefore users) and surface water quality | Moderate importance - groundwater known to present challenges in this part of the Waikato and can be difficult to mitigate effects |
| 5d | Potential for impacts on highly productive soil | Not a differentiator – zero weighting |
| **Built environment** | | |
| 6a | Potential for odour effects | High importance - expected that odour will be a critical consideration for consenting and minimising adverse odour effects on surrounding receptors |
| 6b | Potential for noise effects (including plant and traffic access) | Lower importance - expect mitigation can generally be designed to keep noise within allowable limits (but some cost implications) |
| 6c | Potential for landscape and visual effects | High importance - expected to be a major consideration during consenting / designation processes |

| | Assessment Criteria | Weighting |
|---|---|---|
| 6d | Potential for archaeological impacts | Moderate importance - effects expected to be manageable but a matter of importance to mana whenua |
| 6e | Potential for heritage impacts | Not a differentiator – zero weighting |
| 6f | Alignment with long term growth / alternative land uses | Not a differentiator – zero weighting |

### 9.2.3 MCA preferred option

The preferred option from the MCA is Site 1: Sharpe Farm with Site 2: Narrows / Rukuhia being the alternate.

# 10 Staging

To assist with selection of a preferred site, a series of layouts and renderings were prepared for the Sharpe Farm and Narrows/Rukuhia site (being the two emerging preferred sites from the MCA and early mana whenua assessment). The purpose of the layouts and renderings is to show how a WWTP could develop at each of the sites over time.

Key considerations:

- Minimising effects on natural features (Nukuhau Stream and tributaries, remnant forest (kahikatea) stands and avoiding eastern side of Sharpe Farm site
- Maximising setback from neighbouring dwellings (odour, noise, visual)
- Setting out processing so flows through the WWTP are logical
- Space for utilities etc
- Space for maintenance & renewals and future growth
- Sequencing allows construction of future stages

Limitations:

- These layouts and the associated renderings have been produced to give an early indication of what a WWTP could look like on these two sites.
- No design has been completed at this stage. The layouts and rendering are based on the flows expected and size and shape of process units on other similar sites. Changes should be expected during future design processes

The indicative staging has been developed as per the approach outlined in Table 17.

Table 17: Indicative Staging for the Development of the Southern WWTP – Sites 1 and 2

| | Flows | Notes |
|---|---|---|
| Stage 1<br>*To provide capacity to service the existing and planned development in the Airport, surrounding areas* | 2,000 PE – 5,000 PE (population equivalent)<br>(400-1,000 $m^3$/day) | Originally envisaged as a Sequencing Batch Reactor (SBR) plant by the Southern Metro DBC, HCC's preference is this stage is progressed as a Membrane Bioreactor (MBR) plant consistent with later stages.<br>Assumed to include:<br>• Chemical storage and delivery area and Waste Activated Sludge (WAS) tank (future proofed)<br>• Administration and control building (future proofed)<br>• Small bioreactor and membrane (able to be retained until Stage 3 but then be replaced)<br>• Blower building (able to be retained until Stage 3 but then be replaced)<br>Thickened sludge is proposed to be transferred to the Cambridge WWTP. |
| Stage 2<br>*To consider how staging of the plant may occur to respond to potential demand* | 6,000 PE – 9,500 PE<br>(1,200 – 1,900 $m^3$/day)<br>18,000 PE (3,600$m^3$/day) | Assumed to include Stage 1 processes plus:<br>• Second small bioreactor and membrane (able to be retained until Stage 3 but then be replaced)<br>• Dewatering building (future proofed) |
| Stage 3 | 78,000 PE | Assumed to include Stage 2 processes plus: |

| | Flows | Notes |
|---|---|---|
| *To provide for diversion of the Peacocke development area and other parts of HCC that may diverted within the next 20 - 30 years* | (15,600m$^3$/day) | • Three larger bioreactors and 2 x membranes<br>• Additional blower building<br>• Screens and grit removal (future proofed)<br>• Odour control (future proofed)<br>• Provision for flow balancing (future proofed)<br>The Stage 1-2 blower building, membranes and bioreactors remain but can be phased out to allow re-allocation of space. |
| Ultimate (DBC)<br>*To consider the site capacity and layout that may be required within the next 50 years* | 130,000 PE | Assumed to include Stage 3 processes plus:<br>• Duplication of screen and grit removal<br>• 3x primary sedimentation<br>• 2x digesters<br>• Sludge thickening / fermentation<br>• Duplication of odour control<br>• Third membrane |
| Ultimate (Southern Diversion)<br>*To consider future proofing of the site out to 200,000 PE* | 200,000 PE | Based on South Hamilton Catchment Diversion Report, Beca, 2022<br>Assumed to include DBC ultimate processes plus:<br>• Fourth bioreactor and membranes<br>• Fourth primary sedimentation<br>• Third digester |

