GHD Advisory

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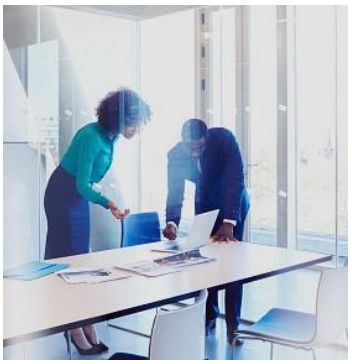

Hamilton Metro Spatial Wastewater Treatment Feasibility Study

Future Proof Partnership

21 September 2020

GHD

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Glossary of Terms

Acronym	Definition
AS	Activated Sludge
BAU	Business as Usual
BOD	Biological Oxygen Demand
IBC	Indicative Business Case
HAIL	Hazardous Activities and Industries List
HCC	Hamilton City Council
LIDAR	Light Detection and Ranging
MCA	Multi-criteria Analysis
MSP	Metro Spatial Plan
NGA	Ngaruawahia
NPV	Net Present Value
TA	Te Awamutu
WDC	Waipa District Council
WGS	Waikato Growth Strategy
WRC	Waikato Regional Council
WWMP	Wastewater Master Plan
WWTP	Wastewater Treatment Plant

Executive summary

The purpose of this report is to provide a high level feasibility assessment of wastewater servicing options within the Waikato-Hamilton-Waipa Metro Area (see Figure 0-1). The assessment provides supporting documentation for the Sub-Regional Three Waters project and as such aligns with its overarching 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.*

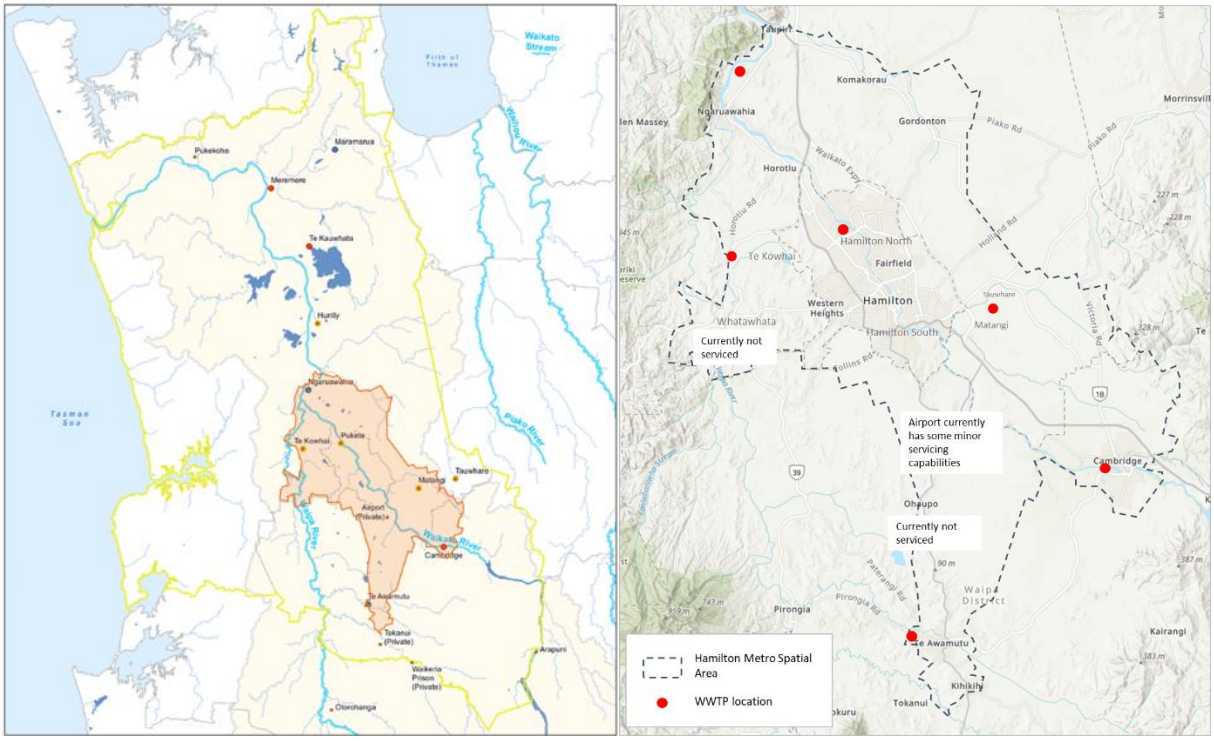
The Waikato-Hamilton-Waipa Metro Area (Metro Area) is from Taupiri through to Cambridge (North - South) and Te Kowhai/Whatawhata to Tauwhare (East - West) and forms part of the Sub-Regional Three Waters Study Area.

These existing communities and potential future development areas include:

- Taupiri
- Hopuhopu
- Ngaruawahia
- Horotiu
- Te Kowhai
- Whatawhata
- Hamilton (North and South)
- Area east of Hamilton
- Matangi
- Tauwhare Pa
- Tamahere
- Hamilton Airport
- Ohaupo
- Cambridge/Karapiro
- Te Awamutu /Kihihkihi

Figure 0-1 below provides a detailed map of the Metro Area study area including all the relevant existing wastewater treatment facilities.

Figure 0-1 Study Area - Waikato-Hamilton-Waipa Metro Area



Methodology

The process consisted of three key steps:

1. Option and Criteria Development
2. Technical Inputs
3. Options Assessment.

The first and last step involved workshops with key stakeholders and partners to ensure all relevant feedback and insights were captured as part of this assessment. To ensure the knowledge captured was comprehensive, stakeholders engaged included subregional district authorities, Mana whenua, Waikato Tainui, Watercare (as service provider for Waikato district Council).

Options Development

The initial list of options consisted of 13 servicing options ranging from fully centralised facilities to fully decentralised facilities (or standalone facilities for each small community). Each of the initial options provided an indicative location of the facility (for new sites) and indicative servicing areas (See Appendix A for initial option descriptions)[1].

These options were presented at a workshop, held on the 28th January. Project partners developed the list further with additional fully centralised facilities and other various combinations. Many of the combinations were minor variations (i.e. Changes in service areas) on a set of common themes/concepts. Servicing areas and locations of new plants are indicative only for the purpose of developing conveyance routes and length estimates.

For the purpose of this assessment, the initial list of concept options were consolidated into a more manageable group. The consolidation process was agreed by the project partners who also confirmed the following six Wastewater Servicing Concepts assessed in this report (see Table 0-1 for the option description and rationale for further assessment of the option).

Table 0-1 Finalised options description and reason for progressing

Option description	Rationale
Option A BAU - Retain existing servicing arrangements for all communities	The BAU option assumes that the current facilities will continue to service the current servicing areas (i.e. Pukete will continue to service only the HCC boundary area, which includes the potential expansions at Peacockes). Areas such as Whatawhata, Ohaupo and areas around the airport will not be serviced (either now or in the future). It is assumed that all the existing plants will undergo some upgrades, particularly as population grows. However, the quality of these upgrades are assumed to be lower than those considered within the other options. Whilst this may not reflect the future plans at some of the facilities, this assumption best captures the current reactive planning and management which is often seen within the wastewater industry. These assumptions allow the assessors to test the other servicing options against the existing situation.

[1] These locations and servicing boundaries are arbitrary for the purposes of developing conveyance routes and lengths for cost estimates. Locations of new sites and servicing boundaries will be considered further as part of detailed investigations.

Option description	Rationale
Option B: Fully centralised facility at Pukete (TA to remain standalone)	This option conveys all communities to Pukete WWTP except for Te Awamutu. This option was considered as it reflects a whole of catchment option, or 'full' centralisation option, with only two plants servicing the whole area. Te Awamutu was not included given the extra distance needed to convey.
Option C: Convey all communities to either a northern or southern centralised facility (new site)	Convey all communities north of Hamilton including the northern and central part of the City to Pukete WWTP, the remainder of Hamilton and all communities south and south east of Hamilton to a new WWTP located between Hamilton and Cambridge. This option reflects a north south centralisation option with a portion of Hamilton being redirected south to a new facility near the airport. This alleviates pressure from the existing Pukete facility which will service areas north, west and east of Hamilton.
Option D Convey all communities to either a northern or southern centralised facility (Cambridge site)	As Per Option C, however the southern facility would be located at the existing Cambridge site. This option also reflects a north south centralisation option, however utilises the existing site at Cambridge.
Option E Five wastewater facilities to cater for the whole metro spatial area including a new southern facility near the airport.	This option assumes all areas to the north of Hamilton (Taupiri, Hopuhopu, Ngaruawahia), will be serviced by Ngaruawahia. Te Kowhai and Whatawhata will be conveyed to Pukete and a new southern plant will service the area between Cambridge and Hamilton. Cambridge and Te Awamutu will continue to be serviced by their own facilities. This option reflects a 'smaller' centralisation of facilities, with five plants servicing the whole area.
Option F: Upgrades of BAU including new facilities at Whatawhata, the airport and Ohaupo	This option would service similar areas to Option A: BAU. That is smaller standalone plants would be assumed for all small communities including areas which aren't currently serviced (such as Whatawhata and Ohaupo). This option reflects the existing situation however, includes the upgrade or replacement of the existing facilities to small package plants or medium plants.

Technical Inputs

The following technical inputs and assumptions informed the options assessment:

- **Population and growth assumptions**: Two growth scenarios were considered; a 2045 growth scenario based on growth projections in the Future Proof Growth Strategy, 2017 and a 100+ year growth scenario, using projections from a range of sources. (See Table 0-2 for a summary of the growth projections (of people) for each scenario for the Metro Area).

Table 0-2 Population growth assumptions

Area	2016 population	2045 population	100 years+ population
Taupiri & Hopuhopu	500	650	13,000
Ngaruawahia	5,400	5,600	25,000
Horotiu	850	1,500	10,800
Te Kowhai	1,600	2,100	4,000
Whatawhata	2,800	2,000	4,000
Hamilton North	160,000	205,000	345,000
East of Hamilton			
Hamilton South		30,000	100,000
Tauwhare	6,150	2,000	3,000
Matangi	2,300	2,800	4,000
Airport		6,900	11,400
Ohaupo	530	720	1,000
Cambridge & Hautapu	17,200	30,700	60,000
Te Awamutu & Kihikhi	13,800	19,300	50,000
Pirongia	1,480	1,960	2,020
TOTAL	**212,610**	**311230**	**633,220**

- **Plant size standardised treatments: T**hree standardised plants were developed (small, medium and large). Each sized plant has its own quality and size assumptions.

Table 0-3 Standardised Treatments

WWTP Size	Plant Philosophy	Servicing population		Flow (m3/d)		Performance levels
		Min	Max	Min	Max	
Small Plant	Nitrifying Activated Sludge (AS), with limited denitrification, chemical Phosphorous and disinfection. Discharge to land where feasible, otherwise to water.	2,000	4,000	500	1,000	Ammonia < 2mg/l Nitrogen Oxides < 12mg/l Total Suspended Solids, <8mg/l Biochemical Oxygen Demand = 8mg/l E. coli <10 no./100ml ***Medium Discharge Performance***

WWTP Size	Plant Philosophy	Servicing population		Flow (m3/d)		Performance levels
		Min	Max	Min	Max	
Medium Plant	Te Awamutu WWTP level of performance or better. High level of nutrient, Biochemical Oxygen Demand (BOD), Solids and Pathogen reduction. For costing purposes and based on level of treatment, a discharge to water is assumed.	4,000	40,000	1,000	10,000	Ammonia < 1mg/l Nitrogen Oxides < 6mg/l Total Suspended Solids <5mg/l Biochemical Oxygen Demand = 5mg/l Total Nitrogen <8 mg/l Total Phosphorous = 0.5mg/l E. coli <10 no./100ml ***High Discharge Performance***
Large Plant	Pukekohe WWTP level of performance or better. High level of nutrient level, BOD, Solids and pathogen reduction. Plus energy recovery. Facility configured to provide for other forms of resource recovery in future such as potable recycling, struvite etc. but not installed. For costing purposes and based on level of treatment, a discharge to water is assumed.	40,000	400,000	10,000	100,000	Ammonia < 1mg/l Nitrogen Oxides < 4mg/l Total Suspended Solids <5mg/l Biochemical Oxygen Demand = 5mg/l Total Nitrogen <5mg/l Total Phosphorous < 0.5mg/l E. coli <10 no./100ml ***Very High Discharge Performance***

- **Conveyancing requirements**: Strategic conveyance routes from communities/urban areas to existing and indicative new treatment plant locations were used to developed in order to estimate conveyance costs. Conveyance routes were located within road corridors as much as practical. The overall lengths of conveyance for each option and the number of additional pump stations is summarised in Table 0-4.

Table 0-4 Indicative conveyance details

Option	Conveyance total length km	Potential number of pump stations
Option A	10	2
Option B	89	10
Option C	79	11
Option D	104	10

Option	Conveyance total length km	Potential number of pump stations
Option E	49	8
Option F	10	2

- **Costs:** Both capital and operational costs were assessed for each option. For comparison purposes a net present value (NPV) has been calculated over 30 years for the operational costs at the 2045 and 2120 flows. The summary of the option costs are outlined in Table 0-5.

Table 0-5 Cost Estimate Summary[2]

Option	Total Capital Cost 2045 $M	NPV Operational Cost 2045 $M	Total Capital Cost 2120 $M	NPV Operational Cost 2120 $M
Option A	$200	$370	$520	$650
Option B	$500	$390	$980	$790
Option C	$540	$370	$1,020	$750
Option D	$580	$380	$1,080	$760
Option E	$380	$370	$780	$570
Option F	$340	$360	$730	$560

The costs presented in the 2120 columns reflect the total cumulative costs (2045 costs and 2120 costs). There is a significant cost associated with conveyance of larger flows and energy recovery systems for large plants, meaning Options B, C and D have higher capital costs. The above technical inputs were used throughout the Multi-criteria Analysis (MCA) of the options.

[2] Numbers have been rounded to the nearest $10 million

Finalised Options

Figure 0-2 Business as Usual (BAU)

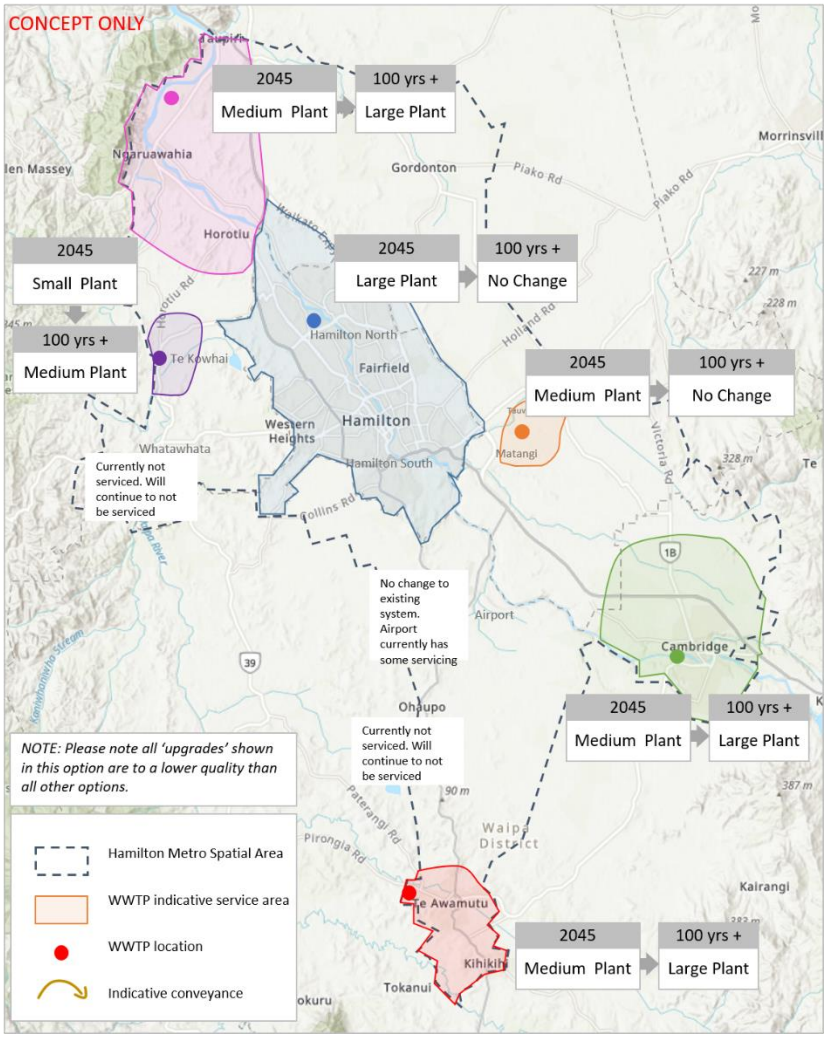


Figure 0-3 Option B: Fully centralised facility at Pukete (TA to remain standalone)

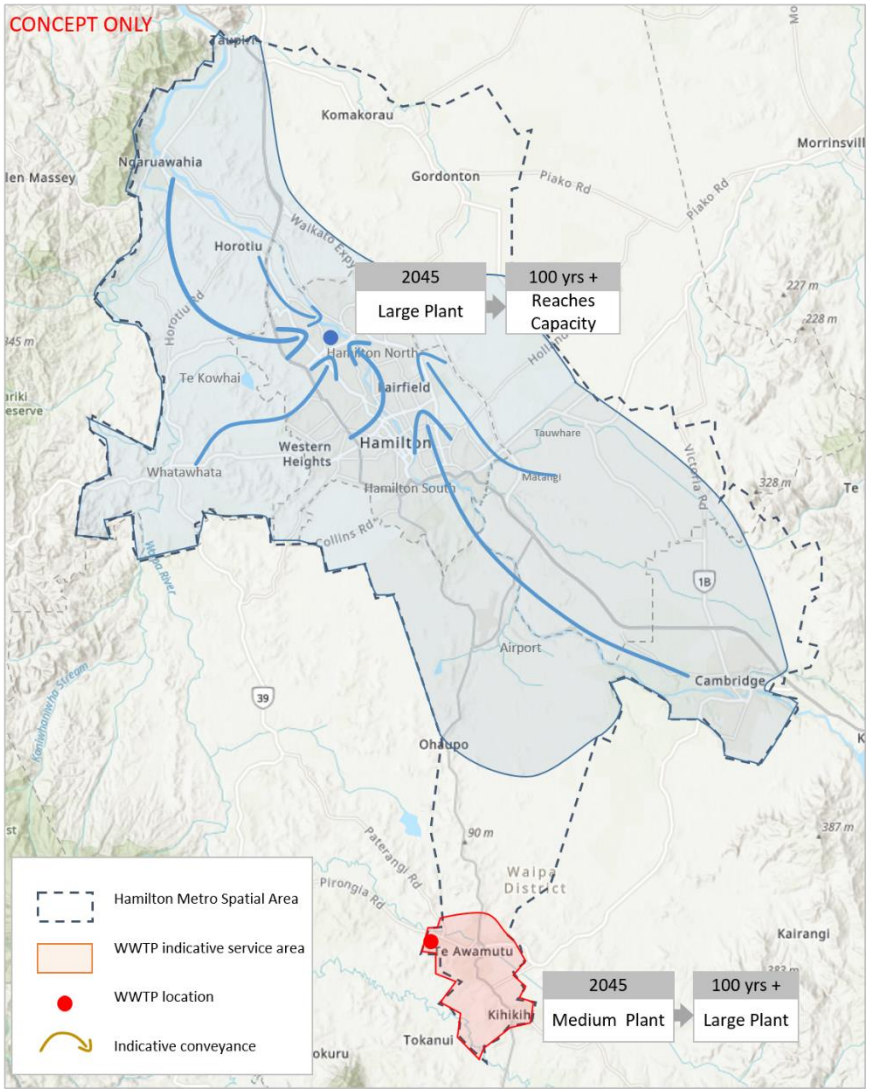


Figure 0-4 Option C: Convey all communities to either a northern or southern centralised facility

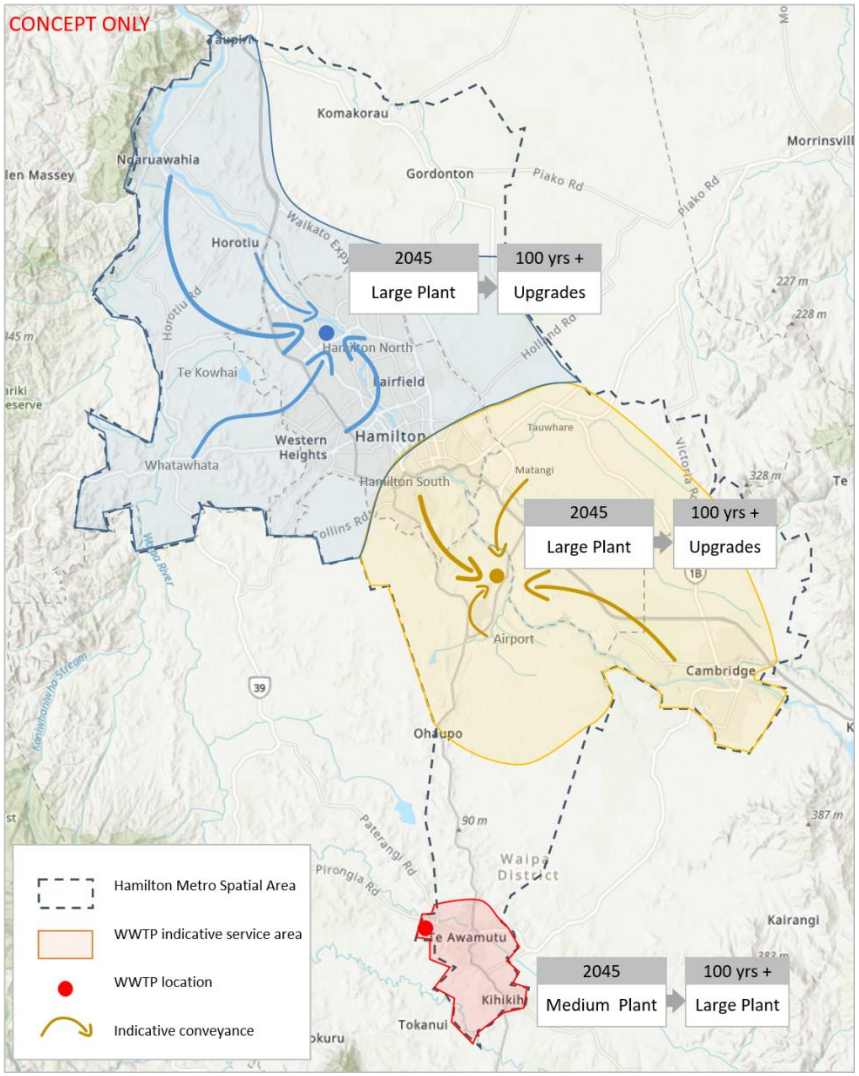


Figure 0-5 Option D: Convey all communities to either a northern or southern centralised facility (Cambridge site)

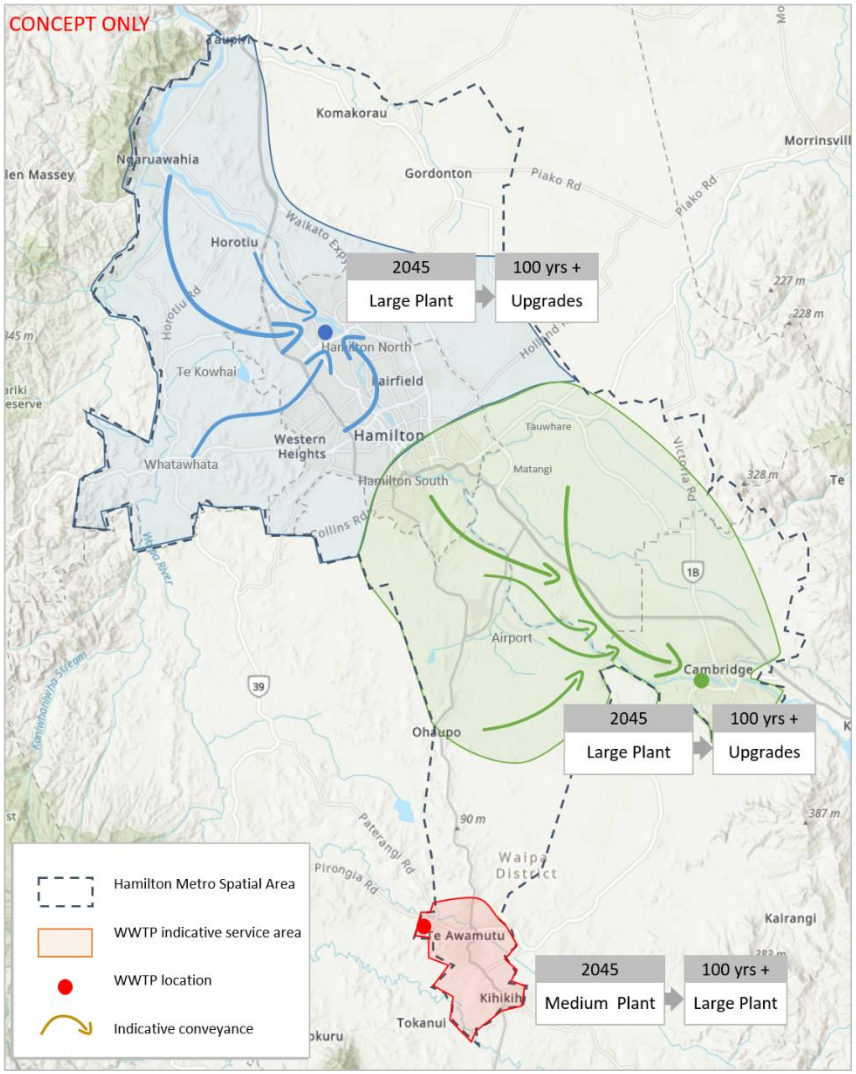


Figure 0-6 Option E: Five wastewater facilities to cater for the whole metro spatial area including a new southern facility near the airport.

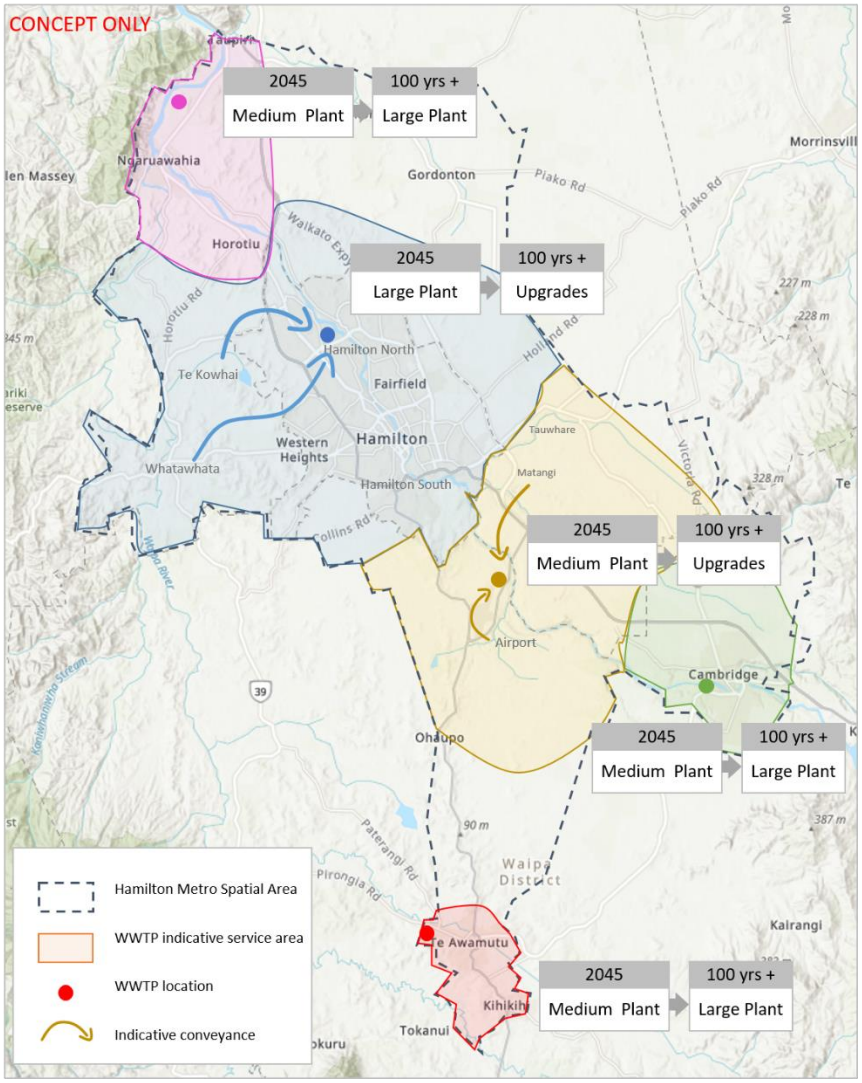
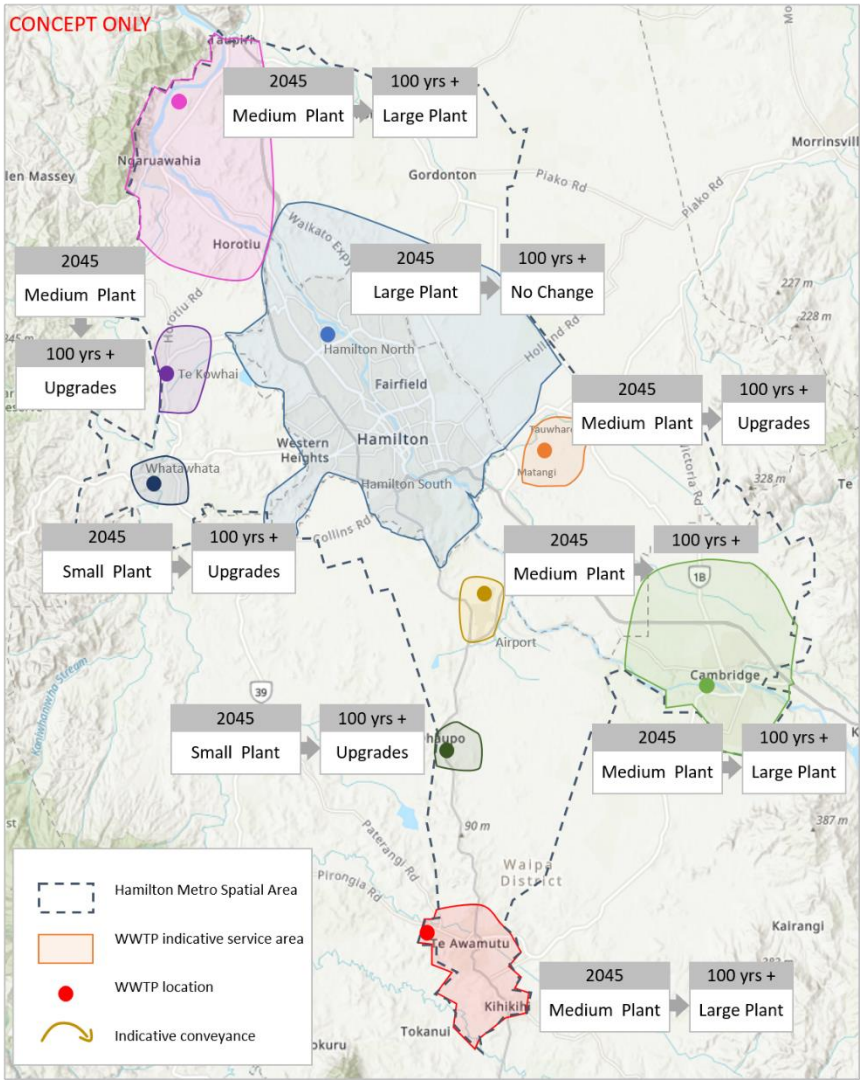


Figure 0-7 Option F: Upgrades of BAU including new facilities at Whatawhata, the airport and Ohaupo



Options Assessment

Options were assessed using an MCA which uses a defined set of criteria to distinguish between options. The following assessment criteria were based on the *Best for River* project objectives developed as part of the Sub-Regional Three Waters Project. These objectives were developed with the purpose of giving effect to the Te Ture Whaimana (Vision and Strategy of the Waikato River). As such the assessment criteria focus on the following themes:

- Natural Environment Improvement Capability
- Public Health Protection
- Cultural Benefits/Impacts
- Flexibility, Scalability and Risk
- Whole of life costs
- Sustainability

Each of the categories included a number of individual measures and factors which would contribute to its overall score of that criteria. At this stage costs have not been scored. However, capital and operational costs have been estimated (as shown above in Table 0-5), but because the costs have a 30% to 50% margin of error, it means the nominal capital and operational costs are not significantly different from each other. Furthermore, these costs do not give an indication on the relative affordability of each option. See section 4.1 for a detailed description of the above criteria.

A summary of the MCA has been outline in Table 0-6 below. This assessment has incorporated feedback and insights gathered at the MCA workshop held on the 10th of March.

The detailed MCA can be found in Appendix F along with detailed option project assessment sheets.

Table 0-6 MCA Summary

Criteria	Option A (BAU)	Option B (fully centralised excludes TA)	Option C (Existing N plant and new S plant)	Option D (Existing N plant and S plant)	Option E (Five plants for the region)	Option F (Standalone plants/upgrade of BAU)
Natural Environment Improvement Capability	-3 Very poor environmental outcomes if nothing changes	3 Quality discharge improvements, removal of upstream discharge location	2 Quality discharge improvements, removal of upstream discharge location, Creation of additional hazardous site	2 Quality discharge improvements, Creation of additional hazardous site	1 Medium improvements to discharge quality, additional discharge location required	0 Minor improvements to discharge quality. Additional three sites become hazardous and three additional discharge points
Public Health Protection	-1 Some potential negative health impacts due to risk of septic tank failure	3 Improvements to public health protection	3 Improvements to public health protection	3 Improvements to public health protection	3 Improvements to public health protection	2 Improvements to public health protection, still requires reliance on septic tanks
Cultural Benefits / Impacts	FF Does not meet Te Ture Whaimana	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.				
Flexibility, Scalability and Risk	FF Will not meet future growth requirements	-2 Pukete has limited build out capacity, high risk of septicity	3 Frees up space at Pukete facility and provides significant growth opportunities	2 Frees up Pukete facility and provides some growth opportunities, higher risk of septicity issues	1 Creates some growth opportunities, Ngaruawahia may have some capacity limitations	-1 Does not provide significant growth opportunities, particularly industrial growth.
Whole of life costs	*Not Scored* Lowest capital costs. OPEX costs similar across all options	*Not Scored* High capital costs. OPEX costs similar across all options. Costs spread over larger population base	*Not Scored* High capital costs. OPEX costs similar across all options. Costs spread over larger population base	*Not Scored* High capital costs. OPEX costs similar across all options. Costs spread over larger population base	*Not Scored* Lower capital costs. OPEX costs similar across all options. Costs spread over smaller population base	*Not Scored* Lower capital costs. OPEX costs similar across all options. Costs spread over smaller population base
Sustainability	-3 Significantly limited sustainability opportunities, currently difficult to retain and attract required skill and labour	2 Potential for reuse and use of sustainable technologies, build out capacity limits ability to construct reuse infrastructure	3 Potential for reuse and use of sustainable technologies, can attract skill and labour opportunities	2 Potential for reuse and use of sustainable technologies, can attract skill and labour opportunities. Ability for industrial reuse is limited due to location	1 Limited potential for reuse and use of sustainable technologies, more difficult to source enough labour for operation of facilities	1 Limited potential for reuse and use of sustainable technologies, more difficult to source enough labour for operation of facilities

Key outcomes and considerations of MCA

The following points highlight some of the key outcomes and implications of the assessment:

- Option A was considered to be fatally flawed with respect to its ability to meet statutory obligations. BAU does not deliver best for river outcomes and does not meet the Te Ture Whaimana. This option was also seen as fatally flawed with respect to its ability to meet future growth requirements.
- A fully centralised option (Option B) has the potential to deliver positive environmental outcomes, particularly by removing the discharge point at Cambridge and relocating this further downstream. However, the most concerning issue with Option B is the limited build out capacity of the Pukete facility site which will have long term implications.
- Option C and D do not present with any significant barriers and generally realise positive impacts for each criteria. Option C has slightly better results, based on the fact that a new greenfield and central location can open up greater growth opportunities, reduce septicity risk and allows for greater flexibility in design.
- Option E has greater limitations (when compared with Option B, C and D) around achieving high quality discharge and using sustainable technologies and reuse which only becomes feasible once the plant reaches a certain size. Five medium and large facilities would also become increasing harder to resource and operate. The costs for the individual plants will be spread across a smaller population base.
- Option F would essentially leave the servicing areas as they currently are, but add additional plants to areas which are not serviced. This would lead to discharge quality improvements when compared with BAU. This option has a greater potential for land discharges as smaller plants have smaller flows. However, a large number of smaller plants would be significantly harder to resource, with greater numbers of staff required to maintain each facility. Additionally smaller plants will at some point be unable to service growth in some areas and may also limit industrial growth.

Preferred option(s)

Based on this high level feasibility study and associated multi-criteria analysis (MCA), **Option C: Convey all communities to either a northern or southern centralised facility (new site)** has the greatest potential benefit and the lowest potential risk and impact. Option D, however, also sees significant benefits over the other options. As noted above, the biggest differential between the two options are the fact that Option C utilises a new more centralised greenfield site, which is more flexible and adaptable, reduces the conveyance risks but will require additional consenting requirements. It is therefore recommended that if this option is pursued, site investigations and site assessments are carried out early with the appropriate level of community and stakeholder engagement.

One of the key issues with both Options C and D is the ability to fund these options. Both have the highest up front capital costs. However there is a greater potential to mitigate affordability challenges through scale, alternative funding and financing tools and larger rating base.

Next Steps

In order to fully understand the viability of Option C, further investigations are required. It is recommended these investigations occur as part of a Detailed Business Case.

The Detailed Business Case will undertake the following steps:

- Review the Sub-Regional Three Waters Strategic Case and the Cambridge Wastewater IBC
- Identify where further strategic assessments and alignment is necessary
- Undertake a detailed capacity assessment of the existing facilities and a more detailed population growth assessment of the impacted areas.
- Define and assess a Do Minimum option
- Undertake more detailed design for Option C, to include the following elements:
    - Site investigation and assessment of the potential new site (to include an assessment of the existing Cambridge site to assess its viability)
    - Cultural assessment
    - Environmental assessment
    - Detailed concept design
    - High level cost estimates
- Undertake a funding assessment:
    - Project funding avenues consideration
    - Staging options
    - Economic assessment of options
- Undertaken a commercial case, to include a procurement strategy
- Undertake a management case
    - Determine governance and management structure for the project delivery
    - Determine governance and management structure for the operation of the project

Disclaimer

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1. Introduction

1.1 Purpose of the report

The purpose of the high-level wastewater servicing assessment is to provide an evidence base for the wastewater servicing options with the Waikato-Hamilton Metro Area (the Metro Area) (see Figure 1-1) that should be considered in further detail as part of the Sub-Regional Study and associated projects. This report documents the process, assumptions and findings of the assessment.

This feasibility assessment is a high-level comparative assessment to determine whether centralised wastewater servicing solutions for the Metro Area should be considered further and in more detail.

This Feasibility Study (the study) also draws together the key elements of works completed by Waipa District Council (WDC), with regards to an Indicative Business Case (IBC) for the Cambridge Wastewater Treatment Plant (WWTP) and is considered a prerequisite for the alignment of these projects, prior to further works progressing in that space.

This study is not a standalone, nor a final assessment of Wastewater servicing options, but acts as a bridge between the High Level Sub Regional 3 Waters Strategic Business Case (SBC) and the more targeted Cambridge WWTP IBC. The study draws on information from both assessments to reach its conclusion and needs to be read in conjunction with the two reports. As such this study will aim to align with the overarching Sub Regional 3 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 Background and context

The Waikato-Hamilton-Waipa Metro Area (Metro Area) is from Taupiri through to Cambridge (North - South) and Te Kowhai/Whatawhata to Tauwhare (East - West) and forms part of the Sub-Regional Three Waters Study Area. The Sub-Regional Three Waters study area and the Metro Area is shown in Figure 1-1.

1.2.1 Sub- Regional Three Waters Project

The Sub-regional three waters project is being delivered through Future Proof and will produce a programme business case that identifies key 3-waters projects and activities necessary to achieve the agreed programme objectives, including delivering 'best for river' outcomes. The strategic case has already been delivered and will be built upon to deliver the programme business case. The strategic case provides the foundation for development of 3-waters infrastructure solutions for the Waikato Sub-region founded on its overarching vision as outlined in Section 1.1 above.

While the programme business case is still under development, several priority projects requiring project level consideration are already emerging.

Consideration of wastewater solutions for the Metro Area, i.e. this work and actions arising from it, is being accelerated ahead of other technical work required to support the Sub-Regional Three Waters Programme

Business Case, in order to support Waipa District Council progress a long-term solution for the Cambridge Wastewater Management with urgency.

1.2.2 Cambridge Wastewater Treatment Project

The Cambridge Wastewater Treatment Indicative Business Case (IBC) was first undertaken to identify a long term solution to the currently non-compliant wastewater treatment plant at Cambridge. The IBC was undertaken in a collaborative fashion with Iwi partners and Hamilton City Council active involvement, and Waikato Regional Council participation. This investigation identified a shortlist of options.

Figure 1-1 Three Waters Project Study Area (Waikato/Waipa River Catchment Area located in the Future Proof Area) and Waikato-Hamilton – Waipa Metro Area (orange highlighted area).

