Hamilton - Waikato - Waipa Metropolitan Area - Southern Metro Wastewater Detailed Business case - Short List Options Report

Metro Wastewater Project Partners
March 2022

Contents

Figures

Tables

Appendices

Glossary of terms

Abbreviation	Description
ADF	Average Daily Flow
BAU	Business as Usual
DBC	Detailed Business Case
ILM	Investment Logic Map
MCA	Multi Criteria Analysis
NPS	National Policy Statement
NPS-Freshwater	National Policy Statement for Freshwater Management
NPS-UDC	National Policy Statement on Urban Development Capacity
NPV	Net Present Value
PDF	Peak Daily Flow
PWWF	Peak Wet Weather Flow
RITS	Regional Infrastructure Technical Specifications
RMA	Resource Management Act
RPS	Regional Policy Statement
SW	Stormwater
TLA	Territorial Local Authority
TN	Total Nitrogen
TP	Total Phosphorous
WLASS	Waikato Local Authority Shared Services
WRC	Waikato Regional Council
WWTP	Wastewater Treatment Plant

Disclaimer

This report: has been prepared by GHD/BECA for Hamilton City Council as the lead agent for the Waikato - Hamilton Metro Area Wastewater Detailed Business Case Project. The Waikato - Hamilton Metro Area Wastewater Detailed Business Case Project is being delivered and funded by the project partners Hamilton City Council, Waipa District Council, Waikato District Council, Waikato-Tainui (Te Whakakitenga o Waikato) and mana whenua from the Metro area. The report may only be used and relied on by the project partners as set out in section 1.1 of this report.

GHD/Beca otherwise disclaims responsibility to any person other than Hamilton City Council and its partners arising in connection with this report. GHD/Beca also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD/Beca in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD/Beca has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD/Beca described in this report (refer section 2). GHD/Beca disclaims liability arising from any of the assumptions being incorrect.

If GHD/Beca has relied on information provided by the client and/or others when preparing the document containing the following should be added to the generic disclaimer detailed above:

GHD/Beca has prepared this report on the basis of information provided by Hamilton City Council and others who provided information to GHD/Beca (including Government authorities)], which GHD/Beca has not independently verified or checked beyond the agreed scope of work. GHD/Beca does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD/Beca has prepared the preliminary cost estimates set out in Section 3.6 of this report ("Cost Estimate") using information reasonably available to the GHD/Beca employee(s) who prepared this report; and based on assumptions and judgments made by GHD/Beca (refer to section 2.4).

The Cost Estimate has been prepared for the purpose of making a relative assessment of options and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD/Beca does not represent, warrant or guarantee that the project can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Executive summary

Introduction

The purpose of the Shortlist Options Report is to document the development and assessment process for the shortlisted wastewater servicing options[1] of the Southern Hamilton, Waipa, and Waikato Metro Areas (southern metro area, refer to Figure 1). The identification of a preferred option to take forward into the next phase of the Detailed Business Case process is the key output of the shortlisted options assessment and this report. This report informs and is part of the Hamilton - Waikato Southern Metropolitan Area Wastewater Detailed Business Case (DBC).

Previous work to date

The Shortlist Options Report follows and builds on the work completed in the Longlist Options development and assessment phase of the Metro Wastewater DBC. This previous phase of work identified and assessed a wider range of longlist wastewater servicing solutions for the metro area. The high-level longlist options assessment determined two centralised wastewater servicing solutions should be carried forward in the DBC process as preferred shortlist options to be considered further and in more detail.

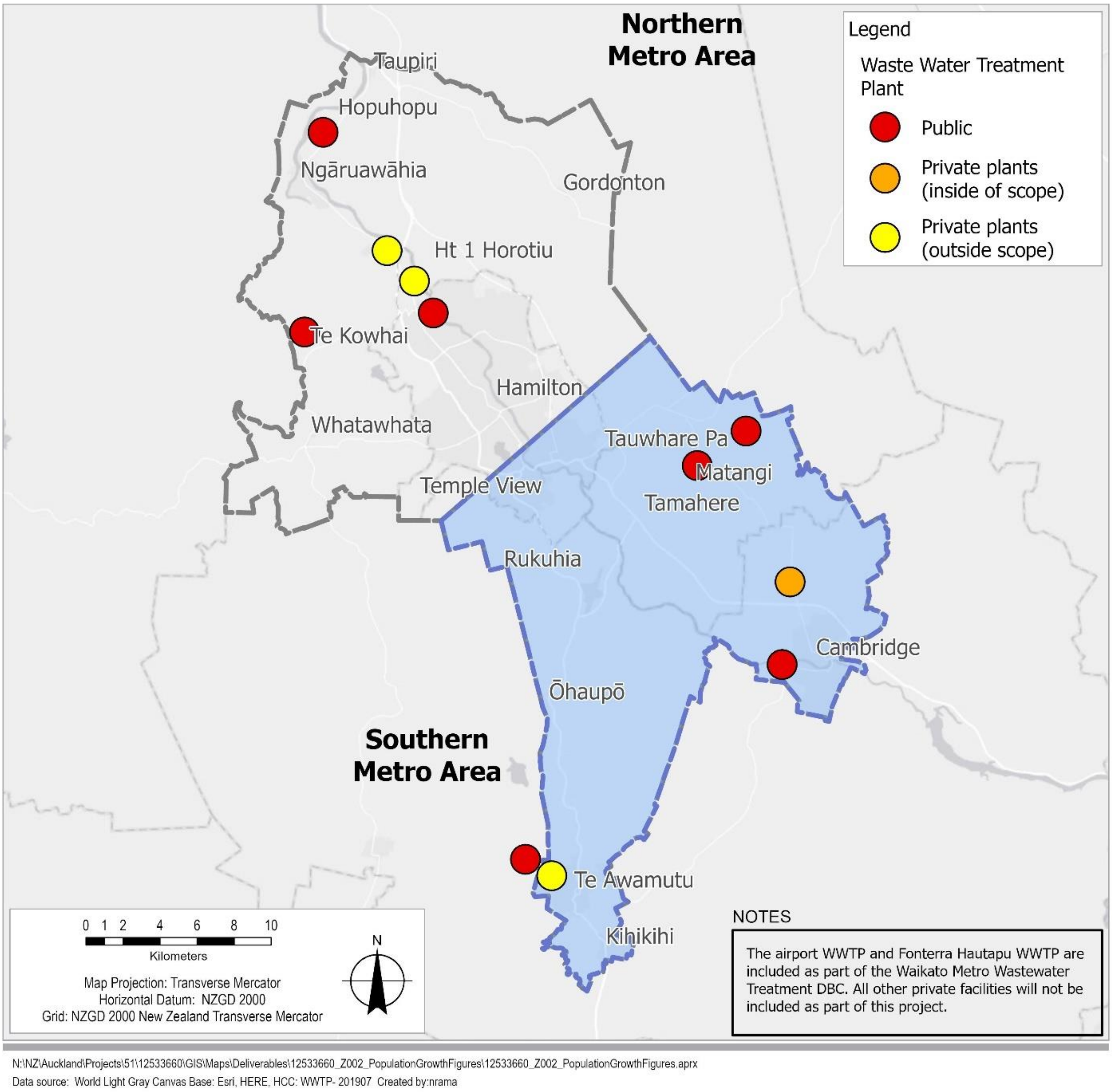
The further investigation and assessment of those shortlist options carried forward from the longlist is the subject of this report. Details of the previous longlist option investigations and assessments can be found in the Longlist Options Report[2].

---

[1] As identified in the Metro Wastewater Long List Options Report.

[2] GHD/Beca, Oct 2020. *Metro Wastewater Detailed Business Case Draft Longlist Options Report*. Future Proof Partners.

Figure 1 Metro Wastewater Detailed Business Case Study Area: Southern Metro Area [3]



[3] Note: The Northern Metro Area and Southern Metro Area boundary shown is indicative only and subject to further consideration following existing WWTP capacity assessments.

Shortlisted options

The shortlist of options identified in the previous longlist options investigation[4] were:

- **Option 1 – Do Nothing** (for comparative purposes only)
- **Option 2A - Three Plant Option** – Involves upgrades and expansion of the Pukete WWTP to service the Northern Metro area (including Taupiri, Ngaruawahia, Te Kowhai, Horotiu and majority of Hamilton); a new southern plant to service the Southern Metro area (including South Hamilton, airport area and environs, Cambridge) and the Te Awamutu WWTP.
- **Option 4A - Five Plant Option** – Involves treatment plant upgrades at Ngaruawahia, Pukete, Cambridge and Te Awamutu and a new southern plant to service the airport area and environs.

The service areas of the short-listed options are in Figure 2 below and are diagrammatic.

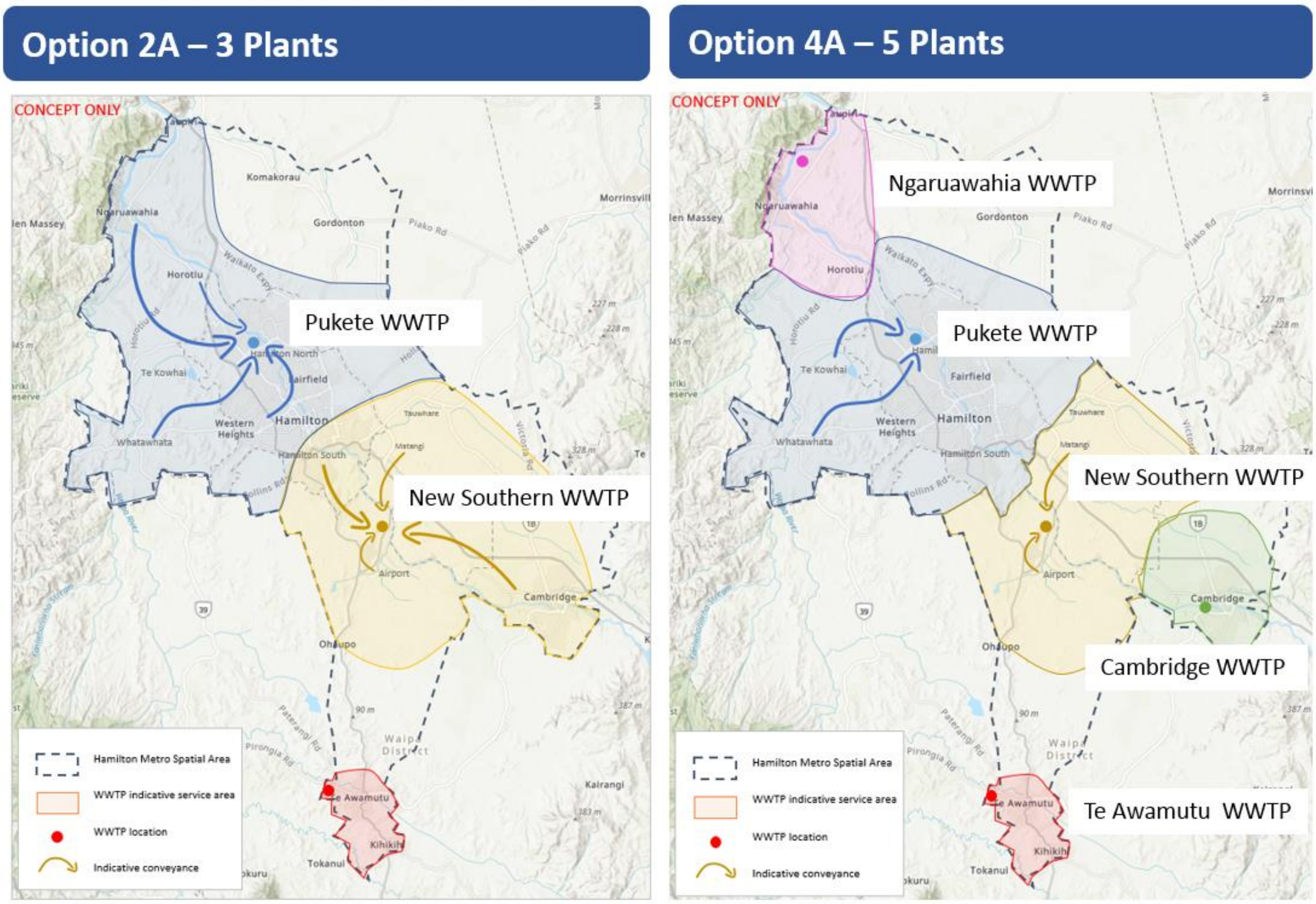


Figure 2: Diagrammatic Overview of Short-listed Metro Area Wastewater Servicing Options

These options have been further developed. This has included a site selection process to identify potential sites for either a subregional plant proposed as part of Option 2A or a smaller southern plant proposed as part of Option 4A. The site selection process is similar for both options, with the same technical constraints for both. Discharge options were also developed for each of the potential sites and assessed for each option.

[4] GHD/Beca, Oct 2020. *Metro Wastewater Detailed Business Case Draft Longlist Options Report*. Future Proof Partners.

The shortlisted options for the Metro Wastewater DBC are described below.

Option 1: Do Nothing - has been brought forward for comparative purposes. This option includes:

- Ngaruawahia WWTP continues to service:
  - Hopuhopu
  - Horotiu
  - Ngaruawahia
  - Taupiri
- Hamilton (Pukete Plant) continues to service:
  - Hamilton (north)
  - Hamilton (south)
  - Te Kowhai
- Hamilton Airport Business Zone – as current (ad-hoc on-site servicing)
- Matangi – continue current local WWTP
- Ohaupo – continue on-site servicing
- Cambridge WWTP continues to operate
- Te Awamutu/Kihikihi (standalone plant) to be upgraded as planned.

Option 2A: Three Plant Option – The treatment plant locations, and areas of service for each along with the key conveyance routes developed for this option are shown in Figure 3**.** This option consists of the following three main WWTP as described below:

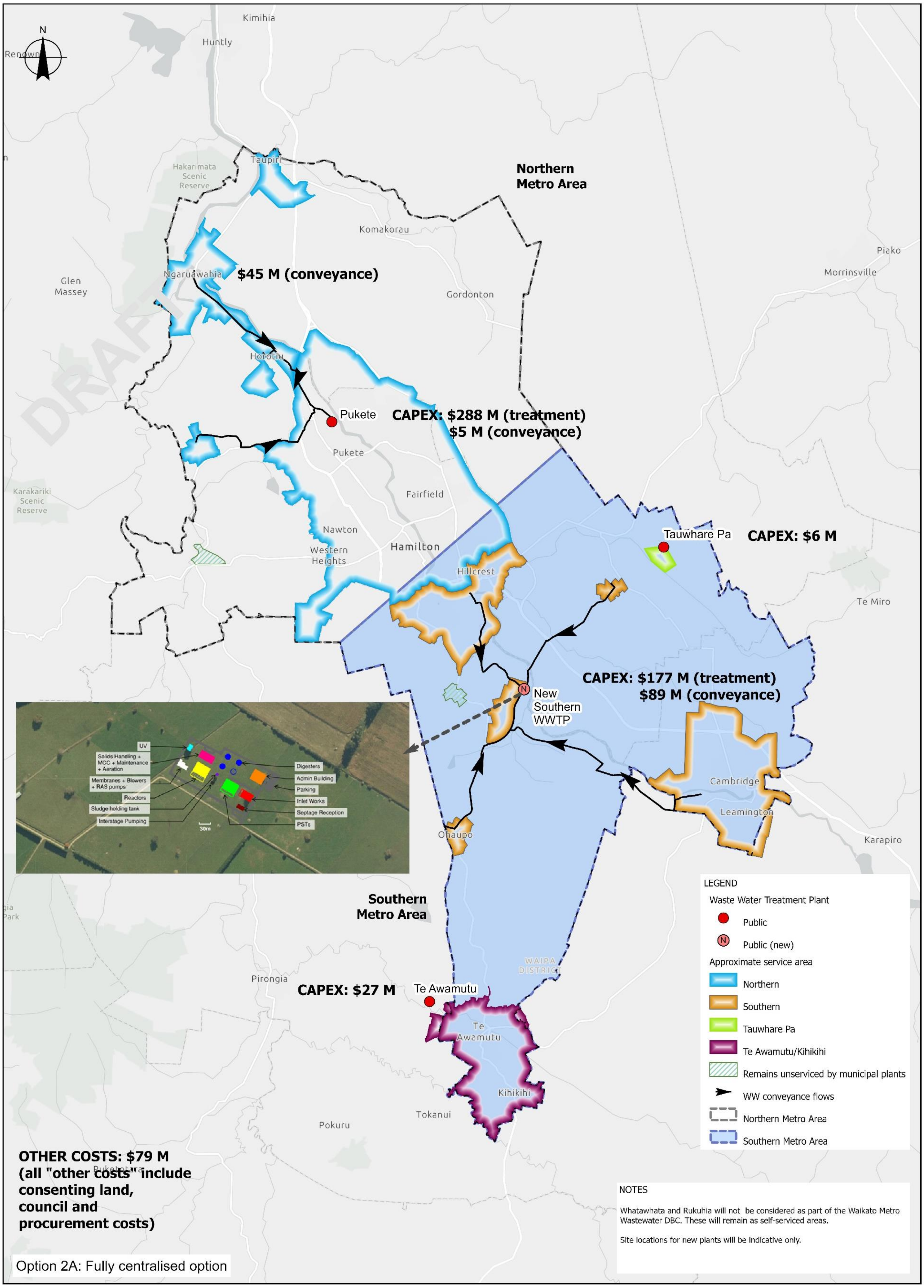
- Pukete WWTP as the centralised northern plant to service northern communities
  - Hamilton (North)
  - Hopuhopu
  - Horotiu
  - Taupiri
  - Te Kowhai.
- One centralised southern plant to service southern communities (plant located south of Hamilton)
  - Cambridge
  - Hamilton Airport Business Zone
  - Hamilton (South)
  - Matangi
  - Ohaupo.
- Te Awamutu/Kihikihi (standalone plant) to be upgraded

For the purpose of the long-list assessment, it is assumed that Tauwhare Pa will continue as a small standalone plant.

The longlist assessment identified Option 2A as the most preferred technical solution under various weightings and sensitivities (excluding a detailed cost assessment). This option provides the flexibility to masterplan an efficient facility on a new site, take advantage of water re-use and waste to energy opportunities due to its size and scale. Some benefits of this option are related to a centralised location between south Hamilton and Cambridge. The reticulation alignment and cost may change depending on the location of the site. For the purposes of this assessment, it has been assumed that the site is as shown in

This option is illustrated in Figure 3 below. Key to this option is the development of a new centralised southern WWTP to service a wide area of communities across traditional territorial authority boundaries. A site selection process is underway and is required to determine potential new locations for the new plant. Some benefits of this option are related to an assumed centralised location between south Hamilton and Cambridge. The reticulation alignment and cost are indicative at this stage and will change depending on the location of the site.

Figure 3 Shortlist Option 2A –Three Plant Option [5]



[5] Note: Te Kowhai connection to the existing Pukete WWTP will be confirmed through the Northern Detailed Business Case.

Insert shows indicative site layout for the New Southern WWTP.

Capex Values refer to the costs associated with WWTP upgrades at the sites adjacent to the values shown.

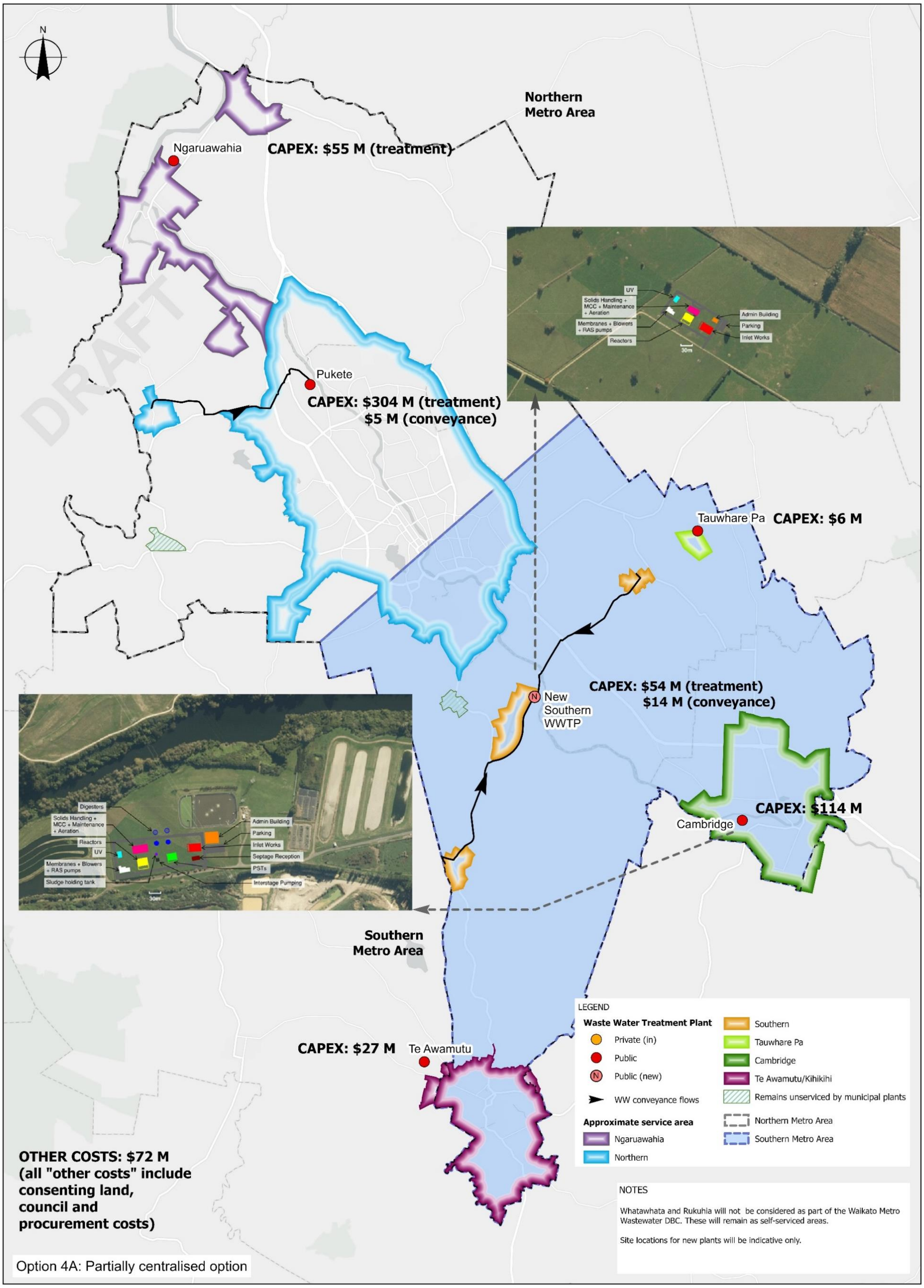
OPTION 4A: Five Plant Option - This option is shown in Figure 4 below consists of the following five main plants:

- Ngaruawahia standalone plant to service:
  - Hopuhopu
  - Horotiu
  - Ngaruawahia
  - Taupiri.
- Hamilton (Pukete Plant) to service:
  - Hamilton (north)
  - Hamilton (south)
  - Te Kowhai.
- Southern plant to service small southern communities (plant located south of Hamilton):
  - Hamilton Airport Business Zone
  - Matangi
  - Ohaupo.
- New plant at Cambridge (standalone plant)
- Te Awamutu/Kihikihi (standalone plant) to be upgraded

As with Option 2A, for the purposes of the long-list assessment, it is assumed that Tauwhare Pa will continue as a small standalone plant which will be upgraded.

This option consists of seven plants in total to service the wider metro area (refer to Figure 4). A new southern plant to service the airport will be master planned to cater for Matangi, Tauwhare and Ohaupo and if selected as the preferred option can be refined over time to allow for growth changes across these communities. In the interim, the Matangi plant is likely to require short to medium term upgrades. It is also expected that the connection of Te Kowhai to Pukete is more economical than building a new plant in Te Kowhai. This connection is likely to be required in the next 10 years. This option also maintains existing council boundaries

Figure 4 Shortlist Option 4A – Five Plant Option[6]



[6] Note: Te Kowhai connection to the existing Pukete WWTP will be confirmed through the Northern Detailed Business Case.

Inserts show indicative site layouts for the New Southern WWTP and Upgraded Cambridge WWTP

Capex Values refer to the costs associated with WWTP upgrades at the sites adjacent to the values shown.

Common Assumptions: Option 2A Centralised and Option 4A Enhanced BAU

As shown in Figure 3 and Figure 4, both shortlist options 2A and 4A assume the smaller communities of Matangi and Ohaupo will be serviced by a new southern sub-regional WWTP, while the Tauwhare Pa WWTP will remain a stand-alone. The rationale informing these shortlist option servicing assumptions for Matangi, Ohaupo and Tauwhare Pa is provided in Table 1 below.

Table 1 Option 2A Centralised and Option 4A Enhanced BAU– Smaller Settlement Servicing Assumptions

Settlement / catchment	Servicing solution	Rationale
Matangi	Transfer to southern sub-regional WWTP	Limited land available for expansion of WWTP. Current compliance issues for WWTP. Opportunities for more dense development around Matangi Village and to include Tamahere commercial hub on route to southern sub-regional WWTP.
Ohaupo (from 2051)	Transfer to southern sub-regional WWTP	Limited well drained land available for on-site systems. Potential impacts of on-site systems on sensitive environments e.g., peat lakes. Opportunities for more dense development.
Tauwhare Pa	Stand alone	Small flows currently which would be difficult to transfer without septicity issues. Low level of certainty in when growth might occur. Land likely to be available/suitable for expansion of existing WWTP.

These smaller catchment shortlist option servicing assumptions will be further tested and refined at the preferred option stage.

MCA assessment summary

Between October 2020 and February 2021 all three shortlist options were subjected to detailed assessments against the MCA criteria, with the results used to inform the selection of a Metro Wastewater DBC preferred option. A preliminary shortlist option assessment occurred in October- November 2020, followed by a more robust re-assessment in February 2021 based on more detailed information being available.

A summary of the shortlist option MCA re-assessment results are shown in Table 2 and Table 3 below. The tables show the 'scores' of each option (Do Nothing, Option 2A and Option 4A) against each investment objective and critical success factor criteria. Table 4 displays the MCA total scores for each shortlist option relative to their expected capital costs to implement.

Table 2 Shortlist Options MCA Investment Objective Summary of results

OBJECTIVE CRITERIA		Do Nothing/BAU	Option 2A – Three Plant Option	Option 4A – Five Plant Option
Water Quality	To what extent does the option reduce the level of Nitrogen, Phosphorus, Nitrates and Ammonia in the quality of the discharge?	-3	3	3
	To what extent does the option reduce the E.coli levels of the discharge to the river?	-2	2	2
	To what extent does the option reduce the risk to public health? Measure by assessing risks associated with contamination of groundwater and the location of the discharges. E.coli has been captured above	-1	1	1
Ecology	To what extent does the option impact or improve river ecosystems and hydrology	-2	1	1
	To what extent does the option provide the ability to improve vegetation coverage around riverbed and terrestrial ecosystems? - This will only be applicable if we are including potential riparian areas as part of the options? This may have to remain very high level for now	0	2	1
Cultural Connectivity	What potential is there for land discharge vs water discharge (How much does the option reduce the discharge to the river?)			
	To what extent does this option enhance and restore cultural connectivity with the river?			
	To what extent does the option increase the opportunity to improve the number of access points to the river and/or other waterways, lakes and wetlands? - measure by considering the potential to rehabilitate existing sites/riparian activities of options/location of site	0	2	1
Sustainable Technology	To what extent does the option allow for water reuse?	0	3	1
	To what extent does the option consider energy and carbon neutral technologies? To what extent do options reduce relative operational carbon associated with conveyance system?	-1	1	1
Sustainable Growth	To what extent does the option provide flexibility to adapt to growth and land use changes?	-3	1	2
	To what extent does this option provide additional growth opportunities which align with the sustainable and planned future growth of the Waikato Metro area?	-3	1	2

Table 3 Shortlist Options MCA Critical Success Factors (Consenting and Implementation) Summary of results

CRITICAL SUCCESS FACTORS CRITERIA		Do Nothing/BAU	Option 2A – Three Plant Option	Option 4A – Five Plant Option
Constructability (treatment)	What are the relative constructability benefits, issues and risks (available space, access, existing utilities, watercourse, rail crossings, reinstatement requirements, Geotechnical impacts, utility impacts, road and traffic impacts)	-1	-1	-2
Constructability (conveyance)		0	-2	-1
Operability (treatment)	What is the relative ease or difficulty of operation and maintenance (includes access, odour treatment, resource availability, monitoring, etc.)?	-2	2	0
Operability (conveyance)		0	-2	-1
Consentability risks – land use and designation	To what extent will the option require consents for a new site (that require land use consent)??	0	-2	-1
Consentability risks - Discharge	To what extent will the option have discharges that are likely to meet discharge parameters acceptable to the consent authority	-4	-1	-2
Resilience	To what extent will the option provide resilience against potential failures, climate change impacts, natural hazards and labour skill.	-2	0	1

The total MCA scores for Options 2A and 4A are displayed in Table 4 relative to the total capital costs and net present values (NPV) calculated for each option. The results indicate that Option 2A has a slightly higher overall benefit across the assessment criteria but also significantly higher estimated capital costs to achieve these benefits.

Table 4 Shortlist Options Overall MCA assessment score, CAPEX and NPV

Option	MCA Total Score (raw unweighted)	TOTAL CAPEX ($ Million) – incl. Pukete Costs	Net Present Value ($ Million)
Option 2A	11	$530	-$1.21
Option 4A	9	$474	-$1.10

Between October 2020 and February 2021 all three shortlist options were subjected to detailed assessments against the MCA criteria, with the results used to inform the selection of a Metro Wastewater DBC preferred option.

A preliminary shortlist option assessment occurred in October- November 2020, followed by a more robust re-assessment in February 2021 based on more detailed information being available.

The key outcomes of the shortlist option MCA re-assessment and cost estimate comparisons were:

- Option 4A and Option 2A achieve similar outcomes in relation to the investment objectives and Best for River outcomes
- Option 4A and Option 2A were assessed as having a similar ability to be successfully consented and implemented

- Option 4A had a capital costs estimate[7] of $652M compared with Option 2A which is $716M[8]; this includes capital costs for the construction timeframes of 2021 to 2061 for both the north and south metro area as well as consenting, procurement, land purchase, make good and council construction overheads.

A Net Present Value (NPV) assessment was undertaken during the short list assessment phase and identified that Option 4A had an NPV estimate of -$1,096 million compared with Option 2A which is -$1,212 million (utilising assumptions including capital cost inflation of 3%, operating cost inflation of 2%, costs modelled to 2071 and 5% discount rate).

Option 4Ais considered more affordable than Option 2A as it gives project partners the potential to defer some capital costs in the first and second decades (2031 and 2041) and staged delivery of wastewater servicing for the airport, environs and South Hamilton.

Development of the short-listed options included more detailed consideration and refinement of the to the capital and operational costs associated with servicing the Southern Metro Area[9]. The main capital cost components include:

- Southern WWTP including staged WWTP development plus land acquisition, masterplanning and consents, outfall, conveyance from Matangi (2041), convenance from Hamilton South (post 2061)
- Cambridge WWTP redevelopment
- Matangi WWTP minor improvements (up to 2041)
- Te Awamutu WWTP upgrade
- Tauwhare Pa WWTP upgrades.

The refined costs and subsequently updated NPV results are shown in Table 5 below (and also provided in the Financial Case). The costs have been discounted using a 5% real discount rate (i.e. no inflation has been applied to costs). The key difference here is changing from a Real to a Nominal discounting methodology to align with Treasury's approach. This change in calculation has resulted in a minor differential change between the two short listed options but does not change the rationale for the decision to confirm Option 4A as the preferred option.

Table 5 Shortlist Options Net Present Value

	Capital Costs	Renewal capital costs	Operating costs	Total
Option 2A	($375.5M)	($9.1M)	($326.5M	($711.1M)
Option 4A	($341.5M)	($10.3M)	($314.4M)	($666.2M)

[7] Capital Cost estimates for WWTP and Conveyance are estimated by Beca and are P50 AACE Class 5 cost estimate; expected accuracy of -30% to +50%. In addition, other costs including procurement, consenting, council resources, land acquisition have also been included and are provided by others.

[8] 8 Total dollars out to 2061 and unadjusted for inflation

Other key risk and opportunity considerations

In addition to the MCA assessment there were a number of other key risk and opportunity considerations for the two short listed options. These risks and opportunities on review did not change the options assessment against the criteria but were key considerations of the preferred option decision-making process. They included:

- **Staging Opportunities for the Airport Precinct** - Further analysis identified that the capital cost - 'developer share' for a new wet industry to locate to the Airport precinct in Option 4A would be significantly higher compared to other existing industrial areas in Hamilton. Retaining this area for light industry only with a much smaller WWTP would further reduce the capital and operational cost associated with Option 4A
- **The risk of lower than planned growth impacts -** There is the possibility that with lower growth than is currently assumed10 Option 4A can better cater for that level of servicing need and the additional capital expenditure required for Option 2A not therefore incurred
- **Opportunity Cost of Option 4A -** It is recognised that there would be some opportunity cost associated with the selection of Option 4A over Option 2A for refinement as the Preferred Option. These include more restricted potential wet industry development.

Preferred option selection

The option recommended for further refinement as the Preferred Option based on the shortlist assessments, risk and opportunity considerations and additional investigation is a refined **Option 4A** (note: this recommendation does not include an assessment of affordability).

The development of a refined Option 4A as the preferred option of the Metro Wastewater DBC is expected to include:

- Building a standalone facility to service Cambridge/Hautapu
- Securing a site (c 15 – 20ha) in the vicinity of the airport to meet medium to long term servicing needs as demand necessitates for a southern sub-regional plant for the long term
- Developing servicing solutions at the airport to meet the immediate and short-term needs of the airport
- Improved servicing for Matangi. The options for further consideration include:
    - upgrading the existing Matangi WWTP and renewing the discharge consent
    - seeking a connection to the existing Hamilton wastewater network (with appropriate upgrades)
    - servicing via a centralised facility
- Improved servicing to meeting growth demand at Tauwhare Pa. The options include:
    - Expanding and upgrading the existing Tauwhare WWTP facility as required,
    - Conveying Tauwhare Pa to an upgraded Matangi WWTP,
    - Connecting to the existing Hamilton system with Matangi.
- Servicing Ohaupo in the future when need arises, and treatment capacity is in place via the southern facility or at Te Awamutu

[10]Note: Which includes the additional growth allowance above NIDEA low for HT1, R2, Southern Links and further infill development.

- Servicing Northern Metro communities via Pukete (to be considered as part of Northern DBC investigations)
- Review potential for servicing Tamahere by conveyance to other WWTPs.

Next steps

The next steps activities required to inform the Concept Design for the Preferred Option include:

- Sensitivity testing of key process elements to growth, characterisation, wet industry
- Redundancy and contingency review
- Outline available services nearby site
- Airport WWTP options assessment
- Review risks and populate risk register
- Further develop operating costs incl. energy recovery assessment and response to changing nutrient concentrations
- Update Capex P50 and P95
- Prepare concept design report

The activities required regarding the environmental aspects include:

- Outline preferred discharge option Cambridge/Airport
- Update nutrient projections (whole Metro Area)

In addition to the activities outlined above for the preferred Option the project team will:

- Review and incorporate feedback from the Governance Group meeting where required
- Further the activities to support the identification and land requirements for the southern / airport WWTP site
- Update all documentation as required for the changes presented
- Prepare information to support stakeholder engagement regarding the Preferred Option, including the change from Option 2A to 4A
- Review Preferred Option refinement tasks against agreed scope, budgets and timeframe and provide an updated project plan to meet the project delivery commitments.

1. Introduction

1.1 Purpose of the report

The purpose of the Shortlist Options Report is to provide detailed documentation of the options development and assessment process of the shortlisted wastewater treatment options for the Hamilton - Waikato Southern Metropolitan Area Wastewater Detailed Business Case (DBC) project (Southern Metro Area, refer to Figure 1). Key aspects of this Shortlist Options Report include:

- The identification and development of shortlist options for the Metro Wastewater DBC
- Descriptions of the short list option assessment results against the MCA criteria
- The identification of a preferred shortlist option for the Metro Wastewater DBC with supporting rationale to be progressed to concept design.

This report follows on from the Longlist Options Report which identified the shortlisted options to be assessed within this report[11]. The shortlist options assessment is a comparative assessment to determine the preferred wastewater servicing solution for the Southern Metro Area. This report is part of the Economic Case of the Waikato Metro Wastewater Treatment Detailed Business Case (DBC).

The purpose of the DBC is to explore potential wastewater strategic options for the wider metro area and determine a preferred wastewater treatment solution for the Southern Metro Area. This project will aim to align with the overarching Waikato Sub-regional Three Waters vision:

Tooku awa koiora me oona pikonga he kura tangihia o te maataamuri

"The river of life, each curve more beautiful than the last"

The investment arising from this DBC and subsequent work seeks to contribute to a future where a healthy Waikato River sustains abundant life and prosperous communities who, in turn, are all responsible for restoring and protecting the health and wellbeing of the Waikato River, and all it embraces, for generations to come.

1.2 Structure of this report

The structure and general content of this Shortlist Options Report is shown in Table 6 below.

Table 6 Metro Wastewater DBC Shortlist Options Report Structure

Section	Description
1. Introduction	Describes the purpose, structure, relevant geographic context and overall DBC methodology to arrive at this short list stage
2. Assumptions	Outlines the assumptions that underpin the development and assessment of the Metro Wastewater DBC shortlist options
3. Shortlist Options Development	Describes the shortlist options of this DBC and details the process undertaken to develop them

[11] GHD/Beca, Oct 2020. *Metro Wastewater Detailed Business Case Longlist Options Report*. Future Proof Partners.

Section	Description
4. Shortlist Options Assessment	Describes the shortlist options assessment process and results of the shortlist MCA assessments. Rationale is also provided to justify the selection of the preferred option
5. Next Steps	Outlines next steps activities to complete the shortlist options development and assessment phase of the Metro Wastewater DBC, and confirm selection of the preferred option

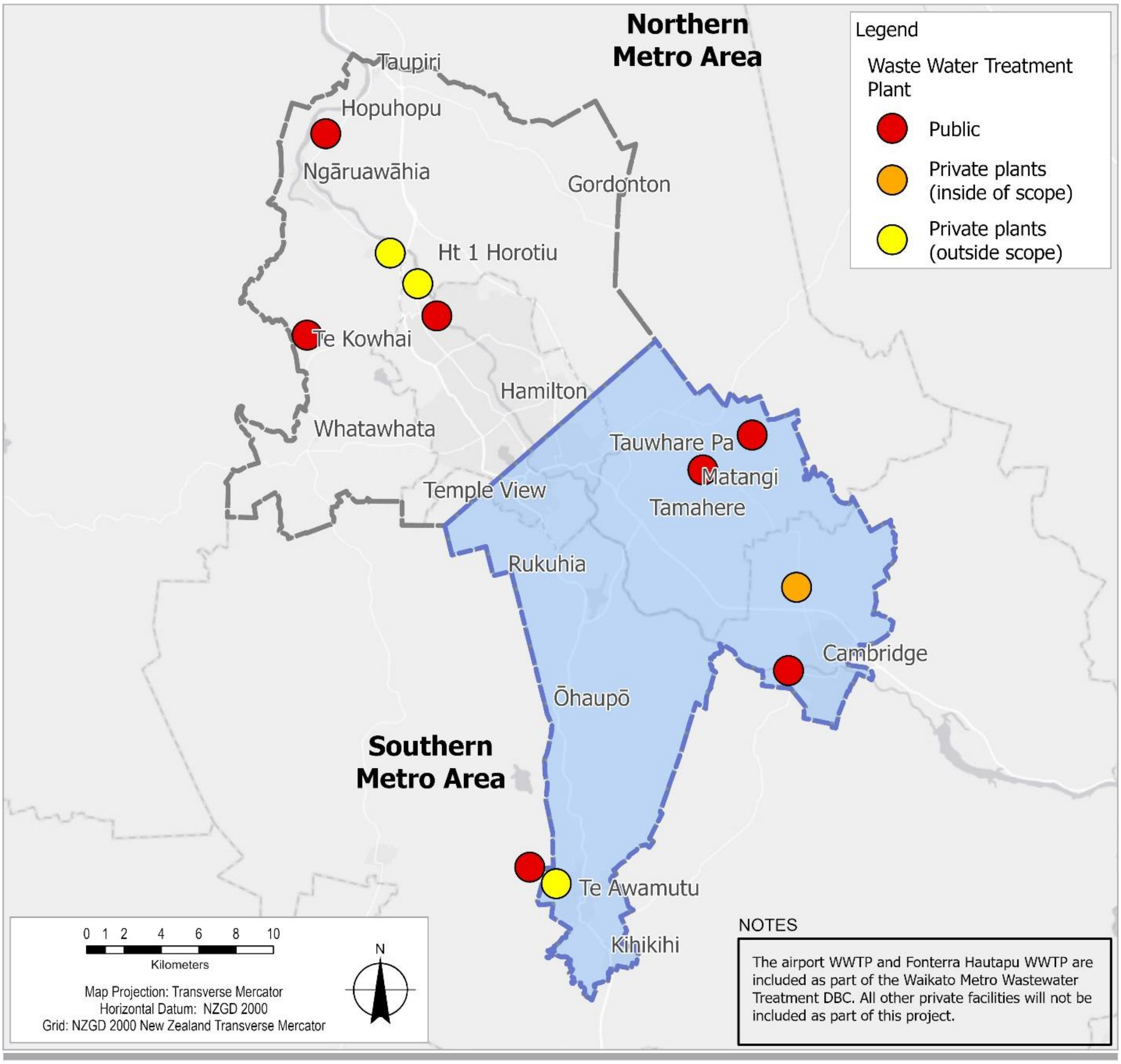
1.3 Geographical context

The Southern Metro Area includes areas in south Hamilton and continues south to Te Awamutu. Specifically this includes the following communities:

- Cambridge
- Hamilton Airport
- Hamilton (South)
- Matangi
- Ohaupo
- Rukuhia
- Tamahere
- Tauwhare Pa
- Te Awamutu /Kihihkihi.

Figure 5 below provides a detailed map of the areas and existing treatment plants currently servicing the metro area.

Figure 5 Metro Wastewater Detailed Business Case Study Area; Southern Metro Area

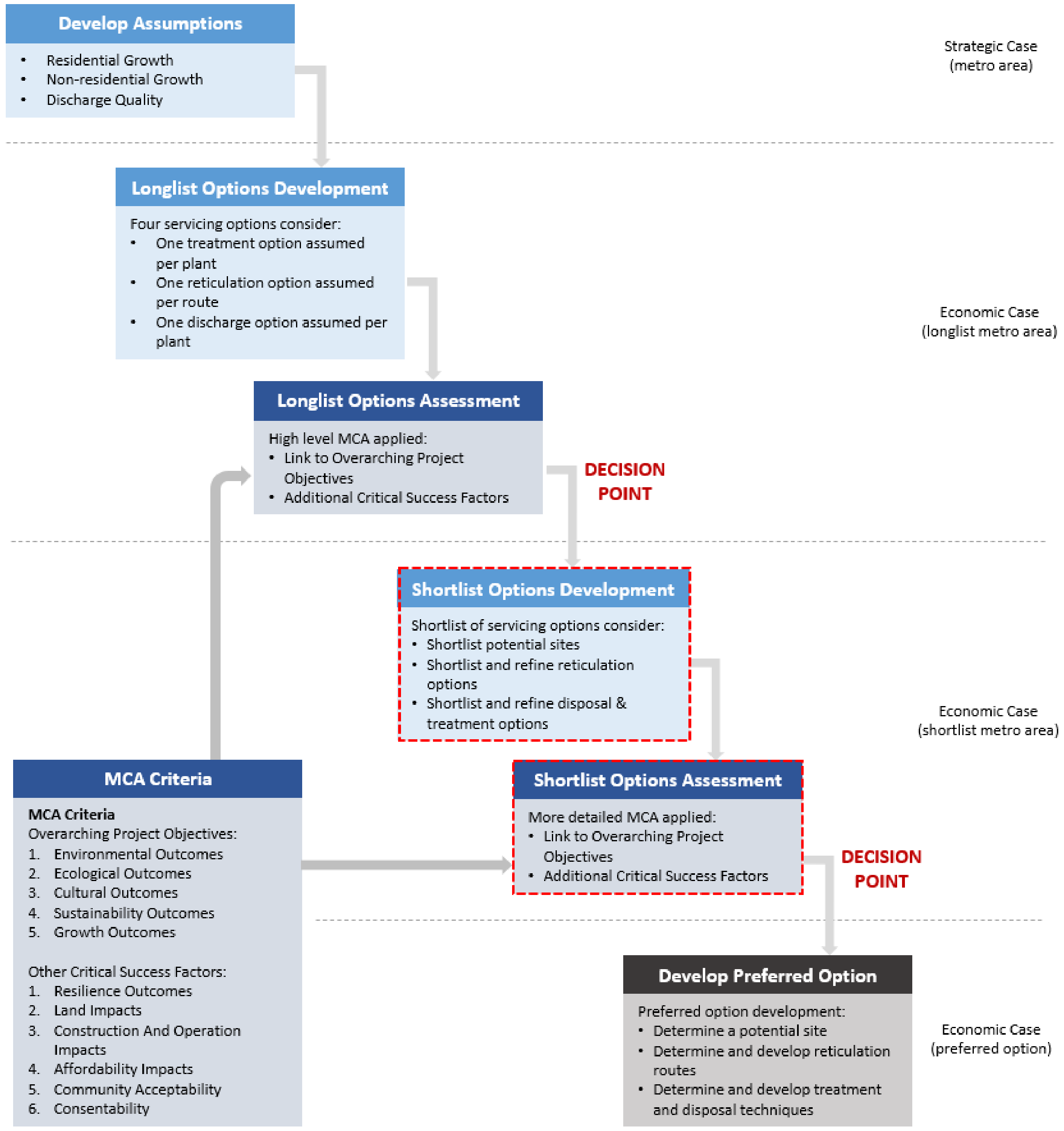


N:\NZ\Auckland\Projects\51\12533660\GIS\Maps\Deliverables\12533660_Z002_PopulationGrowthFigures\12533660_Z002_PopulationGrowthFigures.aprx
Data source: World Light Gray Canvas Base: Esri, HERE, HCC: WWTP- 201907 Created by:nrama

1.4 Methodology

The methodology for the DBC and the short list process relating to this report is outlined in Figure 6 below.

Figure 6 Metro Wastewater DBC Options development and assessment process[12]



[12] Note: Shortlist potential sites work reported separately in the Metro Wastewater DBC Site Selections Option Report.

1.5 Key stakeholder input

As displayed in Figure 6, the Metro Wastewater Detailed Business Case is characterised by collaborative decision points where key stakeholders provide input that can influence the development of the DBC. In the shortlist phase of this project, stakeholder input and feedback were primarily received at the Shortlist Options Assessment Workshop - 19 November 2020.

A list of the key stakeholders who participated in this workshop and contributed to the development of the preferred option is shown in Table 7.

Table 7 Key Stakeholder Workshop Participants – Metro Wastewater DBC Short List Options Phase

Key Stakeholders	
Hamilton City Council	Waikato Tainui
Waikato District Council	Te Haa o te Whenua o Kirikiriroa – Ngati Tamainupo
Waipa District Council	Te Haa o te Whenua o Kirikiriroa – Ngati Wairere
Waikato Regional Council	Te Haa o te Whenua o Kirikiriroa – Ngati Koroki Kahukura
Te Hauora o Ngati Haua	Te Haa o te Whenua o Kirikiriroa – Ngati Haua
Maniapoto	Te Haa o te Whenua o Kirikiriroa – Ngati Mahanga
Nehenehenui Regional Management Committee	Watercare (Waikato)

It is anticipated all key stakeholders listed in Table 5 will continue to be involved in the next phases of the Metro Wastewater Detailed Business Case project.

2. Assumptions

The assumptions that underpin the development and assessment of the shortlist options are outlined below.

2.1 Geographic and WWTPs

The geographic extent of the project is outlined in Figure 5 in Section 1.2 above. The wastewater treatment plants (WWTP) included as part of this study include the following:

- Municipal WWTPs
    - Cambridge WWTP
    - Matangi WWTP
    - Ngaruawahia WWTP
    - Pukete WWTP
    - Tauwhare Pa WWTP
    - Te Awamutu WWTP
    - Te Kowhai WWTP.
- Private WWTPs
    - Fonterra Hautapu WWTP (This WWTP was considered in the development of the long list of options and was not considered for the short list of options)

Other private facilities have not been included in the option development and assessment for this DBC.

2.2 Population and land use assumptions

Population and land use assumptions used for the longlist and shortlist assessments are detailed in the Growth Assumptions for Waikato Metro Wastewater DBC Memorandum (Appendix A). These assumptions were approved for use in the assessment by the Project Control and Governance on 14 October and 28 October respectively.

2.3 Design / flow assumptions

The Design / flow assumptions are contained in the Treatment Options Short List Report (Appendix B).

2.4 Treatment plant performance assumptions

The development of options has assumed the treatment plant performance which has been agreed by the Governance Group[13] and is contained in the Treatment Options Short List Report (Appendix B). Further investigations have informed the specific assumptions made about the capacity of the Pukete WWTP as documented below.

[13] Metro Wastewater Detailed Business Case: Governance Group Meeting. 17th September 2020.

2.4.1 Pukete capacity assessment

An assessment of the Pukete wastewater treatment plant's build out capacity (space requirements) was undertaken by Beca in February 2021 and documented in the Pukete Buildout Capacity Review Memorandum[14] and is shown in Figure 7 below.

This work has confirmed that the Pukete site has sufficient space available to construct processes for predicted demand to at least 2061[15]. This assessment assumes:

- Conversion of treatment processes to MBR to achieve the necessary performance standards
- Installation of additional treatment capacity to service growth
- Expansion of the plant is limited to the existing footprint.

Achieving additional capacity and improved discharge standards at Pukete will require considerable investigation and investment. The requirements are being considered in more detail as part of the Northern Metro WW DBC. Some of the existing assets at Pukete WWTP are reaching the end of their lives and require renewal. Treatment process changes will need to consider how both new assets and renewals could be staged and practically implemented.

The capacity of Pukete WWTP and timing of upgrades has an influence on the supply for the Hamilton urban area and therefore the requirements of a southern WWTP to service the southern areas of Hamilton.

Alternative technologies will need to be considered such as enhanced primary sedimentation, MABR, Anammox and advanced sludge processes to meet performance standards and resource recovery aspirations. The MBR process will require either additional network or onsite peak wet weather flow (PWWF) attenuation to reduce the amount of influent needing to be treated during peak periods.

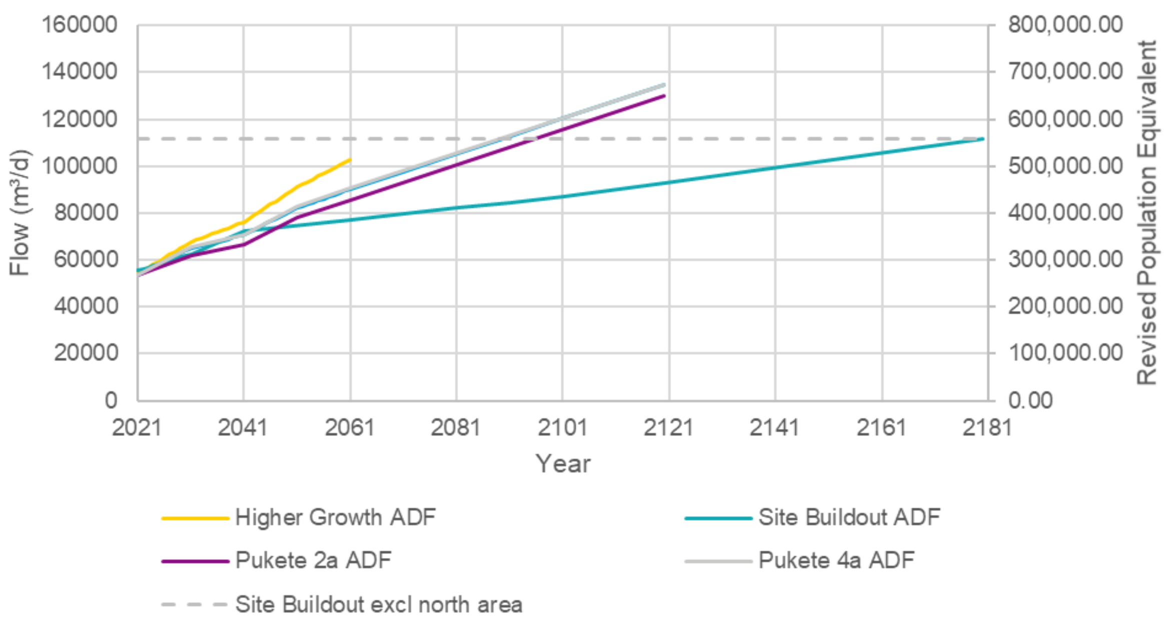


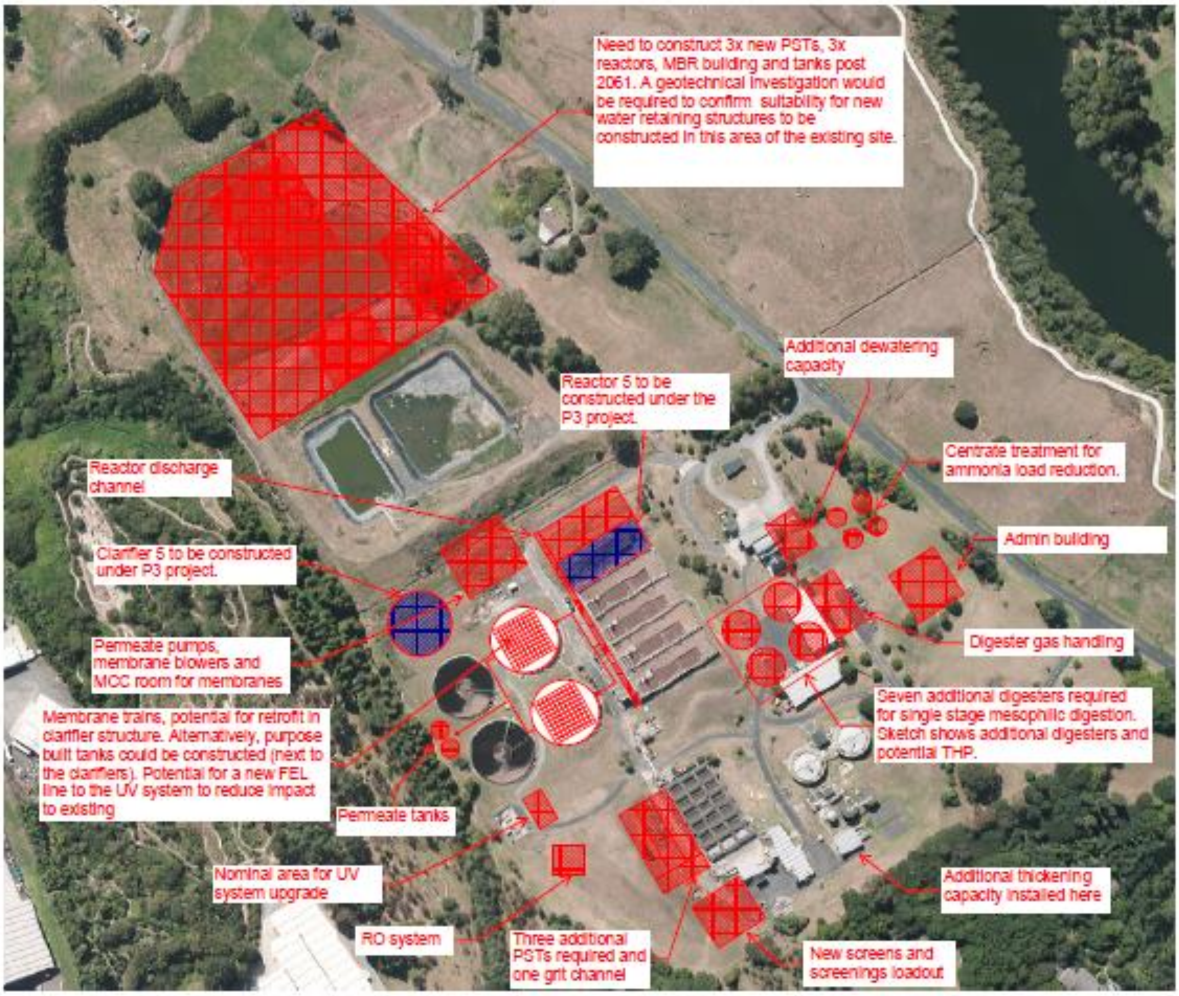
Figure 7: Pukete WWTP Flow Projections

[14] Included as Appendix C in the Short list Options Report (which is Appendix B of this report)

[15] This date assumes that the build out of the site is limited to the current plant footprint, and that growth may occur faster than the base population and growth assumptions used for this DBC. Note that the base assumptions do not specifically provide for the level of growth contemplated through recent policy reforms such as the NPS-UD or the RMA Housing Supply Amendment Bill. The implications of these reforms and accelerated growth could result in Pukete site capacity being built out and expended earlier than predicted and bring forward the need to divert flows to a new plant.

Additional primary and secondary treatment capacity could be provided by utilising areas to the north and/or east of the existing site (e.g. sludge stockpile area) which is shown in Figure 8 below as the hatched area at the top of the figure. This additional area could accommodate growth to 2121 which is the assumed Metro DBC City Full timeframe.

Figure 8 Potential layout of upgrade Pukete WWTP



Key risks, consequences and mitigations

The information outlined above along with the additional information provided below resulted in reassessment of the benefits of Option 4A and its ability to service wastewater needs for the metro (southern and northern) area.

The following is a list of key assumptions, opportunities and risks associated with the assessment:

- Extent of ground dig out and remediation required in northern area (north of existing lagoons) post 2061 is unknown. Additional assessments are required to confirm buildability and costs associated with building additional infrastructure on top of the existing sludge stockpiles and diverting process flows to this area.
- Brownfields construction is more complex (than Greenfield) and can limit the efficiency of equipment placement impacting on capex and operational costs

- The NIDEA growth projections were developed from 2013 Census information. Revised projections from the 2018 Census are expected to be available mid-2021 and these could give more confidence in the short to medium term forecasts
- A technology change to membrane based effluent clarification (necessary to meet projected nutrient levels and space constraints) and the need to provide peak wet weather flow buffering may impose either a need to accelerate additional secondary treatment, stormwater treatment or additional storage at the Pukete WWTP or in the network
- The assessment assumed that current sludge management is per the status quo. Any changes to biosolids disposal end-use could impact (positively or negatively) the overall buildout of the Pukete WWTP
- Static biological process models were used for rough order sizing and quantification of process units. Dynamic biological modelling is required to refine process design, selection and timeframes. HCC's WW process team is currently embarking on a process of upgrading the configuration and calibration of the site Biowin model that will facilitate such detailed modelling
- Changes to the composition of the wastewater from domestic and non-domestic sources, over the medium to long term, can impact on sizing of treatment processes. Depending on the reason for a particular change, it could have a reducing impact on some unit processes and an increasing impact on others
- Staging or replacement of structures as part of a renewals programme has not been considered. Some structures on the Pukete site are already approaching 50 years of age.
- Additional impacts resulting from climate change other than allowed for in the wastewater network model have not been assessed. Considering classical thinking around climate change effects in New Zealand, possible effects could be lower dry weather flows and higher concentrations (loads unchanged) than present and higher peak weather flows if the intensity of major storms increases
- Technology changes could reduce the footprint and increase efficiency of wastewater treatment processes required over time.

These risks are considered to equally affect options 2A and 4A. Mitigation of risks at Pukete would be considered further in the northern business case.

Immediate local needs at airport and surrounding communities

The DBC assumes the development of the Airport industrial precinct occurs by 2051 with 45 PE per hectare as an average wastewater generation level and 1,750 m^3/day of additional wet industry wastewater. Industrial activities have a wide range of wastewater generation rates and at this time, the timing of and nature of industrial development is currently unknown. The provision of significant capacity (approx. 50%) in advance of uncertain demand is a significant risk. A more modular approach could be undertaken with self-contained treatment systems added as development occurs.

In the short to medium term, a package 'secondary treatment' WWTP with land discharge suitable for up to 500 $m^{3/}$day, could service light industry in the Airport industrial precinct. A land area of up to 10 ha would be needed for the land discharge along with additional area for buffers. Over this level of flow, package plants[16] are less cost effective and much larger areas of land would be required for discharge of treated wastewater. Conveying Matangi flows to a smaller package plant at the Airport is unlikely to be more cost effective than a similar standalone WWTP at Matangi due to the significant cost of conveyance ($7M each).

[16] Essentially 'off the shelf' (rather than bespoke designs) treatment plants that are of a standard design and essentially where 'what you see is what you get'

A transfer pipeline from the Airport to Cambridge WWTP was considered in the long list options with an estimated cost of $20M. This option would need a minimum starting flow to avoid excessively long retention times in the conveyance pipe and resulting septicity. A smaller pipeline could be used if wet industry was not to be serviced and this may warrant assessment.

Waipa DC currently have no plans to reticulate Ohaupo for wastewater. Implementing a wastewater system in a community with a large number of on-site systems can be difficult as they cannot be forced to connect. The cost of conveyance is also high for this option ($7M).

The resource consent for Matangi WWTP expires in 2021 and some improvements to the treatment plant and land discharge area are likely to be required before a sub-regional WWTP could be in place. Connection to the Hamilton wastewater network could also be considered.

The current WWTP at Tauwhare Pa discharges secondary treated wastewater to land and is generally compliant with consent requirements. There is uncertainty over the timing and flows likely to be generated at the Pa and potentially from Tauwhare Village. Discharge to land with conventional secondary treatment is likely to have a lower capital and operating cost than an MBR plant with discharge to water. Land is likely to be available and there are limited opportunities for discharge to water in this location. Tauwhare Pa is 3 km from Matangi. Should Matangi be conveyed to a sub-regional WWTP or the Hamilton network, it may be feasible to combine Tauwhare Pa wastewater with Matangi wastewater.

Sensitivity assessments

The following sensitivity tests and results (refer Table 8) are outlined in the Pukete Capacity letter:

Table 8 Pukete Capacity Letter Sensitivity Tests and High-Level Results

Sensitivity Test	Outcome
Higher growth (based on ratio for both residential and non-residential growth)	Brings forward to approximately 2061 when Pukete WWTP needs to expand into northern area
Wet industry growth (further new 3,000 m3/day industry with elevated nutrients)	This growth equates to two large food processing plants and has minimal impact on reactor volume required

2.5 Cost assumptions

The cost assumptions are outlined in Section 4.2.7 of this report and also further outlined in the Treatment Options Short List Report (Appendix B).

2.6 Conveyance assumptions

The Regional Infrastructure Technical Specification (RITS) is a document that sets design specifications for constructing transportation, water supply, wastewater, stormwater and landscaping infrastructure in the Waikato Local Authority Shared Services (WLASS) participating councils' areas[17].

The RITS guidance for wastewater infrastructure has been used together with average daily flow (ADF) data to inform the conveyance assumptions of the Metro Wastewater DBC shortlisted options. The Peak Daily Flow (PDF) and Peak Wet Weather Flow (PWWF) were initially calculated for each catchment using the

[17] WLASS, 2021. *Regional Infrastructure Technical Specifications (RITS).* Retrieved 11 Feb 2021, from https://waikatolass.co.nz/shared-services/regional-infrastructure-technical-specifications/

method provided in RITS. The RITS method includes infiltration and surface water ingress allowances on a catchment area basis, which results in PDF and PWWF values that are approximately 5-10xADF and 10-20xADF respectively.

For comparison, peak flows were calculated using recent catchment ADF data provided by the Councils. The peak flows calculated using RITS were found to be significantly higher than those calculated using actual flow data. This was particularly true for the larger population centres such as Cambridge and Hamilton.

To prevent oversizing the infrastructure, the RITS methodology was modified to more accurately correlate with flow data. While there is a peaking factor applied to the population component of the ADF to determine the PDF, for the PWWF the majority of the additional flow comes from the infiltration and surface water components, which are both based on the reticulated area. This led to peaking factors that were significantly smaller than those calculated under RITS, averaging 5xADF for PDF and 10xADF for PWWF. Note – these revised estimates for Conveyance Peak Flow are representative of actual flow data, these differ from the RITS calculations can provide overly conservative flow rates for large catchments, it is recommended this is further refined in the Preferred option development.

For all towns with a Population<10,000, the RITS calculations in section 5.2.4.2 were used verbatim to calculate the PDF and PWWF.

2.6.1 North – South Metro Area split conveyance assumptions

Discussions were undertaken with HCC operations and planning staff to refine the assumptions on the north/south split for Hamilton and allow flows to be estimated for conveyance and WWTP sizing for Option 2A.

In the short term the simplest area to divert south is the Peacocke area (including the part of Glenview already diverted to Peacocke). Once this area is diverted, maximising the use of the Peacocke rising mains is recommended by diverting as much as feasible of the Hillcrest/Riverlea area in the vicinity of Clyde Street. Diverting more of the upper Western catchment is reasonably difficult due to limited service corridors but this could be considered in future as part of the optioneering for Lorne and Normandy pump station upgrades/storage to address capacity issues. The southern links area also has potential to be diverted south.

Overall, the assumed level of diversion (15% flow, 61,400PE) proposed to the southern WWTP for option 2A is considered appropriate to use for the short list assessment. The design and timing of the N12 pump station and N4-N12 transfer main in Peacocke will be critical to the feasibility of sending flows south. The potential impacts of the diversions on the Hamilton network and Pukete WWTP capacity also need to be investigated further as part of the northern detailed business case.

2.6.2 General conveyance assumptions

In order to develop options, the following assumptions have been made in regard to the conveyance routes.

- The sub-regional WWTP will be located north of Hamilton airport
- It is assumed that the wastewater assets servicing the Airport area are local reticulation and have not been included in the conveyance design
- Conveyance routes will follow public road corridors wherever practical
- The most direct route practical has been used

- All pipelines will pump directly to the wastewater treatment plant (i.e. no discharge into existing interceptor sewers, as capacity is unknown). This is conservative and can be refined during design development
- Daisy-chaining of pump stations has been avoided. This approach can be refined during design development
- It is expected that the pipeline alignment could be optimised by crossing through private properties, however this was considered higher risk than road corridors and as such was not explored at this stage
- 2061 agreed as basis of cost estimating and pipe sizes do not increase significantly over time
- Single conveyance routes have been assumed. Multiple pipelines for the same routes for resilience, staging and septicity control purposes have not been costed
- Pipelines with retention times greater than eight hours will require chemical dosing to mitigate septicity and odour. Requirements can be confirmed through septicity analysis during design development.

Route specific assumptions:

A range of specific conveyance assumptions have been made for the route between Matangi and a new Southern WWTP, particularly where the route crosses State Highway and the Waikato River as described below. All other proposed pipelines are considered to be straight forward and covered by the General Conveyance Assumptions in Section 2.6.2.

Matangi to Southern WWTP:

Where the route crosses SH1 at Tamahere, it is assumed that the pipeline will be constructed in the road through the existing underpass. Should this be deemed to be too disruptive to traffic movements, the pipeline could be installed under the stream, as well as the highway, in a single trenchless construction, likely drilling. The highway is elevated in this location so there is not expected to be any issues with clearances. Detailed ground conditions not known at this stage. The HDD alignment could change (likely to the south) when considered in more detail as working space at exit pit is quite limited.

Where the route crosses the Waikato River near Narrows Bridge, we have assumed that the pipeline will be installed on a dedicated pipebridge due to the risk posed by the ground conditions (hard rock) expected in this area. It is GHD’s experience that Waka Kotahi is becoming less receptive to pipelines being attached to road bridges, therefore we have allowed for a stand-alone structure. There is an opportunity to work with local authorities to provide a multi-functional bridge, e.g. footbridge / cycling in addition to supporting the pipe, however, this has not been included at this stage.

Further investigation of the ground conditions may determine that trenchless installation of the pipe under the river is an achievable alternative.

3. Shortlist option development

The methodology outlined in Section 1.4 shows that the shortlist options assessment is a key part of the Economic Case and therefore the whole of the Metro Wastewater Detailed Business Case. In mid to late 2020 a longlist of options was developed and assessed. As a result of the longlist assessment two options plus the Do Nothing option were identified, investigated further and refined as shortlisted options. The shortlist of options identified in the previous investigation were:

- Option 1A – Do Nothing (Business as Usual)
- Option 2A –Centralised Solution
- Option 4A – Enhanced Business as Usual

The further investigation and refinement of the shortlist options included a site selection process to identify a potential site for either a subregional plant proposed as part of Option 2A or a smaller southern plant proposed as part of Option 4A. The site selection work was undertaken in parallel to the shortlist assessment process along with discharge option and staging investigations for the potential new WWTP sites. The outcomes of the parallel site investigations are outlined in a separate Metro Wastewater DBC: Site Selection Report[18].

The small communities of Matangi (including Tamahere commercial area) and Ohaupo are a small proportion of the flows to the 2A and 4A sub-regional WWTPs at 1% and 8% respectively at 2061. Tauwhare Pa flows at 55m3/day would contribute an additional 0.2% to a sub-regional 2A WWTP and 1% to sub-regional 4A WWTP. Even at double these flows the impact on the conveyance and WWTP sizing is not expected to be significant. These small communities are unlikely to trigger major upgrades at the WWTP when or if they are connected. For Matangi the cost of the conveyance to a sub-regional WWTP and share of the treatment cost will be compared with a standalone land disposal option as part of the upcoming discharge consent renewal. Waipa District currently has no plans to reticulate the Ohaupo community, however, this could be required in future if environmental effects are observed from the existing on-site systems or more dense development occurs. There is a high level of uncertainty over the timing and flows likely to be generated at Tauwhare Pa and potentially from Tauwhare Village. During the development of the preferred option further investigation of the Tauwhare Pa options will be undertaken. If Matangi is connected, Tauwhare Pa is only 3km away which could make the conveyance pipeline more cost effective. Soil conditions and environmental effects associated with land discharge will need to be investigated further for both Tauwhare Pa and Matangi at preferred option stage.