Indicative layouts for the 200,000 PE WWTP and associated visualisations are shown in Figures 60-63 for Sites 1 and 2. A complete set of staged layout drawings and associated renderings is included in **Appendix D**.

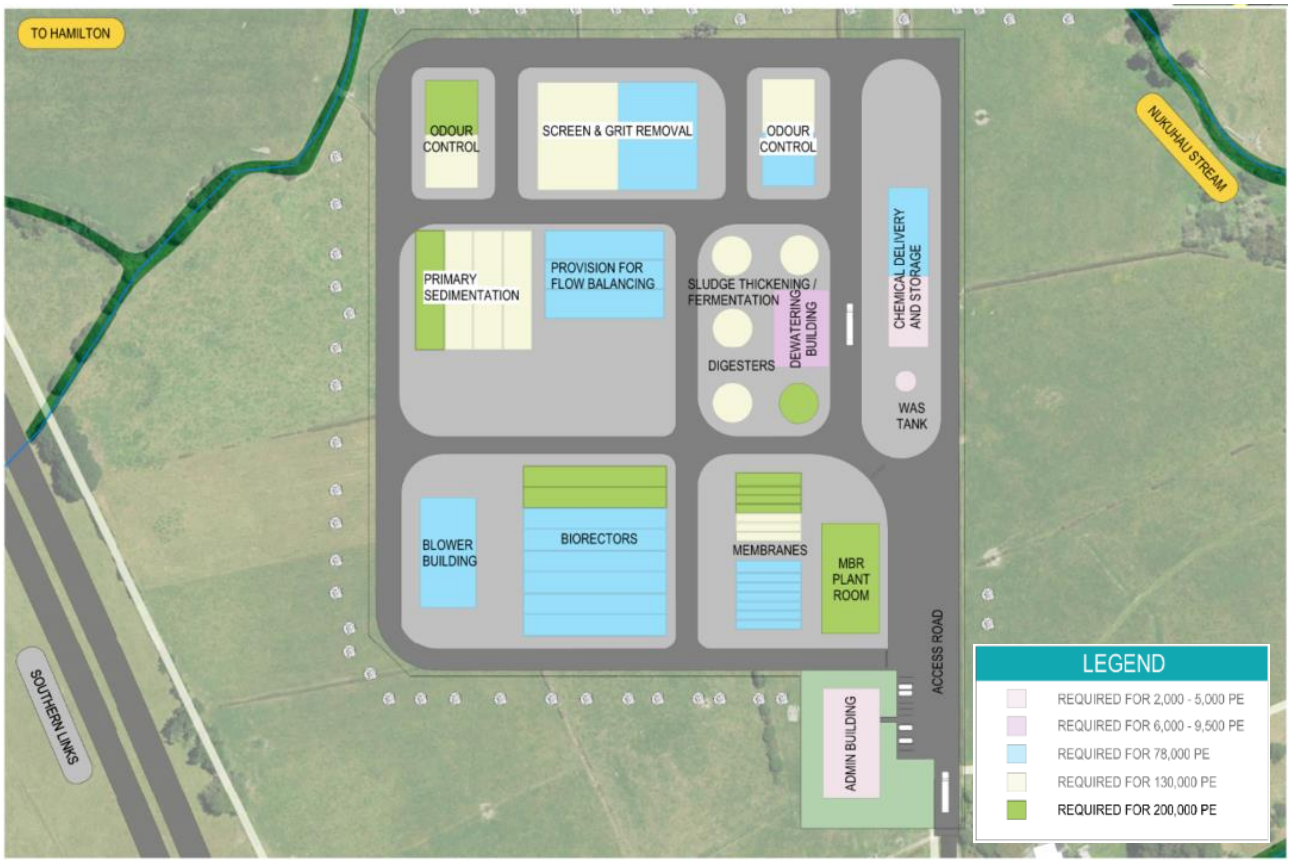


Figure 60: Indicative staging up to 200,000 PE (Sharpe Farm)