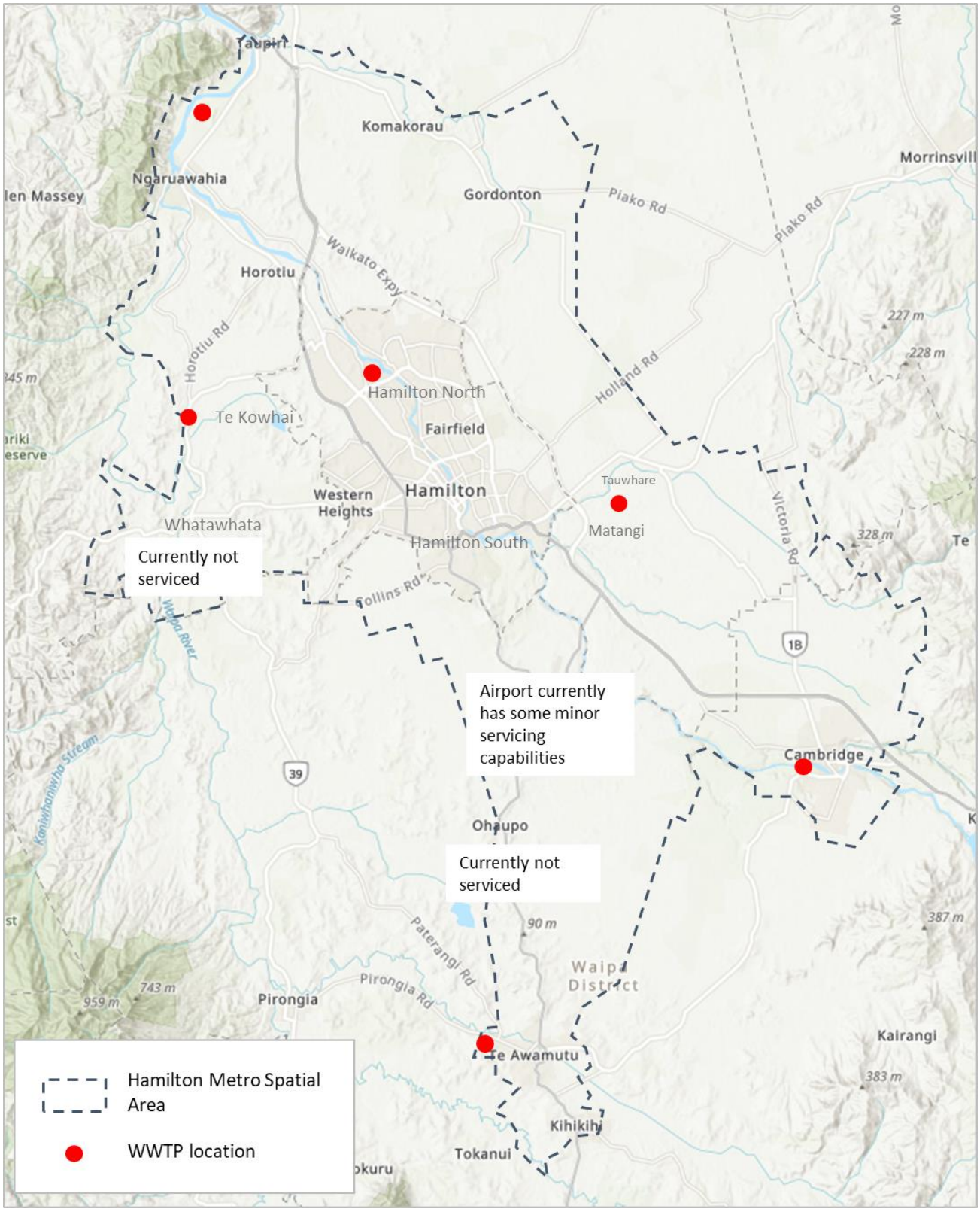
1.2.3 Geographical context

The focus of the high-level assessment are the settlements within the Metro Area that are currently serviced, that are experiencing growth pressure, or are under consideration for future development. These communities/areas are:

- Taupiri
- Hopuhopu
- Ngaruawahia
- Horotiu
- Te Kowhai
- Whatawhata
- Hamilton (North and South)
- Area east of Hamilton
- Matangi
- Tauwhare Pa
- Tamahere
- Hamilton Airport
- Ohaupo
- Cambridge/Karapiro
- Te Awamutu /Kihihkihi

Figure 1-2 below provides a detailed map of the areas and existing treatment plants currently servicing the Metro Area.

Figure 1-2 Waikato-Hamilton-Waipa Metro Area and locations of existing treatment plants (project study area)



1.3 Methodology

The following steps outline the overarching methodology used for this high level feasibility study.

Step 1: Option and criteria development

- An initial brainstorming of options determined a range of potential servicing options within the metro spatial area. This initial options development did not put any limitations to the options and considered the implications of servicing over a 100 year lifespan. Initial criteria for the assessment was developed internally before circulated with stakeholders.
- Initial ideas were workshopped with stakeholders and partners who had the opportunity to provide feedback. Feedback from stakeholders led to some changes to existing options and new options. Stakeholders were also asked to provide further feedback regarding the assessment criteria.
- Options were then consolidated to a more manageable number. The rationalisation of options was based on the following criteria:
    - Which options best reflect the differences between centralisation vs standalone facilities?
    - Which options can be most feasibly delivered and implemented with the existing infrastructure?
    - Which options are best able to minimise the length of conveyance?
- Options and assessment criteria were updated and finalised and sent back to stakeholders for further consideration.

Step 2: Technical Inputs

A number of technical inputs were required to make an appropriate assessment

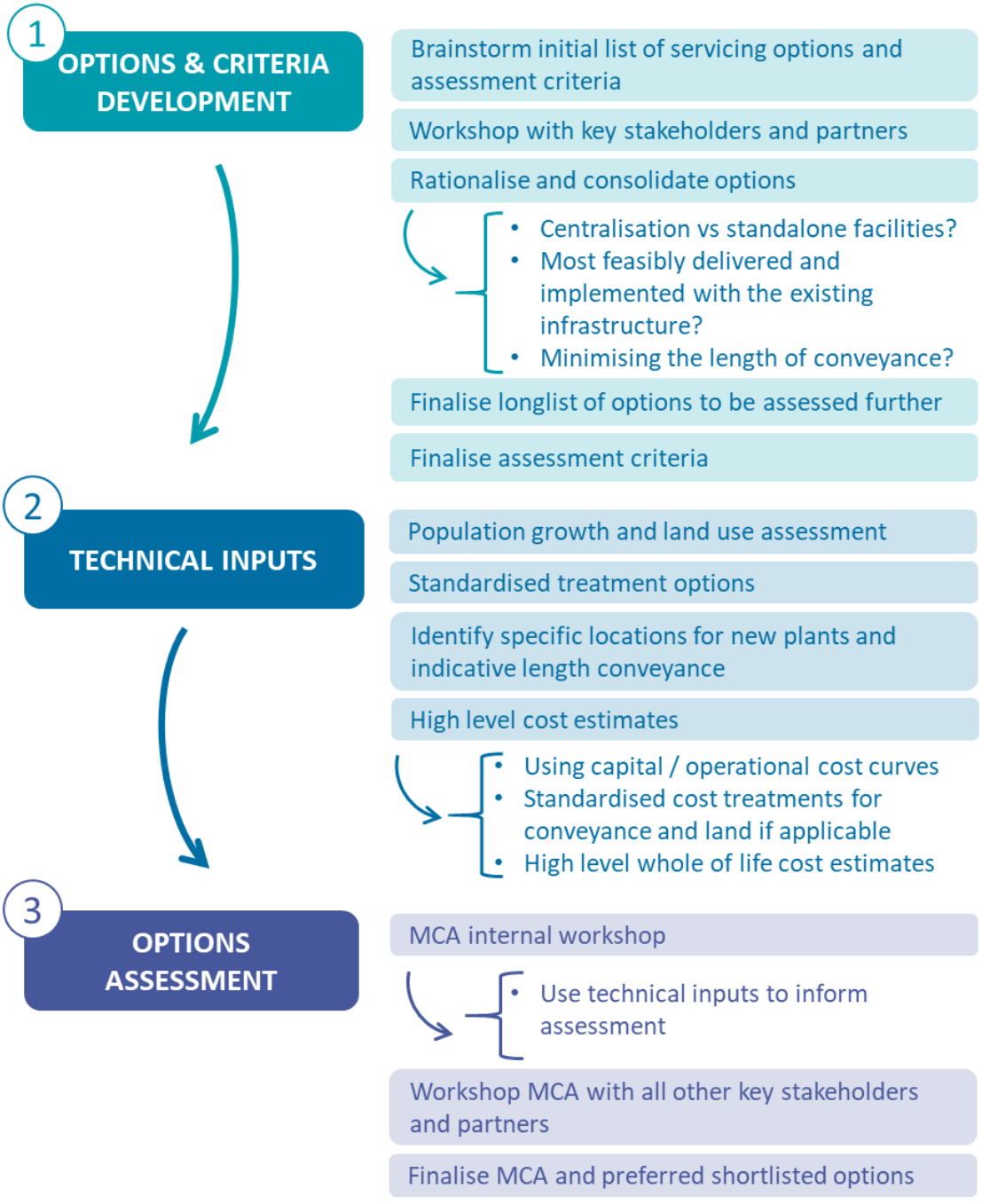
- Population and growth assumptions were determined based on existing sources (Futureproof and other individual council plans). Population assumptions for each of the main areas within the metro spatial area were developed for both a 2045 scenario and a 100+ year scenario (refer to section 1.2.3).
- Standardised treatments were developed which outline the quality, capacity and infrastructure requirements of a small, medium and large plant. These standardised sizes were used to further develop the options.
- For options which require a new plant, a location has been assumed (for both the plant site and conveyance lengths). These are based on the assumptions highlighted in section 3.3.
- High level capital and operational costs were developed which considered the cost of building and/or upgrading new plants, the cost of building new conveyance and pump stations, the potential to reuse existing infrastructure and the operational cost of the plants, conveyance and pump stations (see section 3.4).

Step 3: Options Assessment

- An internal MCA was undertaken first which summarised the technical details determine as part of Step 2.
- The initial MCA was then workshopped with stakeholders. All feedback and insights form stakeholders and partners was fed back into the final MCA.

See Figure 1-3 below for a summary of the methodology

Figure 1-3 Methodology flow chart



2. Options Development

2.1 Initial list of options

An initial list of 13 servicing options was developed with project partners (including HCC and Waipa District Council 3-waters staff). The initial options ranged from very large centralised facilities to standalone facilities for each community. Each option provides an indicative location of the facility (if a new facility is required) and indicative servicing areas. At this early stage of the assessment process, the basis of the options outlined below is largely driven by existing and potential growth areas, coverage and distribution of serviced areas and their associated treatment plants within the Metro Area (see section 4.1).

These options are listed below and further outlined in Appendix A.

- **Option I** BAU - Retain existing servicing arrangements for all communities
- **Option II** Convey all communities to Pukete WWTP
- **Option III** Convey all communities north of Hamilton and existing Hamilton City to Pukete WWTP, all communities south of Hamilton to Cambridge
- **Option IV** Convey all communities north of Hamilton and part of Hamilton to Pukete WWTP, the remainder of Hamilton and all communities south and east of Hamilton to a new WWTP, Te Awamutu standalone facility
- **Option V** As Per Option IV, but part of Hamilton and southern and eastern communities to Cambridge WWTP
- **Option VI** Convey all communities north of Pukete WWTP to a new northern facility. Southern and eastern communities (excluding Cambridge) to a new facility. Cambridge and Te Awamutu standalone facility
- **Option VII** As per VI, but with Te Awamutu wastewater is conveyed to Cambridge
- **Option VIII** As per VI, but Cambridge wastewater is conveyed to Te Awamutu
- **Option IX** As per IV, but Te Awamutu to new centralized facility to the south
- **Option X** Small Standalone WWTP for all small communities
- **Option XI** New Southern WWTP located between Hamilton and Cambridge. Areas north of Hamilton remain as per BAU
- **Option XII** Small Standalone WWTP North of Hamilton and a new southern centralised facility
- **Option XIII** New Southern WWTP located between Hamilton and Cambridge and the expansion of Ngaruawahia WWTP

2.1.1 Workshop feedback and outcomes

The first of two workshops to deliver this assessment was held on 28th January 2020.

Workshop participants included practitioners and experts from the following organisations:

- Hamilton City Council (HCC)
- Waipa District Council (WDC)
- Waikato District Council
- Waikato Regional Council (WRC)
- Futureproof
- Ngati Tamaoho/NKAOTW
- Waikato Tainui
- Ngati Koroki Kahukura
- Raukawa
- Stantec
- Watercare

The objectives of the workshop were to:

- Identify and confirm wastewater servicing options for the Waikato-Hamilton-Waipa Metro Area that should be included in the high-level assessment
- Discuss and agree the method that should be used for the assessment
- Develop and confirm the criteria that should be used for the assessment
- Agree next steps for completing the assessment

Workshop feedback on the options development is summarised in Table 2-1 below. Some additional options along with minor modifications/variations to the initial options were identified. The record from the workshop is included as Apppendix E.

Table 2-1 Stakeholder feedback on options development

Modifications to existing options	New options
Change Option VI, VII, VIII service area for a new southern facility to include part of Hamilton	Convey the wastewater from the western areas to the Hamilton Pukete Plant with discharge treated wastewater into Waipa upstream of new water take
Consider minor variation to Options II, III, IV, V, VI that assume standalone facilities for Tauwhare/Matangi and Whatawhata/Te Kowhai.	Consider servicing Pirongia and sending Ohaupo wastewater south to Te Awamutu plant
	East and Western servicing options for Hamilton.
	Retain the existing wastewater plants at Ngaruawahia and Te Awamutu
	One new waste water treatment plant that services full metro spatial area.
	Ngaruawahia services for all areas to the north of Hamilton (Taupiri, Hopuhopu, Ngaruawahia)
	Horotiu conveyed to Pukete Plan

2.2 Consolidation of options

The options and changes identified above were added to the initial list of servicing options. Given the number and extent of additional options and variations of options, the list was reorganized in the following way:

- 8 x Northern options
- 12 x Southern options
- 96 x North / South combinations
- 2 x East / West combinations
- 2 x Whole of catchment options

This meant that there were a total of 120 variations of servicing options. Many of these options were, however, only slight variations of one another, and many were different types of combinations. It was therefore deemed appropriate to consolidate this list to a more manageable level.

The following high level factors were considered to consolidate the options:

- Which options are most appropriate for highlighting the costs and benefits of centralisation vs standalone facilities?
- Which options are the most feasibly delivered and implemented with the existing infrastructure?
- Which servicing areas make the most sense based on location and minimising the length of conveyance?

The outcomes of this assessment provides guidance on the level of centralisation which is most feasible for the Metro Spatial area. This does not mean other servicing options identified will not be, or not required to be, considered in greater detail in future works. Table 2-2 below outlines the rationale for progressing or not progressing each option, including the options which were identified within the workshop.

Table 2-2 Reasons to progress and not progress

Option description	Rationale	
Option I BAU - Retain existing servicing arrangements for all communities	This BAU option is further considered as it reflects the reference case. All other options will be compared by their ability to improve upon the existing situation. **This option becomes Option A in the next assessment**	Progressed
Option II: Convey all communities to Pukete WWTP except for Te Awamutu.	This option was considered as it reflects a whole of catchment option, or 'full' centralisation option, with only two plants servicing the whole area. Te Awamutu was not included given the extra distance needed to convey. **This option becomes Option B in the next assessment**	Progressed
Option III Convey all communities north of Hamilton and existing Hamilton City to Pukete WWTP, all communities south of Hamilton to Cambridge	Options which included the centralisation of all the northern areas and also included south Hamilton and Peacockes being sent to Pukete were not progressed given that the other north south centralisation options alleviate greater pressure constraints at Pukete.	Not Progressed

Option description	Rationale	
Option IV Convey all communities north of Hamilton and part of Hamilton to Pukete WWTP, the remainder of Hamilton and all communities south and east of Hamilton to a new WWTP.	This option reflects a north south centralisation option with a portion of Hamilton being redirected south to a new facility near the airport. This alleviates pressure from the existing Pukete facility which will service areas north, west and east of Hamilton. **This option becomes Option C in the next assessment**	Progressed
Option V As Per Option D, but part of Hamilton and southern and eastern communities to Cambridge WWTP	This also reflects a north south centralisation option, however areas in the south will be conveyed to a new southern sub-regional facility located on the existing Cambridge site. Option D and Option E reflect those which were short-listed as parted of the Cambridge IBC. **This option becomes Option D in the next assessment**	Progressed
Option VI Convey all communities north of Pukete WWTP to a new northern facility. Southern and eastern communities (excluding Cambridge) to a new facility. Cambridge	All options which required Te Kowhai and Whatawhata being conveyed north to Ngaruawahia were not progressed given that both communities are closer to the existing Pukete facility. It is considered easier, cheaper and less risky to convey the wastewater from these communities to Pukete or to treat them with standalone facilities. However a modification of this option was progressed.	Not Progressed
Option VII As per F, but with Te Awamutu wastewater is conveyed to Cambridge	Te Awamutu facility is already of a relatively high standard, whilst Cambridge would require significant upgrades to cater for the additional flows. Additionally the conveyance distance is considered excessive, particularly considering Te Awamutu's current facility is currently compliant	Not Progressed
Option VIII As per F, but Cambridge wastewater is conveyed to Te Awamutu	The conveyance distance between Cambridge and Te Awamutu is considered to be too far and would require significant capacity upgrades at Te Awamutu	Not Progressed
Option IX As per D, but Te Awamutu to new centralized facility to the south	Te Awamutu facility is already of a relatively high standard. The conveyance distance is considered excessive, particularly considering Te Awamutu's current facility is compliant	Not Progressed
Option X Small Standalone WWTP for all small communities	This option was progressed but was modified slightly so Ngaruawahia facility continued to service Taupiri and Horotiu as per BAU. This option reflects the existing situation, however recommends the upgrade or replacement of the existing facilities to small package plants or medium plants. **This option becomes Option F in the next assessment**	Progressed

Option description	Rationale	
Option XI New Southern WWTP located between Hamilton and Cambridge. Areas north of Hamilton remain as per BAU	This option was not progressed as it was not significantly different from option D. This may be considered as part of a staged solution. Or may be revisited later once detailed investigations are undertaken	Not Progressed
Option XII Small Standalone WWTP North of Hamilton and a new southern centralised facility	Standalone facilities at Ngaruawahia, Taupiri and Horotiu was not considered practical considering the existing Ngaruawahia facility is capable of servicing the northern region and conveyance is not too far.	Not Progressed
Option XIII New Southern WWTP located between Hamilton and Cambridge and the expansion of Ngaruawahia WWTP	All options which required Te Kowhai and Whatawhata being conveyed north to Ngaruawahia were not progressed given that both communities are closer to the existing Pukete facility. It is considered easier, cheaper and less risky to convey the wastewater from these communities to Pukete or to treat them with standalone facilities.	Not Progressed
Ngaruawahia services for all areas to the north of Hamilton (Taupiri, Hopuhopu, and Ngaruawahia), southern centralised plant and expansion of Pukete.	A variation of Option F was considered where Ngaruawahia continued to services areas north of Hamilton, Pukete would service Whatawhata and Te Kowhai and A southern centralised plant would service the airport, Ohaupo and Matangi. Cambridge and Te Awamutu would remain as standalone facilities. This option only centralises areas to the south of Hamilton (excluding Cambridge) and encapsulates Te Kowhai and Whatawhata into the Pukete servicing area. It reflects a 'smaller' centralisation of facilities, with five plants servicing the whole area. **This option becomes Option E in the next assessment**	Progressed
East West servicing options	East West servicing areas were not considered further. This was because of the extra cost involved with redirecting existing pipes and flows on the western side of Hamilton to a new western facility. The distances needed to convey to both the eastern and western facilities were also significant.	Not Progressed
Te Awamutu servicing Pirongia and/or Ohaupo	Te Awamutu may service surrounding areas in the future. These options were not progressed as part of this study but have not been discounted as possibilities for Te Awamutu.	Not Progressed
Other variations of options	All the other variations of the options may be reconsidered after further investigations in to both the capacity and capabilities of the existing facilities.	Not Progressed

2.3 Finalising options

Based on the above rationalisation the following six options were progressed for further investigation (See Figure 2-1 to Figure 2-6):

- **Option A:** Business As Usual/ Do minimum option. This option would retain all existing plants:
    - Ngaruawahia
    - Te Kowhai
    - Pukete
    - Matangi
    - Tauwhare Pa
    - Cambridge
    - Te Awamutu.

  No improved levels of service would be provided for Whatawhata, the airport precinct or Ohaupo.
- **Option B:** One metro wastewater facility at Pukete (existing site) and retention of the Te Awamutu Plant to service Te Awamutu
- **Option C:** Two metro wastewater facilities (i.e. northern and southern metro centralised facilities (i.e. existing Pukete and new southern site respectively) and retention of the Te Awamutu Plant
- **Option D:** Two metro wastewater facilities (i.e. northern and southern metro centralised facilities (i.e. existing Pukete and Cambridge Sites respectively) and retention of the Te Awamutu Plant
- **Option E:** Five upgraded and expanded wastewater facilities to service the metro spatial area:
    - Ngaruawahia
    - Pukete
    - South Hamilton
    - Cambridge
    - Te Awamutu
- **Option F:** Upgrades of BAU including new facilities at Whatawhata, the airport and Ohaupo

Figure 2-1 Option A: Business as Usual (BAU)

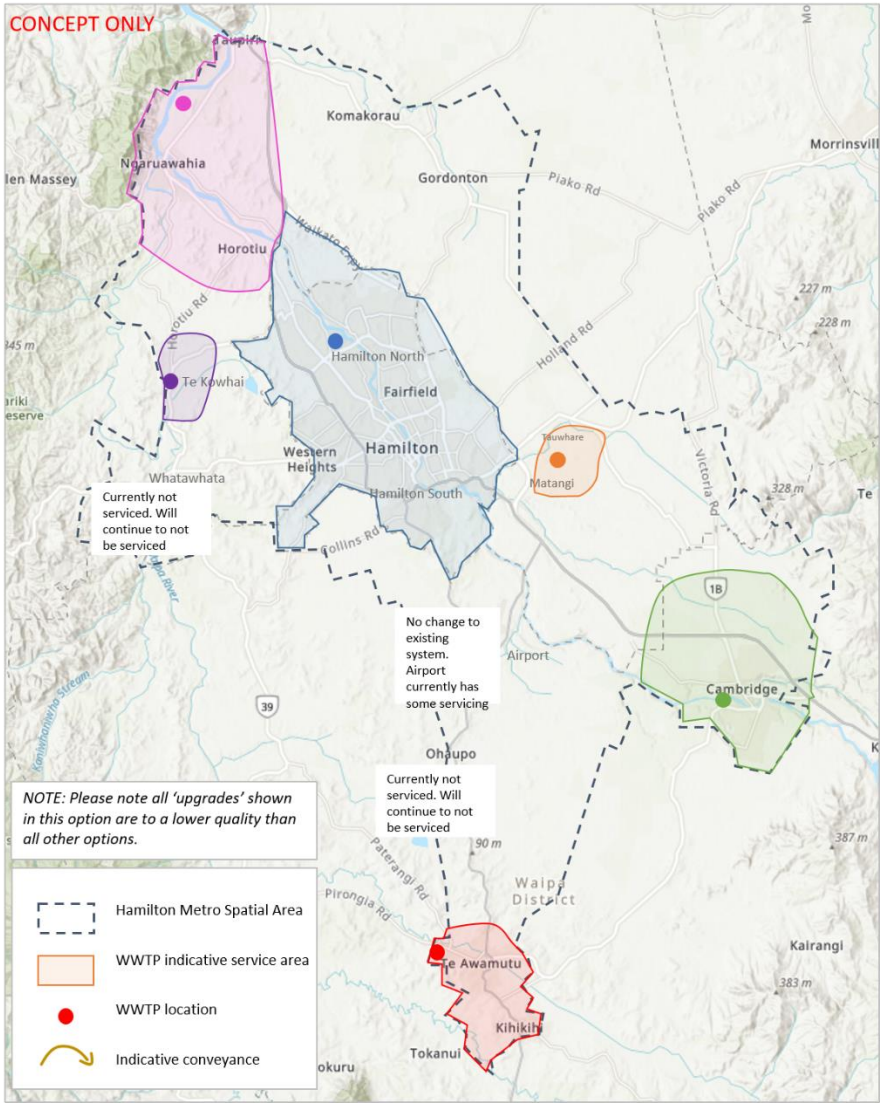


Figure 2-2 Option B: Fully centralised facility at Pukete (TA to remain standalone)

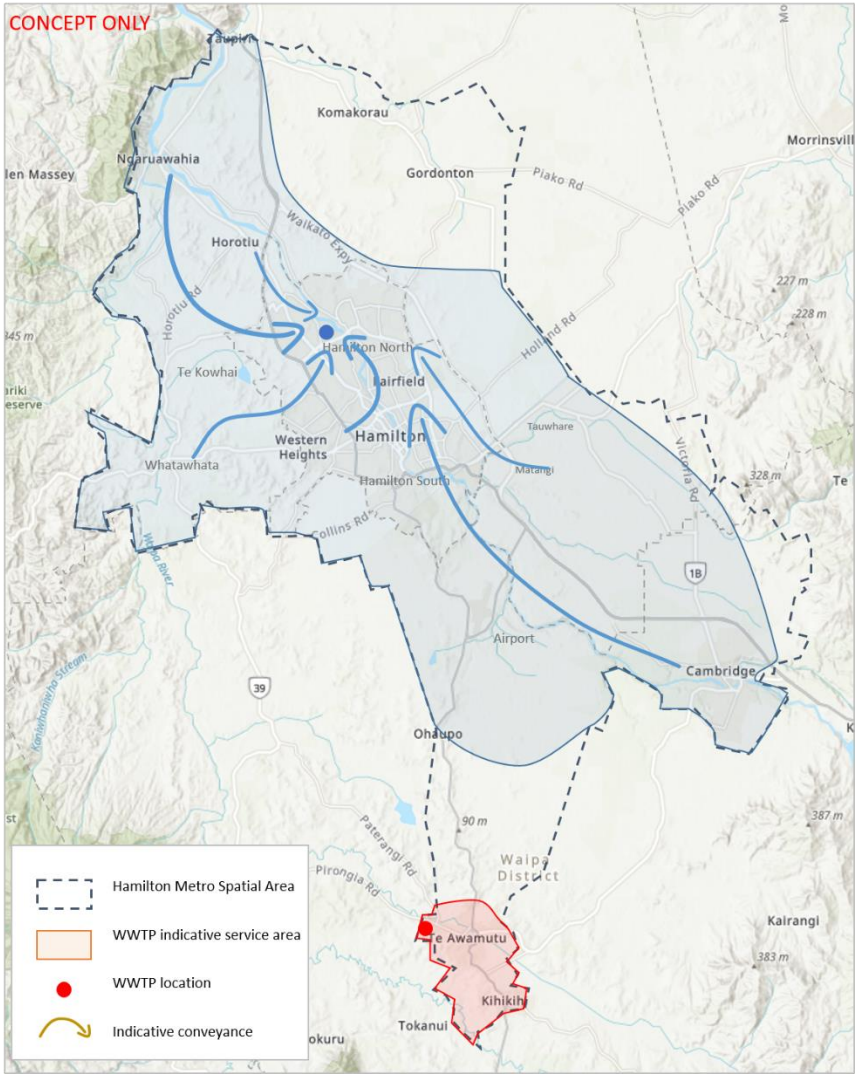


Figure 2-3 Option C: Convey all communities either to a northern or southern centralised facility

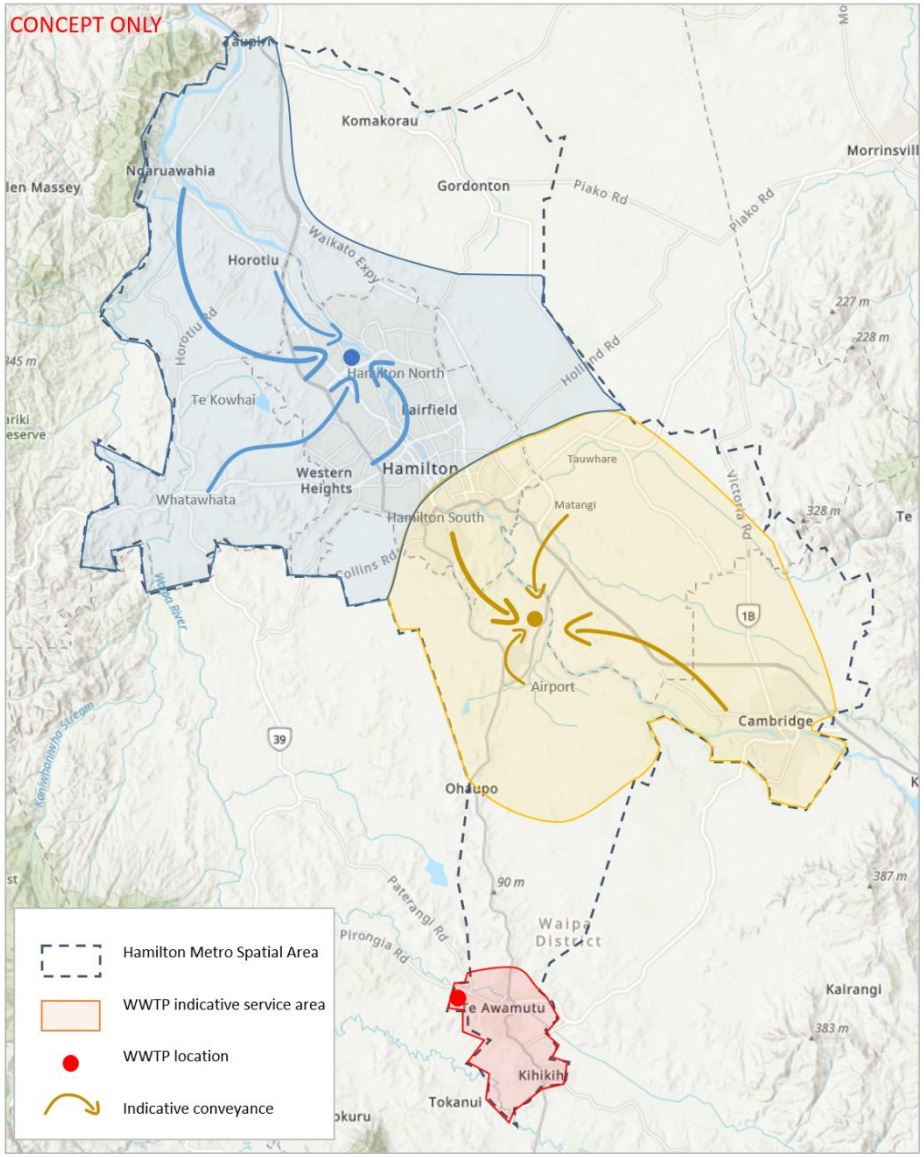


Figure 2-4 Option D: Convey all communities to either a northern or southern centralised facility (Cambridge site)

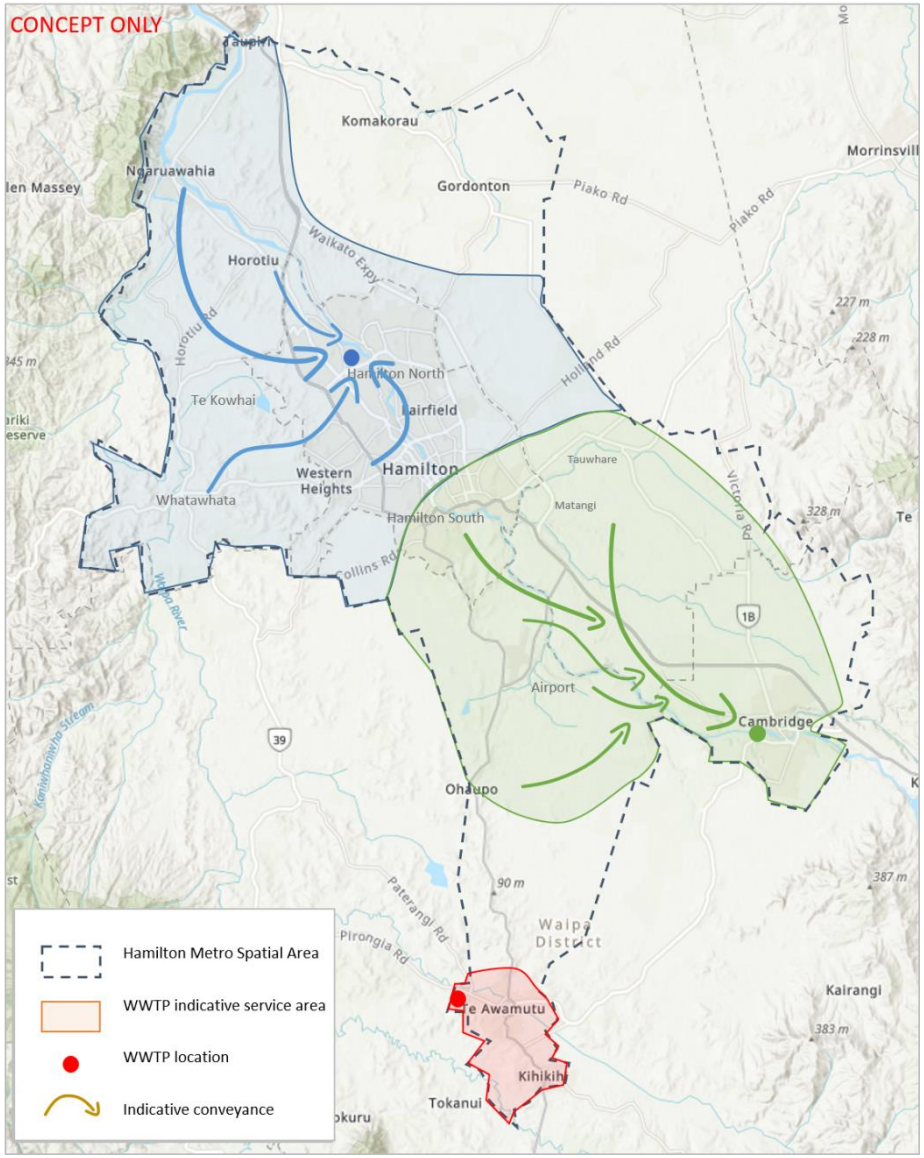


Figure 2-5 Option E: Five wastewater facilities to cater for the whole metro spatial area including a new southern facility near the airport.

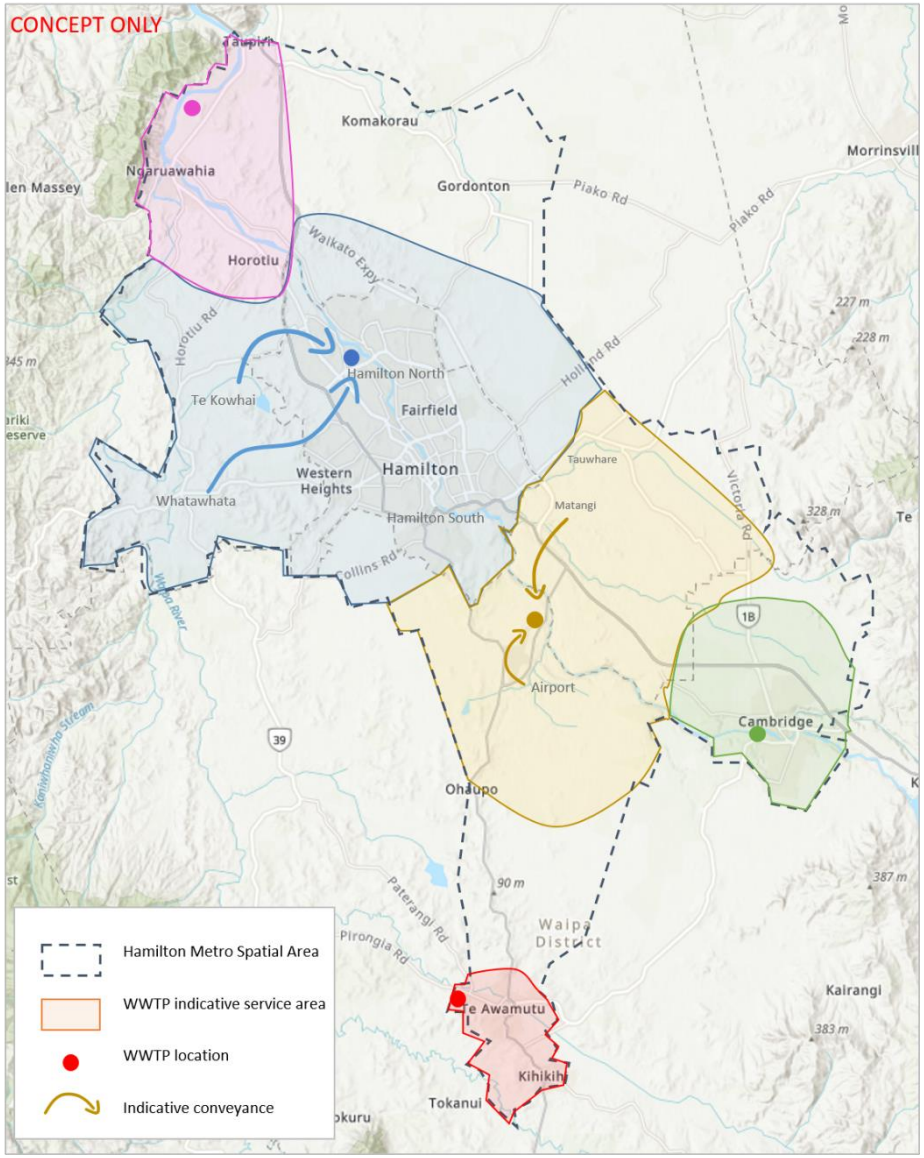
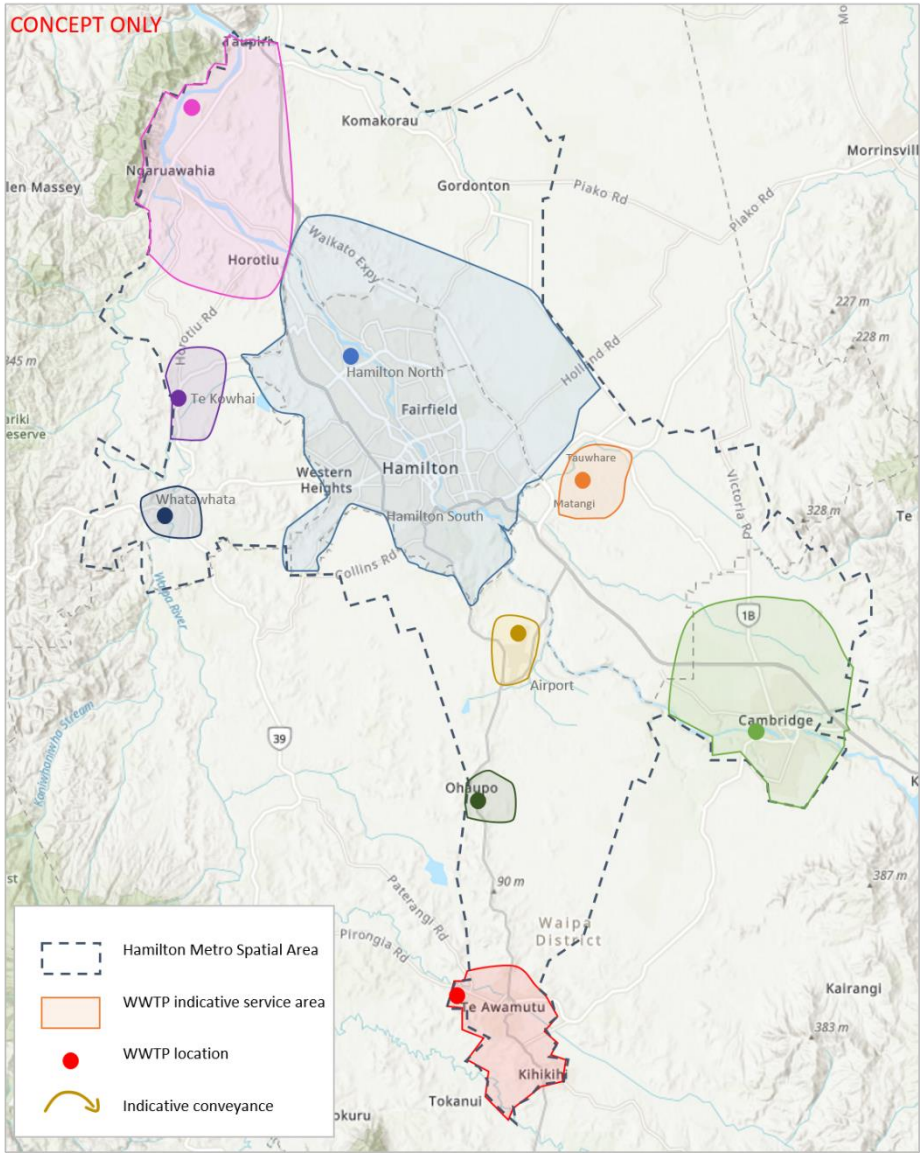


Figure 2-6 Option F: Upgrades of BAU including new facilities at Whatawhata, the airport and Ohaupo



2.3.1 Options descriptions and assumptions

Option A: Business as Usual

The BAU option assumes that the current facilities will continue to service the current servicing areas (i.e. Pukete will continue to service only the HCC boundary area, which includes the potential expansions at Peacockes). Areas such as Whatawhata, Ohaupo and areas around the airport will not be serviced (either now or in the future). It is assumed that all the existing plants will undergo some upgrades, particularly as population grows. However, the quality of these upgrades are assumed to be lower than those considered within the other options. Whilst this may not reflect the future plans at some of the facilities, this assumption best captures the current reactive planning and management which is often seen within the wastewater industry. These assumptions allow the assessors to test the other servicing options against the existing situation.

Option B: Fully centralised facility at Pukete (Te Awamutu to remain standalone)

A fully centralised option considers all communities (excluding Te Awamutu) will be serviced by the Pukete facility in Hamilton. Te Awamutu was excluded given the distance required for conveyance. It was assumed that Pukete would be used as the centralised facility given it currently has the largest capacity and is in a relatively central location. A new fully centralised facility was not considered as this was not the best use of existing facilities.

Option C and D: Convey all communities to a northern and southern centralised facility (alternative site locations)

These options both assume a centralised northern and centralised southern facility. Pukete WWTP would become the northern facility and cater for flows from Te Kowhai, Whatawhata, Ngaruawahia, Taupiri and northern and central Hamilton. The southern facility would cater for Peacockes, southern Hamilton, the southern band from Matangi to Ohaupo and Cambridge.

The only difference being the location of the southern plant. Option C has a southern plant located in a central location between Hamilton and Cambridge and Option D would utilise the Cambridge WWTP site. Option C and Option D reflect those which were short-listed as parted of the Cambridge Wastewater Treatment IBC.

Option E: Five wastewater facilities to cater for the whole metro spatial area including a new southern facility near the airport.

This option reflects a partly centralised network, with five facilities servicing the entire area. Pukete WWTP would service the existing Hamilton boundary area (including Peacockes). It would also service Te Kowhai and Whatawhata. Ngaruawahia WWTP would continue to service communities to the north of Hamilton (Ngaruawahia, Taupiri and Horotiu). A new southern facility located south of Hamilton would service the southern band from Ohaupo to Tauwhare. However, Cambridge would continue to service themselves (including Hautapu). This option largely keeps the existing council boundaries in place.

Option F: Upgrades of BAU including new facilities at Whatawhata, the airport and Ohaupo

Option F reflects the scenario whereby all the existing sites remain with all the existing servicing areas, however it also assumes that small plants will be built for areas which are not currently serviced (at Ohaupo, Whatawhata and the airport). This option also assumes a higher standard facility will be implemented within the medium term timeframe (see section 3.1 for details on the population growth assumptions). In reality, the

current state of the wastewater servicing environment sits in between Option A and Option F, with many facilities in the process of improving or planning upgrades. However, for the purpose of this assessment these two options have very different assumptions so as to emphasise the need to change from current practice.

3. Technical Inputs

3.1 Growth and population considerations

3.1.1 Description of growth scenarios

High level growth assumptions have been used to develop the future size and capacity of the potential plants and servicing areas. Two growth scenarios have been used; the 2045 growth scenario and a 100 year growth scenario. Two growth scenarios were considered to reflect a medium and long term perspective. A 100 year perspective aligns with the planning philosophy highlighted within the Sub-Regional three Waters project. This allows for a more thorough understanding of the long term implications of each option.