3.1 Shortlist option descriptions

3.1.1 Option 1A: Do Nothing

The Do Nothing option has been brought forward for comparative purposes. This option includes:

- Ngaruawahia WWTP continues to service:
    - Hopuhopu
    - Horotiu
    - Ngaruawahia
    - Taupiri

[18] GHD/ Beca, 2021. Metro Wastewater DBC Site Selection Options Report. HCC.

- Hamilton (Pukete Plant) continues to service:
  - Hamilton (north)
  - Hamilton (south)
  - Te Kowhai
- Hamilton Airport Business Zone – as current (ad-hoc on-site servicing)
- Matangi – continue current local WWTP
- Ohaupo – continue on-site servicing
- Cambridge WWTP continues to operate
- Te Awamutu/Kihikihi (standalone plant) to be upgraded as planned.

3.1.2 Option 2A – Three Plant Option

Three Plant Option – The treatment plant locations, and areas of service for each along with the key conveyance routes developed for this option are shown in Figure 9. This option consists of the following three main WWTP as described below:

- Pukete WWTP as the centralised northern plant to service northern communities
  - Hamilton (North)
  - Hopuhopu
  - Horotiu
  - Taupiri
  - Te Kowhai.
- One centralised southern plant to service southern communities (plant located south of Hamilton)
  - Cambridge
  - Hamilton Airport Business Zone
  - Hamilton (South)
  - Matangi
  - Ohaupo.
- Te Awamutu/Kihikihi (standalone plant) to be upgraded

For the purpose of the long-list assessment, it is assumed that Tauwhare Pa will continue as a small standalone plant.

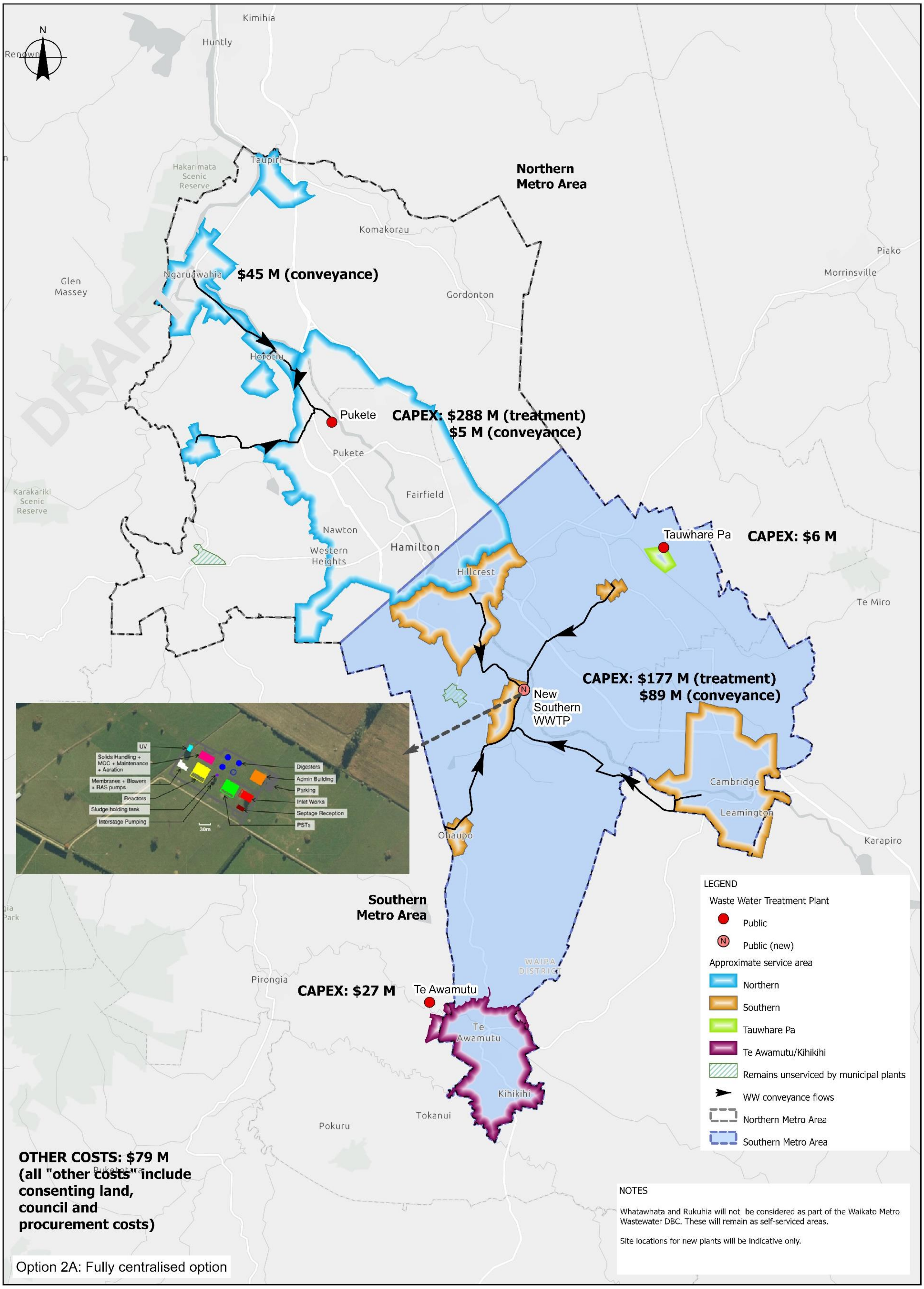
The longlist assessment identified Option 2A as the most preferred technical solution under various weightings and sensitivities (excluding a detailed cost assessment). This option provides the flexibility to masterplan an efficient facility on a new site, take advantage of water re-use and waste to energy opportunities due to its size and scale. Some benefits of this option are related to a centralised location between south Hamilton and Cambridge.

Table 9 Option 2A Centralised – Smaller Settlement Servicing Assumptions

Settlement / catchment	Servicing solution	Rationale
Matangi	Transfer to southern sub-regional WWTP	Limited land available for expansion of WWTP. Current compliance issues for WWTP. Opportunities for more dense development around Matangi Village and to include Tamahere commercial hub on route to southern sub-regional WWTP.
Ohaupo (from 2051)	Transfer to southern sub-regional WWTP	Limited well drained land available for on-site systems. Potential impacts of on-site systems on sensitive environments e.g., peat lakes. Opportunities for more dense development.
Tauwhare Pa	Stand alone	Small flows currently which would be difficult to transfer without septicity issues. Low level of certainty in when growth might occur. Land likely to be available/suitable for expansion of existing WWTP.

These smaller catchment shortlist option servicing assumptions will be further tested and refined at the preferred option stage.

Figure 9 Shortlist Option 2A –Centralised WWTP Network Configuration[19]



[19] Note: Te Kowhai connection to the existing Pukete WWTP will be confirmed through the Northern Detailed Business Case.

Insert shows indicative site layout for the New Southern WWTP.

Capex Values refer to the costs associated with WWTP upgrades at the sites adjacent to the values shown.

Key to this option is the development of a new centralised southern WWTP. **Table 10** below provides a summary of the servicing information, plant make up, conveyance and treatment assumptions.

Table 10 – Shortlist Option 2A: Servicing Information for a centralised Southern Plant

<table>
<tr><th colspan="4">Centralised sub-regional southern plant (at a new site)</th></tr>
<tr><td rowspan="4">Servicing Area</td><td>Population Equivalent</td><td>2031
77,000</td><td>2061
124,000</td></tr>
<tr><td rowspan="2">Industry</td><td colspan="2">Wet industry at Airport and near Cambridge WWTP</td></tr>
<tr><td colspan="2">Greenfield Industrial growth cells around Airport and Hautapu</td></tr>
<tr><td>ML per day (2031 and 2061)</td><td>2031
15.6ML/d</td><td>2061
24.8ML/d</td></tr>
<tr><td rowspan="4">Plant make up</td><td rowspan="2">Technical make up</td><td colspan="2">Liquid Stream:
• Inlet works
• Primary treatment
• Activated sludge reactors
• Membranes
• UV treatment</td></tr>
<tr><td colspan="2">Solid Stream:
• Digestion
• Centrifuge dewatering</td></tr>
<tr><td>Annual Electricity use</td><td>2031 – 3.5 M kWhr @50% recovery</td><td>2061 - 5.7 M kWhr @50% recovery</td></tr>
<tr><td>Biosolids produced</td><td>2031 - 19 m³/d</td><td>2061 - 23 m³/d</td></tr>
<tr><td rowspan="5">Conveyance</td><td rowspan="4">Assumed pipeline distance</td><td>Hamilton South to Southern</td><td>3,200m</td></tr>
<tr><td>Cambridge to Southern</td><td>16,400m</td></tr>
<tr><td>Matangi to Southern</td><td>9,680m</td></tr>
<tr><td>Ohaupo to Southern</td><td>10,000m</td></tr>
<tr><td>Annual Electricity use</td><td>2031 – 1250 MWhr</td><td>2061 - 2250 MWhr</td></tr>
<tr><td rowspan="3">Treatment Assumptions</td><td rowspan="2">Liquid stream</td><td colspan="2">TN 4 mg/L</td></tr>
<tr><td colspan="2">TP 1 mg/L</td></tr>
<tr><td>Solids Stream</td><td colspan="2">26% DS</td></tr>
</table>

The continued use of the existing Pukete WWTP is a common assumption of both shortlisted options (refer Section 2.6). However it is recognised the Pukete WWTP will have a lower serving requirement under option 2A than it otherwise would under Option 4A. Table 11 below outlines the servicing requirement for the existing Pukete WWTP for Option 2A based on work completed to date.

Table 11 – Shortlist Option 2A: Northern Hamilton Area Servicing Assumptions

Pukete Plant (without south Hamilton flows, Ngaruawahia and Te Kowhai)			
Servicing Area	**Population Equivalent**	2031 - 289,000	2061 – 391,000
	Industry	Greenfield Industry growth at Ruakura, Te Rapa, Rotokauri	
		Wet Industry at Te Rapa North and Ruakura	
	ML per day (2031 and 2061)	2031 – 58 ML/d	2061 – 78 ML/d
Plant make up	**Technical make up**	Liquid Stream • Inlet works • Primary treatment • Activated sludge reactors • Membranes • UV treatment	
		Solid Stream • Digestion • Centrifuge dewatering • Advanced solids destruction	
	Annual Electricity use	2031 – 13.4 M kWhr @50% recovery	2061 – 18.0 M kWhr @50% recovery
	Biosolids produced	**2031** - 15 m³/day	**2061** - 17 m³/day
Treatment Assumptions	**Liquid stream**	**T**N 4 mg/L	
		TP 1 mg/L	
	Solids Stream	20% DS	

Conveyancing

The proposed wastewater conveyance network is outlined below for Option 2A and includes four routes.

The pipelines and pump stations documented below have been sized for the 2061 growth horizon. Staging of the infrastructure to meet the interim design horizons (2031 / 2041) has not been considered in detail at the shortlist stage. Smaller diameter rising mains could be installed initially to manage retention times / septicity risk and supplemented with additional pipelines at a later date. Alternatively, intermediate pump stations could be installed on the pipeline to boost flow to overcome the increased headloss associated with the 2061 flows. The full set of conveyance assumptions and details for Option 2A can be found in the Waikato Metro Wastewater DBC: Conveyance Shortlist Options Report (Draft)[20].

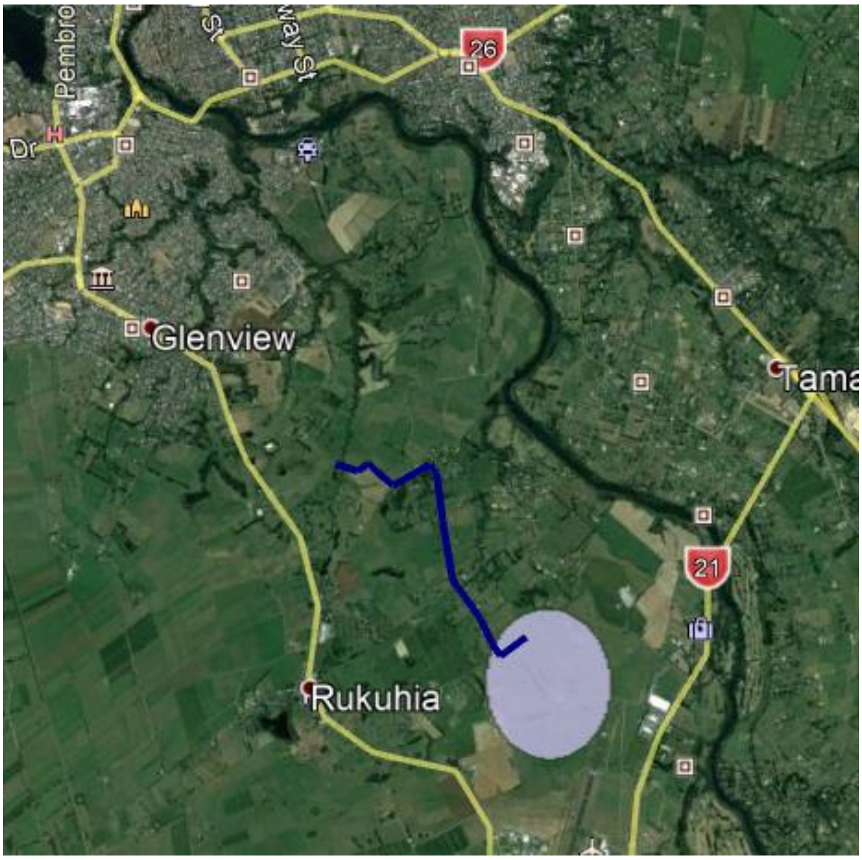
The Cambridge to WWTP pipeline alignment is illustrated in Figure 10 (cyan line).

[20] GHD / Beca, March 2021. *Waikato Metro Wastewater DBC: Conveyance Shortlist Options Report (Draft). Fut*ure Proof Partners.

Figure 10 Shortlist Option 2A: Cambridge to Centralised Southern WWTP pipeline alignment[21]

The Hamilton South to WWTP pipeline alignment is illustrated in Figure 11 (dark blue line).

Figure 11 Shortlist Option 2A: Hamilton South to Centralised Southern WWTP pipeline alignment[22]

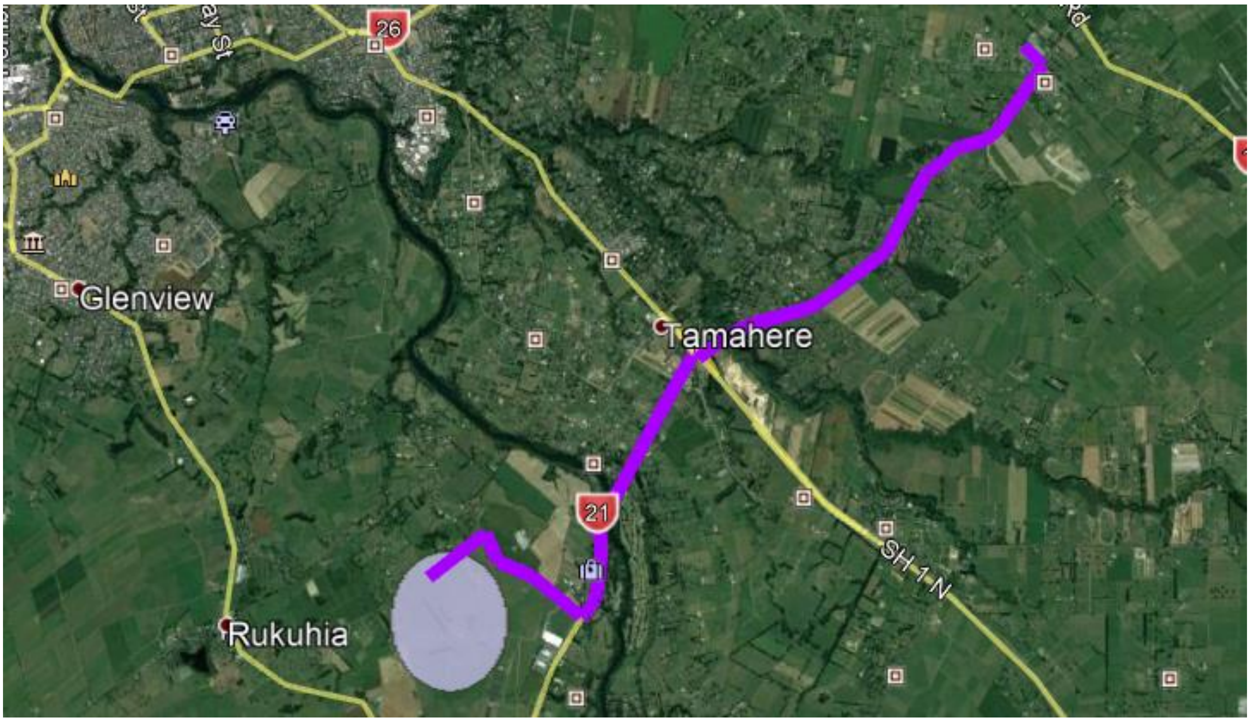


[21] Note: Wastewater flow in direction toward grey circle (Proposed WWTP)

[22] Note: Wastewater flow in direction toward grey circle (Proposed WWTP)

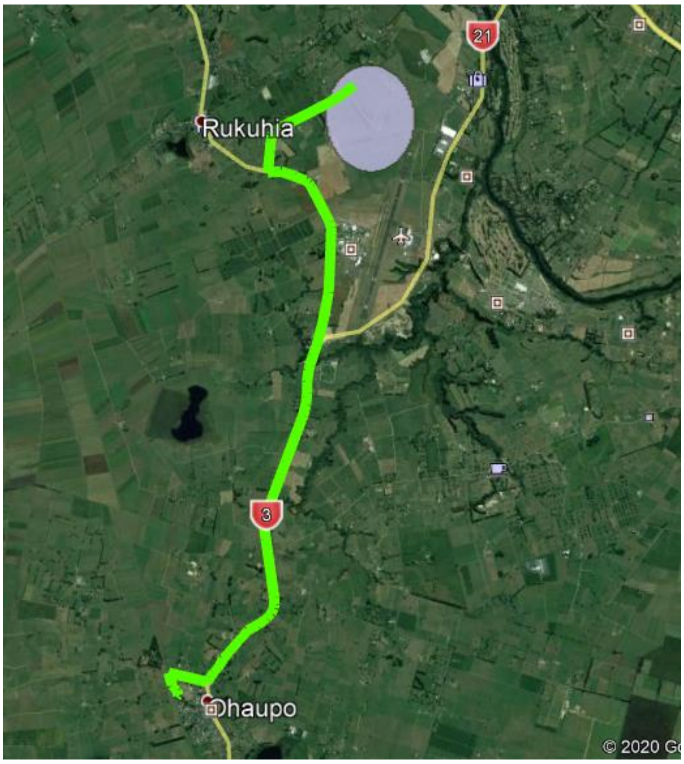
The Matangi to WWTP pipeline alignment is illustrated in Figure 12 (purple line).

Figure 12 Shortlist Option 2A: Matangi to Centralised Southern WWTP pipeline alignment [23]



The Ohaupo to WWTP pipeline alignment is illustrated in Figure 13 (green line).

Figure 13 - Shortlist Option 2A: Ohaupo to Centralised Southern WWTP pipeline alignment [24]



[23] Note: Wastewater flow in direction toward grey circle (Proposed WWTP)

[24] Note: Wastewater flow in direction toward grey circle (Proposed WWTP)

Key pipeline and pump station details are listed in Table 12 and Table 13 below.

Table 12 Shortlist Option 2A Centralised Southern WWTP System Pipe Details

Pipe Route	Duty Flow (L/s)	Length (km)	Diameter (m) - 2061	TDH New / Aged (m) - 2061	Ave Retention Time (hr) - 2061
Cambridge to WWTP	402	16.40	DN710, SDR11	77 / 82	11.5
Hamilton South to WWTP	764	3.20	DN900, SDR11	52 / 53	2.7
Matangi to WWTP	24	9.68	DN200, SDR11	72 / 81	52
Ohaupo to WWTP	40	10.00	DN250, SDR11	79 / 86	38

Table 13 Shortlist Option 2A Centralised Southern WWTP System Pump Station Details

Pipe Route	Total Power @ 60% Efficiency (kW)	Approx. Wet Well Diameter (m)	Emergency Storage (m3) - 2061	Notes
Cambridge to WWTP	538	6	1689	Assumes duty/assist/ assist configuration
Hamilton South to WWTP	666	7	895	Assumes duty/assist/assist configuration
Matangi to WWTP	32	2.5	35	Assumes duty/assist configuration
Ohaupo to WWTP	56	3	77	Assumes duty/assist configuration

3.1.3 Option 4A – Five Plant Option

- Ngaruawahia standalone plant to service:
  - Hopuhopu
  - Horotiu
  - Ngaruawahia
  - Taupiri.
- Hamilton (Pukete Plant) to service:
  - Hamilton (north)
  - Hamilton (south)

- Te Kowhai.

- Southern plant to service small southern communities (plant located south of Hamilton):
  - Hamilton Airport Business Zone
  - Matangi
  - Ohaupo.
- New plant at Cambridge (standalone plant)
- Te Awamutu/Kihikihi (standalone plant) to be upgraded

As with Option 2A, for the purposes of the long-list assessment, it is assumed that Tauwhare Pa will continue as a small standalone plant which will be upgraded.

This option consists of seven plants in total to service the wider metro area (refer to Figure 14). A new southern plant to service the airport will be master planned to cater for Matangi, Tauwhare and Ohaupo and if selected as the preferred option can be refined over time to allow for growth changes across these communities. In the interim, the Matangi plant is likely to require short to medium term upgrades. It is also expected that the connection of Te Kowhai to Pukete is more economical than building a new plant in Te Kowhai. This connection is likely to be required in the next 10 years. This option also maintains existing council boundaries.

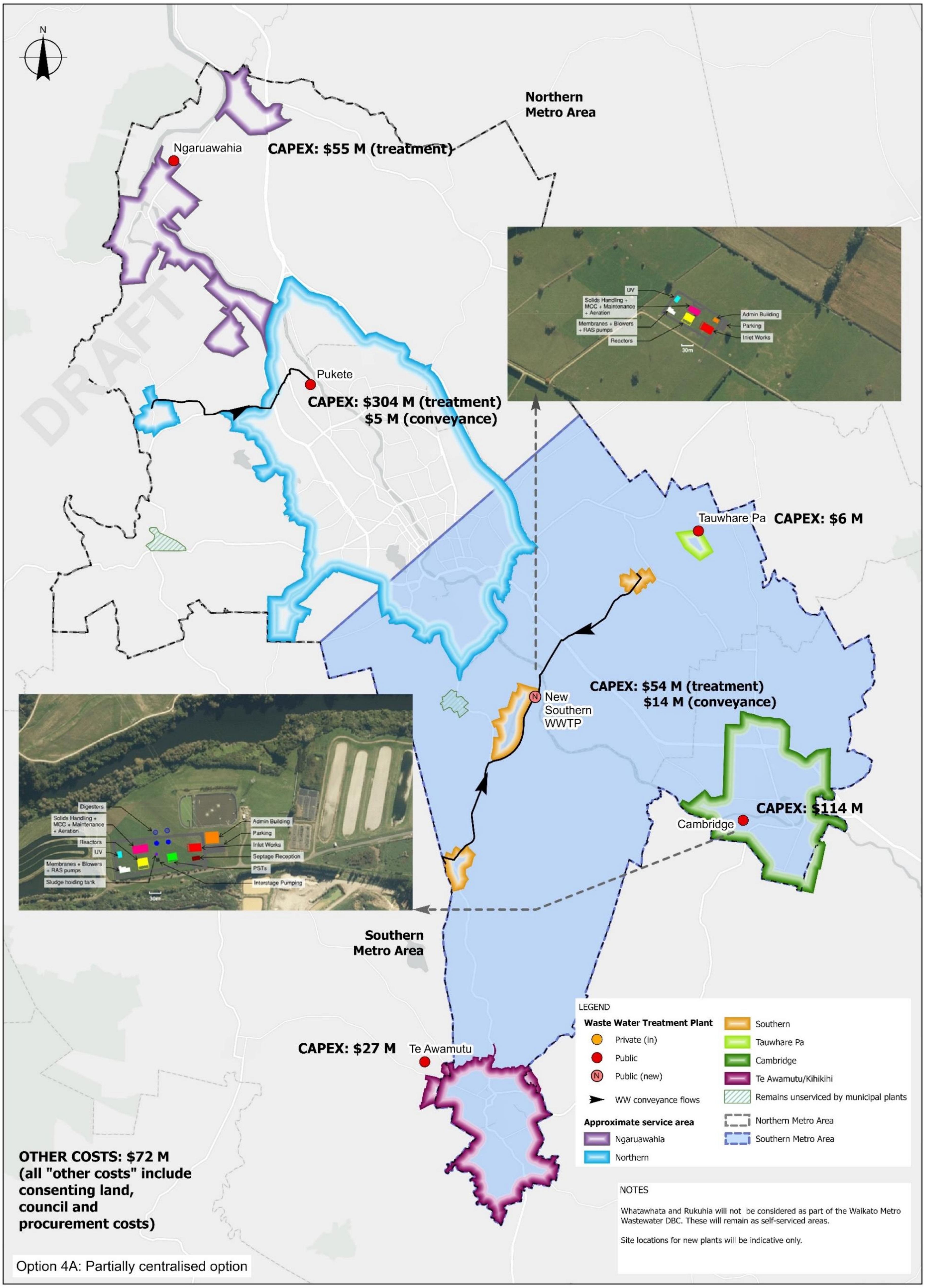
As part of the development of the shortlist options the smaller catchments of the study area were assessed at a high level to determine whether it was more effective to service these communities using a larger more centralised facility or smaller stand-alone facilities. The findings of these assessments determined it was more effective to service Tauwhare Pa using a smaller stand-alone wastewater treatment plant facility. The rationale informing these shortlist option servicing assumptions for Matangi, Ohaupo and Tauwhare Pa is provided in Table 14 below.

Table 14 Option 4A Centralised – Smaller Settlement Servicing Assumptions

Settlement / catchment	Servicing solution	Rationale
Matangi	Transfer to southern sub-regional WWTP	Limited land available for expansion of WWTP. Current compliance issues for WWTP. Opportunities for more dense development around Matangi Village and to include Tamahere commercial hub on route to southern sub-regional WWTP.
Ohaupo (from 2051)	Transfer to southern sub-regional WWTP	Limited well drained land available for on-site systems. Potential impacts of on-site systems on sensitive environments e.g., peat lakes. Opportunities for more dense development.
Tauwhare Pa	Stand alone	Small flows currently which would be difficult to transfer without septicity issues. Low level of certainty in when growth might occur. Land likely to be available/suitable for expansion of existing WWTP.

These smaller catchment shortlist option servicing assumptions will be further tested and refined at the preferred option stage.

Figure 14 Shortlist Option 4A – Enhanced BAU Network Configuration[25]



[25] Note: Te Kowhai connection to the existing Pukete WWTP will be confirmed through the Northern Detailed Business Case.

Insert shows indicative site layout for the New Southern WWTP.

Capex Values refer to the costs associated with WWTP upgrades at the sites adjacent to the values shown.

Key to this option is the development of two new WWTPs. **Table 15** and **Table 16** below provide summaries of the servicing information, plant make up, conveyance and treatment assumptions.

Table 15 – Shortlist Option 4A: Servicing Information for new Southern Airport Plant

Southern Airport Plant			
Servicing Area	**Population Equivalent**	**2031** 6,869	**2061** 17,852
	Industry	Greenfield Industrial growth cells around airport	
		Wet industry near airport	
	ML per day (2031 and 2061)	2031 – 1.6 ML/d	2061 – 3.9 ML/d
Plant make up	**Technical make up**	Liquid Stream • Inlet works • Activated sludge reactors • Membranes UV treatment	
		Solid Stream • Screw press dewatering	
	Annual Electricity use	2031 – 0.7 M kWhr	2061 - 1.8 M kWhr
	Biosolids produced	2031 - 2 m³/d	2061 - 6 m³/d
Conveyance	**Assumed pipeline distance**	Matangi to Southern	9680m
		Ohaupo to Southern	10000m
	Annual Electricity use	2031 – 13 MWh	2061 – 42 MWh
Treatment Assumptions	**Liquid stream**	TN 4 mg/L	
		TP 1 mg/L	
	Solids Stream	19% DS	

Table 16 – Shortlist Option 4A: Servicing Information for Cambridge Plant

Cambridge Plant			
Servicing Area	**Population Equivalent**	2031 32,940	2061 45,031
	Industry	Wet industry near Cambridge WWTP and existing trade waste dischargers	
		Greenfield Industrial growth cell at Hautapu	
	ML per day (2031 and 2061)	2031 - 6.8 ML/d	2061 – 9.0 ML/d
Plant make up	**Technical make up**	Liquid Stream • Inlet works • Primary treatment • Activated sludge reactors • Membranes • UV treatment	
		Solid Stream • Digestion • Centrifuge dewatering	
	Annual Electricity use	2031 – 1.5 M kWhr @ 50% recovery	2061 - 2.1 M kWhr @50% recovery
	Biosolids produced	2031 - 7 m^3/d	2061 - 8 m^3/d
Conveyance	**Assumed pipeline distance**	None additional	
	Annual Electricity use	None additional	
Treatment Assumptions	**Liquid stream**	TN 4 mg/L	
		TP 1 mg/L	
	Solids Stream	26% DS	

A common assumption of both shortlisted options is the continued use of the existing Pukete WWTP. However it is recognised the Pukete WWTP will have a higher serving requirement under option 4A than it otherwise would under Option 2A Table 17 below outlines the servicing requirement for the existing Pukete WWTP for Option 4A based on work completed to date.

Table 17 – Shortlist Option 4A: Northern Hamilton Area Servicing Assumptions

<table>
<tr><th colspan="4">Pukete Plant (with south Hamilton flows, without Ngaruawahia and Te Kowhai)</th></tr>
<tr><td rowspan="4">Servicing Area</td><td>Population Equivalent</td><td>2031 – 325,000</td><td>2061 – 451,000</td></tr>
<tr><td rowspan="2">Industry</td><td colspan="2">Greenfield Industry growth at Ruakura, Te Rapa, Rotokauri</td></tr>
<tr><td colspan="2">Wet Industry at Te Rapa North and Ruakura</td></tr>
<tr><td>ML per day (2031 and 2061)</td><td>2031 - 65 ML/d</td><td>2061 - 90 ML/d</td></tr>
<tr><td rowspan="4">Plant make up</td><td rowspan="2">Technical make up</td><td colspan="2">Liquid Stream
Inlet works
Primary treatment
Activated sludge reactors
Membranes
UV treatment</td></tr>
<tr><td colspan="2">Solid Stream
Digestion
Centrifuge dewatering
Advanced solids destruction</td></tr>
<tr><td>Annual Electricity use</td><td>2031 – 15.0 M kWhr @ 50% recovery</td><td>2061 – 20.8 M kWhr @50% recovery</td></tr>
<tr><td>Biosolids produced</td><td>2031 – 16 m^3/day</td><td>2061 – 18 m^3/day</td></tr>
<tr><td rowspan="3">Treatment Assumptions</td><td rowspan="2">Liquid stream</td><td colspan="2">TN 4 mg/L</td></tr>
<tr><td colspan="2">TP 1 mg/L</td></tr>
<tr><td>Solids Stream</td><td colspan="2">20% DS</td></tr>
</table>

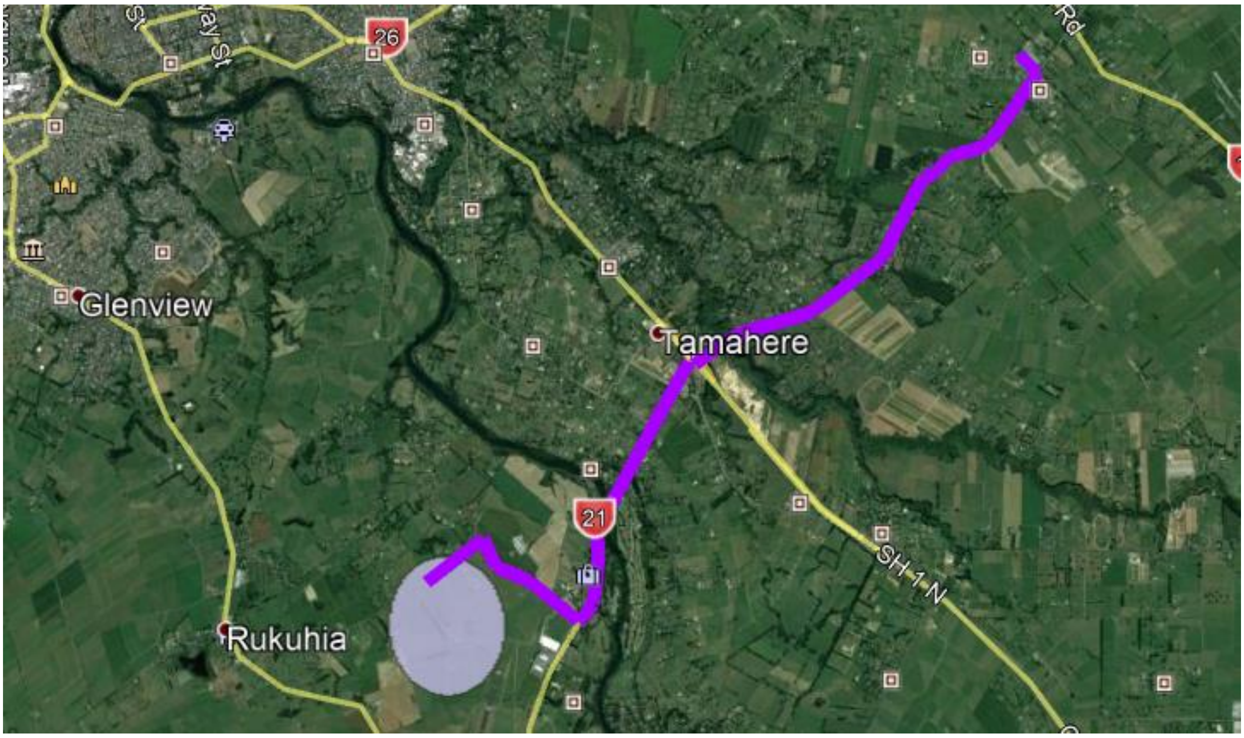
Conveyance

The proposed wastewater conveyance network for Option 4A is outlined below, which includes the Matangi to New Southern Airport WWTP and Ohaupo to New Southern Airport WWTP pipeline alignments only.

The pipelines and pump stations documented below have been sized for the 2061 growth horizon. Staging of the infrastructure to meet the interim design horizons (2031 / 2041) has not been considered in detail at the shortlist stage. Smaller diameter rising mains could be installed initially to manage retention times / septicity risk and supplemented with additional pipelines at a later date. Alternatively, intermediate pump stations could be installed on the pipeline to boost flow to overcome the increased headloss associated with the 2061 flows. The full set of conveyance assumptions and details for Option 4A can be found in the Waikato Metro Wastewater DBC: Conveyance Shortlist Options Report (Draft)[26].

The Matangi to WWTP pipeline alignment is illustrated in Figure 15 (purple line).

Figure 15 Shortlist Option 4A: Matangi to New Southern Airport WWTP pipeline alignment[27]

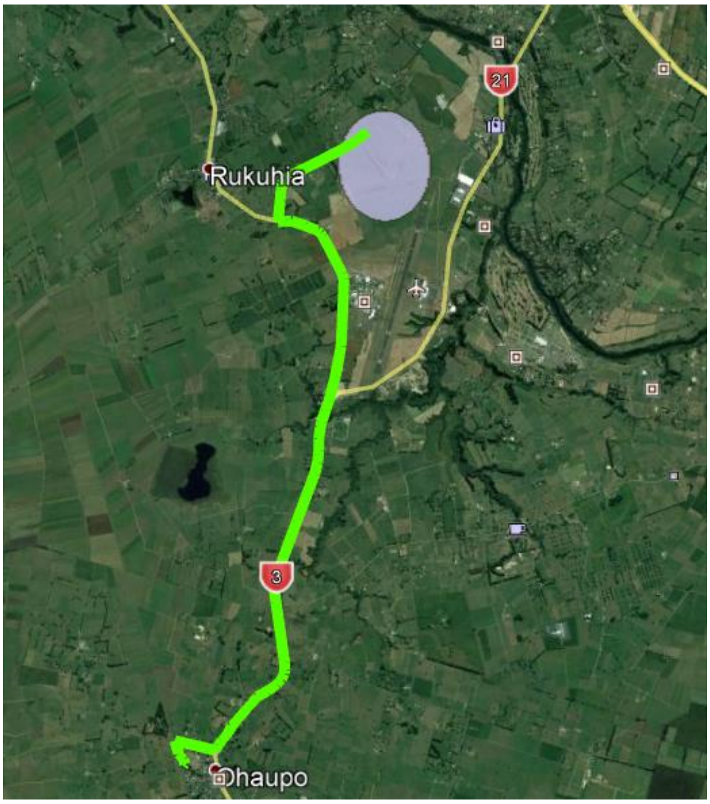


The Ohaupo to WWTP pipeline alignment is illustrated in Figure 16 (green line).

[26] GHD / Beca, March 2021. *Waikato Metro Wastewater DBC: Conveyance Shortlist Options Report (Draft). Fut*ure Proof Partners.

[27] Note: Wastewater flow in direction toward grey circle (Proposed WWTP)

Figure 16 - Shortlist Option 4A: Ohaupo to New Southern Airport WWTP pipeline alignment[28]



Key pipeline and pump station details for Option 4A are listed in Table 18 and Table 19 below.

Table 18 Shortlist Option 4A New Southern Airport WWTP System Pipe Details

Pipe Route	Duty Flow (L/s)	Length (km)	Diameter (m) - 2061	TDH New / Aged (m) - 2061	Ave Retention Time (hr) - 2061
Matangi to WWTP	24	9.68	DN200 SDR11	72 / 81	52
Ohaupo to WWTP	40	10.00	DN250 SDR11	79 / 86	38

[28] Note: Wastewater flow in direction toward grey circle (Proposed WWTP)

Table 19 Shortlist Option 4A New Southern Airport WWTP System Pump Station Details

Pipe Route	Total Power @ 60% Efficiency (kW)	Approx. Wet Well Diameter (m)	Emergency Storage (m3) - 2061[29]	Notes
Matangi to WWTP	32	2.5	35	Assumes duty/assist configuration
Ohaupo to WWTP	56	3	77	Assumes duty/assist configuration

3.2 Discharge options

3.2.1 Wastewater treatment and discharge assumptions

For the purposes of the DBC, the assumption is that the future discharge of treated wastewater will be direct to the Waikato River and to a very high standard[30] For the liquid stream, the proposed level of treatment would provide:

- A high level of nutrient removal of < 4 mg/L Total Nitrogen (TN) and < 1.0 mg/L Total Phosphorus (TP) (as annual means)
- A very high level of pathogen removal (E. coli < 14 cfu/100mL as a 95 percentile).

Notwithstanding the above assumption, any future resource consent process (should the project proceed to that stage) will be required to assess alternative treatment requirements and discharge options in line with requirements of the RMA and regional planning documents.

To provide an indicative assessment of alternative discharge options for each of the potential WWTP sites, a high-level assessment has been undertaken for each of the WWTP sites in the southern metro area under Options 2A and 4A. An assumption was made that the existing discharge systems at Tauwhare Pa WWTP (discharge to land) and Te Awamutu WWTP (discharge to Mangapiko Stream through a buried rock passage) would not be altered.

3.2.2 Mass load vs concentration limits

It is recognised that any future resource consent (for discharge to water) would likely include limits in terms of mass loads of nutrients (kg/day) rather than the concentration limits stated in section 3.3.1 above. However, mass loads are not used to size treatment process units, rather treated wastewater concentration quality targets have been used to size treatment processes for high level costing purposes.

The initial assessment of nutrient baseline mass loads and future loads (using mass load equivalents)[31] has shown that by adopting the preferred treated wastewater quality standard a major reduction in TN mass loads will be achieved when compared to the existing baseline, even when flows increase through to 2061.

For TP, the degree of reduction when compared to the current baseline is not as large, and further treatment may be required in the medium to long term to reduce TP concentrations down to 0.5 mg/L to achieve a reduction in TP mass loads when compared to the existing baseline. This can be readily achieved by existing

[29] Note: Based on 9 hours average daily flow (ADF) in 2061. Storage provided for gravity catchment only (not pumped inflow). Percentage of catchment requiring storage was estimated based on conveyance configuration

[30] Wastewater Treatment Assumptions for Waikato Metro Wastewater DBC. Memorandum dated 4 August 2020. GHD and Beca.

[31] Fonterra Hautapu High Level Consentability Review. Memorandum dated 2 November 2020. GHD and Beca.

treatment processes; however additional chemical treatment is required with an associated higher operating cost.

3.2.3 Discharge options development

Notwithstanding the above, a high-level assessment of alterative discharge methods assessed for the new Southern WWTP (Option 2A and 4A) and the Cambridge WWTP (Option 4A) have been considered and include discharge to land, direct discharge to water (diffuser to the river), artificial rock passage, wetlands, and industrial/potable reuse.

Several of the key considerations for assessing the feasibility of these discharge options are set out below.

3.2.3.1 Discharge to land (Receiving Environment)

Slow rate irrigation is the main method of discharge to land that has been assessed. Rapid infiltration beds may be feasible at sites with well-draining soils; however site-specific geotechnical investigations would be required assess this discharge method. Key considerations for discharge to land are outlined in three aspects below.

Land ownership: a significant amount of land is required to enable discharge to land methods. Slow rate irrigation would require 744 ha of land or 390 ha (including Cambridge standalone WWTP) of land based on the flow rate assumptions for Options 2A and 4A respectively (excluding buffer zone requirements). The type of landowners (private land, Maori land, public land) and the availability of large land parcels (i.e. >15 ha) in the vicinity of the proposed land discharge site are useful considerations.

Land characteristics: well-draining soils are better suited for discharge to land. Soil types, such as peat, that are generally poorly draining are unlikely to be able to be used to land discharge all year round (particularly during the winter). Flat land is ideal for land discharge purposes, however steeper slopes may be feasible with additional planting to minimise runoff. Based on the types of soils in this area a 100% year-round slow rate irrigation system is unlikely to be viable, with soil moisture levels becoming too high in winter so as to preclude discharge to land. In these situations, either storage of treated wastewater is required or discharge to an alternate receiving environment.

Sensitive receiving environments: buffer zones are generally established around sensitive receiving environments (such as gullies, streams or floodplains) and residential properties or urban areas in proximity to land discharge sites. For a high-level assessment, it is reasonable to assume a 100% buffer zone allowance is required on top of the irrigation land requirements. This would also allow for operational matters such as rest periods between irrigation events and land use management (such as a cut and carry harvesting system). This means approximately 1500 ha would be required for Option 2A and 780 ha for Option 4A.

Land use: Some existing land uses (such as dairying) are incompatible with the discharge of treated wastewater (due to Fonterra requirements) and in the majority of cases there would be a requirement to purchase land for the use of discharge of treated wastewater. Changes to land use would also likely be required (such as the removal of dairying stock and retirement of land) to ensure nutrient losses would be less than existing (after applying nutrients in treated wastewater) to achieve consistency with the Vision and Strategy for the Waikato River. Leasing land may be possible but comes with a number of risks including lack of security over the long-term.

Effects on groundwater and surface water: Discharge to land comes with a number of risks to groundwater and surface water. These effects would require assessment which requires the use of complex hydrogeological and nutrient loss models. Due to large degrees of uncertainty with existing models, the monitoring and real world verification requirements for land discharges are much more onerous than for surface water discharges.

For discharge to land, it is feasible that treated wastewater could be pumped to a disposal site within a 7km radius of the WWTP (although ideally discharged within a 5km radius to minimise conveyance costs). A map showing eight potential areas for the new Southern WWTP and land cover for potential land disposal site options within 5km and 7km radii can be found in Figure 17.

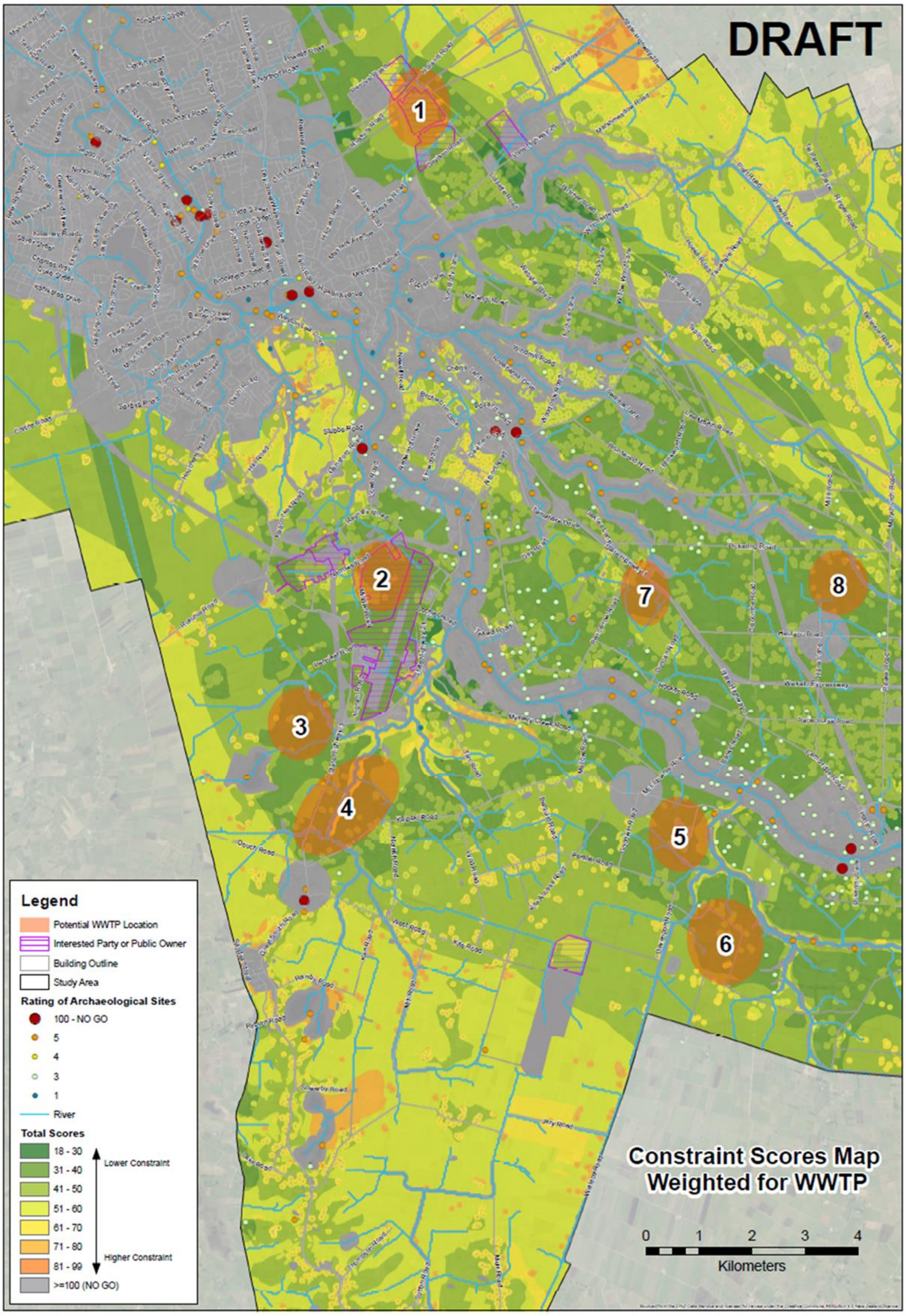


Figure 17 Map showing eight potential areas for the new Southern WWTP and land cover for potential land disposal site options within 5km and 7km radii.

3.2.3.2 Discharge to water (Receiving environment)

Three methods for discharging to water have been considered in this assessment:

1. Direct discharge via a diffuser to the river/stream.
2. Indirect discharge via an artificial rock passage system.
3. Indirect discharge via wetlands.

The main site constraints for direct discharge of treated wastewater via a diffuser and an indirect artificial rock passage system are the:

- **Proximity of the site to the river or stream:** ideally the WWTP is within 5km of the discharge point: the closer the WWTP is to the discharge point, the shorter the conveyance pipeline that is required to be constructed and maintained.
- **Downstream receiving environment:** an assessment of environmental effects would need to be undertaken to understand potential adverse effects of the discharge on receiving water quality, ecology, flows and flooding. In particular, issues such as flooding are more likely to be a concern for discharges into streams that flow through urban areas.

Alternatively, indirect discharge of wastewater to water via wetlands has a different set of site constraints:

- **Land requirements:** an artificial engineered wetland would require approximately 30 ha or 8.3 ha (for airport WWTP only) of land based on the flow rate assumptions for Options 2A and 4A respectively. However, initial feedback from iwi groups has indicated artificial wetlands were not a preferred option from a cultural perspective. Rather, the preferred approach is to identify combined restoration and discharge opportunities in degraded wetlands within the vicinity of the site.
- **Historical wetlands:** if historical wetlands were located in proximity to the site, these may present wetland restoration opportunities. Further field ecology and engineering investigations would be required confirm wetland restoration opportunities and treated wastewater discharge potential.
- **Existing wetland restoration opportunities:** The Waikato and Waipā River Restoration Strategy (2018) sets out priorities for water quality projects. Relevant existing wetland restoration projects have been identified as opportunities for investigating further in collaboration with the Waikato River Authority and iwi groups as part of the discharge feasibility assessment.

3.2.3.3 Industrial and/or potable reuse

Given the proposed treatment standards and the high level of water quality, reuse of the treated wastewater is a viable option. Key considerations include:

- **Potable reuse:** It is unlikely that public opinion would facilitate direct potable reuse of treated wastewater in the short to medium term and legislative changes to the New Zealand Drinking Water Standards are required to facilitate direct potable reuse of recycled water, however there may be opportunities for indirect potable reuse by discharging the treated wastewater upstream of an existing water intake.
- **Industrial reuse:** If wet industrial facilities are in the vicinity of the site, these may also present reuse opportunities. Consideration of where future wet industry is likely to be is also useful but difficult to assess with certainty.

3.2.4 Discharge options assessment

A summary of the results of the site specific discharge assessment is set out in Table 20 and Table 21 below.

Table 20 Summary of Discharge Assessment for potential Option 2A sites

Site	Discharge to land	Discharge to water: diffuser or artificial rock passage to river	Discharge via wetlands	Industrial reuse	Indirect potable reuse
Southern WWTP 1	Discharge to land may be feasible for part of the flow but further assessment is required to determine whether sufficient land available for this discharge method to be practicable. Geotechnical investigations would also be required to confirm land drainage suitability.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required. The discharge pipeline would need to be constructed through the urban area which may present some challenges.	Discharge to restored wetlands in the Mangaonua catchment is likely to be at least partially feasible for part of the flow. Investigation into the land stability of the Mangaonua gully system is required as well as potential flooding effects in the urban area downstream and this may limit the discharge flow rate. Assessment of potential effects on water quality and ecology would also need to be considered. Coordination and collaboration with the Waikato River Authority and iwi groups would be required to identify priority restoration areas.	Industrial reuse is likely to be feasible.	Indirect potable reuse is feasible.
Southern WWTP 2	Discharge to land may be feasible for part of the flow but further assessment is required to determine whether sufficient land available for this discharge method to be practicable. Geotechnical investigations would also be required to confirm land drainage suitability.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge to a restored wetland near the site at the edge of the historical Rukuhia Swamp is likely to be at least partially feasible for part of the flow, provided that the land can be purchased, and field assessments confirm land suitability.	Industrial reuse is likely to be feasible.	Indirect potable reuse is feasible
Southern WWTP 3	Discharge to land may be feasible for part of the flow but further assessment is required to determine whether sufficient land available for this discharge method to be practicable. Geotechnical investigations would also be required to confirm land drainage suitability.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge to a restored wetland near the site at the edge of the historical Rukuhia Swamp is likely to be at least partially feasible for part of the flow, provided that the land can be purchased, and field assessments confirm land suitability.	Industrial reuse is likely to be feasible.	Indirect potable reuse is feasible
Southern WWTP 4	Discharge to land may be feasible for part of the flow but further assessment is required to determine whether sufficient land available for this discharge method to be practicable. Geotechnical investigations would also be required to confirm land drainage suitability.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge to a restored wetland near the site at the edge of the historical Rukuhia Swamp is likely to be at least partially feasible for part of the flow, provided that the land can be purchased, and field assessments confirm land suitability.	Industrial reuse is likely to be feasible.	Indirect potable reuse is feasible
Southern WWTP 5	Discharge to land is likely to be partially feasible for part of the flow.	Discharge to the Waikato River is likely to be	Discharge via wetlands may be feasible for part of the flow,	Industrial reuse is	Indirect potable

Site	Discharge to land	Discharge to water: diffuser or artificial rock passage to river	Discharge via wetlands	Industrial reuse	Indirect potable reuse
	Given the high level of very-poorly draining peat soils in the vicinity of the site, slow rate irrigation options are likely to be limited, however there is potential for rapid infiltration beds onsite. Further geotechnical investigations will be required to confirm suitability of land drainage characteristics.	feasible but further assessment of the environmental effects is required.	however further investigation is required.	likely to be feasible.	reuse is feasible
Southern WWTP 6	Discharge to land is likely to be partially feasible for part of the flow. Given the high level of very-poorly draining peat soils in the vicinity of the site, slow rate irrigation options are likely to be limited, however there is potential for rapid infiltration beds onsite. Further geotechnical investigations will be required to confirm suitability of land drainage characteristics.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge via wetlands may be feasible for part of the flow, however further investigation is required.	Industrial reuse is likely to be feasible	Indirect potable reuse is feasible
Southern WWTP 7	Discharge to land may be partially feasible for part of the flow provided that sufficient land can be purchased, and geotechnical investigations confirm suitability of land drainage characteristics.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge via wetlands may be feasible for part of the flow, however further investigation is required.	Industrial reuse is likely to be feasible	Indirect potable reuse is feasible
Southern WWTP 8	Discharge to land may be partially feasible for part of the flow provided that sufficient land can be purchased, and geotechnical investigations confirm suitability of land drainage characteristics.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge via wetlands may be feasible for part of the flow, however further investigation is required.	Industrial reuse is likely to be feasible	Indirect potable reuse is feasible

Table 21 Summary of Discharge Assessment for potential Option 4A sites

Site	Discharge to land	Discharge to water: diffuser or artificial rock passage to river	Discharge via wetlands	Industrial reuse	Indirect potable reuse
Southern WWTP 1	Discharge to land is likely to be partially feasible for part of the flow. Slow low rate irrigation is likely to be feasible for a	Discharge to the Waikato River is likely to be feasible but further	Discharge to restored wetlands in the Mangaonua catchment is likely to be at least partially feasible for part of	Industrial reuse is unlikely to be feasible as the smaller	Indirect potable reuse may be feasible.

Site	Discharge to land	Discharge to water: diffuser or artificial rock passage to river	Discharge via wetlands	Industrial reuse	Indirect potable reuse
	portion of the discharge provided that sufficient land can be purchased, and geotechnical investigations confirm land drainage suitability.	assessment of the environmental effects is required.	the flow. Investigation into the land stability of the Mangaonua gully system is required as well as potential flooding effects in the urban area downstream and this may limit the discharge flow rate. Assessment of potential effects on water quality and ecology would also need to be considered. Coordination and collaboration with the Waikato River Authority and iwi groups would be required to identify priority restoration areas.	WWTP facility is unlikely to have the scale to be economically feasible.	
Southern WWTP 2	Discharge to land is likely to be partially feasible for part of the flow. Slow low rate irrigation is likely to be feasible for a portion of the discharge provided that sufficient land can be purchased, and geotechnical investigations confirm land drainage suitability.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge to a restored wetland near the site at the edge of the historical Rukuhia Swamp is likely to feasible, provided that the land can be purchased, and field assessments confirm land suitability.	Industrial reuse is unlikely to be feasible as the smaller WWTP facility is unlikely to have the scale to be economically feasible.	Indirect potable reuse may be feasible.
Southern WWTP 3	Discharge to land is likely to be partially feasible for part of the flow. Slow low rate irrigation is likely to be feasible for a portion of the discharge provided that sufficient land can be purchased, and geotechnical investigations confirm land drainage suitability.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge to a restored wetland near the site at the edge of the historical Rukuhia Swamp is likely to feasible, provided that the land can be purchased, and field assessments confirm land suitability.	Industrial reuse is unlikely to be feasible as the smaller WWTP facility is unlikely to have the scale to be economically feasible.	Indirect potable reuse may be feasible.
Southern WWTP 4	Discharge to land is likely to be partially feasible for part of the flow. Slow low rate irrigation is likely to be feasible for a portion of the discharge provided that sufficient land can be purchased, and geotechnical investigations confirm land drainage suitability.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge to a restored wetland near the site at the edge of the historical Rukuhia Swamp is likely to feasible, provided that the land can be purchased, and field assessments confirm land suitability.	Industrial reuse is unlikely to be feasible as the smaller WWTP facility is unlikely to have the scale to be economically feasible.	Indirect potable reuse may be feasible.
Southern WWTP 5	Discharge to land is likely to be partially feasible for part of the flow. Given the high level of very-poorly draining peat soils in the vicinity of the	Discharge to the Waikato River is likely to be feasible but further assessment of	Discharge via wetlands may be feasible for part of the flow, however further investigation is required.	Industrial reuse is unlikely to be feasible as the smaller WWTP	Indirect potable reuse may be feasible.

Site	Discharge to land	Discharge to water: diffuser or artificial rock passage to river	Discharge via wetlands	Industrial reuse	Indirect potable reuse
	site, slow rate irrigation options are likely to be limited, however there is potential for rapid infiltration beds onsite. Further geotechnical investigations will be required to confirm suitability of land drainage characteristics.	the environmental effects is required.		facility is unlikely to have the scale to be economically feasible.	
Southern WWTP 6	Discharge to land is likely to be partially feasible for part of the flow. Given the high level of very-poorly draining peat soils in the vicinity of the site, slow rate irrigation options are likely to be limited, however there is potential for rapid infiltration beds onsite. Further geotechnical investigations will be required to confirm suitability of land drainage characteristics.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge via wetlands may be feasible for part of the flow, however further investigation is required.	Industrial reuse is unlikely to be feasible as the smaller WWTP facility is unlikely to have the scale to be economically feasible.	Indirect potable reuse may be feasible.
Southern WWTP 7	Discharge to land may be partially feasible for part of the flow provided that sufficient land can be purchased, and geotechnical investigations confirm suitability of land drainage characteristics.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge via wetlands may be feasible for part of the flow, however further investigation is required.	Industrial reuse is unlikely to be feasible as the smaller WWTP facility is unlikely to have the scale to be economically feasible.	Indirect potable reuse may be feasible.
Southern WWTP 8	Discharge to land may be partially feasible for part of the flow provided that sufficient land can be purchased, and geotechnical investigations confirm suitability of land drainage characteristics.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge via wetlands may be feasible for part of the flow, however further investigation is required.	Industrial reuse is unlikely to be feasible as the smaller WWTP facility is unlikely to have the scale to be economically feasible.	Indirect potable reuse may be feasible.
Cambridge WWTP	Discharge to land (slow rate irrigation only) may be partially feasible provided that sufficient land can be purchased, and geotechnical investigations confirm suitability. of land drainage characteristics.	Discharge to the Waikato River is likely to be feasible but further assessment of the environmental effects is required.	Discharge via wetlands may be feasible, however further investigation is required.	Industrial reuse is likely to be feasible.	Indirect potable reuse may be feasible.

3.2.5 Summary of the discharge options assessment

Overall, at this initial stage, it is likely that discharge to the Waikato River is the only option able to cater for the volume of predicted flows on a year-round basis. It is therefore appropriate (at this level of investigation) to assume for treatment costing purposes that the proposed discharge is direct to surface water.

Even though opportunities exist for alterative discharge methods, it is highly unlikely that these would be able to cater for the full volume of predicted flow year-round.

Rapid infiltration beds are a possibility to cater for part of the flow in some areas with well-draining soils, but further geotechnical site-specific investigation would be required to confirm this. These well-draining soils are generally located nearer to the Waikato River and site stability issues may preclude their future use.

Slow rate irrigation discharge to land options for all of the predicted flow require very large land areas which, due to existing land uses, would likely require purchasing of the land required for discharge infrastructure and buffers surrounding the proposed irrigation sites. Soil type and climate constraints mean that even if large areas of land are able to be secured for discharge, an alternative form of discharge will be required (such as the Waikato River), or a very large storage facility to store wastewater, when high soil moisture levels prevent irrigation. As an alternative, smaller land areas may be able to be irrigated successfully for part of the flow at times of the year when soil conditions are suitable.

Industrial reuse is more likely to be achieved in the future for larger flows and sites located near future possible industrial developments. Indirect potable reuse options can be achieved where the discharge is to surface water upstream of water supply takes and equally applies to all surface water discharge options.

Additionally, whilst opportunities exist to restore wetlands, receiving environment flow and water quality limitations means it is highly unlikely to be able to discharge the full treated wastewater flow to a wetland restoration discharge option. However, a partial discharge flow may be feasible to restored wetlands or to smaller surface waterways.

In this way a mix-and-match discharge system that combines various discharge options may be feasible and should be explored further in future phases of work.

3.3 Treatment development

To understand the required components, size and staging for the WWTPs in the southern Metro area, treatment plant concepts were developed for the short listed options[32].

The level of treatment assumed for discharges to water was[33]:

- A high level of nutrient removal <4mg/L TN and <1.0mg/L TP (as annual means)
- A very high pathogen removal (E.coli <14 cfu/100ml as a 95th percentile).

Flow assumptions were based on using the RITS standard per capita ADF flow approach of 200L/p/d for the population equivalent associated with each plant at each design time interval. The peak flow to each plant was assumed as four times the ADF. The raw wastewater quality assumptions made for the shortlisting are based on typical values for New Zealand raw wastewater.

The proposed treatment processes for the new WWTPs are outlined in Table 22 below.

[32] GHD / Beca, 12 April 2021. *Treatment Shortlist Options Report.* Future Proof Partners.

[33] GHD / Beca, 2021. *Treatment Assumptions Memorandum*. Future Proof Partners.

Table 22 Treatment Concept Development

Size	Population Equivalent Step (PE)	Flow Step (m^3/d)	Liquid Processes	Solids Processes
	All	All	Inlet Works	-
Small – Tauwhare Pa WWTP	0 – 4,000	0 – 800	Package MBR or Secondary treatment if land disposal	Thickening, transfer to larger WWTP
Medium – Southern sub-regional WWTP (Airport) 4A	4000 – 40,000	800 – 8,000	Reactor Membrane separation UV	Screw Press Dewatering
Large – Cambridge WWTP, Southern sub-regional WWTP 2A	40,000 – 150,000	8,000 – 30,000	Primary Treatment Reactor Membrane separation UV Centrate Treatment	Digester Centrifuge Dewatering

Base staging was developed for key processes including screens, primary sedimentation tanks (PSTs), reactors, digesters and membrane trains.

Installation of the PSTs and Digesters could be delayed for both the Sub-regional southern 2A WWTP and Cambridge 4A stand-alone WWTP, however additional reactor capacity would need to be installed. It may be possible to design reactors that could be converted to PSTs later. If PSTs/Digesters were delayed, operating costs would increase as energy is not recovered and biosolids volumes for disposal are higher.

Delaying the introduction of Ohaupo and Matangi would have minimal impact on treatment process capacity required for 2A or 4A southern sub-regional WWTP as the flows from those communities are such as small component of the total flows.

Delaying the introduction of South Hamilton flows (if practical from a conveyance perspective) could reduce the number of reactors, membrane trains and digesters required to be built at the start for the 2A sub-regional WWTP. However, some components such as civil works (access roads, buildings and fencing), transfer pipes and buildings are generally built at the start at a new site with more limited potential to stage.

Significant wet industry flows have been allowed for at the airport industrial area (1,750 m^3/day by 2061). If wet industry was to not locate at this area or more wet industry arrived than allowed for, processes capacity could be delayed or bought forward to match requirements. The 4A sub-regional WWTP at the airport has a high level of risk around industry flows, timing and composition as there are only very small residential flows for this option.

A new site for a sub-regional WWTP offers the opportunity to masterplan a treatment facility to achieve the greatest operational efficiency and able to adapt quickly and easily to changes. A buffer area around the WWTP is advisable to mitigate potential odour and noise issues. While a new site can be selected with more favourable ground conditions, some ground improvements are likely to be required. Larger WWTPs provide more redundancy with their processes and equipment.

There is uncertainty over the timing and flows likely to be generated at the Tauwhare Pa and potentially from Tauwhare Village. Once a preferred southern option is identified further investigation of Tauwhare Pa options can be undertaken. Soil conditions and environmental effects associated with land discharge will need to be investigated further.

For the preferred option further investigation and design is recommended for:

- Operational costs, benchmarking with existing costs for Pukete and other sites with MBR or biological nutrient removal
- Further investigate capital and operational cost impacts of lower TN target and delaying installation of PSTs and digesters
- Sensitivity analysis for Hamilton flow split, residential and non-residential greenfield growth, connecting small communities (Ohaupo, Matangi, Tauwhare Pa)
- Sensitivity analysis for wet industry growth and infill
- Geotechnical investigations for Cambridge WWTP if 4A is the preferred option
- Develop understanding of redundancy requirements for major process units e.g. screens and reactors.

3.4 Staging considerations

The base case for staging involves adding process elements as needed to accommodate with growth and demand levels and is outlined in Table 23. The deferral of plant elements and related cost implications is shown in Section 4.2.8 below.

Table 23 WWTP Staging

Attribute	2031	2041	2051	2061
Option 2A Southern Sub-Regional WWTP				
Areas of Benefit	Cambridge Airport precinct Hamilton South Matangi		Ohaupo	
Population Equivalent	76,846	97,136	116,956	124,004
Flow (m^3/d)	15,575	19,525	23,381	24,791
2A Staging options	ILW, MBR, UV, Dewatering		+ Primary + Digesters + Side stream	Additional process units as necessary.
	Probably feasible to start adding digesters early, perhaps with Salsnes Filter Primary			
Option 4A Cambridge Standalone WWTP				

Attribute	2031	2041	2051	2061
Areas of Benefit	Cambridge			
Population Equivalent	32,940	37,801	42,892	45,031
Flow (m^3/d)	6,824	7,678	8,578	9,006
4A CB Staging	ILW, MBR, UV, Dewatering		+ Primary + Digesters + Sidestream	Additional process units as necessary
Option 4A Southern WWTP				
Areas of Benefit	Airport precinct Matangi		Ohaupo	
Population Equivalent	6,869	12,360	17,852	17,852
Flow (m^3/d)	1,562	2,707	3,858	3,859
4A Southern Staging	ILW, MBR, UV, Dewatering	Additional process units as necessary		
Option 4A Ngaruawahia WWTP				
Areas of Benefit	Ngaruwahia, Hopuhopu, Taupiri, Horotiu			
Population Equivalent	7,407	9,102	10,516	12,016
Flow (m^3/d)	3872	5132	6301	6685
4A Southern Staging	ILW, MBR, UV, Dewatering	Additional process units as necessary		
Tauwhare Pa				
Tauwhare Package WWTP (m^3/d)	55	55	55	55
Tauwhare Pa Stage	Package WWTP when development occurs or transfer to Matangi			

Other options include:

- Delaying installation of primary sedimentation tanks (PSTs), digesters and associated equipment
- Reducing target Total Nitrogen (TN) when the new WWTPs start up
- Delaying connecting contributing communities and catchments

At the stakeholder workshop reducing target treated wastewater quality was not supported. Delaying energy recovery was considered worth investigating while considering impacts on operational costs (electricity use and biosolids disposal) and greenhouse gas emissions. The timing of connecting communities such as Matangi, Ohaupo and potentially Tauwhare Pa will be dependent on the alternative costs and benefits of stand-alone facilities and environmental effects of existing facilities and on-site systems. Further investigation of the Hamilton network potential catchments which can be diverted south and timing is planned for the preferred option stage.

3.5 Potential staging sensitivity tests

A number of other staging approaches have been discussed and could have some potential benefits for either of the shortlisted options. The benefits of these staging approaches primarily relate to the potential for stakeholders to delay or defer some capital expenditure to make the investments more affordable.

3.5.1 Southern treatment plant developed to delay Pukete capacity increases

The Southern Plan for option 2A is currently designed to be staged but is likely to have sufficient capacity or can be developed with sufficient capacity to service a larger catchment and service more residents in the north in the 2031-2051 (and potentially 2061) periods if required.

3.5.2 Staging of treatment facility – Reduced nitrogen quality

Reducing the total nitrogen target for the treated wastewater reduces the size of the reactors needed for the treatment process and may reduce operational costs for aeration. The capital cost savings are limited and depends on the reactor sizing and redundancy philosophy which will be developed further at the preferred option stage.

3.5.3 Staging of treatment facility – Delayed energy recovery

Delaying the installation of PSTs and digesters defers a significant proportion of the capital cost (approx. 30% direct costs), however, operating costs will approximately double with no energy recovered and more biosolids to dispose of. Currently flows from South Hamilton treated at Pukete WWTP go through energy recovery processes.

3.5.4 Staging of servicing – Delay communities serviced

The flows from Ohaupo, Matangi and Tauwhare Pa would have minimal impact on the sizing of the sub-regional WWTPs as they are a small proportion of the total flows. The Hamilton south flows are much more significant. The Peacocke area is under development and is expected to take at least 20 years. If this area is not set up initially to be pumped south, then changing this later would be difficult (if required to meet demand). Other parts of the upper western and eastern Hamilton catchments could be re-directed at a later date.

4. Shortlist option assessment

Shortlist options were assessed using an MCA Assessment Criteria and Scoring System which use a defined set of criteria to distinguish between each of the shortlisted metro options. The shortlist options were also assessed against its technical and implementability risks. The preferred southern metro option was determined through this process and will be further developed in the next stage.

The MCA criteria for Overarching Project Objectives and Critical Success Factors are the same as the longlist option assessment but with enhanced level of quantification and knowledge.