Figure 61: Rendering of indicative 200,000 PE WWTP (Sharpe Farm)


Figure 62: Indicative staging up to 200,000 PE (Narrows/Rukuhia)


Figure 63: Rendering of indicative 200,000 PE WWTP (Narrows/Rukuhia)

# PART C: Preferred option

Following the technical MCA process and the findings of the TWEA, Sharpe Farm has been identified at the preferred site. Sharpe Farm scored the highest in both the unweighted and weighted MCA.

The Narrows / Rukuhia site has been identified as the alternative option, although at the date of finalising this report the Southern Links Project landholdings are being reassessed by NZTA. This may mean this site is no longer available.

Section 11 below discusses the risks, opportunities and next steps for progressing the Project further.

# 11 Risks, opportunities, and next steps

## 11.1 Concept design

This report is based on high-level sizing of process units for each of the identified stages. Progressing concept design and master planning of the site would give more certainty on process unit sizing and therefore the short- and long-term site footprint.

## 11.2 Capacity for discharge to land

The Sharpe Farm site has imperfectly or poorly drained alluvium soils with some older clayey volcanic tephra. Poor drainage and clayey textures are considered restrictions to discharge to land. These soils have drainage restrictions and limitations for year-round application of treated wastewater, although deficit irrigation of soils may be feasible.

If discharge of Stage 1 flows to land is to be progressed, further investigations are recommended to confirm potential application rates, storage requirements, environmental effects and the volume of any balance flow that may still need to be discharged to water.

## 11.3 Groundwater impacts and risks

This report considers the potential for impacts on groundwater users based on presence of downgradient bores. Ultimately, if a land disposal option is progressed, infiltration rates, level of treatment, soil permeability, and travel time will need to be assessed to determine the actual risk and number of bores potentially affected.

## 11.4 Contaminated land risk

A Preliminary Site Investigation (PSI) is required for the preferred site, involving a site walkover, to inform the potential risk of land uses and materials surrounding the shed and stockyards. Depending on the findings of the PSI, targeted sampling may be required in these areas to inform potential contamination risk and management requirements. This may result in requirements for consents under the NESCS.

## 11.5 Faiping Road shared path

There is a paper road running through the site connecting the end of Faiping Road to Raynes Road. The recent decision on Proposed Private Plan Change 20: Airport Norther Precinct Extension requires construction of a new walking and cycling shared path connecting Peacocke Road to the Northern Precinct via Middle Road and Faiping Road, or a suitable alternative, prior to any development of the Northern Precinct.[17] There is a significant risk of conflict between users of such a shared path and the construction and operational traffic that would be associated with a WWTP at this site. This risk could potentially be managed by routing the pathway closer to the Nukuhau Stream and ensuring that any WWTP traffic accessed the site from Raynes Road (i.e. no WWTP traffic to use the existing section of Faiping Road).

## 11.6 Ecology

There are a number of recommendations made in regard to further ecological investigations for the preferred site including:

[17] Proposed Private Plan Change 20: Airport Norther Precinct Extension, Decisions of Hearings Panel and Section 32AA Evaluation Report (June 2023). Refer Rule 10.4.2.20.

1. No fish/aquatic surveys have been carried out at the site, and there is no available data for native fish presence/absence within the watercourse identified at the site. Due to the connectedness of the watercourse with the Waikato River, there is a high likelihood of At-Risk and/or Threatened species residing here. As such, eDNA, MCI, and fish surveying will provide further information on species presence.
2. Due to the confirmed presence of long-tailed bats within and within proximity to the site, bat management will be required prior to the clearance of any suitable roosting trees. A site-specific bat survey should be undertaken. In addition to this, operational disturbances to bats from noise and lighting (during the construction phase) may need to be considered.
3. Due to the ideal habitat within the site for herpetofauna, lizard management will be required prior to the clearance of any vegetation.
4. Wetland delineation surveys will need to be undertaken within the area of the identified potential natural wetland and along the Nukuhau stream margins.
5. Avifauna within the site is primarily limited to Not Threatened and Introduced species, however, as most native birds are protected under the Wildlife Act (1953), management will be required prior to the clearance of vegetation.