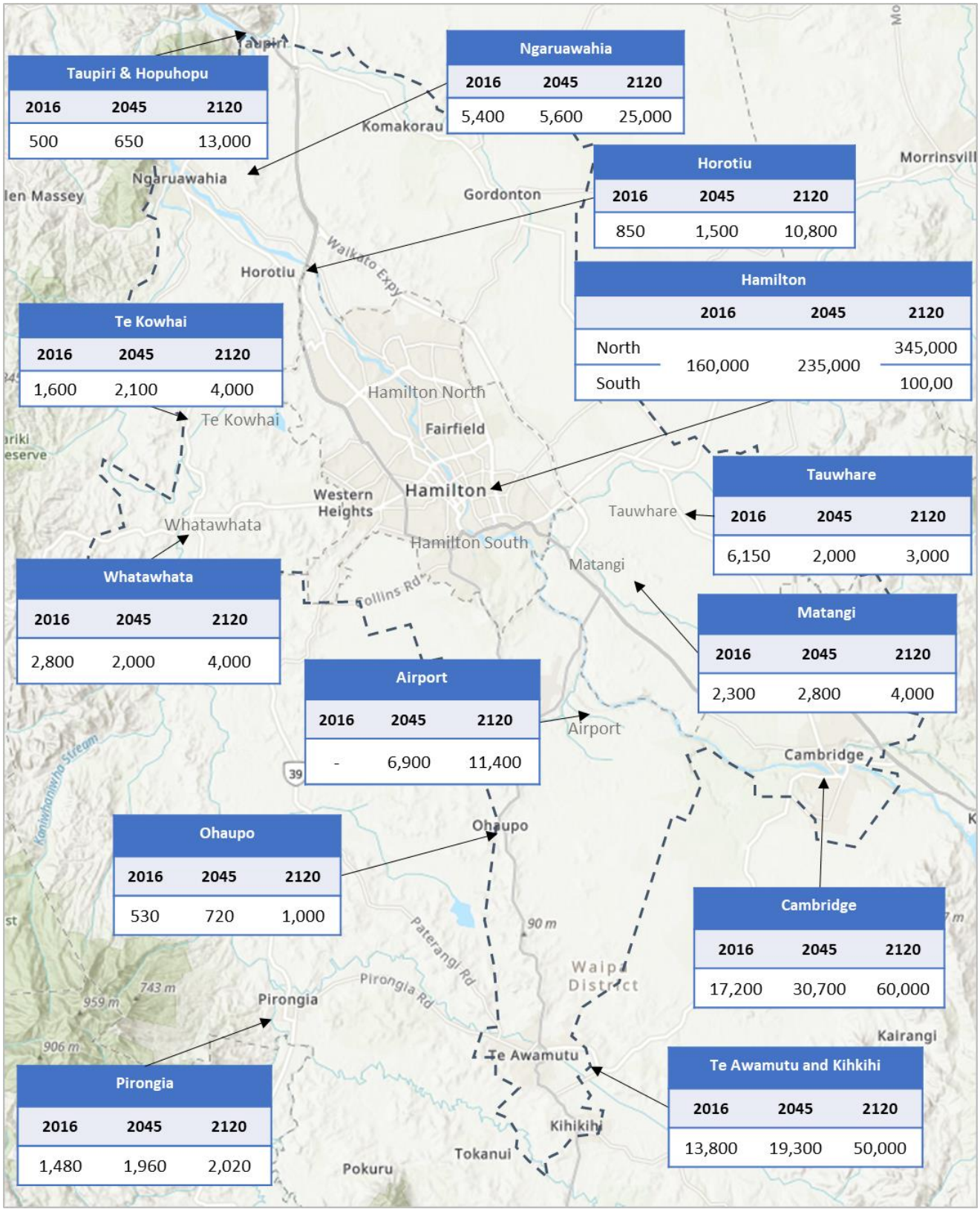
The 2045 population assumptions use Futureproof projections. The 100 years + population projections currently use multiple sources, taking the largest projection for an area. As population increases so does the requirement for larger facilities. In some options when we consider a 100 years + population, the size of plant must increase from a 'medium' size to a 'large' size (see following sections for details). Table 3-1 and Figure 3-1 shows the population projections for the individual communities.

Table 3-1 Population growth assumptions

Area	2016	2020 Servicing (BAU)	2045	100 years+	Source/Notes
Taupiri & Hopuhopu	500	Currently serviced	650	13,000	Metro Spatial Plan (MSP) - split between NGA, Taupiri/Hopuhopu
Ngaruawahia	5,400	Currently serviced	5,600	25,000	MSP - split between NGA, Taupiri/Hopuhopu
Horotiu	850	Currently serviced	1,500	10,800	Waikato Growth Strategy (WGS)
Te Kowhai	1,600	Small part of township serviced	2,100	4,000	WGS
Whatawhata	2,800	Not currently serviced	2,000	4,000	Population likely covers wider area than just township
Hamilton North	160,000	Currently serviced	235,000	345,000	Wastewater Master Plan (WWMP) +MSP for infill+R3+Southern Links
East of Hamilton					
Hamilton South				100,000	
Tauwhare	6,150	Tauwhare Pa only serviced	2,000	3,000	WGS with reduction for area practical to service
Matangi	2,300	Matangi township only serviced	2,800	4,000	WGS with reduction for area practical to service
Airport		Privately serviced - industrial	6,900	11,400	Waipa advice 2019

Area	2016	2020 Servicing (BAU)	2045	100 years+	Source/Notes
Ohaupo	530	Not currently serviced	720	1,000	Environmentally sensitive area so little growth
Cambridge & Hautapu	17,200	Currently serviced	30,700	60,000	MSP
Te Awamutu & Kihikhi	13,800	Currently serviced	19,300	50,000	MSP
Pirongia	1,480	Not currently serviced	1,960	2,020	WWMP
TOTAL	**212,610**		**311230**	**633,220**	

Figure 3-1 Population growth map



3.2 Standardised treatments

As mentioned above, for the purpose of this assessment, standardised plant assumptions have been applied. A small, medium and large sized plant will have different servicing capacities, different performances and different types of technologies. These measures were sourced from existing WWTP's in New Zealand or are under construction in New Zealand. These numbers would not convert directly into resource consent limits. The consentability of the discharge would depend on a combination of factors including microbial risk assessment, changes to nutrient loads discharged as well as any particular stakeholder concerns. This will be further assessed in the next phase of work.

The table below summarises this at a high level. Detailed plant assumptions can be found in Appendix B.

Table 3-2 Standardised Treatments

WWTP Size	Plant Philosophy	Servicing population		Flow (m3/d)		Performance levels
		Min	Max	Min	Max	
Small Plant	Nitrifying Activated Sludge (AS), with limited denitrification, chemical Phosphorous and disinfection. Discharge to land where feasible, otherwise to water.	2,000	4,000	500	1,000	Ammonia < 2mg/l Nitrogen Oxides < 12mg/l Total Suspended Solids, <8mg/l Biochemical Oxygen Demand = 8mg/l E.coli < 10 no./100ml *Moderate Discharge Performance*
Medium Plant	Te Awamutu WWTP level of performance or better. High level of nutrient, Biochemical Oxygen Demand (BOD), Solids and Pathogen reduction. For costing purposes and based on level of treatment, a discharge to water is assumed.	4,000	40,000	1,000	10,000	Ammonia < 1mg/l Nitrogen Oxides < 6mg/l Total Suspended Solids <5mg/l Biochemical Oxygen Demand = 5mg/l Total Nitrogen < 8 mg/l Total Phosphorous = 0.5mg/l E.coli < 10 no./100ml *High Discharge Performance*
Large Plant	Pukekohe WWTP level of performance or better. High level of nutrient level, BOD, Solids and pathogen reduction. Plus energy recovery. Facility configured to provide for other forms of resource recovery in future such as potable recycling, struvite etc. but not installed. For costing purposes and based on level of treatment, a discharge to water is assumed.	40,000	400,000	10,000	100,000	Ammonia < 1mg/l Nitrogen Oxides < 4mg/l Total Suspended Solids <5mg/l Biochemical Oxygen Demand = 5mg/l Total Nitrogen <5mg/l Total Phosphorous < 0.5mg/l *Very High Discharge Performance*

3.3 Conveyance considerations

Strategic conveyance routes from communities/urban areas to existing and indicative new treatment plant locations were developed in order to estimate conveyance costs. Conveyance routes were located within road corridors where possible.

LIDAR data has been used to determine start and end elevations. Pump station and pipe selections have been based on 3 different levels of flow throughput at 2025 and 2120 but are not optimised for operation throughout the period. Indicative conveyance pipe sizes range from 250mm outside diameter (OD) for small communities to dual 650mm OD pipes for larger communities. Pumped flows range from 200m3/day to 9,000m3/day by 2045.

Upgrades to the wastewater reticulation network within each town/city has not been included in the cost estimates.

Conveyance in individual pipe lengths greater than 10km commonly causes septicity and sometimes odour nuisance issues. This has been highlighted as a key risk within the assessment.

Key assumptions made regarding conveyance pipeline and pumping requirements are presented in Appendix C and D

Table 3-3 Indicative conveyance details

Option	Conveyance total length km	Potential number of pump stations
Option A	10	2
Option B	89	10
Option C	79	11
Option D	104	10
Option E	49	8
Option F	10	2

3.4 Whole of life cost estimates

Assumptions

Key cost assumptions are outlined in Appendix C.

Conveyance capital costs are based on the assessed size of pump station needed with the pipeline cost for the length needed. Conveyance operational costs for maintenance and operations are a fixed percentage of pump station capital cost with variable components for energy and septicity control chemicals based on average annual flow.

WWTP capital costs are based on actual costs for comparable sized WWTPs in New Zealand with allowances for additional costs related to increased levels of treatment and energy recovery facilities. An allowance has been made for land use and discharge consenting costs which is not site specific. Most of the WWTPs are located at existing sites where there is sufficient space for additional process units. An

allowance has also been made for future reuse of existing assets at Pukete WWTP ($120M) and Te Awamutu WWTP ($8M).

WWTP operational costs are based on representative costs per megalitre (ML) of flow processed for small, medium and large plants. Costs considered include labour, maintenance costs, energy, chemicals, consumables (e.g. UV lamps), and sludge/biosolids disposal.

Capital costs for each option has been summarised in Table 3-4. These are total capital costs of the plant and conveyance (and pump stations). These costs have not considered the value of reusable assets, which is estimated to be approximately $128 million.

Table 3-4 Capital Cost Estimates[3]

Option	Capital Cost WWTP 2045 $M	Capital Cost Conveyance 2045 $M	Capital Cost WWTP 2120 $M	Capital Cost Conveyance 2120 $M
Option A	$310	$20	$600	$50
Option B	$380	$250	$640	$460
Option C	$460	$210	$770	$380
Option D	$460	$250	$770	$440
Option E	$420	$90	$760	$140
Option F	$450	$20	$810	$50

Annual operational costs are summarised in Table 3-5. As noted above these costs consider the operational cost of the WWTP and the pump station annual operational costs.

Table 3-5 Annual Operational Cost Estimates

Option	Operational Cost WWTP 2045 $M	Operational Cost Conveyance 2045 $M	Operational Cost WWTP 2120 $M	Operational Cost Conveyance 2120 $M
Option A	$26	$1	$46	$1
Option B	$25	$4	$50	$7
Option C	$23	$4	$45	$9
Option D	$24	$3	$46	$9
Option E	$26	$1	$39	$3
Option F	$26	$0.2	$40	$1

3.4.1 Option cost summary

For comparison purposes a net present value (NPV) has been calculated over 30 years for the operational costs at the 2045 and 2120 flows. Over time operational costs are a significant proportion of the whole of life

[3] Values have been rounded to the nearest $10 million

costs. A more detailed phasing and NPV analysis would be required for the preferred options including phasing and implementation plans. To undertake the NPV analysis, a term of 30 years was used. Inflation was disregarded. A discount (or cost of capital) rate of 6.0% was used.

Table 3-6 Cost Estimate Summary[4]

Option	Total Capital Cost 2045 $M	NPV Operational Cost 2045 $M	Total Capital Cost 2120 $M	NPV Operational Cost 2120 $M
Option A	$200	$370	$520	$650
Option B	$500	$390	$980	$790
Option C	$540	$370	$1,020	$750
Option D	$580	$380	$1,080	$760
Option E	$380	$370	$780	$570
Option F	$340	$360	$730	$560

The costs presented in the 2120 columns reflect the total costs from now until that level of capacity has been provided (i.e. this is the 2045 and 2120 cost combined).

The costs shows that Option B, C and D have a higher capital costs than the other options. This is the result of additional conveyance cost requirements. Additionally by 2120 there is the need for dual pipes which reflects the staged nature of growth for many of the towns.

[4] Numbers have been rounded to the nearest $10 million

4. Options Assessment

4.1 Assessment criteria definition and scoring

Options were assessed using an MCA which uses a defined set of criteria to distinguish between options. The following assessment criteria were based on the *Best for River* project objectives and KPIs developed as part of the Sub-Regional Three Waters Project. These objectives were developed with the purpose of giving effect to the Te Ture Whaimana (Vision and Strategy of the Waikato River). This high level assessment does not provide sufficient enough detail to assess against each of the Best for River objectives. The following criteria best capture the Best for River objectives and also allow for a meaningful assessment of options:

- Natural Environment Improvement Capability
- Public Health Protection
- Cultural Benefits/Impacts
- Flexibility, Scalability and Risk
- Whole of life costs
- Sustainability

Each of the categories included a number of individual measures and factors which would contribute to its overall score of that criteria. Table 4-1 below provides the detailed assessment criteria and measures.

Table 4-1 Assessment criteria definitions

Criteria	Measure
Natural Environment Improvement Capability	To what extent does this option improve the quality of the discharge
	To what extent does this option improve the quality of the water in relation to the number and location of discharge points
	To what extent does this option improve the hydrology of the river?
	What potential is there for land discharge vs water discharge
	To what extent does this option impact groundwater?
	Does this option increase or decrease the number of hazardous sits?
Public Health Protection	To what extent does the option reduce the public and operational health and safety risk?
Cultural Benefits/Impacts	To what extent does this option enhance and restore cultural connectivity with the river?
Flexibility, Scalability and Risk	To what extent does this option provide additional growth opportunities which align with the sustainable and planned future growth of the Waikato?
	To what extent does the option allow for growth beyond 2045? I.e. within a 100 year timeframe.
	Is the option flexible enough to adapt to growth and land use changes?
	What are the consentability risks?
	What are the conveyance risks?
	What are the timeliness risks?
	What is the high level capital cost of the option? (Quantitative)

Criteria	Measure
Whole of life costs	What are the high level annual operational cost of the option? (Quantitative)
	Cost per capita (Qualitative)
	Value for money - asset is utilised for its entire lifespan (Qualitative)
Sustainability	To what extent does this option provide the opportunities for the implementation of sustainable practices and technologies?
	To what extent does the option provide resilience for potential failures?
	What are the operational risks/ Can this option be resourced and operated sustainably?
	What is the potential for water reuse and resource recovery?

As shown above only two of the measures are considered quantitatively (capital and operational costs) while all other measures are qualitatively measured.

A seven point scoring system was used ranging from -3 to +3. It also includes a fatally flawed score. Table 4-2 briefly summarises the scoring definitions. Note that the Do minimum option does not always score “0” (i.e. no impact). All options are scored based on the long term impacts of that option. In several instances the Do Minimum option is not sustainable in the short or long term. In this case the Do Minimum case may be fatally flawed or have severely negative impacts.

Table 4-2 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

It should be noted that no weighting of the criteria was undertaken for this assessment. Weightings may be applied when undertaking the detailed analysis within the next phase of work, if a BBC process is followed.

4.2 Options assessment and key outcomes

The following options assessment was undertaken based on a number of key high level assumptions and in collaboration with all involved stakeholders. The results of the MCA identify Option C and D as being the most preferred. These two options represent a south and north centralised solution with Te Awamutu continuing to operate independently. The rationale for this assessment is outlined below.

4.2.1 Assessment assumptions

The following assumptions were made for the purpose of this assessment. Note that these assumptions are specific to the assessment process. Technical assumptions are listed in greater detail in section 3.

- All locations of new facilities, service area boundaries and conveyance lengths were based on arbitrary points within the area of benefit or on pre-existing key infrastructure. This was to provide a basis to determine potential cost estimates for conveyance, pumping stations and sizes of plants. Conveyance location assumptions are further explained in section 3.3.
- It was assumed that the BAU option would not undergo the same level of upgrades as assumed for all other options. Facilities would be upgraded to cater for growth but a lower level of technology and therefore quality was assumed for these facilities.
- Areas around Gordonton were not considered as part of this assessment based on the lack of population growth in this region. It is assumed these areas will continue to be individually serviced by septic systems.
- Two growth scenarios were considered: 2045 growth projections were considered and a 100 year growth timeframe was considered. At different growth scenarios, different sized plants were required. See section 3.1 for details on population and growth assumptions.

4.2.2 Updated option descriptions

The six options described in section 2.3 were developed further based on the above growth and plant assumptions. Figure 4-1 through to Figure 4-6 outline these developed options.

Figure 4-1 Business as Usual (BAU)

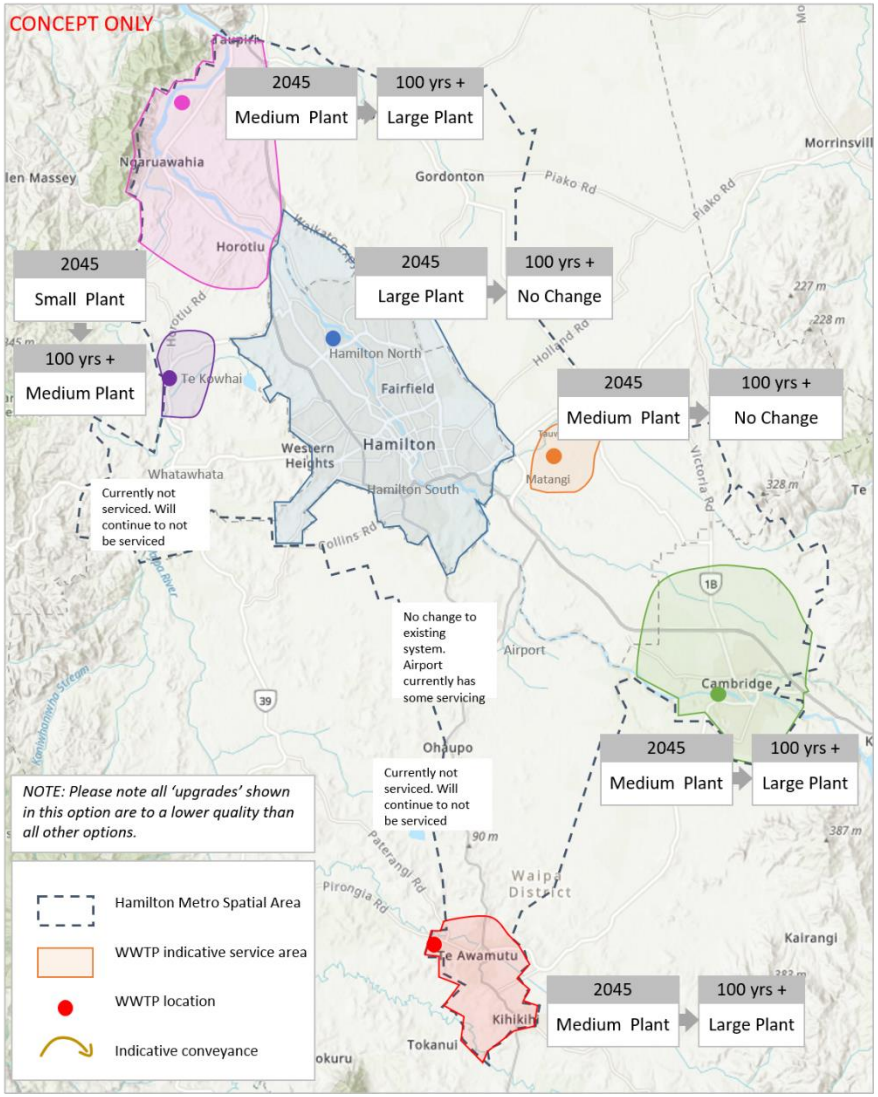


Figure 4-2 Option B: Fully centralised facility at Pukete (TA to remain standalone)

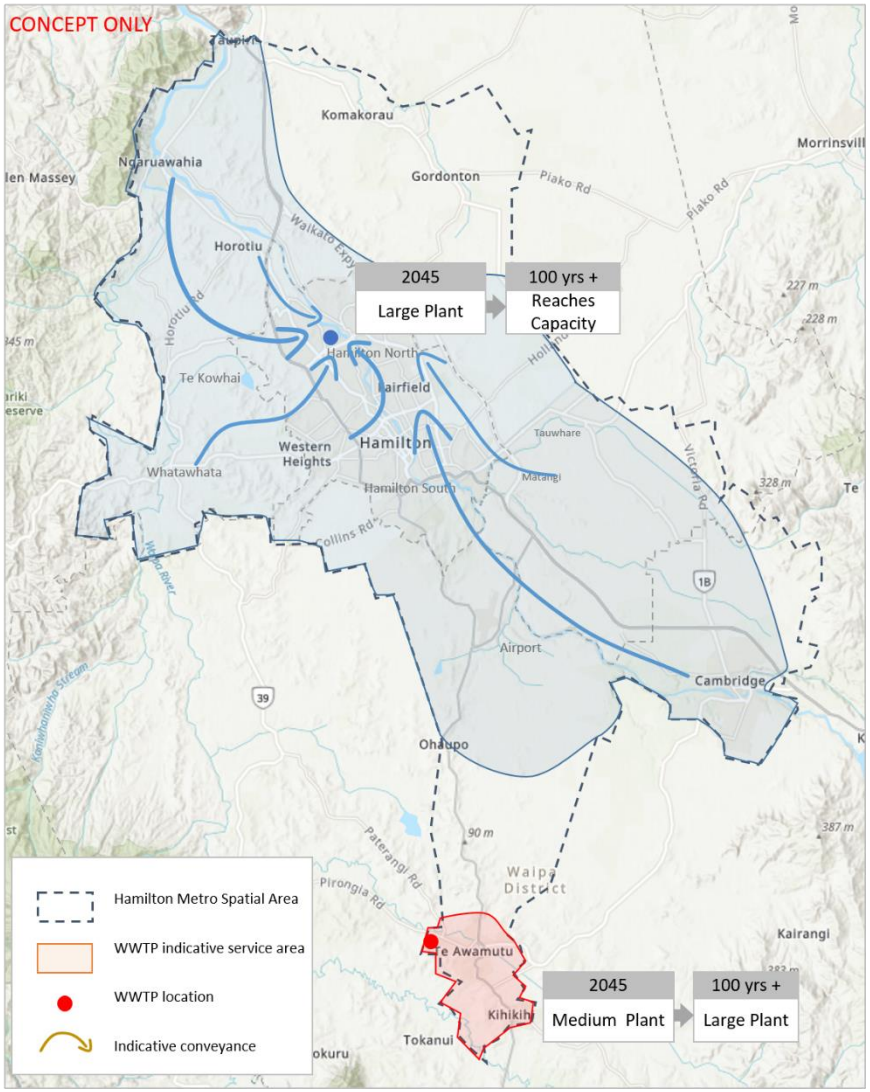


Figure 4-3 Option C: Convey all communities to either a northern or southern centralised facility

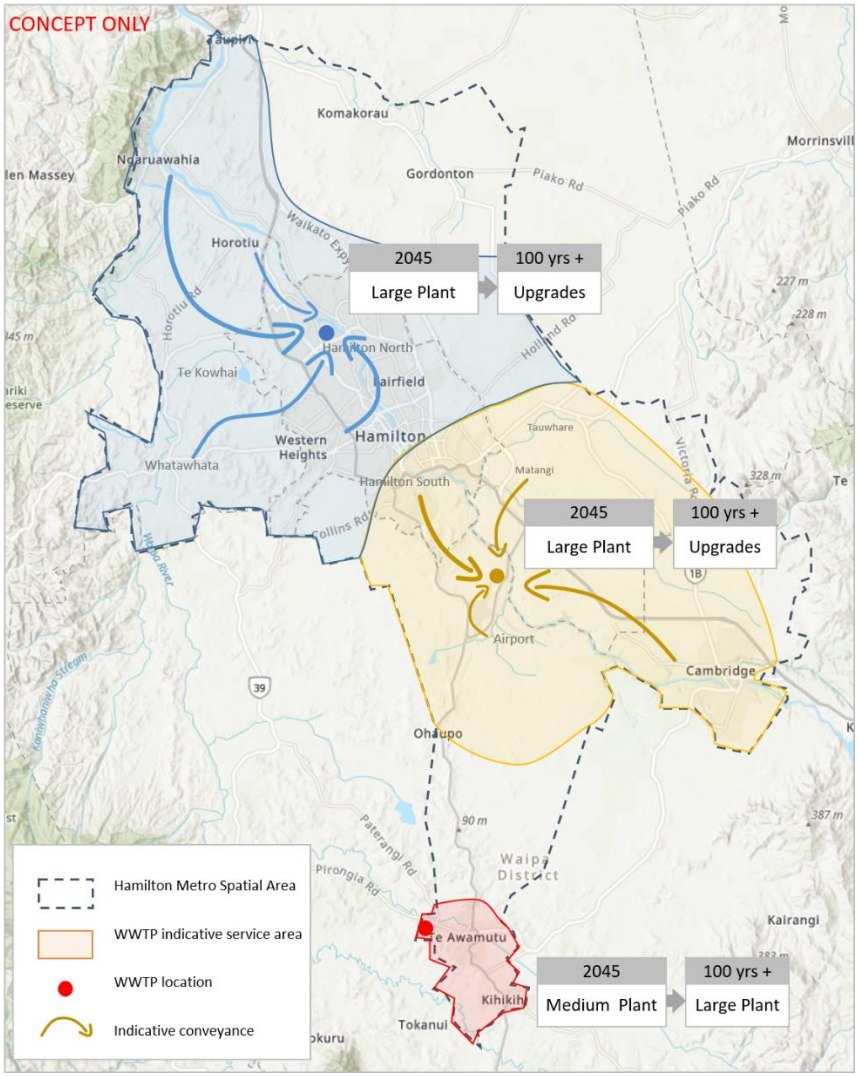


Figure 4-4 Option D: Convey all communities to either a northern or southern centralised facility (Cambridge site)

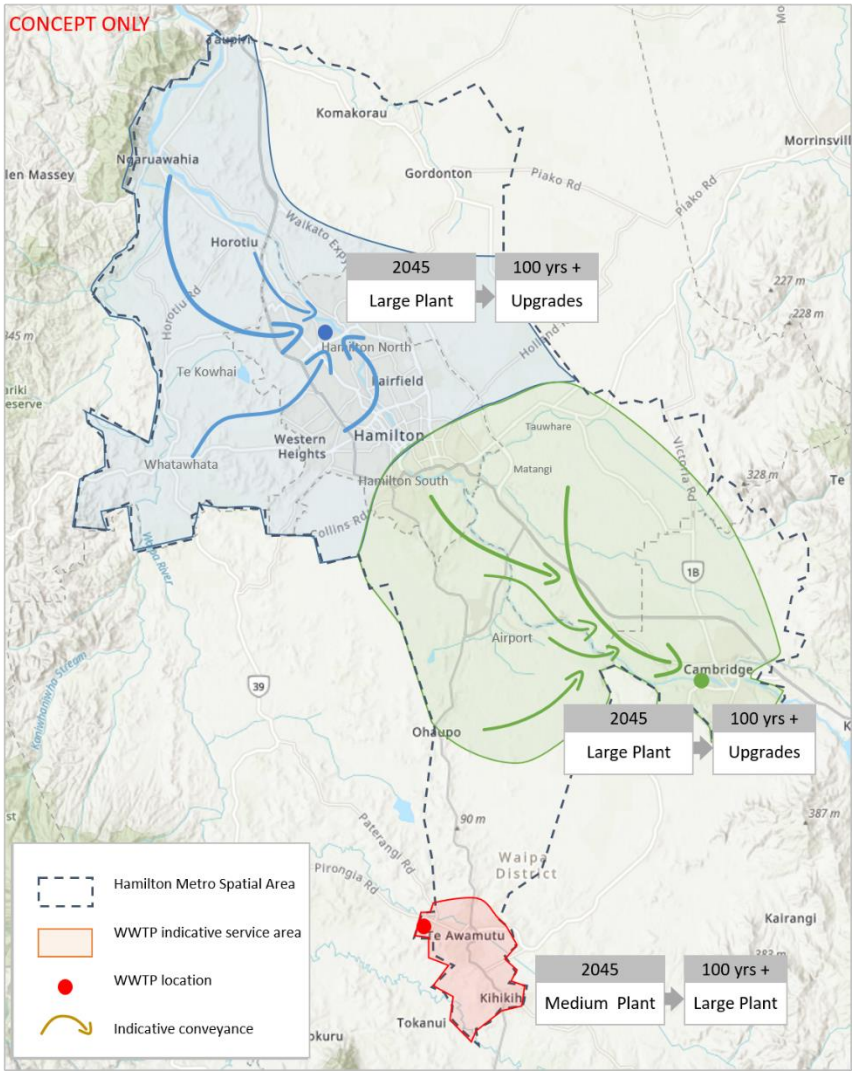


Figure 4-5 Option E: Five wastewater facilities to cater for the whole metro spatial area including a new southern facility near the airport.

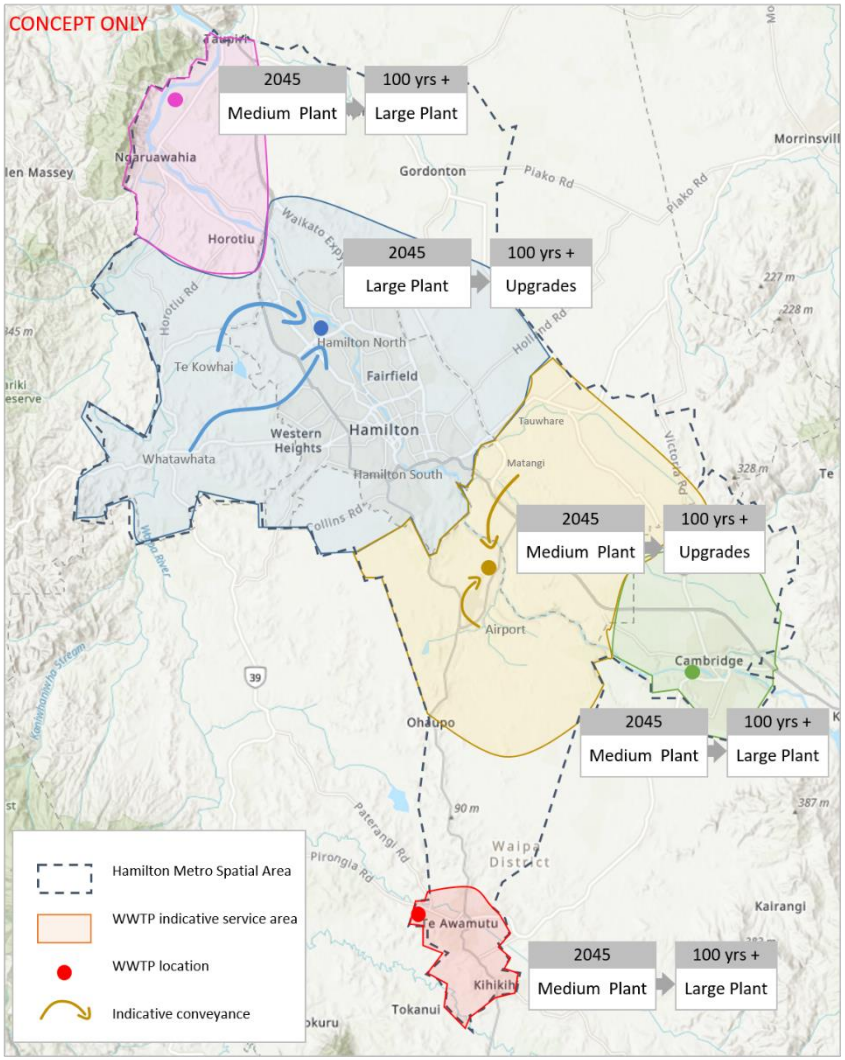
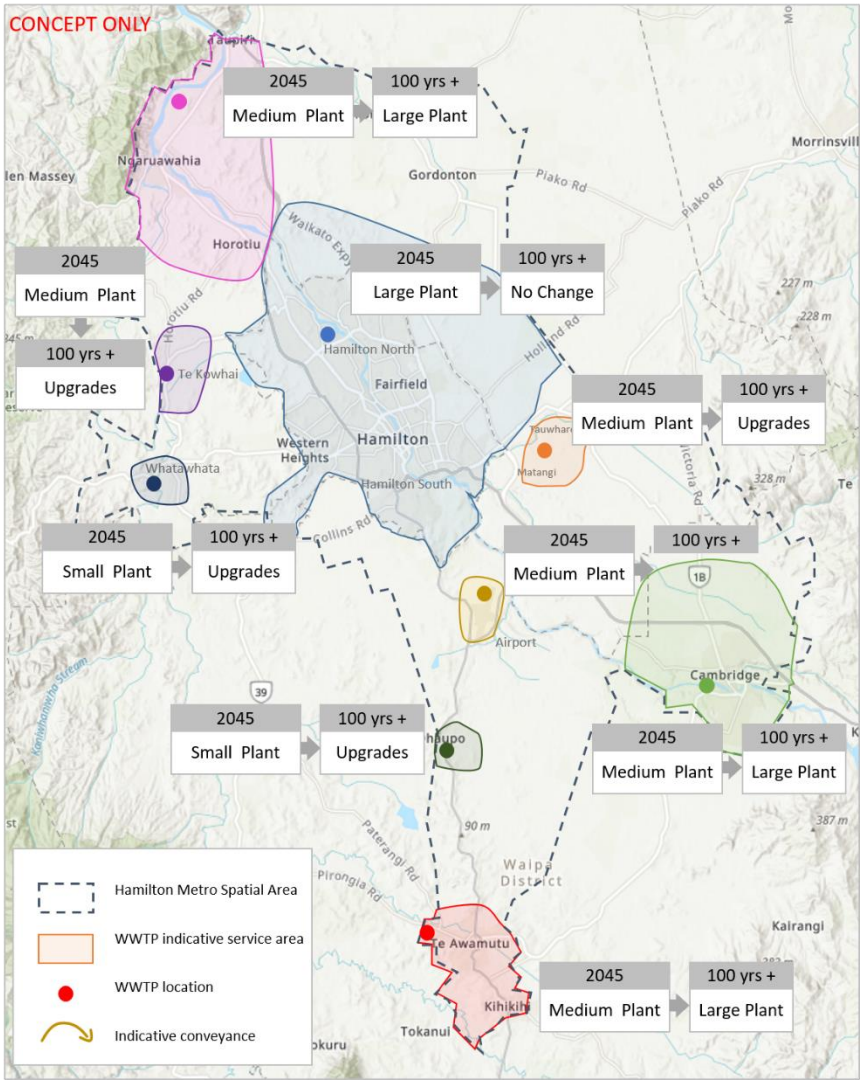


Figure 4-6 Option F: Upgrades of BAU including new facilities at Whatawhata, the airport and Ohaupo



4.2.3 Stakeholder inputs

Two external interactive workshops were held throughout the project. The first was held on the 28th January 2020 and is detailed above in section 2.1.1. The second was held on the 10th March 2020, which aimed to present the outcomes of the options assessment and to gain any additional insights or feedback from key stakeholders to inform the final MCA. In between these two formal workshops, additional hui were organised with individual Iwi and mana whenua groups to discuss the outcomes of the technical assessment and the MCA to ensure appropriate cultural factors were generally considered throughout the process.

The following stakeholders attended the MCA workshop held on the 10th March:

- Hamilton City Council (HCC)
- Waipa District Council (WDC)
- Waikato District Council
- Waikato Regional Council (WRC)
- Futureproof
- Ngaa Karu Atua o te Waka representatives
- Te Haa o te whenua o Kirikiriroa representatives
- Waikato Tainui
- Ngati Koroki Kahukura
- Raukawa
- Maniapoto Maori Trust Board
- Watercare

The MCA workshop involved groups circulated to six different areas which looked at the six different options individually. Table 4-3 summarises the key stakeholder insights which were captured during this session. Further details can be found in Appendix E.

Table 4-3 Stakeholder insights

Option	Stakeholder and partner insights summary
Option A: BAU	Stakeholders and partners were generally satisfied with the assessment of the BAU option. However, comments were made regarding the inability for this option to meet growth requirements in the region. Consequently this option was deemed fatally flawed when assessed against Flexibility, Scalability and Risk. Additional comments were made regarding the ability for the BAU (specifically Te Awamutu and Cambridge) to achieve environmental standards. However, BAU assumes that the relevant upgrades to 'Small' and 'Medium' plants is not to the same quality as other options. BAU assumes the same reactive processes which are currently followed. It was also noted that this option is not resilient to potential policy changes regarding the removal of septicity tanks. Refer to Appendix E for a detailed list of stakeholder feedback.
Option B (fully centralised excludes TA)	Feedback for this option suggested that the build out capacity limitations of the Pukete facility were not necessarily a fatal flaw. There were potential ways of mitigating this risk, however it would assume that to cater for a higher capacity (beyond 2080) the facility will start to encroach on the surrounding buffer between

Option	Stakeholder and partner insights summary
	the plant and commercial or residential areas e.g. by expanding onto the mountain bike park. Some concern as to how recycling opportunities would be pushed out from the single central sites to places of need in the communities. Routes into the existing city for new trunk infrastructure will be difficult to secure and very expensive to implement. Some concerns at pushing waste from all the catchments into / onto a single catchment and a feeling that each catchment should deal with its own waste. There were other comments regarding the resilience / reliance on single plant and the potential issues associated with long pipelines (30km) and septicity impacts. There were some general concerns (with regards to all options) that the conveyance operational cost estimates did not reflect the actual costs. This led to a revision and update of these operational and conveyance costs. Refer to Appendix E for a detailed list of stakeholder feedback.
Option C and D (Existing N plant and new S plant)	Stakeholders and partners were generally satisfied with the assessment of this option. Comments generally focused on creating a better distinction between Option C and Option D. Some of the more distinguishing features between the two are listed below (which were not previously captured): **Option C:** • Ability to provide for industrial growth • Plants closer to areas with highest population • Opportunity to create dedicated wet industry hub on transport connections • Transport overlay fits well • Less complexity in conveyance system • Potential to create wetland area to treat and store water • Greenfield site **Option D:** • Potentially enables Te Awamutu to convey to Cambridge in the future • Existing site has sufficient space • Allows for better planning in regards to wet industry There were some comments regarding the application of industrial reuse, as the land surrounding existing Cambridge site (being at an extremity of the area of benefit) is less adaptable and less likely to cater for industrial land use (when compared with Option C) or additional growth (assuming this aligns with the region's growth strategy) **General:** • Conveyance boundary between the two large sites is flexible • Some risks in terms of investment already made for Peacockes. There is the potential for some sunk costs. Peacockes infrastructure designed to allow change to conveyance. Refer to Appendix E for a detailed list of stakeholder feedback.
Option E (Five plants for the region)	Several comments were made with regards to this option, mostly with regards to its ability to cater for growth. This option has the ability to open up more growth opportunities, particularly between Hamilton and Cambridge. There were comments

Option	Stakeholder and partner insights summary
	around whether the service boundaries proposed for this option were the most optimal and that there seemed to be a considerable distance between the population and the facility. The addition of southern Hamilton and Peacockes to the new southern facility service boundary may result in a larger upscale of the plant and lead to a lower cost per capita. However it was also noted that the conveyance infrastructure from Peacockes to Pukete (which is currently under construction) would potentially become a sunk cost. Other concerns were raised regarding the issues around operating five medium to large plants and being able to adequately resource this. Refer to Appendix E for a detailed list of stakeholder feedback.
Option F (Standalone plants/upgrade of BAU)	Option F had a number of different views with regards to its ability to cater for growth: - It was noted that smaller facilities in communities would require greater investments to cater for future growth and may not facilitate growth as easily as larger centralised plants - There were also argument to suggest that this approach would help stop unwanted developments within the Metro Area and would be able to respond to growth when growth occurred The only other comment raised was with regards to the increased potential for land based discharge Refer to Appendix E for a detailed list of stakeholder feedback.

Feedback was carefully considered and incorporated into the final assessment (see below).

4.2.4 MCA summary

A summary of the MCA has been outline in Table 4-4 below. The detailed MCA can be found in Appendix F along with detailed option project assessment sheets.

Table 4-4 MCA Summary

Criteria	Option A (BAU)		Option B (fully centralised excludes TA)		Option C (Existing N plant and new S plant)		Option D (Existing N plant and S plant)		Option E (Five plants for the region)		Option F (Standalone plants/upgrade of BAU)	
Natural Environment Improvement Capability	-3	The BAU approach characterised by reactive and delayed responses will not be sustainable for the river or the environment. No improvement to groundwater quality. Existing individual septic tanks fail and impact groundwater	3	A large plant has the potential to deliver higher quality discharge to the water. Option B reduces the discharge points to water from 4 to 2. Removal of discharge location at Cambridge which is further upstream.	2	A large plant has the potential to deliver higher quality discharge to the water. Increase in water quality standards create opportunity for irrigation and land based eco-system re-entry methods. Option C reduces the discharge points into water from 4 to 3. Removal of discharge location at Cambridge which is further upstream. New plant will create additional hazardous site.	2	A large plant has the potential to deliver higher quality discharge to the water. Increase in water quality standards create opportunity for irrigation and land based eco-system re-entry methods. Option D reduces the discharge points into water from 4 to 3. Discharge location further upstream.	1	The potential quality of the discharge is slightly less than Options B, C and D for medium sized plants. Discharge points to the river increase as an additional discharge is required at a new location. New plant to the south will make a new site hazardous.	0	There will positive impacts to river quality from the BAU overtime. More remote areas will still rely on septic tanks. Land discharges may also impact groundwater. Greater number of hazardous sites. Greater potential for land discharge
Public Health Protection	-1	Septic tanks used for large lifestyle blocks have a higher risk of contaminating groundwater particular as reliance on septic tanks increases overtime	3	Highest quality plant with membrane and UV technology will have improve water quality outcomes and in doing so improve public health protection	3	Highest quality plant with membrane and UV technology will have improve water quality outcomes and in doing so improve public health protection	3	Highest quality plant with membrane technology will have improve water quality outcomes and in doing so improve public health protection	3	Highest quality plant with membrane technology will have improve water quality outcomes and in doing so improve public health protection	2	Individual upgrades to the existing plants and servicing Whatawhata and Ohaupo will have health improvements More remote areas will rely on septic tanks which has a greater risk of failure.
Cultural Benefits / Impacts	FF	Current situation is currently not meeting the Te Ture Whaimana objectives.	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.									