The assessment of the shortlist options was developed which investigates further the site for new plants, treatment and disposal options, and cost estimates. In summary, the shortlist option assessment is more detailed than the longlist option assessment due to the greater number of inputs, a more detailed study, and feedback received from the stakeholders.

4.1 MCA assessment

4.1.1 Criteria

The following assessment criteria (refer to Table 24) were based on the project objectives and KPIs developed as part of the Strategic Case with the wider stakeholder group.

These objectives were developed with the purpose of giving effect to the Te Ture Whaimana (Vision and Strategy of the Waikato River) and are based around the following five themes:

- Water Quality
- Ecology
- Cultural outcomes
- Sustainable technology
- Sustainable growth.

Note, some minor wording changes to the investment objectives and key performance indicators were agreed with stakeholders between the longlist and shortlist assessments as part of this DBC. The updates are reflected in the investment objectives and key performance indicators Shortlist MCA criteria displayed in Table 24 below.

Additional critical success factors were developed to assess all other distinguishing features of the options. This includes:

- Constructability
- Operability
- Consentability
- Resilience.

Costs were also developed, however they were not scored.

Note that the Do Nothing / BAU option did not always score ‘0’ (i.e. no impact). Option 2A and 4A were scored based on the long term impacts of that option. In several instances, the Do Nothing / BAU option was not sustainable in the short or long term. In this case, the Do Nothing / BAU option was clarified as a baseline option only and may be fatally flawed or have severely negative impacts.

Table 24 MCA criteria descriptions

MCA	KPI Equivalent	Criteria measure / considerations
OBJECTIVE CRITERIA		
Water Quality 1. By 2050 municipal wastewater treatment plant discharges, as part of cumulative discharges to the river, are no longer impacting the ability of people to swim and collect Kai from the river	KPI 1.4: Proportion of plants which are compliant against discharge quality consent conditions	**Water Quality (TN, TP, Nitrates, Ammonia**) To what extent and timeframe does the option reduce the level of Nitrogen, Phosphorus, Nitrates and Ammonia in the quality of the discharge?
	KPI 1.2 Concentration of Total Nitrogen contaminants impacting the river and connected waterways from WWTPs	
	KPI 1.3: Concentration of Total Phosphorous contaminants impacting the river and connected waterways from WWTPs	
	KPI 1.1: Public health risks caused by the concentration of E.coli within the WWTP discharges	**Water Quality (E.coli)** To what extent and timeframe does the option reduce the E.coli levels of the discharge to the river?
		Public Health To what extent does the option reduce the risk to public health?
Ecology 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 eco-system re-entry impacts by 2050	KPI 2.1: Amount of algal biomass in the Waikato River as measured by chlorophyll a concentrations attributable to treated wastewater discharges	**River / Aquatic Ecosystems** To what extent and timeframe does the option impact or improve river ecosystems and hydrology
	KPI 2.2: Health and abundance of mahinga kai species	
	KPI 2.3: Number and variety of terrestrial species at specific locations within the metro area	**Terrestrial Ecosystems** To what extent and timeframe does the option provide the ability to improve vegetation coverage around riverbed and terrestrial ecosystems? - this will only be applicable if we are including potential riparian areas and other restoration opportunities as part of the options? This may have to remain very high level for now
	KPI 2.4: Area coverage of native riparian vegetation surrounding water bodies and within the catchment area	
Cultural Outcomes 3. Wastewater treatment solutions restore and enhance cultural connectivity with the river so that by 2050 Marae and iwi access to the river and other sites of significance within the metro spatial area is no longer impeded by wastewater treatment solutions	KPI 3.1: Maatauranga Maaori Cultural Health Index	What potential is there for land discharge vs water discharge (How much does the option reduce the discharge to the river?) This assumes that land discharges are preferred. However further assessment is required from Iwi
		To what extent does this option enhance and restore cultural connectivity with the river? Cultural assessment to be determined
	KPI 3.2: Number and quality of access points to the river for cultural and recreational activities	**Access to River** To what extent and timeframe does the option increase the opportunity to improve the number of access points to the river and/or other waterways, lakes and wetlands? - measure by considering the potential to rehabilitate existing sites/riparian activities of options/location of site
Sustainable technology	KPI 4.1: Water reuse, water allocations and accounting	**Water Reuse** To what extent and timeframe does the option allow for water reuse?

MCA	KPI Equivalent	Criteria measure / considerations
4. Maximise efficient use of resources and resource recovery to contribute to net zero greenhouse gas related emissions from wastewater treatment systems by 2050	KPI 4.2: Carbon footprint / Energy requirements of plant and plant systems (i.e. pumps)	**Energy / Carbon Reduction** To what extent and timeframe does the option consider energy and carbon neutral technologies? To what extent do options reduce relative operational carbon associated with conveyance system? Biosolid reuse potential.
	KPI 4.3 Proportion of biosolids that are able to be safely reused for beneficial purposes	
Sustainable growth 5. The wastewater solution provides sufficient capacity to ensure sustainable growth in the metro spatial area in accordance with growth projections assumptions for the next 100 years	KPI 5.1 Flexibility and adaptability of solution to be staged / developed over time to meet the needs of the community.	**Flexibility** To what extent does the option provide flexibility to adapt to growth and land use changes?
	KPI 5.2: Proportion of Industrial areas which are serviced by municipal plants sustainably	**Sustainable Growth** To what extent does this option provide additional growth opportunities which align with the sustainable and planned future growth of the Waikato Metro area?
	KPI: 5.3 Proportion of residents in the metro area serviced by municipal treatment plants sustainably	
CRITICAL SUCCESS FACTORS		
Constructability	Treatment	**Construction Impacts** What are the relative constructability benefits, issues and risks (available space, access, existing utilities, watercourse, rail crossings, reinstatement requirements, Geotechnical impacts, utility impacts, road and traffic impacts)
	Reticulation	
Maintenance and operations	Treatment	**Operational Impacts** What is the relative ease or difficulty of operation and maintenance (includes access, odour treatment, resource availability, monitoring, etc).
	Reticulation	
Consentability opportunities and risks	Construction	**Consentability – Land use and designation** What are the relative risks of delays during the consenting process for the option? And are there any consenting fatal flaws?
	Operation	**Consentability – Discharge** To what extent does the option improve the consistency of consents applied to discharges to the river? To what extent does the option reduce the risk of breeching consenting requirements?
Resilience	Operation	**Resilience** To what extent will the option provide resilience against climate change impacts and natural hazards
COSTS		
Capital costs		High level estimates only
Operating Costs		High level estimates only
Whole of life costs		High level estimates only

4.1.2 Scoring

In this stage, 3 shortlist options (Do Nothing/BAU, 2A and 4A) have been scored in accordance with the scoring definitions outlined in the table below. A seven point scoring system was used ranging from -3 to +3. It also includes a fatally flawed score.

Table 25 Scoring definitions

3	Significant positive impact compared with other options
2	Moderate positive impact compared with other options
1	Minor positive impact compared with other options
0	Very limited to no positive or negative impact (neutral)
-1	Minor negative impact compared with other options
-2	Moderate negative impact compared with other options
-3	Significant negative impact compared with other options
FF	Fatally flawed

4.2 Options assessment

The following section provides a summary of the outcomes of the shortlist options MCA assessment.

4.2.1 MCA summary

Between October 2020 and February 2021 all three shortlist options were subjected to detailed assessments against the MCA criteria, with the results used to inform the selection of a Metro Wastewater DBC preferred option. A preliminary shortlist option assessment occurred in October- November 2020, followed by a more robust re-assessment in February 2021 based on more detailed information being available. Assessments were undertaken by the project team including technical specialists with inputs from stakeholders and project partners.

It should be noted that work was undertaken concurrently on the Management, Commercial and Financial cases which informed some of the assessments below such as the Net Present Value Assessments, Constructability, Operability and Resilience.

A summary of the shortlist option MCA re-assessment results shown in Table 26 show the 'scores' of each shortlist against each investment objective and critical success factor criteria. Sensitivity tests, detailed in the Short List report (Appendix B) did not identify any notable influence on the Preferred option selection.

Table 26 MCA summary of results

OBJECTIVE CRITERIA		Do Nothing BAU	Option 2A Centralised	Option 4A – Enhanced BAU
Water Quality	**Water Quality (TN, TP, Nitrates, Ammonia)** To what extent does the option reduce the level of Nitrogen, Phosphorus, Nitrates and Ammonia in the quality of the discharge?	-3	3	3
	Water Quality (E.coli) To what extent does the option reduce the E.coli levels of the discharge to the river?	-2	2	2
	Public Health To what extent does the option reduce the risk to public health? Measure by assessing risks associated with contamination of groundwater and the location of the discharges. E.coli has been captured above	-1	1	1

OBJECTIVE CRITERIA		Do Nothing BAU	Option 2A Centralised	Option 4A – Enhanced BAU
Ecology	**River / Aquatic Ecosystems** To what extent and timeframes does the option impact or improve river ecosystems and hydrology	-2	1	1
	Terrestrial Ecosystems To what extent and timeframe does the option provide the ability to improve vegetation coverage around riverbed and terrestrial ecosystems? - This will only be applicable if we are including potential riparian areas as part of the options? This may have to remain very high level for now	0	2	1
Cultural Connectivity	What potential is there for land discharge vs water discharge (How much does the option reduce the discharge to the river?) This assumes that land discharges are preferred. However further assessment is required from Iwi			
	To what extent does this option enhance and restore cultural connectivity with the river?			
	Access to River To what extent does the option increase the opportunity to improve the number of access points to the river and/or other waterways, lakes and wetlands? - measure by considering the potential to rehabilitate existing sites/riparian activities of options/location of site	0	2	1
Sustainable Technology	**Water Reuse** To what extent does the option allow for water reuse?	0	3	1
	Energy / Carbon Reduction To what extent and timeframe does the option consider energy and carbon neutral technologies? To what extent do options reduce relative operational carbon associated with conveyance system? Biosolid reuse potential	-1	1	1
Sustainable Growth	**Flexibility** To what extent does the option provide flexibility to adapt to growth and land use changes?	-3	1	2
	Sustainable Growth To what extent does this option provide additional growth opportunities which align with the sustainable and planned future growth of the Waikato Metro area?	-3	1	2
CRITICAL SUCCESS FACTORS				
Constructability (treatment)	**Construction Impacts** What are the relative constructability benefits, issues and risks (available space, access, existing utilities, watercourse, rail crossings, reinstatement requirements, Geotechnical impacts, utility impacts, road and traffic impacts)	-1	-1	-2
Constructability (reticulation)		0	-2	-1
Operability (treatment)	**Operational Implications** What is the relative ease or difficulty of operation and maintenance (includes access, odour treatment, resource availability, monitoring, etc.)?	-2	2	0
Operability (reticulation)		0	-2	-1
Consentability risks (land designation)	**Consentability – Land use and designation** What are the relative risk of delays during the consenting process for the option? And are there any consenting fatal flaws?	0	-2	-1
Consentability risks (discharges)	**Consentability – Discharges** To what extent does the option improve the consistency of consents applied to discharges to the river? To what extent does the option reduce the risk of breeching consenting requirements	-4	-1	-2
Resilience	**Resilience** To what extent will the option provide resilience against climate change impacts, natural hazards and labour skill.	-2	0	1

4.2.2 Assessment against objectives

Water Quality

Similar to the longlist assessment, the shortlist assessment assumes the same very high quality of treated wastewater discharge for all options in the southern metro area. This assumed high standard of treated wastewater discharge is the same for both water and land disposal options, which aligns with the policy direction under Plan Change 1 to the Waikato Regional Plan; it assumes a standard of:

- < 4 mg/L Total Nitrogen (TN) as annual mean
- < 1 mg/L Total Phosphorus (TP) as annual mean
- < 14 cfu/100mL (as 95th percentile) of E. coli.

An initial assessment has shown the adoption of this standard, even when taking into account the forecast growth, will lead to a measurable reduction in TN contaminant loads discharged to the Waikato River when compared to the existing situation. This is largely as a result of the significant reduction in the contaminant loads of nitrogen from flows at Cambridge where the current WWTP has a limited ability to remove TN through the existing treatment process.

For TP, the treated wastewater standard of < 1mg/L will lead to an immediate reduction in TP mass loads discharged to the Waikato River. However, there is potential for TP mass loads to increase over time in response to an increase in population and contributing wastewater flows and a further reduction of TP down to < 0.5 mg/L would therefore likely contribute to more certainty with improved water quality outcomes over the longer term. The timing for this further improvement is dependent upon the confirmed projected wastewater flows and the methodology (as yet to be confirmed) to account for the flows diverted away from the Pukete WWTP to the new WWTP facility. The reason for this is that the Pukete flows are currently discharged outside of the Southern Metropolitan area. Further work during the preferred option assessment will confirm these flow projections and associated treated wastewater requirements.

Whilst any reduction of TP concentration down to < 0.5 mg/L can be readily achieved by available treatment process technology this requires additional chemical usage and associated operating cost.

These projected reductions in the mass loads of nutrients will contribute towards an associated improvement in free floating algae in the Waikato River (as measured through chlorophyll a concentrations) with subsequent beneficial effects in terms of contributing towards improved visual clarity, reduced colour and lower levels of free floating algae blocking water intakes and adversely impacting contact recreation sites through the formation of slimes. Given that the effect of nutrients discharged into the Waikato River exert an adverse effect over periods of days, these beneficial effects will be realised down the entire length of the Waikato River down to the mouth at Port Waikato.

In terms of pathogen concentrations, the proposed level of treatment down to a median of < 14 cfu / 100mL is very high and represents a significant improvement over existing levels of pathogen removal through existing treatment processes. This combined with fewer freshwater discharge locations for both options will contribute towards an improvement in the suitability of the Waikato River for contact recreation and cultural use, with a particular reduction in pathogens associated with human waste (e.g. norovirus).

Both options will achieve the same treated wastewater high standard and once implemented can provide immediate reductions in nutrient loads. The high wastewater treatment standard achieved also creates full water recycling or direct potable reuse opportunities in future. This means all options achieve a high score when compared against water quality criteria.

Ecology

The shortlisted options assessment against the ecology criteria assumes direct discharge to the main stem of the Waikato River.

Ecology is linked to the water quality improvements. The reduction of TP has a more significant impact (than nitrogen) on the improvements to concentrations of chlorophyll a in the Waikato River as more recent investigations have shown that algae growth in the Waikato River downstream of Cambridge is limited by the availability of TP rather than TN. The contaminants loads of TP currently being discharged to the Waikato River is relatively low compared to the level of TN. Direct ecological improvements that can be achieved as part of this project are therefore not as significant, as the relative change between the BAU and the project is small (i.e. point source nutrients make up a small percentage of the total available nutrients in the river). The impact the discharge will have on the overall ecological health is also relatively small however these improvements, combined with other improvements occurring independent of this DBC through the wider Waikato River catchment, will contribute towards an overall improvement in the ecological health of the Waikato River downstream of the existing treated wastewater discharges. Both options therefore score a '1' as opposed to '2' or '3'.

In terms of the improvements which can be made to the terrestrial environment, both options will consider carbon offsetting, riparian vegetation and rehabilitation. Option 2A requires multiple parties to pool potential resources which can allow for larger scale rehabilitation programmes to be set up and is shown in Table 27.

Table 27 Assessment against water quality and ecology

OBJECTIVE CRITERIA		DN	2A	4A
Water Quality	To what extent and timeframe does the option reduce the level of Nitrogen, Phosphorus, Nitrates and Ammonia in the quality of the discharge?	-3	3	3
	To what extent and timeframe does the option reduce the E. coli levels of the discharge to the river?	-2	2	2
	To what extent does the option reduce the risk to public health? Measure by assessing risks associated with contamination of groundwater and the location of the discharges. E. coli has been captured above	-1	1	1
Ecology	To what extent and timeframe does the option impact or improve river ecosystems and hydrology	-2	1	1
	To what extent and timeframe does the option provide the ability to improve vegetation coverage around river bed and terrestrial ecosystems? - this will only be applicable if we are including potential riparian areas as part of the options? This may have to remain very high level for now	0	2	1

Cultural connectivity

The cultural criteria at this stage is limited to the assessment of improved access opportunities to the river. There are some opportunities to improve access at the Cambridge WWTP site as part of both options, however decommissioning the site may present better opportunities. Option 2A (centralisation) has the additional benefit of being able to pool resources across multiple councils, which increases the scale of additional projects to improve access. However, this benefit may be offset by the additional complexities in co-managing a project across TLA boundaries.

Discharge options and the potential for land discharge or industrial reuse has been further investigated and is assessed as part of the Water Reuse criteria. A more specific cultural assessment has not been yet undertaken.

Table 28 Assessment against improving access

OBJECTIVE CRITERIA		DN	2A	4A
Cultural connectivity	To what extent does the option increase the opportunity to improve the number of access points to the river and/or other waterways, lakes and wetlands?	0	2	1

Sustainable technology (water reuse)

The potential to reuse treated wastewater for other productive purposes represents the optimal use of a valuable resource. Therefore, the opportunity or potential to reuse treated wastewater for industrial or agricultural purposes needs to be considered.

Option 2A scores higher than Option 4A. At this stage a larger facility, with larger flows (i.e. between 15,000 and 25,000 m3/day) is more likely to have the scale required to build in, in future, water recovery recycling technology making industrial reuse possible. The 100ha of industrial growth area around the airport also potentially provides demand for the industrial reuse if wet industries can be attracted to that area.

Reuse for agricultural purposes (i.e. discharge to land for irrigation) is only possible for a portion of the flows and a portion of the time. Land discharges for 365 days a year would require greater than 740 ha of appropriate land which is unlikely to be readily available in the region, with a large portion of the area between Hamilton and Cambridge designated for larger lifestyle blocks and country living. Additionally, land discharges require the appropriate soil characteristics. Typical soils in the south and west of Hamilton, such as peat, Maeroa Ash and various silt loams are not ideally suited to year-round application of irrigation water. Some ash type soils will tolerate 6 months of irrigation. Some silts will tolerate only 3 months. Due to these constraints a sub-regional facility can only reuse water for agricultural purposes for a smaller portion of its flows and only for a certain timeframe.

A smaller plant located near the airport proposed for Option 4A would mean a smaller area of land is required for 100% land discharges all year round (116 ha (net)) although, this option would mean south Hamilton flows would continue to be serviced by Pukete WWTP which has no potential for land discharge or irrigation reuse.

Both options have some potential for seasonal agricultural reuse, however it is likely only Option 2A would to reuse treated wastewater for industrial reuse purposes and redirect river discharge flows to potential land discharge flows (i.e. south Hamilton).

Sustainable technology (Energy neutral)

There are two competing elements to this assessment, the short term energy impacts and the long term energy recovery potential.

<u>Short Term</u>

- **BAU / Do Nothing** - Greater amounts of energy are required to achieve higher water quality when compared with a Do Nothing / BAU option (i.e. additional power for nitrification and sludge dewatering). This means both Option 2A and Option 4A will both increase the energy requirements compared with BAU *in the short term*.
- **Option 2A** - In the short to medium term, the large plants (includes a new southern sub-regional plant and Pukete plant) have energy recovery potential. A conservative approach (lower range) assumes this will cover at least half of the process energy requirements. A less conservative approach (upper range) assumes there is potential for more energy recovery as large plants are optimised (up to 100% self-sufficiency). However, reaching this higher level of energy self-sufficiency will rely not only on the installation of digestion and co-generation systems, but also on the selection of energy efficient

equipment and systems through the balance of the sites to minimise power and heat demands. This energy recovery does not offset the additional conveyancing energy requirements. A larger facility also needs to convey larger flows across longer distances which requires additional energy for the pumping involved.

- **Option 4A** – Similar to Option 2A, Pukete WWTP has potential for energy recovery which would include the portion of south Hamilton in the short to medium term as the plant is to a sufficient scale. However, in the short to medium term the airport facility and Cambridge WWTP *will not* reach a scale where energy recovery becomes cost effective.

<u>Long term</u>

- **BAU / Do Nothing** – BAU will not be able to provide for any energy recovery unless steps are taken towards an Option 4A.
- **Option 2A** - In the long term, the sub-regional facility and Pukete facility will likely start to see the upper limit of energy recovery as systems are optimised. This energy recovery will still not be enough to offset the additional conveyancing energy requirements.
- **Option 4A** – Energy recovery at the Cambridge WWTP will only become cost effective once flows are higher which likely won't occur until 2051. It's unlikely the airport facility will reach a flow where energy recovery is cost effective even in the long term (i.e. by 2061).

Table 29 below provides a high-level overview of the net energy requirements of the different plants and the conveyance energy requirements at *2061* (reflects the long-term outcome) and the assessment is shown in Table 30. The table does not currently consider the energy requirements for the conveyance from Matangi and Ohaupo as these will be very small in comparison and the same for both options (and therefore balance each other out).

The table shows that both options see a similar energy recovery potential in the long term. As such, Option 2A and Option 4A score the same against this criteria.

It should be noted that the costs presented in section 4.2.7 below allow for the 'lower range' of energy recovery.

Table 29 Long term energy requirements of assets by option - 2061

Option	Asset	Annual net energy use (Million kWh/yr) – lower range	Annual net energy use (Million kWh/yr) – upper range i
Option 2A – Centralised	Sub-regional plant (large)	5.7	0
	Te Awamutu (medium)	3.3	3.3
	Conveyance (Cambridge)	1.1	1.1
	Conveyance (south Hamilton)	0.9	0.9
	TOTAL	**11.0**	**5.3**
Option 4A – Enhanced BAU	Southern plant (medium)	1.8	1.8
	Cambridge Plant (large)	2.1	0
	South Hamilton portion at Pukete WWTP	2.8	0
	Te Awamutu (medium)	3.3	3.3
	TOTAL	**10.0**	**5.1**

Table 30 Shortlist Options Assessment against Sustainable technology

OBJECTIVE CRITERIA		DN	2A	4A
Sustainable Technology	To what extent and timeframe does the option allow for water reuse?	0	3	1
	To what extent and timeframe does the option consider energy and carbon neutral technologies?	-1	1	1

Sustainable growth (flexibility)

In terms of how an option can adapt to changes, Option 4A is more flexible and adaptable than Option 2A.

Option 2A, when investigated in detail was shown to require greater levels of intervention than Option 4A to re-distribute wastewater from the southern suburbs of Hamilton to the proposed sub-regional plant. Some of these challenges include:

- The topography generally falls to the north (away from the proposed WWTP), which rules out a gravity solution for most of the catchment
- The existing reticulation servicing the established catchments generally falls to pump stations located to the north. The pump stations must be upgraded / replaced in order to convey flows through longer rising mains to proposed assets in the south
- The Peacockes pump station and rising mains have already been designed to convey flows to the north and construction has commenced. Modification of these assets to convey flows to the south is possible, but not ideal (operation, cost, etc)
- Short-list development has assumed that 50% of the Peacockes catchment will gravitate south to the N12 pump station and the remaining 50% will gravity north to N4 pump station. This is a high-level assumption and servicing the Peacockes catchment has not been considered in detail
- Infrastructure needs to be staged to suit growth in the Peacockes catchment, which requires multiple rising mains. There is a risk of long retention times causing septicity and odour issues due to low flows during the early stages of development.

There is also limited ability to stage the sub-regional 2A WWTP due to the lower growth rate of the combined catchment forecast post 2040 and relatively low proportion of wet industry. The high funding levels required to implement option 2A is also expected to limit the financial ability of councils to make future WWTP changes to meet any demand changes across the sub-region.

Comparatively, Option 4A scored higher in the assessment of this criteria for the following reasons:

- It offers a range of potential solutions to deal with variability in demand from the airport and nearby catchments which will be further investigated in the Preferred Option refinement; these solutions include:
    - Trucking to a suitable WWTP
    - A small bespoke WWTP in the airport precinct or nearby; either publicly of privately run
    - Conveying to the upgraded Cambridge WWTP in the short to medium term
- The funding requirements of this option are comparatively lower than Option 2A and thus access to funding to respond to land use changes will be comparatively easier.

Sustainable growth (meeting growth expectations)

All options have been designed to meet growth expectations as outlined in the *Population Growth Memorandum*. The Pukete WWTP review confirmed that there is sufficient space available for capacity to be developed to service Hamilton and potentially other catchments for a number of decades using this existing WWTP. With this in mind, there is less pressure to free up additional space at Pukete WWTP, meaning potential new growth area demands (such as Southern Links) can be more easily and cost effectively serviced in future by Option 4A. Therefore, Option 4A scores higher as shown in Table 31 and justified in the text below.

Option 2A was assessed as having a score of 1 for sustainable growth due to the following reasons:

- It is expected to require greater levels of intervention to re-distribute wastewater from the southern suburbs of Hamilton to the proposed sub-regional plant; some of these challenges include:
    - The topography generally falls to the north (away from the proposed WWTP), which rules out a gravity solution for most of the catchment
    - The existing reticulation servicing the established catchments generally falls to pump stations located to the north. The pump stations must be upgraded / replaced in order to convey flows through longer rising mains to proposed assets in the south
    - The Peacockes pump station and rising mains have already been designed to convey flows to the north and construction has commenced. Modification of these assets to convey flows to the south is possible, but not ideal (operation, cost, etc)
    - Short-list development has assumed that 50% of the Peacockes catchment will gravitate south to the N12 pump station and the remaining 50% will gravity north to N4 pump station. This is a high-level assumption and servicing the Peacockes catchment has not been considered in detail
    - Infrastructure needs to be staged to suit growth in the Peacockes catchment, which requires multiple rising mains. There is a risk of long retention times causing septicity and odour issues due to low flows during the early stages of development
- Limited ability to stage the sub-regional 2A WWTP due to the lower growth rate of the combined catchment post 2040 and relatively low proportion of wet industry
- The funding level required to implement Option 2A would have made subsequent changes to meeting the demand changes across the sub-region more difficult due to the large initial outlay by the councils.

Option 4A was assessed as having a score of 2 for sustainable growth due to the following reasons:

- There are solutions to deal with a multitude of options and variability in demand from the airport and nearby catchments which will be further investigated in the Preferred Option refinement; these solutions include:
    - Trucking to a suitable WWTP
    - A small bespoke WWTP in the airport precinct or nearby; either publicly of privately run
    - Conveying to the upgraded Cambridge WWTP in the short to medium term
- The Pukete WWTP review confirmed that there is sufficient space available for capacity to be developed to service Hamilton and potentially other catchments for a number of decades
- The funding requirements of this option are comparatively lower than Option 2A and thus access to funding to respond to land use changes will be comparatively easier.

Whilst this assessment focused on a solution for the southern metro area, the lost opportunities and the opportunity costs associated to the north were also considered to provide a 'like for like' comparison.

Table 31 Shortlist Options Assessment against Sustainable growth

OBJECTIVE CRITERIA		DN	2A	4A
Sustainable Growth	To what extent does the option provide flexibility to adapt to growth and land use changes?	-3	1	2
	To what extent does this option provide additional growth opportunities which align with the sustainable and planned future growth of the Waikato Metro area?	-3	1	2

4.2.3 Assessment against constructability

The constructability criteria assesses the available space, access, implementability, impact to utilities and geotechnical issues associated with the construction of each option. The constructability assessment has been completed to a high level to reflect the current information available for the shortlisted options. This is also consistent with the level of investigation required to develop Detailed Business Cases which precede pre-implementation and detailed design activities.

For Option 2A, a new sub-regional plant would be built on a new site, and Cambridge WWTP site would be decommissioned. Matangi WWTP would also be decommissioned. The site selection process outlined above already identifies sites which minimise risks and impacts as much as possible. From a technical perspective, geotechnical issues are minimised, there is available access, avoids built up areas and residential housing and potential noise implications, and also avoids areas of high cultural and environmental sensitivity. In this respect, the construction of a new plant minimises impacts as much as possible.

Option 4A, also requires a new plant on a new site. This plant will also seek to minimise impacts and will likely be smaller and required to be closer to the airport as this is the main servicing area for the smaller plant. There are sites available near this area which also avoid households and still have access to main roads.

Generally, construction on a 'Greenfields' site is significantly less constrained than a 'Brownfields' site. This is due to unhindered construction and the ability to 'lay out' the site in a logical and efficient manner. Option 4A also involves the construction of a new plant at Cambridge, or on the Cambridge site. This site has some significant limitations. Firstly, there is the need to construct a new plant at the same time as keeping the existing plant operational. This reduces the land available for the construction of a new plant, meaning there are some limitations to the how the plant can be configured. This reduction in available space makes it challenging to plan for future growth. Depending on how quickly Cambridge grows, the quarry site to the south of the Cambridge plant site, may need to be acquired to build out capacity for the additional growth.

In addition to the issues stated above there are geotechnical issues on the existing Cambridge site, as detailed below.

Geotechnical considerations:

A review of the recent geotechnical information provided for the Cambridge site (dated September 2019) was undertaken to determine the geotechnical risks of the site[34]. No additional analysis or intrusive works was undertaken and have focused on the proposed development of the site, not the existing layout.

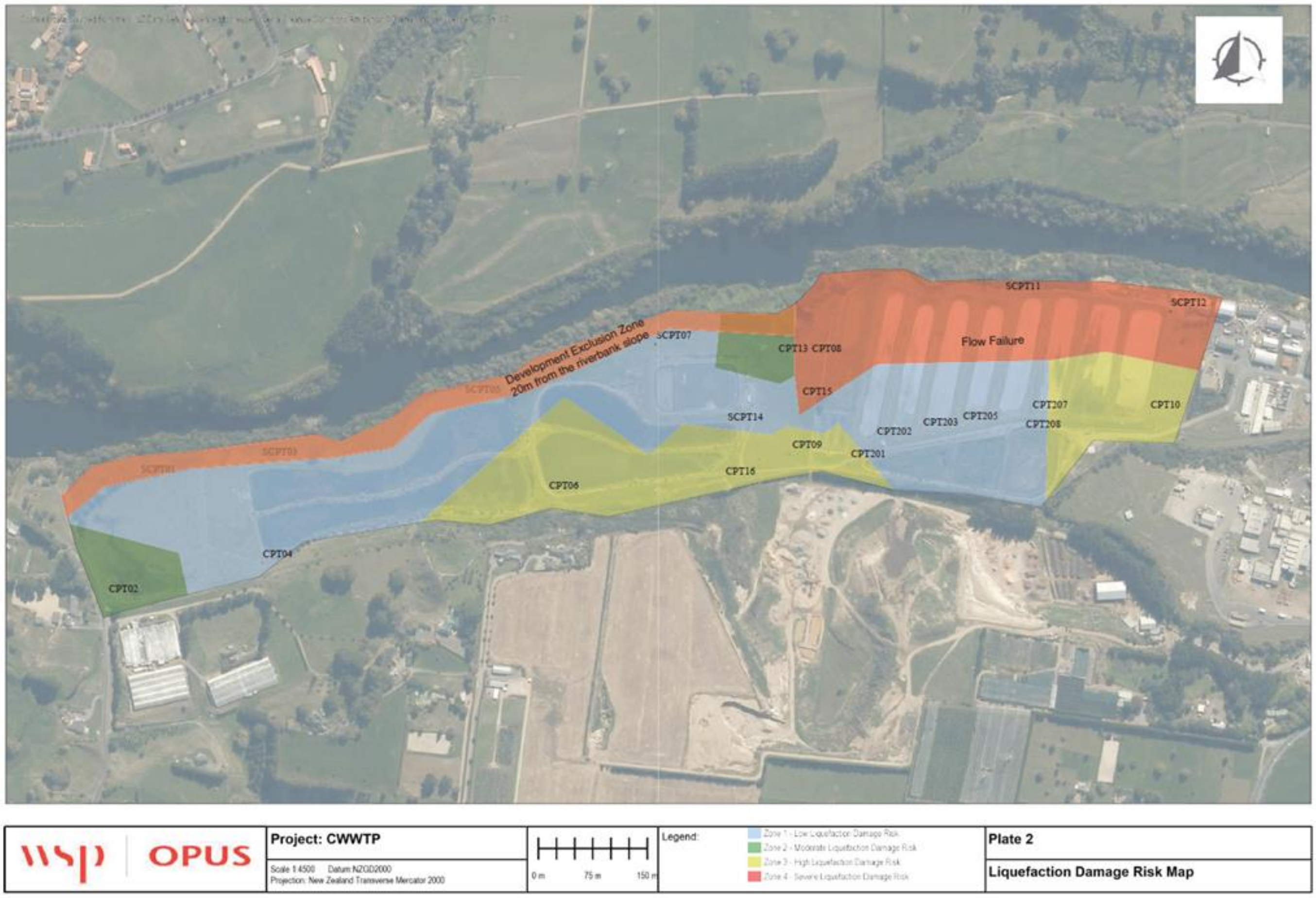
[34] WSP Opus, Sept 2019. *Cambridge Wastewater Treatment Plant Upgrade – Preliminary Geotechnical Assessment*. Waipa District Council.

It has been identified that during an earthquake liquification and in turn lateral spread could occur which could damage buildings beyond repair. The liquification risk is something likely shared by other sites (and all Options) but the lateral spread risk will be significantly higher at the Cambridge site and any other site within approximately 200 m of the Waikato River.

To assist in quantifying the risk to the Cambridge site, a previous consultant has created liquification induced risk ‘zones’. This shows approximately half the site to be a high risk or an area unsuitable to build. The testing has however been limited by the presence of the existing ponds leaving large areas being unable to be tested. Additional risk should be attached to these areas as they are yet to be quantified. This quantification could only be completed on decommissioning of the ponds. This would not be realised on a site free from obstructions to testing (e.g. a site that a large SUV sized vehicle could mostly get around). The figure below shows the areas which have severe and high liquification risk in red and yellow and moderate to low risk in blue and green, with area under the ponds being a large unknown.

At this stage it is assumed that a new site (south of Hamilton) can be tailored to minimise as many risks as possible. This includes geotechnical risks as shown in Figure 18. Choosing a site which is further from the river bank and on stable and permeable soils will reduce the constructability risks.

Figure 18 Liquification risks areas at Cambridge site



Conveyancing construction impacts

Construction of conveyance pipework is expected to be not too complex, with pipework generally installed in road berms or carriageways by open cut trench or HDD methods. Lower traffic volume roads are favoured where possible, while maintaining the straightest line between the source and destination.

The primary risks associated with the conveyance construction are considered to be the river and larger road crossings. Crossings of the Waikato River and State Highway 1 were limited to the minimum number possible, and alignments were chosen that would provide flexibility for construction (drilling under SH1, and either drilling under the Waikato River or bridging across it).

In general, smaller diameter pipelines, like those needed for Matangi and Ohaupo, were considered less risky, as it is more likely they can be efficiently drilled under roads or rivers, while large diameter pipes may necessitate bridges or tunnelling as the bending radius' become too large to effectively drill with the working areas available. Ground conditions, particularly at 'The Narrows' river crossing, will have a major influence on the preferred construction methodology. A pipe bridge has been included at this location in the cost estimates, given the likelihood that rock will be present in significant quantities.

A new site to the west of the Waikato River would limit the river and state highway crossing to one of each (from Matangi). A site located to the east of Waikato River would require a greater number of river and state highway crossing; one for Cambridge flows, one for Peacocke flows and one for Ohaupo flows.

For the Peacocke to Southern plant, major road corridors of the Peacocke development were used to reduce the overall risk, however with sufficient planning the pipeline could be placed in reserves which would enhance future access, meaning the maintenance and operation of the pipeline would become much easier.

All options that require greater lengths and larger diameters of pipework are considered riskier and the scoring reflects this, with Option 2A scoring lower than Option 4A as shown in Table 32. The lengths of pipework are subject to refinement once the treatment plant site is selected.

Table 32 Shortlist Options Assessment against constructability

CRITICAL SUCCESS FACTORS		DN	2A	4A
Constructability (treatment)	What are the relative constructability benefits, issues and risks (available space, access, existing utilities, watercourse, rail crossings, reinstatement requirements, Geotechnical impacts, utility impacts, road and traffic impacts)	-1	-1	-2
Constructability (Conveyance)		0	-2	-1

4.2.4 Assessment against operability

The operational implications of the wastewater treatment solutions consider a number of wider factors:

- The overall number of plants which need to be serviced
- The labour requirements necessary
- The quality and frequency/quantity of monitoring and testing
- Conveying maintenance and repairs.

Option 4A requires the operation of four plants to the south (new southern plant, Cambridge plant, Te Awamutu plant and Tauwhare Pa WWTP). The southern portion of Hamilton is also serviced by Pukete WWTP (five plants in total). Option 2A only requires the operation of three plants (including southern portion of Hamilton).

Option 4A will require several different sizes of plants. Pukete is a large facility, the Cambridge and Te Awamutu are medium sized facilities, the new southern plant will also be medium sized but is a bespoke design servicing significant industrial flows (as opposed to domestic) and Tauwhare Pa is a smaller plant. Each size of plant has different technologies (additional technologies as size increases), which makes it slightly more challenging to resource each site and also substitute staff between facilities (i.e. easy to bring staff from a large site to a small site but not the other way around). In some instances, resourcing smaller, less technical facilities may not be as 'attractive' as larger more sophisticated facilities.

Option 2A will include two larger facilities (Pukete and Southern sub-regional). Both of which will have similar treatment technology and the ability to substitute skilled resources. Additionally, the larger facilities which have more sophisticated technology likely attract more skilled labour.

One of the key differentiators between options is the ability to have consistent, higher quality and more frequent quality monitoring and testing. A larger number of smaller plants may be more difficult to resource (staff, composite samplers etc) due to increase distances to meet a high-quality assurance regime, in terms of monitoring, maintenance and repair work required. In addition, small site consents are likely to require less frequent sampling for compliance. Operational test regimes will likely be developed around compliance test regimes. The reduction in the number of plants may improve the performance consistency between plants and the consistency and quality of monitoring and testing.

It should also be noted that Option 2A is better configured to support centralised governance and management for the wider metro area. This can apply to the management of the plant themselves and also the management of the consents. This would also improve the consistency and quality of the consents and can ensure that a single 'best for river' approach can be taken across all plants. The aim of this type of strategy is that 'as a whole' all the WWTP's in the metro area would be striving to achieve a single vision.

For these reasons Option 2A scores higher than Option 4A.

Septicity is a challenge for the long, small diameter pipelines, with average retention times that are well in excess of 8 hours. Chemical dosing to reduce septicity will likely be required for these pipelines. Apart from septicity, the only major difference in operability was any leakage or pipe breakage and the resulting environmental impacts. Both options require a river crossing, which can be challenging to maintain and repair if necessary. Aerial river crossings in particular would present higher operations and maintenance issues and risk of contamination in the event of failure.

In general Option 2A has greater lengths of pipelines to maintain and operate and therefore scores slightly lower than option 4A as shown in Table 33.

Table 33 Shortlist Options Assessment against operability

CRITICAL SUCCESS FACTORS		DN	2A	4A
Operability (treatment)	What is the relative ease or difficulty of operation and maintenance (includes access, odour treatment, resource availability, monitoring, etc.)?	-2	2	0
Operability (conveyance)		0	-2	-1

4.2.5 Assessment against consentability

Consenting risks were assessed based on:

- The need for designating land through Notice of Requirement process and/or additional land use consents
- The number and potential complexity of discharge consents required.

The BAU option is fatally flawed (scored a '-4') as the existing plants in some cases struggle to meet current consenting conditions and may not be able to meet increasing environmental standards.

Both Option 2A and Option 4A will require new sites to be designated through the Notice of Requirement process of the Resource Management Act. This involves public notification and opportunities for any affected person to make submissions to the proposal to designate a new site for a WWTP. Both Option 2A and Option 4A will also require new discharge consents for discharges to water and/or discharges to land, and discharges to air (odour) which presents additional consenting risks. It was found that Option 2A would require up to 20 ha site for the centralised treatment facility and appropriate buffer distance. A smaller treatment plant needed for Option 4A would need a smaller site (around 10 ha). A general rule of thumb is that a larger site will likely be more difficult to consent and designate for wastewater treatment and therefore Option 2A has been scored lower. The location of the site and relative social and environmental assessment of that site will better inform the consentability risks of designating a new site.

In terms of the discharge, both Option 2A and 4A would require a new discharge consent at a new location. However, Option 4A would also require:

- The renewal of a discharge at Cambridge, Te Awamutu and Tauwhare Pa
- An additional new discharge at new location.

Whilst Option 2A would require:

- The removal of a discharge consent at Cambridge
- The renewal of a discharge at Te Awamutu and Tauwhare Pa
- An additional new discharge at new location.

The reduced number of discharges to consent and the removal of a discharge may reduce some of the risks associated with consenting discharges for Option 2A as shown in Table 34.

Table 34 Shortlist Options Assessment against consentability

CRITICAL SUCCESS FACTORS		DN	2A	4A
Consentability risks – land use and designation	What is the relative risk of delays during the consenting process for th option? And are there any consenting fatal flaws?	0	-1	-2
Consentability risks – Discharge	To what extent does the option improve the consistency of consents applied to discharges to the river? To what extent does the option reduce the risk of breeching consenting requirements?	-4	-2	-1

4.2.6 Assessment against resilience

Option 2A (a centralised facility) will have inbuilt redundancies to cater for any potential failures at the plant. This means that the likelihood of a substantial site failure is relatively small. However, if these redundancies also fail, the consequence of a failure will impact a much larger servicing area (i.e. Cambridge, South Hamilton, Matangi, Ohaupo, airport). The opposite is true for Option 4A. It is unlikely that smaller plants will have those same levels of in-built redundancies without significant costs, and therefore will have a higher likelihood of failure, but the consequence of that failure is smaller (i.e. a Cambridge failure, would affect only Cambridge, a failure at the airport facility would affect only the airport, Matangi and Ohaupo). Option 2A has long lengths of conveyancing and pipes which can be more prone to failures. However, this risk can be minimised quite significantly through design:

- Conveyance is expected to be welded HDPE pipe constructed in road corridors. Welded HDPE has a relatively low vulnerability to seismic activity
- The river crossing on the Matangi pipeline is higher risk if fixed to bridge structure, however flexible couplings can be included in the design to reduce this risk of damage during a seismic event
- Back-up power arrangements will be considered for pump stations
- Pump stations will be located outside of flood plains
- Chambers can be designed to prevent flotation during liquefaction.

These design considerations can improve the resilience of the conveyancing (for both options 2A and 4A).

Based on the above considerations, Option 4A scores slightly higher than Option 2A against the resilience criteria by providing moderate improvements to resilience and reducing consequence of failures compared to Do Nothing and Option 2A as shown in Table 35.

Table 35 Shortlist Options Assessment against resilience

CRITICAL SUCCESS FACTORS		DN	2A	4A
Resilience	To what extent will the option provide resilience against climate change impacts, natural hazards and labour skill.	-2	0	1

4.2.7 Capital costs of options

The following tables (Table 36 and Table 37) provide an overview of the capital costs associated with Option 2A and 4A. These costs have been developed using the following assumptions:

- The costs which exclude the Pukete WWTP and Ngaruawahia WWTP costs, do not allow for the costs associated with the portion of South Hamilton which will continue to be serviced by Pukete for Option 4A
- The costs which include the Pukete WWTP costs, allow for a more accurate comparison between options as both options cater for the same flows
- The Pukete WWTP costs do not include 'other costs'. However, its assumed that "other costs' would be similar or the same for both options
- Other costs include council internal costs, procurement costs, decommissioning costs, land purchase costs and consenting costs
- The WWTP cost estimates are deemed to be Class 5 estimates in terms of the AACE Cost Estimate Classification System guidelines.

Table 36 Shortlist Option 2A – Centralised option Costs [35]

Area	WWTP name	Other Costs ($M)	WWTP Capital Cost ($ M)	PS & Conveyance Costs ($ M)
Hamilton South	Southern Sub-Regional WWTP		$177	$33
Matangi				$7
Airport				
Ohaupo				$7
Cambridge				$42
Te Awamutu & Kihikihi	Te Awamutu		$27	
Tauwhare Pa	Tauwhare Pa		$6	
SUB-TOTAL			**$210**	**$89**
Pukete WWTP Costs			$288	$5
Ngaruawahia Conveyance				$45
Council Internal Costs and procurement		$49		

[35] Note: Cost estimates for Pukete and Ngaruawahia included to provide full picture of wastewater upgrades required in the sub-region for this Shortlist Option. It is recognized that decision made in this DBC can influence upgrades required in the northern metro area.

Area	WWTP name	Other Costs ($M)	WWTP Capital Cost ($ M)	PS & Conveyance Costs ($ M)
Consenting		$16		
Allowance for decommissioning	Cambridge/Matangi	$2		
Land purchase (15 ha)		$12		
TOTALS		$79M	$498M	$139M
TOTAL (incl. Pukete Costs)	**$716M**			

Table 37 Shortlist Option 4A – Partially centralised option Costs [36]

Area	WWTP name	Other costs ($M)	WWTP Capital Cost ($ M)	PS & Conveyance Costs ($ M)
Tauwhare	Airport Southern WWTP		$54	
Matangi				$7
Airport				
Ohaupo				$7
Cambridge	Cambridge		$114	
Te Awamutu & Kihikihi	Te Awamutu		$27	
Tauwhare Pa	Tauwhare Pa		$6	
SUB-TOTAL			**$200**	**$14**
Pukete WWTP Costs			$304	$5
Ngaruawahia WWTP			$55	
Council Internal Costs and procurement		$40		
Consenting		$18		
Allowance for decommissioning	Cambridge/Matangi	$2		
Land purchase (15 ha)		$12		
TOTALS		$72M	$559M	$19M
TOTAL (incl. Pukete Costs)	**$652M**			

The full capital cost estimates for both shortlisted options are sizeable, as they each deliver the significant wastewater investment required for the Southern Metro Area. Shortlisted Option 2A – Centralised is the more expensive of the two options. It is estimated to cost $716M (including Pukete costs), while the capital cost of Shortlisted Option 4A – Enhanced BAU is less expensive at an estimated $652M (including Pukete costs).

The costs presented provide for:

[36] Note: Cost estimates for Pukete and Ngaruawahia included to provide full picture of wastewater upgrades required in the sub-region for this Shortlist Option. It is recognized that decision made in this DBC can influence upgrades required in the northern metro area.

- Treatment process requirements (this includes energy recovery technology as part of the southern sub-regional facility and Cambridge WWTP)
- Creating access to and within the site
- Security of the site
- Operators facilities, laboratory and workshop
- Allowances for Contractors preliminary and general costs
- Design development costs
- Foreign exchange risk
- Saturated construction market
- Some contingency for design development
- Some contingency for the construction phase
- Allowances for sub-soil foundations assuming IL3 resilience requirements. No specific design has been undertaken for this, but the allowances are significant. In addition, the Cambridge site, because of its proximity to the Waikato River bank, is differentiated from other sites by the provision of an allowance for the mitigation in addition to the liquefaction that could occur on this and most other potential sites
- Differentiation between 'Green Field' and 'Brown Field' developments. i.e. an equivalent development on a Brown field site will be spatially less optimal than on a green field site, the required build duration will be longer and there are likely to temporary process works and installations required in order to establish the permanent works in logical locations.

The above estimates include provisional costs for discharge pipelines and structures:

- For Option 2A: 1 km pipeline and discharge structure from the new sub-regional treatment facility
- For Option 4A: 1 km pipeline and discharge structure from the new treatment facility at the airport; 500m pipeline and discharge structure from Cambridge WWTP (for Options 4A).

4.2.8 Staging of implementation and capital cost considerations

Table 38 outlines the indicative base staging construction costs for the 2A Sub-Regional WWTP and 4A Cambridge WWTP which considers the process requirements of each plant over time in response to growth. An additional 10% has been added to costs in later years from 2041 to cover the extra costs expected due to multiple construction periods (including design, some rework and construction supervision). An alternative staging scenario is to delay the installation of PSTs and Digesters to 2051 is also outlined. However, this also defers the onset of operational cost savings (energy purchase and biosolids disposal cost reductions). A cost vs benefit analysis for this deferral has not been undertaken at this time. Staging for the Airport and Tauwhare Pa would depend on development timing and flows being confirmed.

Table 38 Shortlist Options Indicative Capital Costs Staging

WWTP name	Scenario	WWTP Capital Cost 2031 ($ M)	WWTP Capital Cost 2041 ($ M)	WWTP Capital Cost 2051 ($ M)	WWTP Capital Cost 2061 ($ M)	TOTALS
2A Southern Sub-	Base Staging	$ 136.7M	$ 16.2M	$ 18.5M	$ 5.2M	$ 176.6M

Regional WWTP	Delay PSTs and digesters to 2051	$ 120.2M		$ 53.8M		$ 174.0M
4A Cambridge WWTP	Base Staging	$ 95.2M	$ 3.9M	$ 5.5M	$ 9.8M	$ 114.4M
	Delay PSTs and digesters to 2051	$ 82.9M		$ 29.7M		$ 112.6M

For Option 2A, an alternative staging strategy would be to build capacity for Cambridge (because this is critical) plus the current / near future airport flows (which already require a change of management method) as stage 1. Peacocke and the other Hamilton South precincts would continue north in accordance with existing practice and as intended by the new Peacocke rising mains. This initial capacity would likely be built as an aerobic, MBR plant only plus inlet works and UV disinfection. The second stage of development would then likely add primary tanks, digestion and side-stream centrate nutrient removal. The timing of this second stage is complex and would likely be linked to network development in Hamilton (particularly Peacocke), a lack of suitable capacity at Pukete WWTP and/ or the need to divert the northern (Ngaruawahia, Taupiri and Horotiu) flows and loads south to Pukete WWTP. Subsequent development stages would see existing unit processes augmented as the need arose. This alternative staging option could be developed and costed in more detail at the stage of developing of the preferred option and the northern business case.

4.2.9 Whole of life costs of options

The Net Present Value (NPV) of the two short-listed options are:

- Option 2A has a n NPV estimate of -$1,212 million
- Option 4A has an NPV estimate of -$1,096 million

The NPV includes capital cost inflation of 3%, operating cost inflation of 2%, costs modelled to 2071 and 5% discount rate. The summary of the NPV assessment is shown below in Table 39 below.

Table 39 Options 2A and 4A Estimated Net Present Value Costs

2A

Net Present Value - Project	$000's
Capital costs	(555,414)
Renewal capital costs	(24,073)
Operating costs - Conveyancing	(83,826)
Operating costs - Treatment Plant	(549,371)
Total	(1,212,684)

4A

Net Present Value - Project	$000's
Capital costs	(512,438)
Renewal capital costs	(27,100)
Operating costs - Conveyancing	(2,270)
Operating costs - Treatment Plant	(554,894)
Total	(1,096,703)

4.3 MCA results summary

The MCA results and MCA weighting scenario test results are summarised in this section.

4.3.1 Shortlist Option Assessment – Investment Objective Differentiators

Some of the specific and key differentiators between Option 2A and Option 4A outlined below.

Ecology – Terrestrial Ecosystems

Whilst both options will consider riparian vegetation and rehabilitation of the natural ecosystems, Option 4A assumes individual council authorities will continue to act independently which reduces the pool of resources and reduces the potential scale of these projects. Option 4A (score of 1) therefore has a lower score than Option 2A (score of 2).

Cultural Connectivity - Access to the River

Option 2A (score of 2) provides the ability to provide improved access through pathways and dual-purpose pipelines, it also allows for the opportunity to repurpose the current Cambridge WWTP site. Under Option 4A (score of 1) councils will operate more independently and therefore there will be less opportunity to develop access to the river.

Sustainable Technology – Water Reuse

Option 2A (score of 3) by its nature has a large, centralised facility which provides a far greater opportunity for water reuse than Option 4A (score of 1). Option 2A would potentially be able to reuse water at an industrial scale rather than for irrigation which would be possible under Option 4A.

Flexibility

Option 2A (score of 1) requires greater levels of intervention to re-distribute wastewater from the southern suburbs of Hamilton to the proposed sub-regional plant in the near future. It is also more difficult to stage to meet current projected growth and under high growth scenarios. Option 4A (score of 2) has good flexibility to adapt to changing demand and can have stages delayed or accelerated to meet needs including accommodating wet industry in the medium term if required.

Sustainable Growth

The funding level required to implement Option 2A (score of 1) would have made subsequent changes to meeting the demand changes across the sub-region more difficult due to the large initial outlay by the councils. The funding requirements of Option 4A (score of 2) are comparatively lower than Option 2A and thus access to funding to respond to land use changes will be comparatively easier.

4.3.2 Shortlist Options Net Present Value Assessment

A Net Present Value (NPV) assessment was undertaken for the shortlisted options determined that Option 4A had an NPV estimate of -$1,096 million compared with Option 2A which is -$1,212 million (utilising assumptions including capital cost inflation of 3%, operating cost inflation of 2%, costs modelled to 2071 and 5% discount rate). The NPV is a reflection of the overall economic value of an option.

At the time of the Preferred option decision Option 4A is considered more affordable as it gives project partners the potential to defer capital costs in the first and second decades (2031 and 2041) with a smaller WWTP near the airport or through a different servicing arrangement for this catchment.

Through closer examination of the Preferred Option further refinements to the capital and operational costs have been undertaken and subsequently updated NPV calculations. These updated NPV results for the short list options shown in Table 40 below (and also provided in the Financial Case). The costs have been discounted using a 5% real discount rate (i.e. no inflation has been applied to costs). The key difference here is changing from a Real to a Nominal discounting methodology to align with Treasury's approach. This change in calculation has resulted in a minor differential change between the two short listed options but does not change the rationale for the decision to confirm Option 4A as the preferred option.

Table 40: Shortlist Options Net Present Value

	Capital Costs	Renewal capital costs	Operating costs	Total
Option 2A	($375.5M)	($9.1M)	($326.5M	($711.1M)
Option 4A	($341.5M)	($10.3M)	($314.4M)	($666.2M)

4.3.3 Other key risk and opportunity considerations

In addition to the MCA assessment there were a number of other key risk and opportunity considerations for the two short listed options. These risks and opportunities on review did not change the options assessment against the criteria but were key considerations of the preferred option decision-making process. They included:

- **Staging Opportunities for the Airport Precinct** - Further analysis identified that the capital cost - 'developer share' for a new wet industry to locate to the Airport precinct in Option 4A would be significantly higher compared to other existing industrial areas in Hamilton. Retaining this area for light industry only with a much smaller WWTP would further reduce the capital and operational cost associated with Option 4A
- **The risk of lower than planned growth impacts -** There is a possibility that with lower growth than is currently assumed[37], Option 4A could better cater for the level of servicing need and the additional capital expenditure required for Option 2A would therefore not be incurred
- **Opportunity Cost of Option 4A -** It is recognised that there would be some opportunity cost associated with the selection of Option 4A over Option 2A for refinement as the Preferred Option. These include more restricted potential wet industry development.

[37]Note: Which includes the additional growth allowance above NIDEA low for HT1, R2, Southern Links and further infill development.

5. Preferred option selection

The key outcomes of the shortlist option MCA re-assessment and cost estimate comparisons were:

- Option 4A and Option 2A achieve similar outcomes in relation to the investment objectives and Best for River outcomes
- Option 4A and Option 2A were assessed as having a similar ability to be successfully consented and implemented
- Option 4A had a capital cost estimate[38] of $652M compared with Option 2A which is $716M[39]; this includes capital costs for the construction timeframes of 2021 to 2061 for both the north and south metro area as well as consenting, procurement, land purchase, make good and council construction overheads.

Option 4A, subject to some refinements, was accepted as the Preferred Option of the Metro Wastewater DBC as an outcome of the Governance Group meeting held on 26th February 2021. The activities that contributed to the selection of this shortlist option as the preferred option included:

- Understanding servicing requirements and possibilities for settlements including Tamahere, in addition to those already included in the scope such as Matangi
- Detailing of the risks and opportunities with both shortlisted options in the DBC reports such as:
    - Operational risks for the WWTP for both options including plant inefficiencies resulting in high unit costs as a result of operational requirements for WWTP that service wet industries but have a low proportion of municipal waste
    - Operational risks (process instability and non-compliance) for WWTPs where the wet industry served makes up a comparatively large proportion of the total plant loading
    - Pukete and Cambridge plants can better manage wet industries
- Detailing the demand and plant requirements at the airport for Option 4A including staging options as well as alternative servicing options. Initial assessment is that there is potentially considerable saving or deferral of costs from the currently estimated $54M for the airport WWTP due to exclusion or a significant deferral wet industry development. There are also other servicing options to be assessed such as conveyancing to Cambridge, trucking or private servicing arrangements
- Confirming of the long-term site requirements for a WWTP near the airport to service the Hamilton South and airport catchment. An assessment also needs to be undertaken as to the suitability of this site as a potential location for a short- or medium-term solution as a WWTP to service the airport precinct and nearby catchments. The rationale for securing the site in the short term for the long-term benefit of all partners needs confirmed and articulated
- Undertaking sensitivity tests regarding growth scenarios noting these assessments can be used to provide feedback to the Metro Spatial Plan (which does not match the timeframe of this DBC). The sensitivity testing is important to inform the partners about the effects the growth scenarios have on wastewater servicing requirements and help inform land use planning (i.e. the location of wet industry)

[38] Capital Cost estimates for WWTP and Conveyance are estimated by Beca and are P50 AACE Class 5 cost estimate; expected accuracy of -30% to +50%. In addition, other costs including procurement, consenting, council resources, land acquisition have also been included and are provided by others.

[39] Total dollars out to 2061 and unadjusted for inflation

and the discussion around certainty of land use or flexibility. Note: this discussion occurred prior to the announced changes in the RMA.

- The flexibility of the options being revisited and Option 2A whilst able to respond to high levels of growth near the airport not being as flexible as 4A which is able to respond to land use changes across the sub-region well. Option 4A still has the ability to respond to growth in industry.

Further information regarding the selection of Option 4A and the refinements proposed to this option can be found in the Metro Wastewater DBC Preferred Option Memorandum which is an appendix to the Short List Report (Appendix B).

5.1.1 Refinement Opportunities for selected Preferred option (Option 4A)

The refined Option 4A involves building a facility to service Cambridge/Hautapu and a smaller facility to address the immediate needs of the airport, Matangi and possibly Tauwhare Pa through a smaller facility in near the airport that has sufficient land capacity to allow it to be developed in the future to service growth beyond that anticipated in the Metro Spatial Plan. Updated scoring of Option 4A was not undertaken. The project team was instructed to detail a refined option that net the same standards and outcomes of Option 4A but with improved ability to stage development to meet demand for capital expenditure to occur as the demand occurred thus delaying financial outlays and retaining the outcomes sought.

The development of a refined Option 4A as the preferred option of the Metro Wastewater DBC is expected to include:

- Building a standalone facility to service Cambridge/Hautapu
- Securing a site (c 15 – 20ha) in the vicinity of the airport to meet medium to long term servicing needs as demand necessitates for a southern sub-regional plant for the long term
- Developing servicing solutions at the airport to meet the immediate and short-term needs of the airport
- Improved servicing for Matangi. The options for further consideration include:
    - upgrading the existing Matangi WWTP and renewing the discharge consent
    - seeking a connection to the existing Hamilton wastewater network (with appropriate upgrades)
    - servicing via a centralised facility
- Improved servicing to meeting growth demand at Tauwhare Pa. The options include:
    - Expanding and upgrading the existing Tauwhare WWTP facility as required,
    - Conveying Tauwhare Pa to an upgraded Matangi WWTP,
    - Connecting to the existing Hamilton system with Matangi.
- Servicing Ohaupo in the future when need arises, and treatment capacity is in place via the southern facility or at Te Awamutu
- Servicing Northern Metro communities via Pukete (to be considered as part of Northern DBC investigations)
- Review potential for servicing Tamahere by conveyance to other WWTPs.

GHD Centre Level 3 27 Napier Street Freemans Bay Auckland 1011 New Zealand
PO Box 6543 Wellesley Street Auckland 1141 New Zealand

64 9 370 8000
aklmail@ghd.com

Rev.No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Draft V0.1	K. Jackson / C. Scrimgeour	T. Eldridge		T. Eldridge		16/12/2020
Draft V0.2	T Hankinson	T. Eldridge		T. Eldridge		20/04/2021
Final V1.0	T Hankinson	T. Eldridge		T. Eldridge		01/03/2022

Appendix A – Growth Assumptions for Waikato Metro Wastewater DBC Memorandum

Memorandum

10 December 2020

To	Waikato Metro Wastewater DBC Control Group Hamilton City Council		
Copy to	Jackie Colliar		
Author	Claire Scrimgeour and Kate Jackson		
Reviewer	Rob Brodnax	Approver	Sioban Hartwell
Subject	**Growth Assumptions for Waikato Metro Wastewater DBC**	Job no.	12533660/3257177

1 Introduction

The purpose of this technical note is to outline the residential and non-residential growth assumptions proposed to be used for the metro long list and southern short list options stages of the Waikato Metro Wastewater Detailed Business Case (DBC). The DBC will explore potential wastewater strategic options for the wider Hamilton Waikato Waipa Metro Area (the metro area) (see Figure 1-1) and determine a preferred wastewater treatment solution within the southern metro area.

The residential and non-residential growth assumptions as defined within this technical note will inform the development of high level strategic wastewater treatment options. Growth assumptions will provide indications of the size and timing of potential new conveyance systems and wastewater treatment plants and when upgrades are required for existing treatment plants.

The growth forecasts have been updated to incorporate feedback from the Project Control Group.

This technical note has been structured as follows:

1. Introduction
2. Background: Project history and previous investigations
3. Assumptions: List of wider overarching assumptions which have been taken for this project
4. Approach: Detailed description of the population sources, approach and limitations for each council area
    4.1. Residential growth assumptions
    4.2. Non-residential assumptions
5. Metro Area Residential growth: Summary of available projection and capacity information
6. Hamilton City Growth: Summary of Hamilton City population equivalent information and growth areas outside current city boundary
7. Limitations: Discussion of the key limitations and issues with existing sources and approach
8. Recommendations

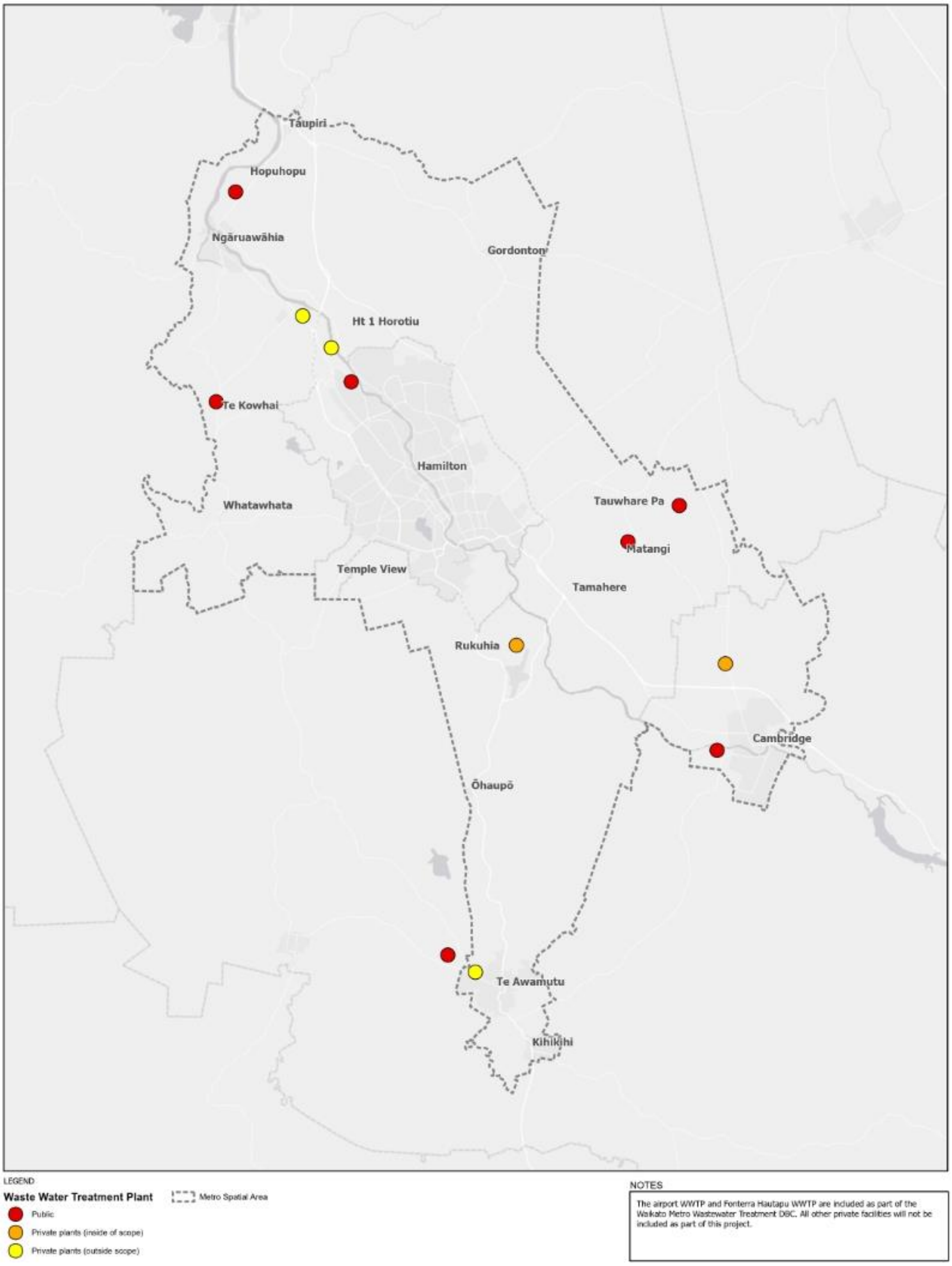


Figure 1-1 Waikato-Hamilton-Waipa Metro Area (Scope Area)

2 Background

High level population assumptions were collated earlier this year as part of the Hamilton Metro Wastewater Treatment Feasibility Study. Population projections were determined for two growth scenarios; the 2045 growth scenario and a 100 year plus growth scenario using a variety of sources.

This assessment provides more recent population projection and capacity information, provides greater granularity for residential and non-residential growth within the metro area and also defines potential longer term growth areas.

3 Assumptions

The following high level assumptions have been taken into account for the purpose of this technical note:

- Growth assumptions have been collated based on information available as of 12th August 2020.
- An ‘ultimate’ growth capacity scenario has been identified which reflects the largest household projection for an area based on known development areas and expected density and is generally indicative of a 60-100 year growth period.
- Population projections for 10 year incremental periods have been collated starting in 2021 and finishing in 2061 (i.e. 2021, 2031, 2041, 2051 and 2061).
- The residential projections collated for this project focus on the “connected” population to be serviced by wastewater infrastructure.
- Maximum growth capacity is informed by zones in District Plans and additional areas indicated in growth strategies, private plan changes and submissions to Proposed District Plans as at August 2020.
- Significant industrial facilities with private wastewater treatment systems and discharge consents (such as Fonterra Te Rapa, Hautapu and Te Awamutu Plants and Affco Horotiu) within the Metro Area are not included in the population equivalent or trade waste flows described in this memo.

3.1 Available data sources

The growth strategies and growth projection information available for the metro area are summarised in Table 3-1.

Table 3-1 Data sources

Available information	Description
Future Proof Strategy – Planning for Growth (November 2017)	Provides direction of the preferred development pattern for the metro area
Metro Spatial Plan (MSP)	The Metro Spatial Plan, currently under development, seeks to determine a shared 100+ year vision and spatial framework. The MSP is supported by several growth scenarios that spatially distribute a future 500,000 PE residential population across the Metro Area. The figures considered for this memo are based on the 70/30 scenario, i.e. 70% of the additional residential population growth occurring within or immediately adjacent to the future Hamilton City Boundary and 30% distributed across the other communities in the Metro Area.

Available information	Description
Waikato 2070 (May 2020)	Provides future residential and industrial development areas planned in the Waikato District Council for the 3,10 and 30 year time frames
Waipa 2050 Growth Strategy (November 2017)	Provides future residential and industrial development areas planned for the Waipa District to 2050
Hamilton Urban Growth Strategy 2010	Outlines growth cells for Hamilton City.
2013 Census data	The 2013 census data along with land use and economic information was used by NIDEA to develop growth projections at the Census area unit (CAU) level from 2021 to 2061.
2018 Census data	The 2018 Census data is not yet available in sufficient detail to update the NIDEA projections, however, it has been used by Waikato District Council and Hamilton City Council to re-baseline the 2016 NIDEA projections.
Land use, demographic and economic projections for the Waikato region, 2013 to 2063 (NIDEA 2016)	Provides household and population projections for the 2021 to 2061 time period for Waikato District Council, Hamilton City Council and Waipa District Council
Waipa Three Waters Master Plan – Growth Gateway 2019.	Provides baseline projections for Waipa District Council for 2025, 2035 and 2050 timeframes
Waikato Growth GIS model 2020	Provides breakdown of household and population growth projections and capacity for Waikato towns for period between 2021 and 2063.
HCC Growth GIS model 2020	Provides breakdown of household and population growth projections for Hamilton City Council area for period between 2021 and 2063.
Regional Infrastructure Technical Specifications (RITS)	Outlines design requirements for new infrastructure. Of particular relevance to this memo are the population equivalence assumptions included in the RITS for different land use activities.
HCC Wastewater Model and Master Plan V3 (WWMP) 2020	Provides population equivalent (PE) and flow forecasts for catchments in the HCC network for 2021-2081 and city full horizons.
Strategic agreement on future urban boundaries Between Hamilton City Council and Waikato District Council March 2005	Waikato District and Hamilton City Council have agreed to future boundary changes that will shift areas from Waikato District into Hamilton City jurisdiction. The strategic agreement sets out the specific areas, conditions and indicative dates for the boundary changes to occur.
Waikato Tainui Iwi Resilience Plan 2020	Includes development plan for Hopuhopu area including additional residential, commercial and recreational activities.
Future Proof Industrial Land study (GMD March 2020)	A study of industrial land demand vs capacity for the metro area.
Business Development Capacity Assessment 2017 (ME Consulting)	This study focuses on the non-residential development capacity within the urban environments of each of the partnership councils, as required by the NPS-UDC.

Available information	Description
HCC Non-Residential Water and Wastewater Design Flows Report (GHD 2017)	A review of flows and typical design allowances for non-residential demand.