## 11.7 Planting

It is expected that planting would be required at the Sharpe Farm. This presents a significant opportunity for environmental restoration and enhancement and could include:

- **Riparian planting**: The Nukuhau Stream or tributaries pass through both sites, riparian planting would enhance the natural environment and ecological value of the waterways and is recommended. Such planting could form part of the offset package likely to be required to demonstrate the project gives effect to Te Ture Whaimana. This could commence in advance of consenting/designation processes to achieve the benefits of planting early.[18]
- **Wetland planting**: If the wetland delineation studies recommended above confirm the presence of wetlands on the confirmed site, restoration and protection of any wetland areas is recommended.
- **Screen planting**: Both sites are highly visible and screen planting is likely to be required. It is recommended that screen planting requirements are confirmed early to allow planting to commence in advance of consenting/designation processes. This will help demonstrate to neighbours and the public that HCC is committed to minimising visual and landscape effects.

Where planting is providing offsetting for the effects of the WWTP and discharge, a mechanism for protection of the planting is often required. Legal protection (by way of an encumbrance or other legal mechanism) also provides greater certainty to mana whenua and the community that planting will remain in place for the life of the WWTP.

## 11.8 Landscape and visual

For similar projects, a landscape and visual constraints mapping exercise has been used to influence the design of the site. A mapping exercise would consider zones of visibility and feed into site layout. This occurs prior to any form of Landscape and Visual Effects Assessment and supports better visual and landscape

[18] If planting occurs in advance of consenting/designation processes, it should be documented that the planting is being undertaken for the purpose of offsetting impacts of the WWTP to ensure this offsetting can be taken into consideration by the consent authority.

outcomes. Careful consideration of design and screening will be needed to mitigate potential adverse effects throughout the next stage of the Project.

## 11.9 Impacts on Highly Productive Land

Sharpe Farm has been classified as LUC 2 with some LUC 1 & 3 along the southern boundary, therefore the NPS-HPL applies. Further consideration of the implications of this NPS will be required through the next stage of the Project.

## 11.10 On-going mana whenua involvement

One of the challenges that seems to arise in the operation of activities is the handover of mana whenua relationships from the team leading the investigations, design and consenting, to the operations team. Commitments made during those earlier project phases can be easily lost or misunderstood due to personnel changes. Using proffered consent conditions is an opportunity to record these agreements in a form that will endure for the life of the consent. Consent conditions could include:

- Development of a comprehensive Accidental Discovery Protocol
- Requirements for cultural inductions for new starters and annual refreshers
- On-going monitoring and reporting against the Cultural Impact Assessment or similar cultural health index monitoring (with a requirement that this is undertaken by or in consultation with mana whenua)
- Requirements for on-going liaison with mana whenua beyond an “annual hui”. This could be through the establishment of kaitiaki monitors or more regular touch points
- Consideration of cultural interpretation/enabling cultural expression: During a site visit to the Pukekohe WWTP with mana whenua representatives, it was noted that there is an absence of cultural interpretation at that site. The Nukuhau Stream has high significance to mana whenua and development of this site presents an opportunity for cultural interpretation – either through the design of the WWTP or through the management of the balance of the site (i.e. the eastern half of the site that is not required for the actual WWTP footprint but provides important buffer distance).

# 12 Conclusion

This assessment of alternative sites has been prepared on behalf of Hamilton to support the NoR for designation and has been prepared in accordance with Section 171(1)(b) of the RMA.

This assessment has evaluated four short-listed sites for the Southern WWTP location through a technical MCA process alongside a TWEA process that is reported separately.

Following an initial consideration of the four short-listed sites, sites 1 and 2 emerged as the two preferred sites. Following a further review of the relative advantages and disadvantages of the two preferred sites and engagement with mana whenua, Site 1 (Sharpe Farm) was selected as the preferred option.

# A

Appendix A – Manaaki Whenua Landcare Research Soils Report

# B

Appendix B – Record of Meeting – Technical MCA

# C

## Appendix C – MCA Assessment Sheets

# D

Appendix D – Sites 1 and 2 Staged Layouts and Renders

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