Criteria	Option A (BAU)		Option B (fully centralised excludes TA)		Option C (Existing N plant and new S plant)		Option D (Existing N plant and S plant)		Option E (Five plants for the region)		Option F (Standalone plants/upgrade of BAU)	
Flexibility, Scalability and Risk	F F	The current situation will not be able to service the area in the medium to long term .Limited ability to respond to land use changes (given there are many locations no currently serviced). Industrial land uses in particular will be constrained	-2	Beyond 2045 the Pukete facility will be nearing its build out capacity limitations and will require additional land to keep growing with population. This will impact the existing buffer which separates the plant from residential areas. Conveyance across large distances will lead to greater risks	3	Creates additional flexibility for future development, particularly in locations between Hamilton and Cambridge. Frees up some capacity for the Pukete facility. New Greenfields treatment plant provides the opportunity for future proofed master planning (adequate space for 100+ timeframes). Reduces septicity issues with reduced lengths of conveyance when compared to Option D.	2	Future development opportunities are more limited than Option C, given the conveyance will not span a wider region (facility in a central location verse facility to the south). Frees up some capacity for the Pukete facility. Cambridge WWTP site has sufficient space for foreseeable requirements. A brownfields site, located on the banks of the Waikato River has greater risk and constraints than a greenfield site. Do not have to consent a new site.	1	Option provides development opportunities between Hamilton and Cambridge. A new plant to the south can be custom built and therefore easier for this facility to adapt to growth and land use changes. Reduces septicity issues with reduced lengths of conveyance when compared to Option D and Option B. There is a requirement to consent a new location and a new discharge point	-1	Small standalone facilities will have a capacity limitations and will require additional level of upgrades as population grows. Does not cater for any other types of development. There is a greater agility to respond to growth. However this works up to the maximum capacity of a small plant. Three new sites will require consenting.
Whole of life costs	Cost not scored	**2045** CAPEX $200 million NVP OPEX (30 yrs) $370million **100 yrs +** CAPEX $520 million NPV OPEX (30 yrs) $650 million Low capital cost. However, costs are spread across smaller population servicing base	Cost not scored	**2045** CAPEX $500 million NVP OPEX (30 yrs) $390 million **100 yrs +** CAPEX $980 million NPV OPEX (30 yrs) $790 million Investing in assets which can't be used for the entire life span of the asset. However costs are spread across very large population base	Cost not scored	**2045** CAPEX $540 million NVP OPEX (30 yrs) $370 million **100 yrs +** CAPEX $1,020 million NPV OPEX (30 yrs) $750 million High capital costs. However costs are spread across very large population base	Cost not scored	**2045** CAPEX $580 million NVP OPEX (30 yrs) $380 million **100 yrs +** CAPEX $1,080 million NPV OPEX (30 yrs) $760 million Higher capital costs. However costs are spread across very large population base	Cost not scored	**2045** CAPEX $380 million NVP OPEX (30 yrs) $370 million **100 yrs +** CAPEX $780 million NPV OPEX (30 yrs) $570 million Lower capital cost. However, costs are spread across smaller population servicing base. Meaning some areas have high costs for smaller populations	Cost not scored	**2045** CAPEX $340 million NVP OPEX (30 yrs) $360 million **100 yrs +** CAPEX $730 million NPV OPEX (30 yrs) $560 million Lower capital cost. However, costs are spread across smaller population servicing base. Meaning some areas have high costs for smaller populations

Criteria	Option A (BAU)		Option B (fully centralised excludes TA)		Option C (Existing N plant and new S plant)		Option D (Existing N plant and S plant)		Option E (Five plants for the region)		Option F (Standalone plants/upgrade of BAU)	
Sustainability	-3	Currently unable to achieve any sustainable improvements. Wastewater plant network is not currently resilient to disruptions. Limited ability to retain and attract the labour required to operate plants. No potential for reuse.	2	High potential to use sustainable technologies including potential for offsetting. Limited build out capacity. Ability to capture greater labour pool skill and retain skill. Large plant has a lower chance of failure and greater consequence if a failure occurs. High potential for reuse	3	High potential to use sustainable technologies including potential for offsetting. Ability to capture greater labour pool skill and retain skill. Large plant has a lower chance of failure and greater consequence if a failure occurs. High potential for reuse	2	High potential to use sustainable technologies including potential for offsetting. Ability to capture greater labour pool skill and retain skill. Large plant has a lower chance of failure and greater consequence if a failure occurs. Limited potential for industrial reuse given its location.	1	Limited potential to use sustainable technologies. Difficulty retaining and to attracting skill and labour requirements. Greater likelihood of failure but lower consequence. Limited potential for reuse	1	Very limited potential to use sustainable technologies. Difficulty retaining and to attracting skill and labour requirements. Greater likelihood of failure but lower consequence. Very limited potential for reuse

4.2.5 Key outcomes and considerations of MCA

Option A: Business as Usual

BAU was considered to be fatally flawed with respect to its ability to meet cultural objectives and also its ability to meet future growth demands for the region. Both Whatawhata and Ohaupo are currently not serviced by a wastewater facility. Growth in these areas is already limited by the lack of wastewater servicing. Individual septic tanks will continue to be used in these areas which has an increasing risk of failure. This has both environmental and health implications. BAU also does not provide any potential for improving the use of sustainable technologies or resource recovery. New and updated plants are required to build in these capabilities.

Despite this option being the lowest cost option, BAU does not meet the future requirements for the region, does not meet environmental or cultural standards and is not feasibly sustainable in the long term.

Option B: Fully centralised facility at Pukete (Te Awamutu to remain standalone)

A fully centralised option has the potential to deliver positive environmental outcomes, particularly by removing the discharge point at Cambridge and relocating this further downstream. This means a greater portion of the river will not be impacted by discharges. Additionally a larger plant has the potential to treat the discharge to a higher quality, there is greater potential to use sustainable technologies and a greater potential for reuse and resource recovery.

However, the most concerning issue with Option B is the likely build out capacity of the Pukete facility site. The existing Pukete site (including the balance ponds and spoil stockpile area) will have enough land area to cater for the 2045 growth scenario and probably out to around 2080[5]. Under a 100 year growth scenario, the existing site will not have sufficient space to expand. There are options to use surrounding land (particularly the mountain bike park to the immediate west) however this would encroach on the existing valuable buffer zones around the treatment plant. This also means there are limitations in its ability to provide sustainable and reuse technologies. Installing additional reuse infrastructure will limit its build out capacity even further.

The other key risk associated with this option is the excessive conveyance distances. It is approximately 30 km between Cambridge and the Pukete facility. Conveying wastewater over these lengths means there is a significant septicity risk with associated chemical dosing costs and increasing consequence of a trunk conveyance failure. Likewise, relying on one plant will also have resilience implications. A larger plant will have certain redundancies and risk mitigations built into its systems, so the likelihood of a failure is lower. However the consequence of a failure is much higher. This option has a relatively high cost, however the costs will be spread across the greatest servicing population base.

Option B, whilst delivering positive environmental and sustainability outcomes will struggle to cater for long term growth within the region. The extensive conveyance adds additional risks and timing constraints to this response. This option was therefore considered to be less feasible, particularly within a 100 year timeframe.

Option C and Option D: Convey all communities to either a northern or southern centralised facility (alternative sites)

Option C and Option D are similar in that they both recommend a northern and southern facility and cater for the same service areas. Given that both options are very similar there are common benefits which they both realise:

[5] Beca 2019

- Both have the potential to deliver high quality discharge quality
- Both have the potential to deliver public health benefits (i.e. removal of individual septic tanks, MBR plants)
- Both options free up capacity at Pukete which is better able to cater for areas north and west of Hamilton
- Both options have a high potential to utilise sustainable technologies
- Both options allow for greater resource resilience and sustainability
- Both options remove Ngaruawahia discharge point from the Waikato River. However, Option C adds one discharge, somewhere near the narrows.
- Both options have very similar capital costs and whole of life costs for both growth scenarios. However, both capital costs and operational costs are higher than for Options A, E and F.
- Both options can spread its costs over a larger population base.

The key differentiators between these options are:

- Option C provides a new plant in a central location and therefore has a greater ability to provide for additional planned growth in the sub-regional area between Hamilton and Cambridge (which aligns with the region's growth strategy)
- Option C has shorter lengths of conveyancing and therefore has a reduced risks of septicity
- Option C will have a plant on a new site which allows for greater flexibility, and adaptability throughout its lifespan meaning it can more easily cater for a 100 year timeframe.
- Option C would mean a new site would become a (Hazardous Activities and Industries List) HAIL classified site and would require consenting which can be a timely process.
- Option D does not require a new site, which would reduce the number of HAIL sites and also not require a new site consent and a new discharge location consent.
- Option D would not be as flexible given the need to construct and operate a plant on the one site at the same time. Its layout and configuration would be sub-optimal
- Option D would likely require significant investment in foundation improvements given its location on a sandy Waikato River terrace.
- Option D may not be able to cater for reuse as well as Option C given the location of the sites.

Option C and D do not present with any significant barriers and generally realise positive impacts for each criteria. Option C has slightly better results, based on the fact that a new and central location can open up greater growth opportunities, reduce septicity risk and allows for greater flexibility in design.

Option E: Five wastewater facilities to cater for the whole metro spatial area including a new southern facility near the airport.

Option E has some centralisation occurring, with Te Kowhai and Whatawhata being conveyed to Hamilton and the southern area in between Hamilton and Cambridge being conveyed to a new southern plant. This option has mostly medium sized plants, which move to large sized plants in a 100 year growth scenario. It therefore has the potential for higher discharge quality than BAU (and Option F) but a lower quality discharge than Options B, C and D. There are also greater limitations around using sustainable technologies and reuse

which only becomes feasible once the plant reaches a certain size. Additionally, this option does not remove any of the discharge locations and adds another discharge location and another HAIL site.

One of the main issues with this option is the large conveyancing requirements necessary for the implementation of the new southern facility which would ultimately cater for a medium and dispersed population. Similarly for smaller communities north of Hamilton (Taupiri and Ngaruawahia) will have a larger cost spread across a smaller population base.

This option may present more opportunities as a staged option, with services slowly being connected into larger plants. Both Option E and F (see below) are cheaper options in the medium and long term, given the reduction in conveyance requirements and therefore may be slightly more financially feasible. If used as a staged solution, careful consideration would be required whilst planning this stage to ensure assets do not become redundant or ineffective in the future.

Option F: Upgrades of BAU including new facilities at Whatawhata, the airport and Ohaupo

Option F would essentially leave the servicing areas as they currently are, but add additional plants to areas which are not serviced. This would mean consenting three new HAIL sites. This would lead to discharge quality improvements when compared with BAU as the plants themselves would all be upgraded to a higher standard. There is also greater potential for land discharge. Small plants have lower flow levels and therefore may still be able to discharge to land. Medium to large plants will have limited opportunities to use only land discharges. A large number of smaller plants will also mean the consequence of one failing is much lower, however there is a higher likelihood of failure.

However, a large number of smaller plants would be significantly harder to resource, with greater numbers of staff required to maintain each facility. Additionally smaller plants will at some point be unable to service growth in some areas and may also limit industrial growth.

Similar to Option E, this option may be used as a staged option. Whilst it is clear, smaller decentralised plants will not be able to cater for growth over a 100 year timeframe, it may be the quickest to implement in the short to medium term. There are no major conveyance requirements for this option and therefore construction would likely take less time and has a slightly lower cost. Careful consideration would be required whilst planning this stage to ensure assets do not become redundant or ineffective in the future.

4.3 Preferred option(s)

Based on this high level feasibility study and associated multi-criteria analysis (MCA), **Option C: Convey all communities to either the existing northern or new southern centralised facility** has the greatest potential to sustainably deliver best for river outcomes with the lowest potential risk and impact.

Option D, however, also sees significant benefits over the other options. As noted above, the biggest differential between the two options are the fact that Option C utilises a new more central Greenfield site, which is more flexible and adaptable, reduces the conveyance risks but will require additional consenting requirements. It is therefore recommended that if this option is pursued, site investigations and site assessments are carried out early with the appropriate level of community and stakeholder engagement.

There was general agreement at the 10 March workshop that Options C is the most favourable concept from the high level assessment and that it should be taken forward to detailed business case stage. In addition to this conclusion, Option E emerged as a potential option that should be considered further as a staged upgrade, if options C and D are unaffordable in the short term. This option could offer benefits in terms of a staged transition from the current state through to the centralised solutions proposed in Options C/D.

One of the key issues with both Options C and D is the ability to fund these options. Both have the highest up front capital costs. However there is a greater potential to mitigate affordability challenges through scale, alternative funding and financing tools and larger rating base.

4.3.1 Alignment of preferred option(s) with Best for River objectives

Section 1.2 highlights how this study provides supporting evidence for both the Sub-Regional Three Waters Project and the Cambridge Wastewater IBC. It is therefore important to show how well the preferred option reflects and delivers the overarching Best for River objectives and therefore gives effect to the Te Ture Whaimana.

Overall both these centralisation options could better meet the Best for River objectives and unlock greater residential development within the Metro Area than the decentralisation. Key benefits of centralised solutions vs decentralised (standalone) solutions are outlined in the Sub-Regional Three Waters Strategic Case and are further detailed in Table 4-5.

Table 4-5 Strategic Alignment

Draft Best for River objectives	Preferred Option alignment
1) The whole of river water quality is improved	Option C has the potential to significantly improve the quality of wastewater discharged to the environment through economies of scale and greater opportunity for resource recovery and use. I.e. larger facilities (which cater for larger population base) have greater potential to better technology and deliver improved outcomes.
2) All life within the stream and surrounding environment benefit	As noted above this option provides greater potential to improve the quality of the discharge. The southern facility proposed within Option C will be built on a Greenfields site which has the greatest potential to introduce land based eco-system re-entry mechanisms (such as wetlands). This option shifts the discharge point from Cambridge (located further upstream) to a point further downstream. There is the potential to rehabilitate five other HAIL sites.
3) All of the community understand and are committed to caring for and protecting the River	It is assumed that throughout the development of the option, greater community engagement and communication will be undertaken to enhance understanding and commitment to best for river outcomes.
4) Cultural connectivity with the river is restored and enhanced	Whilst no specific cultural assessment was undertaken as part of this investigation, centralised options would provide opportunities for the restoration and rehabilitation of decommissioned sites and would reduce the number of discharges to the river. Offsetting and rehabilitation strategies are more feasible for centralised solutions. It is expected that throughout the development of the next phase of the project, greater consideration will be placed on how this objective can be achieved throughout the design and implementation process.

Draft Best for River objectives	Preferred Option alignment
5) Improve access to the Waikato River to better enable sporting, recreational, and cultural opportunities.	The removal of a discharge point upstream and the potential rehabilitation of five HAIL sites may provide opportunities to improve access to the river for recreational activities.
6) All water and land resource policy, regulations and decision making frameworks across the catchment are consistent and fully aligned to achieve the V&S, including RMA instruments, catchment based management approaches.	A reduced number of treatment facilities will likely make it easier to achieve consistent policy and regulation outcomes across the whole catchment: - Greater consistency across consenting requirements and ability to provide an integrated approach to delivering best for river outcomes. - There is also added flexibility when managing consented water allocations from the Waikato River. - Managing consents at a 'whole of catchment' level also allows for the consistent delivery of sustainable water supply.
7) All river and land management decisions are based on robust and comprehensive knowledge and understanding of the river system, including real time and long term data, sites of significance, social and cultural activities.	Not applicable at this stage.
8) Achieve net benefit to the environment	Based on outcomes described as part of objective 1 and 2, Option C delivers environmental improvements (compared against the current situation). There is also a greater potential to better utilising offset mitigation strategies or rehabilitation strategies at a sub-regional level. This means more consideration can be made on where these measures will be delivering the greatest benefit.
9) Increase the efficient use of resources and maximise resource recovery and contribution toward carbon neutrality and energy neutrality.	Option C provides the greatest potential for the use of sustainable technologies. This is largely because the southern plant will be built on a Greenfields site which is more adaptable to cater for innovative technologies. The indicative location of the southern plant will also compliment the industrial growth area near the airport and therefore have greater potential for the industrial reuse of water. The option will also continue to utilise existing infrastructure at Pukete WWTP and Te Awamutu. The potential to reuse water becomes significantly more critical as the impacts of climate change become more real. In the last 120 years, the five of the six driest three months periods for the Waikato region have occurred since 2007. The most recent summer (January through to March 2020) experienced very low levels of rainfall which is now threatening river flows along the Waikato River.

Draft Best for River objectives	Preferred Option alignment
10) Apply and maintain best practice to all three waters management and infrastructure which allows for the sustainable future growth of the Waikato region.	A centralised northern and southern treatment plant are better able to cater for growth in the long term through future proofed strategic infrastructure. In the immediate to medium term this approach is also better able to service smaller communities such as Whatawhata (which is already seeing quite substantive growth), Ohaupo, Peacockes (and areas around the airport), Matangi and Tauwhare. Smaller localised plants will place greater limitations on the growth potential of these smaller communities in the long term and could limit the potential for greater industrial growth, particularly the wet industry. Additionally centralisation allows for the potential to attract and retain the required skilled work force meaning the plants can be sustainably resourced and can continue to operate using best practices.

4.4 Next Steps

In order to fully understand the viability of Option C, further investigations are required. It is recommended these investigations occur as part of a Detailed Business Case.

The Detailed Business Case will undertake the following steps:

- Review the Sub-Regional Three Waters Strategic Case and the Cambridge Wastewater IBC
- Identify where further strategic assessments and alignment is necessary
- Undertake a detailed capacity assessment of the existing facilities and a more detailed population growth assessment of the impacted areas.
- Define and assess a Do Minimum option
- Undertake more detailed design for Option C, to include the following elements:
    - Site investigation and assessment of the potential new site (to include an assessment of the existing Cambridge site to assess its viability)
    - Cultural assessment
    - Environmental assessment
    - Detailed concept design
    - High level cost estimates
- Undertake a funding assessment:
    - What are the funding avenues for the project?
    - Staging options (including consideration of a transition through option E?)
    - Economic assessment of options
- Undertaken a commercial case, to include a procurement strategy
- Undertake a management case

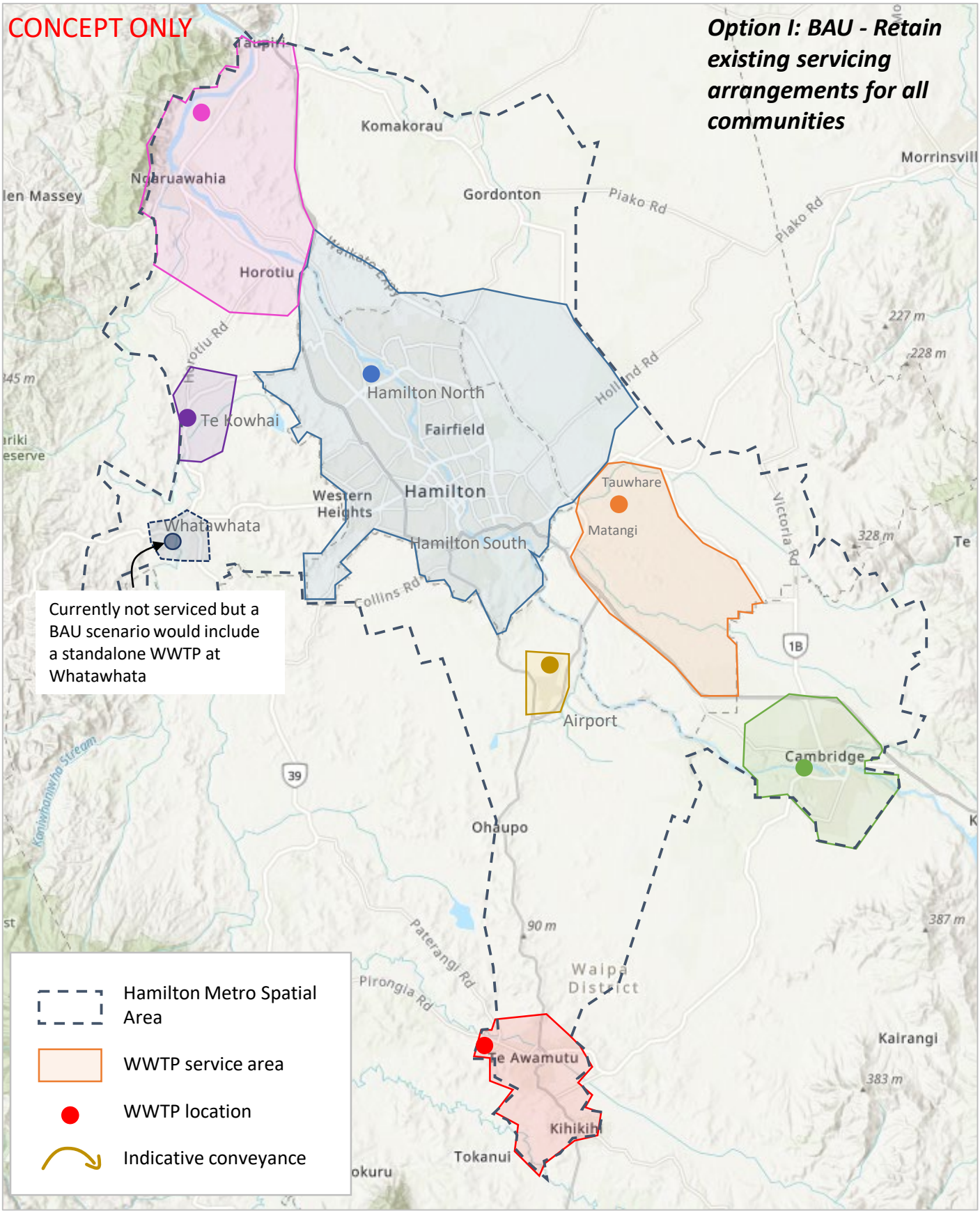
- Determine governance and management structure for the project delivery
- Determine governance and management structure for the operation of the project

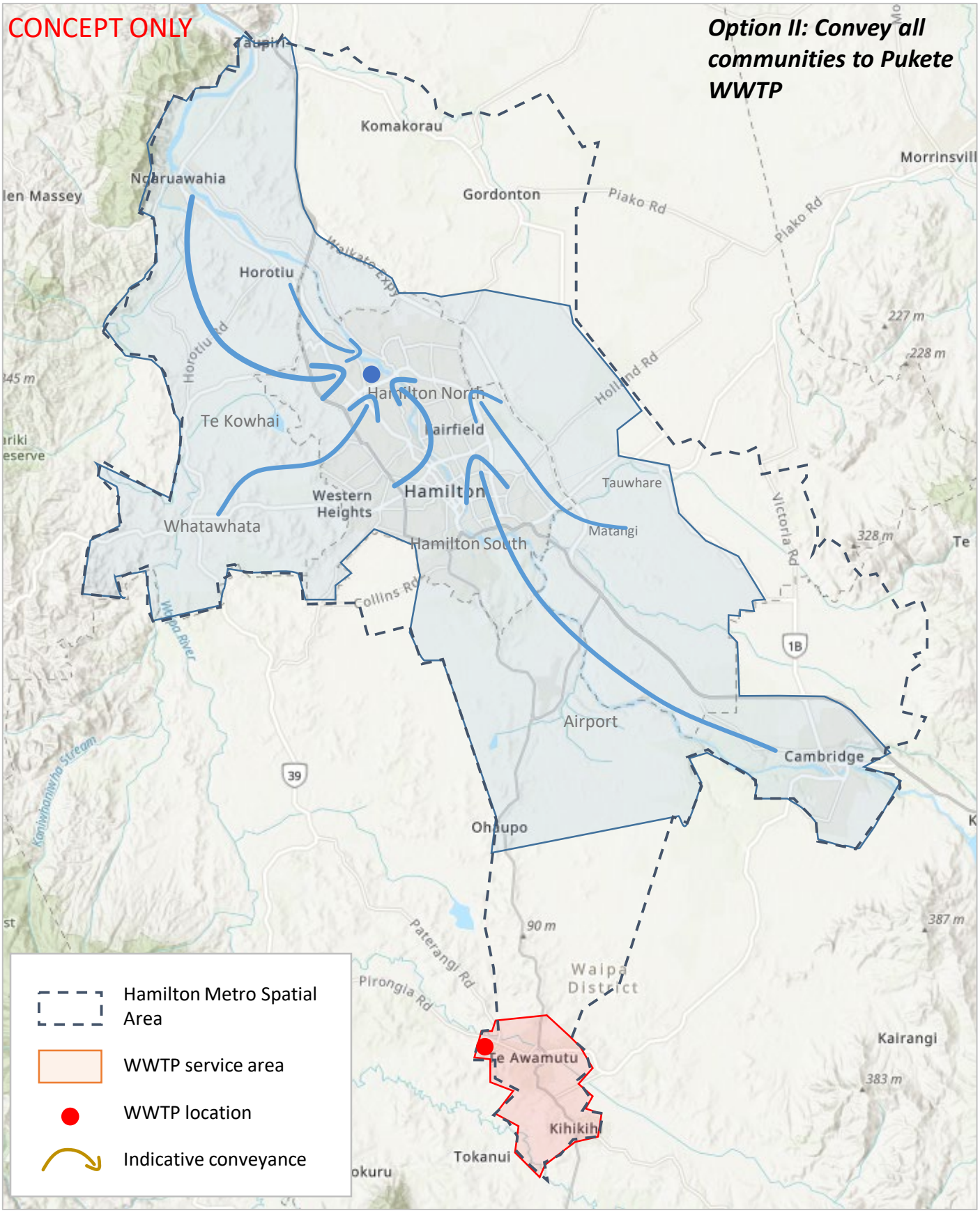
In order to progress this option, a site investigation and assessment is essential at the early stages of the project. This is to help the streamline the consenting process and to provide early and clear communication to the community and stakeholders early.

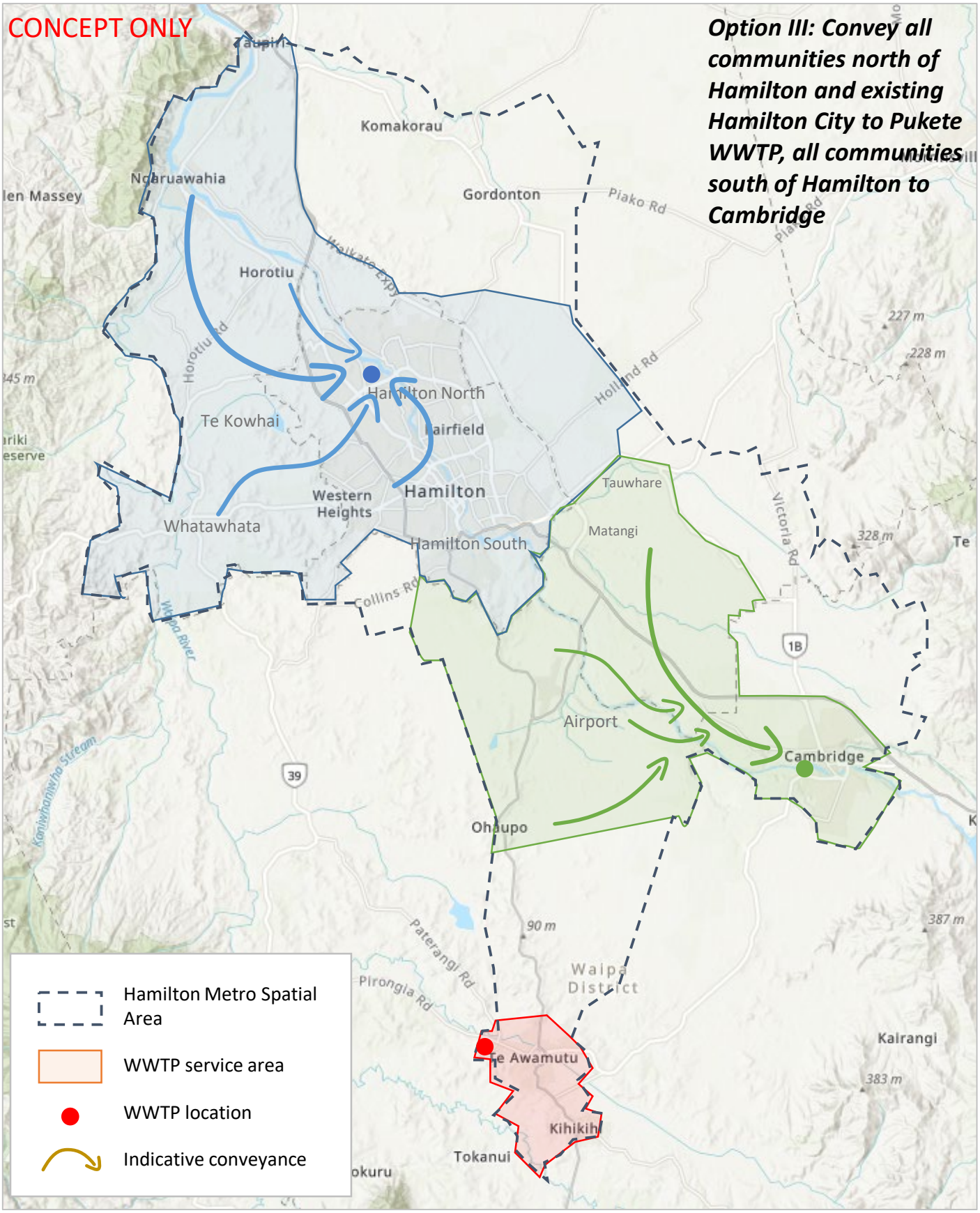
GHD Advisory

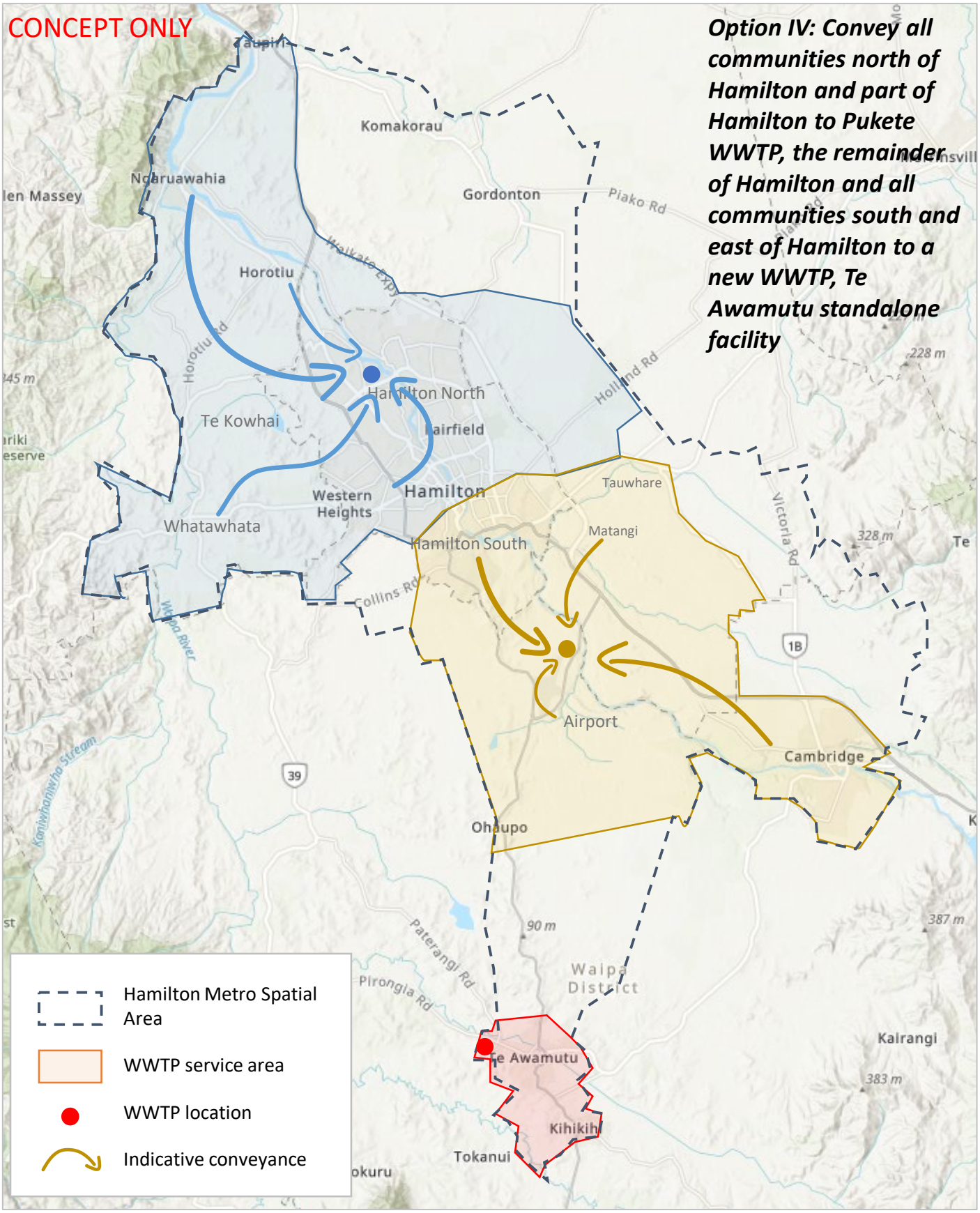
Appendices

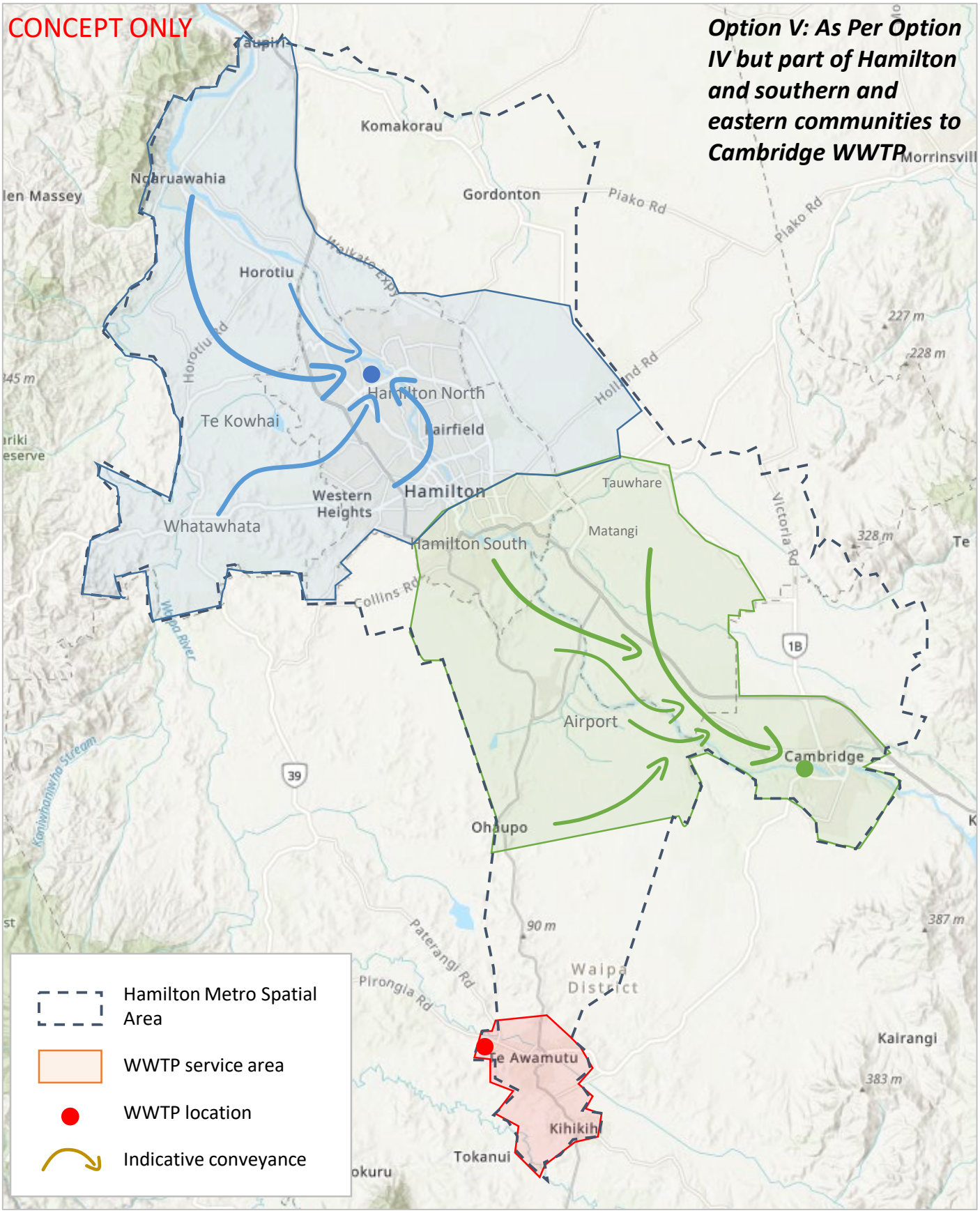
Appendix A - Initial list of options

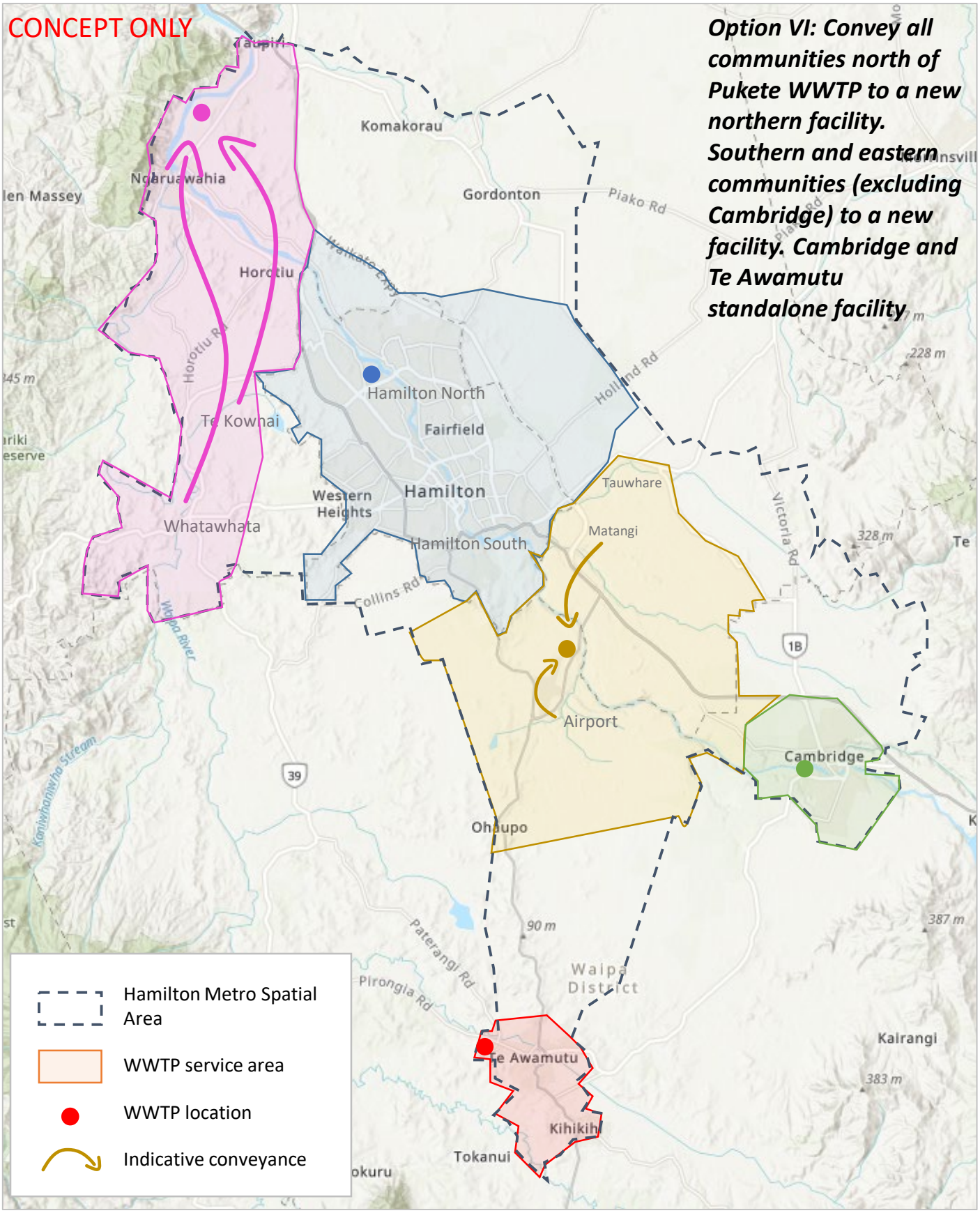

CONCEPT ONLY
Option I: BAU - Retain existing servicing arrangements for all communities
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Horotiu
Hamilton North
Fairfield
Te Kowhai
Hamilton
Western Heights
Hamilton South
Whatawhata
Tauwhare
Matangi
Victoria Rd
Collins Rd
Airport
Cambridge
Ohaupo
Paterangi Rd
Pirongia Rd
Waipa District
Te Awamutu
Kihikihi
Tokanui
Kairangi
Currently not serviced but a BAU scenario would include a standalone WWTP at Whatawhata
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance

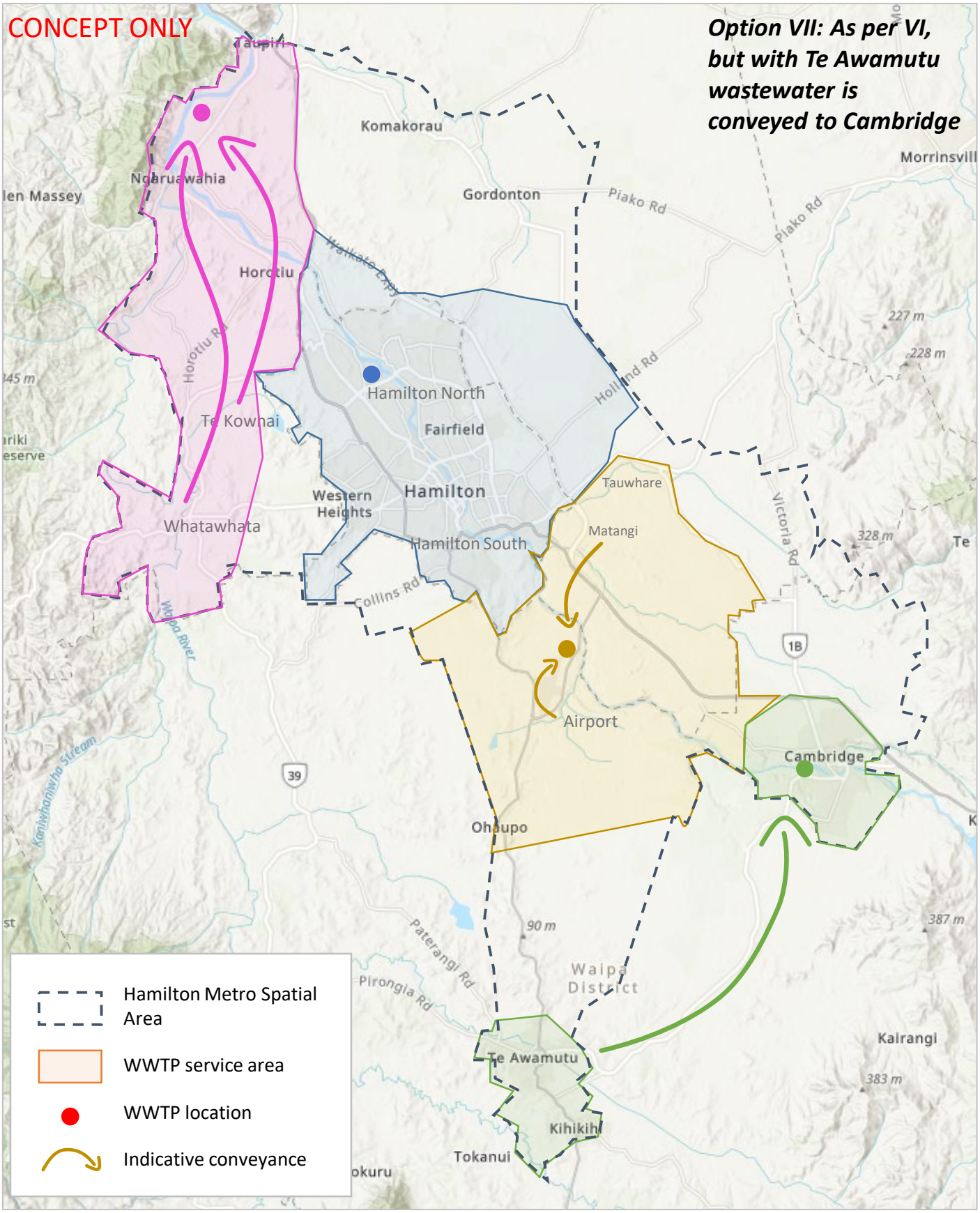

CONCEPT ONLY
Option II: Convey all communities to Pukete WWTP
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Horotiu
Horotiu Rd
Waikato Expy
Hamilton North
Te Kowhai
Fairfield
Hamilton
Western Heights
Whatawhata
Hamilton South
Tauwhare
Matangi
Collins Rd
Victoria Rd
Airport
Cambridge
Ohaupo
39
1B
Waipa River
Kaniwhaniwha Stream
Paterangi Rd
Pirongia Rd
Waipa District
Te Awamutu
Kihikihi
Tokanui
Kairangi
227 m
228 m
328 m
90 m
387 m
383 m
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance

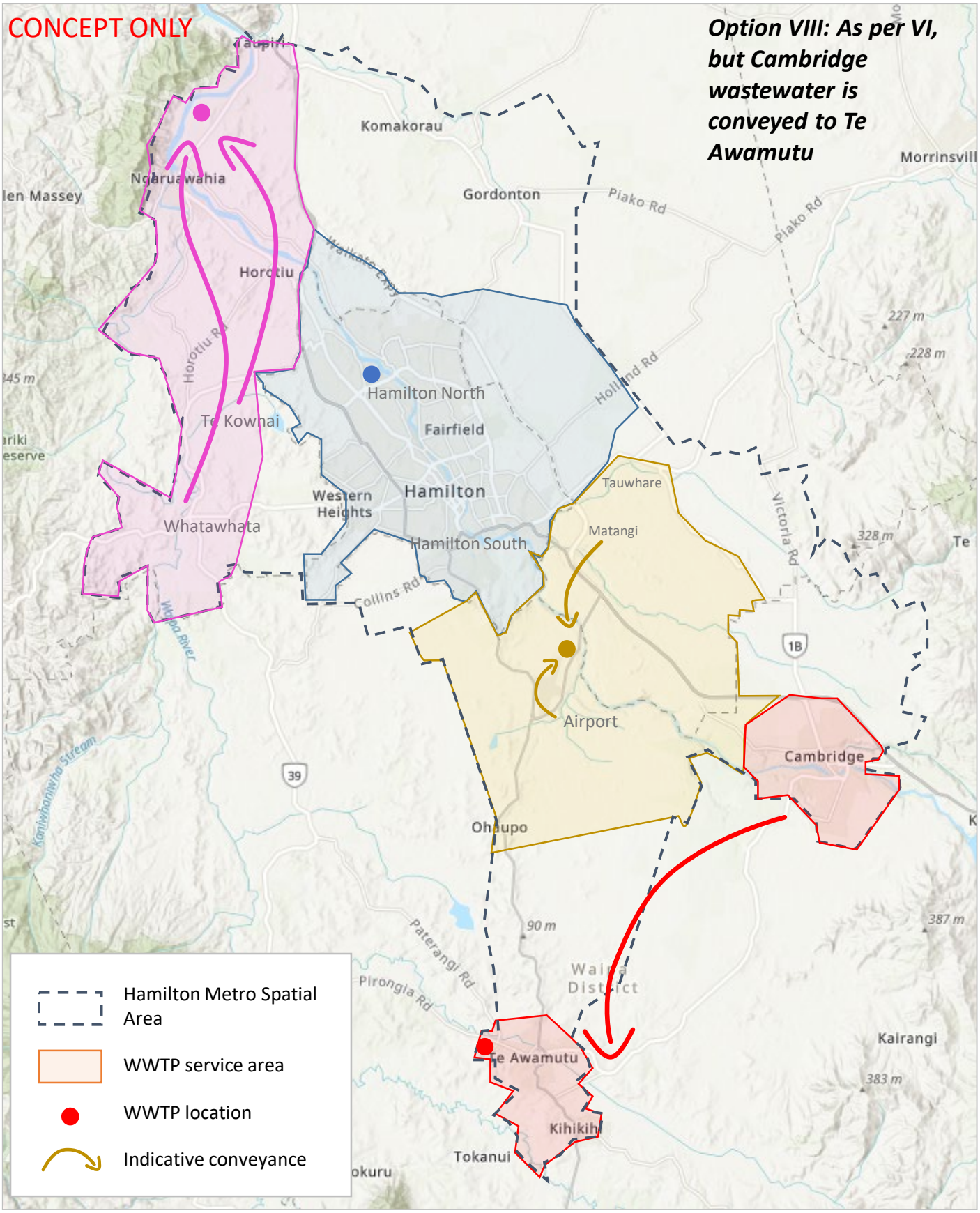

CONCEPT ONLY
Option III: Convey all communities north of Hamilton and existing Hamilton City to Pukete WWTP, all communities south of Hamilton to Cambridge
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Horotiu
Horotiu Rd
Hamilton North
Te Kowhai
Fairfield
Holland Rd
Western Heights
Hamilton
Whatawhata
Hamilton South
Tauwhare
Matangi
Victoria Rd
Collins Rd
Waikato River
1B
Airport
Cambridge
39
Ohaupo
Patetangi Rd
Pirongia Rd
Waipa District
Te Awamutu
Kihikihi
Tokanui
Kairangi
227 m
228 m
328 m
90 m
387 m
383 m
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance

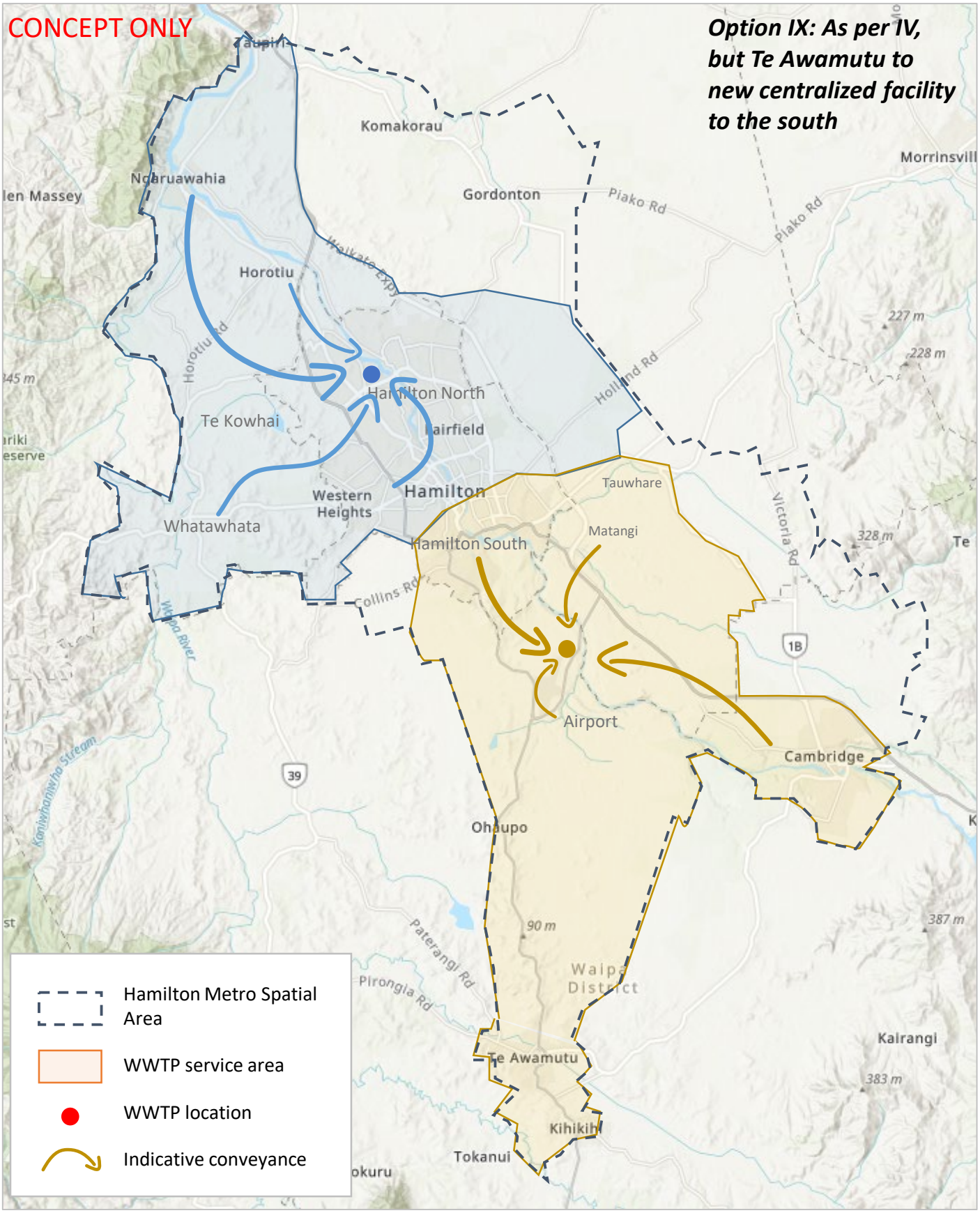

CONCEPT ONLY
Option IV: Convey all communities north of Hamilton and part of Hamilton to Pukete WWTP, the remainder of Hamilton and all communities south and east of Hamilton to a new WWTP, Te Awamutu standalone facility
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Horotiu
Horotiu Rd
Waikato Expy
Hamilton North
Te Kowhai
Fairfield
Holland Rd
Western Heights
Hamilton
Whatawhata
Tauwhare
Matangi
Hamilton South
Victoria Rd
328 m
Collins Rd
Waipa River
1B
Airport
Cambridge
39
Ohaupo
Kaniwhaniwha Stream
90 m
387 m
Paterangi Rd
Pirongia Rd
Waipa District
Te Awamutu
Kairangi
383 m
Kihikihi
Tokanui
228 m
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance

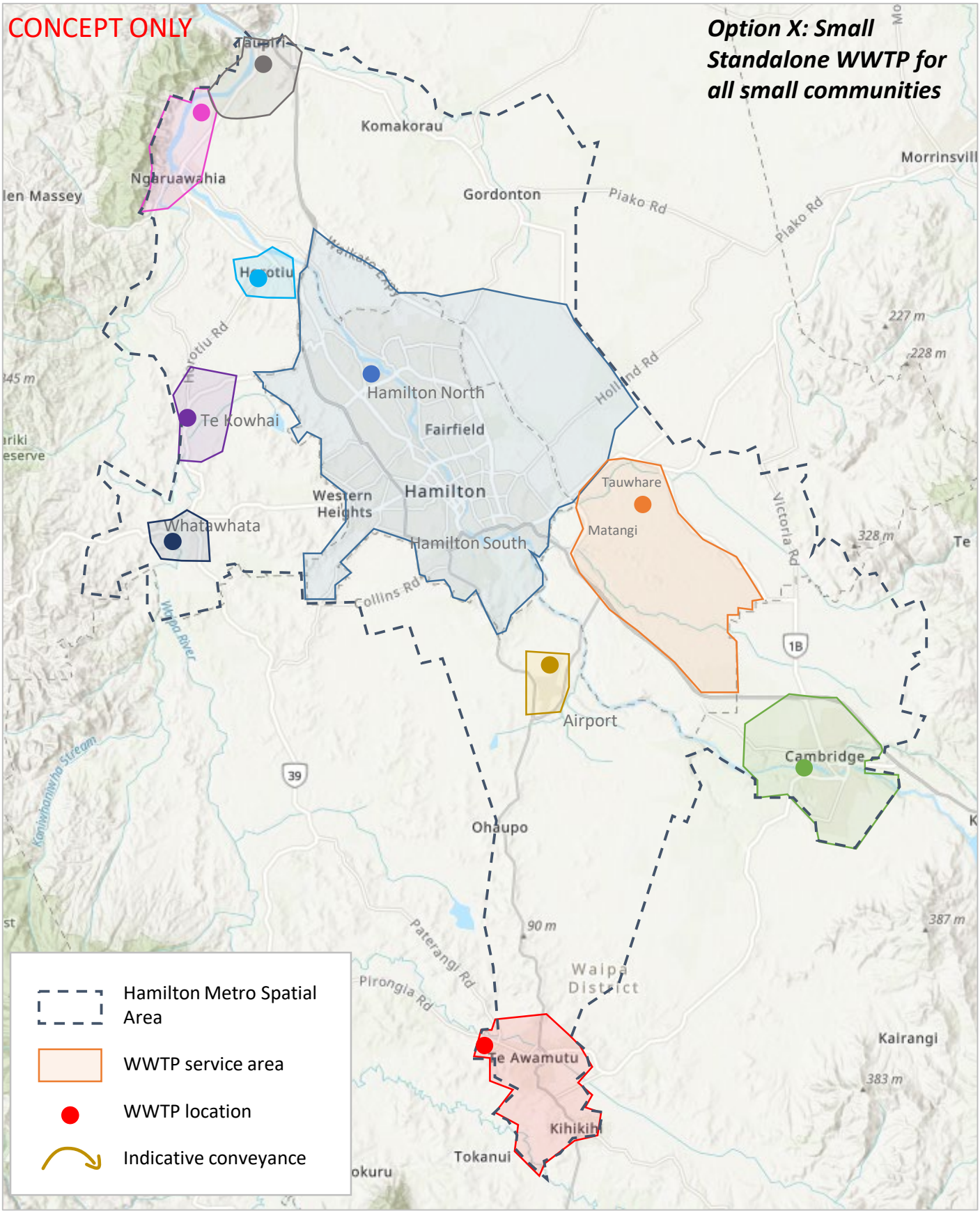

CONCEPT ONLY
Option V: As Per Option IV but part of Hamilton and southern and eastern communities to Cambridge WWTP
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Horotiu
Horotiu Rd
Waikato Expy
Hamilton North
Te Kowhai
Fairfield
Hamilton
Western Heights
Whatawhata
Hamilton South
Tauwhare
Matangi
Victoria Rd
Collins Rd
Waipa River
1B
Airport
Cambridge
39
Ohaupo
Paterangi Rd
Pirongia Rd
Waipa District
Te Awamutu
Kihikihi
Tokanui
Kairangi
227 m
228 m
328 m
387 m
383 m
90 m
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance

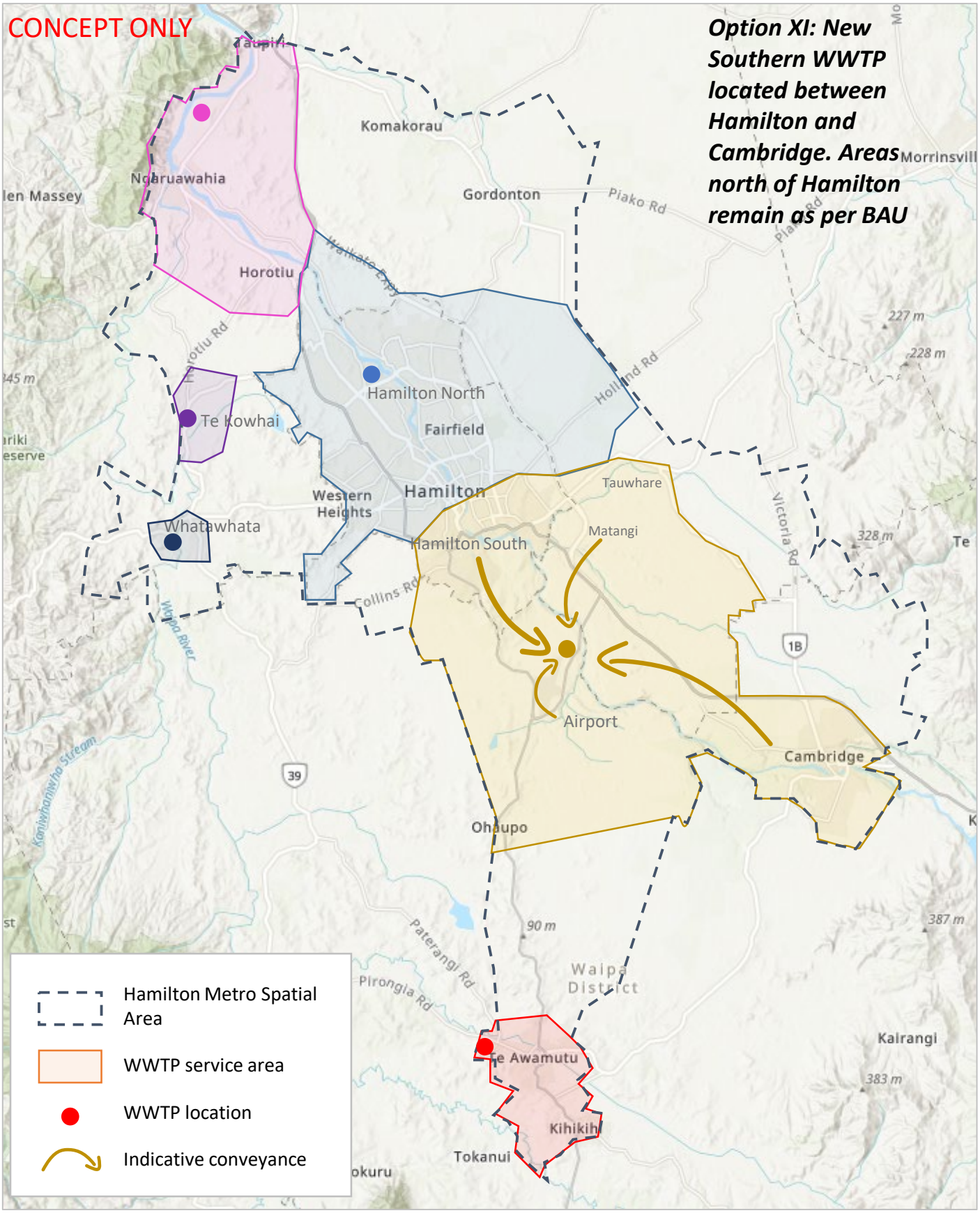

CONCEPT ONLY
Option VI: Convey all communities north of Pukete WWTP to a new northern facility. Southern and eastern communities (excluding Cambridge) to a new facility. Cambridge and Te Awamutu standalone facility
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Horotiu
Hamilton North
Fairfield
Te Kowhai
Hamilton
Western Heights
Whatawhata
Hamilton South
Tauwhare
Matangi
Airport
Cambridge
Ohaupo
Collins Rd
Victoria Rd
Holland Rd
Waipa River
Paterangi Rd
Pirongia Rd
Waipa District
Te Awamutu
Kihikihi
Tokanui
Kairangi
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance

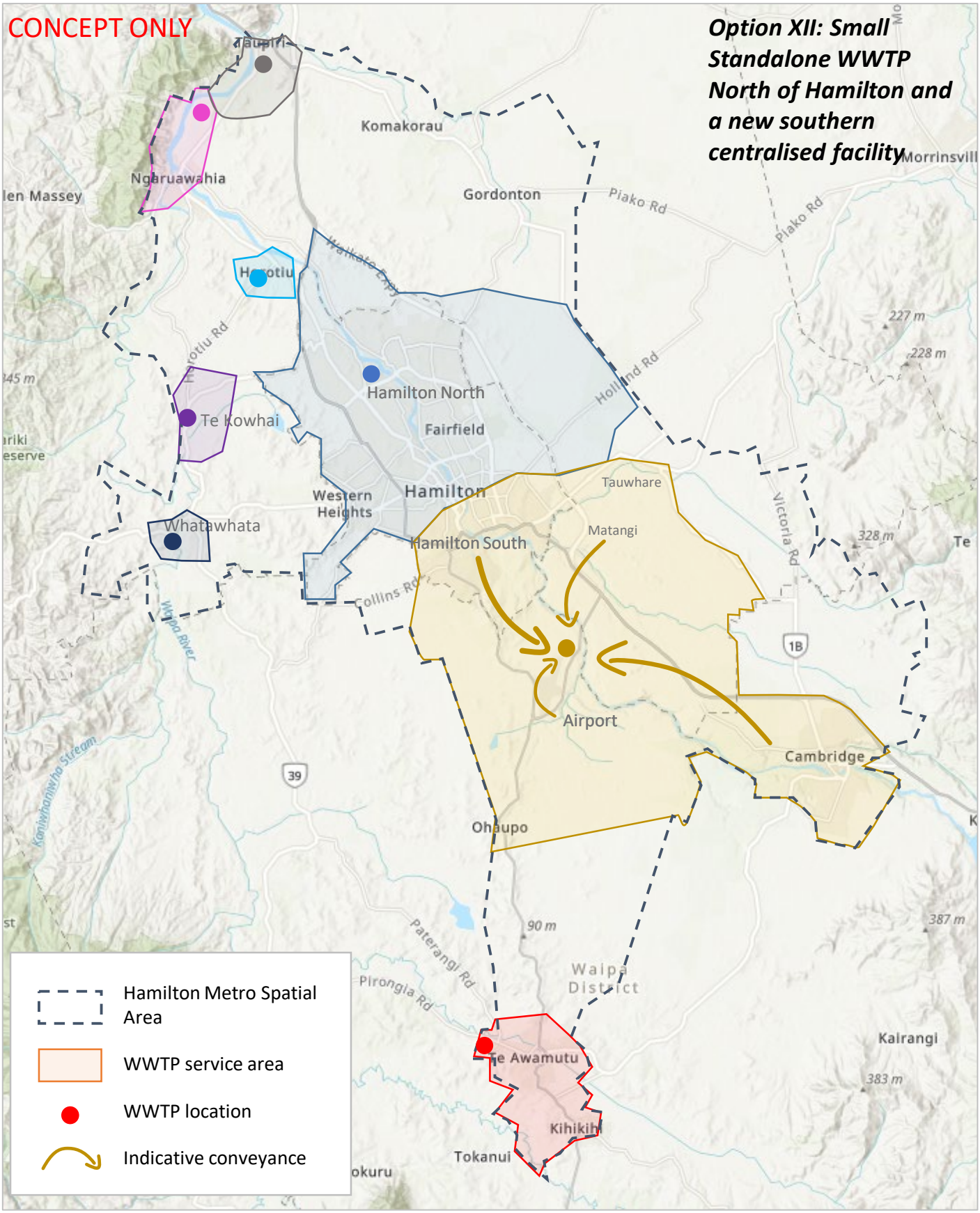

CONCEPT ONLY
Option VII: As per VI, but with Te Awamutu wastewater is conveyed to Cambridge
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Horotiu
Horotiu Rd
Waikato Expy
Hamilton North
Fairfield
Te Kowhai
Whatawhata
Western Heights
Hamilton
Hamilton South
Tauwhare
Matangi
Collins Rd
Holland Rd
Victoria Rd
Airport
Cambridge
Ohaupo
Waipa River
Kaniwhaniwha Stream
39
1B
Waipa District
Pirongia Rd
Paterangi Rd
Te Awamutu
Kihikihi
Tokanui
Kairangi
227 m
228 m
328 m
387 m
383 m
90 m
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance

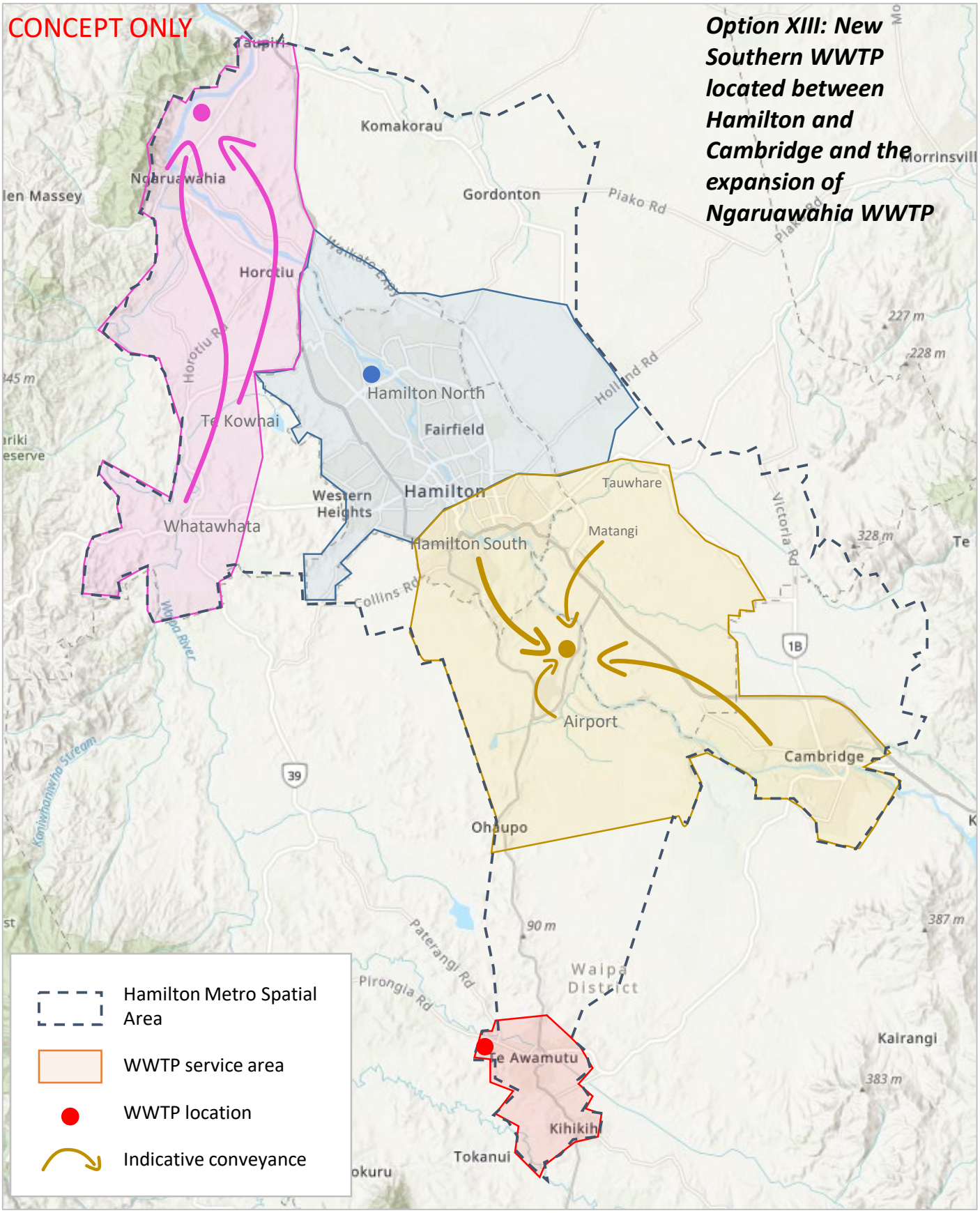

CONCEPT ONLY
Option VIII: As per VI, but Cambridge wastewater is conveyed to Te Awamutu
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Horotiu
Horotiu Rd
Waikato Expy
Hamilton North
Fairfield
Te Kowhai
Whatawhata
Western Heights
Hamilton
Hamilton South
Tauwhare
Matangi
Holland Rd
Victoria Rd
Collins Rd
Waipa River
Airport
1B
39
Cambridge
Ohaupo
Paterangi Rd
Pirongia Rd
Kairangi
Te Awamutu
Kihikihi
Tokanui
227 m
228 m
328 m
90 m
387 m
383 m
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance


CONCEPT ONLY
Option IX: As per IV, but Te Awamutu to new centralized facility to the south
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Horotiu
Horotiu Rd
Hamilton North
Te Kowhai
Fairfield
Western Heights
Hamilton
Whatawhata
Tauwhare
Matangi
Hamilton South
Collins Rd
Victoria Rd
Airport
Cambridge
Ohaupo
Waipa District
Te Awamutu
Kihikihi
Tokanui
Kairangi
Pirongia Rd
Paterangi Rd
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance


CONCEPT ONLY
Option X: Small Standalone WWTP for all small communities
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Hamilton North
Fairfield
Hamilton
Western Heights
Hamilton South
Te Kowhai
Whatawhata
Tauwhare
Matangi
Victoria Rd
Airport
Cambridge
Ohaupo
Collins Rd
Waipa River
Paterangi Rd
Pirongia Rd
Waipa District
Kihikihi
Tokanui
Kairangi
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance


CONCEPT ONLY
Option XI: New Southern WWTP located between Hamilton and Cambridge. Areas north of Hamilton remain as per BAU
Komakorau
Ngaruawahia
Gordonton
Horotiu
Hamilton North
Fairfield
Te Kowhai
Hamilton
Western Heights
Whatawhata
Hamilton South
Tauwhare
Matangi
Airport
Cambridge
Ohaupo
Waipa District
Te Awamutu
Kihikihi
Tokanui
Kairangi
Piako Rd
Holland Rd
Victoria Rd
Collins Rd
Pirongia Rd
Paterangi Rd
Waipa River
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance


CONCEPT ONLY
Option XII: Small Standalone WWTP North of Hamilton and a new southern centralised facility
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Hamilton North
Fairfield
Hamilton
Western Heights
Te Kowhai
Whatawhata
Hamilton South
Matangi
Tauwhare
Victoria Rd
Collins Rd
Airport
Cambridge
Ohaupo
Waipa District
Kihikihi
Tokanui
Kairangi
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance


CONCEPT ONLY
Option XIII: New Southern WWTP located between Hamilton and Cambridge and the expansion of Ngaruawahia WWTP
Komakorau
Ngaruawahia
Gordonton
Piako Rd
Horotiu
Hamilton North
Fairfield
Te Kowhai
Whatawhata
Western Heights
Hamilton
Tauwhare
Matangi
Hamilton South
Airport
Cambridge
Ohaupo
Collins Rd
Victoria Rd
Holland Rd
Waipa River
Kaniwhaniwha Stream
Paterangi Rd
Pirongia Rd
Waipa District
Te Awamutu
Kihikihi
Tokanui
Kairangi
Hamilton Metro Spatial Area
WWTP service area
WWTP location
Indicative conveyance

Appendix B – Standardised treatment details

PLANT SIZE ASSUMPTIONS

Table 0-1 Small Plant Assumptions

Stage	Installed Process	Purpose		Output Quality / Performance
Preliminary	First stage screening	Remove non biodegradable solids	Removal of gross solids down to 3mm	Solids capture ratio TBA
	Grit Removal		Remove sand grit and stones	95% removal
Primary	Nil			
Secondary	Activated sludge reactor	Treat dissolved contaminants and remove nutrients	Biological oxidation of organic material, nitrogen and phosphorus	NH_4-N < 2mg/l NOx – N < 12mg/l
	Membrane based solids separation (MBR)		Retention of activated biomass within the treatment system. Clarification of final effluent. Disinfection by physical removal of pathogenic bacteria and protozoa	TSS , <8mg/l $cBOD_5$, 8mg/l 6 Log_{10} bacteria removal 1-2 log_{10} viral removal
	Possibly alkalinity dosing		Alkalinity – Buffer pH for stable nitrification	pH 6.5 – 7.5
Tertiary	UV Disinfection	Inactivate pathogens (Bacteria, viruses, protozoa)	Primarily for inactivation of pathogenic viruses. Also backstop bacterial kill	3 – 4 log_{10} Viral inactivation
	Internal recycled effluent system	Reduce Potable water consumption on site	Reduce potable water consumption. Cleaning, spray bars, make-up water	
Solids Phase	Sludge thickening	Reduce sludge quantity by removing water. Dewatering elsewhere	Allow tankering of TWAS to larger plants for digestion and or dewatering.	5-6% Dry solids slurry
Secondary	Activated sludge reactor	Treat dissolved contaminants and remove nutrients	Biological oxidation of organic material, nitrogen and phosphorus	

Table 0-2 Medium plant assumptions

Stage	Installed Process	Purpose		Output Quality / Performance
Preliminary	First stage screening	Remove non biodegradable solids	Removal of gross solids down to 3mm	Solids capture ratio TBA
	Grit Removal		Remove sand grit and stones	95% removal
Primary	Nil			
Secondary	Activated sludge reactor	Treat dissolved contaminants and remove nutrients	Biological oxidation of organic material, nitrogen and phosphorus	NH_4-N < 1mg/l NOx – N < 6mg/l
	Membrane based solids separation (MBR)		Retention of activated biomass within the treatment system. Clarification of final effluent. Disinfection by physical removal of pathogenic bacteria and protozoa	TSS , <5mg/l $cBOD_5$, 5mg/l 6 Log_{10} bacteria removal 1-2 log_{10} viral removal
	Possibly alkalinity dosing		Alkalinity – Buffer pH for stable nitrification	pH 6.5 – 7.5
Tertiary	UV Disinfection	Inactivate pathogens (Bacteria, viruses, protozoa)	Primarily for inactivation of pathogenic viruses. Also backstop bacterial kill	3 – 4 log_{10} Viral inactivation
	Internal recycled effluent system	Reduce Potable water consumption on site	Reduce potable water consumption. Cleaning, spray bars, make-up water	
	Alum dosing	Removal of phosphorus chemically	Chemical P Removal	TP 0.5mg/l
Solids Phase	Sludge thickening and dewatering	Reduce sludge quantity by removing water	Reduce sludge volume and tonnage for transport and disposal	20% Dry solids cake

Table 0-3 Large Plant Assumptions

Stage	Installed Process	Purpose		Output Quality / Performance
Preliminary	First stage screening	Remove non biodegradable solids	Removal of gross solids down to 3mm	Solids capture ratio TBA
	Grit Removal		Remove sand grit and stones	95% removal
	Septage receiving	Service to rural septic Tank owners	Receive tankered trade waste and tankered septage from domestic septic tanks. Screen, de-grit and meter slowly into main plant	
Primary	Primary Clarifiers, Salsness filters or Equivalent	Capture solids good for energy generation Power savings	Capture raw VSS and remove for energy generation and solids destruction	40%+ COD capture
Secondary	Second stage screening	Treat dissolved contaminants and remove nutrients	Protect MBR membranes. Remove solids down to 1mm including hair.	
	BNR Activated sludge reactor		Biological oxidation of organic material, nitrogen and phosphorus	NH_4-N < 1mg/l NOx – N < 4mg/l TP<1mg/l
	Membrane based solids separation (MBR)		Retention of activated biomass within the treatment system. Clarification of final effluent. Disinfection by physical removal of pathogenic bacteria and protozoa	TSS , <5mg/l $cBOD_5$, 5mg/l 6 Log_{10} bacteria removal 1-2 log_{10} viral removal
	Probably some alkalinity & or carbon dosing		Alkalinity – Buffer pH for stable nitrification Carbon – Readily degradable COD supplement to complete the necessary level of denitrification Alum – TP Polishing	pH 6.5 – 7.5 . TN <5mg/l TP< 0.5mg/l
Tertiary	UV Disinfection	Inactivate pathogens	Primarily for inactivation of pathogenic viruses.	3 – 4 log_{10} Viral inactivation

Stage	Installed Process	Purpose		Output Quality / Performance
		(Bacteria, viruses, protozoa)	Also backstop bacterial kill	
	Internal recycled effluent system	Reduce Potable water consumption on site	Reduce potable water consumption. Cleaning, spray bars, make-up water	
Solids Phase	Anaerobic Digestion (AD)	Extract methane for energy generation Reduce and stabilize solids for future use or disposal	Energy extraction Reduction of solids for disposal	Maximise gas extraction potential 60% VSS destruction
	Gas holding		Manage gas derived from AD	
	Co-Generation or equivalent energy reuse	Generate electricity and heat for use on site	Use of gas in engines for power generation and heat capture and or in boilers for heat production e.g. steam	Minimise imported energy bill.
	Thickening and dewatering	Reduce sludge quantity by removing water	Reduce sludge volume and tonnage for transport and disposal	24 – 26% Dry solids sludge cake
Future Possibilities	Anammox and nitrite shunt	Short -cut, low energy nitrogen removal	Advanced side-stream and mainstream (respectively) ammonia removal	Minimised energy consumption Minimised n recycle to AS
	Struvite crystallizer	Phosphorus recovery	Recovery of magnesium ammonium phosphate as a commercial fertilizer	
	Reverse Osmosis, UV and Chlorine	Further removal of contaminants suitable for potable/industrial reuse	Direct or indirect potable reuse	0 mg/l TSS 0 pathogenic organisms

.

Appendix C - Cost Assumptions

Project:	**H2A 3 Waters Study - WW Long List**
Document:	**Concept Estimate (Class 5 - 30 to + 50% accuracy range)**
Version:	2
Project No's	3256847
Date:	27 March 2020
Author:	John Crawford, Claire Scrimgeour, Cameron McRobie (reviewed Jerry Foster)

MAIN SUMMARY

1.00 Executive Summary:

1.01 The following concept design cost estimates are for the projects identified in the Hamilton Metro Spatial WWTP Options Summary

2.00 Scope of Work:

2.01 The scope includes new pipes, pump stations, and wastewater treatment plants

3.00 Estimate Approach & Methodology:

3.01 This estimate has been prepared using a combination of high level estimating principles (i.e. cost per functional area, cost per elemental item, cost resourcing, etc) for the key scope items identified. Costs are all in 2020 $.

4.00 Project Risks:

4.01 The following project risks have been identified with the current scheme:

a Land availability
b Growth Cell timing and development rates

5.00 Value Management Opportunities:

5.01 The following Value Management Opportunities have been identified with the current scheme:

a Nil

6.00 Estimate Assumptions:

6.01 Our estimate of cost is based on the following working assumptions:

a The works will be undertaken under normal working hours with no restrictions on timing.

b The works will be tendered and carried out by a variety of contractors, generally grouped into packages for efficient delivery.

c The accuracy of this concept estimate (Class 5) is commensurate with the level of design information available and base assumptions made. 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. For this estimate we have assessed our accuracy range at an individual cost centre level to express confidence levels in the reported figures in relation to the identified scope. Beca Water Business Line Process for Capital Cost Estimates (rev. 1 - 2nd Aug. 2019).

7.00 Estimate Exclusions:

7.01 This concept estimate excludes the following:

a Client management costs

b Legal fees

c Land acquisition costs

d Client insurances

e Escalation allowances

f Goods and Services Tax

8.00 Reference Documentation:

8.01 The concept estimate is based on the following documentation: Hamilton Metro Spatial WWTP Options Summary population projections

9.00 Disclaimers

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

9.03 Where another party has supplied information for use in this report, it is assumed to be reliable.

9.04 Beca reserves the right, but not the obligation, to review all calculations included or referred to in this report and, if considered necessary, to revise its opinion in the light of any new or existing information.

9.05 This cost estimate has been developed solely for the purpose of comparing and evaluating options. They cannot be used 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 budget estimate is required.