4 Approach

The metro area compromises of communities located within Waipa District Council, Waikato District Council and Hamilton City Council (see Figure 1-1). Each council is responsible for developing future growth and capacity projections. However, the methodology for determining growth projections for each council varies and therefore it is important to document the assumptions taken for each council.

Available information sources were identified by each Council and growth projection and capacity information was provided to the project team. The information was reviewed and collated into a form suitable for use in the project and the proposed approach and assumptions were checked with Council staff.

4.1 Residential Growth Assumptions

The following table provides a more detailed description of the assumptions, sources and approach used by the Councils to supply the baseline and 10 year breakdown of residential growth between 2021 and 2061 and also how an 'ultimate' residential growth number was developed. Refer to section 7 for further details on limitations of residential growth projections.

Table 4-1 Sources and methodology – residential growth area assumptions

	Forecasts	Source	Approach	Limitations
Waikato District Council	Base Population	2018 Stats NZ Estimate (supported by actual dwelling counts)	Census Area Unit data resolved to property parcel level was used to calculate the community base population.	
	Forecasts for 2021 through to 2061	Rebased NIDEA (2016) using 2013 Base Stats NZ	NIDEA Midpoint household projection data provided was converted into population using a factor of 2.7 people per household. This data was provided by Waikato District Council - Mark Davey[1].	Information yet to be adopted by Waikato District Council
	Ultimate Forecasts	GIS capacity model, Waikato 2070	Total available household capacity from the GIS based household capacity model (2020) was used for the ultimate growth horizon with a factor of 2.7 people per household. Additional infill has been added to Ngaruawahia from the MSP projections provided by GMD Consultants – Susan Henderson[2].	Information yet to be adopted by Waikato District Council
Hamilton City Council	Base Population	2018 Stats NZ Estimate	Census Area Unit data resolved to property parcel level was used to calculate the community base population.	

[1] Email dated 12/08/2020

[2] Email dated 1/09/2020

	Forecasts	Source	Approach	Limitations
	Forecasts for 2021 through to 2061	Wastewater Master Plan V3 population equivalent projections for 2021-City Full	Detailed population equivalent projections for each wastewater catchment were prepared for the wastewater model V3. PE data was based on the Hamilton City NIDEA 2016 Population projections, with further modelling completed to spatially allocate the residential and non-residential demands across the city, given planning provisions and infrastructure programmes available at the time. Information provided by Hamilton City Council - Manjit Devgun[3]. This is the primary source of information to be used for the DBC infrastructure sizing. Additional infill has been added to the PE projections 2031-2061 from the MSP projections provided by GMD Consultants – Susan Henderson[4] (see Section 6). This covers the key nodes of Hamilton CBD, Te Rapa (The Base), Frankton, Chartwell, Fairfield and the University. NIDEA 2020 Information provided by Hamilton City Council - Nathan Dalgety[5] has been provided in Table 5-1 for comparison with similar data from Waipa and Waikato Districts but will not be used for technical work as the population equivalent information is considered more suitable for infrastructure sizing.	For the 2021/31 LTP, a new set of population projections has been completed, which are referred to as NIDEA 2020. These projections overall are still very similar to the NIDEA 2016 projections; however some adjustments have been made to net migration in the short term due to the Covid related border closures. Additionally, the NIDEA 2020 projections have been rebased to 2019 Population Estimates for Hamilton City. With the additional MSP infill data included the HCC population trend is more consistent with the medium NIDEA projection.

[3] Email dated 11/8/2020

[4] Email dated 1/09/2020

[5] Email dated 21/7/2020

	Forecasts	Source	Approach	Limitations
	Ultimate Forecasts	Metro Spatial Plan	Indicative ultimate population has been sourced from the Metro Spatial Plan work stream population projections July 2020, and City Full Projections from WWMP V3 (2020). Additional infill has been added to Hamilton ultimate forecast from the MSP projections provided by GMD Consultants – Susan Henderson[6] (see Section 6).	Southern Links and area east of Ruakura are not specifically included in the Metro Spatial Plan estimates.
Waipa District Council	Base population	Waipa Three Waters Master Plan Growth Gateway 2019. Statistics New Zealand 2013 Census Data	The population forecasting predictions for Waipa have been based on an analysis carried out for the Waipa Three Waters Master Plan in 2019.Statistics New Zealand 2013 Census Data was adopted as the starting population estimation for each growth area.	
	Forecasts for 2021 through to 2061	NIDEA 2016 Growth Cell Timing Spreadsheet (provided by WDC, 2019)	NIDEA Population mid-point projections were used to predict population growth to 2021. GIS Information was used to determine the proportion of dwellings that are connected to the network. Growth Cell Timing Spreadsheet (provided by Waipa District Council, 2019) was used to assign growth cell population projections to the 2025, 2035 and 2050 horizons.	Limited infill allowed for reflecting historical trends. Infill allowances consistent with projections in MSP.
	Ultimate Forecasts	Waipa Three Waters Master Plan Growth Gateway 2019	Maximum probable growth for each community was calculated using a sensitivity analysis considering infill, density of new growth cells and potential additional growth cells.	

[6] Email dated 1/09/2020

4.2 Non-residential growth assumptions

Demand projections and available capacity for industrial land are outlined in the Future Proof Industrial Land study (GMD Consultants March 2020). Demand projections for the 2020-30 and 2020-50 periods are based on projections developed in the Business Development Capacity Assessment 2017 (ME Consultants). A summary of the available industrial demand and capacity information from the study is provided in Table 4-2.

Table 4-2 Industrial demand and capacity in the metro area

Location	Industrial demand 2020-2030 ha	Industrial demand 2020-2050 ha	Capacity in current zones (incl deferred) ha
Ngaruawahia/ Hopuhopu	4.1	10.1	39
Taupiri/Horotiu/ Te Kowhai	44.3	102	194
Hamilton	318	524	659
Airport	6.4	16.7	104
Cambridge	26.5	71.9	205
Te Awamutu	12	27.5	49
Total	411.3	752.2	1250

For the metro area as a whole there is expected demand for 411 hectares of industrial land over the next 10 years, increasing to 752 hectares over the next 30 years. There is current capacity of 1,250 hectares indicating that there is enough land capacity to facilitate the demand for industrial growth in the metro area. There are also additional non-residential growth areas identified in Waikato 2070 and Waipa 2050 in Taupiri, Hopuhopu, Horotiu and at the Airport. More detailed capacity and timing information for non-residential areas is required to inform the long and short list options development. Available information for individual non-residential growth cells and additional areas in Waipa and Waikato Districts has been collated in **Table 4-3**. The locations of non-residential growth areas are shown in Figure 4-1 with more detail for small townships in Appendix A (Appendix 1).

The current zone and potential additional areas in Table 4-3 will be used to estimate new non-residential flows (using the population equivalent factor) assuming all non-residential growth cells and additional areas will be serviced and developed. This may result in an over-provision of infrastructure capacity for some areas.

Table 4-3 Non-residential growth area assumptions

Location	Type of development	Current zoned (incl deferred) ha	Potential additional areas ha	Recommended PE/ha	Comments/Expected Timing
Taupiri	Light Commercial		150	30	West 3-10 yrs, East 10-30 yrs
Te Kowhai Airpark	Mixed use	45		30	3-10 yrs
Hopuhopu Business Park	Commercial/light industrial		35	45	10-30 yrs
Waikato Tainui - Hopuhopu	Mixed use		24	Varies (PE estimate provided[7])	1-30 years
Horotiu	Light Industrial/ logistics	194	50	30	3-10 years
Te Rapa North	Industrial	As per WWMP			As per WWMP
Rotokauri	Light Industrial				
Ruakura	Light Industrial/ logistics				
Tamahere[8]	Business zone	8.5		30	1-10 years.
Matangi	Commerical/light industrial	5		30	1-10 years.
Airport	Light Industrial	153	100	45	Titanium Park, Meridian 37 by 2035, Montgomery block to 2050, Northern extension post 2050
Cambridge - Hautapu	Industrial	197		45	Small area currently under development, remainder by 2050
Te Awamutu	Light industrial and commercial	37		45	Bond Rd and Paterangi Rd developed by 2030

[7] Email Jackie Colliar 12/8/20

[8] Waikato District Council S92 Report Tamahere Business Zone 2018

At present, the Metro Area local authorities do not specifically plan for or design infrastructure to include capacity for new wet industrial (or high water use) activities. This project, alongside relevant landuse planning projects provides an opportunity to implement more integrated and considered infrastructure planning approaches.

While the portion of non-residential land capacity which will be allocated to wet industries is uncertain, on an area basis it is expected to be small. The servicing of new high water users (wet industry) will be partly limited by water allocation and water treatment plant/network capacity, rather than land capacity unless there are changes to the allocation regime under the Waikato Regional Plan. There are a number of known future trade waste discharges that have been approved and are included as part of the based PE flow estimates as outlined in Table 4-4.

Table 4-4 New trade waste discharge assumptions

Location	Type of development	Additional Wet Industry/trade waste Allowance m^3/d
Dairy industry new site Hamilton	Industrial	2,160
Innovation park	Science and technology	400
Waikeria/Tokanui	Corrections facility/ residential discharge	700

As part of developing these recommendations, relevant staff from HCC, Waikato DC, Waipa DC and Waikato Tainui discussed and reached consensus on reasonable locations to assume (and provide for) new wet industrial activity may be concentrated:

- Te Rapa North
- Ruakura
- Airport
- Near the existing Cambridge WWTP

Table 4-5 outlines the current industrial flow allowance for these areas through to 2061 using the RITS standard allowances. The HCC Non-Residential Water and Wastewater Design Flows Report (GHD 2017) shows that there is a wide variety of flows and population equivalents (PE) from non-residential sources. The key type of activity that would impact the wastewater system is food processing industries which have a typical flow rate of 4L/s/ha (in a 24hr operation this is 346 m^3/day).

Many different approaches can be taken to estimate potential flows from wet industrial activity. For the purpose of this DBC it is recommended that high water use activities are assumed for 2% of total land area allocated for industrial activities as part of the base growth projection assessments. A sensitivity assessment assuming no specific wet industry provision will also be completed to quantify the impact on infrastructure sizing (and timing) associated with the proposed wet industry allowances. The additional wet industry PE and flow allowances are shown in Table 4-5.

Table 4-5 New Wet Industry growth area assumptions

Location	Type of development	Indicative area (incl deferred and non-zoned) ha	Base Industrial Flow allowance* m^3/d	Base Industrial Flow PE/ha	Additional Wet Industry Allowance m^3/d	Additional Wet Industry PE	Total Industrial flow allowance **m^3/d**
Horotiu	Light Industrial/ logistics	194	931	30	1341	6,705	2,272
Te Rapa North	Industrial	60	432	45	415	2,074	847
Ruakura	General Industrial	225	1,620	45	1,555	7,776	3,175
Airport	Light industrial	253	1,822	45	1749	8,744	3,570
Cambridge (near WWTP)	Industrial	23	165	45	159	795	325

The following assumptions for new non-residential areas are recommended:

- For Waikato and Waipa Districts, non-residential growth will be based on the areas in Table 4-3 spread over expected development timeframes and the population equivalent (PE) factor outlined above.
- For Hamilton City, non-residential growth information has been incorporated into the PE forecasts for the Wastewater Master Plan V3 as outlined in Section 6.
- Existing and known future trade waste/wet industry discharges will be included in the wastewater flow and load projections.
- 45 population equivalent per hectare is used per additional hectare of industrial activity as per the RITS unless a different population equivalent is outlined in the table above. Gross areas will be corrected for non-usable areas such as transport corridors based on structure plans where available.
- For areas where wet industry is preferred to occur, an additional flow/load allowance based on 2% of the area used for food processing type wet industry will be assumed. This results in approximately double the flow compared to the standard industrial flow allowances.

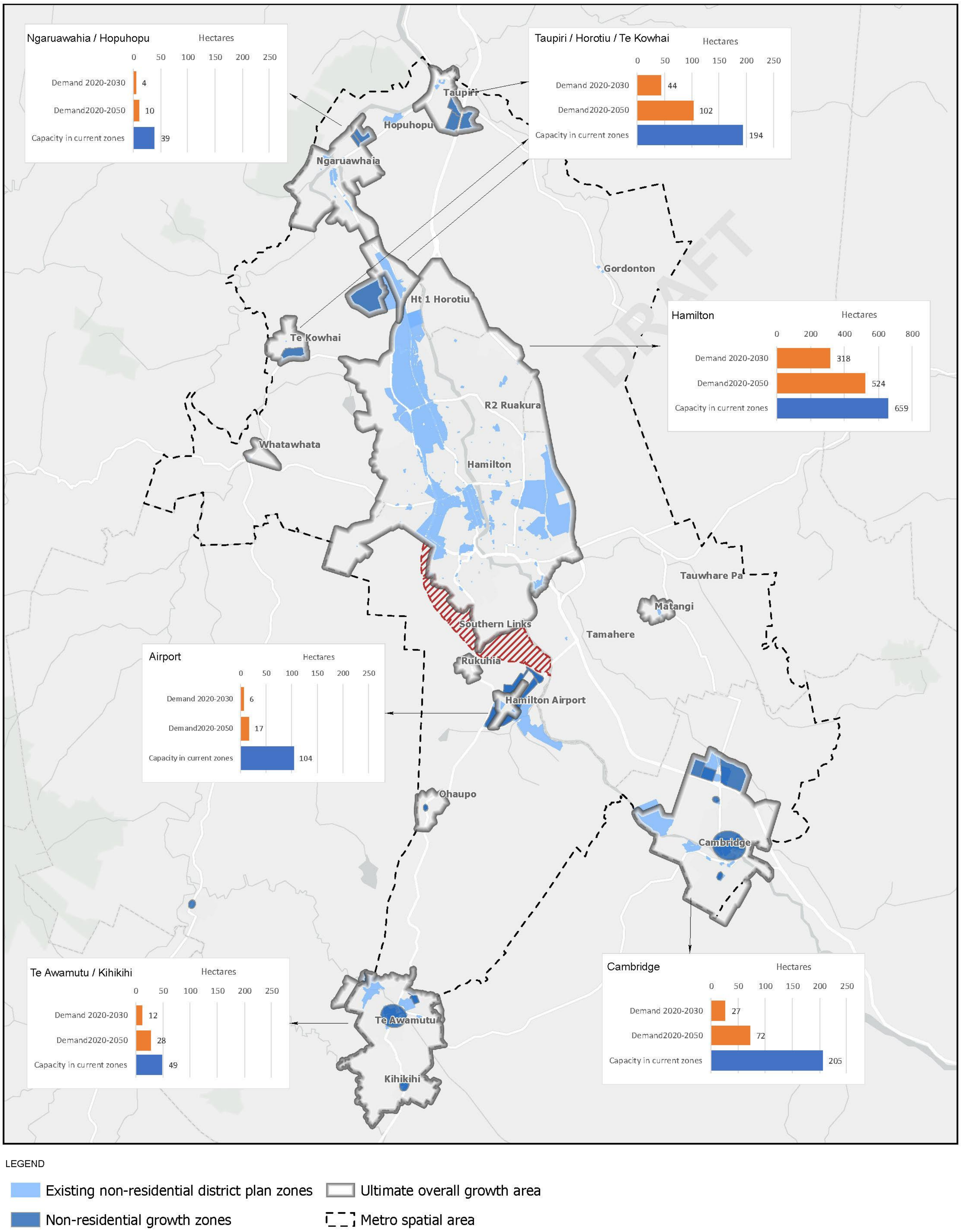


Figure 4-1 Metro Area non-residential growth areas

5 Metro Area Growth

Table 5-1 provides a summary of the residential growth expected for each of the communities in the metro area and the proposed future servicing approach.

Figure 5-1 highlights the areas of residential growth expected within the region and the corresponding population within each area. The figure also highlights the WA, HT1 and R2 areas as preferred longer term areas for residential growth. These are currently outside the current Hamilton City boundary but an agreement is in place with Waikato District for future boundary changes to bring these areas into HCC jurisdiction when specific criteria are met (see Table 3-1).

The Southern Links area and area east of Ruakura are other "Possible Areas" that may be identified for future development. Some discussions have occurred between HCC and Waipa DC around the Southern Links Area.

Residential growth information from the Metro Spatial Plan workstream is provided in Table 5-1 as a comparison with the ultimate forecasts based on capacity information for Waikato and Waipa Districts. The ultimate forecasts for Hamilton City are based on the Metro Spatial Plan information. It is proposed to use the ultimate capacity to inform footprint requirements for new infrastructure only as part of the DBC.

All urban areas will be serviced. Rural residential lots adjacent to towns are currently not serviced for wastewater and this is proposed to continue. Te Kowhai currently has a mixture of on-site (privately serviced) and publicly serviced properties, however, the proposed District Plan signals that Te Kowhai growth areas have the potential for more dense development which would require servicing. It is recommended that Ohaupo, Matangi township and Tamahere commercial flows are included in the wastewater servicing area due to the sensitive environment associated with the peat lakes at Ohaupo and difficult soil conditions in Matangi/Tamahere areas. Little growth is expected in Gordonton, Pirongia and Whatawhata so there would be little benefit in servicing these areas. Rukuhia is a very small community but servicing could be considered in future. Servicing of Tauwhare Pa will continue.

Table 5-1 Metro area residential growth summary

	Area	Current servicing	Future Servicing	Residential population projection 2021	2031	2041	2051	2061	Ultimate	MSP (for comparison only)
Waikato District Council	Taupiri	Currently serviced	Yes	2,062	2,776	3,167	3,391	3,656	4,800	
	Ngaruawahia (incl Hopuhopu)	Currently serviced	Yes	6,234	7,277	7,975	8,392	9,892	19,867	28,893 (covers larger area)
	Horotiu	Currently serviced	Yes	650	1,015	1,229	1,436	1,596	1,596	5,468
	Te Kowhai	Small part of township serviced	Yes all new development and existing township post 2030	2,079	2,265	2,649	3,059	3,335	5,670	1,173
	Matangi	Township only serviced	Yes, continue existing township only and include existing commercial area	149	149	149	149	149	711	711
	Whatawhata[9]	Not currently serviced	No	3,092	3,310	3,713	4,136	4,455	4,455	

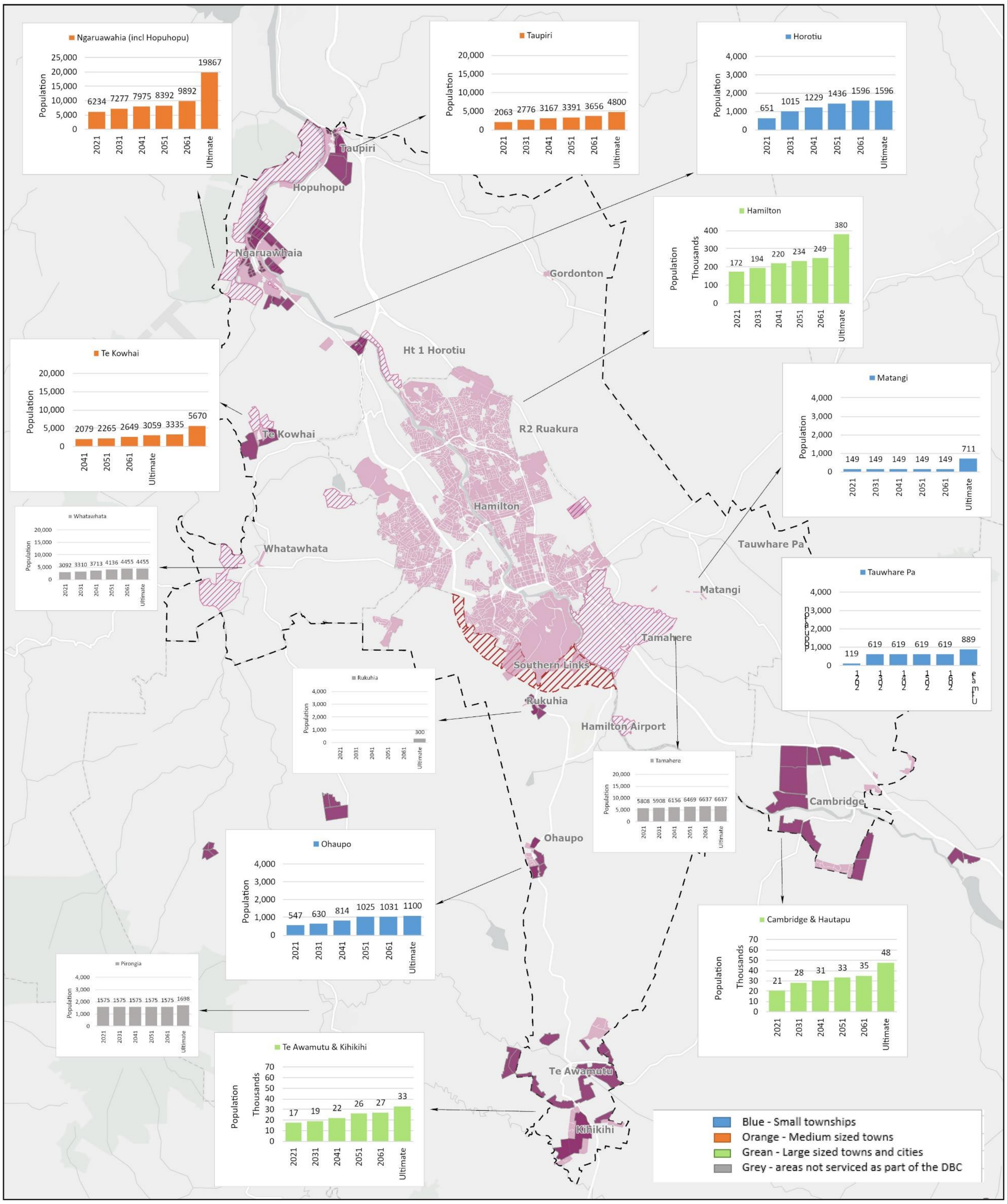
[9] Large lot or houses in "Country living zone" which are currently serviced by onsite wastewater treatment facilities.

	Area	Current servicing	Future Servicing	Residential population projection 2021	2031	2041	2051	2061	Ultimate	MSP (for comparison only)
	Gordonton	Not currently serviced	No	103	103	103	103	103	103	
	Tauwhare Pa	Yes, Pa only	Yes, Pa only (allowance for 100 extra houses in ultimate)	119	619[10]	619	619	619	889	
	Tamahere Country Living Zone[11]	Not currently serviced	No, note servicing of Tamahere commercial area see Table 4-3	5,808	5,908	6,156	6,469	6,637	6,637	
Hamilton City Council	Hamilton	Currently serviced	Yes (includes R2, HT1 and Southern Links)	171,606	194,186	219,737	234,194	248,650	380,000	MSP used for ultimate
Hamilton City Council	Additional area - East of expressway	Not currently serviced	Yes post 2061						30,000	

[10] Allowance for extra Papakainga housing – 50 houses at 10 person per house occupancy

[11] Large lot or houses in "Country living zone" which are currently serviced by onsite wastewater treatment facilities.

				Residential population projection						
	Area	**Current servicing**	**Future Servicing**	**2021**	**2031**	**2041**	**2051**	**2061**	**Ultimate**	**MSP (for comparison only)**
Waipa District Council	Ohaupo	Not currently serviced	Yes post 2051	547	630	814	1,025	1,031	1,100	720
	Rukuhia	Not currently serviced	No						300	
	Cambridge (incl Hautapu and Karapiro)	Currently serviced	Yes (excluding large lot residential)	20,520	28,311	30,543	33,005	35,144	47,762	39,151
	Te Awamutu & Kihikihi	Currently serviced	Yes (excluding large lot residential)	17,488	19,157	22,073	26,150	27,169	33,179	33,848
	Pirongia	Not currently serviced	No	1,575	1,575	1,575	1,575	1,575	1,698	



LEGEND

- Existing residential district plan zones
- Existing country living zone (Waikato district plan)
- Residential growth zones
- Potential future growth area
- Ultimate overall growth area
- Metro spatial area

NOTES

Whatawhata, Pirongia and Tamahere Country Living Zone will not be considered as part of the Waikato Metro Wastewater DBC. These will remain as self-serviced areas

Figure 5-1 Metro Area residential growth

6 Hamilton City Growth

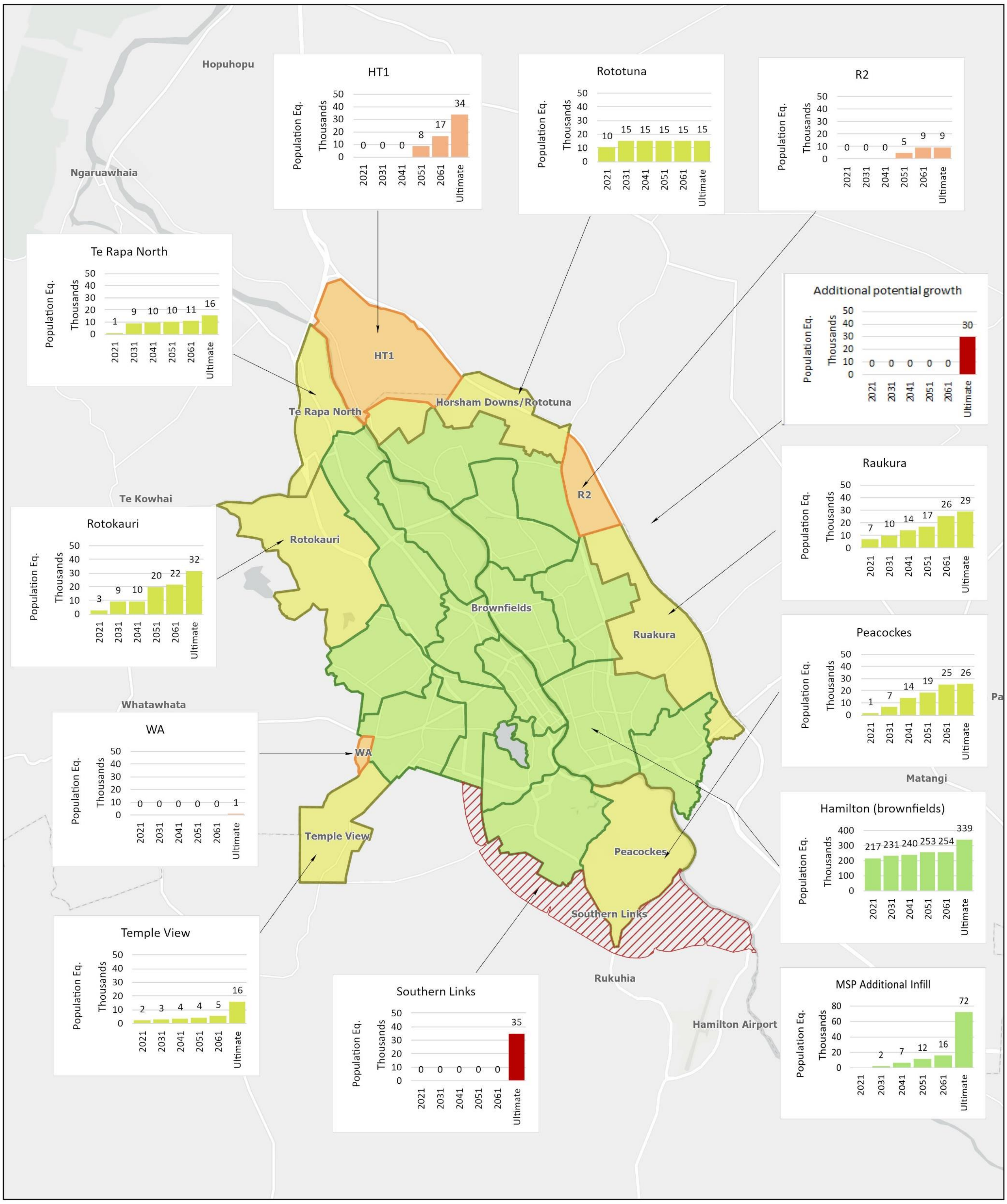
A more detailed breakdown of population equivalent projections was developed for the Hamilton wastewater network model V3 and are recommended for the DBC. Population equivalent includes both residential, commercial and industrial inputs and is available for the main growth cells and infill locations within Hamilton (see Table 6-1).

Figure 6-1 shows where the growth cells are located and the growth expected over time. This information will be used to determine which areas could potentially be diverted to a southern sub-regional WWTP and what flows would continue to be treated at Pukete WWTP. The areas marked * are currently outside the Hamilton City boundary but are subject to an agreement with Waikato District Council regarding future transfer to the city. A detailed breakdown is provided in Appendix 2.

Table 6-1 Hamilton City population equivalent growth breakdown

Growth Cell	2021	2031	2041	2051	2061	City Full
Te Rapa North	1,167	9,073	9,677	10,280	10,884	15,898
Ruakura	6,816	10,127	13,965	17,014	25,697	28,769
Peacockes	1,346	6,532	14,161	18,648	25,489	25,607
Templeview	2,031	2,681	3,550	4,419	5,289	15,860
Rotokauri	2,897	9,129	9,567	19,913	21,570	31,624
Te Rapa	13,892	15,003	15,993	17,290	19,168	39,698
Rototuna	10,433	15,165	15,068	14,972	14,875	15,284
WA*	0	0	0	0	0	1,000
HT1*	0	0	0	8,398	16,796	33,591
R2*	179	179	179	4,725	9,450	9,450
East of Ruakura						30,000
MSP Additional Infill		2,311	6,934	11,557	16,180	72,278
Brownfield	217,377	231,480	239,636	253,447	254,244	339,475

The PE figures for Hamilton City, detailed in Table 6-1 do not include population equivalents for the existing trade waste discharges. The population equivalent figures for Hamilton City do include allowances for schools, hospitals, additional flow within the Ruakura Growth Cell and other existing and planned commercial and industrial activities (not specifically listed in the trade waste discharge list) within the city. The infill nodes in the MSP are outlined in Figure 6-2. The current Hamilton trade waste dischargers are shown in Figure 6-3.



LEGEND

- Greenfields development areas inside current city boundary
- Existing brownfields
- Potential growth zone
- Future development areas (defined in Strategic Agreement on Future Urban Boundaries between Hamilton City Council and Waikato District Council, March 2015)
- Future HCC boundary (including future development areas)

NOTES

- The population equivalents shown in this figure are Total PE (including residential and non-residential land use activities).
- These figures exclude PE associated with existing trade waste discharges and specific allocations for new trade waste allocations.
- The figures exclude industrial activities with private wastewater facilities.

Figure 6-1 Hamilton City growth breakdown

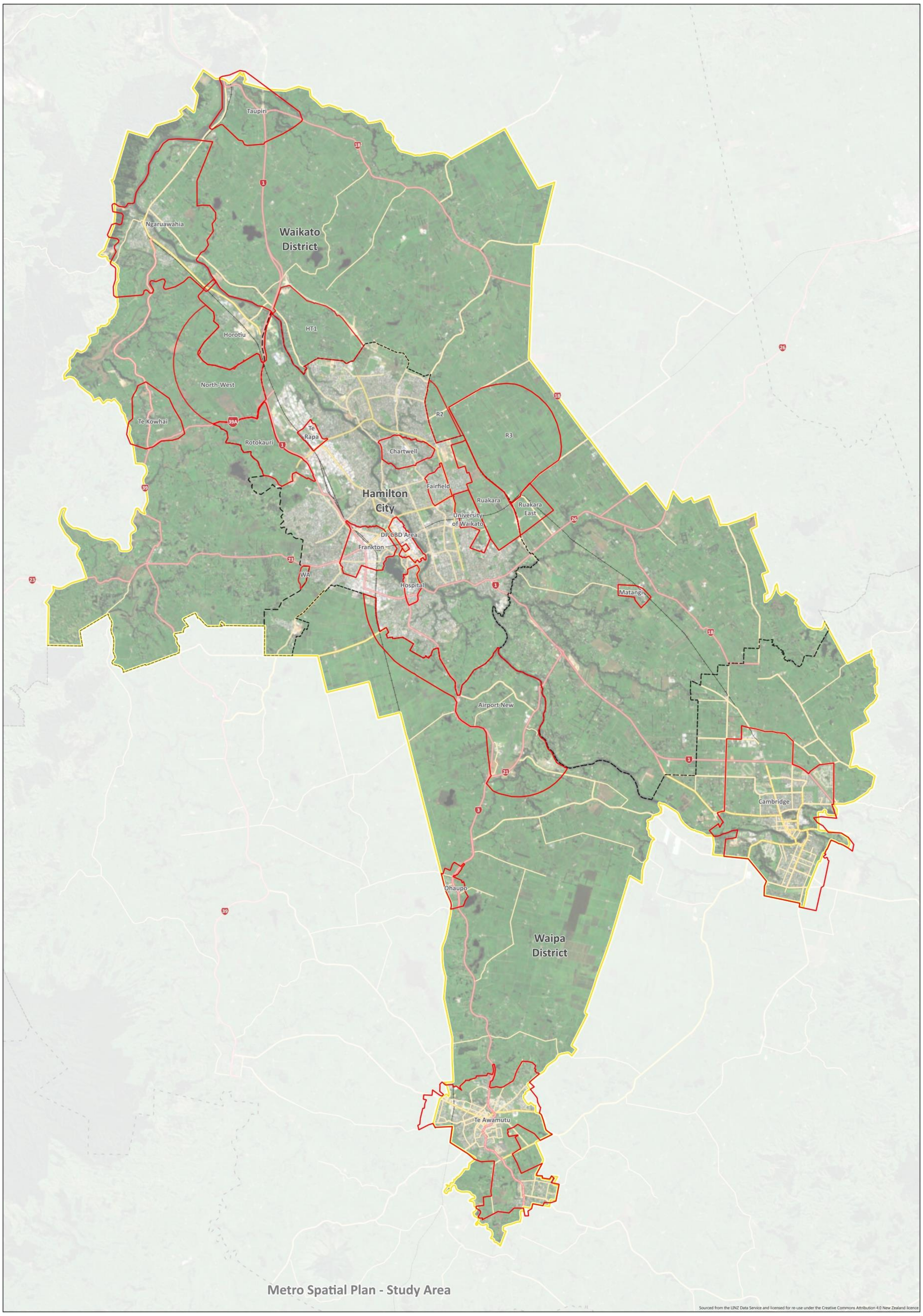


Figure 6-2 MSP Nodes

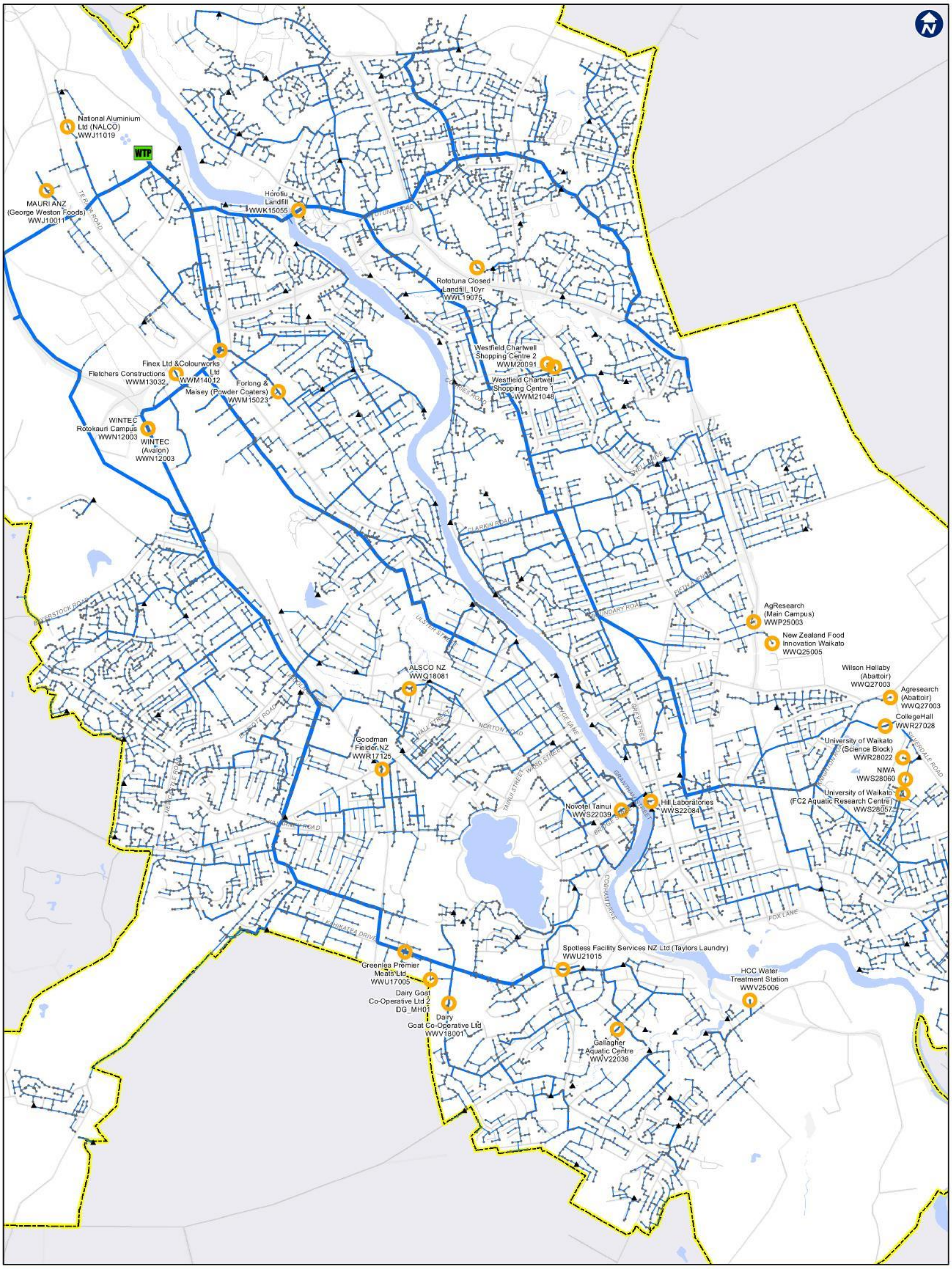


Figure 6-3 Hamilton City Trade Waste Discharges (Aecom 2016)

7 Limitations

Waipa and Waikato District residential growth projections are based on the mid-point NIDEA projections while Hamilton City growth projections are based on the low projection with additional allowance for infill under the Hamilton Waikato Metro Spatial Plan.[12]

The assumptions are consistent with those being used to inform Master Plans and Activity Management Plans (AMPs) feeding into the 2021-2031 Long Term Plans. If residential growth occurs faster than expected, infrastructure upgrades would need to be bought forward. Sensitivity analysis for growth projections will therefore be undertaken for the preferred southern option.

Development of non-residential zones is highly dependent on economic and transport factors. New wet industries in the area are likely to be relatively small scale given the limited water allocation available under current water take consents. Different industries have varying flow profiles and population equivalents. Using the RITS design basis for new non-residential growth cells is consistent with wastewater network modelling methodology. However it is acknowledged that the RITS approach does not adequately capture flows that may be associated with medium or high water use activities and therefore some specific additional provisions are included in the recommended growth figures to be adopted for the DBC. The total non-residential capacity, including the additional areas identified in Waikato 2070, appears to be in excess of expected demand, however, infrastructure will need to be capable of servicing these areas if they could be developed. Additional sensitivity analysis will be carried out at the preferred option stage to confirm the capacity allowance for non-residential areas.

NIDEA household/population projections will be reviewed once full 2018 Census data is available and updated forecasts are expected to be available mid-2021. A staged approach to providing wastewater infrastructure capacity will provide flexibility to adapt if population growth rates change.

COVID-19 – effects on growth projections for the Waikato are expected to be short-term.

Calibrated network models are available for all main serviced areas. These models provide peak flow information and population equivalent data for different catchments. The network models allow for the impact of climate change on peak flows which will be considered during conveyance design. Wastewater treatment plant design for the metro long list stage will be based on average daily flow which is less influenced by climate change.

At the preferred southern option stage, sensitivity analysis is proposed to further investigate how changes in growth affect infrastructure sizing and staging. This will involve estimating expected upper and lower ranges for:

- Infill growth,
- greenfield residential growth,
- industrial/commercial growth and
- wet industry activity (quantity and composition).

---

[12] **"For Hamilton City, the low NIDEA forecast in 2060 is 226,000, and the medium forecast is 259,000, a difference of 33,000. The DBC has adopted the low NIDEA population forecast of 226,000, with additional allowance for infill of 18,000 in 2060 (and 72,000 for the city full scenario), giving a total of 244,000. The difference between this adopted forecast and the medium NIDEA forecast is relatively minor."**

Once the likely lower and upper flows and loads are calculated, impacts on infrastructure sizing and operations can be assessed.

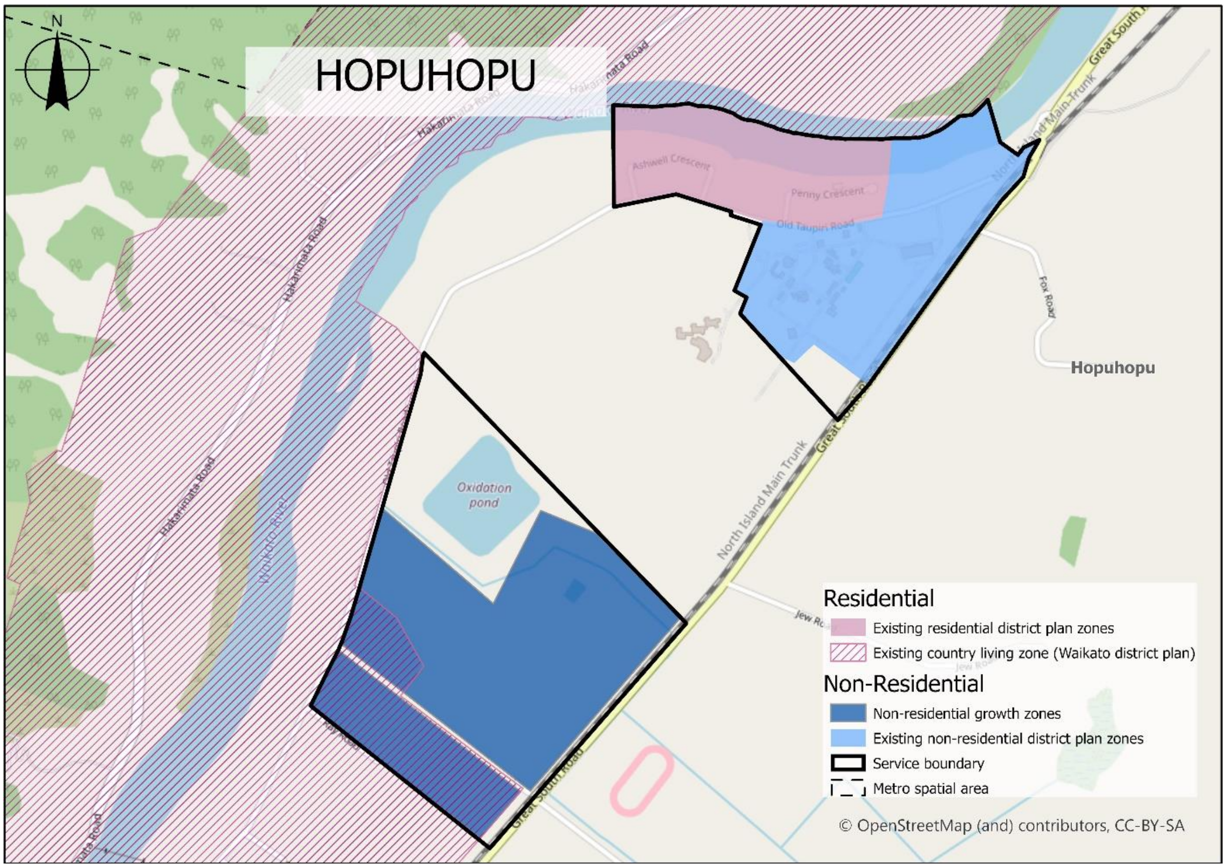
8 Recommendation

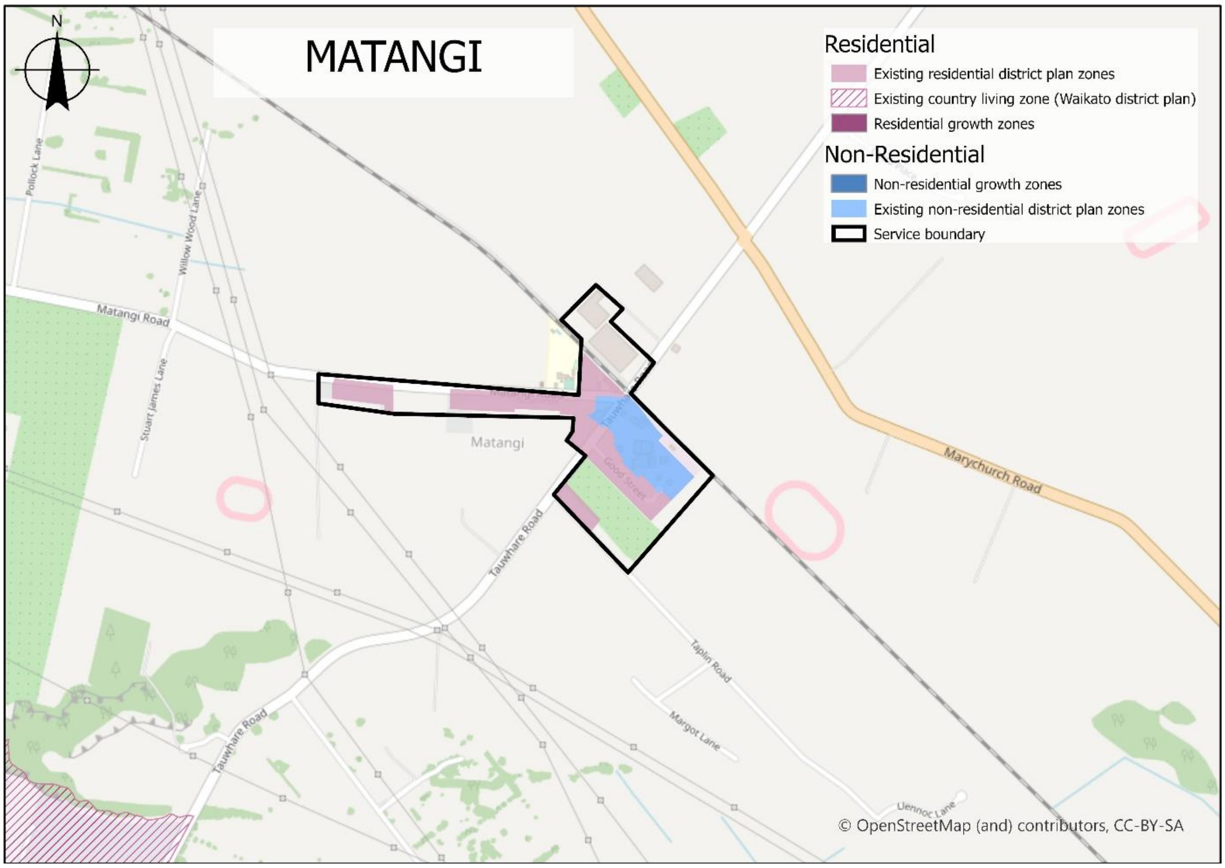
It is recommended that the residential and non-residential servicing and growth assumptions outlined in Tables 4-3, 4-4, 4-5, 5-1, and 6-1 of this technical note are used for the metro wastewater DBC long list and southern short list stages.

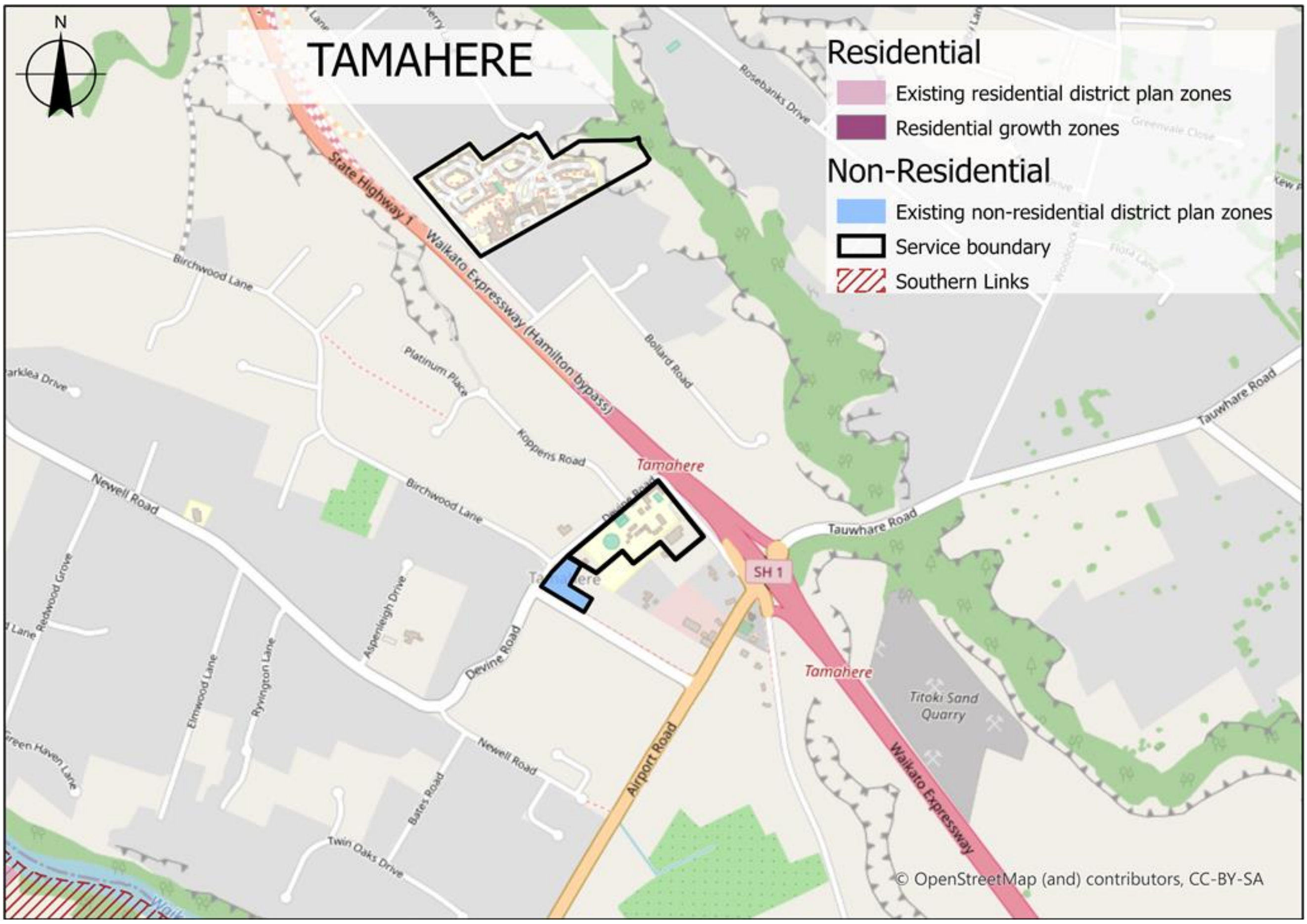
Version Control

Version	Author		Reviewer	Approver
Draft v2	Claire Scrimgeour/ Kate Jackson	13/8/2020	Rob Brodnax	Sioban Hartwell
Draft v3	Claire Scrimgeour/ Kate Jackson	14/8/2020	Rob Brodnax	Sioban Hartwell
Final	Claire Scrimgeour/ Kate Jackson	28/9/2020	Rob Brodnax	Sioban Hartwell
Updated Final	Claire Scrimgeour/ Kate Jackson	5/10/2020	Rob Brodnax	Sioban Hartwell
Final V3	Claire Scrimgeour	10/12/2020	Rob Brodnax	Sioban Hartwell

Appendix 1 – Small towns growth areas



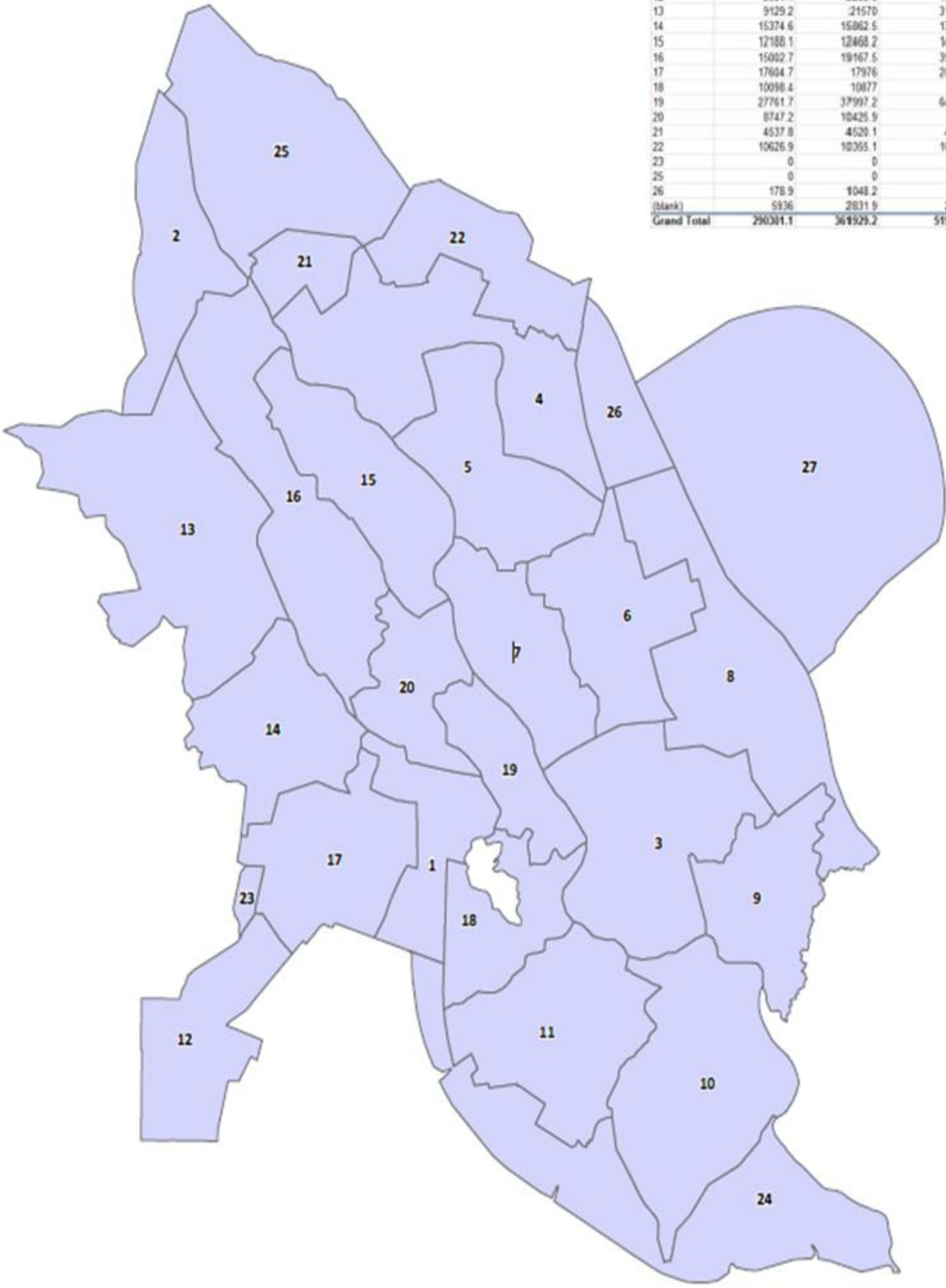



TAMAHERE
N
Residential
Existing residential district plan zones
Residential growth zones
Non-Residential
Existing non-residential district plan zones
Service boundary
Southern Links
State Highway 1
Waikato Expressway (Hamilton bypass)
Birchwood Lane
Platinum Place
Koppens Road
Bollard Road
Rosebanks Drive
Tamahere
Tauwhare Road
Tauwhare Road
SH 1
Newell Road
Devine Road
Airport Road
Aspenleigh Drive
Elmwood Lane
Ryrington Lane
Redwood Grove
Green Haven Lane
Bates Road
Twin Oaks Drive
Titoki Sand Quarry
Waikato Expressway
© OpenStreetMap (and) contributors, CC-BY-SA

Appendix 2 – Hamilton Population Equivalent Forecast by Area

Area	PE_2021	PE_2031	*PE_2041*	*PE_2051*	PE_2061	City Full
1	7,567	8,118	*8,690*	*9,283*	9,958	20,222
2	1,167	9,073	*9,677*	*10,280*	10,884	15,898
3	24,730	25,020	*24,786*	*25,373*	24,658	28,584
4	21,763	21,928	*20,622*	*21,720*	21,002	23,301
5	11,996	11,943	*11,843*	*12,087*	11,824	14,107
6	15,637	16,318	*16,606*	*16,894*	17,182	18,814
7	10,958	11,589	*12,091*	*12,715*	12,488	14,506
8	6,816	10,127	*13,965*	*17,014*	25,697	28,769
9	11,371	11,967	*13,178*	*15,084*	13,276	15,562
10	1,346	6,532	*14,161*	*18,648*	25,489	25,607
11	16,913	17,820	*18,409*	*19,720*	19,081	20,732
12	2,031	2,681	*3,550*	*4,419*	5,289	15,860
13	2,897	9,129	*9,567*	*19,913*	21,570	31,624
14	15,181	15,375	*15,537*	*15,700*	15,863	17,546
15	11,940	12,188	*12,406*	*12,413*	12,468	14,283
16	13,892	15,003	*15,993*	*17,290*	19,168	39,698
17	16,181	17,605	*17,728*	*17,852*	17,976	20,349
18	9,238	10,098	*10,358*	*10,617*	10,877	15,022
19	21,625	27,762	*32,271*	*36,655*	37,997	64,800
20	8,386	8,747	*9,118*	*10,042*	10,426	11,951
21	3,464	4,538	*4,532*	*4,526*	4,520	4,547
22	6,969	10,627	*10,536*	*10,446*	10,355	10,737
23	0	0	*0*	*0*	0	1,000
25	0	0	*0*	*8,398*	16,796	33,591
26	179	179	179	*4,725*	9,450	9,450

Identifier	Sum of PE_2031	Sum of PE_2061	Sum of PE_CityFul
1	8118.4	9958	20222
2	9072.9	10884.2	15898
3	25019.8	24657.9	28584.3
4	21927.7	21002.2	23300.6
5	11942.5	11824.4	14107
6	16317.9	17182.2	18813.7
7	11589.2	12488.2	14506.1
8	10126.7	25697.3	28769
9	11967	13276	15561.5
10	6631.8	25489.4	25606.6
11	17819.9	19081.2	20731.5
12	2881.1	5288.8	15880.1
13	9129.2	21570	31624.4
14	15374.6	15862.5	17546.2
15	12188.1	12468.2	14283.2
16	15002.7	19167.5	39697.6
17	17604.7	17976	20348.9
18	10098.4	10877	15022
19	27761.7	37997.2	64799.8
20	8747.2	10425.9	11951
21	4537.8	4520.1	4546.7
22	10626.9	10355.1	10737.1
23	0	0	1000
25	0	0	33591
26	178.9	1048.2	9450
(blank)	5936	2831.9	2848.8
Grand Total	**290301.1**	**361929.2**	**519407.1**



Appendix B - Treatment Short List Options Report

Hamilton - Waikato - Waipa Metropolitan Area - Southern Metro Wastewater Detailed Business Case - Wastewater Treatment Short-list Options Report

Metro Wastewater Project Partners

April 2021

Contents

Figures

Tables

Appendices

Executive summary

Purpose

The purpose of this report is to provide more detail on the shortlisted southern wastewater treatment plants (WWTPs).

Option 2A consists of:

- A centralised southern plant to service the southern communities of hamilton South, Matangi, Airport Industrial precinct, Ohaupo and Cambridge (site not yet confirmed)
- Tauwhare Pa (standalone plant) to be upgraded
- Te Awamutu/Kihikihi (standalone plant) to be upgraded.

Option 4A was progressed as the stand alone option. This option consists of the following southern plants:

- Southern plant to service small southern communities of Matangi, Airport Industrial precinct and Ohaupo (site not yet confirmed)
- Tauwhare Pa (standalone plant) to be upgraded
- New plant at Cambridge (standalone plant)
- Te Awamutu/Kihikihi (standalone plant) to be upgraded.

The methodology followed was:

- Based on the treatment and growth assumptions as outlined within the Longlist Options Report, develop process flow and size assumptions.
- Confirm the Treatment processes which are to be reassessed as part of the shortlisting process. WWTPs have varying levels of treatment dependent on population size at 2061, however it is likely for each considered option that the full treatment process proposed based on population size will not be required within the next 10 years. Some treatment processes only become feasible once flows reach a certain level.
- Information on some technical risks and issues is provided in this report to assist the assessment of the treatment component of the southern shortlist options assessment. Further assessment will be carried out as part of the site selection and discharge options work and will be documented in the southern shortlist assessment report.

Conveyance

For Option 2A the parts of Hamilton that could be diverted to the south were investigated. In the short term diverting Peacocke and Fitroy/Te Anau and Splitt south via N4/N12 pump stations is recommended, to be confirmed once preferred WWTP site is selected. Once this area is diverted, maximising the use of the Peacocke rising mains is recommended by diverting as much as feasible of the Hillcrest/Riverlea area in the vicinity of Clyde Street. Diverting more of the upper Western catchment is reasonably difficult due to limited service corridors but this could be considered as part of the optioneering for Lorne and Normandy pump station upgrades/storage to address capacity issues.

Longer term there are opportunities to use the Peacocke mains between Clyde and Snells to divert parts of those catchments north. Diverting south areas in the CBD (potentially Hillsborough) and upper Western catchment (potentially in conjunction with southern links) via new rising mains may provide additional capacity to service infill growth in these areas and address network issues.

Treatment

The level of treatment selected for discharges to water:

- A high level of nutrient removal <4mg/L TN and <1.0mg/L TP (as annual means) and
- A very high pathogen removal (E.coli <14 cfu/100ml as a 95th percentile).

Flow assumptions were based on using the RITS[1] standard per capita ADF flow approach of 200L/p/d for the population equivalent associated with each plant at each design time interval. The peak flow to each plant was assumed as four times the ADF. The raw wastewater quality assumptions made for the shortlisting are as carried forward from the longlisting assumptions, based on typical values for New Zealand raw wastewater.

The proposed treatment processes for the new WWTPs are outlined below.

Table 1-1 Treatment Concept Development

Size	Population Equivalent Step (PE)	Flow Step (m^3/d)	Liquid Processes	Solids Processes
	All	All	Inlet Works	-
Small – Tauwhare Pa WWTP	0 – 4,000	0 – 800	Package MBR or Secondary treatment if land disposal	Thickening, transfer to larger WWTP
Medium – Southern sub-regional WWTP (Airport) 4A	4000 – 40,000	800 – 8,000	Reactor Membrane separation UV	Screw Press Dewatering
Large – Cambridge WWTP, Southern sub-regional WWTP 2A	40,000 – 150,000	8,000 – 30,000	Primary Treatment Reactor Membrane separation UV Centrate Treatment	Digester Centrifuge Dewatering

Staging considerations

Process sizing was initially developed for the WWTPs for the 2061 horizon and then base staging was developed for key processes including screens, primary sedimentation tanks (PSTs), reactors, digesters and membrane trains.

Installation of the PSTs and Digesters could be delayed for both the Sub-regional southern 2A WWTP and Cambridge stand alone WWTP, however additional reactor capacity would need to be installed. It may be possible to design reactors that could be converted to PSTs later. If PSTs/Digesters were delayed, operating

[1] Regional Infrastructure Technical Specifications

costs would increase as energy is not recovered and biosolids volumes for disposal are higher. A lower TN target would reduce reactor sizing and energy requirements.

Delaying the introduction of Ohaupo and Matangi would have minimal impact on treatment process capacity required as the flows from those communities are such as small component of the total flows.

Delaying the introduction of South Hamilton flows (if practical from a conveyance perspective) could reduce the number of reactors, membrane trains and digesters required to be built at the start for the 2A sub-regional WWTP. However, some components such as civil works, transfer pipes and buildings are generally built at the start at a new site with more limited potential to stage.

Significant wet industry flows have been allowed for at the airport industrial area (1,750 m^3/day by 2061). If wet industry was to not locate to this area or more wet industry arrived than allowed for, process capacity could be delayed or bought forward to match requirements. The 4A southern sub-regional has a high level of risk around industry flows, timing and composition as there are only very small residential flows for this option.

A new site offers the opportunity to masterplan a treatment facility to achieve the greatest operational efficiency and be able to adapt quickly and easily to changes. A buffer area around the WWTP is advisable to mitigate potential odour and noise issues. Process equipment can be added over time as flows increase due to residential and industrial growth.

While a new site can be selected with more favourable ground conditions, some ground improvements are likely to be required. Larger WWTPs provide more redundancy with their processes and equipment.

There is uncertainty over the timing and flows likely to be generated at the Pa and potentially from Tauwhare Village. Once a preferred southern option is identified further investigation of Tauwhare Pa options can be undertaken. Soil conditions and environmental effects associated with land discharge will need to be investigated further.

Cost Estimates

A comparative cost exercise was undertaken to establish the order of magnitude capital and operational costs of the various options. We recommend that that these costs are not used for capital appropriation and that a conceptual design of the preferred option be undertaken to confirm the estimated capital and operating costs. A costing exercise has been completed for the four potential WWTPs that form a part of Option 2A and Option 4A. This exercise uses the costing assumptions from Section 2 and develops the potential costs for each of these plants should they be built to their design flow process unit requirements at 2061. The cost estimates are deemed to be Class 5 estimates as per the AACE[2] Cost Estimate Classification System and have an expected accuracy range of -30% / +50%.

The table below summarises the capital costs for Option 2A and Option 4A respectively to build a WWTP to service flows at 2061. Council internal costs, procurement and consenting costs are excluded from the cost estimates and are incorporated into the financial modelling being undertaken by PWC.

[2] Association for the Advancement of Cost Engineering – Practice No. 18R-97

Table 1-2 Capital Costs summary at 2061 (excluding conveyance)

	Option 2A		Option 4A	
Area	**WWTP name**	**WWTP Capital Cost ($ M)**	**WWTP name**	**WWTP Capital Cost ($ M)**
Hamilton south	Southern Sub-Regional WWTP	$ 169M	(to Pukete)	
Matangi			4ASouthern Sub-Regional WWTP	$ 54M
Airport				
Ohaupo				
Cambridge & Hautapu			Cambridge	$ 113M
Te Awamutu & Kihikhi	Te Awamutu	$ 29M	Te Awamutu	$29M
Tauwhare Pa	Tauwhare Pa	$ 6M	Tauwhare Pa	$ 6M

Over time the total operational costs increase as flows increase. The large plants that have PSTs and digesters have significantly lower costs per ML due to energy recovery and reduced biosolids volumes for disposal. Option 4A has slightly higher annual operational costs than Option 2A. Delaying the installation of PSTs and digesters at the 2A sub-regional or Cambridge plants would increase operational costs.

Recommendations

For the preferred option further investigation and design is recommended as follows:

- For operational costs and energy, benchmarking with existing performance and costs for Pukete and other sites with MBR or biological nutrient removal
- Further investigate capital and operational cost impacts of lower TN concentration target and delaying installation of PSTs and digesters
- Sensitivity analysis for Hamilton flow split, residential and non-residential greenfield growth, connecting small communities (Ohaupo, Matangi, Tauwhare Pa), wet industry and infill
- Geotechnical investigations for Cambridge WWTP if 4A is the preferred option
- Review of redundancy requirements for major process units e.g. screens and reactors
- Biosolids reuse and disposal options.

Disclaimer

This report: has been prepared by GHD/Beca for Future Proof Partners and may only be used and relied on by Future Proof Partners for the purpose agreed between GHD and the Future Proof Partners as set out in section 1.1 of this report.

GHD/Beca otherwise disclaims responsibility to any person other than Future Proof Partners arising in connection with this report. GHD/Beca also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD/Beca in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD/Beca has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD/Beca described in this report (refer section 2). GHD/Beca disclaims liability arising from any of the assumptions being incorrect.

If GHD/Beca has relied on information provided by the client and/or others when preparing the document containing the following should be added to the generic disclaimer detailed above:

GHD/Beca has prepared this report on the basis of information provided by Future Proof Partners and others who provided information to GHD/Beca (including Government authorities)], which GHD/Beca has not independently verified or checked beyond the agreed scope of work. GHD/Beca does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD/Beca has prepared the preliminary cost estimates set out in Section 3.6 of this report ("Cost Estimate") using information reasonably available to the GHD/Beca employee(s) who prepared this report; and based on assumptions and judgments made by GHD/Beca (refer to section 2.4).

The Cost Estimate has been prepared for the purpose of making a relative assessment of options and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD/Beca does not represent, warrant or guarantee that the project can or will be undertaken at a cost which is the same or less than the Cost Estimate.

1 Introduction

1.1 Purpose of the report

The purpose of the Treatment Shortlist Technical Report is to provide documentation of the options development for the treatment options for the southern metro area. This report provides supporting documentation for the Waikato Metro Wastewater Treatment Detailed Business Case (DBC).

The purpose of the DBC is to determine a shortlist of feasible wastewater treatment solutions for the Waikato Hamilton Waipa Metro Area (metro area) and to determine a preferred option for the southern metro area. A longlist to shortlist assessment has already been undertaken. This identified centralised wastewater treatment options as being preferred for both the northern and southern metro areas. In order to determine a preferred option for the southern metro area, treatment options for a centralised and partially centralised solution need to be further investigated. This report documents this process.

This project aims to align with the overarching Waikato Sub-regional Three Waters vision:

Tooku awa koiora me oona pikonga he kura tangihia o te maataamuri

“The river of life, each curve more beautiful than the last”

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

1.2 Geographical context

The metro area covers from Taupiri through to Te Awamutu (North - South) and Te Kowhai/Whatawhata to Tauwhare (East - West) and forms part of the Sub-Regional Three Waters Study Area. Figure 1-1 outlines the metro area, highlighting the WWTPs within this area.

This report will only consider the southern metro area, which consists of the following small communities and areas:

- Southern Hamilton
- Peacockes
- Rukuhia
- Matangi (including Tamahere hub commercial area)
- Tauwhare Pa
- Airport industrial area
- Ohaupo
- Cambridge
- Te Awamutu.

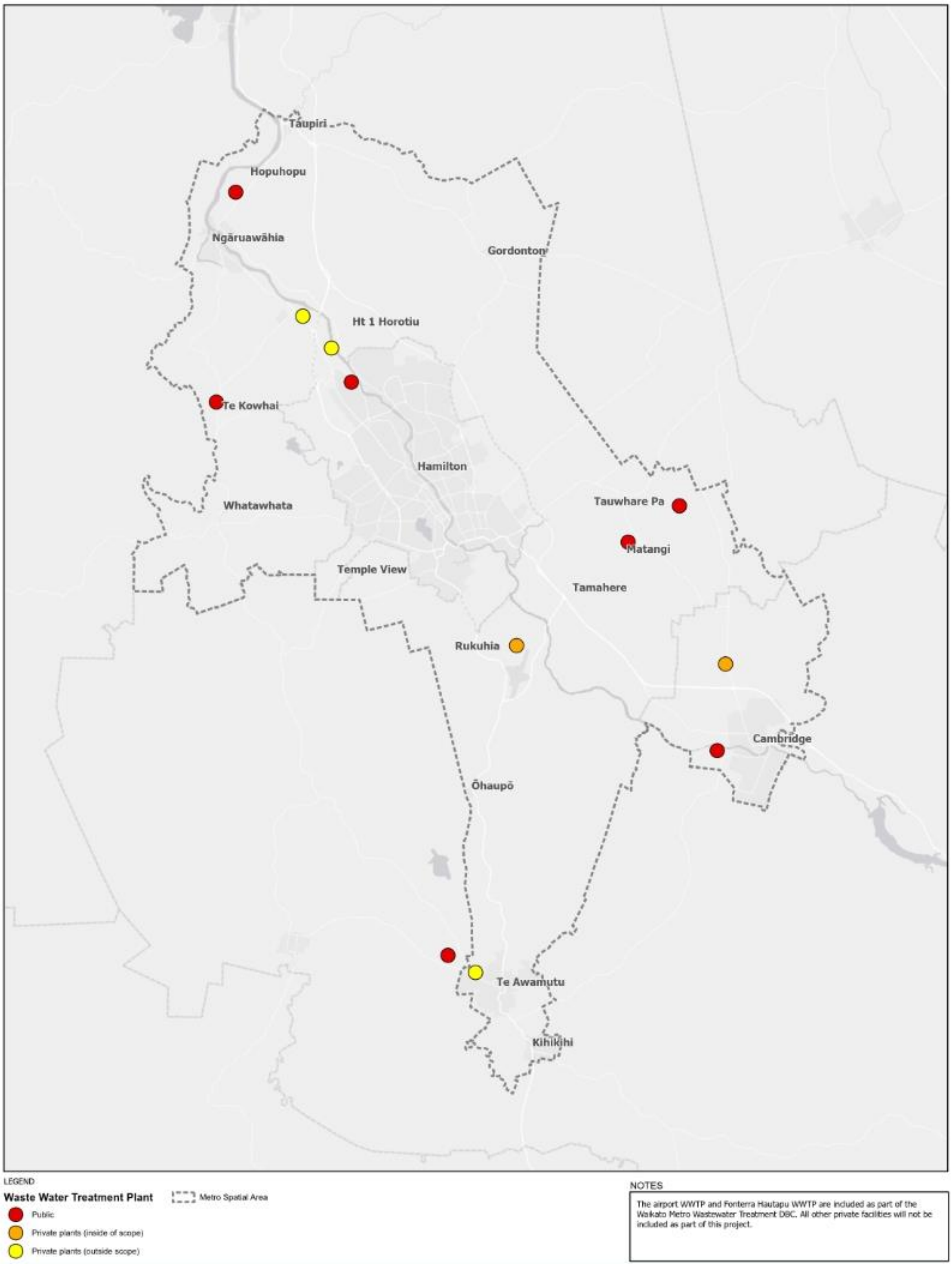


Figure 1-1 Hamilton Waikato Waipā Metro Area

1.3 DBC Methodology

The DBC options development and assessment process is summarised within Figure 1-2.

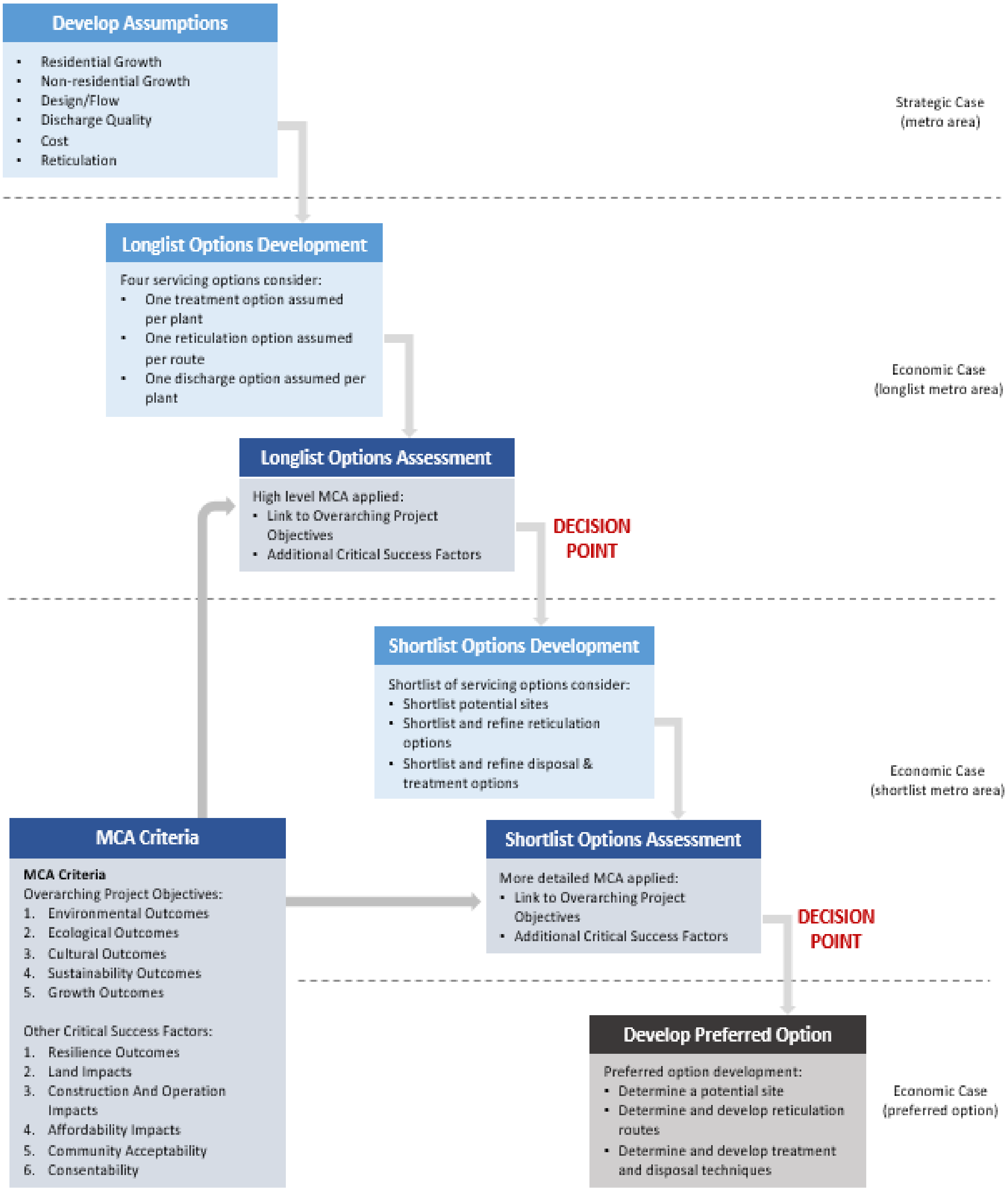


Figure 1-2 DBC option development and assessment methodology

The methodology for the treatment shortlist option development is as follows:

Step 1: Outline Treatment/Discharge assumptions

Based on the treatment and growth assumptions[3] as outlined within the Longlist Options Report, develop process flow and size assumptions.

Step 2: Confirm Treatment to be considered in greater detail

Confirm the treatment processes which are to be reassessed as part of the shortlisting process. WWTPs have varying levels of treatment dependent on projected population size at 2061, however it is likely for each considered option that the full treatment process proposed based on population size will not be required within the next 10 years. Some treatment processes only become feasible once flows reach a certain level.

Step 3: Assess the southern metro WWTP options

Information on some technical risks and issues is provided in this report to assist the assessment of the treatment component of the southern short list. Further assessment will be carried out as part of the site selection and discharge options work and will be documented in the southern shortlist assessment report.

1.4 Short list options overview

The longlist option assessment process identified the following options for shortlisting:

- Option 2A as a centralised option
- Option 4A (refined with staging limitations) as a partially centralised option.

OPTION 2A: Centralised southern plant (new site)

Option 2A consists of one centralised southern plant to service the following southern communities (plant located south of Hamilton):

- Hamilton (South)
- Matangi (at appropriate time, 2031 assumed)
- Hamilton Airport
- Ohaupo (at appropriate time, 2051 assumed)
- Cambridge.

The following southern WWTPs would also be upgraded:

- Tauwhare Pa (standalone plant) to be upgraded
- Te Awamutu/Kihikihi (standalone plant) to be upgraded – this WWTP will receive flow from Waikeria from 2021.

This option consists of five facilities to service the wider metro area, with four of them serving the southern metro area (refer to Figure 1-3). The longlist assessment identified Option 2A as the most preferred option under all various weightings and sensitivities. This option provides the flexibility to masterplan an efficient facility on a new site. A site selection process is required to determine potential new locations for the new plant. Some benefits of this option are related to a centralised location between south Hamilton and Cambridge. The conveyance alignment and cost will change depending on the location of the site.

[3] Treated Wastewater Assumptions for Waikato Wastewater Metro DBC, Beca, August 2020. Growth Assumptions for Waikato Metro Wastewater DBC, December 2020.

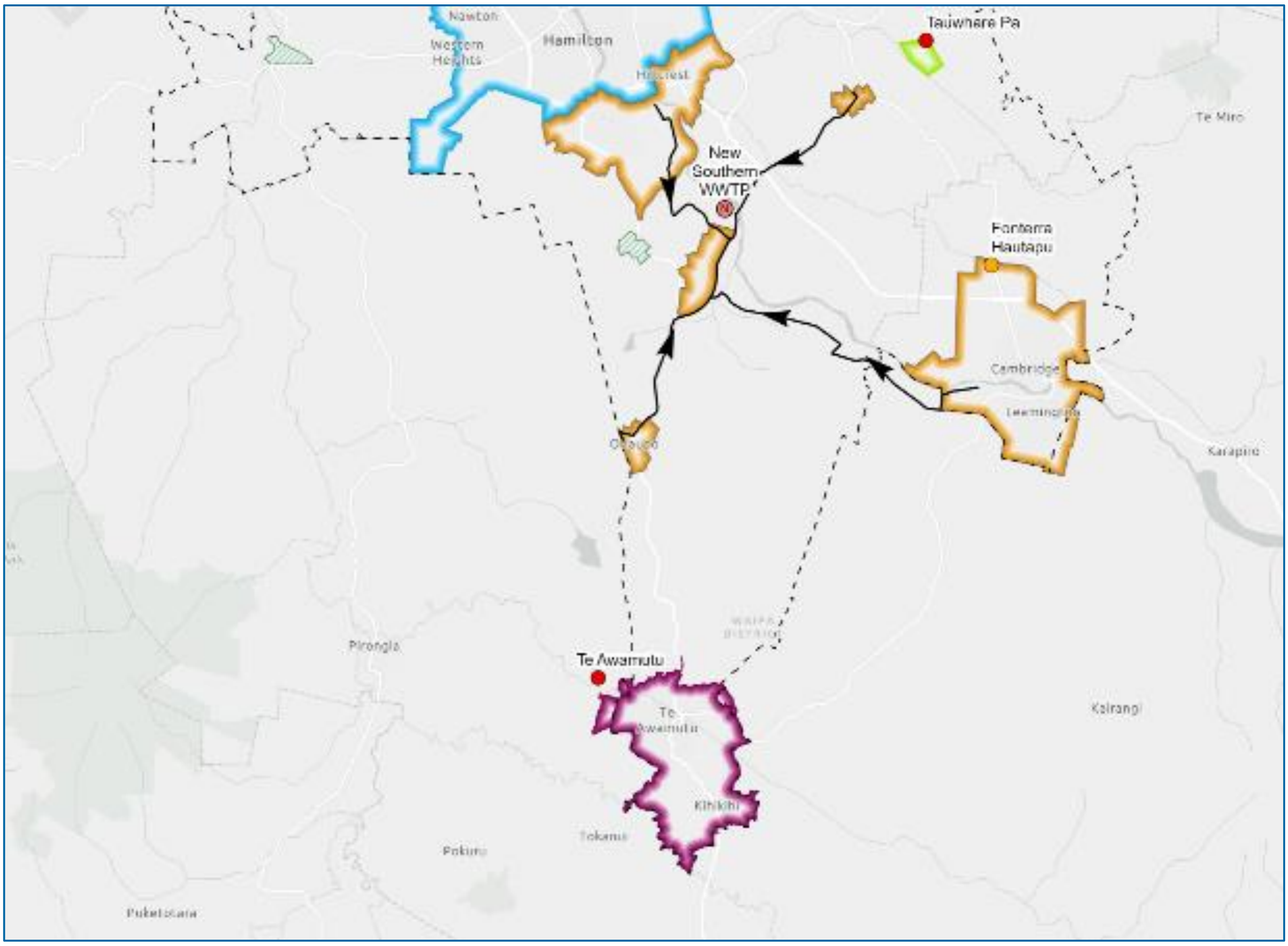


Figure 1-3 Option 2A – Centralised southern plant (site yet to be determined)

OPTION 4A: Partially Centralised option

Option 4A was progressed as the partially centralised option. This option consists of the following southern plants:

- Southern plant to service small southern communities (plant located south of Hamilton):
    - Matangi (at appropriate time, 2031 assumed)
    - Hamilton Airport
    - Ohaupo (at appropriate time, 2051 assumed)
- Tauwhare Pa (standalone plant) to be upgraded
- New plant at Cambridge (standalone plant)
- Te Awamutu/Kihikihi (standalone plant) to be upgraded– this WWTP will receive flow from Waikeria from 2021.

This option consists of seven plants to service the wider metro area, with four serving the southern metro area (refer to Figure 1-4). It is proposed that this option is refined to allow for growth considerations. A new southern plant to service the airport will be master planned to cater for Matangi and Ohaupo. However, both communities will only be connected once flows are large enough to minimise retention risks and the servicing option is needed to reduce environmental impacts of alternatives. In the interim, the Matangi plant is likely to require short to medium term upgrades. This option also maintains areas of benefit defined by existing council boundaries other than for Matangi.

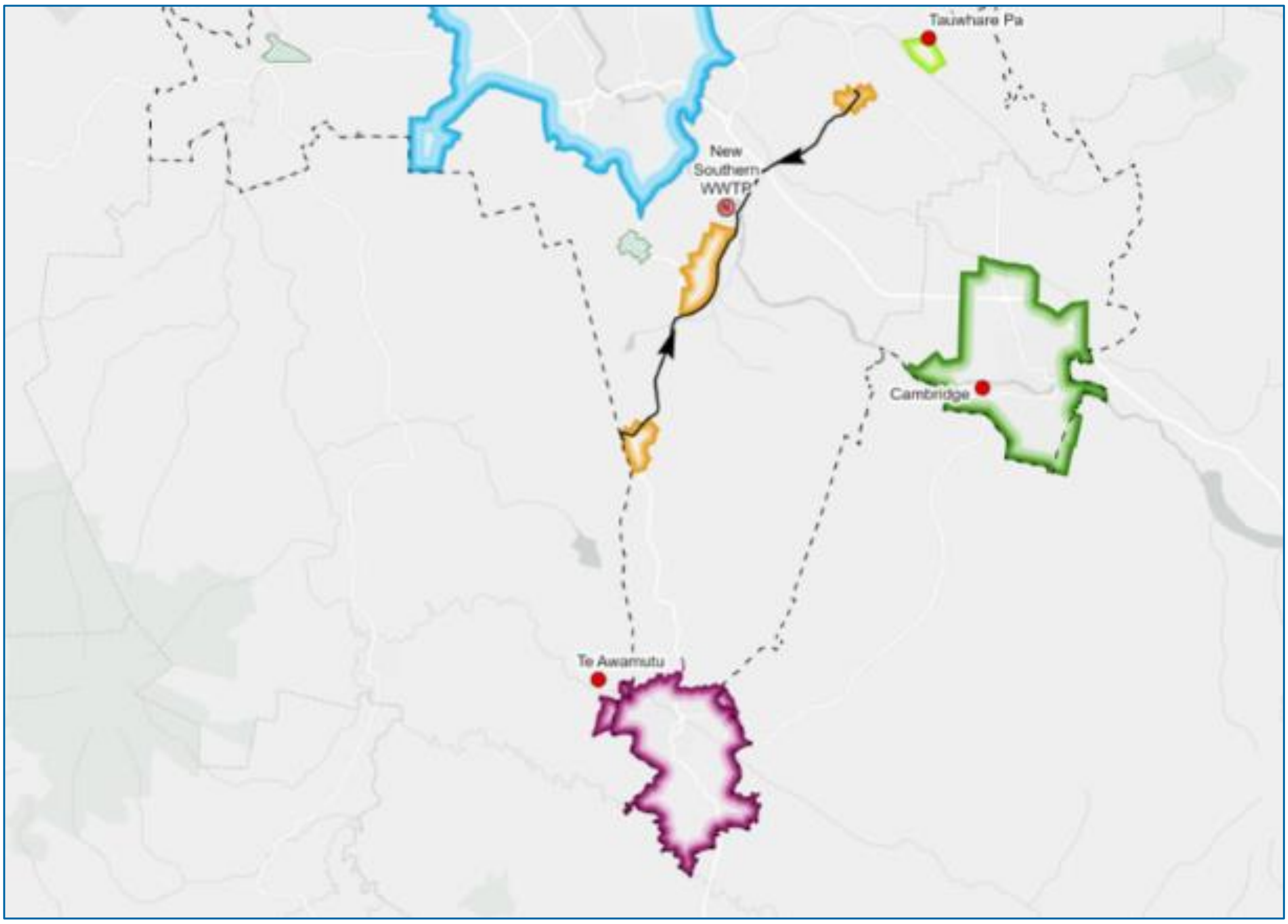


Figure 1-4 Option 4A Partially centralised option

2 Assumptions

The plants included as part of this study include the following:

- Option 2A – Large Southern WWTP
- Option 4A – Small Southern WWTP
- Option 4A – Cambridge Standalone WWTP
- Tauwhare Pa Package MBR Plant WWTP

2.1 Population assumptions

The following relevant residential and non-residential growth assumptions have been taken into account as developed in the Population and Growth Assumptions Memo:

- Growth assumptions have been collated based on information available as of 12th August 2020.
- An 'ultimate' growth capacity scenario has been identified which reflects the largest household projection for an area based on known development areas and expected density and is generally indicative of a 60-100 year growth period.
- Population projections for 10 year incremental periods have been collated starting in 2021 and finishing in 2061 (i.e. 2021, 2031, 2041, 2051 and 2061).
- The residential projections collated for this project focus on the "connected" population to be serviced by wastewater infrastructure.
- Maximum growth capacity is informed by zones in District Plans and additional areas indicated in growth strategies, private plan changes and submissions to Proposed District Plans as at August 2020.
- Significant industrial facilities with private wastewater treatment systems and discharge consents (such as Fonterra Te Rapa, Hautapu and Te Awamutu Plants and AFFCO Horotiu) within the Metro Area are not included in the population equivalent or trade waste flows.
- For Waikato and Waipa Districts, non-residential growth will be based on the areas outlined in the growth memo spread over expected development timeframes and the population equivalent (PE) factor.
- For Hamilton City, non-residential growth information has been incorporated into the PE forecasts for the Wastewater Master Plan V3.
- Existing and known future trade waste/wet industry discharges will be included in the wastewater flow and load projections.
- 45 population equivalent per hectare is used per additional hectare of industrial activity as per the RITS unless a different population equivalent is outlined in the growth assumptions memo. Gross areas will be corrected for non-usable areas such as transport corridors based on structure plans where available.
- For areas where wet industry is preferred to occur, an additional flow/load allowance based on 2% of the area used for food processing type wet industry will be assumed. This results in approximately double the flow compared to the standard industrial flow allowances.

The residential and non-residential information was then collated to provide population equivalent at each time horizon for each community as summarised in Table 2-1.

Table 2-1 Population Equivalent Forecasts

		Population Equivalents					
Area	**Serviced from**	**2021**	**2031**	**2041**	**2051**	**2061**	Ultimate
Taupiri	Current	2,063	5,176	6,167	6,991	7,256	8,400
Ngaruawahia	Current	6,234	7,407	9,102	10,516	12,016	21,991
Horotiu	Current	1,815	6,778	10,390	13,996	14,156	14,156
Te Kowhai	2031	35	1301	1685	2095	2371	4,706
Hamilton North	Current	237,642	288,590	306,351	356,325	391,330	600,703
Hamilton South	Current	29,630	36,573	46,511	54,723	59,626	68,633
Tauwhare Pa	Current	140	619	619	619	619	889
Matangi (incl Tamahere commercial)	Current	140	464	464	464	464	1,035
Airport	2031	1377	6869	12,360	17,852	17,852	17,852
Ohaupo	2051	547	630	814	1,025	1,031	1,100
Cambridge & Hautapu	Current	22,520	32,940	37,801	42,892	45,031	57,649
Te Awamutu & Kihikihi	Current	24,988	27,989	30,905	34,982	36,001	42,011
Sub - Totals	-	*327,131*	*415,336*	*463,169*	*542,480*	*587,753*	*839,125*

2.2 Design / Flow assumptions

To be able to assess each WWTP short listed, assumptions were made on the likely wastewater volume and quality expected to be received by each WWTP. These assumptions are consistent between WWTPs and are detailed below.

2.2.1 Flow Assumptions

Flow assumptions for the work completed, as per the long listing work was to use the RITS standard per capita ADF (average daily flow) approach of 200L/p/d for the population equivalent associated with each plant at each design time interval.

The peak flow to each plant was assumed as four times the ADF.

The flow projections associated with each plant considered in the shortlisting are as per Table 2-2 and Table 2-3.

Table 2-2 Average daily flow per WWTP to 2061

WWTP ADF (m^3/d)	2031	2041	2051	2061
Option 2A Southern WWTP	15,575	19,525	23,381	24,791
Option 4A Cambridge Standalone WWTP	6,824	7,678	8,578	9,006
Option 4A Southern WWTP	1,562	2,707	3,858	3,859
Tauwhare Package WWTP	55	55	55	55

Table 2-3 Peak instantaneous flow per WWTP to 2061

WWTP PIF (L/s)	2031	2041	2051	2061
Option 2A Southern WWTP	730	910	1,090	1,150
Option 4A Cambridge Standalone WWTP	320	360	400	420
Option 4A Southern WWTP	80	130	180	180
Tauwhare Package WWTP	10	10	10	10

2.2.2 Quality Assumptions

The raw wastewater quality assumptions made for the shortlisting are as carried forward from the longlisting assumptions, based on typical values for New Zealand raw wastewater but with nutrients at upper end of typical range. They were assumed as consistent across all four WWTPs. The concentrations assumed for the incoming wastewater into the shortlisted WWTPs is as per Table 2-4.

Table 2-4 Incoming wastewater quality assumptions

Parameter	Value	Units
Total Suspended Solids (TSS)	360	mg/L
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	320	mg/L
Chemical Oxygen Demand (COD)	704	mg/L
Total Kjedahl Nitrogen (TKN)	60	mg/L
Total Phosphorus (TP)	10	mg/L

2.3 Treatment assumptions

The WWTPs developed for this short list report used the treatment assumptions outlined in the treatment standards memo.

2.3.1 Liquid Stream

The level of treatment for discharges to water:

- A high level of nutrient removal <4mg/L TN and <1.0mg/L TP (as annual means)
- A very high pathogen removal (E.coli <14 cfu/100ml as a 95th percentile).

The treated wastewater quality standards would be introduced by 2031 or when the existing resource consent for the discharge expires. For WWTPs including digestion facilities, primary treatment will also be included. It is expected that future consents, for any river based discharges, would be based on mass loads of nitrogen and phosphorus permitted to be discharged to the subject river. That will provide scope, in early years for plants to be loaded to allow slightly higher effluent concentrations in the discharge and still achieve the objective of significantly lowering point source based nutrients to the river below what is currently discharged.

For discharges to land where the full wastewater stream can be discharged, a lower standard of wastewater treatment can be considered. The actual parameters will depend on nitrogen and phosphorus loads able to be sustainably discharged to the land irrigation system. Secondary treatment would be the minimum requirement and pathogen removal would need to be considered if spray irrigation was used, otherwise additional pathogen removal may not be required.

2.3.2 Solids Stream

A graduated approach to solids management is proposed with complexity and extent of solids destruction and energy potential realisation increasing in steps with population equivalent served.

For WWTPs up to the digester threshold (currently proposed as 40,000 PE), the extent of treatment would increase to dewatering to a minimum of 19% dry solids, being a 'last resort' standard for landfilling if that had to be adopted temporarily or permanently.

WWTPs above 40,000PE would adopt primary sedimentation (or equivalent) and anaerobic digestion with one or more forms of energy recovery, for example a co-generation engine producing both heat and electrical energy. And above 150,000PE a more advanced form of solids destruction would be adopted. For WWTPs with digesters, side stream digestate treatment will be provided for to mitigate the nutrient removal (and consequently energy consumption) burden imposed by the resulting centrate return cycle on the main biological process. The concept intended is that this side stream process would use one of the modern ‘short circuit’ granular or fixed film biological process based around Anammox or similar bacteria.

2.3.3 Atmospheric emissions

Proposed provisions for atmospheric emissions are reasonably general but all would require best practice to be implemented. The costs of such initiatives are not able to be differentiated at the Class 5 estimating level, apart from large items such as co-generation plant. These initiatives are intended to include:

- Noise mitigation to levels that are safe for operators and which comply with local ordinances at the boundary
- No objectionable odours beyond the boundary. However, it is also assumed that the treatment plant owners will do all in their power to create and maintain odour buffers around the WWTPs
- Process units and equipment will be specified and configured to minimise the release of fugitive greenhouse gas emissions. For example, use of biogas in boilers, furnaces or co-generation engines and providing for very stable nitrogen removal processes that release a minimum of nitrous oxide
- In all process plant development, life cycle emissions will be given due consideration and it is anticipated that the councils will adopt the zero carbon bill aspirations and optimization of life cycle emissions generally. And that these will be drivers for initiatives, particularly in the larger plants, for processes that drive the plants towards energy neutrality (Scope 2 reductions) and emissions minimisation, whether on site (Scope 1) or off site for residuals management (Scope 3).

2.3.4 General

The treatment plants will be configured such that the limit of capability is not fixed at the initial target performance but can be upgraded by augmentation of processes at appropriate times. At this time, it is expected, if TN concentration is immediately targeted 4mg/l or less, that any appreciable upgrading is unlikely to be feasible.

2.4 Cost assumptions

The following items have been included in the comparative capital costs:

- Operations and maintenance facilities
- Land purchase for new WWTPs
- Process items and structures
- Mechanical and electrical installation
- Instrumentation and control
- Site civil works (platform preparation, roading, drainage, fencing etc.)
- Project costs (P+G, contractor margins, forex risk)
- Consultant fees (Investigation/Design/Engineering)
- A contingency allowance.

The following items have been excluded from the comparative capital costs:

- Client management/overhead costs (to be provided by PWC)
- Consenting costs (to be provided by PWC)
- Procurement costs (to be provided by PWC)
- Legal fees
- Client insurances

- Escalation after 2nd quarter 2020
- Site decommissioning and restoration
- Goods and Services Tax.

A conceptual design of the preferred option will need to be prepared to confirm the estimated capital and operating costs. We have allowed for an estimating tolerance to account for general unknowns in the design and for any discrepancies in the design information prepared to date. The cost estimates are deemed to be Class 5 estimates as per the AACE Cost Estimate Classification System and have an expected accuracy range of -30% / +50%.

2.5 Hamilton North South Split

HCC network

The HCC Wastewater Master Plan V3 (2020) outlines the areas of the Hamilton wastewater network under most pressure due to asset deterioration, infiltration and inflow and growth. The Masterplan proposed storage on the Eastern Interceptor and Upper Western Interceptor along with pump station upgrades and diversions as illustrated in Figure 2-1.

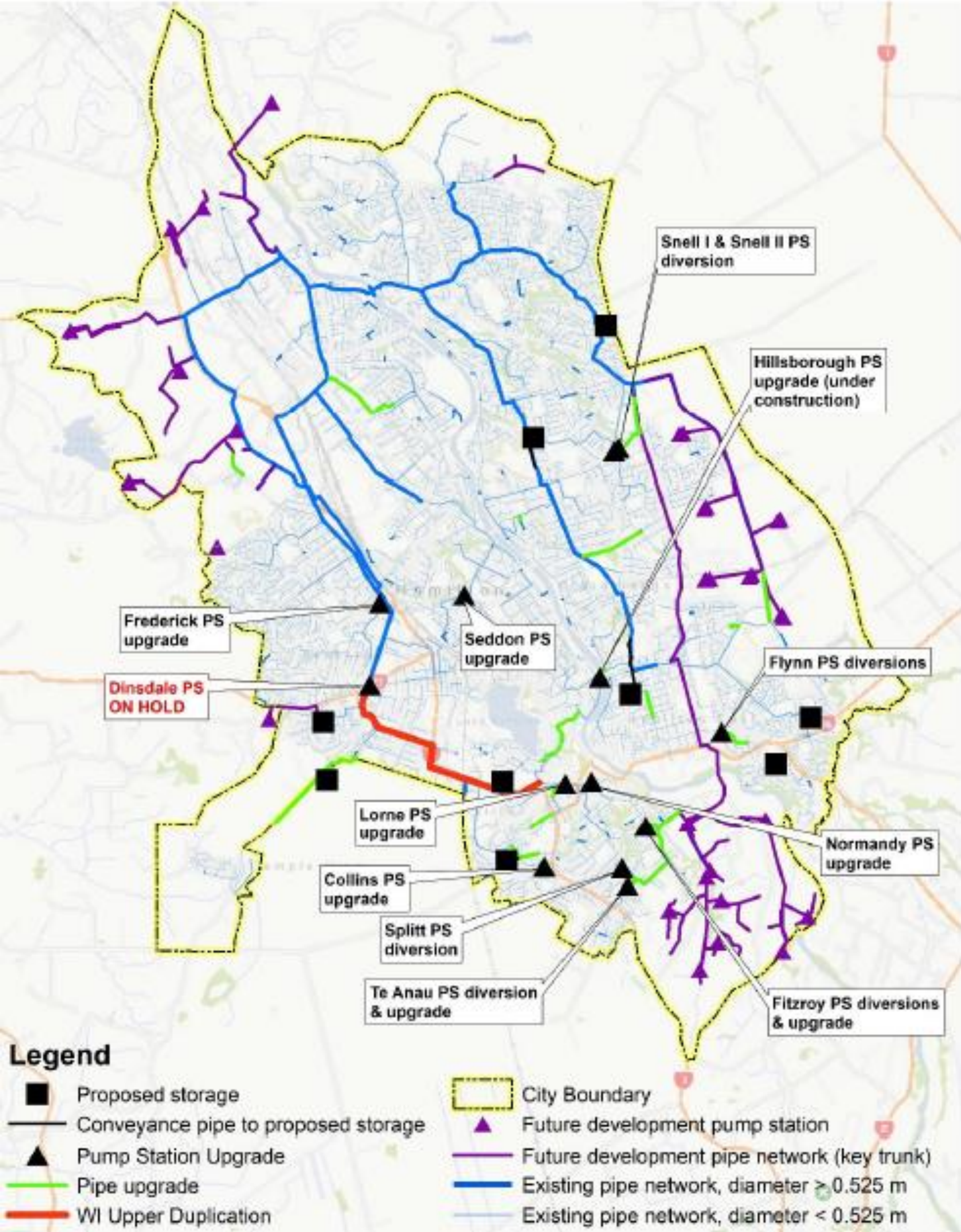


Figure 2-1 Hamilton Wastewater Master Plan V3 Proposed upgrades

Population equivalent data for 2021 to 2081 and for 'City Full' scenario was collated for the HCC network model for the areas outlined in Figure 2-2 and Table 2-5. For the purpose of the long list assessment it was assumed that areas 9,10 and 11 are diverted to the southern sub-regional WWTP from 2031 as outlined in Table 2-6. These areas were selected for the following reasons:

- Area 9 – Hillcrest/Riverlea – there is significant infill expected in these areas and they could use (in reverse) the rising main no longer required by Peacocke area when diverted south. Diverting these areas could reduce the need for network storage on the eastern interceptor (Steel Park, Donny Park) and free up capacity for infill. The population equivalent by 2061 is 13,276.
- Area 10 – Peacocke – this new greenfield area is under development and has a terminal pump station N4 which sends the wastewater north via a 6 km rising main to the Far Eastern Interceptor (FEI). During the design development for the N4 pumps station, the ability of the pump station to divert south instead of north was considered. Diverting this flow south could reduce the need for future storage on the FEI. The population equivalent by 2061 is 25,489.
- Area 11 – Glenview – the catchments of Splitt, Te Anau and Fitzroy will be diverted to the Peacocke N4 pump station in the next few years. The upper Western Interceptor (WI) is under pressure and requires storage and pump station upgrades at Lorne, Normandy and Collins. The population equivalent by 2061 is 19,081.

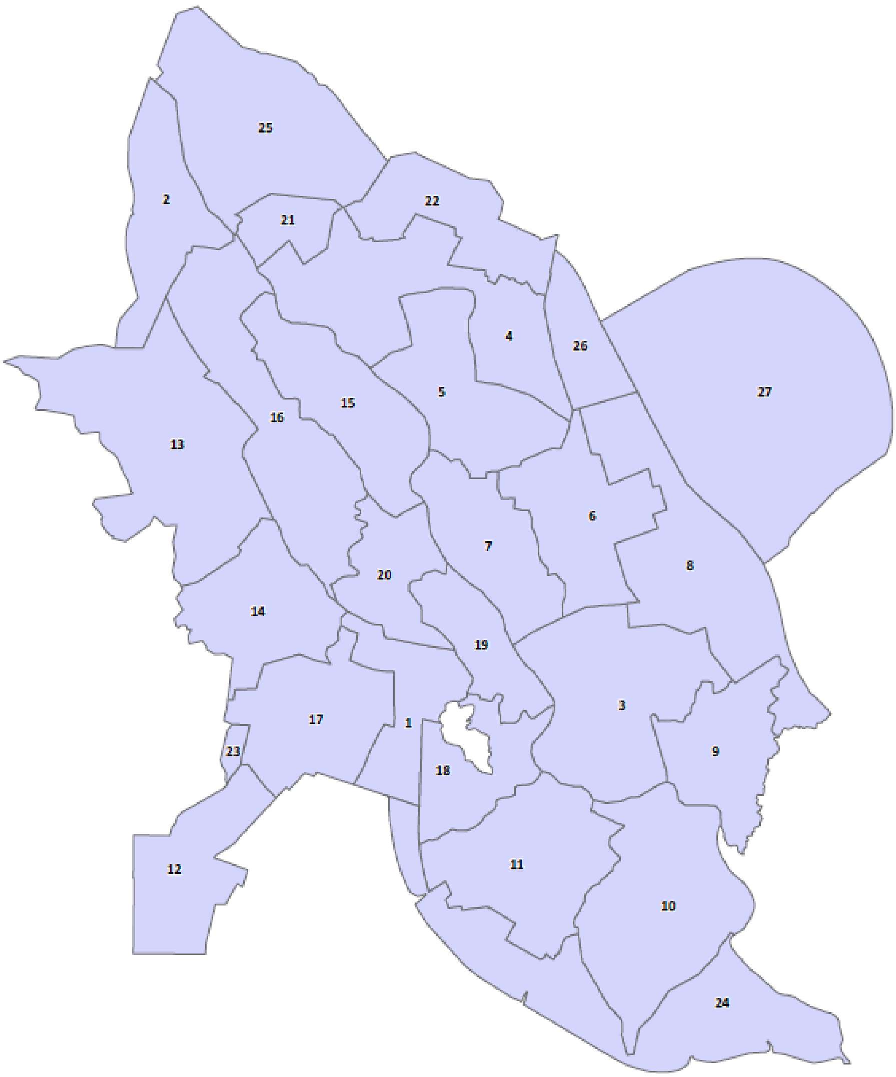


Figure 2-2 Hamilton wastewater model areas

Table 2-5 Hamilton Population Equivalent Breakdown

Area	PE_2021	PE_2031	*PE_2041*	*PE_2051*	PE_2061	City Full
1	7,567	8,118	*8,690*	*9,283*	9,958	20,222
2	1,167	9,073	*9,677*	*10,280*	10,884	15,898
3	24,730	25,020	*24,786*	*25,373*	24,658	28,584
4	21,763	21,928	*20,622*	*21,720*	21,002	23,301
5	11,996	11,943	*11,843*	*12,087*	11,824	14,107
6	15,637	16,318	*16,606*	*16,894*	17,182	18,814
7	10,958	11,589	*12,091*	*12,715*	12,488	14,506
8	6,816	10,127	*13,965*	*17,014*	25,697	28,769
9	11,371	11,967	*13,178*	*15,084*	13,276	15,562
10	1,346	6,532	*14,161*	*18,648*	25,489	25,607
11	16,913	17,820	*18,409*	*19,720*	19,081	20,732
12	2,031	2,681	*3,550*	*4,419*	5,289	15,860
13	2,897	9,129	*9,567*	*19,913*	21,570	31,624
14	15,181	15,375	*15,537*	*15,700*	15,863	17,546
15	11,940	12,188	*12,406*	*12,413*	12,468	14,283
16	13,892	15,003	*15,993*	*17,290*	19,168	39,698
17	16,181	17,605	*17,728*	*17,852*	17,976	20,349
18	9,238	10,098	*10,358*	*10,617*	10,877	15,022
19	21,625	27,762	*32,271*	*36,655*	37,997	64,800
20	8,386	8,747	*9,118*	*10,042*	10,426	11,951
21	3,464	4,538	*4,532*	*4,526*	4,520	4,547
22	6,969	10,627	*10,536*	*10,446*	10,355	10,737
23	0	0	*0*	*0*	0	1,000
25	0	0	*0*	*8,398*	16,796	33,591
26	179	179	179	*4,725*	9,450	9,450

Table 2-6 Proposed North/South flow splits

Area	PE_2021	PE_2031	*PE_2041*	*PE_2051*	PE_2061	City Full
Hamilton directed north to Pukete WWTP (excluding wet industry)	242,272	256,040	266,251	308,675	343,680	553,053
Hamilton directed south to sub-regional WWTP (areas 9-11)		36,573	46,511	54,723	59,626	68,633
Additional infill Hamilton Remainder		2,057	6,171	10,286	14,400	65,545
Additional infill Hamilton 9-11 (University)		254	763	1,271	1,780	6,733
Potential area east of the Expressway						30,000

Area	PE_2021	PE_2031	*PE_2041*	*PE_2051*	PE_2061	City Full
Potential % Diverted south	0%	13%	15%	15%	15%	12%
Total Hamilton (excluding wet industry)	242,272	292,612	312,762	363,398	403,306	621,686

Potential areas for diversion

Discussions were undertaken with HCC operations and planning staff at a workshop on 28 October 2020 to refine the assumptions on the north/south split for Hamilton. The draft Hamilton North/South split section in this report was provided to the workshop attendees for feedback and comments incorporated.

In the short term the simplest area to divert south is the Peacocke area (including the part of Glenview already diverted to Peacocke). The key objective is to maximise the use of what would become the redundant Peacocke rising mains on the eastern side of the river and reduce flow to the upper Western and Eastern interceptors. The options for diversion illustrated in Figure 2-3 by Sven Ericksen HCC include:

- Divert south a significant part of the Hillcrest, Riverlea areas (areas 9 and part of 3) by diverting at Clyde Street/Flynn PS utilising the Peacocke rising mains. This could avoid the need for the proposed Steel and Donny Park storage on the Eastern Interceptor.
- Divert Snells catchments (area 6) south utilising the Peacocke rising mains (this is unlikely to be able to be done at the same time as Hillcrest/Riverlea proposal), this is currently proposed to be diverted from the Eastern to the Far Eastern Interceptor.
- Divert Ruakura catchment south of the railway line and potentially more of Hamilton East either north or south (parts of area 8). This area needs to be pumped as no gravity discharge is available and this option could preserve capacity in the far eastern interceptor or avoid storage at this point. The northern part of the Ruakura development is planned to be serviced by a new gravity main flowing to the Far Eastern Interceptor.
- Divert Peacocke (area 10) south from N12 pump station with current terminal pump station N4 pumping through to N12 and then to the new sub-regional WWTP. Continue to divert Splitt/Fitzroy and Te Anau (via N4) in conjunction with other Peacocke flows.
- Divert Lorne or Normandy pump station (area 11) to N4 pump station in Peacocke or pump directly to the new southern WWTP. This would reduce pressure on the upper western catchment and avoid need for duplication and storage/pump station upgrades at Lorne and Normandy.
- Southern Links, Area 24 – although not expected to develop in the next 30 years, the southern links area could be directed to the Southern WWTP – 35,000 PE, not currently included in the HCC Master Plan.

Wet weather flows at the diversion points and key impacts of these diversions were provided by Aecom[4] as per Table 2-7.

[4] Email received 9/12/20 via Manjit Devgun (prepared by Stepanka Vajlikova Aecom)

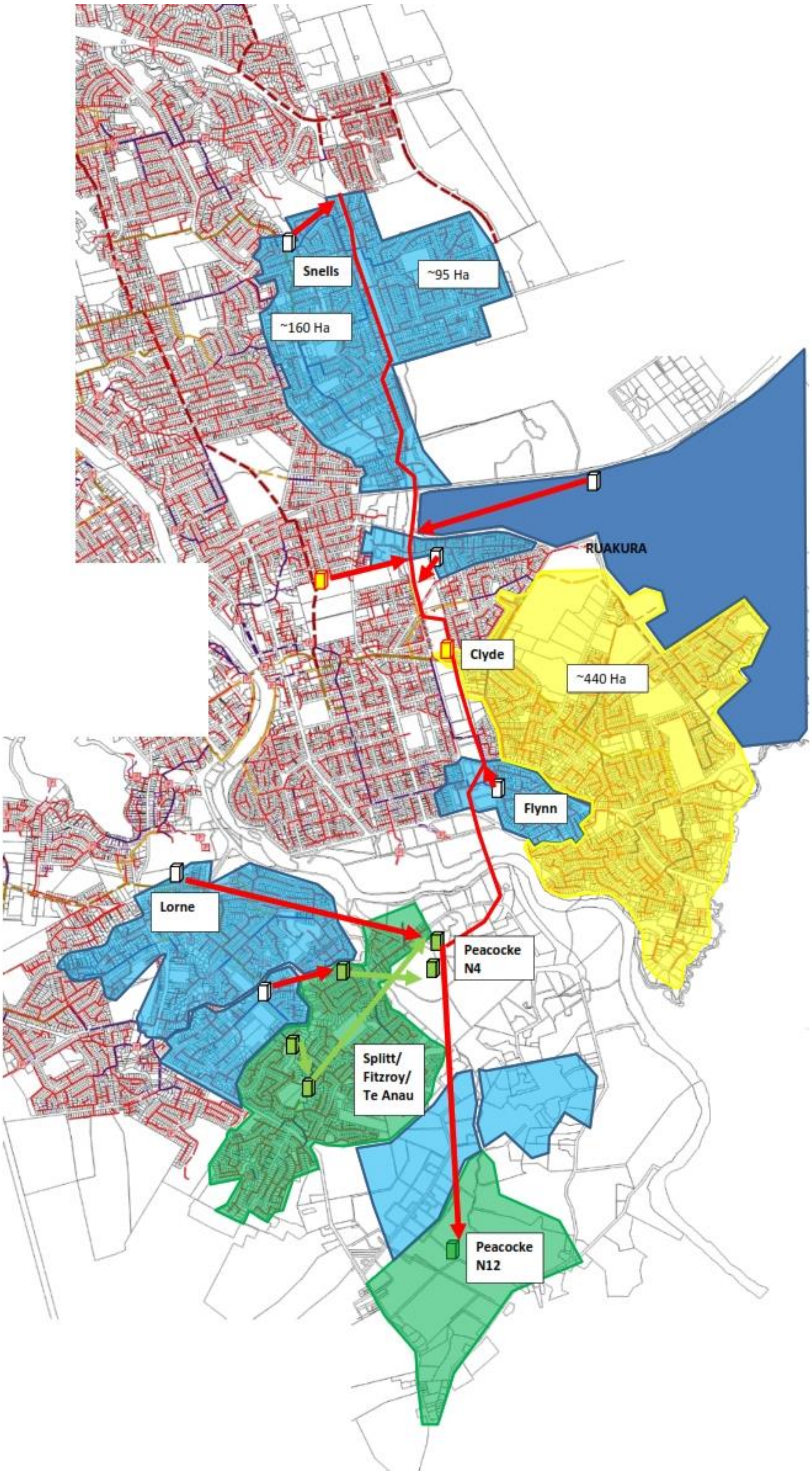


Figure 2-3 Potential diversions south – provided by Sven Ericksen HCC

Table 2-7 Potential diversion location details

Location	Average Wet Weather Flow [L/s]	Peak Wet Weather Flow [L/s]	Benefits	Comments
Flynn PS	23	72.5	Likely elimination or significant decrease of the required storage volume of Steel Park storage and Donny Park storage.	Flow rates are from RM Flynn PS and pipe upgrade upstream of the PS is still required (at 2061).
Hillcrest (at Clyde St)	132	35	Likely elimination or significant decrease of the required storage volume of Steel Park storage and Donny Park storage.	Flow rates are from pipe ID 48081 (WWS23050 to WWS23032) All masterplan upgrades upstream of this pipe are accounted for in the flow rates shown.
Snell 1&2 PSs	62	179	Likely significant decrease of the required storage volume of Darjon Park storage.	Flow rates are combined for both PSs. Flow rates are from RM.
Fitzroy/Te Anau/Splitt PSs	77	139	Ultimately decrease in storage volume or complete elimination of Darjon Park storage.	Te Anau & Fitzroy pump capacity increase as per MP still required. Flow rates presented are combined for all three pump stations.
Peacocke - N4 (Receives flow from N12, Fitzroy/Te Anau/Splitt and remainder of Peacocke)	126	310	Ultimately decrease in storage volume or complete elimination of Darjon Park storage. Ultimately relieves capacity in the Far Eastern Interceptor (FEI) for the development in Northern areas of the City	
Lorne PS	68	181	Reduced flows to the Western Interceptor (WI). Will have a positive impact on the Upper WI solution.	Lorne pump capacity increase as per MP still required.
Normandy PS	13	56	Reduced flows to the WI and to Lorne PS.	Normandy pump capacity increase as per MP still required.

Notes:

1. WWMP Version 3 model outputs used.
2. 1 in 2-year overflow event
3. AWWF is an average for 3 days of the simulation (from 25/04/2011 to 28/04/2011)

Recommended approach

In the short term diverting Peacocke and Fitroy / Te Anau and Splitt south via N4/N12 pump stations is recommended (to be confirmed once preferred WWTP site is selected). Once this area is diverted, maximising the use of the Peacocke rising mains is recommended by diverting south as much as feasible of the Hillcrest / Riverlea area in the vicinity of Clyde Street. Diverting more of the upper Western catchment is difficult due to limited service corridors but this could be considered as part of the optioneering for Lorne and Normandy pump station upgrades / storage to address capacity issues.

Longer term there are opportunities to use the redundant Peacocke mains between Clyde and Snells to divert other catchments north. Diverting south areas in the CBD (potentially Hillsborough) and upper Western catchment (potentially in conjunction with southern links) via new rising mains may provide additional capacity to service infill growth in these areas and address network issues.

Overall, the assumed level of diversion (15%, 61,400PE) proposed to the southern WWTP for option 2A is considered appropriate to use for the short list assessment. The design and timing of the N12 pump station and N4-N12 transfer main in Peacocke would be critical to the feasibility of sending flows south. The potential impacts of the diversions on the Hamilton network and Pukete WWTP capacity also need to be investigated further as part of the northern detailed business case. The conveyance cost estimates outlined in the short list report have allowed for pump stations at Peacocke N12 and Clyde Street and modifications to Peacocke N4 pump station.

3 Treatment Shortlist Option Development

3.1 Methodology

Using recommendations from the treatment standards memo[5], all plants on the shortlist were categorised as either small, medium or large based on their design horizon population equivalent (PE). This allowed them to be allocated a set of treatment processes they would be sized for at the 2061 design horizon. The relevant population equivalent and flows that correspond to the plant sizes that were determined are detailed below in Table 3-1.

Table 3-1 Allocation of process units based on plant size

Size	Population Step (PE)	Flow Step (m^3/d)	Liquid Processes	Solids Processes
	All	All	Inlet Works (flow metering, screening & grit removal)	-
Small	0 – 4,000	0 – 800	Small Membrane Bioreactor (MBR) or other Secondary treatment if land disposal	Thickening, transfer to larger WWTP
Medium	4000 – 40,000	800 – 8,000	Reactor Membrane separation UV	Screw Press Dewatering
Large	40,000 – 150,000	8,000 – 30,000	Primary Treatment Reactor Membrane separation UV Centrate Treatment	Digester Centrifuge Dewatering
	150,000 +	30,000 +	Primary Treatment Reactor Membrane separation UV Centrate Treatment	Digester Centrifuge Dewatering Advanced Solids Destruction

[5] Treated Wastewater Assumptions for Waikato Wastewater Metro DBC, Beca, August 2020

3.2 Process Element Descriptions

The wastewater treatment process elements the Southern Metro options incorporate include the following:

Inlet Works

An inlet works facility comprising of two (2) packaged pre-treatment systems appropriate for a membrane bioreactor (MBR) plant. Packaged system to include:

- Influent collection chamber
- Coarse (5mm aperture), primary band screen
- Aerated grit removal tanks which includes aeration, grit removal conveyors and scum removal
- Grit classifiers
- Fine (1mm aperture), secondary band screen
- Screenings load out conveyors to skip
- Screening washer/compactors if the screens do not include an integral compaction zone
- Scum collection tank including decanting pipework.

Primary Treatment

A primary sedimentation system comprising of:

- Sedimentation tanks for settling removal of colloidal particles via gravity
- An in-tank sludge scraping mechanism for collection of sludge
- A sludge hopper at the entry end of the tank
- Primary sludge pumps and pipework for sludge removal from the hopper
- An in-ground pump and pipework gallery to house all sludge handling equipment
- As an alternative and perhaps for the duration of one equipment lifespan (say 25 years) mechanical systems such as Salsness filters of cloth pile filters could be employed as the primary clarification devices up front of the MBR and the digesters.

MBR

A new MBR facility, comprising:

- Activated sludge reactors (ASRs) configured for nitrogen and phosphorus removal
- Blowers and diffused aeration system, including internal recycle
- Ultrafiltration membrane separation using submerged hollow fibre membranes
- Permeate pumps for managing effluent flows through and downstream of the membranes
- A clean in place (CIP) systems required for the membranes
- Return activated sludge (RAS) and waste activated sludge (WAS) pumping
- Alum dosing for phosphorus removal where necessary (the reactors/membrane tanks are set up as 5 stage Bardenpho (or similar) for biological phosphorus removal)

UV

A tertiary UV disinfection system comprising:

- Either an in-channel lamp bank or in-pipe pressurized UV disinfection system

Centrate Treatment

A centrate treatment system, for the removal of ammonia from the dewatering centrate consisting of:

- An MBBR for Anammox side stream treatment (or equivalent Anammox process)
- An effluent transfer pump and wetwell system for pumping back to the inlet works
- Aeration blowers and piping

Digestion

A single stage mesophilic digestion system consisting of:

- A sludge holding tank where primary sludge and WAS are mixed and buffered prior to digestion
- Circular, above ground and insulated digesters for volatile solids destruction and biogas generation
- Sludge mixing system
- Sludge transfer pumps and pipework
- Heat exchangers for regulating digester temperature
- Galleries to access all sludge pumps and pipework for operation and maintenance purposes
- A biogas collection and storage system
- A biogas engine for cogeneration of energy to offset electricity and or natural gas use

Dewatering

A hall containing a dewatering system consisting of either:

- Screw presses for smaller plants, capable of dewatering undigested WAS to ≈19%DS, or
- Centrifuges for larger plants, capable of dewatering co-digested sludge to ≈26-30%DS
- Polymer make-up systems and feed pumps
- Dewatering day tanks for storing digested sludge until the dewatering systems operate
- Sludge pumps and piping to feed dewatering
- Sludge loadout conveyors and skips for removal of dewatered sludge from site.

Other

Other facilities required include:

- Operations building
- Maintenance and stores building
- Entry gate
- Septage disposal system for larger plants
- Security fencing
- Internal roads and carparking
- Electrical transformer and back up generator.

3.3 Option 2A: Southern WWTP Description

Option description

The Southern sub-regional WWTP is designed to treat an average daily flow in 2061 of ~25,000 m^3/d. To achieve this level of treatment the following plant features are proposed:

- Inlet works
- Primary Sedimentation

- Digestion
- Centrifugal dewatering
- Centrate Treatment
- MBR
- UV treatment.
- Discharge to River

The process flow diagram (PFD) is shown in Figure 3-1.

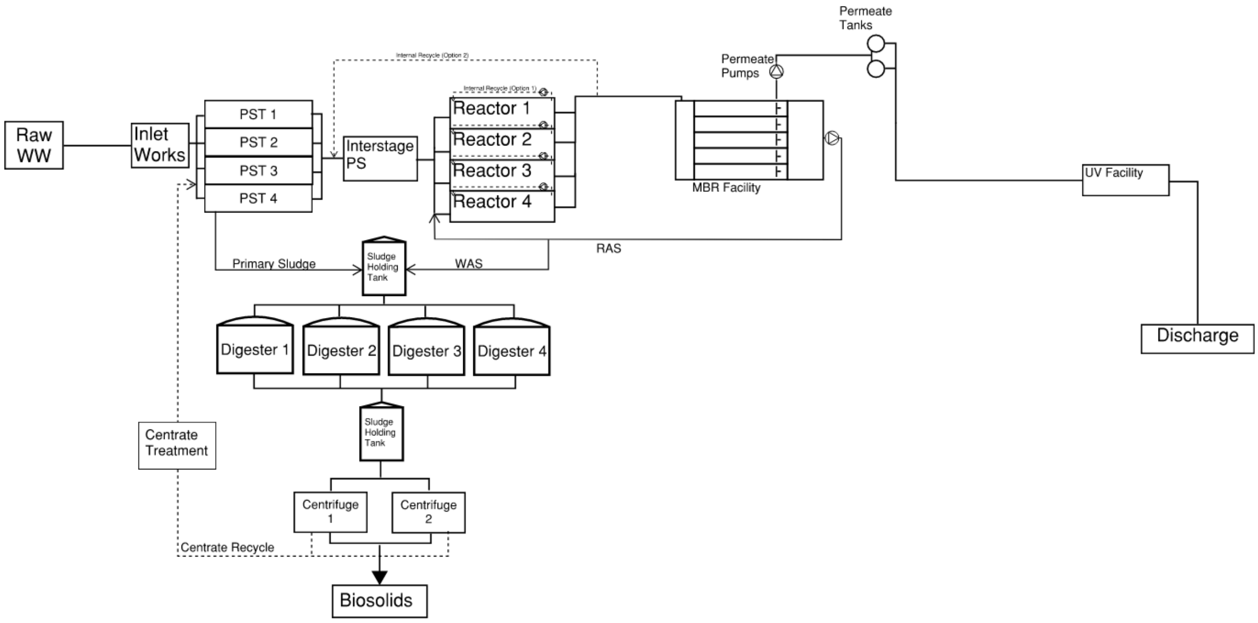


Figure 3-1 Option 2A Southern WWTP PFD

Layout

The plant is expected to require an approx. 5 ha footprint with a potential layout illustrated below. This does not include buffer areas for the WWTP. It is recommended that a site of minimum 15 ha is acquired. In addition to this an area of approx. 200m around the site may need to have some restrictions to use.

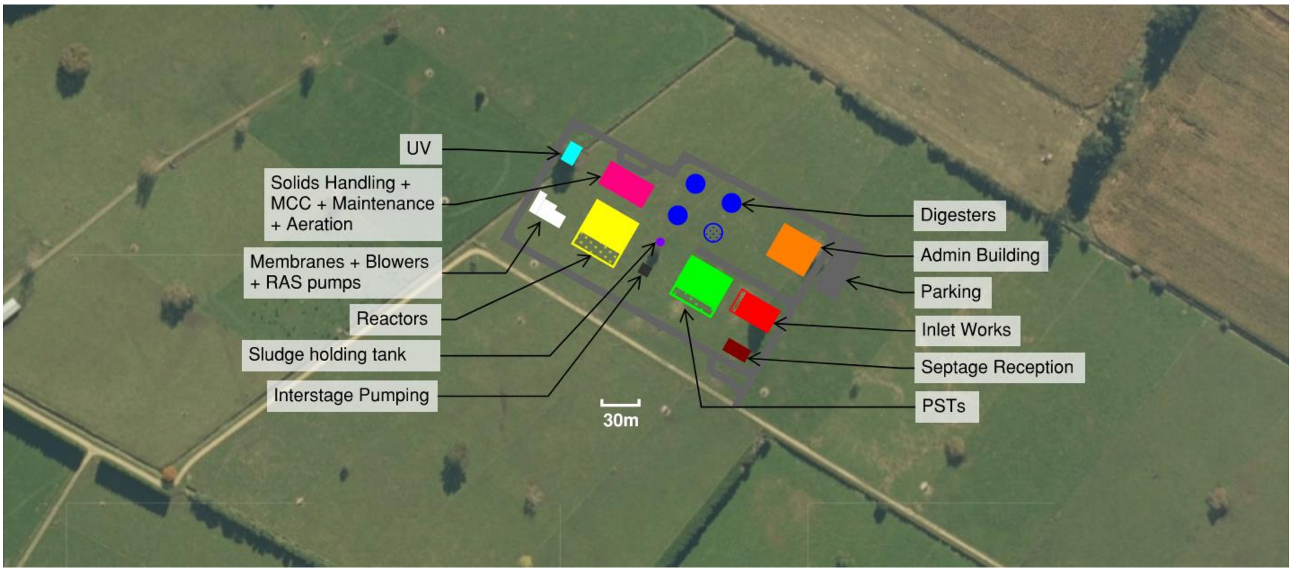


Figure 3-2 Option 2A Southern WWTP Example Layout

Staging

In order to determine process unit sizing and staging, a Site Buildout sizing spreadsheet was used to analyse the process units required and time intervals that might be required. In addition to the Site Buildout spreadsheet, a steady state activated sludge model (based on the ATV [6]standard guidelines) and sizing spreadsheet was used specifically to determine the bioreactor sizes for an effluent TN concentration of 4 mg/L and effluent TP concentration of 1mg/L.

This was modelled including allowance for PSTs, digesters and centrate treatment on the recycle stream to determine a reasonable reactor size suitable for staging. The flows and associated loads were evaluated at each timeframe to estimate the major process units required over time as outlined in Table 3-2:

Table 3-2 Option 2A Southern WWTP Base Staging

Asset	Size	2031	2041	2051	2061
Flow	m^3/d	15,575	19,525	23,381	24,791
Screening trains	500L/s	2	2	3	3
Grit Removal					
PSTs	$180m^2$	3	3	4	4
Reactors	$2000m^3$	3	4	5	5
Membrane Trains	200L/s	4	5	6	6
Digesters	$1,500m^3$	3	4	4	4
Dewatering	$20m^3/hr$	2	2	2	2
Biosolids @ 26%DS	m^3/d	15	16	17	17
Energy use	Million KWh/year	3.5	4.5	5.4	5.7

[6] Abwasser Technische. Vereinigung, the German standard guidelines for design of activated sludge WWTPs

Installation of the PSTs and Digesters could be delayed to 2051 however additional secondary reactor capacity would need to be installed (estimated at approximately 5 reactors). It may be possible to design reactors that could be converted to PSTs later. If PSTs/Digesters were delayed, operating costs in the intervening years would increase as energy is not recovered and biosolids volumes for disposal are higher.

A lower TN concentration target would reduce reactor sizing and energy requirements – this impact is outlined below in Table 3-3. This analysis also shows the potential impact on required reactor size of removing the primary treatment/digesters (increasing the load to the reactors).

Table 3-3 Option 2A Reactor Volume Sensitivity

Option 2A Southern WWTP		2031	2041	2051	2061
PST, TN 4mg/L (Base)	Reactor vol at 6,600mg/L MLSS (m^3)	6,719	8,219	9,692	10,208
PST, TN 7.5mg/L	Reactor vol at 6,600mg/L MLSS (m^3)	5,621	6,878	8,043	8,460
No PST, TN 7.5mg/L	Reactor vol at 6,600mg/L MLSS (m^3)	8,058	9,764	11,690	12,400

Delaying the introduction of Ohaupo and Matangi would have minimal impact on treatment process capacity required as the flows from those communities are such a small component of the total flows.

Delaying the introduction of South Hamilton flows (if practical from a conveyance perspective) could reduce the number of reactors, membrane trains and digesters required to be built at the start. However, some components such as civil works, transfer pipes and buildings are generally built to ultimate sizing at the start at a new site with more limited potential to stage due to the major interventions required on large hydraulic items.

Significant wet industry flows have been allowed for at the airport industrial area (1,750 m^3/day by 2061). If wet industry was to not locate at this area or more wet industry arrived than allowed for, process capacity could be delayed or bought forward to match requirements.

The ultimate flows to the 2A southern sub-regional WWTP could be up to 30,000 m^3/day based on the current growth assumptions. The 5ha footprint proposed is likely to be suitable for these flows but the site master plan should identify reserve areas for additional screens, PSTs, reactors, digesters and buffers and therefore a total site area of approximately 15ha.

Issues and Risks

A new site offers the opportunity to masterplan a treatment facility to achieve the greatest operational efficiency and be able to adapt quickly and easily to changes.

A buffer area around the WWTP is advisable to mitigate potential odour and noise issues. Process equipment can be added over time as flows increase due to residential and industrial growth.

While a new site can be selected with more favourable ground conditions, some ground improvements are likely to be required.

Larger WWTPs provide more redundancy with their processes and equipment.

Option 2A, with its longer and larger conveyance mains than option 4A, presents a greater resilience risk in the face of major seismic activity in the area. However, with modern PE piping systems and adoption of the lessons learned following the Christchurch earthquakes, these risks can be significantly mitigated.

The larger 2A facility provides the greatest opportunity for adoption and implementation of sustainable engineering and management practices and the consequent gains in terms of operational cost savings and reductions in Greenhouse gas emissions associated with the plants.

3.4 Option 4A: Standalone Cambridge WWTP Description

Option description

For the Cambridge WWTP to treat an average daily flow in 2061 of ~9000 m^3/d the following plant features are proposed:

- Inlet works
- Primary Sedimentation
- Digestion
- Centrifugal dewatering
- Centrate treatment
- MBR
- UV treatment.
- Discharge to river

The process flow diagram (PFD) is shown in Figure 3-3.

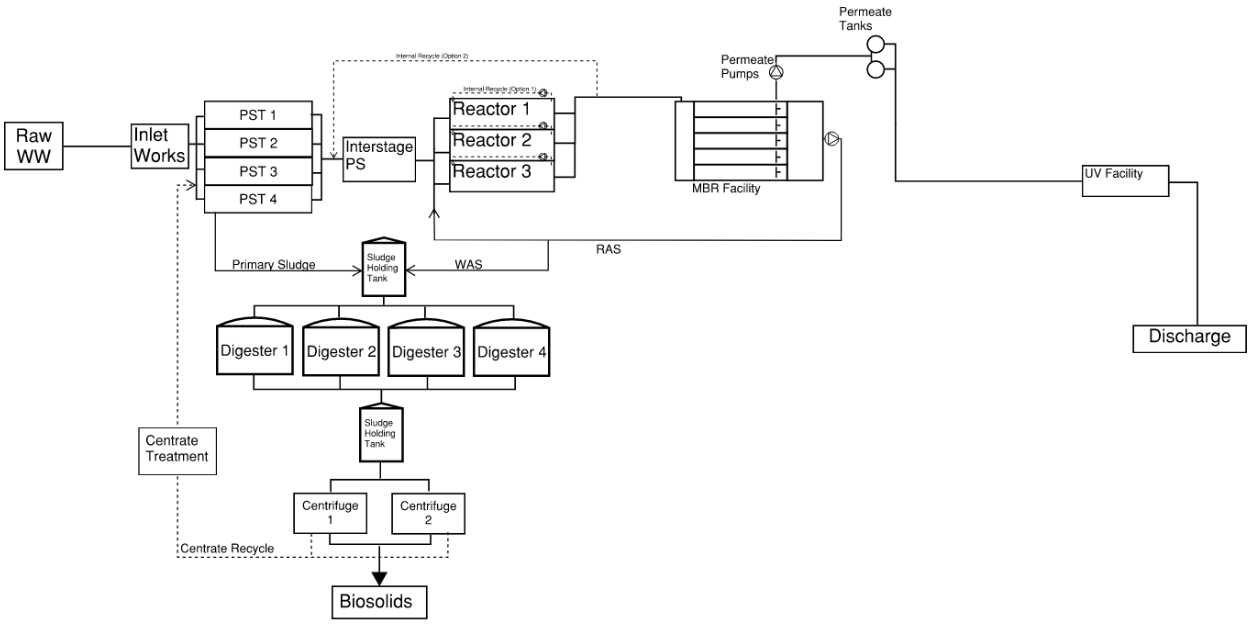


Figure 3-3 Option 4A Standalone Cambridge WWTP PFD

Layout

The plant is expected to require an approx. 3 ha footprint. The site could be located in the area currently used for wetlands or ponds to avoid areas with highest risk geotechnical conditions and be further from the river. A detailed geotechnical investigation is required to confirm suitable sites.

Layout could be compromised by the need to keep the existing WWTP operational and compliant during construction of the new facility. Temporary relocation of some existing services or unit processes may be required while the new treatment plant is being built.

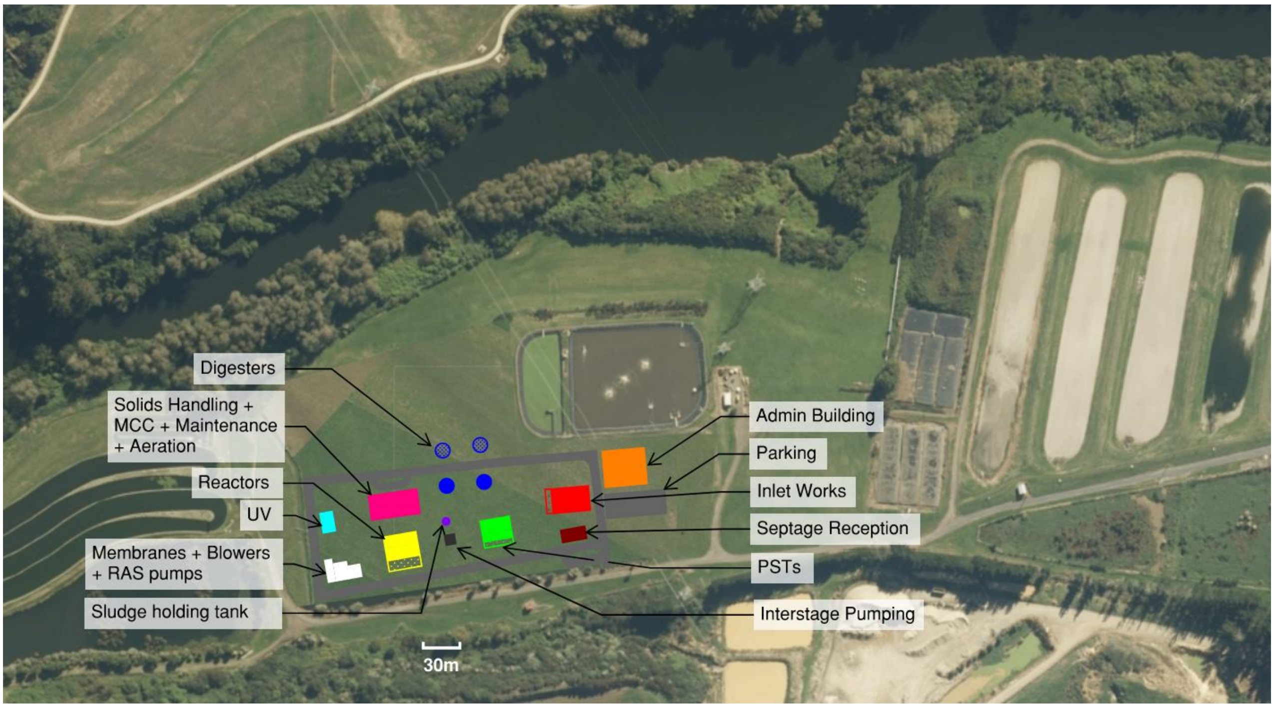


Figure 3-4 Option 4A Cambridge WWTP Example Layout

Staging

To determine process unit sizing and staging, a Site Buildout sizing spreadsheet was used to analyse the process units required and time intervals they might be required. In addition to the Site Buildout spreadsheet, an a steady state activated sludge model (based on the ATV [7]standard guidelines) was used specifically to determine the bioreactor sizes for an effluent TN concentration of 4 mg/L and effluent TP concentration of 1mg/L.