ASSUMPTIONS

General Allowance for P&G and Design, Consenting **30%**

Flows and Population for Transmission to WWTP

These populations are used to select the pump station and conveyance size

Parameter	DW Flows	Population (max)	Flow Range (min)	Flow Range (max DW)
Pop. Size	**L/p/d**	**p**	**m^3/d**	**m^3/d**
Small	250	2,000	187	500
Medium	250	12,000	500	3,000
Large	310	28,472	3,000	8,826

Industrial Flow Allowance	0.15 * catchment area residential flow

Pipe Sizing

Velocity Assumptions Min WW velocity (m/s) **0.7** Max WW velocity (m/s) **1.5**

Parameter			Nearest Actual Diameter	Pipe Specs	Dry weather flow velocity range (m/s)			Approx Max System Head Loss	Pipe $
Pipe Size			**ID mm**	**PE 100 PN16**	**m/s**	**m/s**		**m/1000m**	**$/m**
Small			203	DN250	0.13	0.36		10.0	896
Medium			366	DN450	0.11	0.66		10.0	1,775
Large			513	DN630	0.34	0.99		10.0	4,095

Conveyance Capex and Opex

Parameter	Peak Flow (2.5 PF)	Pumps			Total Conveyance	Pump Station Capital Cost ($)		Power Cost	Operations and Maintenance	Chemical Dosing Cost
Pump Station Size	**(L/s)**	**Arrangement**			**Total capital cost**	**Chamber etc ($)**	**Storage ($/$m^3$)**		**Annual 5% capex PS**	$/m3 per year
Small	20	duty, standby			*1,900,000*	1,400,000	500,000		$ 95,000.00	
Medium	90	duty, standby			*3,150,000*	2,150,000	1,000,000	formula based on flow, headloss	$ 157,500.00	43
Large	260	duty, standby			*7,300,000*	4,800,000	2,500,000		$ 365,000.00	

Treatment Plants Assumptions

Capex

Parameter	Description	Population Equivalent		Flow (m^3/d)		Plant Cost ($M)		OPEX	
WWTP Size	**Plant Philosophy**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**$./ML/year**	
Small	Better than current - Nitrifying AS, with limited denitrification, Chemical P, and disinfection. Land disposal where feasible.	2000	4000	500	1000	7.8	13	650000	
Medium	Te Awamutu or better. High level of nutrient, BOD, Solids and pathogen reduction. Discharge to water.	4000	40000	1000	10000	15.6	39	400000	
Large	Pukekohe or better. High level of nutrient, BOD, Solids and pathogen reduction. Plus Energy recovery. Facility for other forms of resource recovery in future such as potable recycling, struvite etc but not installed. Discharge to water or re-use.	40000	500000	12400	155000	72	480	230000	

WWTP Small Opex Capex $M min 7.8

Cost Component	Useage		Throughput		Annual		Unit Cost		Annual Cost	Rounded Annual Cost		
Power (including Tarrifs)	1265	kW.hr/ML	1	ML/D	461725	kW.hr	$ 0.1569	$/kW.hr	$ 72,458	$ 72,000		
Operator	1	FTE					120000	$/FTE	$ 120,000	$ 120,000		
UV Lamp replacement	10						791	$/Lamp	$ 7,913	$ 8,000		
Monitoring & compliance									$ 50,000	$ 50,000		
Maintenance - Civil and Mechanical									$ 150,000	$ 150,000		2%
Chemicals (CIP/Alum/Caustic)									$ 20,000	$ 20,000		
Screenings & Grit							130	$/T	$ 50,000	$ 50,000		
Polymer	11	kg.poly/T.DS	0.2	T.DS/day		kg.poly/yr		$/kg	$ -	$ -		
Sludge disposal			0.8	T/day	294	T/yr	$ 400.00	$/T	$ 117,530	$ 118,000		
Sub- Total									$ 587,901	$ 588,000		
Contingency									$ 58,790		Annual Cost per MLD	
Estimated Annual OPEX									**$ 646,691**	**$ 647,000**	$	647,000

WWTP Medium Opex Capex $M min 15.6

Cost Component	Useage		Throughput		Annual		Unit Cost		Annual Cost	Rounded Annual Cost		
Power (including Tarrifs)	1265	kW.hr/ML	5	ML/D	2308625	kW.hr	$ 0.1569	$/kW.hr	$ 362,290	$ 362,000		
Operator	3	FTE					120000	$/FTE	$ 360,000	$ 360,000		
UV Lamp replacement	20						791	$/Lamp	$ 15,826	$ 16,000		
Monitoring & compliance									$ 200,000	$ 200,000		
Maintenance - Civil and Mechanical									$ 300,000	$ 300,000		2%
Chemicals (CIP/Alum/Caustic)									$ 50,000	$ 50,000		
Screenings & Grit							130	$/T	$ 50,000	$ 50,000		
Polymer	11	kg.poly/T.DS	0.8	T.DS/day	3232	kg.poly/yr	$ 12.00	$/kg	$ 38,785	$ 39,000		
Sludge disposal			4.0	T/day	1469	T/yr	$ 300.00	$/T	$ 440,738	$ 441,000		
Sub- Total									$ 1,817,638	$ 1,818,000		
Contingency									$ 181,764		Annual Cost per MLD	
Estimated Annual OPEX									**$ 1,999,402**	**$ 1,999,000**	$	399,800

WWTP Large Opex Capex $M min 126

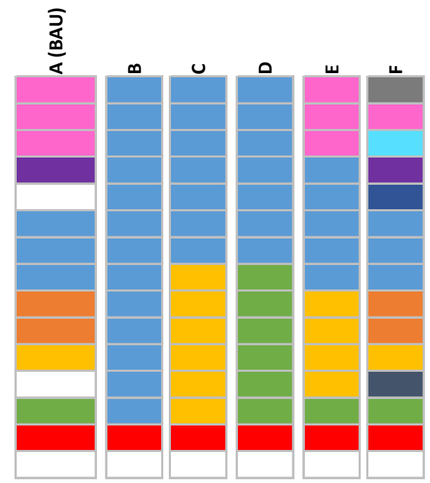
Cost Component	Useage		Throughput		Annual		Unit Cost		Annual Cost	Rounded Annual Cost		
Power (including Tarrifs)	1265	kW.hr/ML	50	ML/D	23086250	kW.hr	$ 0.1569	$/kW.hr	$ 3,079,464	$ 3,079,000		
Operator	7	FTE					120000	$/FTE	$ 840,000	$ 840,000		
UV Lamp replacement	50						791	$/Lamp	$ 39,565	$ 40,000		
Monitoring & compliance									$ 500,000	$ 500,000		
Maintenance - Civil and Mechanical									$ 2,500,000	$ 2,500,000		2%
Chemicals (CIP/Alum/Caustic)									$ 200,000	$ 200,000		
Screenings & Grit							130	$/T	$ 200,000	$ 200,000		
Polymer	11	kg.poly/T.DS	5.5	T.DS/day	21932	kg.poly/yr	$ 12.00	$/kg	$ 263,183	$ 263,000		
Sludge disposal			27.3	T/day	9969	T/yr	$ 300.00	$/T	$ 2,990,719	$ 2,991,000		
Sub- Total									$ 10,612,931	$ 10,613,000		
Contingency									$ 1,061,293		Annual Cost per MLD	
Estimated Annual OPEX									**$ 11,674,224**	**$ 11,674,000**	$	233,480

Appendix D - Cost Estimates

Population Projections

Area	2016	2020 Servicing	2045*	100 years+*	Source/Notes
Taupiri & Hopuhopu	500	Currently serviced	650	13000	MSP - split between Nga, Taupiri/Hopuhopu
Ngaruawahia	5,400	Currently serviced	5,600	25000	MSP - split between Nga, Taupiri/Hopuhopu
Horotiu	850	Currently serviced	1,500	10800	WGS
Te Kowhai	1,600	Small part of township serviced	2,100	4000	WGS
Whatawhata	2,800	Not currently serviced	2,000	4000	Population likely covers wider area than just township
Hamilton North					
East of Hamilton	160,000	Currently serviced	235,000	345000	WWMP +MSP for infill (50,00
Hamilton South				100000	
Tauwhare	6,150	Tauwhare Pa only serviced	2,000	3000	WGS with reduction for area practical to service
Matangi	2,300	Matangi township only serviced	2,800	4000	WGS with reduction for area practical to service
Airport		Privately serviced - industrial	6,900	11400	Industrial population equivalent - Waipa advice 2019
Ohaupo	530	Not currently serviced	720	1,000	Sensitive area so little growth
Cambridge & Hautapu	17,200	Currently serviced	30,700	60,000	MSP
Te Awamutu & Kihikhi	13,800	Currently serviced	19,300	50,000	MSP
Pirongia	1,480	Not currently serviced	1,960	2,020	WMP
TOTAL	**212,610**		**311,230**	**633,220**	

* - excludes industrial PE unless noted



Option Cost Comparison 2045

	WWTP Capital Cost	Current Assets re-used	PS Capital Cost	Conveyance Cost	TOTAL CAPEX (-30% / +50%)
Option A (BAU)	$ 311,812,857	$ 128,000,000	$ 4,000,000	$ 15,000,000	$ 203,000,000
Option B	$ 378,000,000	$ 128,000,000	$ 30,000,000	$ 219,105,000	$ 500,000,000
Option C	$ 457,000,000	$ 128,000,000	$ 37,000,000	$ 176,658,000	$ 543,000,000
Option D	$ 455,000,000	$ 128,000,000	$ 30,000,000	$ 218,936,000	$ 576,000,000
Option E	$ 417,000,000	$ 128,000,000	$ 18,000,000	$ 75,952,000	$ 383,000,000
Option F	$ 449,000,000	$ 128,000,000	$ 4,000,000	$ 14,127,000	$ 340,000,000

	WWTP Annual Operational Cost		PS Annual Operational Cost	TOTAL OPEX	30 year NPV OPEX @6%	CAPEX+30Y NPV OPEX $M
Option A (BAU)	$ 25,769,000		$ 1,000,000	$ 26,769,000	$ 369,000,000	$572
Option B	$ 25,000,000		$ 3,529,000	$ 28,529,000	$ 393,000,000	$893
Option C	$ 23,173,000		$ 3,932,000	$ 27,105,000	$ 374,000,000	$917
Option D	$ 24,000,000		$ 3,408,000	$ 27,408,000	$ 378,000,000	$954
Option E	$ 25,659,000		$ 1,236,000	$ 26,895,000	$ 371,000,000	$754
Option F	$ 26,206,000		$ 227,000	$ 26,433,000	$ 364,000,000	$704

**This cost estimate has been developed solely for the purpose of comparing and evaluating options. They cannot be used 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 budget estimate is required.*

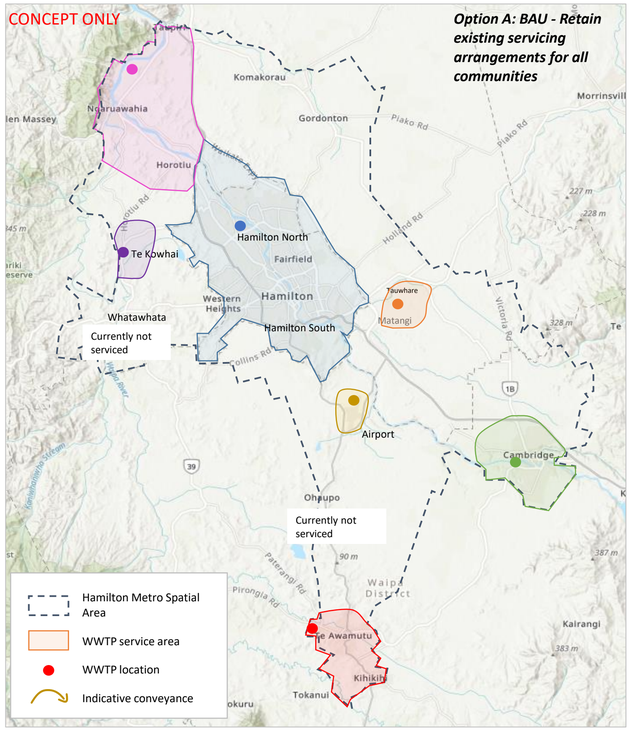
Option A (BAU)

Population Projections

Area	2016	2045	2120				Flows (m^3/d) (2045)	Flows (m^3/d) (2120)	A	Treatment Plant Size 2045 (m^3/d)	Treatment Plant Size 2120 (m^3/d)	Type of plant (2045)	Capital Cost ($) 2045	WWTP Operational Cost ($) @2045	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static)	Conveyance Size	Conveyance ($)
Taupiri & Hopuhopu	500	650	13000				187	3,738							Small	1,900,000	105,990	4.34	-8	Small	3,887,338
Ngaruawahia	5,400	5,600	25000				1,610	7,188		2,228	14,030	Medium	19,660,000	935,813							
Horotiu	850	1,500	10800				431	3,105							Small	1,900,000	121,002	5.77	-20	Medium	10,238,865
Te Kowhai	1,600	2,100	4000				604	1,150		604	1,150	Small	8,820,000	404,513							
Whatawhata	2,800	2,000	4000				575	1,150		-	-	-									
Hamilton North																					
East of Hamilton	160,000	235,000	345000				67,563	127,938		67,563	127,938	Large	208,142,857	16,890,625							
Hamilton South			100000																		
Tauwhare	6,150	2,000	3000				575	863													
Matangi	2,300	2,800	4000				805	1,150		1,587	2,314	Medium	16,850,000	666,540							
Airport		6,900	11400				1,984	3,278		1,984	3,278	Medium	18,700,000	833,175							
Ohaupo	530	720	1,000				207	288		-	-	-	-	-							
Cambridge & Hautapu	17,200	30,700	60,000				8,826	17,250		8,826	17,250	Medium	31,100,000	3,707,025							
Te Awamutu & Kihikhi	13,800	19,300	50,000				5,549	14,375		5,549	14,375	Medium	27,240,000	2,330,475							
Pirongia	1,480	1,960	2,020				564	581		-		-									
										-	-	-	311,812,857	25,769,000	-	4,000,000	1,000,000	10.11	-28	0	15,000,000

Includes 15% industrial allowance

Includes 15% industrial allowance Similar to current plant performance (no additional factors for plant improvements)



Option B

Population Projections

Area	2016	2045	2120	Flows (m^3/d) (2045)	Flows (m^3/d) (2120)	B
Taupiri & Hopuhopu	500	650	13000	187	3,738	
Ngaruawahia	5,400	5,600	25000	1,610	7,188	
Horotiu	850	1,500	10800	431	3,105	
Te Kowhai	1,600	2,100	4000	604	1,150	
Whatawhata	2,800	2,000	4000	575	1,150	
Hamilton North						
East of Hamilton	160,000	235,000	345000	67,563	127,938	
Hamilton South						
Tauwhare	6,150	2,000	3000	575	863	
Matangi	2,300	2,800	4000	805	1,150	
Airport		6,900	11400	1,984	3,278	
Ohaupo	530	720	1,000	207	288	
Cambridge & Hautapu	17,200	30,700	60,000	8,826	17,250	
Te Awamutu & Kihikhi	13,800	19,300	50,000	5,549	14,375	
Pirongia	1,480	1,960	2,020	564	581	

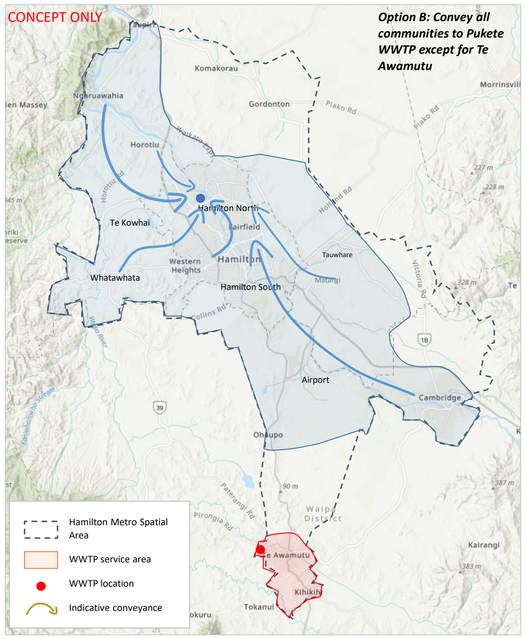
Includes 15% industrial allowance

Area	Treatment Plant Size 2045 (m^3/d)	Treatment Plant Size 2120 (m^3/d)	Type of plant (2045)	WWTP Capital Cost ($)	WWTP Operational Cost ($)	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static m)	Conveyance Size	Conveyance ($)
Taupiri & Hopuhopu						Small	1,900,000	109,883	7.1	14	Small	6,359,470
Ngaruawahia						Medium	3,150,000	278,545	5.68	10	Medium	10,079,160
Horotiu						Medium	3,150,000	236,784	5.32	10	Medium	9,440,340
Te Kowhai						Small	1,900,000	139,433	5.9	12	Medium	10,469,550
Whatawhata						Small	1,900,000	145,964	8.7	19	Medium	15,438,150
Hamilton North												
East of Hamilton	89,479	182,051	Large	344,900,000	22,369,656	-			-	0	-	
Hamilton South												
Tauwhare						Small	1,900,000	137,374	6.65	4	Medium	11,800,425
Matangi						Medium	3,150,000	202,914	4.52	-16	Medium	8,020,740
Airport						Medium	3,150,000	306,311	7.77	-5	Medium	13,787,865
Ohaupo						Small	1,900,000	108,676	6.18	-10	Small	5,535,426
Cambridge & Hautapu						Large	7,300,000	1,862,247	31.3	-26	Large	128,173,500
Te Awamutu & Kihikhi	5,548.75	14,375.00	Medium	32,688,000	2,330,475		-	-	-	0	-	
Pirongia	-	-	-	-		Small	-	-	-		-	
	-	-	-	378,000,000	25,000,000	-	30,000,000	3,529,000	89.12		0	219,105,000

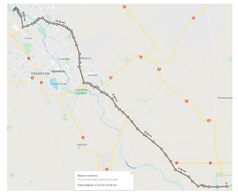
Includes 15% industrial allowance

CONCEPT ONLY

Option B: Convey all communities to Pukete WWTP except for Te Awamutu

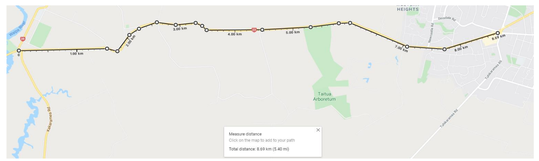


Cambridge to Pukete: 31.3 km



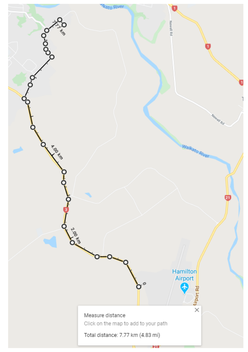
Taupiri & Hopuhopu to Ngaruawahia: 7.1km

Whatawhata to Dinsdale Interceptor: 8.7 km

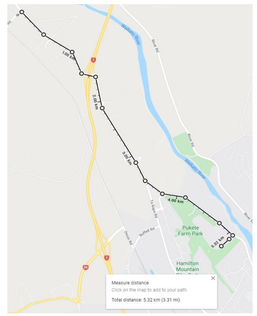


Te Kowhai to Rotokauri Interceptor: 5.9 km

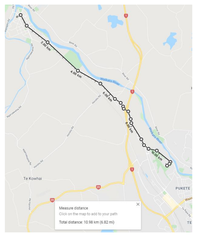
Airport to Peacockes Interceptor: 7.77 km



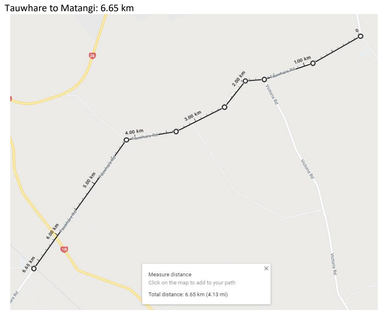
Horotiu to Pukete: 5.32 km



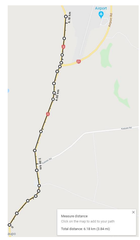
Ngaruawahia to Pukete: 11km



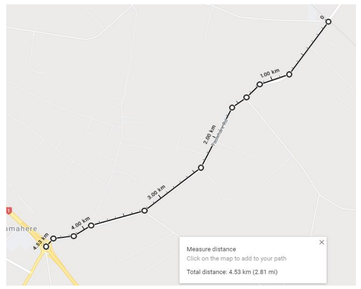
Tauwhare to Matangi: 6.65 km



Ohaupo to Airport: 6.18 km



Matangi to SH1B Intersection: 4.52 km



Option C

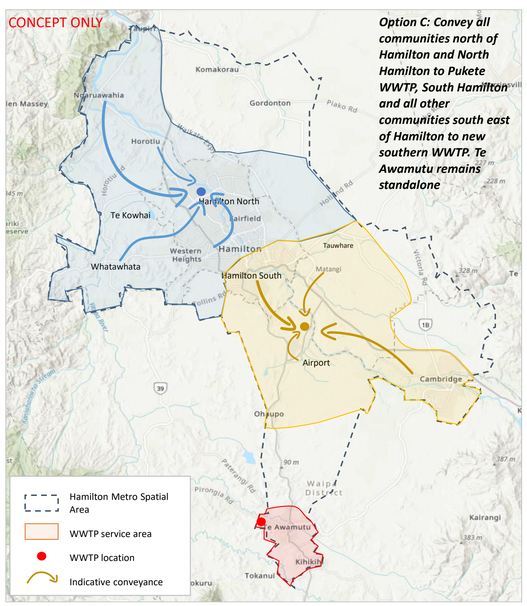
Population Projections

Area	2016	2045	2120
Taupiri & Hopuhopu	500	650	13000
Ngaruawahia	5,400	5,600	25000
Horotiu	850	1,500	10800
Te Kowhai	1,600	2,100	4000
Whatawhata	2,800	2,000	4000
Hamilton North East of Hamilton	160,000	205,000	345000
Hamilton South		30,000	100000
Tauwhare	6,150	2,000	3000
Matangi	2,300	2,800	4000
Airport		6,900	11400
Ohaupo	530	720	1,000
Cambridge & Hautapu	17,200	30,700	60,000
Te Awamutu & Kihikhi	13,800	19,300	50,000
Pirongia	1,480	1,960	2,020

Area	Flows (m^3/d) (2045)	Flows (m^3/d) (2120)	C
Taupiri & Hopuhopu	187	3,738	
Ngaruawahia	1,610	7,188	
Horotiu	431	3,105	
Te Kowhai	604	1,150	
Whatawhata	575	1,150	
Hamilton North East of Hamilton	58,938	99,188	
Hamilton South	8,625	28,750	
Tauwhare	575	863	
Matangi	805	1,150	
Airport	1,984	3,278	
Ohaupo	207	288	
Cambridge & Hautapu	8,826	17,250	
Te Awamutu & Kihikhi	5,549	14,375	
Pirongia	564	581	

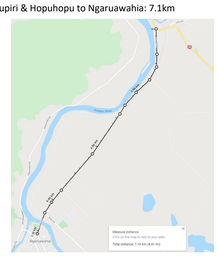
Area	Treatment Plant Size 2045 (m^3/d)	Treatment Plant Size 2120 (m^3/d)	Type of plant (2045)	WWTP Capital Cost ($)	WWTP Operational Cost ($)
Taupiri & Hopuhopu Ngaruawahia Horotiu Te Kowhai Whatawhata Hamilton North East of Hamilton	**62,344**	**115,518**	**Large**	**277,680,000**	**15,586,094**
Hamilton South Tauwhare Matangi Airport Ohaupo Cambridge & Hautapu Te Awamutu & Kihikhi Pirongia	**21,022**	**51,578**	**Large**	**146,630,000**	**5,255,500**
	5,549	**14,375**	**Medium**	**32,688,000**	**2,330,475**
	-				
	-	-	-	**457,000,000**	**23,173,000**

Area	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static m)	Conveyance Size	Conveyance ($)
Taupiri & Hopuhopu	**Small**	**1,900,000**	**109,883**	**7.1**	**14**	**Small**	**6,359,470**
Ngaruawahia	**Medium**	**3,150,000**	**278,545**	**5.68**	**10**	**Medium**	**10,079,160**
Horotiu	**Medium**	**3,150,000**	**236,784**	**5.32**	**10**	**Medium**	**9,440,340**
Te Kowhai	**Small**	**1,900,000**	**139,433**	**5.9**	**12**	**Medium**	**10,469,550**
Whatawhata	**Small**	**1,900,000**	**145,964**	**8.7**	**19**	**Medium**	**15,438,150**
Hamilton North East of Hamilton	-			-	**0**	-	
Hamilton South	**Large**	**7,300,000**	**1,065,432**	**6.64**	**23**	**Large**	**27,190,800**
Tauwhare	**Small**	**1,900,000**	**137,097**	**6.54**	**4**	**Medium**	**11,605,230**
Matangi	**Medium**	**3,150,000**	**214,697**	**7.41**	**-11**	**Medium**	**13,149,045**
Airport	**Medium**	**3,150,000**	**254,656**	**1.82**	**-5**	**Medium**	**3,229,590**
Ohaupo	**Small**	**1,900,000**	**110,904**	**8.64**	**-10**	**Small**	**7,738,848**
Cambridge & Hautapu	**Large**	**7,300,000**	**1,237,652**	**15.13**	**-26**	**Large**	**61,957,350**
Te Awamutu & Kihikhi		-	-	-	**0**	-	
Pirongia		-	-	-		-	
		37,000,000	**3,932,000**	**78.88**		**0**	**176,658,000**

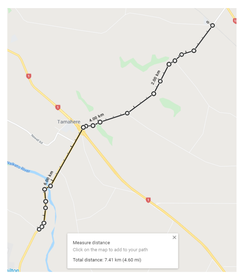


Includes 15% industrial allowance

Taupiri & Hopuhopu to Ngaruawahia: 7.1km



Matangi to Airport: 7.41 km



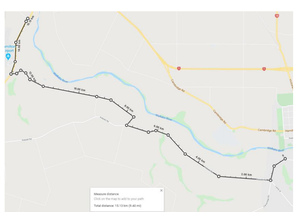
Includes 15% industrial allowance

Ngaruawahia to Pukete: 11km

Whatawhata to Dinsdale Interceptor: 8.7 km

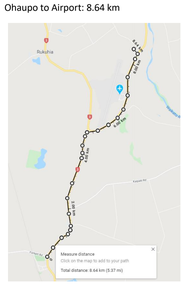
Te Kowhai to Rotokauri Interceptor: 5.9 km

Cambridge to Airport: 15.13 km



Airport to Peacockes Interceptor: 6.54 km (1.7km current farmland)

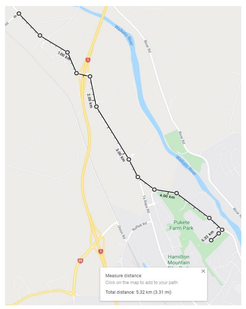
Ohaupo to Airport: 8.64 km



Tauwhare to Matangi: 6.65 km

Airport to WWTP: 1.82 km

Horotiu to Pukete: 5.32 km



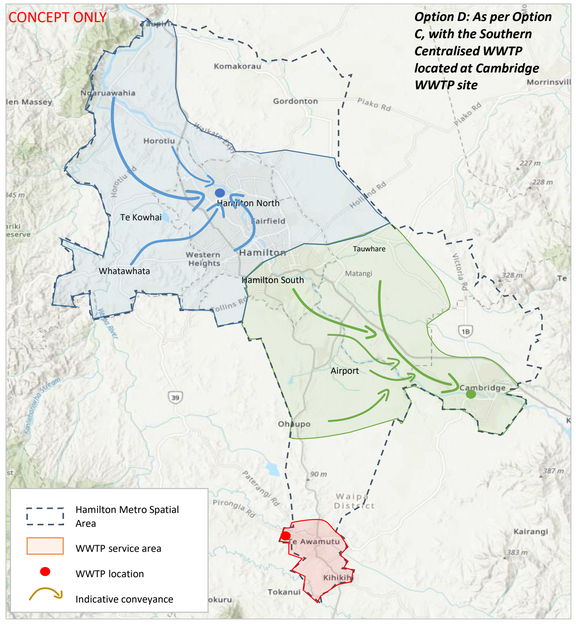
Option D

Population Projections

Area	2016	2045	2120	Flows (m³/d) (2045)	Flows (m³/d) (2120)	D	Treatment Plant Size 2045 (m³/d)	Treatment Plant Size 2120 (m³/d)	Type of plant (2045)	WWTP Capital Cost ($)	WWTP Operational Cost ($)	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static m)	Conveyance Size	Conveyance ($)
Taupiri & Hopuhopu	500	650	13000	187	3,738							Small	1,900,000	109,883	7.1	14	Small	6,359,470
Ngaruawahia	5,400	5,600	25000	1,610	7,188							Medium	3,150,000	278,545	5.68	10	Medium	10,079,160
Horotiu	850	1,500	10800	431	3,105							Medium	3,150,000	236,784	5.32	10	Medium	9,440,340
Te Kowhai	1,600	2,100	4000	604	1,150							Small	1,900,000	139,433	5.9	12	Medium	10,469,550
Whatawhata	2,800	2,000	4000	575	1,150							Small	1,900,000	145,964	8.7	19	Medium	15,438,150
Hamilton North		205,000																
East of Hamilton	160,000		345000	58,938	99,188		62,344	115,518	Large	277,680,000	15,586,094	-	-	-	-	0	-	-
Hamilton South		30,000	100000	8,625	28,750							Large	7,300,000	1,653,755	23.59	8	Large	96,601,050
Tauwhare	6,150	2,000	3000	575	863							Small	1,900,000	137,374	6.65	4	Medium	11,800,425
Matangi	2,300	2,800	4000	805	1,150							Medium	3,150,000	246,487	15.07	4	Medium	26,741,715
Airport		6,900	11400	1,984	3,278		21,022	51,578	Large	144,630,000	5,255,500	Medium	3,150,000	341,108	9.96	15	Medium	17,674,020
Ohaupo	530	720	1,000	207	288							Small	1,900,000	118,395	16	0	Small	14,331,200
Cambridge & Hautapu	17,200	30,700	60,000	8,826	17,250							-	-	-	-	0	-	
Te Awamutu & Kihikihi	13,800	19,300	50,000	5,549	14,375		5,549	14,375	Medium	32,688,000	2,330,475		-	-	-	0	-	
Pirongia	1,480	1,960	2,020	564	581		-	-	-	-			-	-			-	
							-	-	-	455,000,000	24,000,000	-	30,000,000	3,408,000	103.97	-	-	218,936,000

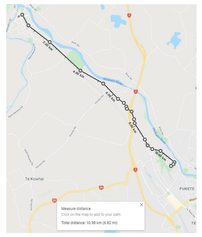
Includes 15% industrial allowance

Includes 15% industrial allowance



Taupiri & Hopuhopu to Ngaruawahia: 7.1km

Ngaruawahia to Pukete: 11km



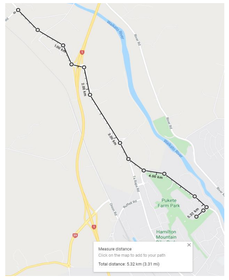
Whatawhata to Dinsdale Interceptor: 8.7 km

Tauwhare to Matangi: 6.65 km

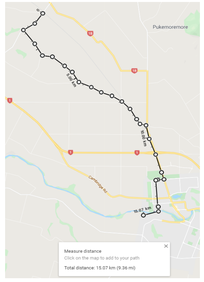
Cambridge to Airport: 15.13 km

Te Kowhai to Rotokauri Interceptor: 5.9 km

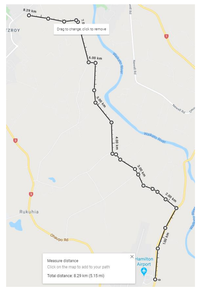
Horotiu to Pukete: 5.32 km



Matangi to Cambridge: 15.07 km



Peacockes to Airport: 8.29 km



Airport to (proposed) Ohaupo Interceptor: 9.96 km

Ohaupo to Cambridge: 16 km

Option E

Population Projections

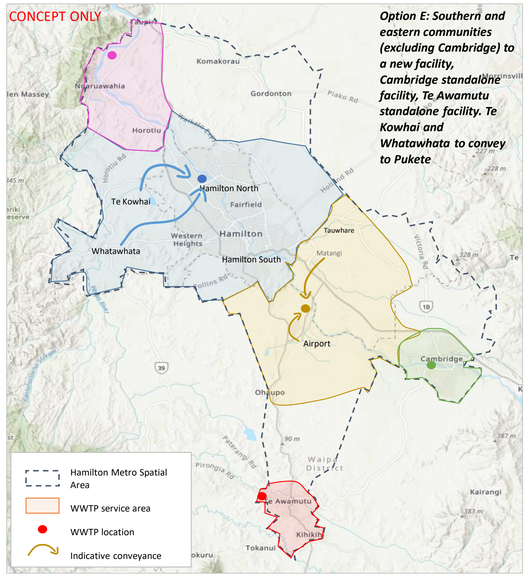
Area	2016	2045	2120				Flows (m^3/d) (2045)	Flows (m^3/d) (2120)	
Taupiri & Hopuhopu	500	650	13000				187	3,738	
Ngaruawahia	5,400	5,600	25000				1,610	7,188	
Horotiu	850	1,500	10800				431	3,105	
Te Kowhai	1,600	2,100	4000				604	1,150	
Whatawhata	2,800	2,000	4000				575	1,150	
Hamilton North									
East of Hamilton	160,000	235,000	345000				67,563	127,938	
Hamilton South			100000						
Tauwhare	6,150	2,000	3000				575	863	
Matangi	2,300	2,800	4000				805	1,150	
Airport		6,900	11400				1,984	3,278	
Ohaupo	530	720	1,000				207	288	
Cambridge & Hautapu	17,200	30,700	60,000				8,826	17,250	
Te Awamutu & Kihikihi	13,800	19,300	50,000				5,549	14,375	
Pirongia	1,480	1,960	2,020				564	581	

Includes 15% industrial allowance

Treatment Plant Size 2045 (m^3/d)	Treatment Plant Size 2120 (m^3/d)	Type of plant (2045)	WWTP Capital Cost ($)	WWTP Operational Cost ($)
2,228	14,030	Medium	23,592,000	935,813
68,741	130,238	Large	294,440,000	17,185,313
3,571	5,578	Medium	28,296,000	1,499,715
8,826	17,250	Medium	37,320,000	3,707,025
5,549	14,375	Medium	32,688,000	2,330,475
-	-	-		
-	-	-	417,000,000	25,659,000

Includes 15% industrial allowance

PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static m)	Conveyance Size	Conveyance ($)
Small	1,900,000	105,990	4.34	-8	Small	3,887,338.00
Small	1,900,000	121,002	5.77	-20	Medium	10,238,865.00
Small	1,900,000	138,952	5.9	10	Medium	10,469,550.00
Small	1,900,000	145,278	8.7	16	Medium	15,438,150.00
-	-	-	-	0	-	
Small	1,900,000	137,374	6.65	4	Medium	11,800,425.00
Medium	3,150,000	214,697	7.41	-11	Medium	13,149,045.00
Medium	3,150,000	261,759	1.82	4	Medium	3,229,590.00
Small	1,900,000	110,410	8.64	-16	Small	7,738,848.00
-	-	-	-	0	-	
-	-	-	-	0	-	
-	-	-	-		-	
-	18,000,000	1,236,000	49.23		0	75,952,000



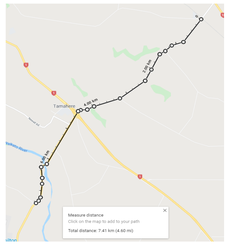
Taupiri & Hopuhopu to WWTP: 4.34 km

Airport to WWTP: 1.82 km

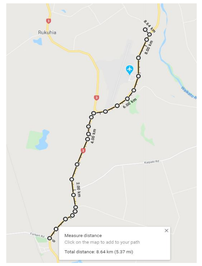
Whatawhata to Dinsdale Interceptor: 8.7 km

Te Kowhai to Rotokauri Interceptor: 5.9 km

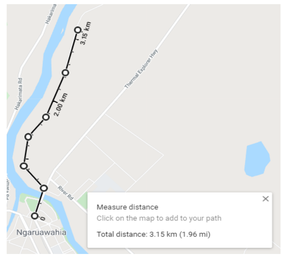
Matangi to Airport: 7.41 km



Ohaupo to Airport: 8.64 km



Ngaruawahia to WWTP: 3.15 km



Horotiu to Ngaruawahia: 5.77 km

Tauwhare to Matangi: 6.65 km

Option F

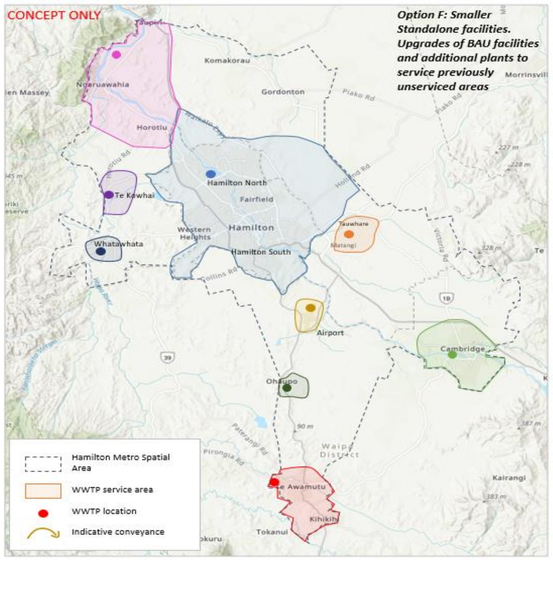
Population Projections

Area	2016	2045	2120			Flows (m^3/d) (2045)	Flows (m^3/d) (2120)	F.
Taupiri & Hopuhopu	500	650	13000			187	3,738	
Ngaruawahia	5,400	5,600	25000			1,610	7,188	
Horotiu	850	1,500	10800			431	3,105	
Te Kowhai	1,600	2,100	4000			604	1,150	
Whatawhata	2,800	2,000	4000			575	1,150	
Hamilton North								
East of Hamilton	160,000	235,000	345000			67,563	99,188	
Hamilton South			100000					
Tauwhare	6,150	2,000	3000			575	863	
Matangi	2,300	2,800	4000			805	1,150	
Airport		6,900	11400			1,984	3,278	
Ohaupo	530	720	1,000			207	288	
Cambridge & Hautapu	17,200	30,700	60,000			8,826	17,250	
Te Awamutu & Kihikhi	13,800	19,300	50,000			5,549	14,375	
Pirongia	1,480	1,960	2,020			564	581	

Includes 15% industrial allowance

Treatment Plant Size 2045 (m^3/d)	Treatment Plant Size 2120 (m^3/d)	Type of plant (2045)	WWTP Capital Cost ($)	WWTP Operational Cost ($)	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static)	Conveyance Size	Conveyance ($)	Land disposal irrigation costs	Land disposal land costs
					Small	1,900,000	105,990	4.34	-8	Small	3,887,338		
2,228	14,030	Medium	23,592,000	935,813									
					Small	1,900,000	121,002	5.77	-20	Medium	10,238,865		
604	1,150	Small	8,820,000	404,513		-	-	-				483,000	1,449,000
575	1,150	Small	8,410,000	385,250		-	-	-				460,000	1,380,000
								-					
67,563	99,188	Large	291,400,000	16,890,625				-					
								-					
1,380	2,013	Medium	18,816,000	579,600		-	-	-					
1,984	3,278	Medium	22,440,000	833,175		-	-	-					
207	288	Small	4,662,400	138,690		-	-	-				165,600	496,800
8,826	17,250	Medium	37,320,000	3,707,025		-	-	-					
5,549	14,375	Medium	32,688,000	2,330,475		-	-	-					
-	-	-	-			-	-	-					
-	-	-	449,000,000	26,206,000	-	4,000,000	227,000	10.11	-	-	14,127,000	Totals	

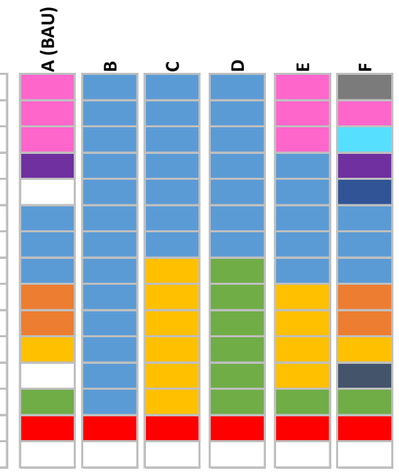
Includes 15% industrial allowance



ECISION MADE TO COMBINE NGARUAWAHIA, TAUPIRI AND HOPUHOPU FOR THIS OPTION

Population Projections

Area	2016	2020 Servicing	2045*	100 years+*	Source/Notes
Taupiri & Hopuhopu	500	Currently serviced	650	13000	MSP - split between Nga, Taupiri/Hopuhopu
Ngaruawahia	5,400	Currently serviced	5,600	25000	MSP - split between Nga, Taupiri/Hopuhopu
Horotiu	850	Currently serviced	1,500	10800	WGS
Te Kowhai	1,600	Small part of township serviced	2,100	4000	WGS
Whatawhata	2,800	Not currently serviced	2,000	4000	Population likely covers wider area than just township
Hamilton North	160,000	Currently serviced	235,000	345000	WWMP +MSP for infill (50,000)+R3 (20,000)+Southern Links (20,000)
East of Hamilton					
Hamilton South				100000	
Tauwhare	6,150	Tauwhare Pa only serviced	2,000	3000	WGS with reduction for area practical to service
Matangi	2,300	Matangi township only serviced	2,800	4000	WGS with reduction for area practical to service
Airport		Privately serviced - industrial	6,900	11400	Industrial population equivalent - Waipa advice 2019
Ohaupo	530	Not currently serviced	720	1,000	Sensitive area so little growth
Cambridge & Hautapu	17,200	Currently serviced	30,700	60,000	MSP
Te Awamutu & Kihikhi	13,800	Currently serviced	19,300	50,000	MSP
Pirongia	1,480	Not currently serviced	1,960	2,020	WMP
TOTAL	**212,610**		**311,230**	**633,220**	



* - excludes industrial PE unless noted

Option Cost Comparison 2120

	WWTP Capital Cost	Current Assets re-used	PS Capital Cost	Conveyance Cost	TOTAL CAPEX (-30% / +50%)
Option A (BAU)	$ 594,500,000	$ 128,000,000	$ 11,000,000	$ 42,000,000	$ 520,000,000
Option B	$ 643,310,000	$ 128,000,000	$ 47,000,000	$ 413,549,000	$ 976,000,000
Option C	$ 767,000,000	$ 128,000,000	$ 59,000,000	$ 318,270,000	$ 1,017,000,000
Option D	$ 765,000,000	$ 128,000,000	$ 51,000,000	$ 386,889,000	$ 1,075,000,000
Option E	$ 761,788,000	$ 128,000,000	$ 33,000,000	$ 107,450,000	$ 775,000,000
Option F	$ 808,000,000	$ 128,000,000	$ 11,000,000	$ 41,401,000	$ 733,000,000

	WWTP Annual Operational Cost		PS Annual Operational Cost	TOTAL OPEX	30 year NPV OPEX @6%	CAPEX+30Y NPV OPEX $M
Option A (BAU)	$ 46,230,000		$ 1,000,000	$ 47,230,000	$ 651,000,000	$1,171
Option B	$ 50,000,000		$ 7,287,000	$ 57,287,000	$ 789,000,000	$1,765
Option C	$ 45,368,000		$ 8,908,000	$ 54,276,000	$ 748,000,000	$1,765
Option D	$ 46,000,000		$ 8,997,000	$ 54,997,000	$ 758,000,000	$1,833
Option E	$ 39,129,000		$ 2,543,000	$ 41,672,000	$ 574,000,000	$1,349
Option F	$ 39,592,000		$ 930,000	$ 40,522,000	$ 558,000,000	$1,291

**This cost estimate has been developed solely for the purpose of comparing and evaluating options. They cannot be used 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 budget estimate is required.*

Option A (BAU)

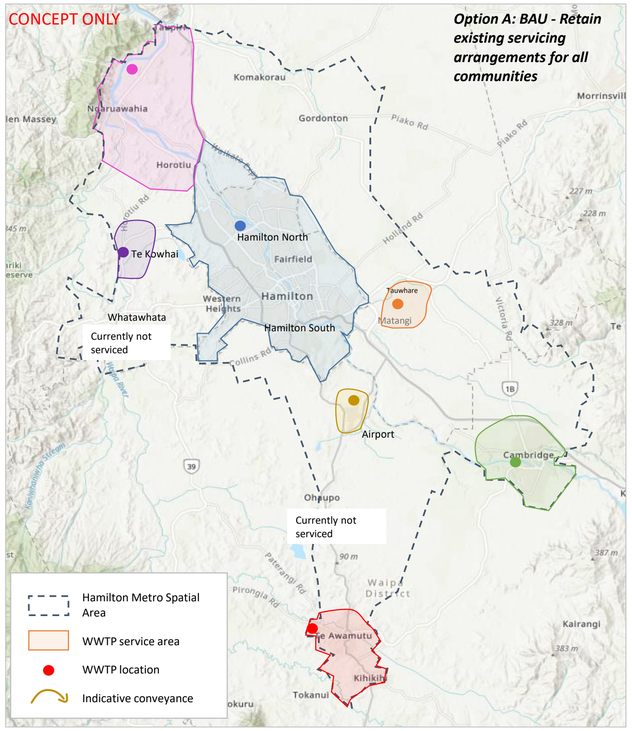
Population Projections

Area	2016	2045	2120				Flows (m³/d) (2120)	Flows (m³/d) (2120)	A	Treatment Plant Size 2120 (m³/d)	Treatment Plant Size 2120 (m³/d)	Type of plant (2120)	Capital Cost ($) 2120	WWTP Operational Cost ($) @2120	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static)	Conveyance Size	Conveyance ($)
Taupiri & Hopuhopu	500	650	13000				3,738	3,738							Large	7,300,000	584,804	4.34	-8	Large	17,772,300
Ngaruawahia	5,400	5,600	25000				7,188	7,188		14,030	14,030	Large	81,057,143	3,507,500							
Horotiu	850	1,500	10800				3,105	3,105							Medium	3,150,000	344,715	5.77	-20	Large	23,628,150
Te Kowhai	1,600	2,100	4000				1,150	1,150		1,150	1,150	Medium	14,170,000	483,000							
Whatawhata	2,800	2,000	4000				1,150	1,150		-	-	-									
Hamilton North																					
East of Hamilton	160,000	235,000	345000				127,938	127,938		127,938	127,938	Large	305,300,000	31,984,375							
Hamilton South			100000																		
Tauwhare	6,150	2,000	3000				863	863		2,314	2,314	Medium	19,980,000	972,038							
Matangi	2,300	2,800	4000				1,150	1,150													
Airport		6,900	11400				3,278	3,278		3,278	3,278	Medium	22,870,000	1,376,550							
Ohaupo	530	720	1,000				288	288		-	-	-	-	-							
Cambridge & Hautapu	17,200	30,700	60,000				17,250	17,250		17,250	17,250	Large	91,750,000	4,312,500							
Te Awamutu & Kihikhi	13,800	19,300	50,000				14,375	14,375		14,375	14,375	Large	82,242,857	3,593,750							
Pirongia	1,480	1,960	2,020				581	581		-		-									
										-	-	-	594,500,000	46,230,000	-	11,000,000	1,000,000	10.11	-28	0	42,000,000

Includes 15% industrial allowance

Includes 15% industrial allowance

Similar to current plant performance (no additional factors for plant improvements)



Option B

Population Projections

Area	2016	2045	2120				Flows (m^3/d) (2120)	Flows (m^3/d) (2120)	
Taupiri & Hopuhopu	500	650	13000				3,738	3,738	
Ngaruawahia	5,400	5,600	25000				7,188	7,188	
Horotiu	850	1,500	10800				3,105	3,105	
Te Kowhai	1,600	2,100	4000				1,150	1,150	
Whatawhata	2,800	2,000	4000				1,150	1,150	
Hamilton North East of Hamilton Hamilton South	160,000	235,000	345000 100000				127,938	127,938	
Tauwhare	6,150	2,000	3000				863	863	
Matangi	2,300	2,800	4000				1,150	1,150	
Airport		6,900	11400				3,278	3,278	
Ohaupo	530	720	1,000				288	288	
Cambridge & Hautapu	17,200	30,700	60,000				17,250	17,250	
Te Awamutu & Kihikhi	13,800	19,300	50,000				14,375	14,375	
Pirongia	1,480	1,960	2,020				581	581	

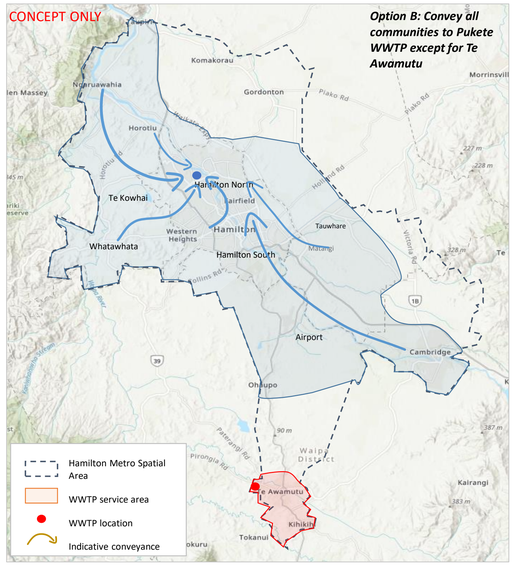
Includes 15% industrial allowance

Treatment Plant Size 2120 (m^3/d)	Treatment Plant Size 2120 (m^3/d)	Type of plant (2120)	Capital Cost ($) 2120	WWTP Operational Cost ($) @2120	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static m)	Conveyance Size	Conveyance ($)
					Large	7,300,000	662,662	7.1	14	Large	29,074,500
					Large	7,300,000	989,098	5.68	10	Large	23,259,600
					Large	7,300,000	880,982	5.32	10	Large	21,785,400
					Medium	3,150,000	242,134	5.9	12	Medium	10,469,550
					Medium	3,150,000	259,428	8.7	19	Medium	15,438,150
182,051	**182,051**	**Large**	**528,170,000**	**45,512,688**	-			-	**0**	-	
					Medium	3,150,000	221,061	6.65	4	Medium	11,800,425
					Medium	3,150,000	222,378	4.52	-16	Medium	8,020,740
					Medium	3,150,000	403,362	7.77	-5	Large	31,818,150
					Small	1,900,000	113,994	6.18	-10	Small	5,535,426
					Large	7,300,000	3,291,215	31.3	-26	Large	256,347,000
14,375.00	**14,375.00**	**Large**	**115,140,000**	**3,593,750**		-	-	-	**0**	-	
-	-	-			Small	-	-	-		-	
-	-	-	**643,310,000**	**50,000,000**	-	**47,000,000**	**7,287,000**	**89.12**		**0**	**413,549,000**

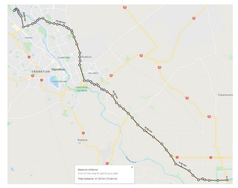
Includes 15% industrial allowance

CONCEPT ONLY

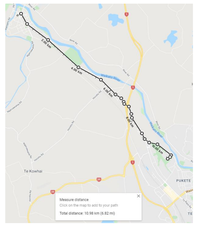
Option B: Convey all communities to Pukete WWTP except for Te Awamutu



Cambridge to Pukete: 31.3 km

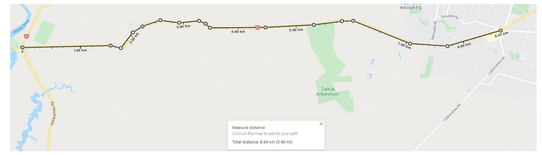


Ngaruawahia to Pukete: 11km



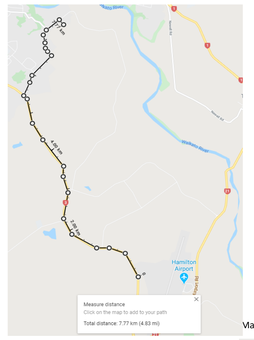
Taupiri & Hopuhopu to Ngaruawahia: 7.1km

Whatawhata to Dinsdale Interceptor: 8.7 km

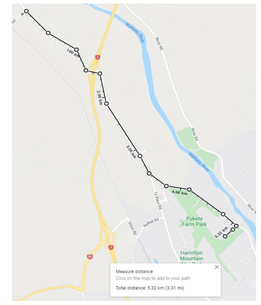


Te Kowhai to Rotokauri Interceptor: 5.9 km

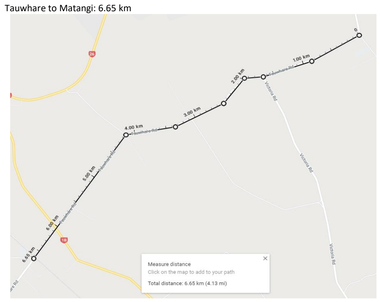
Airport to Peacockes Interceptor: 7.77 km



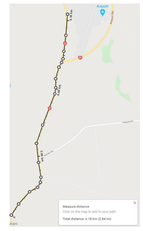
Horotiu to Pukete: 5.32 km



Tauwhare to Matangi: 6.65 km



Ohaupo to Airport: 6.18 km



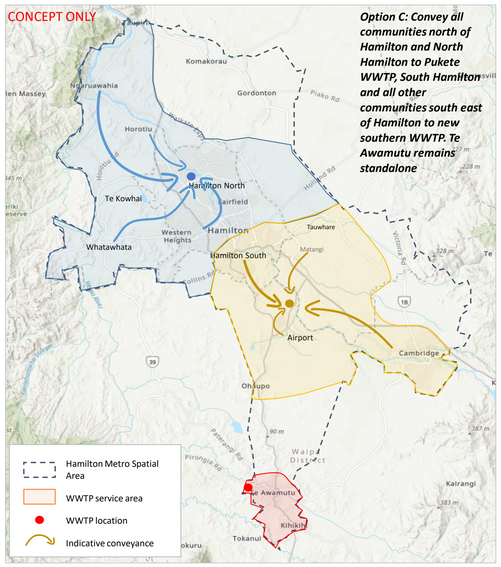
Viatangi to SH1B Intersection: 4.52 km

Option C

Population Projections

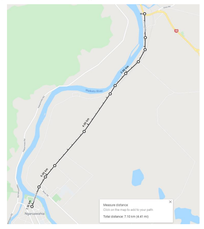
Area	2016	2045	2120			Flows (m^3/d) (2120)	Flows (m^3/d) (2120)	C
Taupiri & Hopuhopu	500	650	13000			3,738	3,738	
Ngaruawahia	5,400	5,600	25000			7,188	7,188	
Horotiu	850	1,500	10800			3,105	3,105	
Te Kowhai	1,600	2,100	4000			1,150	1,150	
Whatawhata	2,800	2,000	4000			1,150	1,150	
Hamilton North East of Hamilton	160,000	205,000	345000			99,188	99,188	
Hamilton South		30,000	100000			28,750	28,750	
Tauwhare	6,150	2,000	3000			863	863	
Matangi	2,300	2,800	4000			1,150	1,150	
Airport		6,900	11400			3,278	3,278	
Ohaupo	530	720	1,000			288	288	
Cambridge & Hautapu	17,200	30,700	60,000			17,250	17,250	
Te Awamutu & Kihikihi	13,800	19,300	50,000			14,375	14,375	
Pirongia	1,480	1,960	2,020			581	581	

Treatment Plant Size 2120 (m^3/d)	Treatment Plant Size 2120 (m^3/d)	Type of plant (2120)	Capital Cost ($) 2120	WWTP Operational Cost ($) @2120	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static m)	Conveyance Size	Conveyance ($)
115,518	115,518	Large	402,020,000	28,879,375	Large	7,300,000	662,662	7.1	14	Large	29,074,500
					Large	7,300,000	989,098	5.68	10	Large	23,259,600
					Large	7,300,000	880,982	5.32	10	Large	21,785,400
					Medium	3,150,000	242,134	5.9	12	Medium	10,469,550
					Medium	3,150,000	259,428	8.7	19	Medium	15,438,150
					-			-	0	-	
51,578	51,578	Large	249,820,000	12,894,375	Large	7,300,000	2,699,774	6.64	23	Large	54,381,600
					Medium	3,150,000	220,646	6.54	4	Medium	11,605,230
					Medium	3,150,000	239,210	7.41	-11	Medium	13,149,045
					Large	7,300,000	525,518	1.82	-5	Large	7,452,900
					Small	1,900,000	117,090	8.64	-10	Small	7,738,848
					Large	7,300,000	2,070,509	15.13	-26	Large	123,914,700
14,375	14,375	Large	115,140,000	3,593,750		-	-	-	0	-	
-						-	-	-		-	
-	-	-	767,000,000	45,368,000	-	59,000,000	8,908,000	78.88		0	318,270,000



Includes 15% industrial allowance

Taupiri & Hopuhopu to Ngaruawahia: 7.1km



Ngaruawahia to Pukete: 11km

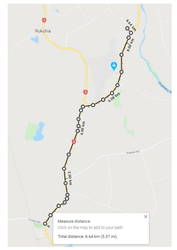
Whatawhata to Dinsdale Interceptor: 8.7 km

Te Kowhai to Rotokauri Interceptor: 5.9 km

Matangi to Airport: 7.41 km

Cambridge to Airport: 15.13 km

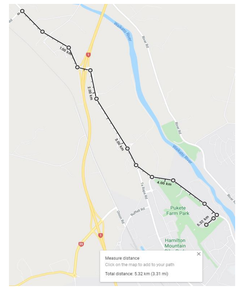
Ohaupo to Airport: 8.64 km



Tauwhare to Matangi: 6.65 km

Airport to WWTP: 1.82 km

Horotiu to Pukete: 5.32 km



Option D

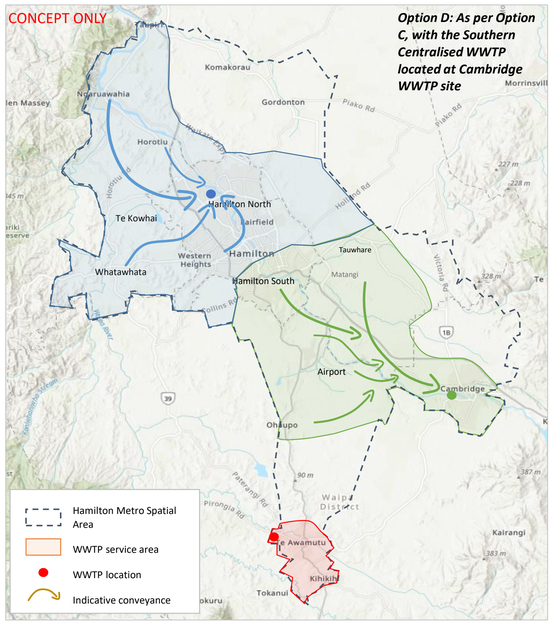
Population Projections

Area	2016	2045	2120
Taupiri & Hopuhopu	500	650	13000
Ngaruawahia	5,400	5,600	25000
Horotiu	850	1,500	10800
Te Kowhai	1,600	2,100	4000
Whatawhata	2,800	2,000	4000
Hamilton North		205,000	
East of Hamilton	160,000		345000
Hamilton South		30,000	100000
Tauwhare	6,150	2,000	3000
Matangi	2,300	2,800	4000
Airport		6,900	11400
Ohaupo	530	720	1,000
Cambridge & Hautapu	17,200	30,700	60,000
Te Awamutu & Kihikihi	13,800	19,300	50,000
Pirongia	1,480	1,960	2,020

Flows (m^3/d) (2120)	Flows (m^3/d) (2120)	D	Treatment Plant Size 2120 (m^3/d)	Treatment Plant Size 2120 (m^3/d)	Type of plant (2120)	Capital Cost ($) 2120	WWTP Operational Cost ($) @2120	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static m)	Conveyance Size	Conveyance ($)
3,738	3,738							Large	7,300,000	662,662	7.1	14	Large	29,074,500
7,188	7,188							Large	7,300,000	989,098	5.68	10	Large	23,259,600
3,105	3,105							Large	7,300,000	880,982	5.32	10	Large	21,785,400
1,150	1,150		115,518	115,518	Large	402,020,000	28,879,375	Medium	3,150,000	242,134	5.9	12	Medium	10,469,550
1,150	1,150							Medium	3,150,000	259,428	8.7	19	Medium	15,438,150
99,188	99,188							-	-	-	-	0	-	-
28,750	28,750							Large	7,300,000	4,660,851	23.59	8	Large	193,202,100
863	863							Medium	3,150,000	221,061	6.65	4	Medium	11,800,425
1,150	1,150		51,578	51,578	Large	247,820,000	12,894,375	Medium	3,150,000	284,624	15.07	4	Medium	26,741,715
3,278	3,278							Large	7,300,000	668,353	9.96	15	Large	40,786,200
288	288							Small	1,900,000	127,494	16	0	Small	14,331,200
17,250	17,250							-	-	-	-	0	-	
14,375	14,375		14,375	14,375	Large	115,140,000	3,593,750		-	-	-	0	-	
581	581		-	-	-	-			-	-	-		-	
			-	-	-	765,000,000	46,000,000	-	51,000,000	8,997,000	103.97	-	-	386,889,000

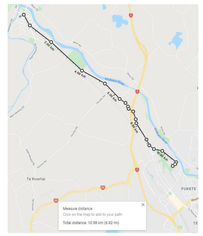
Includes 15% industrial allowance

Includes 15% industrial allowance

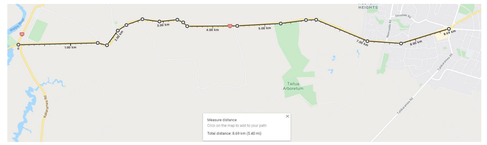


Taupiri & Hopuhopu to Ngaruawahia: 7.1km

Ngaruawahia to Pukete: 11km



Whatawhata to Dinsdale Interceptor: 8.7 km

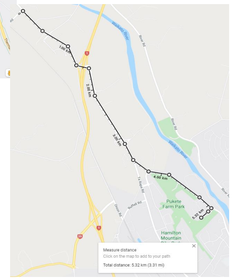


Tauwhare to Matangi: 6.65 km

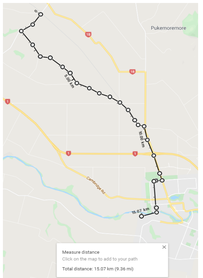
Cambridge to Airport: 15.13 km

Te Kowhai to Rotokauri Interceptor: 5.9 km

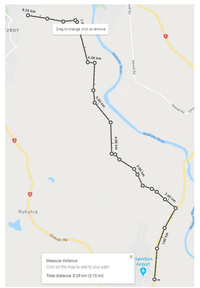
Horotiu to Pukete: 5.32 km



Matangi to Cambridge: 15.07 km



Peacockes to Airport: 8.29 km



Airport to (proposed) Ohaupo Interceptor: 9.96 km

Ohaupo to Cambridge: 16 km

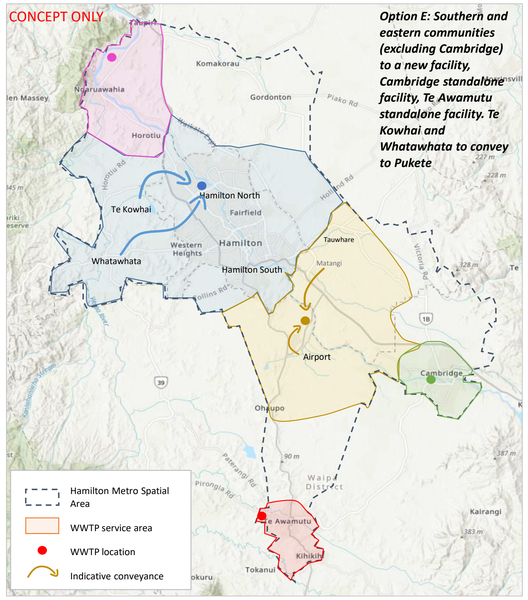
Option E

Population Projections

Area	2016	2045	2120				Flows (m^3/d) (2120)	Flows (m^3/d) (2120)	E	Treatment Plant Size 2120 (m^3/d)	Treatment Plant Size 2120 (m^3/d)	Type of plant (2120)	Capital Cost ($) 2120	WWTP Operational Cost ($) @2120	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static m)	Conveyance Size	Conveyance ($)
Taupiri & Hopuhopu	500	650	13000				3,738	3,738							Large	7,300,000	584,804	4.34	-8	Large	17,772,300.00
Ngaruawahia	5,400	5,600	25000				7,188	7,188		14,030	14,030	Large	113,480,000	3,507,500							
Horotiu	850	1,500	10800				3,105	3,105							Medium	3,150,000	344,715	5.77	-20	Large	23,628,150.00
Te Kowhai	1,600	2,100	4000				1,150	1,150							Medium	3,150,000	241,219	5.9	10	Medium	10,469,550.00
Whatawhata	2,800	2,000	4000				1,150	1,150							Medium	3,150,000	258,056	8.7	16	Medium	15,438,150.00
Hamilton North										101,488	101,488	Large	371,970,000	25,371,875							
East of Hamilton	160,000	235,000	345000				99,188	99,188							-	-	-	-	0	-	
Hamilton South			100000																		
Tauwhare	6,150	2,000	3000				863	863							Medium	3,150,000	221,061	6.65	4	Medium	11,800,425.00
Matangi	2,300	2,800	4000				1,150	1,150		5,578	5,578	Medium	32,748,000	2,342,550	Medium	3,150,000	239,210	7.41	-11	Medium	13,149,045.00
Airport		6,900	11400				3,278	3,278							Large	7,300,000	537,253	1.82	4	Large	7,452,900.00
Ohaupo	530	720	1,000				288	288							Small	1,900,000	116,403	8.64	-16	Small	7,738,848.00
Cambridge & Hautapu	17,200	30,700	60,000				17,250	17,250		17,250	17,250	Large	128,450,000	4,312,500		-	-	-	0	-	
Te Awamutu & Kihikhi	13,800	19,300	50,000				14,375	14,375		14,375	14,375	Large	115,140,000	3,593,750		-	-	-	0	-	
Pirongia	1,480	1,960	2,020				581	581		-	-	-				-	-	-		-	
										-	-	-	761,788,000	39,129,000	-	33,000,000	2,543,000	49.23		0	107,450,000

Includes 15% industrial allowance

Includes 15% industrial allowance



Taupiri & Hopuhopu to WWTP: 4.34 km

Whatawhata to Dinsdale Interceptor: 8.7 km

Ngaruawahia to WWTP: 3.15 km

Horotiu to Ngaruawahia: 5.77 km

Te Kowhai to Rotokauri Interceptor: 5.9 km

Airport to WWTP: 1.82 km

Matangi to Airport: 7.41 km

Ohaupo to Airport: 8.64 km

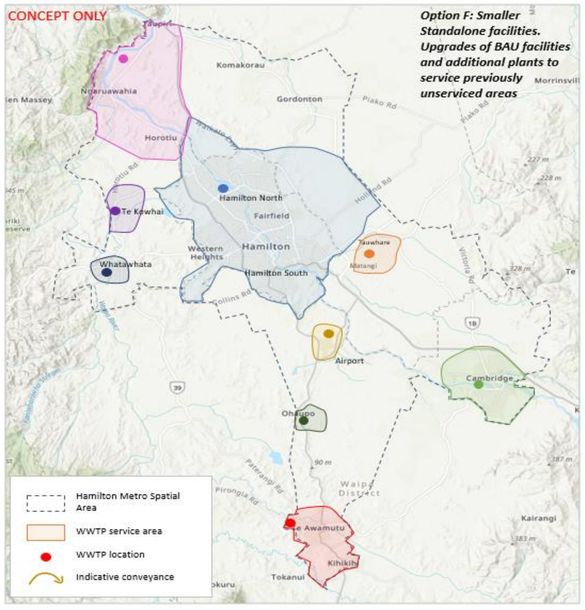
Tauwhare to Matangi: 6.65 km

Option F

Population Projections

Area	2016	2045	2120	Flows (m^3/d) (2045)	Flows (m^3/d) (2120)		Treatment Plant Size 2120 (m^3/d)	Treatment Plant Size 2120 (m^3/d)	Type of plant (2120)	Capital Cost ($) 2120	WWTP Operational Cost ($) @2120	PS Size	PS Capital Cost ($)	PS Operational Cost ($)	Conveyance (km)	Elevation Change (Static)	Conveyance Size	Conveyance ($)	Land disposal irrigation costs	Land disposal land costs
Taupiri & Hopuhopu	500	650	13000	3,738	3,738		14,030	14,030	Large	113,480,000	3,507,500	Large	7,300,000	584,804	4.34	-8	Large	17,772,300		
Ngaruawahia	5,400	5,600	25000	7,188	7,188															
Horotiu	850	1,500	10800	3,105	3,105							Medium	3,150,000	344,715	5.77	-20	Large	23,628,150		
Te Kowhai	1,600	2,100	4000	1,150	1,150		1,150	1,150	Medium	17,004,000	483,000		-	-	-				-	-
Whatawhata	2,800	2,000	4000	1,150	1,150		1,150	1,150	Medium	17,004,000	483,000		-	-	-				-	-
Hamilton North															-					
East of Hamilton	160,000	235,000	345000	99,188	99,188		99,188	99,188	Large	366,890,000	24,796,875				-					
Hamilton South			100000												-					
Tauwhare	6,150	2,000	3000	863	863		2,013	2,013	Medium	17,004,000	845,250		-	-	-					
Matangi	2,300	2,800	4000	1,150	1,150								-	-	-					
Airport		6,900	11400	3,278	3,278		3,278	3,278	Medium	27,444,000	1,376,550		-	-	-					
Ohaupo	530	720	1,000	288	288		288	288	Small	4,920,000	192,625		-	-	-				230,000	690,000
Cambridge & Hautapu	17,200	30,700	60,000	17,250	17,250		17,250	17,250	Large	128,450,000	4,312,500		-	-	-					
Te Awamutu & Kihikhi	13,800	19,300	50,000	14,375	14,375		14,375	14,375	Large	115,140,000	3,593,750		-	-	-					
Pirongia	1,480	1,960	2,020	581	581		-	-	-	-			-	-	-					
				Includes 15% industrial allowance			-	-	-	808,000,000	39,592,000	-	11,000,000	930,000	10.11	-	-	41,401,000	Totals	
							Includes 15% industrial allowance													

NOTE DECISION MADE TO COMBINE NGARUAWAHIA, TAUPIRI AND HOPUHOPU FOR THIS OPTION



Appendix E – Workshop outcomes

Waikato Sub-Regional Three Waters Project
Metro Area Wastewater Feasibility Assessment
– 28 January 2020

Date & Time:	28th January 2020, 9am – 12pm
Location:	Hudson 2, Jet Park Hotel, Hamilton Airport
Workshop attendees:	Dian Verbeek (HCC), Mark Walmsely (Waipa DC), Melissa Allfrey (Waipa DC), Pavarti Patel (HCC), Lucie Rutherfurd (Ngati Tamaoho/NKAOTW), Evan Vaughters (HCC), Kahurimu Flavell (HCC), Jim Bradley (Stantec), Ken Tremaine (Futureproof), Marie McIntyre (Waipa DC), Sharon Danks (Watercare), Chris Allen (Watercare), Mark Curtis (Waipa DC), Martin Mould (Waipa DC), Andrew Parsons (HCC), Rae Simpson (HCC), Brent Sinclair (WRC), Bruce McAuliffe (WRC), Gavin Donald (GMD Consultants + Waikato Tainui), Karaitiana Tamatea (Ngati Korori Kahukura – Nga koru o te waka), Laise Harris (Raukawa), David Totman (Waipa DC), Vishal Ramduny (Waikato DC), Ryan Crawford (HCC), Poto Davies (Ngati Koroki Kahukura – CWWTP), Luke O'Dwyer
Apologies:	Sarah Poleschek (DIA), Wikitoria Tane (Waikato-Tainui), Maire Porter (HCC), Tony Denton (HCC), Sven Erickson (HCC), Rawiri Bidois (Te Haa O Te Whenua o Kirikiriroa), Lisa Gardiner (Ngaati Hana), Sarah Pitches (Waipa DC), Ian Cathcart (Waikato DC), Manaaki Nepia (Waikato-Tainui)
Workshop facilitators, Technical Team & contributors:	Tipene Wilson (Maximize Consulting) / Jackie Colliar (HCC) John Crawford (Beca), Kate Johnson (GHD)
Pre-circulated materials	Agenda and briefing materials, Concept Option Diagrams

Mihimihi / Karakia

Karaitiana Tamatea

Whakawhanaungatanga / Introductions

Tipene Wilson explained the programme for the day and attendees introduced themselves

Overview of Project & Workshop

Purpose of the day

The purpose of the high-level wastewater servicing assessment and the objectives of the workshop were outlined. The purpose of the high-level wastewater servicing assessment is to provide an evidence base for the options that should be considered in further detail as part of the Sub-Regional Study and associated projects.

The objectives of the workshop are to:

- *Identify and confirm wastewater servicing options for the Waikato-Hamilton-Waipa Metro Area that should be included in the high-level assessment*

- *Discuss and agree the method that should be used for the assessment*
- *Develop and confirm the criteria that should be used for the assessment*
- *Agree next steps for completing the assessment*

The focus of the workshop and the high-level assessment is for the Waikato-Hamilton-Waipa Metro Area (Taupiri to Cambridge/Te Awamutu; Whatawhata to Tauwhare) was emphasized. The assessment is not about Cambridge wastewater consenting, although that is a consideration in the timing of the assessment.

Overview of Sub-Regional Three Waters Project

Overview of the Sub-Regional Three Waters Project provided for those not familiar with the project to set the context for the workshop before focussing in on the Metro Area. Key points included:

- How the project relates to the corridor plan initiative
- What the project seeks to achieve:
    - deliver an agile and adaptive intergenerational 3-waters infrastructure investment plan unconstrained by territorial boundaries
    - give effect to the Vision and Strategy for the Waikato River
    - be a catalyst for paradigm shift in 3 waters management
    - exemplify collaboration
    - support tangata whenua aspirations
    - identify candidate projects to showcase and pilot emergent central govt. tools
    - inform Metro Spatial Plan and support delivery of Hamilton-Auckland Corridor Plan growth management objectives
- Key principles agreed by the collective as part of Phase 1:
    - 10, 30 and 100-year planning horizons
    - Integrated, holistic and boundary-less approach that delivers the best for river and best for community outcomes.
    - Three waters infrastructure (water supply, wastewater and stormwater) but excluding rural drainage and flood management
    - Critical linkages with H2A spatial planning, blue/green network and transport corridor initiatives
    - The study focus area is the Waikato River catchment within the Future Proof area but within the context of the whole Waikato River Catchment.
    - The project vision is Te Ture Whaimana. The key objective is to give effect to the vision.
      Overall project phasing and outcomes to date i.e. Three phase project. Phase 1 largely complete. Phase 2 currently being initiated. Phase 3 is implementation phase.

The Metro Spatial Area

The metro spatial area was defined geographically (Taupiri to Cambridge/Te Awamutu; Whatawhata to Tauwhare). Luke O'Dwyer (Director of the Metro Spatial Plan Initiative being delivered through the corridor plan) provided an update/overview of the population target and distribution approach being adopted for the Metro Spatial Plan. The intention is to plan for up to 500,000 people. The current population is 215,000. The high-level distribution assumptions are that 70% of the additional 285,000 people will be focussed in the City (i.e. 200,000 people) and the remaining 30% will be shared across other metro area nodes.

Two growth/population scenarios are proposed for the high-level assessment. Determining the actual population and distribution is an iterative process. Informed by spatial planning and constraints analysis, serviceability, ability to achieve vision and objectives.

Proposing that a baseline scenario is used for nearer term outlook e.g. Future Proof, or Metro Spatial Plan, and that a "stretch" scenario is tested, e.g. what could happen in 100 years' time.

Feedback invited on the scenarios that should be used for this assessment. They won't be perfect and will be refined through the Phase 2 work but are needed to allow a comparative assessment.

John Crawford provided an overview of the current wastewater servicing provided within the metro area, some of the challenges associated with those facilities/solutions.

Discussion

- Question on highly productive soil constraints and how that was being considered as part of the metro area? A solid evidence base would take a more spatially focussed approach that looks at constraints, opportunities, impacts etc. Can't see that in the proposed approach to the assessment.
- How do we base things on evidence in a time of deep uncertainty and where there are so many unknowns? For example, climate change impacts? Need to make assumptions. At this stage we're doing a course assessment so won't have all the information needed to undertake a detailed analysis right now. That will come later.
- Emphasis on the importance of economic development and long-term employment to the picture and ensuring that we are providing adequate servicing for those activities. This entire project is a good chance to improve the long-term well-being of the Waikato.
- There are potential disrupters to the land use assumptions that will need to be factored in somehow, including potential development in areas currently unplanned for such as east of the expressway.

WORKSHOP SESSION #1: OPTION IDENTIFICATION

The first workshop session was to review the concept options included in the pre-workshop briefing material, consider those options, and identified any additional options that should be considered.

No option should be discounted at this stage. As this is a high-level study, at this early stage the basis of the options tabled in the briefing material is largely driven by existing and potential growth areas, coverage and distribution of sewered areas and their associated treatment plants within the Waikato-Hamilton-Waipa Metro Area.

Consideration has not been given to the receiving environments for treated wastewater discharge, reuse options/solutions or other factors that require a more detailed analysis. Steps to include these considerations will happen at a later phase when there is a broadly established direction in place that is agreed upon by the project stakeholders. However, potential disposal options associated with different treatment options is proposed to be factored into the assessment and will be discussed in Workshop Session #2.

The workshop was divided into four groups. Copies of the concept option diagrams and briefing papers were provided to each group.

Feedback from the workshop is summarised below:

Feedback on the Pre-Circulated Concepts

- **Change Option F, G, H** service area for a new southern facility to include part of Hamilton
- **Consider minor variation to Options B, C, D, E, F** that assume standalone facilities for Tauwhare/Matangi and Whatawhata/Te Kowhai.

New Option:

Suggests conveying the wastewater western areas to the Hamilton Pukete Plant with discharge treated wastewater into Waipa upstream of new water take.

- Servicing Pirongia (growth nodes)
- Sending Ohaupo wastewater south to the Te Awamutu plant

New Option:

- East and Western servicing options for Hamilton.
- Retain the existing wastewater plants at Ngaruwahia and Te Awamutu

New Option:

- One new waste water treatment plant that services full metro spatial area.

New Option:

- Ngaruawahia services for all areas to the north of Hamilton (Taupiri, Hopuhopu, Ngaruawahia)
- Horotiu conveyed to Pukete Plant
- Te Kowhai/Whatawhata package plants

Further Feedback:

- Full re-use and recycling, minimising discharge should be a key principle
- Full self-contained solutions for new areas
- Technology selection will be key:
- Keep Tauwhare and Matangi as separate small facility
- Intensification. Influence on urban form.
- Funding and financing need to be considered.
- Stage adaptability.
- Another option considers the viability of Pirongia should it be in or should it be out?
- Minimise discharge and maximise reuse and quality.
- Potential disposal routes that should be considered in the future were noted and included river discharge , land application , aquifer injection , ocean discharge , various types of reuse including potable reuse and various combinations of these.
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WORKSHOP #2: HIGH LEVEL ASSESSMENT METHOD & CRITERIA

Outline of the proposed assessment method provided:

- High level comparative assessment
- Largely qualitative given timeframes that the assessment needs to be completed in and the level of information available at this stage
- Propose to use a traffic light MCA approach
- One of the objectives is to compare centralised vs de-centralised solutions relative to each other. Further detailed assessments will occur as part of the sub-regional three waters project and any "projects that come out of the study".
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Participants were comfortable with the use of a traffic light mutli-criteria analysis (MCA) to be used for the purpose of this high-level assessment.

Some potential themes/categories were outlined as a starting point for discussion and

workshopping:

- Environmental Improvement Capability
- Whole of life costs
- Potential disposal techniques
- Cultural Benefits/impacts
- Flexibility/Scalability

Feedback on potential criteria:

Public Health Protection

- Health and Safety Risk on public and operators
- Safe water and Sanitation
- Management efficiency in terms of air discharges, sludges, biosolids disposal, reuse and treated wastewater discharge

Natural Environment Improvement Capability

- Does the Vision & Strategy align with the goals of the criteria?
- What options present the best environmental standards?
- What abilities are there to improve water quality

Potential Disposal/Eco-system re-entry

- What is the Risk (consenting, wastewater discharge, constructability) associated with various options?
  Request to change terminology from disposal to eco-system re-entry just as has been done with changing Wastewater Treatment Plant terminology to Resource Recovery Facility.

Cultural Benefits/Impacts

- Community and political buy in
- Social acceptability especially with re-use (Both criteria could be captured under a separate category or incorporated as part of cultural benefits and impacts)
- Maximise wellness
- Propose to seek direct input from iwi/mana whenua on the appropriate criteria that could be used for the assessment.

Flexibility/Scaleability

- Economies of scale
- Modular by design
- Proven reliability of technology
- Alignment with planned policy and appropriate practice

Whole of life costs

- Capital and Operational
- Co-operational
- Implications for supporting future growth
- Impacts on existing infrastructure

Sustainability

- Will issues regarding legacy be resolved?

- Resource recovery
- Technology
- Climate Change
- Resource Recovery
- Political Resilience
- EQ, Security and Supply
- Inter-generated Equity
- Resiliency (could be captured as part of sustainability or technical risk)

Technical and Constructability risks and opportunities

- Topography and Geology
- Land Take
- Technology Opportunity
- Criticality and timing
- Engineering risks
- Resiliency (could be captured as part of sustainability or technical risk)

Other Feedback

Need to draw from the work that's been completed in Phase 1. While acknowledging that this is a high-level assessment.

It should also be noted that the criteria descriptions will align with previously discussed and approved best for river objectives. Best for river objectives are based on the Vision and Strategy and giving effect to the Vision and Strategy.

Next steps & Key Assessment assumptions

Facilitators thanked everyone for their participation in the workshop and provided an overview of the next steps for the project.

Now that options and criteria have been developed, the next step is to undertake the options assessment with the criteria developed in this workshop.

This options assessment will involve, developing technical inputs for the assessment, undertake quantitative and qualitative analysis, and assessment using the MCA tool.

There are several key assumptions and technical inputs required for the Options Assessment.

- Two growth scenarios will be tested as part of the assessment:
  - Future Proof population and land use growth assumptions
  - An "ultimate" development capacity assessment and associated land use growth assumptions. This will draw on the Metro Spatial Planning work, specific work completed by various councils and possible land use changes that could happen in the next 100 years.
- How well options can adapt to each growth scenario will be tested as part of the Multi-Criteria Assessment (MCA)
- High level capital and operational costs developed using generalised cost curves will be used
- Assessment will assume standardised the quality of treatment for different types of plants.
- Location of potential new sites will be selected for the purpose of the study only. Actual locations will be the subject of much more detailed investigations at a project level and are outside the scope of this project. This will allow conveyance lengths etc to be estimated for the assessment.
- The potential eco system re-entry techniques of each option will be considered from a flexibility perspective rather than assessing all of the various treatment and ecosystem re-entry combinations at this stage. i.e. does the option provide the opportunity for re-

use, resource recovery, land and/or water discharges etc.

The next hui will present the draft assessment for the group to feed into, review and confirm. Ahead of the workshop, separate focussed korero with iwi/mana whenua will be undertaken. The next hui will be in around 4 – 5 weeks.

Summary of next steps:

- Meet with Te Haa o te Whenua o Kirikiriroa (THAWK) and Waikato-Tainui to provide summary of outcomes of this workshop and seek input.
- Prepare and release workshop record
- Review feedback from the workshop, consolidate options and refine criteria to be used for the assessment.
- Release post workshop package with proposed options and criteria to be considered and used in the assessment.
- Follow up workshop for early March 2020 to review draft assessment.
- Meet with iwi/mana whenua for focussed korero ahead of the workshop

Karakia Whakamutunga – Karaitiana Tamatea

Workshop closed 12.30 pm

Attachments:

1. Presentation
2. Concept Option Diagrams

Waikato Sub-Regional Three Waters Investigation Project – Scoping Workshop
Workshop Record – 10 March 2020

Date & Time:	10th March 2019, 9:30am – 1pm
Location:	Manu Korero Building, Hopuhopu Sports Park and Conference Centre, Old Taupiri Rd
Workshop attendees:	Mark Curtis (Waipa DC), Michelle White (Future Proof), Mark Tamura (WRC), Bruce McAuliffe (WRC), Sharon Danks (WSL), Mark Bourne (Watercare), Chris Allen (Watercare), Rae Simpson (HCC), David Totman (Waipa DC), Dian Verbeek (HCC), Parvati Patel (HCC), Sven Eriksen (HCC), Andrew Parsons (HCC), Rawiri Bidois (THAWK), Rangiuia Riki (THAWK), Raiha Gray (THAWK), Manjit Devgun (HCC), Vishal Ramduny (WDC), Evan Vaughters (HCC), Mark Walmsley (Waipa DC), Dawn Inglis (Waipa DC), Martin Mould (Waipa DC), Zac Rutherford-Sirett (Ngati Tamaoho), Lucie Rutherford (Ngati Tamaoho/Nga Karu Atua o Te Waka), Marie McIntyre (Waipa DC), John Crawford (BECA), Kate Jackson (GHD), Manaaki Nepia (Waikato Tainui), Gannin Ormsby (Maniapoto Maori Trust Board), Ryan Crawford (HCC), Poto Davies (NKK – CWWTP)
Apologies:	Hugh Keane (WRC), Karaitiana Tamatea (NKAOTW), Sonny Karena (THAWK), Maire Porter (HCC), Jim Bradley (Stantec), Sarah Polaschek (DIA), Muna Wharawhara (HCC), Tremaine Murray (Maniapoto), Darren Teulon (HCC), Ken Tremaine (Future Proof)
Workshop facilitator:	Tipene Wilson (Maximize Consulting)
Pre-circulated materials:	Agenda and briefing materials

Mihimihi / Whakatau - Tipene

Whakawhanaungatanga / Introductions
Tipene Wilson explained the programme for the day
Karakia - Gannin

Part 1 a) Recap and Overview (Presentation attached)

Jackie Colliar introduced new members to the group – Mark Bourne (Watercare), Rangiuia Riki (THAWK), Raiha Grav (THAWK), Rawiri Bidois and Dawn Inglis (Waipa DC). Jackie introduced the workshop covering the workshop's objectives listed below (refer slides).

- Overview and update of the Metro Spatial Plan Imitative.
- Consideration and feedback on draft options assessment
- If appropriate, seek support for the conclusions drawn from the assessment.
- Update on overall and related projects

Jackie also provided a brief recap on the project study area, emphasising that this is still a high-level assessment which should not be considering any finer details until a later stage of the project.

Part 1 b) Hamilton-Waikato-Waipa Metro Spatial Plan Overview and Update

Luke O'Dwyer presented an overview and update of the Metro Spatial Plan.

The purpose of the Metro Spatial Plan is to determine a shared vision and spatial framework for the Hamilton-Waikato-Waipa area. These aim to be realised by planning for both a 100 year and 30-year vision for priority development areas and enabling investment, regardless of territorial boundaries.

Phase 1 of the project delivery has been completed with Phase 2 nearing completion. The Metro Plan Steering Group will be considering work to date on 12 March 2020, which will then be workshopped with the Future Proof Implementation Committee (FPIC) on 20 March. FPIC will consider a draft spatial plan on 9 June, which will then go to Cabinet in July.

Political engagement is ongoing, with councillor workshops, FPIC, and a stakeholder event planned for early April.

Key Messages

- 100-year vision, with a 30-year plan for priority development areas.
- Planning for a future population of 500,000 people in the Metro Plan area. Current population is around 215,000.
- A number of communities have been identified to accommodate this population growth.
- Target distribution is 70% City focused (35% infill and 35% expansion) and 30% shared growth across towns, villages and nodes (15% infill and 15% expansion).
- Hamilton City has achieved 50% infill target for the last 10 years; however, starting to come against some barriers e.g. political and community expectations.
- Emphasis on planning for a compact urban form.
- Types of greenfield development will have to be very different moving forward.
- Current RPS density target for Hamilton greenfield is 16 households/ha. This will need to increase especially, to deliver viable and financially efficient public transport.
- Transport mode shift requires greater urban density.
- Emphasis on creating urban communities with better walkability and improved cycling connections.

Questions

- Have cultural aspects taken into account e.g. marae and surrounding hub? Poto
    - Too high-level to take individual sites into account.
- How much emphasis is there on protecting high class soils from development – Mark
    - Soil class is one of several key criteria being used to identify 'Waihi Toitu' and 'Waihi Toiora' areas. Weighing all of these criteria up will invariably require trade offs to be made.
    - Much of the land surrounding Hamilton is already subdivided. Land fragmentation has been mapped.

Part 1 c) Overview of Metro Area Wastewater Servicing Concepts

Jackie provided a recap of the Metro Area wastewater assessment, noting that it is a high-level assessment. Servicing options were identified, and assessment criteria reviewed at a workshop on 28 January 2020. 13 concepts with over 120 combinations were consolidated to 6 servicing options. The process of consolidation and the proposed criteria to be used for the assessment were documented and distributed to the group for feedback following the 28 January workshop. Some feedback (of a relatively minor nature) was received and incorporated into the assessment criteria.

The 6 options were evaluated against the assessment criteria. The draft assessment was workshopped with mana whenua last week.

Kate Jackson provided an overview of the 6 servicing options considered in the assessment to the group:

- Option A: business as usual (BAU) – retain existing servicing facilities and arrangements
- Option B: Convey all communities (except for Te Awamutu) to a single plant at Pukete, Te Awamutu remains standalone
- Option C: northern (Pukete) + southern (Airport) treatment centralisation; Te Awamutu remains standalone
- Option D: northern (Pukete) + southern (Cambridge) treatment centralisation; Te Awamutu remains standalone
- Option E: southern and eastern communities (excluding Cambridge) convey to a new facility; Cambridge standalone; Te Awamutu standalone; Te Kowhai and Whatawhata convey to Pukete.
- Option F: upgrades to all BAU facilities and additional plants to service previously not serviced areas.