This was modelled including allowance for PSTs, digesters and centrate treatment on the recycle stream to determine a reasonable reactor size suitable for staging. The flows and associated loads were evaluated at each timeframe to estimate the major process units required over time as outlined in Table 3-4:

[7] Abwasser Technische. Vereinigung, the German standard guidelines for design of activated sludge WWTPs

Table 3-4 Option 4A Cambridge WWTP Base Staging

Asset	Size	2031	2041	2051	2061
Flow	m^3/d	6,824	7,678	8,578	9,006
Screens	200L/s	2	2	2	3
PSTs	$80m^2$	3	4	4	4
Reactors	$1000m^3$	3	3	3	4
Membrane Trains	100L/s	4	4	4	5
Digesters	$600m^3$	3	3	4	4
Dewatering	$10m^3/hr$	2	2	2	2
Biosolids @ 26%DS	m^3/d	5.6	5.8	6	6.1
Energy Use	Million KWh/year	1.5	1.7	2.0	2.1

Installation of the PSTs and Digesters could be delayed to be installed at approximately 2051 when the population equivalent is expected to be at the 'target' level typically used for this technology. Extra secondary reactor capacity would be needed in the intervening years which may be able to be designed to convert into primary sedimentation tanks later. However, operating costs would increase as energy is not recovered and biosolids volumes for disposal are higher.

A lower TN concentration target would reduce reactor sizing and energy requirements. Table 3-5 outlines potential reactor size requirements for changing the target treated wastewater quality from 4mg/L TN to 7.5mg/L or removing the primary treatment (increasing the load to the reactors).

Table 3-5 Option 4A Cambridge reactor volume sensitivity

Option 4A Cambridge WWTP		2031	2041	2051	2061
PST, TN 4mg/L (Base)	Reactor vol at 6,600mg/L MLSS (m^3)	2,766	3,102	3,454	3,626
PST, TN 7.5mg/L	Reactor vol at 6,600mg/L MLSS (m^3)	2,311	2,593	2,882	3,023
No PST, TN 7.5mg/L	Reactor vol at 6,600mg/L MLSS (m^3)	4,201	4,698	5,208	5,448

Wet industry flows for Cambridge WWTP are a small proportion of the total flow and are not expected to have a significant impact on staging.

The ultimate flows to the 4A Cambridge WWTP could be up to 11,500 m^3/day based on the current growth assumptions. The 3ha footprint proposed is likely to be suitable for these flows but the site master plan should identify reserve areas for additional screens, PSTs, reactors, digesters and buffers. The site may need to expand into the adjacent quarry site to minimise geotechnical concerns and to minimise process disruptions in the existing treatment plant while the new facilities are constructed.

Issues and Risks

The existing Cambridge WWTP site is fairly constrained and is expected to require significant ground improvements.

Constructing a new WWTP on an existing site adds complexity and time to the implementation phase of the project. This will result in additional P&G costs, additional temporary works costs and additional compliance risks.

Process equipment can be added over time as flows increase due to residential and industrial growth.

3.5 Option 4A: Southern Sub-regional Plant

Option description

For the Southern WWTP sub-regional plant to treat an average daily flow in 2061 of ~3,900 m^3/d the following plant features are proposed:

- Inlet Works
- Screw Press dewatering
- MBR
- UV treatment
- Discharge to river and potentially discharge to land within a larger, future proofed site.

The process flow diagram (PFD) is shown in Figure 3-5.

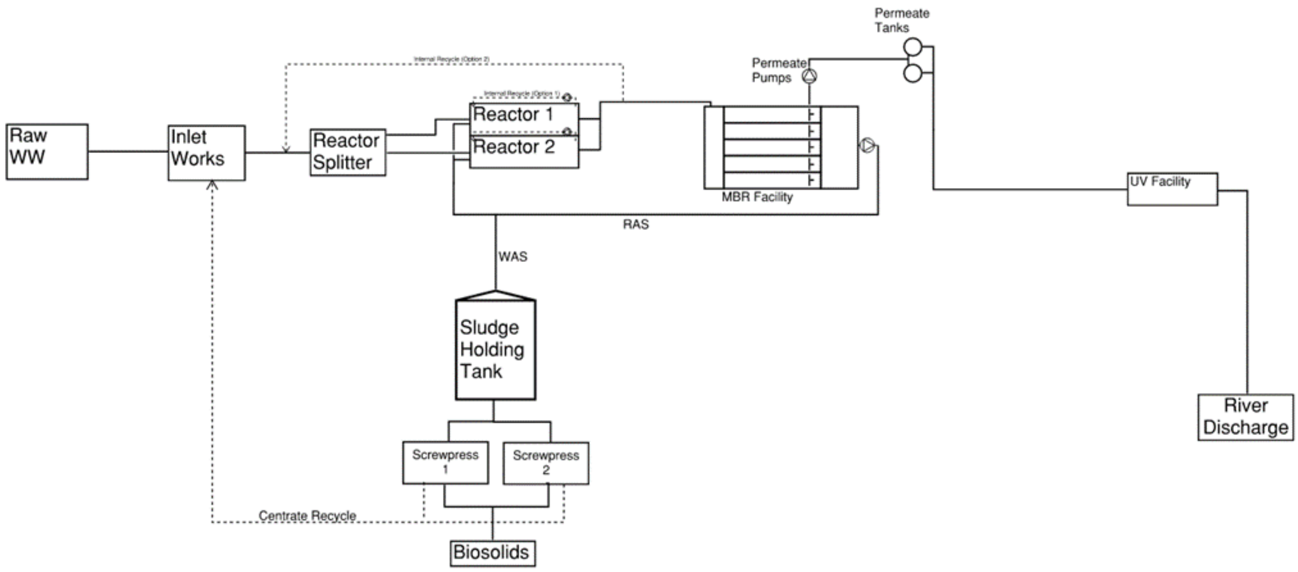


Figure 3-5 Option 4A Southern Sub-regional WWTP PFD

Layout

The plant is expected to require an approx. 3 ha footprint for the 2061 and ultimate development (i.e. most development expected to be complete prior to 2061). This does not include buffer areas for the WWTP. It is recommended that a site of minimum 15 ha is acquired. In addition to this an area of approx. 200m around the site would need to have some restrictions to use.

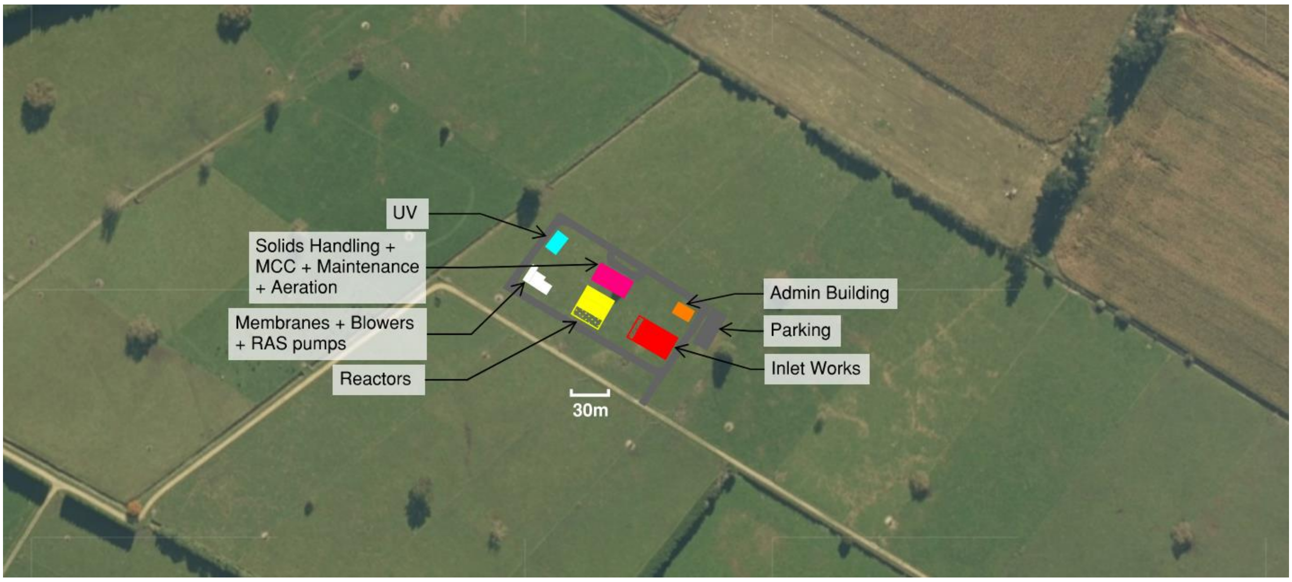


Figure 3-6 Option 4A Southern WWTP Example Layout

Staging

To determine process unit sizing and staging, a Site Buildout sizing spreadsheet was used to analyse the process units required and time intervals they might be required. In addition to the Site Buildout spreadsheet, an a steady state activated sludge model (based on the ATV [8]standard guidelines) was used specifically to determine the bioreactor sizes for an effluent TN concentration of 4 mg/L and effluent TP concentration of 1mg/L.

The flows and associated loads were evaluated at each timeframe to estimate the major process units required over time as outlined in Table 3-6. Further membrane trains could be added in 2041/51 or when wet industry flows required. A minimum of 2 screens and 2 reactors would likely be required at start up to provide a level of operational redundancy.

Table 3-6 Option 4A Southern WWTP Base Staging

	Size/Unit	2031	2041	2051	2061
Flow	m^3/d	1,562	2,707	3,858	3,859
Screens	100L/s	1	2	2	2
Reactors	800m^3	1	2	2	2
Membrane Trains	50L/s	2	3	4	4
Biosolids volume @ 26%DS	m^3/d	2	4	6	6
Energy Use	Million KWh/year	0.7	1.2	1.8	1.8

The above staging assumes the development of the Airport industrial precinct occurs by 2051 with 45 PE per hectare as an average wastewater generation level and 1,750 m^3/day of additional wet industry wastewater. Industrial activities have a wide range of wastewater generation rates and at this time, the timing of and nature of industrial development is currently unknown. The provision of significant capacity (approx. 50%) in advance of uncertain demand is a significant risk. A more modular approach could be undertaken with self contained treatment systems added as development occurs. Smaller modular units would be less likely to be cost effective for larger wet industries of uncertain waste volume and composition.

In the short to medium term, a package 'secondary treatment' WWTP with land discharge may be suitable for up to 500 m^3/day, to service light industry in the Airport industrial precinct. A land area of up to 10 ha would be needed for the land discharge along with additional area for buffers. Over this level of flow, package plants are less cost effective and much larger areas of land would be required for discharge of treated wastewater.

A transfer pipeline from the Airport to Cambridge WWTP was considered in the long list options with an estimated cost of $20M (this also included capacity for south Hamilton flows). This option would need a minimum starting flow to avoid excessively long retention times in the conveyance pipe and resulting septicity. A smaller pipeline could be used if wet industry was not serviced.

Issues and Risks

A new site offers the opportunity to masterplan a treatment facility to achieve the greatest operational efficiency and able to adapt quickly and easily to changes.

This WWTP is most sensitive to uncertainty and changes in demand and does not have a significant starting base flow other than the domestic waste from the existing airport terminal and a light industrial facilities.

[8] Abwasser Technische. Vereinigung, the German standard guidelines for design of activated sludge WWTPs

The existing airport terminal and the light industrial facilities of Titanium Park and surrounds are already at the point where they require a revised solution to wastewater management rather than the current tankering operation.

3.6 Tauwhare Pa WWTP (Both Options)

Option description

The current WWTP at Tauwhare Pa discharges secondary treated wastewater to land and is generally compliant with consent requirements. The treated wastewater quality required for discharge to land depends on the soil type, climate and intended land use. Soils in the area have reasonable drainage characteristics and there are limited opportunities for discharge to water.

There is uncertainty over the timing and flows likely to be generated at the Pa and potentially from Tauwhare Village. Based on average wastewater generation rates per household, a 55 m^3/day package MBR plant has been sized for comparative purposes. No allowance has been made for discharge to land.

Discharge to land with conventional secondary treatment is likely to have a lower capital and operating cost than an MBR plant.

Tauwhare Pa is 3 km from Matangi. Should Matangi be conveyed to a sub-regional WWTP, it may be feasible to convey Tauwhare Pa wastewater to Matangi and then onto the sub-regional WWTP.

Layout

An MBR plant would have a similar process to the WWTP for the 4A southern WWTP. The plant is expected to require less than 1 ha footprint. An additional 2 ha would be required for land discharge (excluding buffer areas). Further land area would be required in future if provision is made for future servicing of Tauwhare village.

Staging

Staging would depend on the timing of development at Tauwhare Pa and availability of suitable land.

Issues and Risks

Once a preferred southern option is identified further investigation of Tauwhare Pa options can be undertaken. Soil conditions and environmental effects associated with land discharge will need to be investigated.

3.7 Treatment Cost Estimates

A costing exercise has been completed for the four potential WWTPs that form a part of Option 2A and Option 4A. This exercise uses the costing assumptions from Section 2 and develops the potential costs for each of these plants should they be built to their design flow process unit requirements at 2061. These cost estimates have an estimation accuracy range of -30% / +50% of which is standard at Conceptual Appraisal stage.

3.7.1 Capital Costs

Table 3-7 and Table 3-8 summarises the capital costs for Option 2A and Option 4A respectively. The detail is provided in Appendix A. As outlined in the costing assumptions Council internal costs, procurement and consenting costs are excluded from the cost estimates.

Table 3-7 Option 2A Capital Costs summary

Area	WWTP name	Size of plant	WWTP Capital Cost ($ M) to 2061
Hamilton South	2A Southern Sub-Regional WWTP	Large	$ 169M
Matangi			
Airport			
Ohaupo			
Cambridge & Hautapu			
Te Awamutu & Kihikihi	Te Awamutu	Medium	$ 29M
Tauwhare Pa	Tauwhare Pa	Small	$ 6M
TOTAL			**$ 204M**

Table 3-8 Option 4A Capital Costs summary

Area	WWTP name	Size of plant	WWTP Capital Cost ($ M) to 2061
Matangi	4A Southern Sub-Regional	Medium	$ 54M
Airport			
Ohaupo			
Cambridge & Hautapu	Cambridge	Large	$ 113M
Te Awamutu & Kihikihi	Te Awamutu	Medium	$ 29M
Tauwhare Pa	Tauwhare Pa	Small	$ 6M
TOTAL			**$ 202M**

To compare the capital costs on an equivalent basis, the equivalent cost of the Pukete WWTP capacity consumed by the Hamilton south flows needs to be determined. Based on work undertaken for HCC for the 2021 LTP and Site Buildout reports[9], the expected capital costs for Pukete upgrades was estimated with and without Hamilton South flows. This work assumed Pukete would be converted into an MBR process. This information is indicative only as it is not based on the same level of detail as the southern short list development work. Further options for Pukete WWTP include retaining the existing clarifiers instead of converting to an MBR which would result in a minimum TN concentration of 7.5mg/L. Further investigation on the options for Pukete WWTP staging is expected to be undertaken in the northern detailed business case assessment.

[9] Pukete WWTP Site buildout report, Beca 2021. Pukete WWTP LTP 2021/31 cost estimates report, Beca 2020

Table 3-9 Pukete Capital Costs summary

WWTP name	Size of plant	WWTP Capital Cost to 2061 ($ M)
Pukete 2A upgrades (without Hamilton south, with Te Kowhai and Ngaruawahia)	Large MBR	$ 288M
Pukete 4A (Hamilton only)	Large MBR	$ 304M

3.7.2 Annual Operational Costs

Table 3-10 and Table 3-11 outline the details of the operational costs for each of the options for 2031, 2041, 2051 and the 2061 flows. Over time the total operational costs increase as flows increase. The large plants that have PSTs and digesters have significantly lower costs per ML processed due to energy recovery and reduced biosolids volumes for disposal. Assumptions are outlined in Appendix A. These amounts provide a relative indication of OPEX between the plant options. They could be refined and the OPEX costs rendered more accurate with some verification or similar contemporary operational cost data from the HCC and WDC operations teams.

The components included for operational costs were:

- Electricity (50% recovery assumed for WWTPs that have PSTs and digesters)
- Chemicals (CIP, alum, caustic, polyelectrolyte)
- Operators
- General maintenance
- UV lamp replacement
- Biosolids and screenings disposal (landfill disposal assumed)
- Compliance monitoring
- Renewals expenditure is excluded from the operational costs.

Table 3-10 Option 2A Operational Costs summary

WWTP name	Size of plant	WWTP Operational Cost 2031 ($ M)	WWTP Operational Cost 2041 ($ M)	WWTP Operational Cost 2051 ($ M)	WWTP Operational Cost 2061 ($ M)
Southern Sub-Regional WWTP	Large	$ 3.7M	$ 4.7M	$ 5.6M	$ 6.0M
Te Awamutu	Medium	$ 2.6M	$ 2.8M	$ 3.2M	$ 3.3M
Tauwhare Pa	Small	$ 0.1M	$ 0.1M	$ 0.1M	$ 0.1M

Table 3-11 Option 4A Operational Costs summary

WWTP name	Size of plant	WWTP Operational Cost 2031 ($ M)	WWTP Operational Cost 2041 ($ M)	WWTP Operational Cost 2051 ($ M)	WWTP Operational Cost 2061 ($ M)
Airport Southern Sub-Regional	Medium	$ 0.7M	$ 1.2M	$ 1.8M	$ 1.8M
Cambridge – with PSTs/Digesters	Large	$ 1.6M	$ 1.8M	$ 2.1M	$ 2.2M
Cambridge – without PSTs/Digesters	*Medium*	*$ 3.0M*	*$ 3.5M*	*$ 3.9M*	*$ 4.1M*
Te Awamutu	Medium	$ 2.6M	$ 2.8M	$ 3.2M	$ 3.3M
Tauwhare Pa	Small	$ 0.1M	$ 0.1M	$ 0.1M	$ 0.1M

3.7.3 Staging of Costs

Table 3-12 outlines the indicative base staging for the 2A Sub-Regional and 4A Cambridge WWTP construction costs considering the process requirements over time in response to growth. An additional 10% has been added to costs in later years from 2041 to cover the extra costs expected due to multiple construction periods (including design, some rework and construction supervision). An alternative staging scenario is to delay the installation of PSTs and Digesters to 2051 is also outlined. However, this also defers the onset of operational cost savings (energy purchase and biosolids disposal cost reductions). A cost vs benefit analysis for this deferral has not been undertaken at this time. Staging for the Airport and Tauwhare Pa would depend on development timing and flows being confirmed.

Table 3-12 Indicative Capital Costs Staging

WWTP name	Scenario	WWTP Capital Cost 2031 ($ M)	WWTP Capital Cost 2041 ($ M)	WWTP Capital Cost 2051 ($ M)	WWTP Capital Cost 2061 ($ M)
2A Southern Sub-Regional WWTP	Base Staging	$ 136.7M	$ 16.2M	$ 18.5M	$ 5.2M
	Delay PSTs and digesters to 2051	$ 120.2M		$ 53.8M	
4A Cambridge WWTP	Base Staging	$ 95.2M	$ 3.9M	$ 5.5M	$ 9.8M
	Delay PSTs and digesters to 2051	$ 82.9M		$ 29.7M	

For Option 2A, an alternative staging strategy would be to build capacity for Cambridge (because this is critical) plus the current / near future airport flows (which already require a change of management method) as stage 1. Peacocke and the other Hamilton South precincts would continue north in accordance with existing practice and as intended by the new Peacocke rising mains. This initial capacity would likely be built as an aerobic, MBR plant only plus inlet works and UV disinfection. The second stage of development would then likely add primary tanks, digestion and side-stream centrate nutrient removal. The timing of this second stage is complex and would likely be linked to network development in Hamilton (particularly Peacocke), capacity burn at Pukete WWTP and or the need to divert the northern (Ngaruawahia, Taupiri and Horotiu) flows and loads south to Pukete WWTP. Subsequent development stages would see existing unit processes augmented as the need arose. This alternative staging option could be developed and costed in more detail at the stage of developing of the northern business case and preferred option.

4 Next Steps

For the preferred option further investigation and design is recommended as follows:

- For operational costs and energy recovery, benchmarking with existing performance and costs for Pukete and other sites with MBR or biological nutrient removal
- Further investigate capital and operational cost impacts of lower TN target and delaying installation of PSTs and digesters
- Sensitivity analysis for Hamilton flow split, residential and non-residential greenfield growth, connecting small communities (Ohaupo, Matangi, Tamahere hub and Tauwhare Pa), wet industry and infill
- Geotechnical investigations for Cambridge WWTP if 4A is the preferred option
- Review of redundancy requirements for major process units e.g. screens and reactors
- Biosolids reuse and disposal options.

Appendices

Appendix A – Cost Estimates

Waikato Metro DBC Southern Shortlist - Treatment Plants

Comparative Cost Estimate Summary

Ref	Description	Capital cost	
		Most Likely Estimate	P95 Estimate
	Wastewater Treatment Plant Upgrades		
	Option 2A Southern WWTP	$169,098,295	$187,090,664
	Option 4A Southern WWTP	$54,476,479	$61,614,836
	Option 4A Cambridge WWTP	$112,664,171	$124,964,566
	Tauwhare Pa Package WWTP (excludes irrigation)	$5,733,900	$7,207,276
	TOTAL ESTIMATE	**$341,972,845**	**$380,877,341**

General Estimate Exclusions

0.0 Goods and services Tax (GST).
0.1 Incurred costs to date.
0.2 Fast track or accelerated programme.
0.3 Work outside normal working hours.
0.4 Professional fees other than those listed.
0.5 Client cost of finance, legal, and accounting fees
0.6 Costs associated with staging of the works.
0.7 Council internal costs and procurement (included in PWC cost elements)

Project Specific Exclusions

0.7 Procurement costs (included in PWC cost elements)
0.8 Consenting costs (included in PWC cost elements)
0.9 Relocating existing services. Subject to further investigations
0.10 Restoration work at existing sites
0.11 Landscaping.
0.12 Architectural treatment to exterior of buildings and structures.

Waikato Metro DBC Southern Shortlist - Treatment Plants

Comparative Cost Estimate Summary

0.13 Cost of land purchase and access (easements etc.).
0.14 Costs of impacts associated with extraordinary global events (such as the current COVID-19 outbreak).

Assumptions

0.15 All quantities and dimensions are approximate and are subject to design development.
0.16 The basis of the estimate is the Beca concept design information in the treatment options report including high level layouts and process details.
0.17 Elements of cost included within this estimate are based on costs from similar projects and other Beca cost benchmarks.
0.18 We assume that all of the work will be undertaken by a single 'Main Contractor' through a single contract for the project.
0.19 We assume that a robust tendering process will be followed and that a minimum of 3 sub-contractor tenders (where possible) are received for the project as part of the agree
0.20 We assume that all works are carried out during normal daytime working hours.
0.21 We assume that the Contractor will have unobstructed access to the whole site throughout the construction phase.
0.22 All base prices are current to November 2020. No allowance for cost escalation has been included in the estimate.
0.23 Professional fees and consent fees are yet to be developed. We have included an allowance in the estimate to cover these anticipated costs.

Expected Estimate Range:

0.24 Estimate range is an indication of the degree to which the final cost outcome for a given project will vary from the estimated cost – it is not an additional Contingency. Range point of estimate after the application of contingency, with a stated level of confidence that the actual cost outcome would fall within this range. As the level of project definitio expected range of the estimate tends to improve, as indicated by a tighter +/- range.

0.25 The WWTP estimates are deemed to be Class 5 estimates in terms of the AACE Cost Estimate Classification System guidelines. The probable accuracy range of the estima

Risks

Risks with a potential cost effect include:

0.26 Design development.
0.27 Geotechnical design development.
0.28 Foreign exchange rates (an allowance for this risk has been included in the estimate).
0.29 General cost escalation.
0.30 Cost associated with revised sequencing or staging of the works.
0.31 Ground conditions and ground water levels and temporary work requirements.
0.32 Working around existing services.
0.33 Cost of land purchase and access (easements etc.).

Waikato Metro DBC Southern Shortlist - Treatment Plants

Comparative Cost Estimate Summary

0.34 Costs of impacts associated with extraordinary global events (such as the current COVID-19 outbreak).

General Considerations and Limitations.

0.35 The estimates above are deemed to be high-level comparative estimates intended for options appraisal.

0.36 These estimates are solely for our Client’s use for the purpose for which they were intended in accordance with the agreed scope of work. They may not be disclosed to any p by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

0.37 The high-level cost estimates presented in this section have been developed solely for the purpose of comparing and evaluating competing options. They are sufficiently accu for budget-setting purposes as common elements between options may have been omitted and/or the works not fully scoped. A functional design should be undertaken if a b

Project	**Metro DBC Southern WWTPs Development**	
Phase	Shortlist Design Development	
Version	2A Southern V1	
Purpose	Cost estimation	
Estimate Class	5	
Quantities Prepared by	C McRobie	11/11/2020
Rates Prepared by	C McRobie; J Crawford	11/11/2020
Reviewed By	R Verbeek	30/11/2020
Amended		

Stage

Basic Dimensions of Plant

Southern site	Length:	Width:	Area:	Perim:	Water Depth	Total Volume
Walls		0.4				
Total Site	250	220	55000	940		
Inlet Works	30	20	600	100	-	
Primary Treatment	40.0	30	1200	140	5	6000
MBR Fine Screens	15.0	10	150	50		
Reactors	50.0	40.0	2000	180	5	10000
Blower/MCC Room	30.0	8.0	240	76		
MBR tank	18.8	21.9	411	81		
MBR building	38.1	18.8	718	114		
Dewatering Building	45	15	675	120		
Admin Building	20	20	400	80		
Anitamox	16	8	128	48		
Digesters		16	965	50		
Carpark	40	20	800	120		
Maintenance/MCC F	30	20	600	100		
UV Channels	13	4	52	34	2.4	
UV Building	6	5	30	22		
Cogen Building	9	7	63	32		

Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
1	**Siteworks and Civil**										Civil Subtotal	$10,006,123
1.1	Form & Maintain temporary site access for construction purposes.		C		m2	200	400	800	$25	$30	$45	$12,000
1.2	Platform Development	Site stripping & Tree Removal	C	Site not decided, as little as zero and as much as whole site	m2	0	27,500	55,000	$1.50	$3.00	$5.00	$82,500
1.3		Strip contaminated topsoil to landscaping bunds within the site	C		m2	0	27,500	55,000	$5.00	$6.00	$7.00	$165,000
1.4		Undercut to stockpile all process unit and building site to -1m	C	Assume 1m deep. Cut to waste on site.	m3	10,050	11,170	12,290	$10	$12	$15	$134,040

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
		Foundation improvement below subgrade formation level to mitigate potential liquifaction and provide for IL3 structural solution	C		Sum	1	1	1	$2,000,000	$3,000,000	$5,000,000	$3,000,000
1.5		Supply, place and compact in layers imported fill. Assume AP65 or similar.	C	Assume AP65 or similar - sourced locally.	m3	7,540	8,378	10,050	$70	$90	$100	$753,975
1.6		Recompact excavated granular fill	C	Uplift and place from stockpile immediately adjacent excavation	m3	2,510	2,793	2,240	$10	$12	$15	$33,510
1.7		Allow to install two layers geogrid in recompacted fill	C	Quantitiy multiplies treated area by 2. So, total area of geogrid used.	m2	5,020	5,585	4,480	$5.00	$7.00	$9.00	$39,095
1.8		Spread and roll surplus excavated material somewhere on the wider site <500m.	C		m3	7,540	2,234	6,702	$10	$12	$15	$26,808
		Entry from Public Road	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	1,000	2,000	8,000	$160	$180	$190	$360,000
		Drainage for entry	C		m	125	250	1,000	$150	$250	$300	$62,500
		Formal Entry Gate	C		Sum	1	1	1	$50,000	$65,000	$80,000	$65,000
1.9	Internal Circulation Road	Around new reactor, PSTs, dewatering MBR and admin building - sealed	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	5,512	6,890	8,268	$160	$180	$190	$1,240,245
1.10	Internal Circulation Road	Around plant perimeter - unsealed, max sealed	C	Allows for basecourse and surfacing (but no nib kerb nor drainage) 8m wide	m2	6,800	7,520	8,300	$30	$50	$200	$376,000
1.11	Security Fencing	Temporary for construction period	C	Including double gates, say 12 months	m	752	940	1,222	$50	$60	$70	$56,400
1.12	Security Fencing	Fencing of the new site	C	From new access area to behind inlet work. Include two sets of double gates. Manual. Whole site.	m	470	940	1,222	$75	$120	$180	$112,800

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
1.13	Create Influent Calamity Pond	Earthworks to form Bund. Grassed, no liner, within existing oxidation pond	C	Approx 9000 m3 storage x ave 1.5m deep 150m long bund, 2m high, 2:1 side slopes and 4m top width	Sum	0	1	1	$400,000	$600,000	$1,200,000	$600,000
1.14		Sump for return pumping	C	Fully formed concrete sump say 3m diameter x 3m deep with apron	Sum	1	1	1	$400,000	$500,000	$1,000,000	$500,000
1.15		Return to ILW Pipeline	C	400mm PE approx	m	80	100	200	$300	$400	$450	$40,000
1.16	Operator Building	3604 house: Lab, Lunch room, Bathroom, Operator station, Hall	C		m2	300	400	600	$2,500	$3,000	$3,500	$1,200,000
	Visitor and Staff Car parking		C		m2	640	800	960	$250	$400	$500	$320,000
	Maintenance and Store Building		C		m2	320	400	800	$1,500	$2,000	$2,500	$800,000
1.17	Misc Plant Slabs	Miscellaneous 30MPa 250mm thick plant slabs not allowed for elsewhere.	C	30MPa RC	m2	40	60	100	$375	$438	$500	$26,250
2	**Inlet works**										ILW Subtotal	$9,252,583
2.1	Screening Structure	Includes: Construction, inlet works equipment, odour control system & dayworks - installed	S	All concrete structures, per linked drawing	Sum	1	1	1	$3,574,517	$3,797,383	$4,020,249	$3,797,383
2.2	Grit	Supply and install new Vortex Grit System Complete Channels, Vortex Chamber, Grit pum. Classifier	M		Sum	1	2	2	$298,400	$373,000	$484,900	$746,000
2.3		Post Grit Flow Splitter	M		Sum	1	1	1	$20,000	$30,000	$40,000	$30,000
2.4		Biofilter	C		Sum	1	1	1	$80,000	$600,000	$1,850,000	$600,000

Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
2.5		Incoming Flow Meters Incoming x 1, Recycles x 2	I	Average 800mm Mag in Riser to ILW on reactor end wall. No chambers	Sum	2	3	5	$25,600	$32,000	$38,400	$96,000
	Septage receival system	Full septage reception w/ below ground pit, and pump station	C	Allowance for septage reception per Gisborne costs: incl Huber facility	Sum	1	1	1	$900,000	$1,000,000	$1,200,000	$1,000,000
4.01	MBR Pretreatment Structural	Pre treatment area	S	Incl: Fine screening facility, washpress slab, covers, Access stairways and platforms	Sum	1.0	1.0	1.0	$407,200	$509,000	$610,800	$509,000
4.02	MBR Pretreatment Mechanical	New MBR Fine Screens	M	Centreflow municipal bandscreens (based on 3 screens capable of treating 1800L/s total)	Ea	3	3	4	$240,000	$300,000	$360,000	$900,000
4.03		Launder	M	Supply to site 316L screening launder and receiving distribution box to convey flume water/screenings from the screens to wash presses, c/w screening discharge control knife gates and DN250/300 pipework.	Ea	1	1	1	$125,000	$150,000	$200,000	$150,000
4.04		New screening handling equipment	M	DUTY/STANDBY unit - sized based on feedback from Brickhouse	Ea	2	2	2	$70,000	$88,000	$95,000	$176,000
4.05		Installation of new equipment for pretreatment area only	M		%	10%	15%	20%	$435,000	$538,000	$655,000	$80,700
4.06		Penstocks (pneumatic) Includes: Frames, gates and pneumatic actuators	M	Supply to site 1.5mx3.5m penstock valves for isolation purposes, c/w support frame and supports.	Ea	3	3	3	$38,400	$48,000	$57,600	$144,000
4.07		Stoplogs Includes: SS frames and UHMV polyethylene side seals and neoprene flush invert seal.	M	Supply to site 1.2mx3.5m aluminium stoplogs for isolation purposes	Ea	4	6	6	$16,800	$21,000	$25,200	$126,000
4.08		Redirecting influent from the IPS to the screening facility	M	2x DN450 lines - A/G SS and U/G 475mm PE	m	15	25	35	$2,500	$3,000	$4,500	$75,000
4.09		Redirecting effluent from the facility to the bioreactors	M	2x600mm SS lines - gravtiy lines	m	15	25	35	$5,000	$7,500	$8,500	$187,500
4.10		Isolating valves	M	Valves on redirected influent and effluent lines	Sum	1	1	1	$70,000	$95,000	$142,000	$95,000
4.11		Washwater pipework	M	New SS316 washwater network for equipment	Sum	1	1	1	$16,000	$23,000	$29,000	$23,000
4.12		Odour Control	M	BTF Unit - 12ACH and rated for 1500m3/hr. Inclusive of ducting and fans	Sum	1	1	1	$158,000	$189,000	$221,000	$189,000
4.13		Electrical general	E	incl. motor control centre to finescreen, allowance for site wide power, instrument and control cabling, cable support and ducting, general lighting and small power	Sum	1	1	1	$192,000	$240,000	$288,000	$240,000

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.14	MBR Pretreatment Electrical & Instrumentation	Instrumentation	I	Software dev. & integration	Sum	1	1	1	$16,000	$32,000	$48,000	$32,000
4.15			I	Flowmeters	ea	1	2	2	$13,000	$16,000	$23,000	$32,000
4.16			I	General instrumentation allowances for level	Sum	1	1	1	$13,000	$24,000	$24,000	$24,000
3	**Primary Treatment**										Primary Subtotal	$9,853,675
	PST Tank Structure	Floors	S	Reinforced Concrete to floors inclusive of concrete, reinforcing and formwork includes strip ftgs	m³	600	600	720	$1,850	$2,000	$2,200	$1,200,000
		Walls	S	Reinforced Concrete to walls inclusive of concrete, reinforcing and formwork including tall narrow walls	m³	229	287	344	$3,000	$3,500	$4,000	$1,003,800
		Scum Hopper	S	Allowance for scum hopper concrete works at higher rate than standard floor slab. 25m wide total, 2m x 1m deep	m³	60	65	70	$3,000	$3,500	$4,000	$225,750
		Galleries / Access Area Allowance	S	On per metre basis	m	24	28	32	$22,000	$25,000	$28,000	$700,000
	PST Mechanical	Scum hopper	M	Collector with helical mechanism and collection chamber	Sum	4	4	4	$18,400	$23,000	$27,600	$92,000
		Scum scrapers	M	PST longitudinal and cross scrapers	Sum	4	4	4	$91,200	$114,000	$136,800	$456,000
		Primary Effluent discharge weirs	M	Longitudinal V-Notch weirs 316 SS or FRP rectangular weirs * say 15m long. Section say 300 side walls and 300 base width	ea	4	6	8	$15,000	$20,000	$25,000	$120,000
		Primary sludge pumps	M	Progressive cavity, 2 per PST	ea	8	8	8	$18,400	$23,000	$27,600	$184,000
		PS suction pipework	M	DN150 SS SCH 10	m	40	80	160	$1,250	$2,000	$2,500	$160,000

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
		PS discharge pipework	M	DN150 SS SCH 10	m	115	130	150	$1,250	$2,000	$2,500	$260,000
		PS discharge valves	M	150mm plug valves	ea	8	8	8	$2,500	$3,500	$4,500	$28,000
		Primary scum pump	M	air driven diaphragm pump, nominal allowance and include connection to compressed air line	ea	4	4	4	$6,400	$8,000	$9,600	$32,000
		Primary scum pipework and valves	M	DN100, discharge into PST line	m	4	4	4	$1,250	$2,000	$2,500	$8,000
		PST drainage system	M	DN150 PVC piping into sump system with pump. Underneath galleries with a DN2000 sump and 2x small drainage pumps. Water returned to headworks.	Sum	4	4	4	$34,400	$43,000	$51,600	$172,000
		Scum removal header and pipework in PST	M		Sum	4	4	4	$40,800	$51,000	$61,200	$204,000
		Scum removal blower	M	2 x blowers per PST to be installed	Sum	8	8	8	$10,400	$13,000	$15,600	$104,000
		Water spray system	M		Sum	4	4	4	$26,400	$33,000	$39,600	$132,000
		PST installation of mechanical equipment	M	PST equipment inside the tank only	%	10%	15%	20%	$304,500	$304,500	$304,500	$45,675
		Vendor support	M		%	5%	10%	15%	$304,500	$304,500	$304,500	$30,450
	PST Electrical	General Electrical Upgrade / PST	E		Sum	4	4	4	$75,000	$100,000	$125,000	$400,000
		Programming and Commissioning	I	PLC SCADA P&C	Sum	4	4	4	$20,000	$30,000	$40,000	$120,000
	PST Testing and Commissioning	Hydrostatic testing	I		Sum	1	1	1	$10,000	$10,000	$15,000	$10,000
		Commissioning of PST	I		Sum	1	1	1	$30,000	$50,000	$65,000	$50,000
	Interstage Pumpstation	Allowance for IPS	M	PST to Reactors	Sum	1	1	1	$3,292,800	$4,116,000	$4,939,200	$4,116,000
3	**Reactor**										Reactor Subtotal:	$12,926,684
3.01	Reactor Structure	Reinforced Concrete to floors inclusive of concrete, reinforcing and formwork	S	Total tank block area x 500mm floor thickness	m3	833	1,000	1,200	$1,850	$2,000	$2,200	$2,000,000
3.02		Reinforced Concrete to walls inclusive of concrete, reinforcing and formwork	S	400mm wall thickness	m3	788	876	1,051	$3,000	$3,500	$4,000	$3,064,600
3.03		Walkways between reactor zones	S	Webforge open grating 4kPa, all MSG	m2	150	180	270	$1,000	$1,100	$1,500	$198,000
3.04		Handrails around reactor walkways	S	Mono wills, 2m c-c, 2 Rail + Kicker MSG	m	300	360	540	$350	$400	$500	$144,000
3.05		2 x Staircase from ground level 6m up towalkways on top of reactor walls	S	Webforge open grating 4kPa, all MSG	m rise	10	11	12	$3,500	$3,720	$4,000	$40,920
3.09		R/C Tilt slab blower & MCC building	S	30m x 8m (1 x 50m wall shared with reactor), 12m x 8m blowers + 8m x 8m for MCC. Metal roofing on steel framing with precast walls on concrete slab.	m2	192	240	288	$2,500	$3,000	$3,500	$720,000

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
3.06	Reactor Mech.	Mixers	M	1 per pre-annox, 2 per main reactor	ea	10	12	18	$18,000	$25,000	$40,000	$300,000
3.07		Internal A-Recycle pipe Laid on reactor base)	M	900mm dia, PN8 PE pipe length of reactor. Laid on reactor floor through wall penetrations.	m	130	162	195	$750	$1,000	$1,250	$162,400
3.08		A-Recycle pump & strap on flow meter	M	Supply and install	ea	4	4	4	$36,000	$45,000	$90,000	$180,000
3.10		Blowers, complete with hot air extraction system/cooling fans, air inlet louvres, silencers and acoustic shrouds, isolation & NRVs	M	110 kW Blowers - from ATV model	ea	5	5	6	$100,000	$116,000	$150,000	$580,000
3.07		Diffusers and main aeration pipework complete with grid pipework, support system, control valves & isolation valves	M	Supply and install	Sum	4	4	4	$472,000	$590,000	$708,000	$2,360,000
3.08		MLSS Line from Reactors to MBR	M	assume 600mm diameter SS above ground	m	80	100	110	$2,500	$3,000	$4,500	$300,000
3.09		Instrumentation	I	Reactor instrumentation allowance	Sum	1	1	1	$144,000	$180,000	$216,000	$180,000
3.11		Weir plates	M	Nominal allowance for weir plates.	Sum	1	1	1	$5,000	$7,500	$10,000	$7,500
3.08		Pipework, valves etc.	M		Sum	4	4	4	$142,400	$178,000	$213,600	$712,000
3.09		Penstocks, valves etc.	M		Sum	4	4	4	$48,000	$60,000	$72,000	$240,000
	Reactor Electrical	Upgrade of the electrical system	E		Sum	4	4	4	$223,000	$247,000	$322,000	$988,000
		Programming and commissioning	E		Sum	4	4	4	$38,000	$50,000	$62,000	$200,000
		Hardware (MCC Drives, Starters PLC IO)	E		Sum	4	4	4	$40,000	$47,762	$95,524	$191,048
		Cabling (Power and control incl installation)	E		Sum	4	4	4	$20,000	$23,881	$47,762	$95,524
		Installation labour	E		Sum	4	4	4	$30,000	$35,822	$71,643	$143,286
		PLC/SCADA P&C	E		Sum	4	4	4	$25,000	$29,851	$59,703	$119,405
4	**MBR**										MBR Subtotal:	$26,025,212
4.17		Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	New MBR tank to suit the requirements of the MBR system vendor	m³	123	144	173	$1,850	$2,000	$2,200	$287,745

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.18	MBR Tank Structural	Includes: Concrete structure reinforced walls with allowances for formwork and tall narrow channel dividing walls	S	300mm thick walls, 7 trains assumption	m³	231	254	279	$3,000	$3,500	$4,000	$887,809
4.19		Foundation ring beam - Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	800 to 1000mm x 350mm ground beams	m³	23	28	34	$1,850	$2,000	$2,200	$56,932
4.20		Coating System to concrete	S	Coating system to be applied to all walls and floors in the MBR flow splitter & membrane tanks	Sum	1	1	1	$1,760,000	$1,760,000	$2,346,667	$1,760,000
4.21		Overhead Crane	S	Overhead crane over the MBR Tank area	Sum	1	1	1	$417,000	$626,000	$834,000	$626,000
4.22		Handrail	S		m	81	81	108	$350	$400	$500	$32,533
4.23		Staircases and Platforms	S	Access staircase onto tank	Sum	1	2	3	25,000	$50,000	$75,000	$100,000
4.24		Grating system over tank	S	FRP or equivalent	m2	411	452	497	$725	$1,000	$1,500	$452,170
4.25		Mechanical Equipment	M	Sump pumps and mixers	Sum	1	1	1	$547,000	$646,000	$676,000	$646,000
4.26		Stoplogs and Penstocks	M	SS Penstocks and Aluminium stoplogs	Sum	1	1	1	$158,000	$221,000	$315,000	$221,000
4.27	MBR Process Building Structural	Steel structure with PC Panel construction - building to house all MBR equipment. Rate inclusive of HVAC, fire protection and plumbing and drainage.	S	38m x 18m building assumed building to house all membrane trains	m²	359	718	862	$2,000	$3,000	$3,500	$2,154,869
4.28	Permeate Tank Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	12x15m slab - 300mm thick	m³	54	54	81	$1,850	$2,000	$2,200	$108,000
4.29	RAS Pumpstation Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	12x18m slab - 200mm thick	m³	43	43	65	$1,850	$2,000	$2,200	$86,400
4.30		MBR Equipment, RAS pumps and permeate tanks	M	incl. UF Filtration system - cassette hollow fibre units with all necessary pumping equipment, valves and controls Dry mount submersible pumps 30kL SS304 tanks	Sum	1.0	1.0	1.0	$7,970,000	$9,280,000	$12,461,000	$9,280,000
4.31		Installation of above	M		%	10%	13%	20%	$9,280,000	$9,280,000	$9,280,000	$1,206,400
4.32		Permeate Pipework from Cassettes to Pumps	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN500 pipes	m	144	180	360	$1,250	$1,750	$2,500	$315,000
4.33		Permeate Pipework from Pumps with connection to Final Effluent Line - Above ground	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN1000 FRP or SS header	m	20	30	40	$1,200	$4,000	$6,400	$120,000
4.34		Permeate Pipework from Pumps with connection to Final Effluent Line - Belowground	M	FRP Pipework DN1400 FRP	m	32	40	60	$2,400	$3,000	$4,800	$120,000

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
4.35	MBR Tank Mechanical	MBR Aeration Pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 2 x DN 600	m	100	134	170	$2,500	$3,000	$4,500	$402,000
4.36		RAS pumpstation pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 4 x 800mm SS lines from PS above ground	m	350	400	500	$5,000	$6,750	$7,750	$2,700,000
4.37		RAS pumpstation pipe bridge	M	HDG MS Pipe bridge. Rate to include foundations	Ea	8	12	16	$15,000	$25,000	$30,000	$300,000
4.38		Valves	M	Manual isolating valves	Sum	1	1	1	$610,000	$1,500,000	$1,780,000	$1,500,000
4.39		Stopboards	M	Aluminium stoplogs/boards - nominal 4-5m deep	Sum	1	1	1	$340,000	$490,000	$810,000	$490,000
		MBR Mech Installation Allowance	M	Installation of the above mech. Items	%	10%	13%	20%	$2,033,500	$2,033,500	$2,033,500	$264,355
4.40	MBR Electrical	Electrical general incl. MCC, cable supports, cables, materials, effort	E	All sums scaled down from Pukete using 2/3 power law. Most instrumentation will be provided with MBR system already	Sum	1	1	1	$945,000	$1,575,000	$3,150,000	$1,575,000
4.41		Instrumentation	I		Sum	1	1	1	$63,000	$95,000	$126,000	$95,000
4.42		Controls	I		Sum	1	1	1	$32,000	$95,000	$126,000	$95,000
4.43		Programming and FAT	I		Sum	1	1	1	$32,000	$48,000	$63,000	$48,000
4.44		Process Commissioning	I		Sum	1	1	1	$63,000	$95,000	$126,000	$95,000
5	**Tertiary Treatment**										UV Subtotal	$6,466,905
5.1	Disinfection											
5.2	UV Channel	Bottom of channel, incl 2 x channels	S	RC Slab 350mm thick	m³	17	18	28	$1,850	$2,000	$2,200	$36,680
5.3		3 x Channel walls + allowance for inlet and outlet structures	S	RC walls 250mm thick	m³	32	36	43	$2,000	$3,000	$3,500	$108,225
5.4	UV Plant House	Allowance for UV Plant House	S	3604 100mm Mesh Slab. 90x45 Framing, PB insulated, Ply Lining, Steel cladding. No windows. Heat pump.	m2	24	30	36	$1,500	$2,000	$3,500	$60,000
5.5	UV Disinfection Plant	Supply and Install UV Modules.	M	Trojan Signa Modules ex Napier quote	Sum	1	1	1	$1,023,300	$1,137,000	$1,478,100	$1,137,000
5.6	UV Electrical	Electrical General	E	General allowance for non-included electrical; tie-in	Sum	1	1	1	$100,000	$125,000	$150,000	$125,000
6	**Outfall / Disposal**											
	Outfall pipeline	From WWTP to river, distrance TBC	C	PE DN900	m	500	1000	2000	$3,000	$4,000	$5,000	$4,000,000

Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
	Outfall Diffuser	Allowance for complete outfall diffuser	C	Installed in river	Sum	1	1	1	$800,000	$1,000,000	$2,000,000	$1,000,000
6	**Digestion & Gas**										Digestion Subtotal	$17,409,024
6.01	4 x Digesters Structural	14.8m diameter tank - ring beam foundations	S	Site Concrete	m²	804	804	1528	$20	$50	$75	$40,212
6.02			S	RC Floor Slab (400 thick)	m³	1287	1287	2445	$2,000	$2,200	$2,500	$2,830,952
6.03			S	Ring Beam (1.5m wide and 750mm thick)	m³	247	247	495	$2,000	$2,200	$2,500	$544,281
6.04		Precast Panels -supply and erect (250mm th	S	14.8m Diameter Tank - Precast panels with post tensioning. Tank walls are 8m high. Walls are insulated	m³	204	226	484	$4,500	$5,000	$6,000	$1,017,684
6.05		Post tensioning of walls	S		Sum	3	4	5	$75,000	$100,000	$150,000	$400,000
6.06		DIGESTER ROOF	S	14.8m diameter - min & max to include floating and membrane options	Ea	4	4	4	$129,000	$544,000	$750,000	$2,176,000
6.07		Digester Insulation - excluding cladding	S		Sum	3	4	5	$109,758	$131,710	$174,230	$526,839
6.08		Staircase and platform allowances	S		Sum	1	1	1	$92,250	$123,000	$153,750	$123,000
6.09		Architectural Features	S		Sum	2	2	2	$125,000	$185,000	$250,000	$370,000
6.10		Allowance for gallery	S	Allowance for gallery or like	Sum	1	1	1	$65,000	$93,000	$125,000	$93,000
6.11	Digester Pump Room Structural	Pump room based on Pukete Acid Digester Pump Room and scaled up for digestion volume of 6000m³ total - refer to existing drawings for information assume 22 x 17m	S	Insitu Site Concrete	m²	374	374	374	$20	$50	$75	$18,700
6.12			S	Insitu RC Floor Slab (500 thick)	m³	187	187	187	$1,850	$2,000	$2,200	$374,000
6.13		Pump room based on Acid Digester Pump Room - refer to existing drawings for information	S	Precast Panels -supply and errect (350mm average thickness	m³	98	98	147	$2,000	$3,000	$3,500	$294,000
6.14			S	Precast Panels for the roof -supply and errect (300mm average thick)	m2	280	280	420	$3,000	$4,000	$4,500	$1,120,280
6.15		Allowances for building structure ontop of pump room	S	Tilt slab panel system with architectural features	m³	158	158	237	$3,500	$4,000	$4,500	$632,400
		New meso LP blowers	M	15kW motor	ea	4	6	6	$30,000	$40,000	$50,000	$240,000

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
	Digester Mechanical	LP Gas pipework	M	Pipework to be gas compliant and includes fire rated valves DN150 SCH10 Gas lines from the digester roofs to suction side of blowers - allowances for manifold and centralised location of blowers	m	50	75	85	$2,000	$2,500	$3,000	$187,500
		New slab for blowers at ground level	M	Blowers are 2x1.5m 6x5m - 250mm thick Reinforced concrete slab	m2	15	25	35	$1,000	$1,500	$2,000	$37,500
		Installation of the blowers/ mechanical equipm	M		%	10%	15%	20%	$40,000	$40,000	$40,000	$6,000
6.16		Sludge Feed Pumps	M	Borger Pumps	ea	4	6	6	$16,000	$20,000	$24,000	$120,000
6.17		Digester Outlet/Supernatant pumps	M	Submersibles	ea	4	6	6	$9,600	$12,000	$14,400	$72,000
6.18		Heat exchangers	M	Lackeryby or Spiral	ea	3	4	5	$93,600	$117,000	$140,400	$468,000
6.19		Recirculation pumps	M	Submersibles	ea	3	4	5	$9,600	$12,000	$14,400	$48,000
6.20		Hotwater Circulation Pumps	M	Single stage centrifugal	ea	4	6	6	$4,800	$6,000	$7,200	$36,000
6.21		Digester Mixing Pumps	M	Dry mounted submersibles per existing	ea	12	16	16	$16,000	$ 20,000.00	$30,000	$320,000
6.22		Supernatant wetwell	M	FRP wet well with external pumps	Sum	1	1	1	$50,000	$75,000	$100,000	$75,000
6.23		Digester feed pipework	M	SS Sch 10 piping - DN150	m	50	125	150	$1,000	$1,250	$1,500	$156,250
6.24		Digester Supernatant pipework	M	SS Sch 10 piping - DN150	m	50	65	70	$1,000	$1,250	$1,500	$81,250
6.25		Digester Mixing pipework	M	SS Sch 10 piping - DN150 - Fully insulated	Sum	3	4	5	$ 106,000.00	$ 131,000.00	$ 156,000.00	$524,000
6.26		Hotwater Circulation Network	M	Insulated mild steel pipework - DN150	m	100	250	300	$1,000	$1,500	$2,000	$375,000
6.27		Isolation valves - digester valving only	M	Plug valves	ea	60	80	100	$2,500	$3,500	$5,000	$280,000
6.28		Tie into existing system	M	Various tie-ins	Sum	1	1	1	$20,000	$30,000	$40,000	$30,000
6.29		Installation of mechanical equipment	M		%	10%	15%	20%	2,585,500	2,585,500	2,585,500	$387,825
	Digester Electrical	Electrical upgrades	E		Sum	1	1	1	$200,000	$216,000	$250,000	$216,000
		Instrumentation and Controls	I		Sum	1	1	1	$150,000	$185,000	$200,000	$185,000
		Programming and FAT	I		Sum	1	1	1	$75,000	$95,000	$115,000	$95,000
		Digestion Process Commissioning	E		Sum	1	1	1	$150,000	$185,000	$200,000	$185,000
		Cogen Building	S	Building to house all Cogen equipment	m²	57	63	95	$3,500	$4,000	$4,500	$252,000
		RC Slab	S	250mm thk	m³	14	16	24	$1,850	$2,000	$2,200	$28,350

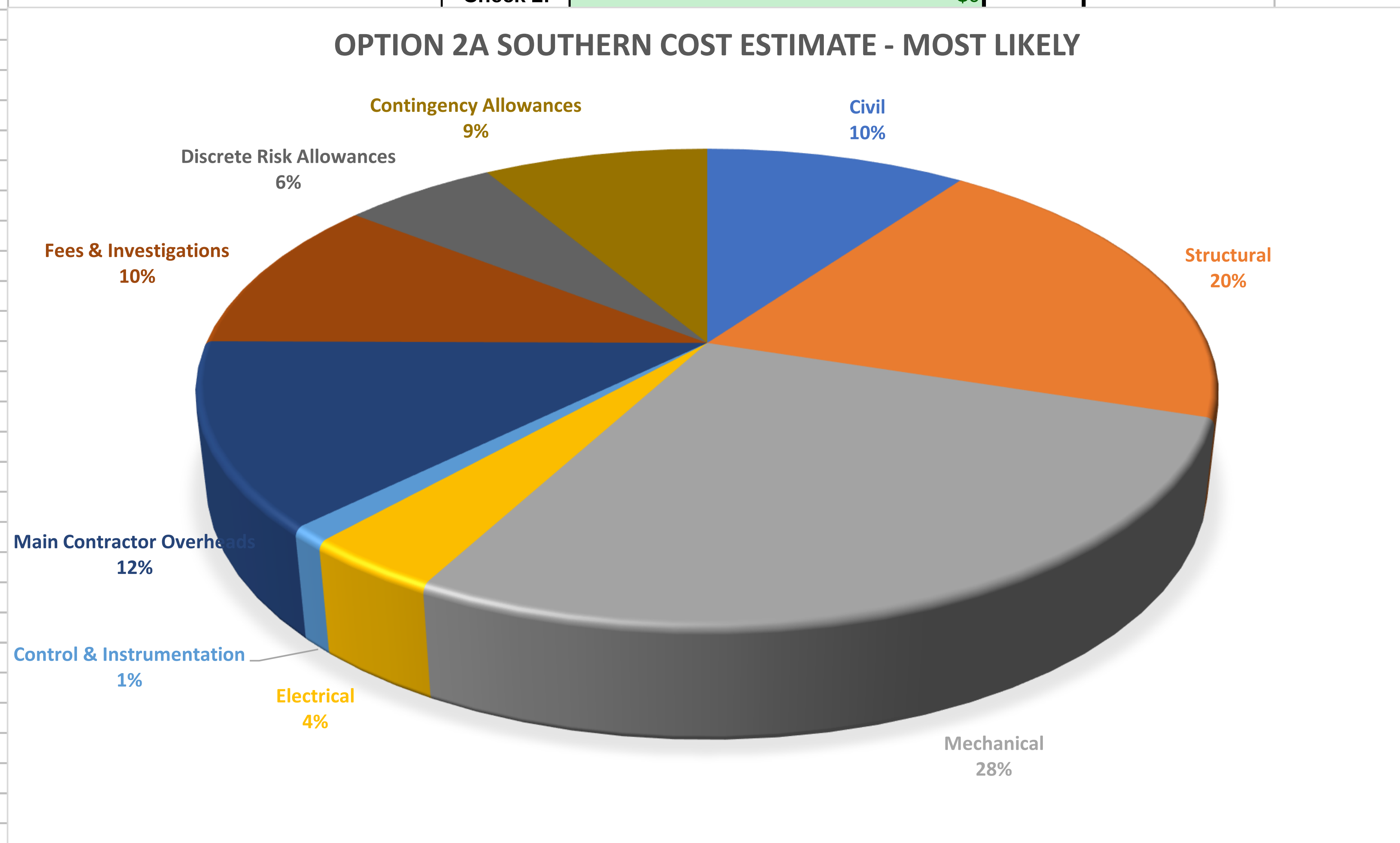
	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
	Gas Handling	Mechanical Equipment. Based on 307kW electricity available in ATV model digester sheet	M	Incl: Biogas scrubber/gas conditioning, Biogas Engine, Heat dump, installation, and pipework	Sum	1	1	1	$1,146,000	$1,910,000	$3,903,000	$1,910,000
		Electrical - General for Cogen	E	Incl: General tie into main MCC, P&C, instrumentation, power change over and controls.	Sum	1	1	1	$336,000	$532,000	$838,000	$532,000
7	**Solids Handling**										Dewatering Subtota	$6,699,000
7.1	Dewatering Building		S		m²	608	675	810	$2,500	$3,000	$3,500	$2,025,000
7.2	Dewatering Mechanical	FRP Pumpstation	M	Allowance for FRP Pumpstation	Sum	1	1	1	$180,000	$200,000	$240,000	$200,000
7.3	Dewatering	Polymer Make up and feed system	M		Sum	1	1	1	$3,030,400	$3,788,000	$5,682,000	$3,788,000
7.4		Allowance for drainage facilities	C									
7.5		Centrifuges	M									
7.6		Load Out Screws	M									
7.7		Dewatered Cake skips	M	12m3 Skip bin for moving by hook Truck		3	4	5	$50,000	$100,000	$150,000	$400,000
7.8		Sludge Holding Tank	M	2 tanks, 2 days storage from digestion 1100m³ storage	Sum	2	2	2	$114,400	$143,000	$171,600	$286,000
8	**Anitamox Centrate Treatment**										Anitamox Subtotal	$4,494,250
8.1	Insitu Concrete - for tank											
	Site Concrete	8x16m tank which is 4m tall x 2	S		m2	256	282	535	$20	$50	$75	$12,800
	RC Floor Slab (250 thick)		S		m³	64	70	134	$1,850	$2,000	$2,200	$128,000
	Ring Beam (1.5m wide and 500mm th		S		m³	72	50	94	$1,850	$2,000	$2,200	$144,000
	Precast Concrete- for tank											
	Precast Panels -supply and errect (25	Precast panels . Tank walls are 4m high	S		m³	49	54	81	$4,000	$5,000	$6,000	$243,000
	Staircase and platform allowances	Per around the digester	S		Sum	1	1	1	$75,000	$100,000	$125,000	$100,000
	Insitu Concrete - for blower building											
	Site Concrete	5x5m building - to be acoustically treated	S		m2	25	28	52	$20	$50	$75	$1,250
	RC Floor Slab (250 thick)		S		m³	6	7	13	$1,850	$2,000	$2,200	$12,500
	Building - moderate construction		S		m³	20	25	35	$2,500	$3,500	$4,000	$70,000
	MBBR Equipment	MBBR equipment for Anammox side stream treatment	M	Based on quotation from Veolia - ANITA MOX process	Sum	1	1	1	$2,494,800	$2,772,000	$4,158,000	$2,772,000

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
	Effluent tranfer wetwell	FRP wet well with external pumps	M	2m diameter - assume 3m deep	Sum	1	1	1	$34,000	$51,000	$68,000	$51,000
	Pumps to transfer the effluent from the MBBR tank back to the headworks	Submersibles	M		ea	2	3	3	$7,333	$11,000	$14,667	$33,000
	Aeration Blowers	Nominal allowance - 3000m3/hr - 30kW blowers	M		ea	2	3	3	$10,286	$24,000	$34,286	$72,000
	Aeration piping	SS Sch 10 piping - DN300	M	10-25m of pipework	m	10	25	50	$1,500	$2,000	$2,500	$50,000
	Tie into existing system	Various tie-ins	M	Nominal allowance for connecting to existing system	Sum	1	1	1	$14,000	$21,000	$28,000	$21,000
	Installation of mechanical equipment		M		%	2,546,419	2,858,000	4,274,952	10%	15%	20%	$428,700
	Pipework from the new pumpstation to t	New 225 PE100 return line - includes trenching	M		Sum	1	1	1	$17,000	$34,000	$51,000	$34,000
	Electrical upgrades		E		Sum	1	1	1	$67,333	$101,000	$134,667	$101,000
	Instrumentation and Controls		I		Sum	1	1	1	$34,000	$68,000	$102,000	$68,000
	Programming and FAT		I		Sum	1	1	1	$34,000	$51,000	$68,000	$51,000
	Process Commissioning		E		Sum	1	1	1	$67,333	$101,000	$266,667	$101,000
6	**Electrical & Control**									Electrical General Sub		$2,196,000
6.1	Electrical - General	MCC	E	1000kVa.	Sum	1	1	1	$848,000	$1,060,000	$1,378,000	$1,060,000
6.2		Incomer	E									
6.3		Allowance for Site wide power, Instrument and control cabling, cable support & ducting	E									
6.4		General Lighting and small power	E	Small DBs, task & security lighting, 3 Ph task outlets								
6.5	Control	Instrumentation, HMI, SCADA, PLC, Telemetry	I			1	1	1	$240,000	$300,000	$390,000	$300,000
6.6		Software	I		sum	1	1	1	$107,000	$200,000	$300,000	$200,000
6.6	Electrical Ancilliaries	Standby Generator	M	assume 1000kvA	Sum	1	1	1	$486,000	$540,000	$702,000	$540,000
6.7		Fire Prevention or Extinguisher System	M	VESDA Early Alarm system + Inert Gas Supression system	Sum	1	1	1	$20,000	$30,000	$120,000	$30,000
6.8		Transformer Blast wall	S		m2	6	9	12	$300	$1,000	$1,200	$9,000
6.10		Allowance to have Network company supply new 1000kVA transformer	E	1000kVA	sum	1	1	1	0	$57,000	$113,000	$57,000
7	**Other Utilities**											
7.1		Misc site services, drainage, etc	C		Sum	1	1	1	$20,000	$25,000	$50,000	$25,000

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
8	**Sub-Total - Physical Works**									%		**$105,354,457**
8.1	Contractor Preliminary & General		OH		%	$105,354,457	$105,354,457	$105,354,457	15%	20%	25%	$21,070,891
8.2	Design and Project Management	Concept design	F		Sum	$126,425,348	$126,425,348	$126,425,348	1%	2%	3%	$2,528,507
8.3		Preliminary & detailed design	F			$126,425,348	$126,425,348	$126,425,348	6%	8%	10%	$10,114,028
8.4		Procurement	F			$126,425,348	$126,425,348	$126,425,348				$0
8.5		Construction supervision	F			$126,425,348	$126,425,348	$126,425,348	3%	4%	6%	$5,057,014
8.6		Council Internal costs	F			$126,425,348	$126,425,348	$126,425,348				$0
	Consents & Investigations											
8.7		Site Survey & Prep Terrain Model	F		Sum	1	1	1	$15,000	$20,000	$25,000	$20,000
8.8		HAIL Investigation & Consent	F		Sum	1	1	1	$16,000	$18,000	$26,000	$18,000
		Site Designation	F		Sum				$300,000	$500,000	$700,000	$0
8.9		Discharge Consent	F		Sum				$1,200,000	$1,600,000	$2,000,000	$0
		Geotechnical Field Investigations	C		Sum	1	1	1	$40,000	$100,000	$200,000	$100,000
8.1		Geotechnical Investigations & Interpretation	F		Sum	1	1	1	$30,000	$40,000	$60,000	$40,000
9	**Gross Construction Cost Estimate**											**$144,302,897**
10	**Allowances for Risk Register Items and Residual Uncertainty**											
10.1	Saturated construction market		RA		Sum	$144,302,897	$144,302,897	$144,302,897	0	5%	10%	$7,215,145
10.2	FOREX Risk	Foreign exchange risk on imported M&E plant	RA		Sum	$52,999,269	$52,999,269	$52,999,269	-10%	5%	15%	$2,649,963
10.3	Allowance for Design Development Contingency		CA		Sum	$144,302,897	$144,302,897	$144,302,897	0%	5%	10%	$7,215,145
10.4	Allowance for Construction Phase Risk Contingency		CA		Sum	$144,302,897	$144,302,897	$144,302,897	0%	5%	10%	$7,215,145
		GAS Storage vessel - risk allowance	M	If need additional storage to digester roof	Sum	0	1	1	$400,000	$500,000	$600,000	$500,000
11	**Total Expected Cost Estimate**										20%	**$169,098,295**

Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
Asset Type Totals - Most Likely		**Code**			**Respread**	**Total**				**Cost Breakdown (Direct only)**	
Direct Works	Civil	C	$ 16,731,123	10%	$9,970,957	$26,702,080	16%			Civil	$10,006,123
	Structural	S	$ 33,948,064	20%	$20,231,438	$54,179,503	32%			Inlet Works	$9,252,583
	Mechanical	M	$ 47,170,005	28%	$28,111,089	$75,281,094	45%			Primary Treatment	$9,853,675
	Electrical	E	$ 6,329,264	4%	$3,771,942	$10,101,206	6%			Reactors	$12,926,684
	Control & Instrumentation	I	$ 1,776,000	1%	$1,058,412	$2,834,412	2%			MBR	$26,025,212
										UV	$6,466,905
Indirect Works	Main Contractor Overheads	OH	$ 21,070,891	12%						Digestion	$17,409,024
	Fees & Investigations	F	$ 17,777,549	11%						Solids Handling	$6,699,000
	Discrete Risk Allowances	RA	$ 9,865,108	6%						Electrical General	$2,196,000
	Contingency Allowances	CA	$ 14,430,290	9%						Other Utilities	$25,000
	Direct Works Total		**$ 105,954,457**	63%							
	Indirect Works Total		**$ 63,143,838**	37%							
	Total Expected Cost Estimate		**$ 169,098,295**	100%		**$169,098,295**	100%				
		Check 1:	$0								
		Check 2:	$0								
Total											
Cumulative Total											



Project	**Metro DBC Southern WWTPs Development**	
Phase	Shortlist Design Development	
Version	4A Cambridge Standalone WWTP	
Purpose	Cost estimation	
Estimate Class	5	
Quantities Prepared by	C McRobie	11/11/2020
Rates Prepared by	C McRobie; J Crawford	11/11/2020
Reviewed By	R Verbeek	30/11/2020
Amended		

Basic Dimensions of Plant

Cambridge site	**Length:**	**Width:**	**Area:**	**Perim:**	**Water Depth**	**Total Volume**
Walls		0.4		3620		
Total Site (approx)	368	80	29440	1034		
Inlet Works	30	20	600	100	-	
Primary Treatment	24.0	20	480	88	5	2400
MBR Fine Screens	15.0	10	150			
Reactors	27.0	27.0	729	108	5	3645
Blower/MCC Room	30.0	8.0	240			
MBR tank	18.8	9.4	176	56		
MBR building	38.1	18.8	716	114		
Dewatering Building	40	20	800	120		
Admin Building	20	20	400	80		
Digesters		11.5	499	36	5.75	
Anitamox	12	6	72	36		
Carpark	40	20	800	120		
Maintenance/MCC E	20	20	400	80		
UV Channels	12	3	36	30	2.4	
Current Ponds for fill in			21675			
UV building	6	5	30	22		
Cogen Building	8	6	48	28		

Option 4A Cambridge WWTP

	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity Min**	**Quantity ML**	**Quantity Max**	**Rate Min**	**Rate ML**	**Rate Max**	**Most Likely**
1	**Siteworks and Civil**										Civil Subtotal	$10,532,876
1.1	Form & Maintain temporary site access for construction purposes.		C		m2	200	400	800	$25	$30	$45	$12,000
1.2	Platform Development	Site stripping & Tree Removal	C	Unlikely to be any, cambridge site well established	m2	0	736	1,472	$1.50	$3.00	$5.00	$2,208
1.3		Strip contaminated topsoil to landscaping bunds within the site	C	Likely to be majority of site - leftover from previous WWTP	m2	26,496	29,440	29,440	$5.00	$6.00	$7.00	$176,640
1.4		Undercut to stockpile all process unit and building site to -1m	C	Assume 1m deep. Cut to waste on site.	m3	6,860	7,620	8,380	$10	$12	$15	$91,440
		Foundation improvement below subgrade formation level to mitigate potential liquifaction and provide for IL3 structural solution	C		Sum	1	1	1	$3,000,000	$5,000,000	$10,000,000	$5,000,000

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
1.5		Supply, place and compact in layers imported fill. Assume AP65 or similar.	C	Assume AP65 or similar - sourced locally.	m3	5,140	5,715	6,860	$70	$90	$100	$514,350
1.6		Recompact excavated granular fill	C	Uplift and place from stockpile immediately adjacent excavation	m3	1,720	1,905	1,520	$10	$12	$15	$22,860
1.7		Allow to install two layers geogrid in recompacted fill	C	Quantitiy multiplies treated area by 2. So, total area of geogrid used.	m2	3,440	3,810	3,040	$5.00	$7.00	$9.00	$26,670
1.8		Spread and roll surplus excavated material somewhere on the wider site <500m.	C		m3	5,140	5,715	17,145	$10	$12	$15	$68,580
		Desludging of existing polishing ponds Majority of site to exist on current pond area. Reclamation of entire pond system.	C	Excavate solids from lagoon (as practicable, based on level of dryness), transport approximately 25 km to Te Awamutu WWTP (569 Paterangi Rd) and dispose in monofill. Include removal of brush in excavation.	m³				$16	$17	$20	$0
		Fill in of ponds	C	assume ponds 2m deep avg Fill with AP65 or similar sourced locally	m³				$70	$90	$100	$0
		Upgrade to formal Entry Gate	C		Sum	1	1	1	$50,000	$65,000	$80,000	$65,000
			C									
1.9	Internal Circulation Road	Around new reactor, PSTs, dewatering MBR and admin building - sealed	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	3,751	4,689	5,627	$150	$180	$190	$844,038
1.10	Internal Circulation Road	Around plant perimeter - unsealed	C	Allows for basecourse and surfacing (but no nib kerb nor drainage) 8m wide	m2	6,800	7,520	8,300	$30	$45	$200	$338,400
1.11	Security Fencing	Temporary for construction period	C	Including double gates, say 12 months, internal "new" site only	m	827	1,034	1,344	$50	$60	$70	$62,040
1.12	Security Fencing	Upgrade fencing of entire existing site	C	From new access area to behind inlet work. Include two sets of double gates. Manual. Whole site.	m	1,810	3,620	4,706	$75	$120	$180	$434,400
1.13	Create Influent Calamity Pond	Earthworks to form Bund. Grassed, no liner, within existing oxidation pond	C	Likely able to use existing aeration pond, anaerobic pond or other - therefore no upgrade required	m3	0	0	0	$25	$30	$40	$0

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
1.14		Sump for return pumping + return ps	C	concrete sump say 3m diameter x 6m deep with apron	Sum	1	1	1	$400,000	$500,000	$1,000,000	$500,000
1.15		Return to ILW Pipeline	C	400mm PE. From sump	m	56	70	140	$300	$400	$450	$28,000
1.16	Operator Building	3604 house: Lab, Lunch room, Bathroom, Operator station, Hall	C		m2	300	400	600	$2,500	$3,000	$3,500	$1,200,000
	Visitor and Staff Car parking		C		m2	640	800	960	$250	$400	$500	$320,000
	Maintenance and Store Building		C		m2	320	400	800	$1,500	$2,000	$2,500	$800,000
1.17	Misc Plant Slabs	Miscellaneous 30MPa 250mm thick plant slabs not allowed for elsewhere.	C	30MPa RC	m2	40	60	100	$375	$438	$500	$26,250
2	**Inlet works**										ILW Subtotal	$4,749,660
2.1	Screening Structure	Includes: Construction, inlet works equipment, odour control system & dayworks - installed	S	All concrete structures, per linked drawing	Sum	1	1	1	$1,769,062	$1,879,360	$1,989,659	$1,879,360
2.2	Grit	Supply and install new Vortex Grit System Complete Channels, Vortex Chamber, Grit pum. Classifier	M	All SS Construction. Standing on floor of anoxic reactors	Sum	1	1	1	$179,200	$224,000	$291,200	$224,000
2.3		Post Grit Flow Splitter	M	Short SS Channel	Sum	1	1	1	$8,000	$10,000	$20,000	$10,000
2.4		Biofilter	C		Sum	1	1	1	$40,000	$300,000	$660,000	$300,000
2.5		Incoming Flow Meters Incoming x 1, Recycles x 2	I	Average 600mm Mag in Riser to ILW on reactor end wall. No chambers	Sum	2	3	5	$21,600	$27,000	$32,400	$81,000
	Septage receival system	Allowance for upgrade / tie in to existing	C		Sum	1	1	1	$300,000	$500,000	$700,000	$500,000
2.5		Incoming Flow Meters Incoming CBWWTP x 1, Recycles x 2	I	Average 300mm Mag in Riser to ILW on reactor end wall. No chambers	Sum	2	3	5	$17,600	$22,000	$26,400	$66,000
4.01	Pretreatment Structural	Pre treatment area	S	Incl: Fine screening facility, washpress slab, covers, Access stairways and platforms	Sum	1.0	1.0	1.0	$202,400	$253,000	$303,600	$253,000

Option 4A Cambridge WWTP

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
4.02	Pretreatment Mechanical	New MBR Fine Screens	M	Centreflow municipal bandscreens (based on 2 screens capable of treating 1800L/s total)	Ea	3	3	4	$91,200	$114,000	$136,800	$342,000
4.03		Launder	M	Supply to site 316L screening launder and receiving distribution box to convey flume water/screenings from the screens to wash presses, c/w screening discharge control knife gates and DN250/300 pipework.	Ea	1	1	1	$125,000	$150,000	$200,000	$150,000
4.04		New screening handling equipment	M	DUTY/STANDBY unit - sized based on feedback from Brickhouse	Ea	2	2	2	$70,000	$88,000	$95,000	$176,000
4.05		Installation of new equipment for pretreatment area only	M		%	10%	15%	20%	$286,200	$352,000	$431,800	$52,800
4.06		Penstocks (pneumatic) Includes: Frames, gates and pneumatic actuators	M	Supply to site 1.5mx3.5m penstock valves for isolation purposes, c/w support frame and supports.	Ea	3	3	3	$19,200	$24,000	$28,800	$72,000
4.07		Stoplogs Includes: SS frames and UHMV polyethylene side seals and neoprene flush invert seal.	M	Supply to site 1.2mx3.5m aluminium stoplogs for isolation purposes	Ea	4	6	6	$8,800	$11,000	$13,200	$66,000
4.08		Redirecting influent from the IPS to the screening facility	M	2x DN450 lines - A/G SS and U/G 475mm PE	m	15	25	35	$2,500	$3,000	$4,500	$75,000
4.09		Redirecting effluent from the facility to the bioreactors	M	2x600-1000mm SS lines - gravtiy lines	m	15	25	35	$5,000	$7,500	$8,500	$187,500
4.10		Isolating valves	M	Valves on redirected influent and effluent lines	Sum	1	1	1	$35,000	$47,000	$71,000	$47,000
4.11		Washwater pipework	M	New SS316 washwater network for equipment	Sum	1	1	1	$8,000	$11,000	$15,000	$11,000
4.12		Odour Control	M	BTF Unit - 12ACH and rated for 1500m3/hr. Inclusive of ducting and fans	Sum	1	1	1	$79,000	$94,000	$110,000	$94,000
4.13	Pretreatment Electrical & Instrumentatio	Electrical general	E	incl. motor control centre to finescreen, allowance for site wide power, instrument and control cabling, cable support and ducting, general lighting and small power	Sum	1	1	1	$95,200	$119,000	$142,800	$119,000
4.14		Instrumentation	I	Software dev. & integration	Sum	1	1	1	$8,000	$16,000	$24,000	$16,000
4.15			I	Flowmeters	ea	1	2	2	$7,000	$8,000	$11,000	$16,000
4.16			I	General instrumentation allowances for level	Sum	1	1	1	$13,000	$12,000	$12,000	$12,000
3	**Primary Treatment**										Primary Subtotal	$5,826,575
	PST Tank Structure	Floors	S	Reinforced Concrete to floors inclusive of concrete, reinforcing and formwork includes strip ftgs	m³	192	240	288	$1,850	$2,000	$2,200	$480,000
		Walls	S	Reinforced Concrete to walls inclusive of concrete, reinforcing and formwork including tall narrow walls	m³	153	191	229	$3,000	$3,500	$4,000	$669,200

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
		Scum Hopper	S	Allowance for scum hopper concrete works at higher rate than standard floor slab	m³	36	45	53	$2,000	$2,500	$3,000	$111,250
		Galleries / Access Area Allowance	S	On per metre basis	m	16	20	24	$22,000	$25,000	$28,000	$500,000
	PST Mechanical	Scum hopper	M	Collector with helical mechanism and collection chamber	Sum	4	4	4	$11,200	$14,000	$16,800	$56,000
		Scum scrapers	M	PST longitudinal and cross scrapers	Sum	4	4	4	$53,600	$67,000	$80,400	$268,000
		Primary Effluent discharge weirs	M	Longitudinal V-Notch weirs 316 SS or FRP rectangular weirs * say 15m long. Section say 300 side walls and 300 base width	Sum	4	6	8	$15,000	$20,000	$25,000	$120,000
		Primary sludge pumps	M	Progressive cavity, 2 per PST	ea	8	8	8	$11,200	$14,000	$16,800	$112,000
		PS suction pipework	M	DN150 SS SCH 10	m	40	80	160	$1,250	$2,000	$2,500	$160,000
		PS discharge pipework	M	DN150 SS SCH 10	m	115	130	150	$1,250	$2,000	$2,500	$260,000
		PS discharge valves	M	150mm plug valves	ea	8	8	8	$2,500	$3,500	$4,500	$28,000
		Primary scum pump	M	air driven diaphragm pump, nominal allowance and include connection to compressed air line	ea	4	4	4	$4,000	$5,000	$6,000	$20,000
		Primary scum pipework and valves	M	DN100, discharge into PST line	m	4	4	4	$1,250	$2,000	$2,500	$8,000
		PST drainage system	M	DN150 PVC piping into sump system with pump. Underneath galleries with a DN2000 sump and 2x small drainage pumps. Water returned to headworks.	Sum	4	4	4	$20,000	$25,000	$30,000	$100,000
		Scum removal header and pipework in PST	M		Sum	4	4	4	$24,000	$30,000	$36,000	$120,000
		Scum removal blower	M	2 x blowers per PST to be installed	Sum	8	8	8	$6,400	$8,000	$9,600	$64,000
		Water spray system	M		Sum	4	4	4	$16,000	$20,000	$24,000	$80,000
		PST installation of mechanical equipment	M	PST equipment inside the tank only	%	10%	15%	20%	$64,800	$212,500	$97,200	$31,875
		Vendor support	M		%	5%	10%	15%	$64,800	$212,500	$97,200	$21,250
	PST Electrical	General Electrical Upgrade / PST	E		Sum	4	4	4	$75,000	$100,000	$125,000	$400,000
		Programming and Commissioning	I	PLC SCADA P&C	Sum	4	4	4	$20,000	$30,000	$40,000	$120,000
	PST Testing and Commissioning	Hydrostatic testing	I		Sum	1	1	1	$10,000	$10,000	$15,000	$10,000
		Commissioning of PST	I		Sum	1	1	1	$30,000	$50,000	$65,000	$50,000
	Interstage Pumpstation	Allowance for IPS	M	PST to Reactors	Sum	1	1	1	$1,629,600	$2,037,000	$2,444,400	$2,037,000
3	**Reactor**										Reactor Subtotal:	$8,034,492
3.01	Reactor Structure	Reinforced Concrete to floors inclusive of concrete, reinforcing and formwork	S	Total tank block area x 0.5 500mm floor thickness	m3	333	365	437	$1,850	$2,000	$2,200	$729,000
3.02		Reinforced Concrete to walls inclusive of concrete, reinforcing and formwork	S	400mm wall thickness	m3	492	546	656	$3,000	$3,500	$4,000	$1,912,680

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
3.03		Walkways between reactor zones	S	Webforge open grating 4kPa, all MSG	m2	90	108	162	$1,000	$1,100	$1,500	$118,800
3.04		Handrails around reactor walkways	S	Mono wills, 2m c-c, 2 Rail + Kicker MSG	m	180	216	324	$350	$400	$500	$86,400
3.05		2 x Staircase from ground level 6m up towalkways on top of reactor walls	S	Webforge open grating 4kPa, all MSG	m rise	10	11	12	$3,500	$3,720	$4,000	$40,920
3.09		R/C Tilt slab blower & MCC building	S	30m x 8m (1 x 50m wall shared with reactor), 12m x 8m blowers + 8m x 8m for MCC. Metal roofing on steel framing with precast walls on concrete slab.	m2	192	240	288	$2,500	$3,000	$3,500	$720,000
3.06	Reactor Mech.	Mixers	M	1 per pre-annox, 2 per main reactor	ea	10	12	18	$18,000	$25,000	$40,000	$300,000
3.07		Internal A-Recycle pipe Laid on reactor base)	M	900mm dia, PN8 PE pipe length of reactor. Laid on reactor floor through wall penetrations.	m	99	123	148	$750	$1,000	$1,250	$123,200
3.08		A-Recycle pump & strap on flow meter	M	Supply and install	ea	4	4	4	$24,000	$30,000	$36,000	$120,000
3.10		Blowers, complete with hot air extraction system/cooling fans, air inlet louvres, silencers and acoustic shrouds, isolation & NRVs	M	55 kW Blowers - from ATV model	ea	4	4	4	$50,000	$73,000	$125,000	$292,000
3.07		Diffusers and main aeration pipework complete with grid pipework, support system, control valves & isolation valves	M	Supply and install	Sum	4	4	4	$310,400	$388,000	$465,600	$1,552,000
3.08		MLSS Line from Reactors to MBR	M	assume 600mm diameter	m	40	47	56	$2,500	$3,000	$4,500	$141,000
3.09		Instrumentation	I		Sum	1	1	1	$96,000	$120,000	$144,000	$120,000
3.11		Weir plates	M		Sum	1	1	1	$5,000	$7,500	$10,000	$7,500
3.08		Pipework, valves etc.	M		Sum	4	4	4	$93,600	$117,000	$140,400	$468,000
3.09		Penstocks, valves etc.	M		Sum	4	4	4	$31,200	$39,000	$46,800	$156,000
	Reactor Electrical	Upgrade of the electrical system	E		Sum	4	4	4	$147,000	$163,000	$211,000	$652,000
		Programming and commissioning	E		Sum	4	4	4	$25,000	$33,000	$41,000	$132,000
		Hardware (MCC Drives, Starters PLC IO)	E		Sum	4	4	4	$26,000	$31,045	$62,091	$124,181
		Cabling (Power and control incl installation)	E		Sum	4	4	4	$13,000	$15,523	$31,045	$62,091

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
		Installation labour	E		Sum	4	4	4	$20,000	$23,881	$47,762	$95,524
		PLC/SCADA P&C	E		Sum	4	4	4	$17,000	$20,299	$40,598	$81,196
4	**MBR**										MBR Subtotal:	$14,780,696
4.17	MBR Tank Structural	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	New MBR tank to suit the requirements of the MBR system vendor Assume 3 trains, 0.35 thk	m³	53	62	74	$1,850	$2,000	$2,200	$123,319
4.18		Includes: Concrete structure reinforced walls with allowances for formwork and tall narrow channel dividing walls	S	300mm thick walls	m³	112	123	135	$3,000	$3,500	$4,000	$429,615
4.19		Foundation ring beam - Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	800 to 1000mm x 350mm ground beams	m³	16	20	24	$1,850	$2,000	$2,200	$39,436
4.20		Coating System to concrete	S	Coating system to be applied to all walls and floors in the MBR flow splitter & membrane tanks	Sum	1	1	1	$1,040,000	$1,040,000	$1,386,667	$1,040,000
4.21		Overhead Crane	S	Overhead crane over the MBR Tank area	Sum	1	1	1	$237,000	$356,000	$474,000	$356,000
4.22		Handrail	S		m	56	56	75	$350	$400	$500	$22,535
4.23		Staircases and Platforms	S	Access staircase onto tank	Sum	1	2	3	25,000	$50,000	$75,000	$100,000
4.24		Grating system over tank	S	FRP or equivalent	m2	159	159	174	$725	$1,000	$1,500	$158,553
4.25		Mechanical Equipment	M	Sump pumps and mixers	Sum	1	1	1	$271,000	$323,000	$338,000	$323,000
4.26		Stoplogs and Penstocks	M	SS Penstocks and Aluminium stoplogs	Sum	1	1	1	$79,000	$110,000	$157,000	$110,000
4.27	MBR Process Building Structural	Steel structure with PC Panel construction - building to house all MBR equipment. Rate inclusive of HVAC, fire protection and plumbing and drainage.	S	38m x 18m building	m²	358	716	860	$2,000	$3,000	$3,500	$2,148,840
4.28	Permeate Tank Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	12x15m slab - 300mm thick	m³	54	54	81	$1,850	$2,000	$2,200	$108,000
4.29	RAS Pumpstation Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	12x18m slab - 200mm thick	m³	43	43	65	$1,850	$2,000	$2,200	$86,400
4.30		MBR Equipment, RAS pumps and permeate tanks	M	incl. UF Filtration system - cassette hollow fibre units with all necessary pumping equipment, valves and controls Dry mount submersible pumps 30kL SS304 tanks	Sum	1.0	1.0	1.0	$3,958,000	$4,609,000	$6,189,000	$4,609,000
4.31		Installation of above	M		%	10%	13%	20%	$4,609,000	$4,609,000	$4,609,000	$599,170
4.32		Permeate Pipework from Cassettes to Pumps	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN500 pipes	m	72	90	108	$1,250	$1,750	$2,500	$157,500

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.33	MBR Tank Mechanical	Permeate Pipework from Pumps with connection to Final Effluent Line - Above ground	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN800 FRP or SS header	m	20	30	40	$1,200	$4,000	$6,400	$120,000
4.34		Permeate Pipework from Pumps with connection to Final Effluent Line - Belowground	M	FRP Pipework DN1000 FRP	m	72	90	135	$2,500	$3,000	$5,000	$270,000
4.35		MBR Aeration Pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 2 x DN 600	m	86	96	144	$2,500	$3,000	$4,500	$288,000
4.36		RAS pumpstation pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 4 x 500mm SS lines from PS above ground	m	240	300	360	$3,750	$5,000	$5,500	$1,500,000
4.37		RAS pumpstation pipe bridge	M	HDG MS Pipe bridge. Rate to include foundations	Ea	8	12	16	$15,000	$25,000	$30,000	$300,000
4.38		Valves	M	Manual isolating valves	Sum	1	1	1	$300,000	$590,000	$880,000	$590,000
4.39		Stopboards	M	Aluminium stoplogs/boards - nominal 4-5m deep	Sum	1	1	1	$170,000	$240,000	$400,000	$240,000
		MBR Mech Installation Allowance	M	Installation of the above mech. Items	%	10%	13%	20%	$871,750	$871,750	$871,750	$113,328
4.40	MBR Electrical	Electrical general incl. MCC, cable supports, cables, materials, effort	E	All sums scaled down from Pukete using 2/3 power law. Most instrumentation will be provided with MBR system already	Sum	1	1	1	$470,000	$783,000	$1,565,000	$783,000
4.41		Instrumentation	I		Sum	1	1	1	$32,000	$47,000	$63,000	$47,000
4.42		Controls	I		Sum	1	1	1	$16,000	$47,000	$63,000	$47,000
4.43		Programming and FAT	I		Sum	1	1	1	$16,000	$24,000	$32,000	$24,000
4.44		Process Commissioning	I		Sum	1	1	1	$32,000	$47,000	$63,000	$47,000
5	**Tertiary Treatment**										UV Subtotal	$2,830,250
5.1	Disinfection											
5.2	UV Channel	Bottom of channel, incl 1 x channels	S	RC Slab 350mm thick	m³	15	16	24	$1,850	$2,000	$2,200	$32,550
5.3		2 x Channel walls + allowance for inlet and outlet structures	S	RC walls 250mm thick	m³	14	16	19	$2,000	$3,000	$3,500	$47,700
5.4	UV Plant House	Allowance for UV Plant House	S	3604 100mm Mesh Slab. 90x45 Framing, PB insulated, Ply Lining, Steel cladding. No windows. Heat pump.	m2	24	30	36	$1,000	$2,000	$3,500	$60,000
5.5	UV Disinfection Plant	Supply and Install UV Modules.	M	Trojan Signa Modules ex Napier quote	Sum	1	1	1	$508,500	$565,000	$734,500	$565,000
5.6	UV Electrical	Electrical General	E	General allowance for non-included electrical; tie-in	Sum	1	1	1	$100,000	$125,000	$150,000	$125,000
	Outfall / Disposal											
5.7	Outfall pipeline		C	PE DN600	m	400	500	800	$2,000	$3,000	$4,000	$1,500,000

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
5.8	Outfall Diffuser	Allowance for complete outfall diffuser	C	Installed in river	Sum	1	1	1	$400,000	$500,000	$1,000,000	$500,000
6	**Digestion & Gas**										Digestion Subtotal	$11,894,564
6.01	4 x 600m3 Digesters Structural	11.5m diameter tank - ring beam foundations	S	Site Concrete	m²	415	415	789	$20	$50	$75	$20,774
6.02			S	RC Floor Slab (400 thick)	m³	665	665	1263	$2,000	$2,200	$2,500	$1,462,474
6.03			S	Ring Beam (1.5m wide and 750mm thick)	m³	184	184	368	$2,000	$2,200	$2,500	$404,323
6.04		Precast Panels -supply and errect (250mm th	S	11.5m Diameter Tank - Precast panels with post tensioning. Tank walls are 6m high. Walls are insulated	m³	117	130	264	$2,000	$3,000	$3,500	$351,101
6.05		Post tensioning of walls	S		Sum	3	4	5	$75,000	$100,000	$150,000	$400,000
6.06		DIGESTER ROOF	S	11.5m diameter - min & max to include floating and membrane options	Ea	4	4	4	$67,000	$460,000	$750,000	$1,840,000
6.06		Digester Insulation - excluding cladding	S		Sum	3	4	5	$59,586	$71,503	$94,587	$286,012
6.07		Staircase and platform allowances	S		Sum	1	1	1	$50,250	$67,000	$83,750	$67,000
6.08		Architectural Features	S		Sum	4	4	4	$80,800	$101,000	$121,200	$404,000
6.09		Allowance for gallery	S	Allowance for gallery or like	Sum	1	1	1	$65,000	$95,000	$125,000	$95,000
6.10	Digester Pump Room Structural	Pump room based on Pukete Acid Digester Pump Room and scaled up for digestion volume of 6000m³ total - refer to existing drawings for information assume 22 x 17m	S	Insitu Site Concrete	m²	374	374	374	$20	$50	$75	$18,700
6.11			S	Insitu RC Floor Slab (500 thick)	m³	187	187	187	$1,850	$2,000	$2,200	$374,000
6.12		Pump room based on Acid Digester Pump Room - refer to existing drawings for information	S	Precast Panels -supply and errect (350mm average thickness	m³	98	98	147	$2,000	$3,000	$3,500	$294,000
6.13			S	Precast Panels for the roof -supply and errect (300mm average thick)	m2	280	280	420	$3,000	$4,000	$4,500	$1,120,280
6.14		Allowances for building structure ontop of pum	S	Tilt slab panel system with architectural features	m³	158	158	237	$3,500	$4,000	$4,500	$632,400
6.15		Sludge Feed Pumps	M	Borger Pumps	ea	4	6	6	$8,800	$11,000	$13,200	$66,000

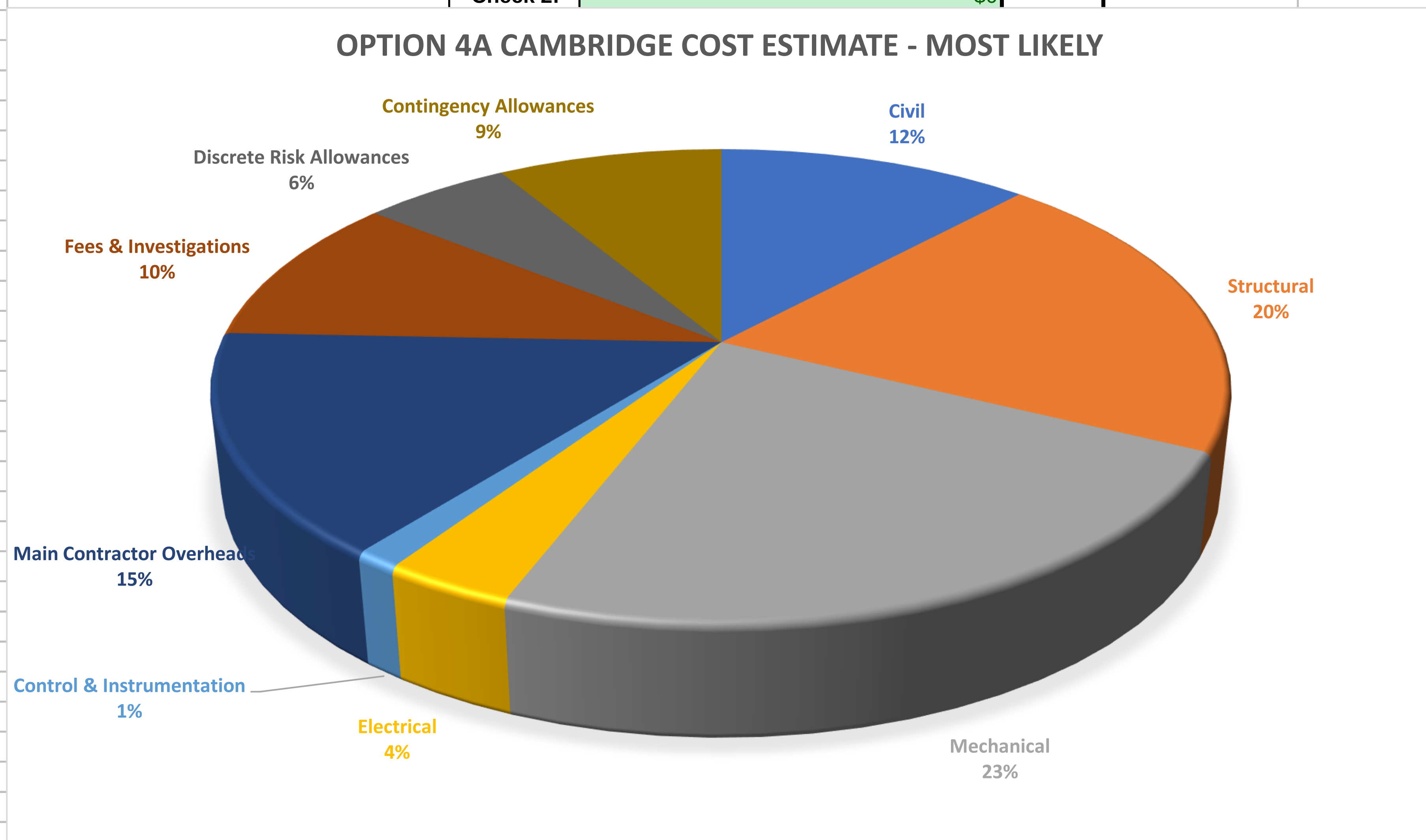
	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
6.16	Digester Mechanical	Digester Outlet/Supernatant pumps	M	Submersibles	ea	4	6	6	$5,600	$7,000	$8,400	$42,000
6.17		Heat exchangers	M	Lackeryby or Spiral	ea	3	4	5	$51,200	$64,000	$76,800	$256,000
6.18		Recirculation pumps	M	Submersibles	ea	3	4	5	$5,600	$7,000	$8,400	$28,000
6.19		Hotwater Circulation Pumps	M	Single stage centrifugal	ea	4	6	6	$3,200	$4,000	$4,800	$24,000
6.20		Digester Mixing Pumps	M	Dry mounted submersibles per existing	ea	12	16	16	$9,000	$ 20,000.00	$30,000	$320,000
6.21		Supernatant wetwell	M	FRP wet well with external pumps	Sum	1	1	1	$50,000	$75,000	$100,000	$75,000
6.22		Digester feed pipework	M	SS Sch 10 piping - DN150	m	50	125	150	$1,000	$1,250	$1,500	$156,250
6.23		Digester Supernatant pipework	M	SS Sch 10 piping - DN150	m	50	65	70	$1,000	$1,250	$1,500	$81,250
6.24		Digester Mixing pipework	M	SS Sch 10 piping - DN150 - Fully insulated	Sum	3	4	5	$ 87,000.00	$ 106,000.00	$ 125,000.00	$424,000
6.25		Hotwater Circulation Network	M	Insulated mild steel pipework - DN150	m	100	250	300	$1,000	$1,500	$2,000	$375,000
6.26		Isolation valves - digester valving only	M	Plug valves	ea	60	80	100	$2,500	$3,500	$5,000	$280,000
6.27		Tie into existing system	M	Various tie-ins	Sum	1	1	1	$20,000	$30,000	$40,000	$30,000
6.28		Installation of mechanical equipment	M		%	10%	15%	20%	736,000	736,000	736,000	$110,400
	Digester Electrical	Electrical upgrades	E		Sum	1	1	1	$93,600	$117,000	$140,400	$117,000
		Instrumentation and Controls	I		Sum	1	1	1	$80,800	$101,000	$121,200	$101,000
		Programming and FAT	I		Sum	1	1	1	$76,000	$95,000	$114,000	$95,000
		Digestion Process Commissioning	E		Sum	1	1	1	$80,800	$101,000	$121,200	$101,000
	Gas Handling	Cogen Building	S		m²	43	48	72	$3,500	$4,000	$4,500	$192,000
		RC Slab	S	250mm thk	m³	11	12	18	$1,850	$2,000	$2,200	$21,600
		Mechanical Equipment. Based on 110kW electricity available in ATV model digester sheet	M	Incl: Biogas scrubber/gas conditioning, Biogas Engine, Heat dump, installation, and pipework	Sum	1	1	1	$577,000	$961,000	$1,963,000	$961,000
		Electrical - General for Cogen	E	Incl: General tie into main MCC, P&C, instrumentation, power change over and controls.	Sum	1	1	1	$169,000	$268,000	$422,000	$268,000
7	**Solids Handling**										Dewatering Subtotal	$4,922,000
7.01	Dewatering Building		S		m²	720	800	960	$2,500	$3,000	$3,500	$2,400,000

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
7.02	Dewatering Mechanical	FRP Pumpstation	M	Allowance for FRP Pumpstation	Sum	1	1	1	$180,000	$200,000	$240,000	$200,000
7.03	Dewatering	Polymer Make up and feed system	M		Sum	1	1	1	$1,537,600	$1,922,000	$2,883,000	$1,922,000
7.04		Allowance for drainage facilities	C									
7.05		Centrifuges	M									
7.06		Load Out Screws	M									
7.07		Dewatered Cake skips	M	12m3 Skip bin for moving by hook Truck		3	4	5	$50,000	$100,000	$150,000	$400,000
7.08		Sludge Holding Tank	M	2 tanks, 2 days storage from digestion	Sum	2	2	2	$59,200	$74,000	$88,800	$148,000
	Odour destruction System	use same as for inlet works										
8	**Anitamox Centrate Treatment**										Anitamox Subtotal	$2,216,650
8.1	Insitu Concrete - for tank											
	Site Concrete	5x10m tank which is 3m tall x 2	S		m2	100	110	209	$20	$50	$75	$5,000
	RC Floor Slab (250 thick)		S		m³	25	28	52	$1,850	$2,000	$2,200	$50,000
	Ring Beam (1.5m wide and 500mm thi		S		m³	45	50	94	$1,850	$2,000	$2,200	$90,000
	Precast Concrete- for tank											
	Precast Panels -supply and errect (25(	Precast panels . Tank walls are 4m high	S		m³	24	26	39	$2,000	$3,000	$3,500	$70,875
	Staircase and platform allowances	Per around the digester	S		Sum	1	1	1	$75,000	$100,000	$125,000	$100,000
	Insitu Concrete - for blower building											
	Site Concrete	5x5m building - to be acoustically treated	S		m2	6	6	11	$20	$50	$75	$275
	RC Floor Slab (250 thick)		S		m³	1	2	3	$1,850	$2,000	$2,200	$2,750
	Building - moderate construction		S		m³	20	25	35	$2,500	$3,500	$4,000	$70,000
	MBBR Equipment	MBBR equipment for Anammox side stream treatment	M	Based on quotation from Veolia - ANITA MOX process	Sum	1	1	1	$1,168,200	$1,298,000	$1,947,000	$1,298,000
	Effluent tranfer wetwell	FRP wet well with external pumps	M	2m diameter - assume 3m deep	Sum	1	1	1	$34,000	$51,000	$68,000	$51,000
	Pumps to transfer the effluent from the MBBR tank back to the headworks	Submersibles	M		ea	2	3	3	$3,333	$5,000	$6,667	$15,000
	Aeration Blowers	Nominal allowance - 3000m3/hr - 30kW blowers	M		ea	2	3	3	$4,714	$11,000	$15,714	$33,000
	Aeration piping	SS Sch 10 piping - DN300	M	10-25m of pipework	m	10	25	50	$1,500	$2,000	$2,500	$50,000
	Tie into existing system	Various tie-ins	M	Nominal allowance for connecting to existing system	Sum	1	1	1	$6,667	$10,000	$13,333	$10,000
	Installation of mechanical equipment		M		%	1,210,248	1,365,000	2,037,381	10%	15%	20%	$204,750
	Pipework from the new pumpstation to tl	New 225 PE100 return line - includes trenching	M		Sum	1	1	1	$8,000	$16,000	$24,000	$16,000
	Electrical upgrades		E		Sum	1	1	1	$31,333	$47,000	$62,667	$47,000
	Instrumentation and Controls		I		Sum	1	1	1	$16,000	$32,000	$48,000	$32,000
	Programming and FAT		I		Sum	1	1	1	$16,000	$24,000	$32,000	$24,000
	Process Commissioning		E		Sum	1	1	1	$31,333	$47,000	$266,667	$47,000

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
6	**Electrical & Control**										Electrical General Subtotal	$1,821,000
6.1	Electrical - General	MCC	E	1000kVa								
6.2		Incomer	E									
6.3		Software	E		Sum	1	1	1	$628,800	$786,000	$1,021,800	$786,000
6.4		Allowance for Site wide power, Instrument and control cabling, cable support & ducting	E									
6.5		General Lighting and small power	E	Small DBs, task & security lighting, 3 Ph task outlets								
6.6	Control	Instrumentation, HMI, SCADA, PLC, Telemetry	I			1	1	1	$240,000	$300,000	$390,000	$300,000
6.7		Software	I		Sum	1	1	1	$93,000	$173,000	$259,000	$173,000
					Sum							
6.7	Electrical Ancilliaries	Standby Generator	M	1000kVA	Sum	1	1	1	$419,400	$466,000	$605,800	$466,000
6.8		Fire Prevention or Extinguisher System	M	VESDA Early Alarm system + Inert Gas Supression system	Sum	1	1	1	$20,000	$30,000	$120,000	$30,000
6.9		Transformer Blast wall	S		m2	6	9	12	$300	$1,000	$1,200	$9,000
6.10		Allowance to have Network company supply new 1000kVA transformer	E	1000kVA	sum	1	1	1	0	$57,000	$113,000	$57,000
7	**Other Utilities**											
7.1		Misc site services, drainage, etc	C		Sum	1	1	1	$20,000	$25,000	$50,000	$25,000
8	**Sub-Total - Physical Works**									%		**$67,781,763**
8.1	Contractor Preliminary & General		OH		%	$67,781,763	$67,781,763	$67,781,763	20%	25%	30%	$16,945,441
	Brown Field Development	Allow ance for greenfield development complications, temporary pipes, temporary process configurations, non ideal plant layout	OH		%	$0	$0	$0	3%	7%	10%	$0
8.2	Design and Project Management	Concept design	F		Sum	$84,727,204	$84,727,204	$84,727,204	1%	2%	3%	$1,694,544
8.3		Preliminary & detailed design	F			$84,727,204	$84,727,204	$84,727,204	6.0%	7.5%	11%	$6,354,540

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
8.4		Procurement	F			$84,727,204	$84,727,204	$84,727,204				$0
8.5		Construction supervision	F			$84,727,204	$84,727,204	$84,727,204	3%	4%	6%	$3,389,088
8.6		Council Internal costs	F			$84,727,204	$84,727,204	$84,727,204				$0
	Consents & Investigations											
8.7		Site Survey & Prep Terrain Model	F		Sum	1	1	1	$6,000	$6,000	$10,000	$6,000
8.8		HAIL Investigation & Consent	F		Sum	1	1	1	$16,000	$18,000	$26,000	$18,000
		Site Designation	F		Sum				$0	$0	$0	$0
8.9		Discharge Consent	F		Sum				$1,000,000	$1,400,000	$1,800,000	$0
8.1		Geotechnical Investigations & Interpretation	F		Sum	1	1	1	$30,000	$40,000	$60,000	$40,000
9	**Gross Construction Cost Estimate**											**$96,229,377**
10	**Allowances for Risk Register Items and Residual Uncertainty**											
10.1	Saturated construction market		RA		Sum	$96,229,377	$96,229,377	$96,229,377	0	5%	10%	$4,811,469
10.2	FOREX Risk	Foreign exchange risk on imported M&E plant	RA		Sum	$30,007,764	$30,007,764	$30,007,764	-10%	5%	15%	$1,500,388
10.3	Allowance for Design Development Contingency		CA		Sum	$96,229,377	$96,229,377	$96,229,377	0%	5%	10%	$4,811,469
10.4	Allowance for Construction Phase Risk Contingency		CA		Sum	$96,229,377	$96,229,377	$96,229,377	0%	5%	10%	$4,811,469
		GAS Storage vessel - risk allowance	M	If need additional storage to digester roof	Sum	0	1	1	$400,000	$500,000	$600,000	$500,000
11	**Total Expected Cost Estimate**										19%	**$112,664,171**

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
	Asset Type Totals - Most Likely		Code			Respread	Total				Cost Breakdown (Direct only)	
	Direct Works	Civil	C	$ 13,357,876	12%	$8,682,475	$22,040,351	20%			Civil	$10,532,876
		Structural	S	$ 23,035,123	20%	$14,972,581	$38,007,704	34%			Inlet Works	$4,749,660
		Mechanical	M	$ 26,510,773	24%	$17,231,716	$43,742,488	39%			Primary Treatment	$5,826,575
		Electrical	E	$ 3,996,992	4%	$2,598,002	$6,594,993	6%			Reactors	$8,034,492
		Control & Instrumentation	I	$ 1,381,000	1%	$897,635	$2,278,635	2%			MBR	$14,780,696
											UV+ outfall	$2,830,250
	Indirect Works	Main Contractor Overheads	OH	$ 16,945,441	15%						Digestion	$11,894,564
		Fees & Investigations	F	$ 11,502,173	10%						Solids Handling	$4,922,000
		Discrete Risk Allowances	RA	$ 6,311,857	6%						Electrical General	$1,821,000
		Contingency Allowances	CA	$ 9,622,938	9%						Other Utilities	$25,000
		Direct Works Total		**$ 68,281,763**	61%							
		Indirect Works Total		**$ 44,382,408**	39%							
		Total Expected Cost Estimate		**$ 112,664,171**	100%		**$112,664,171**	100%				
			Check 1:	$0								
			Check 2:	$0								
	Total											
	Cumulative Total											



Project	**Metro DBC Southern WWTPs Development**	
Phase	Shortlist Design Development	
Version	4A Southern V1	
Purpose	Cost estimation	
Estimate Class	5	
Quantities Prepared by	C McRobie	11/11/2020
Rates Prepared by	C McRobie, J Crawford	11/11/2020
Reviewed By	R Verbeek	30/11/2020
Amended		

Basic Dimensions of Plant

Southern site	Length:	Width:	Area:	Perim:	Water Depth	Total Volume
Walls		0.4				
Total Site	200	140	28000	680		
Inlet Works	20	20	400	80	-	
Primary Treatment			0	0		0
MBR Fine Screens	12.0	8	96	40		
Reactors	23.2	22.5	522	91	4.5	2349
Blower/MCC Room	25.0	8.0	200	66		
MBR tank	18.8	6.2	117	50		
MBR building	18.5	17.4	322	72		
Dewatering Building	30	15	450	90		
Carpark	20	30	600	100		
Admin Building	15	10	150	50		
SHT		4	60	13	4	241
UV Building	12	6	72	36		
Maintenance/MCC b	20	20	400	80		

Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
1	**Siteworks and Civil**										Civil Subtotal	$6,765,818
1.1	Form & Maintain temporary site access for construction purposes.		C		m2	100	200	400	$25	$30	$45	$6,000
1.2	Platform Development	Site stripping & Tree Removal	C	Site not decided, as little as zero and as much as whole site	m2	0	14,000	28,000	$1.50	$3.00	$5.00	$42,000
1.3		Strip contaminated topsoil to landscaping bunds within the site	C		m2	0	14,000	28,000	$5.00	$6.00	$7.00	$84,000
1.4		Undercut to stockpile all process unit and building site to -1m	C	Assume 1m deep. Cut to waste on site.	m3	3,370	3,740	4,490	$10	$12	$15	$44,880
		Foundation improvement below subgrade formation level to mitigate potential liquifaction and provide for IL3 structural solution	C		Sum	1	1	1	1,500,000	2,000,000	4,000,000	$2,000,000
1.5		Supply, place and compact in layers imported fill. Assume AP65 or similar.	C	Assume AP65 or similar - sourced locally.	m3	2,520	2,805	3,370	$70	$90	$100	$252,450

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
1.6		Recompact excavated granular fill	C	Uplift and place from stockpile immediately adjacent excavation	m3	850	935	1,120	$10	$12	$15	$11,220
1.7		Allow to install two layers geogrid in recompacted fill	C	Quantitiy multiplies treated area by 2. So, total area of geogrid used.	m2	1,700	1,870	2,240	$5.00	$7.00	$9.00	$13,090
1.8		Spread and roll surplus excavated material somewhere on the wider site <500m.	C		m3	2,520	2,805	8,415	$10	$12	$15	$33,660
		Entry from Public Road	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	1,000	2,000	8,000	$150	$180	$190	$360,000
		Ditto - Drainage for entry	C		m	125	250	1,000	$100	$150	$300	$37,500
		Formal Entry Gate	C		Sum	1	1	1	$50,000	$65,000	$80,000	$65,000
1.9	Internal Circulation Road	Around new reactor, PSTs, dewatering MBR and admin building - sealed	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	3,131	3,914	4,697	$150	$180	$190	$704,568
1.10	Internal Circulation Road	Around plant perimeter - unsealed	C	Allows for basecourse and surfacing (but no nib kerb nor drainage) 8m wide	m2	4,900	5,440	6,000	$30	$45	$200	$244,800
1.11	Security Fencing	Temporary for construction period	C	Including double gates, say 12 months	m	544	680	884	$50	$60	$70	$40,800
1.12	Security Fencing	Fencing of the new site	C	From new access area to behind inlet work. Include two sets of double gates. Manual. Whole site.	m	340	680	884	$75	$120	$180	$81,600
1.13	Create Influent Calamity Pond	Earthworks to form Bund. Grassed, no liner, within existing oxidation pond	C	Approx 9000 m3 storage x ave 1.5m deep 150m long bund, 2m high, 2:1 side slopes and 4m top width	Sum	0	1	1	$400,000	$600,000	$1,200,000	$600,000
1.13		Sump for return pumping	C	Fully formed concrete sump say 3m diameter x 3m deep with apron	Sum	1	1	1	$300,000	$400,000	$800,000	$400,000
1.14		Return to ILW Pipeline	C	400mm PE approx	m	56	70	140	$300	$400	$450	$28,000
	Visitor and Staff Car parking		C		m2	480	600	720	$250	$400	$500	$240,000
	Maintenance and Store Building		C		m2	320	400	800	$2,000	$2,500	$3,500	$1,000,000

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
1.15	Operator Building	3604 house: Lab, Lunch room, Bathroom, Operator station, Hall	C		m2	113	150	225	$2,500	$3,000	$3,500	$450,000
1.16	Misc Plant Slabs	Miscellaneous 30MPa 250mm thick plant slabs not allowed for elsewhere.	C	30MPa RC	m2	40	60	100	$375	$438	$500	$26,250
2	**Inlet works**										ILW Subtotal	$3,650,700
2.1	Screening Structure	Includes: Construction, inlet works equipment, odour control system & daywaorks - installed	S	All concrete structures, per linked drawing	Sum	1	1	1	$1,003,000	$1,065,500	$1,128,000	$1,065,500
2.2	Grit	Supply and install new Vortex Grit System Complete Channels, Vortex Chamber, Grit pum. Classifier	M	All SS Construction. Standing on floor of anoxic reactors	Sum	1	2	2	$84,000	$105,000	$136,500	$210,000
2.3		Post Grit Flow Splitter	M	Short SS Channel	Sum	1	1	1	$20,000	$30,000	$40,000	$30,000
2.4		Biofilter	C		Sum	1	1	1	$40,000	$300,000	$660,000	$300,000
2.5		Incoming Flow Meters Incoming x 1, Recycles x 2	I	Average 300mm Mag in Riser to ILW on reactor end wall. No chambers	Sum	3	4	5	$14,400	$18,000	$21,600	$72,000
4.01	MBR Pretreatment Structural	Pre treatment area	S	Incl: Fine screening facility, washpress slab, covers, Access stairways and platforms	Sum	1.0	1.0	1.0	$115,200	$144,000	$172,800	$144,000
4.02		New MBR Fine Screens	M	Centreflow municipal bandscreens (based on 2 screens capable of treating 1800L/s total)	Ea	2	3	4	$240,000	$300,000	$360,000	$900,000
4.03		Launder	M	Supply to site 316L screening launder and receiving distribution box to convey flume water/screenings from the screens to wash presses, c/w screening discharge control knife gates and DN250/300 pipework.	Ea	1	1	1	$125,000	$150,000	$200,000	$150,000
4.04		New screening handling equipment	M	DUTY/STANDBY unit - sized based on feedback from Brickhouse	Ea	2	2	2	$70,000	$88,000	$95,000	$176,000
4.05		Installation of new equipment for pretreatment area only	M		%	10%	15%	20%	$435,000	$538,000	$655,000	$80,700
4.06		Penstocks (pneumatic) Includes: Frames, gates and pneumatic actuators	M	Supply to site 1.5mx3.5m penstock valves for isolation purposes, c/w support frame and supports.	Ea	3	3	3	$11,200	$14,000	$16,800	$42,000
4.07	MBR Pretreatment Mechanical	Stoplogs Includes: SS frames and UHMV polyethylene side seals and neoprene flush invert seal.	M	Supply to site 1.2mx3.5m aluminium stoplogs for isolation purposes	Ea	4	6	6	$4,800	$6,000	$7,200	$36,000
4.08		Redirecting influent from the IPS to the screening facility	M	2x DN450 lines - A/G SS and U/G 475mm PE	m	15	25	35	$2,500	$3,000	$4,500	$75,000

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
4.09	MBR Pretreatment Electrical & Instrume	Redirecting effluent from the facility to the bioreactors	M	2x600-1000mm SS lines - gravtiy lines	m	15	25	35	$5,000	$7,500	$8,500	$187,500
4.10		Isolating valves	M	Valves on redirected influent and effluent lines	Sum	1	1	1	$20,000	$27,000	$41,000	$27,000
4.11		Washwater pipework	M	New SS316 washwater network for equipment	Sum	1	1	1	$5,000	$7,000	$9,000	$7,000
4.12		Odour Control	M	BTF Unit - 12ACH and rated for 1500m3/hr. Inclusive of ducting and fans	Sum	1	1	1	$45,000	$54,000	$63,000	$54,000
4.13		Electrical general	E	incl. motor control centre to finescreen, allowance for site wide power, instrument and control cabling, cable support and ducting, general lighting and small power	Sum	1	1	1	$54,400	$68,000	$81,600	$68,000
4.14		Instrumentation	I	Software dev. & integration	Sum	1	1	1	$5,000	$9,000	$14,000	$9,000
4.15			I	Flowmeters	ea	1	2	2	$4,000	$5,000	$7,000	$10,000
4.16			I	General instrumentation allowances for level	Sum	1	1	1	$4,000	$7,000	$7,000	$7,000
3	**Reactor**										Reactor Subtotal:	$6,477,190
3.01	Reactor Structure	Reinforced Concrete to floors inclusive of concrete, reinforcing and formwork	S	Total tank block area x 0.5 500mm floor thickness	m3	261	313	376	$1,850	$2,000	$2,200	$626,400
3.02		Reinforced Concrete to walls inclusive of concrete, reinforcing and formwork	S	400mm wall thickness	m3	337	375	450	$3,000	$3,500	$4,000	$1,311,100
3.03		Walkways between reactor zones	S	Webforge open grating 4kPa, all MSG	m2	76	91	137	$1,000	$1,100	$1,500	$100,540
3.04		Handrails around reactor walkways	S	Mono wills, 2m c-c, 2 Rail + Kicker MSG	m	152	183	274	$350	$400	$500	$73,120
3.05		2 x Staircase from ground level 6m up towalkways on top of reactor walls	S	Webforge open grating 4kPa, all MSG	m rise	9	10	12	$3,500	$3,720	$4,000	$37,200
3.09		R/C Tilt slab blower & MCC building	S	25m x 8m (1 x 25m wall shared with reactor), 12m x 8m blowers + 8m x 8m for MCC. Metal roofing on steel framing with precast walls on concrete slab.	m2	160	200	240	$2,500	$3,000	$3,500	$600,000
3.06		Mixers	M	1 per pre-annox, 2 per main reactor	ea	7	9	14	$18,000	$25,000	$40,000	$225,000
3.07		Internal A-Recycle pipe Laid on reactor base)	M	450mm dia, PN8 PE pipe length of reactor. Laid on reactor floor through wall penetrations.	m	72	90	108	$750	$1,000	$1,250	$89,600

Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
3.08	Reactor Mech.	A-Recycle pump & strap on flow meter	M	Supply and install	ea	3	3	3	$36,000	$45,000	$54,000	$135,000
3.10		Blowers, complete with hot air extraction system/cooling fans, air inlet louvres, silencers and acoustic shrouds, isolation & NRVs	M	30 kW Blowers - from ATV model	ea	5	5	6	$30,000	$49,000	$100,000	$245,000
3.07		Diffusers and main aeration pipework complete with grid pipework, support system, control valves & isolation valves	M	Supply and install	Sum	4	4	4	$264,000	$330,000	$396,000	$1,320,000
3.08		MLSS Line from Reactors to MBR	M	assume 600mm diameter	m	56	70	84	$650	$750	$1,000	$52,500
3.09		Instrumentation	I		Sum	1	1	1	$108,000	$135,000	$162,000	$135,000
3.11		Weir plates	M		Sum	1	1	1	$5,000	$7,500	$10,000	$7,500
3.08		Pipework, valves etc.	M		Sum	4	4	4	$80,000	$100,000	$120,000	$400,000
3.09		Penstocks, valves etc.	M		Sum	4	4	4	$27,200	$34,000	$40,800	$136,000
	Reactor Electrical	Upgrade of the electrical system	E		Sum	4	4	4	$125,000	$139,000	$180,000	$556,000
		Programming and commissioning	E		Sum	4	4	4	$21,000	$28,000	$35,000	$112,000
		Hardware (MCC Drives, Starters PLC IO)	E		Sum	4	4	4	$23,000	$27,463	$54,926	$109,853
		Cabling (Power and control incl installation)	E		Sum	4	4	4	$12,000	$14,329	$28,657	$57,315
		Installation labour	E		Sum	4	4	4	$17,000	$20,299	$40,598	$81,196
		PLC/SCADA P&C	E		Sum	4	4	4	$14,000	$16,717	$33,433	$66,867
4	**MBR**										MBR Subtotal:	$8,838,490
4.17	MBR Tank Structural	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	New MBR tank to suit the requirements of the MBR system vendor	m³	35	41	49	$1,850	$2,000	$2,200	$82,213
4.18		Includes: Concrete structure reinforced walls with allowances for formwork and tall narrow channel dividing walls	S	300mm thick walls, 2 trains	m³	82	90	99	$3,000	$3,500	$4,000	$315,066
4.19		Foundation ring beam - Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	800 to 1000mm x 350mm ground beams	m³	14	18	21	$1,850	$2,000	$2,200	$35,062
4.20		Coating System to concrete	S	Coating system to be applied to all walls and floors in the MBR flow splitter & membrane tanks	Sum	1	1	1	$690,000	$690,000	$920,000	$690,000
4.21		Overhead Crane	S	Overhead crane over the MBR Tank area	Sum	1	1	1	$181,000	$272,000	$362,000	$272,000
4.22		Handrail	S		m	50	50	67	$350	$400	$500	$20,036

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.23		Staircases and Platforms	S	Access staircase onto tank	Sum	1	2	3	25,000	$50,000	$75,000	$100,000
4.24		Grating system over tank	S	FRP or equivalent	m2	106	106	116	$725	$1,000	$1,500	$105,702
4.25		Mechanical Equipment	M	Sump pumps and mixers	Sum	1	1	1	$91,000	$109,000	$103,000	$109,000
4.26		Stoplogs and Penstocks	M	SS Penstocks and Aluminium stoplogs	Sum	1	1	1	$45,000	$63,000	$89,000	$63,000
4.27	MBR Process Building Structural	Steel structure with PC Panel construction - building to house all MBR equipment. Rate inclusive of HVAC, fire protection and plumbing and drainage.	S	12m x 38m building	m²	322	322	386	$2,000	$3,000	$3,500	$965,543
4.28	Permeate Tank Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	5 x 8m slab - 300mm thick	m³	12	12	18	$1,850	$2,000	$2,200	$24,000
4.29	RAS Pumpstation Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	6x9m slab - 200mm thick	m³	11	11	16	$1,850	$2,000	$2,200	$21,600
4.30	MBR Tank Mechanical	MBR Equipment, RAS pumps and permeate tanks	M	incl. UF Filtration system - cassette hollow fibre units with all necessary pumping equipment, valves and controls Dry mount submersible pumps 30kL SS304 tanks	Sum	1.0	1.0	1.0	$2,250,000	$2,620,000	$3,518,000	$2,620,000
4.31		Installation of above	M		%	10%	13%	20%	$2,620,000	$2,620,000	$2,620,000	$340,600
4.32		Permeate Pipework from Cassettes to Pumps	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN400 pipes	m	42	52	78	$1,429	$2,000	$2,857	$104,000
4.33		Permeate Pipework from Pumps with connection to Final Effluent Line - Above ground	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN600 FRP or SS header	m	20	30	40	$900	$3,000	$4,800	$90,000
4.34		Permeate Pipework from Pumps with connection to Final Effluent Line - Belowground	M	FRP Pipework DN800 FRP	m	32	40	60	$1,667	$2,000	$3,333	$80,000
4.35		MBR Aeration Pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 2 x DN 600	m	88	110	132	$2,500	$3,000	$4,500	$330,000
4.36		RAS pumpstation pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 3 x 450mm SS lines from PS above ground	m	196	245	294	$3,500	$4,750	$5,250	$1,163,750
4.37		RAS pumpstation pipe bridge	M	HDG MS Pipe bridge. Rate to include foundations	Ea	6	9	12	$15,000	$25,000	$30,000	$225,000
4.38		Valves	M	Manual isolating valves	Sum	1	1	1	$170,000	$335,000	$500,000	$335,000

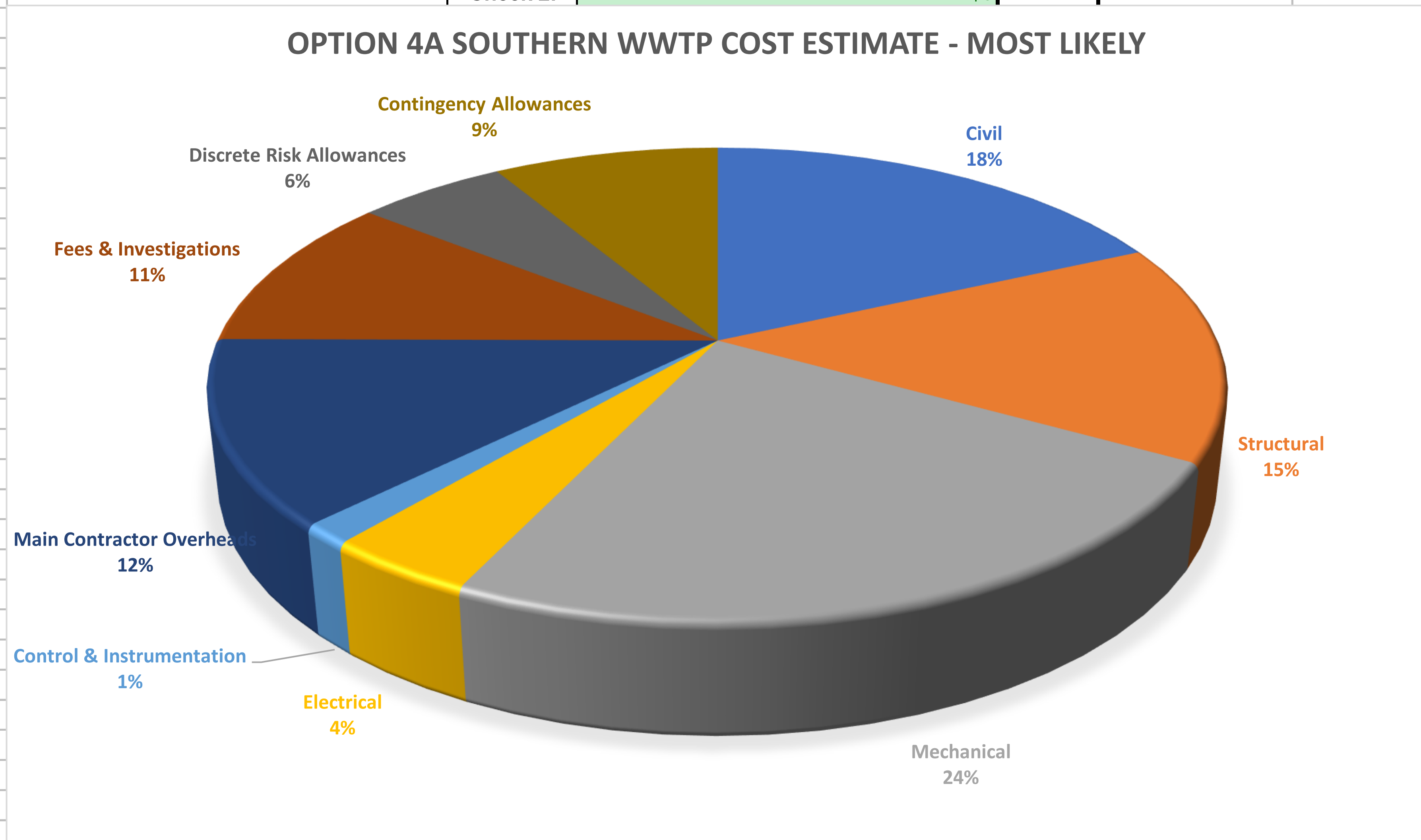
	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.39		Stopboards	M	Aluminium stoplogs/boards - nominal 4-5m deep	Sum	1	1	1	$90,000	$140,000	$230,000	$140,000
		MBR Mech Installation Allowance	M	Installation of the above mech. Items	%	10%	13%	20%	$514,750	$514,750	$514,750	$66,918
4.40		Electrical general incl. MCC, cable supports, cables, materials, effort	E		Sum	1	1	1	$267,000	$445,000	$890,000	$445,000
4.41		Instrumentation	I		Sum	1	1	1	$18,000	$27,000	$36,000	$27,000
4.42	MBR Electrical	Controls	I	All sums scaled down from Pukete using 2/3 power law. Most instrumentation will be provided with MBR system already	Sum	1	1	1	$9,000	$27,000	$36,000	$27,000
4.43		Programming and FAT	I		Sum	1	1	1	$9,000	$14,000	$18,000	$14,000
4.44		Process Commissioning	I		Sum	1	1	1	$18,000	$27,000	$36,000	$27,000
5	**Tertiary Treatment**										UV Subtotal	$3,836,000
5.1	Disinfection											
5.2	UV Plant House	Allowance for UV Plant House	S	3604 100mm Mesh Slab. 90x45 Framing, PB insulated, Ply Lining, Steel cladding. No windows. Heat pump.	m2	97	108	162	$1,500	$2,000	$3,500	$216,000
5.3	UV Disinfection Plant	Supply and Install UV Reactor, floor mounted, enclosed	M	Trojan Signa Modules ex Gisborne quote	Sum	1	1	1	$625,500	$695,000	$903,500	$695,000
5.4	UV Electrical	Electrical General	E	General allowance for non-included electrical; tie-in	Sum	1	1	1	$100,000	$125,000	$150,000	$125,000
6	**Outfall / Disposal**											
	Outfall pipeline	From WWTP to river (site TBC)	C	PE DN450	m	500	1000	2000	$2,000	$2,300	$3,000	$2,300,000
	Outfall Diffuser	Allowance for complete outfall diffuser	C	Installed in river	Sum	1	1	1	$400,000	$500,000	$1,000,000	$500,000
7	**Solids Handling**										Dewatering Subtota	$3,006,000
7.1	Dewatering Building		S		m²	405	450	540	$2,500	$3,000	$3,500	$1,350,000
7.2	Dewatering Mechanical	FRP Pumpstation	M	Allowance for FRP Pumpstation	Sum	1	1	1	$180,000	$200,000	$240,000	$200,000
7.3		Polymer Make up and feed system	M									
7.4		Allowance for drainage facilities	C									
7.5	Dewatering	***Screwpresses***	M		Sum	1	1	1	$744,000	$930,000	$1,395,000	$930,000
		Feed Pumps	M									
		Pipework, valves etc.	M									
7.6		Load Out Screws	M									
7.7		Dewatered Cake skips	M	12m3 Skip bin for moving by hook Truck		3	4	5	$50,000	$100,000	$150,000	$400,000
7.8		Sludge Holding Tank	M	2 tanks, 2 days storage forWAS approx 400m³	Sum	2	2	2	$50,400	$63,000	$75,600	$126,000
	Odour destruction System	use same as for inlet works										
6	**Electrical & Control**										Electrical General Subt	$1,496,000

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
6.1	Electrical - General	MCC	E	500kVa.								
6.2		Incomer	E									
6.3		Software	E		Sum	1	1	1	$468,000	$585,000	$760,500	$585,000
6.4		Allowance for Site wide power, Instrument and control cabling, cable support & ducting	E									
6.5		General Lighting and small power	E	Small DBs, task & security lighting, 3 Ph task outlets								
6.6	Control	Instrumentation, HMI, SCADA, PLC, Telemetry	I			1	1	1	$240,000	$300,000	$390,000	$300,000
6.7		Software	I		sum	1	1	1	$68,000	$126,000	$189,000	$126,000
6.7	Electrical Ancilliaries	Standby Generator	M	300kVa., assume 1000kW	Sum	1	1	1	$306,000	$340,000	$442,000	$340,000
6.8		Fire Prevention or Extinguisher System	M	VESDA Early Alarm system + Inert Gas Supression system	Sum	1	1	1	$80,000	$100,000	$120,000	$100,000
6.9		Transformer Blast wall	S		m2	6	9	12	$300	$1,000	$1,200	$9,000
6.10		Allowance to have Network company supply new 500kVA transformer	E	500kVA	sum	1	1	1	0	$36,000	$71,000	$36,000
7	**Other Utilities**											
7.1		Misc site services, drainage, etc	C		Sum	1	1	1	$20,000	$25,000	$50,000	$25,000
8	**Sub-Total - Physical Works**									%		**$34,095,197**
8.1	Contractor Preliminary & General		OH		%	$34,095,197	$34,095,197	$34,095,197	15%	20%	25%	$6,819,039
8.2	Design and Project Management	Concept design	F		Sum	$40,914,237	$40,914,237	$40,914,237	1%	2%	3%	$818,285
8.3		Preliminary & detailed design	F			$40,914,237	$40,914,237	$40,914,237	6%	8%	10%	$3,273,139
8.4		Procurement	F			$40,914,237	$40,914,237	$40,914,237				$0
8.5		Construction supervision	F			$40,914,237	$40,914,237	$40,914,237	3%	4%	6%	$1,636,569
8.6		Council Internal costs	F			$40,914,237	$40,914,237	$40,914,237				$0
	Consents & Investigations											
8.7		Site Survey & Prep Terrain Model	F		Sum	1	1	1	$6,000	$6,000	$10,000	$6,000
8.8		HAIL Investigation & Consent	F		Sum	1	1	1	$16,000	$18,000	$26,000	$18,000
		Site Designation	F		Sum				$300,000	$500,000	$700,000	$0
8.9		Discharge Consent	F		Sum				$600,000	$1,000,000	$1,400,000	$0

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
8.1		Geotechnical Investigations & Interpretation	F		Sum	1	1	1	$30,000	$40,000	$60,000	$40,000
9	**Gross Construction Cost Estimate**											**$46,706,230**
10	**Allowances for Risk Register Items and Residual Uncertainty**											
10.1	Saturated construction market		RA		Sum	$46,706,230	$46,706,230	$46,706,230	0	5%	10%	$2,335,311
10.2	FOREX Risk	Foreign exchange risk on imported M&E plant	RA		Sum	$15,286,297	$15,286,297	$15,286,297	-10%	5%	15%	$764,315
10.3	Allowance for Design Development Contingency		CA		Sum	$46,706,230	$46,706,230	$46,706,230	0%	5%	10%	$2,335,311
10.4	Allowance for Construction Phase Risk Contingency		CA		Sum	$46,706,230	$46,706,230	$46,706,230	0%	5%	10%	$2,335,311
11	**Total Expected Cost Estimate**										19%	**$54,476,479**

Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
Asset Type Totals - Most Likely		**Code**			**Respread**	**Total**				**Cost Breakdown (Direct only)**	
Direct Works	Civil	C	$ 9,890,818	18%	$5,912,491	$15,803,308	29%			Civil	$6,765,818
	Structural	S	$ 8,164,082	15%	$4,880,290	$13,044,373	24%			Inlet Works	$3,650,700
	Mechanical	M	$ 13,044,068	24%	$7,797,427	$20,841,495	38%			Reactors	$6,477,190
	Electrical	E	$ 2,242,230	4%	$1,340,351	$3,582,580	7%			MBR	$8,838,490
	Control & Instrumentation	I	$ 754,000	1%	$450,723	$1,204,723	2%			UV & outfall	$3,836,000
										Solids Handling	$3,006,000
Indirect Works	Main Contractor Overheads	OH	$ 6,819,039	13%						Electrical General	$1,496,000
	Fees & Investigations	F	$ 5,791,993	11%						Other Utilities	$25,000
	Discrete Risk Allowances	RA	$ 3,099,626	6%							
	Contingency Allowances	CA	$ 4,670,623	9%							
	Direct Works Total		**$ 34,095,197**	63%							
	Indirect Works Total		**$ 20,381,282**	37%							
	Total Expected Cost Estimate		**$ 54,476,479**	100%		**$54,476,479**	100%				
		Check 1:	$0								
		Check 2:	$0								
Total											
Cumulative Total											



Project	**Metro DBC Southern WWTPs Development**	
Phase	Shortlist Design Development	
Version	Tauwhare WWTP Package Plant - All Options	
Purpose	Cost estimation	
Estimate Class	5	
Quantities Prepared by	C McRobie	11/11/2020
Rates Prepared by	C McRobie; J Crawford	11/11/2020
Reviewed By	R Verbeek	30/11/2020
Amended		

Basic Dimensions of Plant

Southern site	Length:	Width:	Area:	Perim:	Water Depth	Total Volume
Walls		0.4				
Total Site	80	80	6400	320		
Inlet Works	10	5	50	30	-	
Primary Treatment			0	0		0
Reactors						0
MBR Package	12.1	2.5	30	29	2.9	88
MBR Tank area		5.0	20	16	2.801126998	55
Dewatering Building						
Admin Building	10	10	100	40		
SHT						
UV Building	14	5	70	38		

Tauwhare WWTP Package WWTP All options

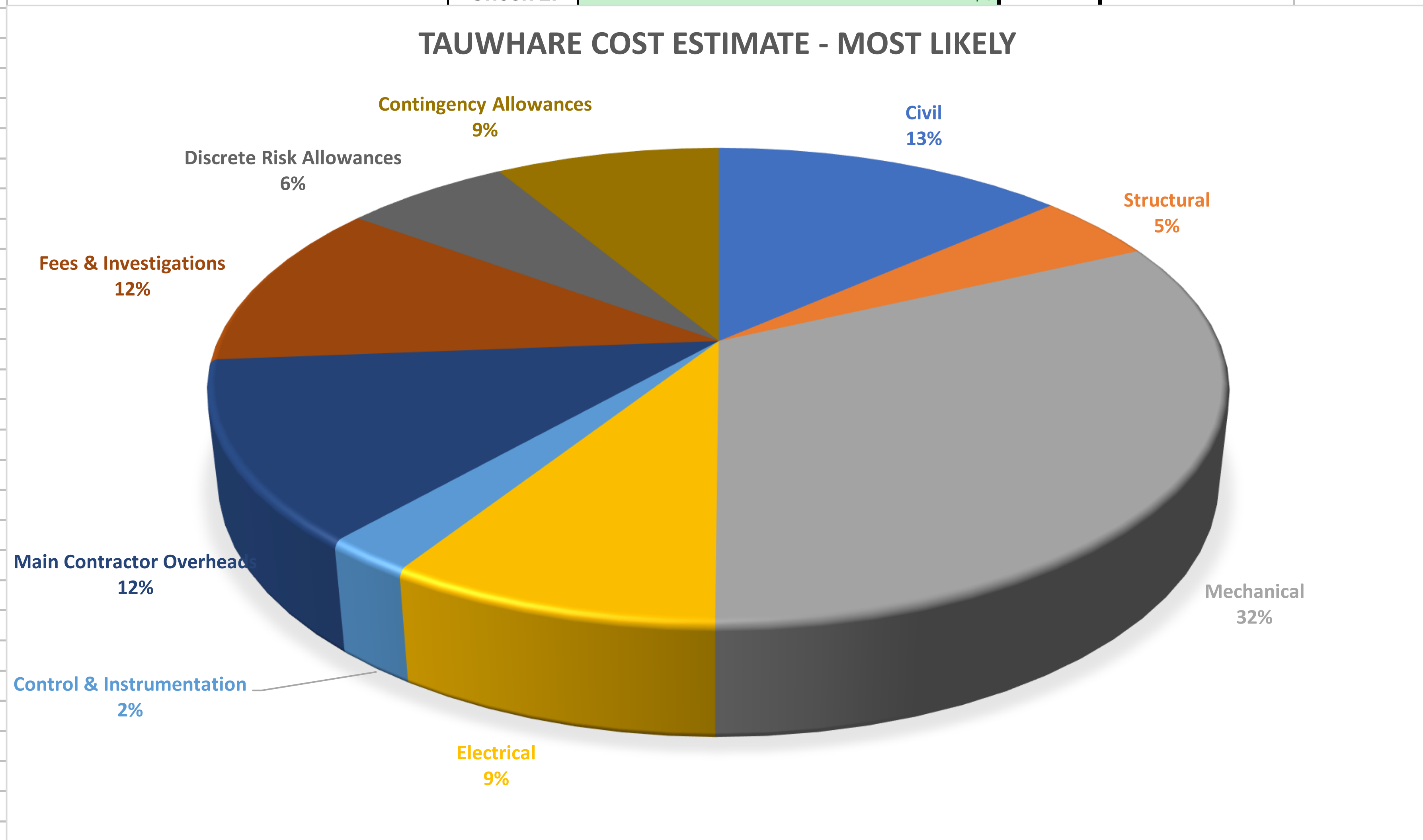
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
1	**Siteworks and Civil**										Civil Subtotal	$743,679
1.1	Form & Maintain temporary site access for construction purposes.		C		m2	50	100	200	$25	$30	$45	$3,000
1.2	Platform Development	Site stripping & Tree Removal	C	Site not decided, as little as zero and as much as whole site	m2	0	3,200	6,400	$1.50	$3.00	$5.00	$9,600
1.3		Strip contaminated topsoil to landscaping bunds within the site	C		m2	0	3,200	6,400	$5.00	$6.00	$7.00	$19,200
1.4		Undercut to stockpile all process unit and building site to -1m	C	Assume 1m deep. Cut to waste on site.	m3	310	340	370	$10	$12	$15	$4,080
1.5		Supply, place and compact in layers imported fill. Assume AP65 or similar.	C	Assume AP65 or similar - sourced locally.	m3	230	255	310	$70	$90	$100	$22,950
1.6		Recompact excavated granular fill	C	Uplift and place from stockpile immediately adjacent excavation	m3	80	85	60	$10	$12	$15	$1,020
1.7		Allow to install two layers geogrid in recompacted fill	C	Quantitiy multiplies treated area by 2. So, total area of geogrid used.	m2	160	170	120	$5.00	$7.00	$9.00	$1,190
1.8		Spread and roll surplus excavated material somewhere on the wider site <500m.	C		m3	230	255	765	$10	$12	$15	$3,060
1.9	Internal Circulation Road	Around package MBR and admin building - sealed	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	736	920	1,104	$150	$180	$190	$165,529
1.10	Internal Circulation Road	Around plant perimeter - unsealed	C	Allows for basecourse and surfacing (but no nib kerb nor drainage) 8m wide	m2	2,300	2,560	2,800	$30	$45	$50	$115,200
1.11	Security Fencing	Temporary for construction period	C	Including double gates, say 12 months	m	256	320	416	$50	$60	$70	$19,200
1.12	Security Fencing	Fencing of the new site	C	From new access area to behind inlet work. Include two sets of double gates. Manual. Whole site.	m	160	320	416	$75	$120	$180	$38,400
1.13		Sump for return pumping (portable pump)	C	Shallow concrete sump say 1.5m diameter x 1.5m deep with apron	Sum	1	1	1	$10,000	$15,000	$20,000	$15,000
1.14	Operator Building	3604 house: Lab, Lunch room, Bathroom, Operator station, Hall	C		m2	75	100	150	$2,500	$3,000	$3,500	$300,000

Tauwhare WWTP Package WWTP All options

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
1.15	Misc Plant Slabs	Miscellaneous 30MPa 250mm thick plant slabs not allowed for elsewhere.	C	30MPa RC	m2	40	60	100	$375	$438	$500	$26,250
2	**Inlet works**										ILW Subtotal	$142,500
2.1	Screening Structure	Includes: Construction, inlet works equipment	M	All stainless steel, incline drum screen	Sum	1	1	1	$58,000	$61,500	$65,000	$61,500
		Slab for Inlet works	S	RC 350mm	m³	18	21	25	$1,850	$2,000	$2,200	$42,000
2.2		Incoming Flow Meters Incoming x 1, Recycles x 2	I	Average 300mm Mag in Riser to ILW on reactor end wall. No chambers	Sum	2	3	5	$10,400	$13,000	$15,600	$39,000
3	**MBR Package Plant**										MBR Subtotal:	$1,029,538
3.01	MBR Package Plant	All Mechanical and Electrical Items	M	Incl: Fine screening facility, containerised MBR plant & electrical equipment supply 2-3 40' shipping containers	Sum	1.0	1.0	1.0	$380,000	$811,207	$2,125,509	$811,207
		Tank slab	S	RC 350mm	m³				$1,850	$2,000	$2,200	$0
3.02		Tanks	S	Assume all raw & treated water storage, concrete tanks 24hrs min storage	Sum	2	2	2	$24,800	$31,000	$37,200	$62,000
3.03		Installation of above mechanical and electrical	M	Installation %	%	10%	15%	20%	$84,221	$126,331	$168,441	$126,331
3.04		Tie-in to system	M	Assumption	Sum	1	1	1	$20,000	$30,000	$40,000	$30,000
4	**Tertiary Treatment**										UV Subtotal	$971,515
4.1	Disinfection											
4.2	UV Plant House	Allowance for UV Plant House	S	3604 100mm Mesh Slab. 90x45 Framing, PB insulated, Ply Lining, Steel cladding. No windows. Heat pump.	m2	61	76	91	$1,000	$2,000	$3,500	$151,515
4.3	UV Disinfection Plant	Supply and Install UV Reactor, floor mounted, enclosed	M	Trojan Signa Modules ex Gisborne quote	Sum	1	1	1	$625,500	$695,000	$903,500	$695,000
4.4	UV Electrical	Electrical General	E	General allowance for non-included electrical; tie-in	Sum	1	1	1	$100,000	$125,000	$150,000	$125,000
5	**Land Disposal Upgrade**											
5.1												
5.2	Pumps		M		m2							$0
5.3	Building		S		Sum							$0
5.4	Irrigation System		M		Sum							$0
5	**Electrical & Control**										Electrical General Subt	$611,000
5.1	Electrical - General	MCC	E	120VAC single phase480/575 VAC, 3 phase, 60 Hz Control circuit	Sum	1	1	1	$289,600	$362,000	$470,600	$362,000
5.2		Incomer	E									
5.3		Software	E									
5.4		Allowance for Site wide power, Instrument and control cabling, cable support & ducting	E									
5.5		General Lighting and small power	E	Small DBs, task & security lighting, 3 Ph task outlets								
5.6	Control	Instrumentation, HMI, SCADA, PLC, Telemetry	I			1	1	1	$80,000	$100,000	$130,000	$100,000

	Tauwhare WWTP Package WWTP All options											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
5.7	Electrical Ancilliaries	Standby Generator	M	300kVa., assume 100kW	Sum	1	1	1	$68,000	$85,000	$110,500	$85,000
5.8		Fire Prevention or Extinguisher System	M	VESDA Early Alarm system	Sum	1	1	1	$20,000	$30,000	$120,000	$30,000
5.9		Transformer Blast wall	S		m2	6	9	12	$300	$1,000	$1,200	$9,000
6.10		Allowance to have Network company supply new 300kVA transformer	E	300kVA	sum	1	1	1	0	$25,000	$50,000	$25,000
7	**Other Utilities**											
7.1		Misc site services, drainage, etc	C		Sum	1	1	1	$20,000	$25,000	$50,000	$25,000
8	**Sub-Total - Physical Works**									%		**$3,523,232**
8.1	Contractor Preliminary & General		OH		%	$3,523,232	$3,523,232	$3,523,232	15%	20%	25%	$704,646
8.2	Design and Project Management	Concept design	F		Sum	$4,227,878	$4,227,878	$4,227,878	1%	2%	3%	$84,558
8.3		Preliminary & detailed design	F			$4,227,878	$4,227,878	$4,227,878	6%	8%	10%	$338,230
8.4		Procurement	F			$4,227,878	$4,227,878	$4,227,878				$0
8.5		Construction supervision	F			$4,227,878	$4,227,878	$4,227,878	3%	4%	6%	$169,115
8.6		Council Internal costs	F			$4,227,878	$4,227,878	$4,227,878				$0
	Consents & Investigations											
8.7		Site Survey & Prep Terrain Model	F		Sum	1	1	1	$6,000	$6,000	$10,000	$6,000
8.8		HAIL Investigation & Consent	F		Sum	1	1	1	$16,000	$18,000	$26,000	$18,000
8.9		Discharge Consent	F		Sum				$700,000	$1,000,000	$1,500,000	$0
8.1		Geotechnical Investigations & Interpretation	F		Sum	1	1	1	$30,000	$40,000	$60,000	$40,000
9	**Gross Construction Cost Estimate**											**$4,883,781**
10	**Allowances for Risk Register Items and Residual Uncertainty**											
10.1	Saturated construction market		RA		Sum	$4,883,781	$4,883,781	$4,883,781	0	5%	10%	$244,189
10.2	FOREX Risk	Foreign exchange risk on imported M&E plant	RA		Sum	$2,351,038	$2,351,038	$2,351,038	-10%	5%	15%	$117,552
10.3	Allowance for Design Development Contingency		CA		Sum	$4,883,781	$4,883,781	$4,883,781	0%	5%	10%	$244,189
10.4	Allowance for Construction Phase Risk Contingency		CA		Sum	$4,883,781	$4,883,781	$4,883,781	0%	5%	10%	$244,189
11	**Total Expected Cost Estimate**										20%	**$5,733,900**

Tauwhare WWTP Package WWTP All options											
Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
					Min	**ML**	**Max**	**Min**	**ML**	**Max**	
Asset Type Totals - Most Likely		**Code**			**Respread**	**Total**					
Direct Works	Civil	C	$ 768,679	13%	$482,311	$1,250,990	22%				
	Structural	S	$ 264,515	5%	$165,971	$430,486	8%				
	Mechanical	M	$ 1,839,038	32%	$1,153,913	$2,992,951	52%				
	Electrical	E	$ 512,000	9%	$321,257	$833,257	15%				
	Control & Instrumentation	I	$ 139,000	2%	$87,216	$226,216	4%				
Indirect Works	Main Contractor Overheads	OH	$ 704,646	12%							
	Fees & Investigations	F	$ 655,903	11%							
	Discrete Risk Allowances	RA	$ 361,741	6%							
	Contingency Allowances	CA	$ 488,378	9%							
	Direct Works Total		**$ 3,523,232**	61%							
	Indirect Works Total		**$ 2,210,668**	39%							
	Total Expected Cost Estimate		**$ 5,733,900**	100%		**$5,733,900**	100%				
		Check 1:	$0								
		Check 2:	$0								
Total											
Cumulative Total											



GHD Centre Level 3 27 Napier Street Freemans Bay Auckland 1011 New Zealand PO Box 6543 Wellesley Street Auckland 1141 New Zealand

64 9 370 8000
aklmail@ghd.com

C:\Users\CMS1\Documents\Treatment Shortlist Technical Report V0.4.docx

Rev.No.	Author	Reviewer Name	Reviewer Signature	Approved for Issue Name	Approved for Issue Signature	Date
Draft for client comment	C. McRobie, C. Scrimgeour	J. Crawford		Sioban Hartwell		14 December 2020
Final	C Scrimgeour	J. Crawford		Sioban Hartwell		14 April 2021

Appendix C - Pukete Buildout Capacity Review

Level 2 Waitomo House,
6 Garden Place, Hamilton,
3240, New Zealand
T: +64 7 838 3828 // **F:** +64 7 838 3808
E: info@beca.com // www.beca.com

24 February 2021

Hamilton City Council
260 Anglesea Street
Council Building
Hamilton
3240

Attention: Jackie Colliar

Dear Jackie

Pukete Buildout Capacity Review

Hamilton City Council (HCC) have requested that Beca Limited (Beca) undertake a high-level reassessment of the potential Pukete Wastewater Treatment Plant (WWTP) site buildout capacity to confirm if future population growth and a more stringent effluent quality scenario can be accommodated. The desktop exercise was limited to the following:

- Quantify the impact varying population equivalent (PE) projections could have on the Pukete WWTP capacity. To do so, a comparison was undertaken which compared the flow projections and loading outcomes from the Site Buildout letter[1] (referred to as the Site Buildout) and the revised projections which were adopted as part of the Metro DBC study[2] (referred to as Metro DBC);
- The differences in flow, BOD, TSS and nutrient loading rates were used to reassess, at a high-level, how much additional capacity/number of process units could be required over time;
- Stipulate any assumptions regarding specific trade waste allowances as part of the Metro DBC study and the impact of additional wet industry on the existing plant and capacity;
- Detailing any assumptions, risks, opportunities (or lost opportunities) associated with this assessment.

The following is a summary from the outcomes of the reassessment – Refer to Appendix A and B for comparison graphs and revised buildout sketch

- Based on the outcomes from this review, it is plausible that the Pukete WWTP could cater for the following total demand based on the growth and influent characterisation assumptions used as part of the Metro DBC study:
  - 490,000-510,000 PE – buildout capacity of the current secondary treatment area (south of the balancing lagoons) which includes six bioreactors (of which 5 are existing) converted to membrane (MBR) bioreactors (existing 5 to be converted to MBR as part of the 2021-2031 LTP cycle due to consent renewal and need for capacity). The capacity of the processes in this area could be exhausted around 2070-2083 due to the anticipated phosphorous and nitrogen loading rates.
  - 650,000 PE* – the required peak capacity requirement under Metro DBC Option 4a until 2121. To cater for this growth, new infrastructure would need to be constructed on top of the existing (retired) sludge storage lagoon (north east of the site) which would need to be rehabilitated OR potentially to

[1] Beca Limited, Pukete WWTP - Site build-out, letter, 6th July 2020. Reissued 29th January 2021 to include population equivalence values

[2] Beca/GHD, Draft Treatment Short List Options Report, Future Proof Partners, 14th December 2020

Council owned land directly to the East or a combination. This would provide the additional 140,000-165,000PE capacity (potentially without exhausting the full extra area to the north) which is the current projected demand requirement although a detailed study would need to be undertaken to quantify how much additional capacity can actually be achieved by further developing this area.

- To achieve additional capacity, the following, although not a comprehensive list, could plausibly be implemented on the site in addition to the main MBR conversion – *we strongly recommend that these be reviewed as part of a site masterplan or the Metro DBC northern business case*:
  - Further develop the northern portion of the existing site.
  - The existing Pukete Road could be realigned east to allow for expansion by moving site the eastern boundary further east. This could provide additional real estate to allow for the expansion of the site. It could however potentially reduce the effective buffer between active process units and housing to the east of the river.
  - Alternative technologies could be considered. Some examples per the following:
    - High rate or chemically enhanced primary sedimentation.
    - High rate could be achieved by, as an example, installing/retrofitting lamella plates inside the primary sedimentation tanks (PSTs). This would reduce the number of PSTs required.
    - Implementation of mainstream Partial Nitrification/Anammox processes. Current capacity review is considering side stream Anammox once sufficient colonies are available in New Zealand for seeding.
    - Converting the bioreactors to a combined Membrane Aerated Biofilm Reactor (MABR) and membrane bioreactor (MBR) process. This would further reduce the reactor volumes required for nitrification and denitrification.
    - Implementation of an advanced sludge lysis process or thermal drying processes. Advances in lysis technology could allow for reduced digestion capacity (beyond what is currently being considered) although the creation of colour and recalcitrant compounds in the effluent (potential effect on UV) are to be further evaluated.
  - Either additional network or onsite peak wet weather flow (PWWF) attention which could reduce the amount of influent needing to be treated during peak period. Currently peak events are attenuated in the existing lagoon which is limited in the medium-long term.

The sections below provide the reasoning and justifications for the summarised outcomes.

Population Equivalence Projections

A comparison was undertaken, as summarised in Table 1, to quantify the differences in population equivalence between the two studies.

Table 1 – Population equivalence projections (PE) summary from the two studies

	Site Buildout (Jan 2021) – *Based on medium growth projections*	**Metro DBC (Dec 2020)**
Population Equivalence at 2021	246,063	267,307
Population Equivalence at ultimate time horizon	483,471 at 2180	649,956 (Option 2A) - 674,042 (Option 4A) assumed to be 2121 *– includes additional allowances for non-domestic users and infill.*
Overall % Change between 2021 and ultimate time horizon	+96% at 2180	+152% (*34.4% overall difference when compared to the Site Buildout*)

The Site Buildout used calculated population equivalence figures based on the HCC Wastewater network model outputs (2018/19 – provided by AECOM), population forecasts (HCC 2019 LTP 2016 NIDEA medium figures) and actual site influent flow to quantify the relative changes over the various design horizons. Through doing so, the approach taken for the Site Buildout accounted for both the domestic and non-domestic contributions through the site characterisation, as conceptually illustrated by Figure 1, with both domestic and non-domestic sources increasing proportionally based on the current allocation within the existing catchment.

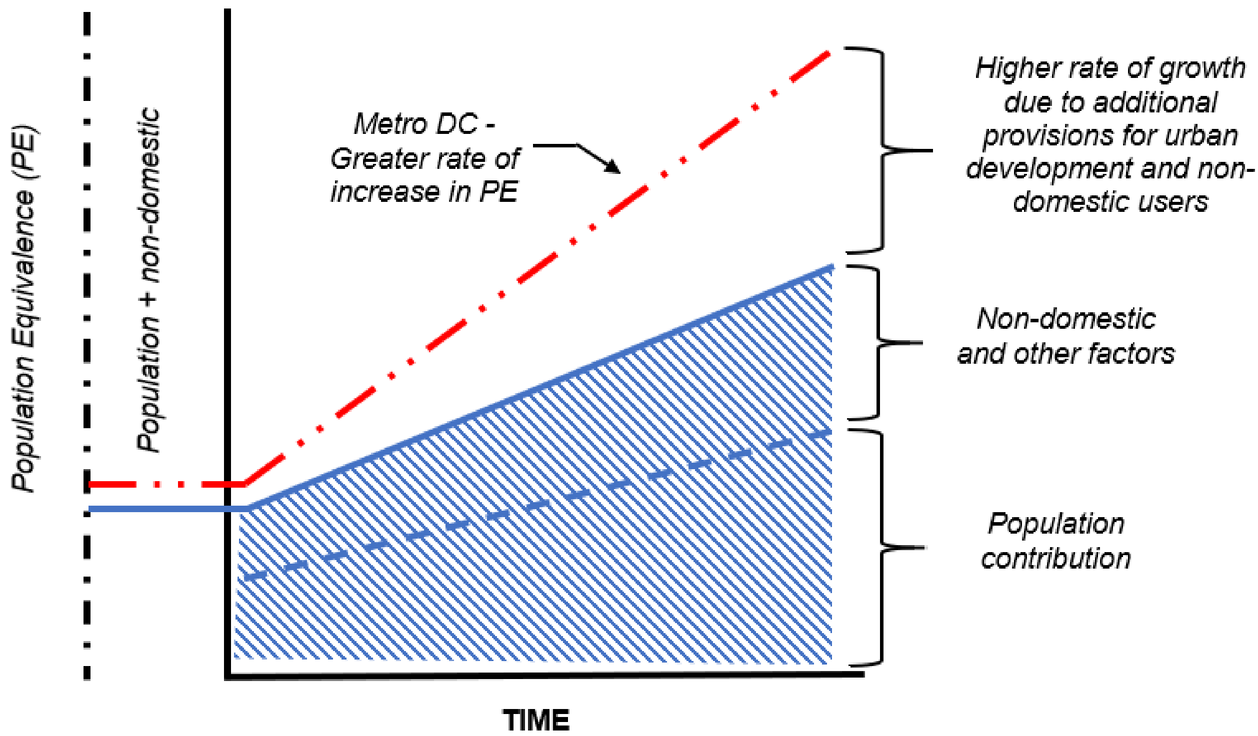


Figure 1 - Conceptual representation of how population equivalence is accounted for

The Metro DBC study reset the population equivalence projection and associated characterisation to allow comparison between the short list options. The reset included additional allowance for population growth including the inclusion of neighbouring towns/areas (refer to below) into the catchment and an increased allocation regarding the number of potential non-domestic users within the redefined Pukete WWTP catchments. These additions have resulted in the Metro DBC population equivalence forecasts being 34% higher at 2121 than compared to original Site Buildout at 2180 city full/ultimate buildout time horizon.

Neighbouring Towns/Areas

For clarity, the Metro DBC included the following contributing towns/areas as part of the study:

- Option 2a – Ngaruawahia, Taupiri, Horotiu, Te Kowhai go to the Pukete WWTP, Hamilton south goes to the new proposed southern sub-regional WWTP.
- Option 4a – Only Hamilton and Te Kowhai are treated by the Pukete WWTP.

Flow and Nutrient Loading Rates

Both the average daily flow (assuming Options 2a and 4a) projections and influent concentrations differed between the two studies, which is illustrated by Table 2 and 3 and the comparison figures in Appendix A, as a result of the revised Metro DBC population equivalence reset (*the grey dashed line indicates the PE capacity the 6 MBR reactors within the current secondary treatment area have hit capacity for a particular parameter):*

Table 2 – Buildout ultimate flow projection from the two studies

Flow Scenarios	Average Daily Flow (m^3/day)
Site Buildout (re-issued Jan 2021)	111,000 @ 2180 – *the existing outfall and primary bypasses* have an instantaneous hydraulic capacity of 4.8m^3/s or 415,000 m^3/day with the 1 in 10yr ARI AECOM model outputs indicating 3.73-4.72** m^3/s peak instantaneous flow (PIF)*
Metro DBC 4a (Dec 2020)	135,000 @ Ultimate (assumed to be 2121 – 91,000 at 2061 for comparison) – *PIF is assumed to be the same as the Site Buildout therefore sufficient outfall and primary bypass capacity*

* *Outfall and primary sedimentation overflow bypasses only*

*** 4.72m^3/s is a revised upper figure from the 2021 network wastewater model – provided by AECOM (January 2021)*

Table 3 - Influent characterisation summary from the two studies*

Parameter	Site Buildout (re-issued Jan 2021) – *Median concentrations derived from site data*	Metro DBC (Dec 2020)
Average Daily Flow, L/PE/day	229	200
BOD – mg/L	350	320
TSS -mg/L	422	360
Total Phosphorus – mg/L	7.8	10
Total Kjeldahl Nitrogen (TKN) – mg/L	52	60

**The nutrient concentration values for both studies are deemed medium to high strength for untreated domestic wastewater when compared to typical composition figures stipulated within Metcalf and Eddy, 5th edition.*

The work completed to date for the Metro DBC study has assumed a greater rate of growth and a more conservative level of nutrients in the waste stream for total phosphorus (TP) and Total Kjeldahl Nitrogen (TKN) which could accelerate the need to further develop additional process units on the available Pukete WWTP site. Even though the difference in flow from the two studies is 22% at 2121, changes in the nutrient loading rates were more substantial. These relative changes have been summarised in Table 4).

Table 4 – Relative difference between influent parameters based on outcomes from the studies.

Parameter	% Difference between the Site Buildout report and the following Metro DBC 4a project scenarios at 2121
Average Daily Flow	22%
BOD load	10%
TSS load	3%
Total Phosphorus load	55% - *The Metro DBC indicates that all 6 bioreactor (as MBR) within the current secondary treatment area would be exhausted by 2070-2078 – 490,000 PE (486,995-491,332 PE)*
Total Kjeldahl Nitrogen (TKN) load	39% - *The Metro DBC indicates that all 6 bioreactor (as MBR) within the current secondary treatment area would be exhausted by 2077-2083 – 510,000 PE (510,216-513,181 PE)*

Based on the Metro DBC scenario, the previously assumed liquid stream buildout capacity using MBR technology could plausibly be exhausted by 2070-83 rather than 2180 if no additional site development outside the currently used footprint was undertaken. The predominating factor is due to the plausibly higher DBC nitrogen and phosphorous loading rates which would require additional reactor capacity.

Additional primary and secondary treatment could be accommodated by rehabilitating the abandoned sludge stockpile, which is north of the current attenuation lagoon – refer to Appendix B for the revised buildout layout sketch for additional information. Based on the Metro DBC forecasts the following process units, per Table 5, would be required by 2121 which represents a 100-year design horizon.

Additional capacity could also be accommodated by installing new deeper reactor and primary sedimentation tanks, a change in treatment technology or expanding the boundary of the site towards the existing Pukete Road as an alternative or in addition.

Table 5 – Revised buildout requirements

Process Unit	Size	2031	2041	2051	2061	2121
Flow	m^3/d	65,293	70,909	82,629	90,665	134,809
Screens	1170L/s		3			*Replace existing screens*
Grit Tanks	4,750L/s					2
PSTs	$502m^2$			5	6	9*
Reactors	$4380m^3$		4		5	9*
Membrane Trains	200L/s	16	17	20	21	32
Digesters – *with THP (primary and secondary)*	$2815m^3$	2		3	3	4**
Digesters – *without THP pretreatment (primary and Secondary)*	$2815m^3$	4		5	6	8**
Dewatering Systems	$38m^3/hr$			1		2***

* To include the need for a new influent interstage pump or redirecting the future northern interceptor so that future flow can be forwarded to any new PSTs and reactors by the abandoned sludge lagoon.

** Potential need to consider advance sludge condition such as thermal hydrolysis or recuperative thickening to reduce the number of required digesters onsite. Impact due to any recalcitrant and colour issues will need to be further investigated prior to proceeding with any advanced hydrolysis onsite.

*** Larger dewatering system to be considered as part of the 2041-2051 upgrades if needed for the dewatering system.

Consideration has been given to future rearrangement and optimisation of the Pukete site layout to better accommodate future spatial and operational needs. The layout sketch includes the following high-level staging features which have been discussed and (we understand) agreed to with HCC operational site staff – this is appliable for both studies and is to be verified as part of master planning for the site which is yet to be finalised:

- Many of the existing structural features of the site are now approaching 50 years of age and by the time major rearrangements of the site are required, will be approaching 80 to 100 years and as such their replacement (potentially in a new location or configuration) is a real consideration within the time frames being considered here.

  The site buildout only included nominal provisions and a detailed assessment is required to accurately define the timing of staging and process upgrades including renewals onsite. Replacement of end of life assets would be a common requirement across Metro servicing options, is a renewals issue and is not provided for in the comparative cost estimates of the Metro DBC options.

- The existing Administration Building, which is approaching end of life (seismic issues), is proposed to be relocated near the existing site entrance to free up area for additional process equipment and associated structures as part of the renewals programme. Building functionality per existing although there is an opportunity for the building to be shared with Civil Defence.
- Any new digestion processes are proposed to be located centrally to the site (where the Administration and Maintenance Building car park is currently located). This will allow for new galleries to be constructed and phasing of the works in conjunction with either refurbishing or seismically strengthening (if required) the existing methane digesters (which are approaching end of life and are vulnerable to seismic events). Overall number of digesters and set out of any new galleries are to be further investigated to confirm feasibility.
- The gas processing and handling equipment (depended on biogas end use pathway) are proposed to be located where the current Administration Building is located – this would mitigate the need for buried biogas pipework and would alleviate some of the current operational constraints.
- The existing clarifiers are proposed to be repurposed as new MBR tanks rather than constructing additional tanks which would otherwise be required – a detailed assessment is required to confirm the feasibility of fitting out the tanks including staging. Another possible consideration is the use of these for peak flow balancing. In this latter context they have the added benefit of having existing sediment/sludge extraction equipment.
- The area currently reserved for the future 6th clarifier is proposed to be redesignated instead for the new MBR building.
- Space for a new Reverse osmosis (RO) plant is suggested to be sited near the UV system. This unit process is not critical to build out of the site. However, it is suggested that the space is reserved to provide for the potential to, in the future, manufacture recycled water for industrial or other uses.

Non-domestic Sources and Trade waste

As previously stated within this letter, the Site Buildout assumed that the number of non-domestic dischargers into the Pukete catchment would proportionally increase as part of overall population growth and that the current trade waste limits for the catchment would also remain fixed. As a result no additional non-domestic or trade waste discharge allowances above what has been allowed for were made as part of the Site Buildout.

To account for conceivable additional non-domestic or trade waste, the following approved new trade waste and wet industry allowances were included as part of the Metro DBC study as summarised in Table 5 and 6. Overall trade waste was accounted for as adjusted flow based on population equivalences. The impact of the additional flow has been accounted within flow and nutrient projections within Appendix A. These exclude current major self-treating dischargers such as Fonterra and AFFCO.

Table 1 - New trade waste discharge assumptions

Location	Type of development	Additional Wet Industry/trade waste Allowance m^3/d
Dairy industry new site Hamilton	Industrial	2,160
Innovation park	Science and technology	400

Table 2 - New wet Industry growth area assumptions

Location	Type of development	Indicative area (incl deferred and non-zoned) ha	Base Industrial Flow allowance* m^3/d	Base Industrial Flow PE/ha	Additional Wet Industry Allowance m^3/d	Additional Wet Industry PE	Total Industrial flow allowance m^3/d
Horotiu	Light Industrial/ logistics	194	931	30	1341	6,705	2,272
Te Rapa North	Industrial	60	432	45	415	2,074	847
Ruakura	General Industrial	225	1,620	45	1,555	7,776	3,175

As requested to by HCC the impact of additional wet industry (above what has already been allowed for), on the Pukete WWTP, has been evaluated at a high-level. This included assuming the inclusion of two additional food processing facilities within the Pukete WWTP catchments. The following summarises the outcomes from the additional high-level assessment:

- Flow was increased by 3000m³/d with an assumed higher TKN and BOD load, to account for the inclusion of industrial trade waste. The discharge parameters were based on current trade waste limits for similar facilities within the existing catchment.
- To account for the increase, the overall influent BOD concentration assumption was increased from 320mg/L to 350mg/L and the TKN concentration was raised from 60mg/L to 62mg/L. These increases were derived by proportionally adjusting the influent concentration based on the mass loading rates the new processing facilities would have on the Pukete WWTP.
- All other parameters remained unchanged in the model and the recycle streams were updated to suit the new influent.
- The modelled reactor size at each design horizon increased by 0.2% across each of the Metro DBC design horizons. Overall, this constitutes a negligible impact on the plant which indicates that the Pukete WWTP would allow HCC to accommodate additional wet industry (within reason and if current trade waste conditions were retained).

Key Assumptions, Opportunities and Risk

The following is a list of key assumptions, opportunities and risks associated with the assessment:

- The treatment performance standards for the site is based on the following:
  - A high level of nutrient removal <4mg/L TN and <1.0mg/L TP (as annual means)
  - A very high pathogen removal (E.coli <14 cfu/100ml as a 95th percentile).
- Both studies are based on NIDEA growth projections which were developed from 2013 Census information. Revised projections from the 2018 Census are expected to be available mid-2021 and these could give more confidence in the short to medium term forecasts.
- The review is based on and assumes that the long-term programme of network upgrades (involving interceptor, bulk storage, and trunk network improvements) set out within the Wastewater Master Plan (Version 3) are implemented.

- All work to date does not include assessing peak wet weather flow buffering which may impose either a need to accelerate additional secondary treatment, stormwater treatment or additional storage;
- The assessment assumed that current sludge management is per the status quo. Any changes to biosolids disposal end-use could impact (positively or negatively) the overall buildout of the Pukete WWTP;
- The assessment assumed that the actual outfall and associated pre/primary treatment capacities are as per the original 1972 design;
- The assessment assumed that the existing site boundary (property owned by HCC) would remain as is. There is also potentially an opportunity to realign Pukete Rd, if necessary, and provide additional build out area for future growth if overall demand is more extensive than anticipated;
- The Metro DBC nutrient projections could be overestimating the associated loading rates over the short to medium term period. The influent characterisations assumed as part of the original Site Buildout included actual site data which included the impact of existing dilution, infiltration and industry. A less conservative approach for the Metro DBC would be to proportionally adjust characterisation to suit expected changes in the contributing network over time. Alternatively, a network characterisation programme could be implemented which would provide a more accurate account of individual sub catchments;
- Both the Site Buildout and Metro DBC used static models for rough order sizing and quantification of process units. Dynamic biological modelling is required to refine process design, selection and timeframes
- Significant influent characterisation changes, over the medium to long term, is a significant risk to the project. Factors leading to this could include the following:
  - Sudden increase in non-domestic users in the catchment over the short to medium term above what has been allowed for. These could introduce step changes in loading. There are unknowns also regarding the precise timing and scale of any future industrial/non-domestic contributors wanting to establish within Hamilton.
  - Residential intensifications beyond what has been allowed.
  - Changing nature and efficiency of the collection and conveyance systems. These include, ‘tighter’ sewers, higher population density within a given catchment area, septicity and the implication of network storage.

  These could either impact the timing and staging of any identified process upgrades or negatively impact the ability for Pukete to fully service catchment up to the ultimate design horizons. Mitigations include:
  - Undertake biological modelling calibrated using updated process characterisation information (currently underway) of the Pukete WWTP and assess the impact of various future non-domestic users on the plant. The outputs could assist with refining current trade waste and associated wet industry bylaws.
  - Implement and enforce strict tradewaste regulations on new or existing non-domestic user if capacity at the plant is nearing capacity.
  - Complete early feasibility studies to confirm the suitability of expanding the site near the existing sludge lagoon and surrounding area.
  - Recognition of the need and ability to develop available areas of the site to the north and east of the existing balancing ponds.
  - Regularly review emerging technologies to identify those that would likely contribute to the overall efficiency and capacity of the site.
- The rehabilitation of the existing sludge lagoons (next to the current storage lagoon) and installation of up to three (3) additional reactors (making the total of 9). This, along with additional primary

sedimentation tanks and membrane trains for the ultimate city full scenario, presents an opportunity to minimize the need for additional storage;

- Both the original and revised site buildout present an opportunity to repurpose the existing secondary clarifiers as either MBR tanks or to be used as peak weather balancing/buffering tanks. The constructability and staging of work associated with converting the existing clarifiers is to be investigated as part of future feasibility/master planning studies;
- Neither study includes staging or replacement of structures as part of a renewals programme. Staging has been initially considered for the MBR conversion with nominal allowances allowed for. Additional investigations are required to formally review the operation and overall compliance of the existing site while the MBR conversion is being implemented as part of the Metro DBC northern business case due to overall financial and technical implication it may present;
- Both studies exclude the impact of growth on all auxiliary services like electrical, compressed air, recycled effluent, river water and potable services.
- Neither study has included additional impacts resulting from climate change other than allowed for in the wastewater network model. Further work could be undertaken to quantify overall impact such as more frequent and intense storm events, hydrological ecological changes in the river and more concentrated wastewater over extended dry weather periods. Considering classical thinking around climate change effects in New Zealand, possible effects could be lower dry weather flows and higher concentrations (loads unchanged) than present and higher peak weather flows if the intensity of major storms increases.
- HCC has an opportunity to proactively reduce I&I and work with non-domestic dischargers to further reduce flow and load to the Pukete WWTP. By doing so, HCC would be able to use any freed-up capacity to enable and fast-track residential development in the short to medium term.

Yours sincerely

David Grace
Associate - Mechanical Engineering

on behalf of

Beca Limited

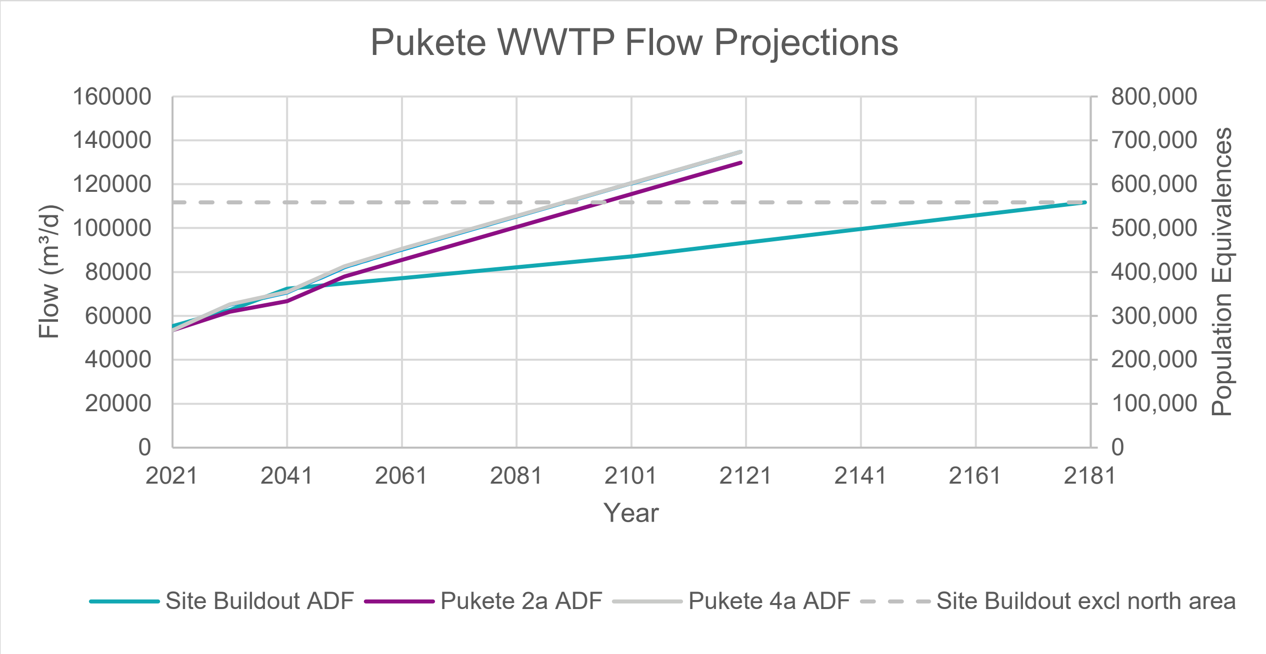
Phone Number: +6479602339
Email: David.Grace@beca.com

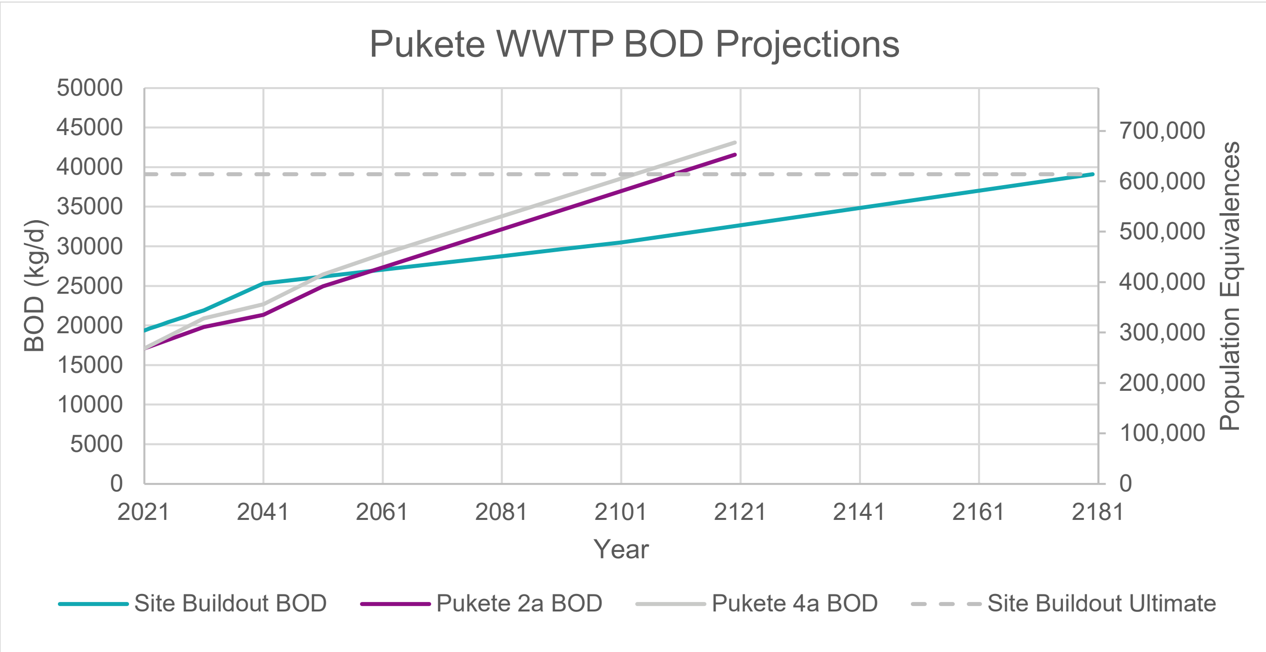
Copy

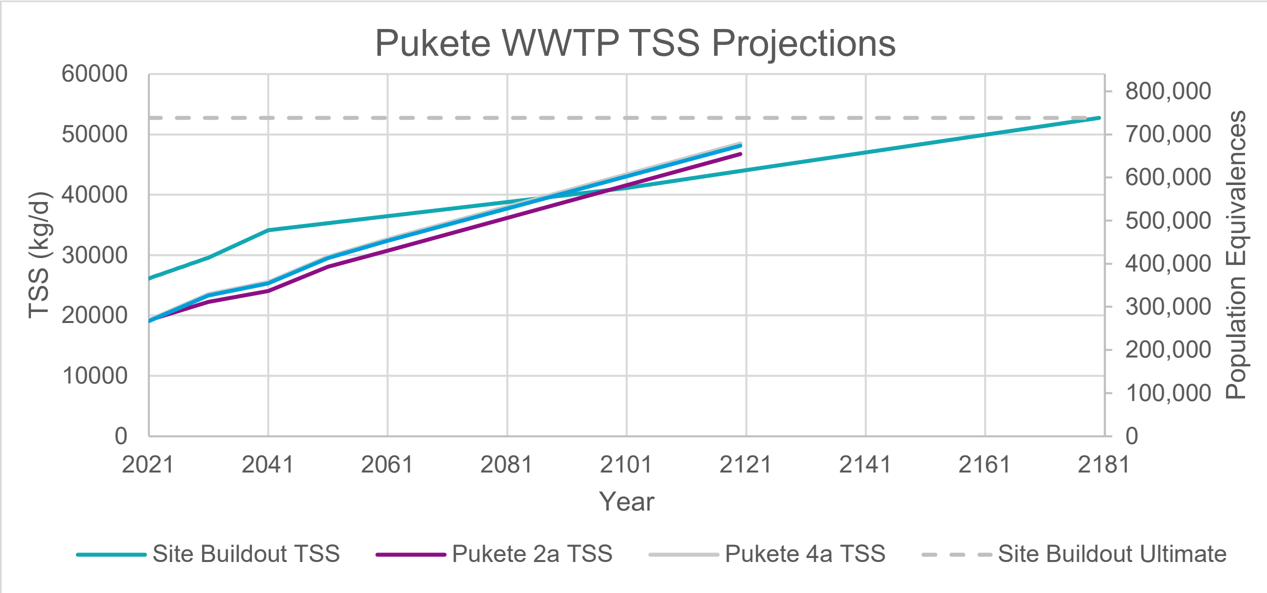
Tim Eldridge – GHD
Rob Brodnax – Beca Limited
Claire Scrimgeour – Beca Limited
John Crawford – Beca Limited

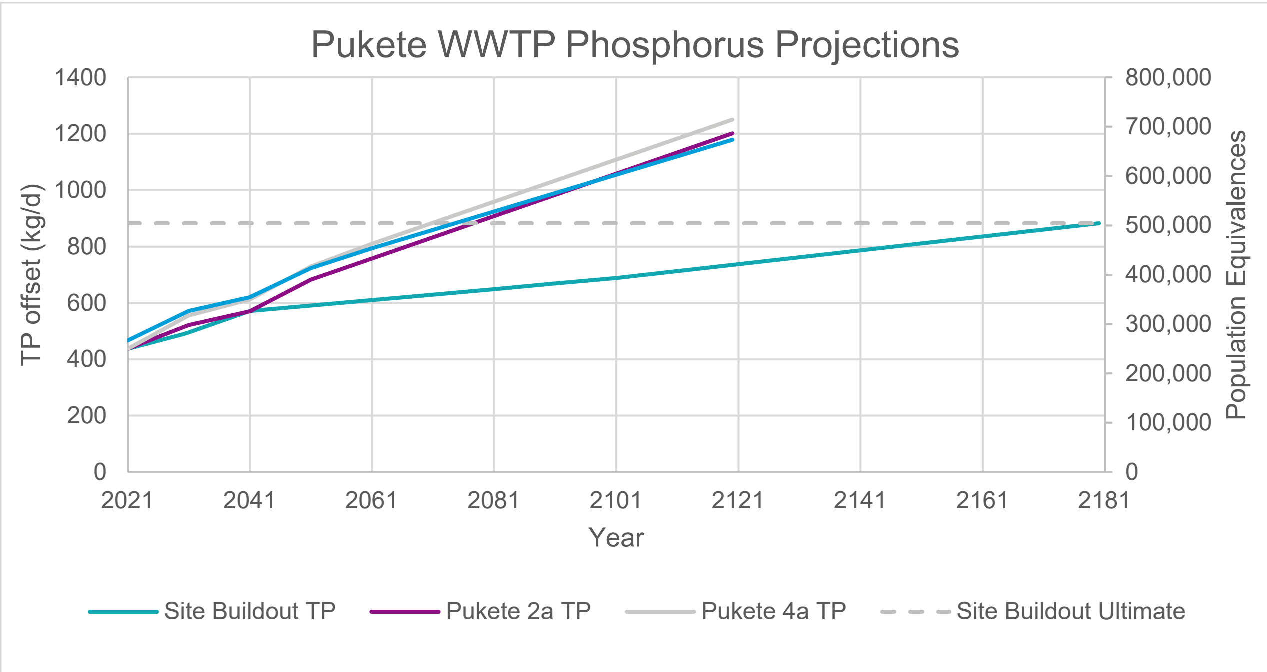
Level 2 Waitomo House,
6 Garden Place, Hamilton,
3240, New Zealand
T: +64 7 838 3828 // **F:** +64 7 838 3808
E: info@beca.com // www.beca.com

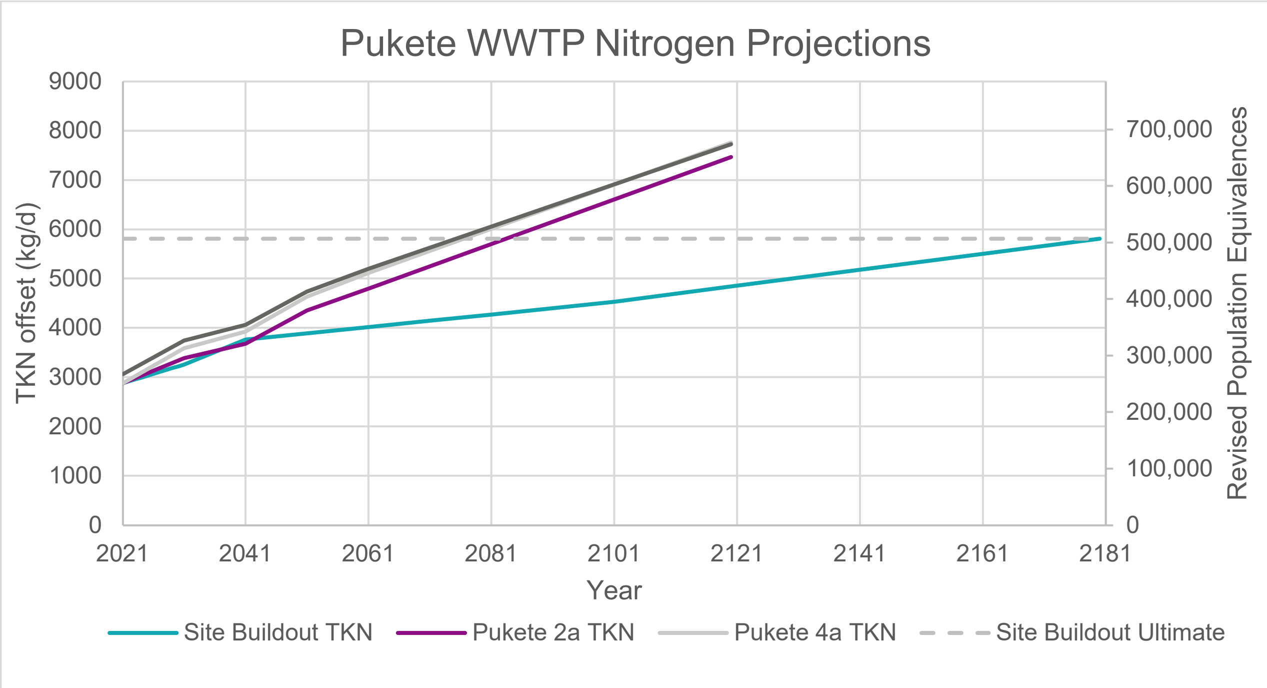
APPENDIX A – COMPARISON FIGURES



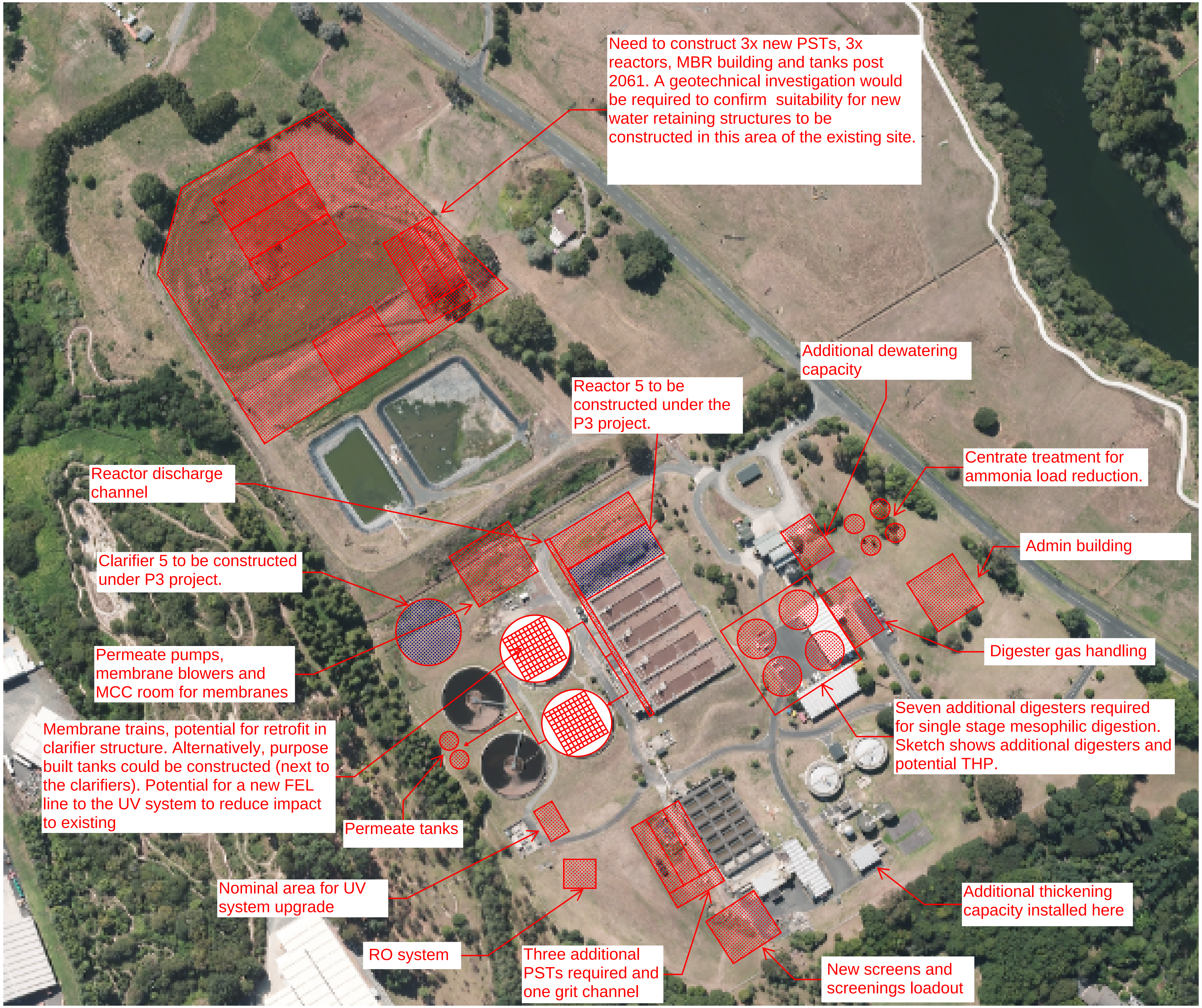



Pukete WWTP TSS Projections
TSS (kg/d)
60000
50000
40000
30000
20000
10000
0
2021
2041
2061
2081
2101
2121
2141
2161
2181
Year
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Population Equivalences
Site Buildout TSS
Pukete 2a TSS
Pukete 4a TSS
Site Buildout Ultimate


Pukete WWTP Phosphorus Projections
TP offset (kg/d)
1400
1200
1000
800
600
400
200
0
2021
2041
2061
2081
2101
2121
2141
2161
2181
Year
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Population Equivalences
Site Buildout TP
Pukete 2a TP
Pukete 4a TP
Site Buildout Ultimate


Pukete WWTP Nitrogen Projections
TKN offset (kg/d)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Revised Population Equivalences
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
2021
2041
2061
2081
2101
2121
2141
2161
2181
Year
Site Buildout TKN
Pukete 2a TKN
Pukete 4a TKN
Site Buildout Ultimate

APPENDIX B – REVISED SITE BUILDOUT



www.beca.com

www.beca.com

No.	Revision	By	Chk	Appd	Date
A	Draft For Discussion	DG	JC	JC	19/01/21

Drawing Originator: Beca

Original Scale (A1)	Design	DG	19/01/21
	Drawn	DG	19/01/21
Reduced Scale (A3)	Dsg Verifier	JC	19/01/21
	Dwg Check	JC	19/01/21

* Refer to Revision 1 for Original Signature

Client: Hamilton City Council

Project: Pukete WWTP - Metro DBC

Title: 2121 Site Buildout

Discipline: Process

Drawing No. 3257177-PA-K0001

Rev. A

BLUEBEAM

DO NOT SCALE

IF IN DOUBT ASK.

Appendix D Detailed Multi-Criteria Analysis

MCA	KPI equivalent	Criteria measure						
OBJECTIVE CRITERIA			Do Nothing		Option 2A		Option 4A	
1.By 2050 municipal wastewater discharges are no longer impacting on the ability of people to swim and collect Kai from the river and connected waterways thereby restoring and protecting the health and wellbeing of the river	KPI 1.4: Proportion of plants which are compliant against discharge quality consent conditions KPI 1.2 Concentration of Total Nitrogen contaminants impacting the river and connected waterways from WWTPs KPI 1.3: Concentration of Total Phosphorous contaminants impacting the river and connected waterways from WWTPs	**Water Quality (TN, TP, Nitrates, Ammonia)** To what extent and timeframe does the option reduce the level of Nitrogen, Phosphorous, Nitrates and Ammonia in the quality of the discharge?	-3	The existing discharges do not meet current consenting conditions for 6 of the 7 municipal plants. The consenting conditions for some of the smaller plants (such as Matangi) are out dated. New consenting conditions will likely require higher performances from all plants. Existing plants will not be able to meet increasing standards. Increasing population and flows will likely increase the level of Nitrogen, Phosphorus, Nitrates and Ammonia entering the river	3	All options will seek to deliver the same water discharge quality. The discharge quality which has been assumed delivers: o< 4 mg/L of Nitrogen o< 1 mg/L of Phosphorus This is considered a very high quality for WW discharges and is significantly higher than the current quality of discharges.	3	All options will seek to deliver the same water discharge quality. The discharge quality which has been assumed delivers: o< 4 mg/L of Nitrogen o< 1 mg/L of Phosphorus This is considered a very high quality for WW discharges and is significantly higher than the current quality of discharges. Particularly for smaller plants (i.e. Tauwhare Pa and the airport).
	KPI 1.1: Public health risks caused by the concentration of E.coli within the WWTP discharges	**Water Quality (E.coli)** To what extent and timeframe does the option reduce the E.coli levels of the discharge to the river?	-2	It is expected that plants such as Ngaruawahia and Te Kowhai will struggle to reduce E.coli levels as population and flow loads start increasing.	2	All plants will be upgraded or built to produce lower levels of E.coli. o< 14 cfu/100mL (as 95th percentile) of E.coli However it is expected that plants will achieve a much greater reduction for other nutrient levels (nitrogen and phosphorus) than for E.coli.	2	All plants will be upgraded or built to produce lower levels of E.coli. o< 14 cfu/100mL (as 95th percentile) of E.coli However it is expected that plants will achieve a much greater reduction for other nutrient levels (nitrogen and phosphorus) than for E.coli.
		Public Health To what extent and timeframe does the option reduce the risk to public health? measure by assessing risks associated with contamination of groundwater and the location of the discharges. E.coli has been captured above	-1	Currently there is a heavy reliance on septic tanks used for large lifestyle blocks and some rural towns and small communities which have a risk of failure. This has the potential to lead to public health issues. A continuing reliance on individual septic tanks may have public health implications in the future as they could fail and contaminate groundwater or potentially nearby water bores. This is particularly true for Te Kowhai which is likely to see large population increases and a large increase in septic tank use.	1	This option will reduce the public health risk associated with potential fails of septic tanks at Ohaupo. The improved discharge quality will reduce health risks associated with swimming and collected kai from the river. It should be noted that the change in the discharge location in relation to the water intake will not make a significant difference to public health risks.	1	This option will reduce the public health risk associated with potential fails of septic tanks at Ohaupo. The improved discharge quality will reduce health risks associated with swimming and collected kai from 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 eco-system re-entry impacts by 2050	KPI 2.1: Amount of algal biomass in the Waikato River as measured by chlorophyll a concentrations attributable to treated wastewater discharges KPI 2.2: Health and abundance of mahinga kai species	**River / Aquatic Ecosystems** To what extent and timeframedoes the option impact or improve river ecosystems and hydrology	-2	River ecology may be impacted by increasing discharges to the river. Discharges currently do no meet consenting requirements and will likely to continue to degrade the river, with increasing nutrient loads. This reduces the oxygen in the water and therefore impacts on aquatic health.	1	Water quality improvements can be achieved through improved discharge qualities. This contribute towards the improvement to the number and variety of aquatic life in the river. The number and location of discharges is unlikely to make a significant difference to ecological health. Water quality improvements will have a much greater impact on this criteria. Therefore all options will achieve the same benefit with regards to ecological health improvements	1	Water quality improvements can be achieved through improved discharge qualities. This contribute towards the improvement to the number and variety of aquatic life in the river. The number and location of discharges is unlikely to make a significant difference to ecological health. Water quality improvements will have a much greater impact on this criteria. Therefore all options will achieve the same benefit with regards to ecological health improvements
	KPI 2.3: Number and variety of terrestrial species at specific locations within the metro area KPI 2.4: Area coverage of native riparian vegetation surrounding water bodies and within the catchment area	**Terrestrial Ecosystems** To what extent and timeframe does the option provide the ability to improve vegetation coverage around river bed and terrestrial ecosystems? - this will only be applicable if we are including potential riparian areas as part of the options? This may have to remain very high level for now	0	No change or improvement to terrestrial ecosystems	2	All options will consider carbon offsetting, riparian vegetation and rehabilitation.Option 2A requires multiple parties to pool potential resources which can allow for larger scale rehabilitation programmes to be set up.	1	All options will consider carbon offsetting, riparian vegetation and rehabilitation. At this stage no one option can achieve this better than another. Therefore all options will achieve the same benefit with regards to terrestrial ecosystems.
3. Wastewater treatment solutions restore and enhance cultural connectivity with the river so that by 2050 Marae and iwi access to the river and other sites of significance within the metro spatial area is no longer impeded by wastewater treatment solutions	KPI 3.1: Maatauranga Maaori Cultural Health Index	What potential is there for land discharge vs water discharge (How much does the option reduce the discharge to the river?) This assumes that land discharges are preferred. However further assessment is required from Iwi						
		To what extent does this option enhance and restore cultural connectivity with the river?						
	KPI 3.2: Number and quality of access points to the river for cultural and recreational activities	**Access to River** To what extent and timeframe does the option increase the opportunity to improve the number of access points to the river and/or other waterways, lakes and wetlands? - measure by considering the potential to rehabilitate existing sites/riparian activities of options/location of site	0	No change to access points	2	It is assumed that all options will seek to improve the quality of access particularly around and near the existing plants. A new plant south of Hamilton may incorporate some additional access points to the river for monitoring purposes. This option decommissions the Cambridge WWTP which opens up some potential opportunities for improvements to public access to the river due to its location next to the river. Other plant sites in the southern metro area are not located near rivers or waterways and therefore have limited potential to improve access points. Option 2A, however also requires multiple parties to pool potential resources which can allow for larger scale projects to improve access using pathways, dual purpose pipelines etc.	1	It is assumed that all options will seek to improve the quality of access particularly around and near the existing and new plants. This could apply to the new smaller plant at the airport and the redevelopment at Cambridge may improve 'look/feel' or provide additional connectivity to the river.
4. Maximise efficient use of resources and resource recovery to contribute to net zero greenhouse gas related emissions from wastewater treatment systems by 2050	KPI 4.1: Water reuse, water allocations and accounting	**Water Reuse** To what extent and timeframe does the option allow for water reuse?	0	No potential for reuse - quality and technology not available to achieve reuse	3	Potential for water reuse with the industrial growth area south of Peacockes. This area has an industrial growth area/capacity of approximately 100ha. The greater scale of flows also means its more economical to invest in industrial reuse technology. Reusing a portion of the effluent discharge for irrigation purposes is possible. There are some parcels of land within the area which could be used for land disposal/irrigation, but they will not be large enough to cater for all the flows form the plant. No agricultural land around Pukete WWTP will mean that the southern area of Hamilton has greater potential for irrigation reuse (when compared to Option 4A).	1	Limited potential for industrial reuse of water. Most of the plants remain at a smaller scale and it is therefore uneconomical to build infrastructure to cater for industrial reuse. Southern Hamilton area, may contribute to reuse water at Pukete if build out capacity allows for it. Smaller plants have the ability for irrigation reuse / disposal to land is more feasible with lower flows as smaller portions of land is required.
	KPI 4.2: Carbon footprint / Energy requirements of plant and plant systems (i.e. pumps) KPI 4.3 Proportion of biosolids that are able to be safely reused for beneficial purposes	**Energy / Carbon Reduction** To what extent and timeframe does the option consider energy and carbon neutral technologies. To what extent do options reduce relative operational carbon associated with conveyance system. Biosolid reuse potential	-1	Currently unable to achieve any sustainable improvements. But does not provide any additional opportunities for energy recovery.	1	Greater amounts of energy is required to achieve high water quality when compared to the Do Nothing. This option has the benefit of only needing to operate 3 plants (3 instead of 5) in the southern metro area, but must also convey flows across greater distances which is energy intensive. The key differentiator is that this options has the ability to become energy neutral for the operation of the plants. Recovering heat and electricity.	1	Greater amounts of energy is required to achieve high water quality when compared to the Do Nothing. This option has 5 plants but does represent an opportunity to reduce carbon emissions in the longer term at the larger WWTP. This option will use less enegy than Option 2A due to reduced conveyance distances.
5. The wastewater solution provides sufficient capacity to ensure sustainable growth in the metro spatial area in accordance with growth projections assumptions for the next 100 years	KPI 5.1 Flexibility and adaptability of solution to be staged / developed over time to meet the needs of the community.	**Flexibility** To what extent does the option provide flexibility to adapt to growth and land use changes?	-3	Limited ability to respond to land use changes (given there are many locations not currently serviced). Industrial land uses in particular will be constrained	1	Option 2A, when investigated in detail was shown to require greater levels of intervention than Option 4A to re-distribute wastewater from the southern suburbs of Hamilton to the proposed sub-regional plant. There is also limited ability to stage the sub-regional 2A WWTP due to the lower growth rate of the combined catchment forecast post 2040 and relatively low proportion of wet industry. The high funding levels required to implement option 2A is also expected to limit the financial ability of councils to make future WWTP changes to meet any demand changes across the sub-region.	2	Comparatively, Option 4A scored higher in the assessment of this criteria for the following reasons: - It offers a range of poten al solu ons to deal with variability in demand from the airport and nearby catchments which will be further investigated in the Preferred Option refinement; these solutions include: - T rucking to a suitable WWTP - A small bespoke WWTP in the airport precinct or nearby; either publicly of privately run oC onveying to the upgraded Cambridge WWTP in the short to medium term - T he funding requirements of this op on are comparatively lower than Option 2A and thus access to funding to respond to land use changes will be comparatively easier.
	KPI 5.2: Proportion of Industrial areas which are serviced by municipal plants sustainably KPI: 5.3 Proportion of residents in the metro area serviced by municipal treatment plants sustainably	**Sustainable Growth** To what extent does this option provide additional growth opportunities which align with the sustainable and planned future growth of the Waikato Metro area?	-3	The current situation will not be able to service the area in the medium to long term. Ohaupo are not currently serviced but will soon require plant facilities. Growth at the airport will be limited based on the existing systems available at the airport	1	Option 2Aa was re-assessed with theas having a score of 1 for sustainable growth due to the following reasons: - W hen inves gated in further detail it was shownIt is expected to require greater levels of intervention to redistribute wastewater from the southern suburbs of Hamilton to the proposed sub-regional plant; - Limited ability to stage the sub-regional 2A WWTP due to the lower growth rate of the combined catchment post 2040 and relatively low proportion of wet industry - The funding level required to implement Op on 2A would have made subsequent changes to meeting the demand changes across the sub-region more difficult due to the large initial outlay by the councils.	2	•T here are solu ons to deal with a mul tude of options and variability in demand from the airport and nearby catchments which will be further investigated in the Preferred Option refinement; these solutions include: - T rucking to a suitable WWTP - A small bespoke WWTP in the airport precinct or nearby; either publicly of privately run - C onveying to the upgraded Cambridge WWTP in the short to medium term - T he Pukete WWTP review confirmed that there is sufficient space available for capacity to be developed to service Hamilton and potentially other catchments for a number of decades - T he funding requirements of this op on are comparatively lower than Option 2A and thus access to funding to respond to land use changes will be comparatively easier.
CRITICAL SUCCESS FACTORS								
Constructability	Treatment	**Construction impacts** What are the relative constructability benefits, issues and risks (available space, access, existing utilities, watercourse, rail crossings, reinstatement requirements, Geotechnical impacts, utility impacts, road and traffic impacts)	-1	No construction impacts/no construction activities beyond what is proposed in the LTP. Upgrades or a new plant will be required at Cambridge.	-1	One new plant and new location for plant south of Hamilton. However a new site will be easier to construct and more flexible as we can choose site based on minimising impacts	-2	Constructing whilst keeping the Cambridge operational will be difficult, more costly and higher risk of delays. There is some risk of not performing to high quality standard? Difficult to master plan a long term site. Cambridge is located near a river - which means its at risk of lateral spread. Greater costs associated with rehabilitating site to meet seismic standards. Difficult to do in retrospect. This option will also require a new site south of Hamilton
	Reticulation		0	No construction impacts/no construction activities beyond what is proposed in the LTP	-2	Considerable conveyancing requirements. Crossing of SH1 and Waikato River required for Matangi pipeline. This assumes the new southern facility is located to the west of the River, these risks may change depending on the site selected. Overall there is greater length of conveyance construction required (when compared with Option 4A and Do Nothing) and therefore sees a lower score. Reasonable risk for consenting and construction, however small diameter pipe reduces risk. Rest of pipelines in road reserves on arterial roads, considered relatively low risk. There is potential to avoid network upgrades in the city which are greater risk and potentially higher costs.	-1	Reasonable conveyancing requirements. Crossing of SH1 and Waikato River required for Matangi pipeline - reasonable risk for consenting and construction, however small diameter pipe reduces risk. Rest of pipelines in road reserves on arterial roads, considered relatively low risk

Maintenance and Operations	Treatment	**Operational implications** What is the relative ease or difficulty of operation and maintenance (includes access, odour treatment, resource availability, monitoring, etc.).	-2	Community and regulatory tolerance of the existing operational scheme is low, and there is a high likelihood of greater prosecution for failure to meet consents. Greater visibility of compliance by community will likely exacerbate this risk.	2	Option 2A will reduce the total number of facilities from 10 to 5 for the wider metro area, and from 5 to 3 in the southern metro area. The reduction in the number of plants will improve the performance consistency between plants and the consistency and quality of monitoring and testing. A larger centralised facility will attract more skilled staff and allow for the substitution of staff between facilities (as they are likely to use the same technology). A further consideration is the additional opportunity this option has in providing a centralised organisational strategy. This includes setting up a centralised consenting strategy across the wider metro area, and operability management across council boundaries. This can significantly improve consistancy and efficiency of the consents and the consenting process.	0	A large number of small plants require (in total) more full time operators to cover the requisite number of sites. Smaller plants may struggle to have the necessary resources and funds to meet a high quality assurance regime, in terms of monitoring, maintenance and repair work required. The ability to share resources across facilities will be more challenging given the different size, types and technology for different plants
	Reticulation		0	No additional conveyance (i.e. trunk lines)	-2	Conveyance across large distances will lead to greater septicity risks than BAU or decentralisation. The greatest distance being 14.5km. This is greater than Option 4A and the Do Nothing. It is proposed to include chemical dosing in any of the pipelines that have more than 8 hours average retention time to address septicity and odour issues. If an aerial river crossing is considered this would present higher operations and maintenance issues and risk of contamination in the event of failure.	-1	Fewer conveyance requirements than option 2A with the greatest distance being 9.5km. It is proposed to include chemical dosing in any of the pipelines that have more than 8 hours average retention time to address septicity and odour issues. Aerial river crossings would present higher operations and maintenance issues and risk of contamination in the event of failure.
Consentability opportunities and risks	Construction	**Consentability - Land use and designation** What are the relative risk of delays during the consenting process for the option? And are there any consenting fatal flaws?	0	No additional consenting requirements beyond what is already planned. However, ability to consent BAU in current and likely future planning environment is extremely limited.	-2	Land use consents / a new designation for a WWTP site will be required for a new location. The consentability risks for a new site will be dependent on a number of variables, and those risks can be minimised by the selection of a site as free from constraints as possible. Potentially there may be greater consentability risks for larger new plant than for a smaller plant, due to the wider area to be serviced and potentially impacted by a new plant (e.g by traffic movements, visual effects etc).	-1	Land use consent/a new designation for a WWTP site will be required for a new location. The consentability risks for a new site will be dependent on a number of variables, and those risks can be minimised by the selection of a site as free from constraints as possible. Potentially there may be fewer consentability risks for a smaller plant than a larger plant. Retention of the WWTP at Cambridge may necessitate the extension of the existing designation to provide room for an upgrade to that plant.
	Operation	**Consentability - Discharge** To what extent does the option improve the consistency of consents applied to discharges to the river? To what extent does the option reduce the risk of breeching consenting requirements?	-4	No additional consenting requirements beyond what is already planned. However, ability to consent BAU in current and likely future planning environment is extremely limited.	-1	This option requires fewer number of consents to be renewed. Compliance with potentially stricter consents in the future may possibly be easier and more reliably achieved with a new centralised plant.	-2	This option will require a larger number of consents to be renewed.
Resilience	Operation	**Resilience** To what extent will the option provide resilience against climate change impacts and natural hazards	-2	Wastewater plant network is not currently resilient to disruptions.	0	Improved resilience but high consequence of failure.	1	Option 4A includes smaller plant sizes, meaning it is more difficult to build in redundancies but there is less consequence when failures occur