Questions

- Resilience of the network – can existing networks be retained as a fail-safe with the addition of a new centralised plant? – Gannin
    - All existing plants, except for Te Awamutu and Pukete, will need to be upgraded or new plants built, as they don't meet the Vision and Strategy. Land of the existing site might be used, but essentially start from scratch for most plants.
    - In many cases, existing treatment facilities would likely become the site of terminal pumping stations (i.e. the site where flow is pumped to the centralised facility). This is because the existing networks are set up to drain to that location. In these cases, the "redundant" treatment facilities could be converted to emergency storage to improve overall network resilience.
- Should Option B be on the table as there may not be sufficient space to expand the Pukete plant?
    - Yes Pukete has limitations based on current site,
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- Considerations for fail-safe measures – Poto
- Potential flaws in options – Mark Walmsley
- Assumptions on biosolids? – Evan Vaughters
    - Assumptions include: large plants – digestion; medium plants – dewatering with biosolids taken to landfill or digestion; small plants – thickened and taken to another site. In terms of a potential regional biosolid facility, the intention is to bring the Metro Spatial Plan and River Communities Spatial Plan together to assess commonalities e.g. the need for a regional biosolid facility.
- Lack of mid Hamilton servicing options – Vishal Ramduny
- Hamilton south option lacking inclusion – Mark

Part 1 d) Key Assumptions and Assessment Criteria

Key Assumptions

Jackie introduced the key assumptions to the project group. Population figures (pg 10-11) were projected using the best information available at the time. They were taken from the Future Proof Growth Strategy, 3-Waters and Wastewater Masterplan working figures based on possible growth and design assumptions.

John Crawford presented to the project group how plant size and cost assumptions were applied for this assessment. Standarised plant assumptions were applied for the assessment. Size: small = 2,000-4,000 PE; medium = 4,000-40,000 PE; large = 40,000-400,000 PE. Cost: total capital costs determined using high level cost curves; costs factors applied for consents; inflation included; large costs applied for advanced facilities.

Due to time constraints, Assessment Criteria was not presented.

Fielding Questions

- In response to questions fielded, there was no time available to estimate the cost of recycling plants as there are none at this scale currently in New Zealand to compare.
- Does the assessment take into account potential increases in industrial activity?
    - Only in the areas that are currently earmarked for industrial activity; only assumed what is currently known.
- There is no need for smaller plans to have a lower level of performance.
    - The only reason for lower performance is the discharge method – to land.
- Have old pipes been taken into account?
    - Assessment is just for trunk infrastructure. Assuming local reticulation will take waste to the trunk line.
- Concerns around omitting recycling from the assessment.

Part 2 a) Group Workshop Session

The second part of the workshop split all members into 6 even groups (1 for each option). The purpose of this exercise was to facilitate a review of each wastewater servicing option with each group spending 15 minutes reviewing each option. Each session would be divided into three 5-minute parts:

1. Facilitator will describe option and key elements of assessment

2. Group will consider assessment by criteria
3. Any suggested changes/concerns/questions etc will be noted

After each session, the groups would rotate clockwise until every option had been reviewed by each group. The facilitators would then give feedback to the wider project group including any changes made from the discussions. Comments/questions/feedback and conclusions followed this.

Part 2 a) Option A

- Not servicing areas will limit growth
- Not resilient in terms of policy changes e.g. septic tanks
- Although 'natural environment improvement capability' is red, Te Awamutu and Cambridge could be upgraded in the future
- Lowest cost option but does not give value for money
- Ngaruawahia will need to undergo consenting renewal and upgrade
- Generally not considered the direction we want to head
- Not being on the front foot

Part 2 b) Option B

- Resilience low because of single point of failure
- Long pipelines could lead to septicity issues – significant operational costs in terms of this
- Operation costs underestimated
- Single large discharge
- Considered better to treat waste in catchment it is generated rather than conveying to another catchment
- It is possible that the current buffer around the Pukete site could be developed in the future, which might change the scalability assessment from fatally flawedchange rating to orange

Part 2 c) Options C and D

Option C:

- Ability to provide for industrial growth
- Plants closer to areas with highest population
- Ability to influence land use and direct growth
- Opportunity to create dedicated wet industry hub on transport connections
- Transport overlay fits well
- Better transition without working on live plants
- Less complexity in conveyance system
- Potential to create wetland area to treat and store water
- More central
- Greenfield site
- Allows flexibility in terms of location
- Guides development
- Potential on transport routes
- Discharge further downstream

Option D:

- Potentially enables Te Awamutu to convey to Cambridge in the future
- Benefit of existing site
- Existing site has sufficient space
- Discharge to river further upstream

General:

- Conveyance boundary between the two large sites is flexible
- Some risks in terms of investment already made for Peacocke. There is the potential for some sunk costs. Peacocke infrastructure designed to allow change to conveyance.
- Each catchment has its own characteristics; considered better to treat waste in catchment it is generated rather than conveying to another catchment
- Less opportunity for land base disposal
- Reliant on one or two providers
- Risk of land opening up around infrastructure
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Part 2 d) Option E

- High cost option
- Cater for new wet industry
- Complex with 5 plants
- High labour and operational costs associated with 5 plants
- Benefit in terms of following political boundaries
- Shouldn't be constrained in terms of thinking on upgrades
- Should be thinking to work with the environment and take a catchment-based view

Wider Option Feedback:

- Considerable distance between water treatment plant and population
- Most flexible option, could cater for water reuse, very scalable
- Complexity of multiple parts and Higher Operating Costs
- Should be catchment based to be more sustainable
- Staging within Concept E
- Need for discussion on emerging contaminants

Part 2 e) Option F

- Land based discharge achievable with small plants
- Ability to ring fence growth around each area

Part 3 Closing remarks and next steps

Jackie summarised the group session and provided the next steps.

- Option A: no change
- Option B: red could change to orange
- Options C & D: essentially the same; shades of green could change
- Option E: emerged as potential option to consider; red could change to orange
- Option F: potential change to orange

Next steps:

- Update and finalise the assessment
- Seek endorsement of findings by the relevant partners
- Establish appropriate project governance and delivery structures to take the most favourable options forward

Karakia and Lunch

Workshop closed 1pm

Appendix F - Detailed MCA and Option assessment sheets

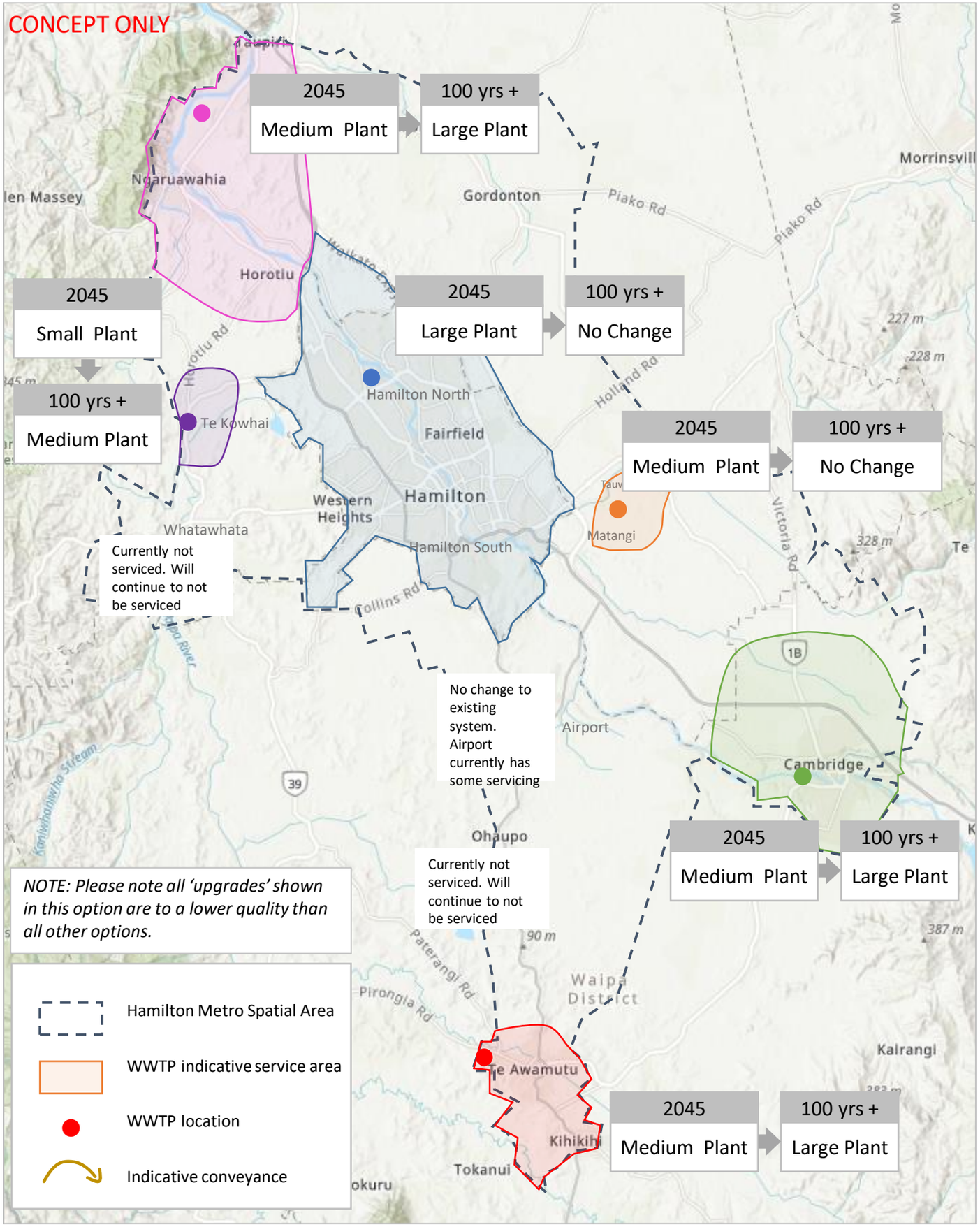
Criteria	Measure	Option A (BAU)		Option B (fully centralised excludes TA)		Option C (Existing N plant and new S plant)		Option D (Existing N plant and S plant)		Option E (Five plants for the region)		Option F (Standalone plants/upgrade of BAU)	
	To what extent does this option improve the quality of the discharge		Current situation is producing discharges which do not meet consenting requirements. In the medium term (even with planned upgrades) there will be limited improvements to the discharge quality at some locations due existing funding and technology constraints at some of the plants		A larger plant has greater potential to deliver the highest water quality discharge to the river due to economies of scale, available technology.		A larger plant has greater potential to deliver the highest water quality discharge to the river due to economies of scale, available technology.		A larger plant has greater potential to deliver the highest water quality discharge to the river due to economies of scale, available technology.		Quality of the discharge is slightly less than Options B, C and D for medium sized plants. But quality will be greater than Option F.		Assumes upgrades to a reasonable level of performance based on contemporary consents. There will minor positive impacts to the quality fo the discharge from the BAU.
	To what extent does this option improve the quality of the water in relation to the number and location of discharge points		No change with the number of discharges.		Reduction of discharge points to water from 4 to 2. Centralising to Pukete will result in a longer reach of the Waikato River main stem with no municipal wastewater discharge. Discharge would also be downstream of Cambridge and Hamilton Water Intakes. (Overall positive environmental impact in terms of the discharge).		Potential reduction of discharge points to water from 4 to 3. Proposal assumes Ngaruawahia discharge is removed and flows conveyed to Pukete and discharged upstream of Ngaruawahia. A new discharge location is likely between Cambridge and Hamilton which is further upstream than Cambridge, resulting in a longer reach of the Waikato River main stem with no municipal wastewater discharge. (Overall positive environmental impact in terms of the discharge).		Potential reduction of discharge points to water from 4 to 3. Hamilton discharge point downstream of NG and Te Kowhai. Greater flows discharged further upstream (at Cambridge discharge point), meaning larger flows of wastewater being discharged further upstream.		Discharge points to water increase as an additional discharge is required at airport.		No change with the number or location of discharges.
Natural Environment Improvement Capability	To what extent does this option improve the hydrology of the river?	-3	No change to flows into the river	3	Greater flows of water discharged to the river has hydrological benefits	2	Greater flows of water discharged to the river has hydrological benefits	2	Greater flows of water discharged to the river has hydrological benefits	1	Greater flows of water discharged to the river has hydrological benefits	0	No increase to flows to river compared with BAU.
	What potential is there for land discharge vs water discharge		Land discharge continues at Matangi and Te Kowhai.		Limited potential for *only* land discharge given the large flows. However centralisation to a new site (depending on location) and increase in water quality standards create opportunity/potential land based eco-system re-entry methods over and above BAU. Irrigation re-use is particularly limited for this option due to the location of the plant (i.e. would require long conveyance to appropoate location) (Potential for reuse is captured under sustainability).		Limited potential for *only* land discharge given the large flows. However centralisation to a new site (depending on location) and increase in water quality standards create opportunity/potential land based eco-system re-entry methods over and above BAU. (Potential for reuse is captured under sustainability). Irrigation may be possible during summer (using a Cut and Carry approach).		Limited potential for *only* land discharge given the large flows. However centralisation to a new site (depending on location) and increase in water quality standards create opportunity/potential for some irrigation (during summer) or land based eco-system re-entry methods over and above BAU. (Potential for reuse is captured under sustainability)		Limited potential for *only* land discharge given the large flows. However centralisation to a new site (depending on location) and increase in water quality standards create opportunity/potential land based eco-system re-entry methods over and above BAU. (Potential for reuse is captured under sustainability). Irrigation may be possible during summer (using a Cut and Carry approach).		Small plants (4 plants) have the potential for land discharge (i.e. no discharge to the river) as flows are till relatively small and manageable.
	To what extent is the impacts to groundwater?		No improvement to groundwater quality. Existing individual septic tanks fail and impact groundwater		Net improvement to groundwater quality (i.e. reduction of individual septic tanks)		Net improvement to groundwater quality (i.e. reduction of individual septic tanks)		Net improvement to groundwater quality (i.e. reduction of individual septic tanks)		Net improvement to groundwater quality (i.e. reduction of individual septic tanks)		More remote areas will still rely on septic tanks. Land discharges may also impact groundwater.
	Does this option increase or decrease the number of hazardous sits?		No change to number of sites required		Potential to rehabilitate 5 existing facility sites, no new site required		New plant to the south will make a new site hazardous. However it will allow for the potential to rehabilitate 5 sites		No requirement for new site. Potential to rehabilitate 4 other sites.		New plant to the south will make a new site hazardous. However it will allow for the potential to rehabilitate 3 sites		Three new sites will be required (therefore three new sites become hazardous).
Public Health Protection	To what extent doe the option reduce the health and safety risk?	-1	Septic tanks used for large lifestyle blocks have a risk of failure which could lead to public health issues. A greater reliance on individual septic tanks may have public health implications in the future as they could fail and contaminate groundwater.	3	Highest quality plant with membrane and UV technology will have improve water quality outcomes and in doing so improve public health protection. Net improvements to groundwater with the reduction of individual septic tanks.	3	Highest quality plant with membrane and UV technology will have improve water quality outcomes and in doing so improve public health protection. Net improvements to groundwater with the reduction of individual septic tanks.	3	Highest quality plant with membrane and UV technology will have improve water quality outcomes and in doing so improve public health protection. Net improvements to groundwater with the reduction of individual septic tanks.	3	Highest quality plant with membrane and UV technology will have improve water quality outcomes and in doing so improve public health protection. Net improvements to groundwater with the reduction of individual septic tanks.	2	Individual upgrades to the existing plants and servicing Whatawhata and Ohaupo will have health improvements over the current situation. More remote areas will still rely on septic tanks which has a greater risk of failure.
Cultural Benefits/Impacts	To what extent does this option enhance and restore cultural connectivity with the river?	FF	Current situation is currently not meeting the Te Ture Whaimana objectives.	No assessment	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.	No assessment	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.	No assessment	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.	No assessment	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.	No assessment	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.
	To what extent does this option provide additional growth opportunities which align with the sustainable and planned future growth of the Waikato?		The current situation will not be able to service the area in the medium to long term. Whatawhata and Ohaupo are not currently serviced but will soon require plant facilities.		This option will open up a number of new areas for development, including areas between Hamilton and Cambridge. It also allows the growth of Te Kowhai and Whatawhata and areas east of the Hamilton. Careful consideration will be required to determine the best and most appropriate locations for development.		Creates additional flexibility for future development, particularly in locations between Hamilton and Cambridge. It also allows the growth of Te Kowhai and Whatawhata and areas east of the Hamilton. Careful consideration will be required to determine the best and most appropriate locations for development.		Future development opportunities are more limited than Option C, given the conveyance will not span a wider region (facility in a central location verse facility to the south). It also allows the growth of Te Kowhai and Whatawhata and areas east of the Hamilton. Careful consideration will be required to determine the best and most appropriate locations for development.		This option provides development opportunities between Hamilton and Cambridge and also allows growth of Te Kowhai and Whatawhata and areas east of Hamilton.		Small standalone facilities will have a capacity limitations and will require additional level of upgrades as population grows, however they are better able to meet low level growth
	To what extent does the option allow for growth beyond 2045? i.e. within a 100 year timeframe.		This option does not free up space at Pukete, however it is expected Pukete will be able to cater for the 100 year population growth of the proposed servicing area. However in a 100 year timeframe other smaller communities, particularly those which are not currently serviced will have significant growth limitations. Does not cater for any other unplanned development which could occur between Hamilton and Cambridge.		Pukete treatment facility site has limited build out capacity. Beyond 2045 the facility will be nearing its capacity limitations and will require additional land to keep growing with population or a major change to site development (e.g. vertical/multi-level treatment facility). Extending the site footprint beyond the current boundaries will impact the existing buffer which separates the plant from residential areas. Note that extending the site to site on the banks of the Waikato River is not considered in line with Te Ture Whaimana, and so has been discounted for the purpose of this assessment.		This option frees up some capacity for the Pukete facility and will be better able to cater for areas further north and east. Pukete will need to expand but not beyond its footprint. Better able to cater for population growth beyond 2045 when compared against Option B A new Greenfields treatment plant provides the opportunity for future proofed master planning to be undertaken which would include adequate space for 100 year + timeframes.		This option frees up some capacity for the Pukete facility and will be better able to cater for areas further north and east. Pukete will need to expand but not beyond its footprint. Better able to cater for population growth beyond 2045 compared against Option B. The Cambridge WWTP site has sufficient space for foreseeable requirements and provides flexibility for additional growth in the future. The site is however a brownfields site, located on the banks of the Waikato River which would present more risk and constraints than a greenfield site (i.e. Option C).		This option does not free up capacity at Pukete, however it is expected Pukete will be able to cater for the 100 year population growth of the proposed servicing area (i.e. current Hamilton City). Space limitations at Ngaruawahia may become an issue going forward, but could likely be managed.		This option does not fee up space at Pukete, however it is expected Pukete will be able to cater for the 100 year population growth of the proposed servicing area. However in a 100 year timeframe other smaller communities may have growth limitations. Does not cater for any other unplanned development which could occur between Hamilton and Cambridge
Flexibility, Scalability and Risk	Is the option flexible enough to adapt to growth and land use changes?	FF	Limited ability to respond to land use changes (given there are many locations no currently serviced). Industrial land uses in particular will be constrained	-2	The limitations at the site will also mean the site may be less flexible to adapt to changes.	3	A new plant to the south can be master planned and custom built and therefore easier for this facility to adapt to growth and land use changes and technology changes. This option also provides the opportunity for infrastructure led landuse. E.g. locating appropriate activities around new resource recovery facilities.	2	Less flexibility at an existing site due to the need to keep the existing facility operational during construction	1	A new plant to the south can be custom built and therefore easier for this facility to adapt to growth and land use changes and technology changes. This option also provides the opportunity for infrastructure led landuse. E.g. locating appropriate activities around new resource recovery facilities. Option potentially provides for improved staging and deliverability through staggered major investment. Would enable trigger points to be established, at which time transition to further centralisation may occur. However, could also result in significant investment in facilities that become redundant before the asset life.	-1	There is a greater agility to respond to growth through relatively limited immediate investment. However this simply defers long term investment decisions. Given rapid change in technology, this could be an advantage over large scale capital investment required by centralisation. However this works up to the maximum capacity of a small plant. Greater technological upgrades is required for a move to large scale plants.

Criteria	Measure	Option A (BAU)		Option B (fully centralised excludes TA)		Option C (Existing N plant and new S plant)		Option D (Existing N plant and S plant)		Option E (Five plants for the region)		Option F (Standalone plants/upgrade of BAU)	
	What are the consentability risks?		No additional consenting requirements beyond what is already planned. However, ability to consent BAU in current and likely future planning environment is extremely limited.		No requirement to consent a new site or new discharge point. However new consents will be required to provide for increased discharge volumes and contaminant loads. Improved treatment quality through scale and larger user base expected to deliver best of River outcomes relative to Options A, E and F		In addition to renewing the existing discharge consent for Pukete, there is a requirement to consent a new location and a new discharge point. Improved treatment quality through scale and larger user base expected to deliver best of River outcomes relative to Options A, E and F		No requirement to consent a new site or new discharge point. However new consents will be required to provide for increased discharge volumes and contaminant loads. Improved treatment quality through scale and larger user base expected to deliver best of River outcomes relative to Options A, E and F		In addition to renewing existing discharge consents, consents for new location and discharge points will be needed.		Consenting and land designation risks (i.e. three new sites requiring consenting)
	What are the conveyance risks?		No additional conveyance risks (no conveyance requirements)		Conveyance across large distances will lead to greater septicity risks. Conveyance across large distances will lead to greater septicity risks than BAU or decentralisation. Also potential implications of failure potentially higher than existing situation and would require adequate systems to be in place to reduce and mitigate risks and impacts of failure.		Reduces septicity issues with reduced lengths of conveyance when compared to Option D and Option B. Conveyance across large distances will lead to greater septicity risks than BAU or decentralisation. Also potential implications of failure potentially higher than existing situation and would require adequate systems to be in place to reduce and mitigate risks and impacts of failure.		Greater risk of septicity (compared with Option C) with conveyance flows needing to span greater distances. Conveyance across large distances will lead to greater septicity risks than BAU or decentralisation. Also potential implications of failure potentially higher than existing situation and would require adequate systems to be in place to reduce and mitigate risks and impacts of failure.		Reduces septicity issues with reduced lengths of conveyance when compared to Option D and Option B. However there is still some risks associated with the potential implications of failure being higher than the existing situation and would require adequate systems to be in place to reduce and mitigate risks and impacts of failure.		No additional conveyance risks (no conveyance requirements)
	What are the timeliness risks?		N/A		There will be a timeliness issue with constructing the required conveyance, pump stations and additional treatment capacity needed and consenting the discharge(s).		There will be a timeliness issue with constructing the required conveyance, pump stations and additional treatment capacity needed and consenting the discharge(s) and the new site.		There will be a timeliness issue with constructing the required conveyance, pump stations and additional treatment capacity needed and consenting the discharge(s).		There will be a timeliness issue with constructing the required conveyance, pump stations and additional treatment capacity needed and consenting the discharge(s) and the new site.		Fewer timing constraints. i.e. smaller plants are easier and quicker to implement and upgrade in response to growth. However it will take time to consent three new sites for construction and for discharges
Whole of life costs	What is the high level capital cost of the option?	Not Scored	2045 CAPEX $200 million NVP OPEX (30 yrs) $370 million	Not Scored	2045 CAPEX $500 million NVP OPEX (30 yrs) $390 million	Not Scored	2045 CAPEX $540 million NVP OPEX (30 yrs) $370 million	Not Scored	2045 CAPEX $580 million NVP OPEX (30 yrs) $378 million	Not Scored	2045 CAPEX $380 million NVP OPEX (30 yrs) $370 million	Not Scored	2045 CAPEX $340 million NVP OPEX (30 yrs) $360 million
	What are the high level annual operational cost of the option?		100 yrs + CAPEX $520 million NPV OPEX (30 yrs) $650 million		100 yrs + CAPEX $980 million NPV OPEX (30 yrs) $790 million		100 yrs + CAPEX $1,020 million NPV OPEX (30 yrs) $750 million		100 yrs + CAPEX $1,080 million NPV OPEX (30 yrs) $760 million		100 yrs + CAPEX $780 million NPV OPEX (30 yrs) $570 million		100 yrs + CAPEX $730 million NPV OPEX (30 yrs)$560 million
	Distribution of costs across population service base		Low capital cost. However, costs are spread across smaller population servicing base		Investing in assets which can't be used for the entire life span of the asset. However costs are spread across very large population base		High capital costs. However costs are spread across very large population base for the two larger plants		High capital costs. However costs are spread across very large population base for the two larger plants		Lower capital cost. However, costs are spread across smaller population servicing base. Meaning some areas have high cost to cater for a very small population. (This includes areas like Ngaruawahia, Taupiri and Ohaupo)		Lower capital cost. However, costs are spread across smaller population servicing base. Meaning some areas have high cost to cater for a very small population (This includes areas like Ngaruawahia, Taupiri and Ohaupo).
	Value for money (asset is utilised for its entire lifespan)				Investing in assets which we cant use for the entire life span of the asset (i.e. major trunk of pipelines to a facility which will reach its build out capacity).								
Sustainability	To what extent does this option provide the opportunities for the implementation of sustainable practices and technologies?		Currently unable to achieve any sustainable improvements. Wastewater plant network is not currently resilient to disruptions.		High potential to utilise carbon neutral or carbon reducing technologies. - However this may impact the build out capacity of the facility Limited flexibility to be able to introduce new technologies. Provides opportunity to increase overall water management sustainability through offsetting potable water demand.		High potential to utilise carbon neutral or carbon reducing technologies. Greater flexibility to introduce new technologies on new site. Provides opportunity to increase overall water management sustainability through offsetting potable water demand.		High potential to utilise carbon neutral or carbon reducing technologies. Greater flexibility to introduce new technologies on new site. Provides opportunity to increase overall water management sustainability through offsetting potable water demand.		Limited potential to utilise carbon neutral or carbon reducing technologies. Flexibility to change when better technology becomes available		Very limited potential to utilise carbon neutral or carbon reducing technologies. Flexibility to change when better technology becomes available
	To what extent does the option provide resilience for potential failures?	-3	Wastewater plant network is not currently resilient to disruptions.	2	One plant may reduce operational resilience (i.e. no backup plant if there is a failure). However large plant has a lower chance of failure and greater consequence if a failure occurs	3	Slightly greater resilience than Option B (3 plants over 2). Large plants has a lower chance of failure and greater consequence if a failure occurs. Opportunity to interconnect the northern and southern metro facilities could be pursued.	2	Slightly greater resilience than Option B (3 plants over 2). Large plants has a lower chance of failure and greater consequence if a failure occurs	1	Consequence of failure is less - likelihood of continuing BAU with a significant plant failure is lower	1	Consequence of failure is less - likelihood of continuing BAU with a significant plant failure is lower
	What are the operational risks/ Can this option be resourced sustainably?		Limited ability to retain and attract the labour required to operate plants.		Ability to capture greater labour pool skill and retain skill		Ability to capture greater labour pool skill and retain skill		Ability to capture greater labour pool skill and retain skill		Difficult retaining and attracting skill and labour requirements for greater number of plants		Difficult retaining and attracting skill and labour requirements for greater number of plants. More difficult to operate multiple plants and to keep plants consistent and performing in a consistent way
	What is the potential for water reuse and resource recovery?		No potential for reuse - quality and technology not available to achieve reuse		High potential for water reuse with nearby industrial sector (i.e. Horotiu) - Build out capacity will be lower if recycling is introduced. However could be serviced at Horotiu/another location. High potential to maximise resource recovery		High potential for water reuse with nearby industrial sector (i.e. Horotiu , Airport) High potential to maximise resource recovery		Moderate potential for reuse. There is limited capacity for industrial reuse around the Cambridge site.		Limited potential for water reuse with nearby industrial sector (i.e. Horotiu , Airport) Limited potential to maximise resource recovery		Very limited potential for water reuse with nearby industrial sector (i.e. Horotiu) Very limited potential to maximise resource recovery

	Option A (BAU)	Option B	Option C	Option D	Option E	Option F
Average (equal weighting) score	Fatally Flawed	1.5	2.75	2.25	1.5	0.5

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

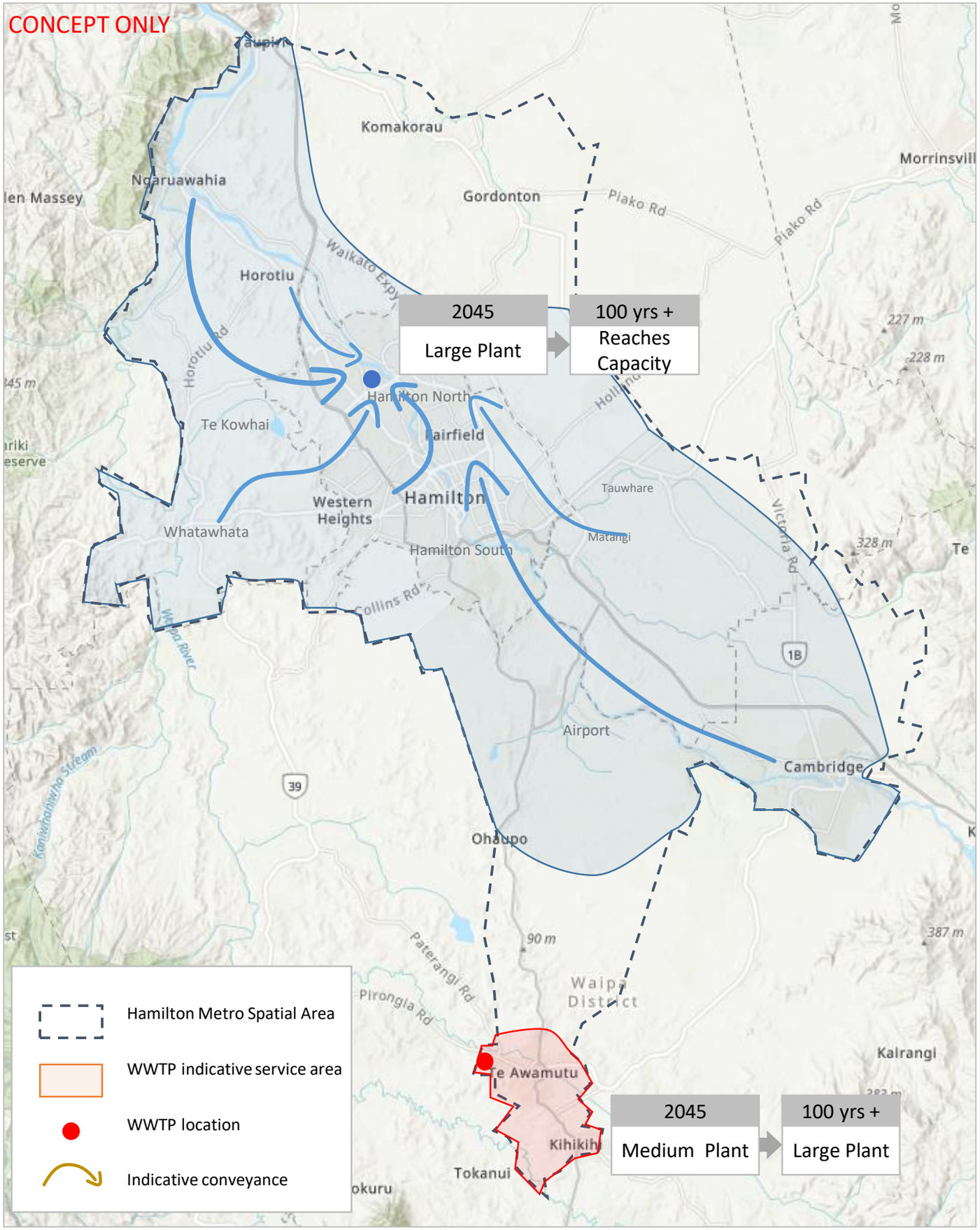
Option A: BAU - Retain existing servicing arrangements for all communities



Key features of the option		Option A is business as usual. This assumes no additional technical upgrades (scale upgrades only) will be made beyond what is already planned. This assumes Whatawhata, Ohaupo and the airport will remain unserviced, along with other remote areas in Tauwhare and Matangi.
Natural Environment Improvement Capability	-3	The BAU approach characterised by reactive and delayed responses will not be sustainable for the river or the environment. No improvement to groundwater quality. Existing individual septic tanks fail and impact groundwater
Public Health Protection	-1	Septic tanks used for large lifestyle blocks have a higher risk of contaminating groundwater particular as reliance on septic tanks increases overtime
Cultural Benefits / Impacts	FF	Current situation is currently not meeting the Te Ture Whaimana objectives.
Flexibility, Scalability and Risk	FF	The current situation will not be able to service the area in the medium to long term .Limited ability to respond to land use changes (given there are many locations no currently serviced). Industrial land uses in particular will be constrained
Whole of life costs / Value for money	Not scored	**2045** CAPEX $200 million NVP OPEX (30 yrs) $370million **100 yrs +** CAPEX $520 million NPV OPEX (30 yrs) $650 million Low capital cost. However, costs are spread across smaller population servicing base
Sustainability and resilience	-3	Currently unable to achieve any sustainable improvements. Wastewater plant network is not currently resilient to disruptions. Limited ability to retain and attract the labour required to operate plants. No potential for reuse.

Cost Estimates	**2045 costs**	**100 yrs + costs**
Total Capital Costs ($) (-30% / +50%)	$200 million	$520 million
Total Annual Operational Costs ($)	$27 million	$47 million
Total km of conveyance	0 km (No additional conveyance requirements above what is already planned)	
30 Year NPV of OPEX @ 6% discount rate	$370 million	$650 million

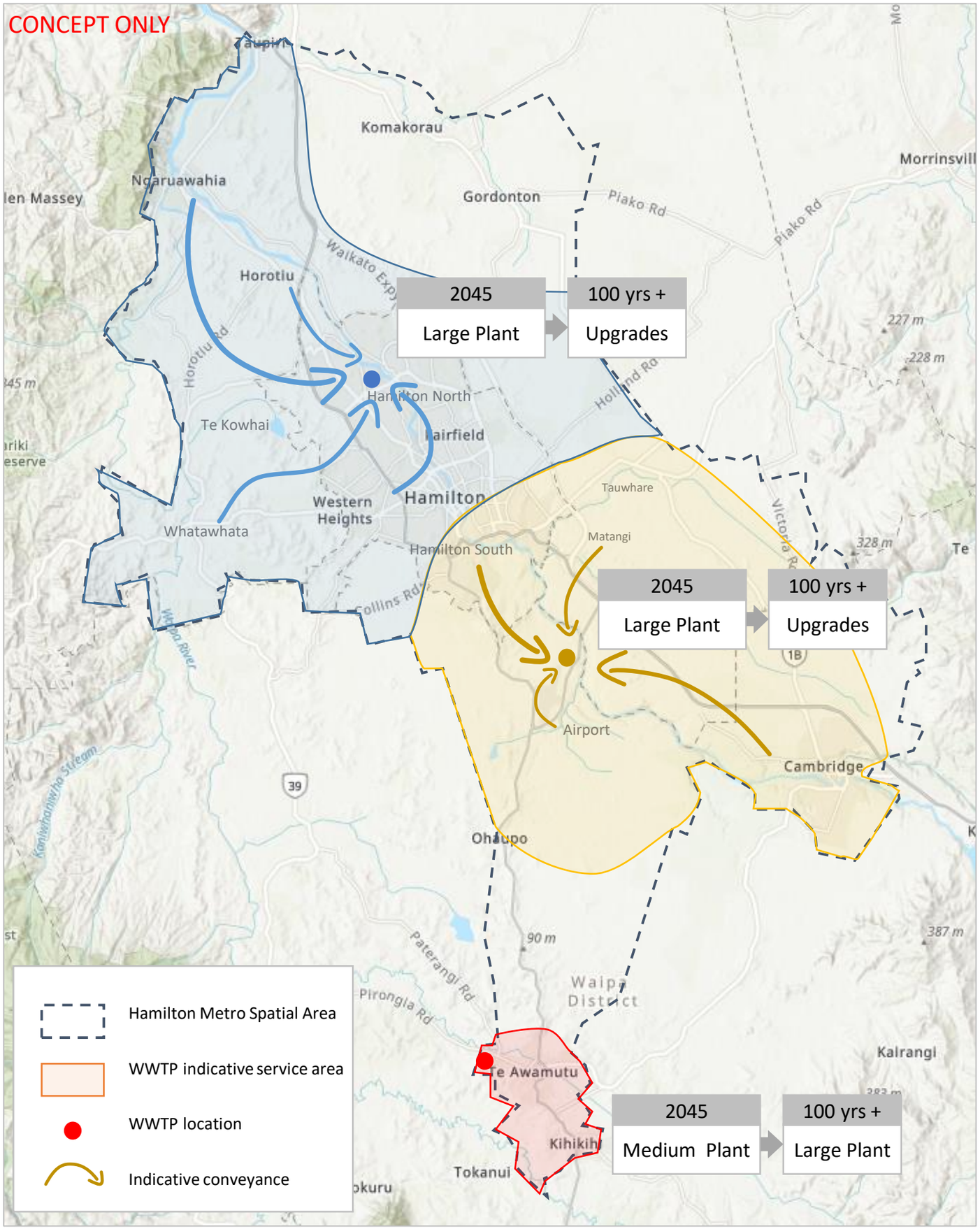
Option B: Convey all communities to Pukete WWTP except for Te Awamutu



Key features of the option		Option B includes a large centralised facility located at Pukete. All surrounding communities will convey to Pukete. Te Awamutu will remain as a standalone facility.
Natural Environment Improvement Capability	3	A large plant has the potential to deliver higher quality discharge to the water. Increase in water quality standards create opportunity for land based eco-system re-entry methods. Option B reduces the discharge points to water from 4 to 2. Removal of discharge location at Cambridge which is further upstream.
Public Health Protection	3	Highest quality plant with membrane and UV technology will have improve water quality outcomes and in doing so improve public health protection
Cultural Benefits / Impacts	No Assessment	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.
Flexibility, Scalability and Risk	-2	Beyond 2045 the Pukete facility will be nearing its build out capacity limitations and will require additional land to keep growing with population. This will impact the existing buffer which separates the plant from residential areas. Conveyance across large distances will lead to greater risks
Whole of life costs / Value for money	Not scored	**2045** CAPEX $500 million NVP OPEX (30 yrs) $390 million **100 yrs +** CAPEX $980 million NPV OPEX (30 yrs) $790 million Investing in assets which can't be used for the entire life span of the asset. However costs are spread across very large population base
Sustainability and resilience	2	High potential to use sustainable technologies including potential for offsetting. Limited build out capacity. Ability to capture greater labour pool skill and retain skill. Large plant has a lower chance of failure and greater consequence if a failure occurs. High potential for reuse

Cost Estimates	**2045 costs**	**100 yrs + costs**
Total Capital Costs ($) (-30% / +50%)	$500 million	$980 million
Total Annual Operational Costs ($)	$29 million	$57million
Total km of conveyance	90 km	
30 Year NPV of OPEX @ 6% discount rate	$390 million	$790 million

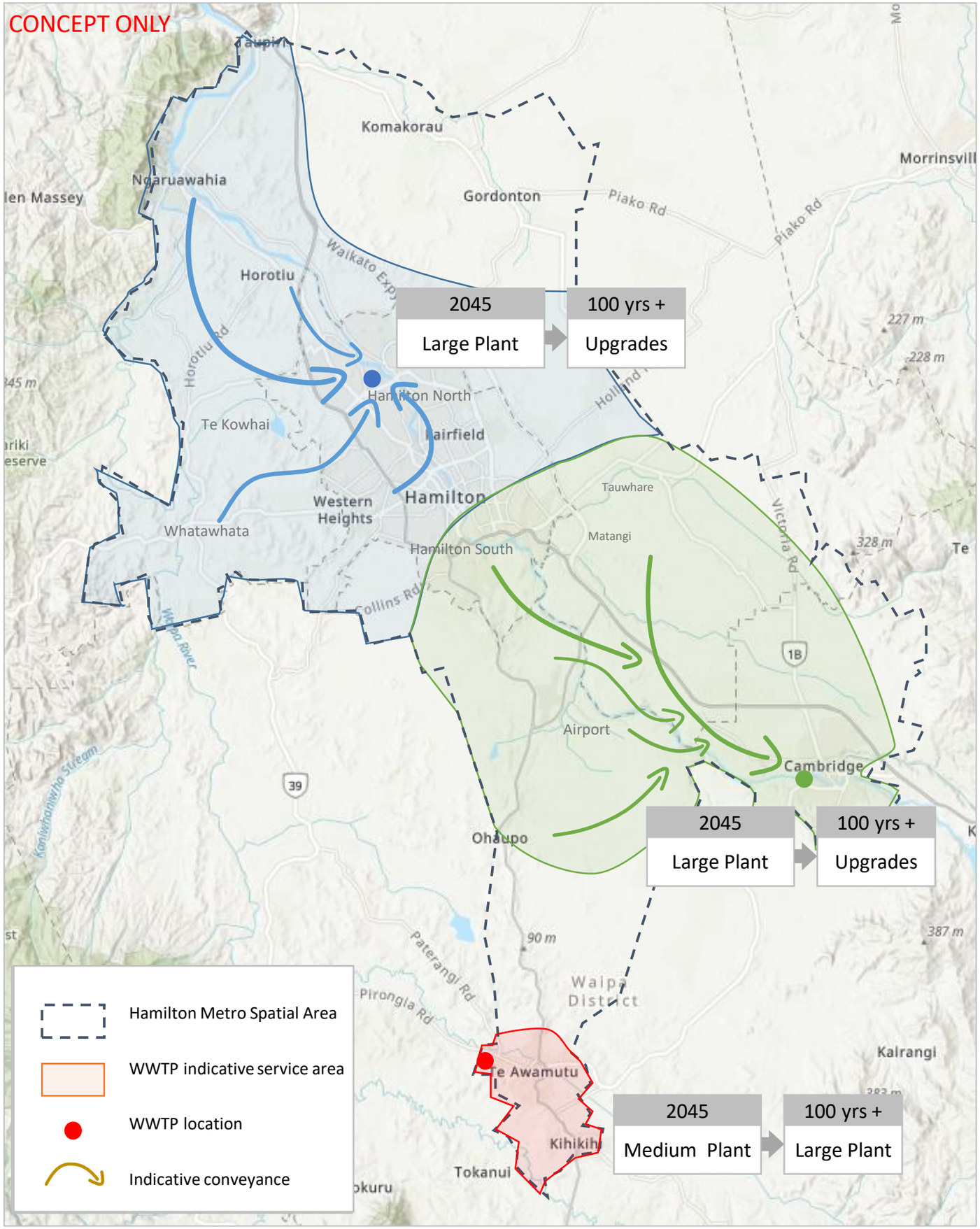
Option C: Convey all communities to a northern and southern centralised facility (new site)



Key features of the option		Option C conveys all communities north of Hamilton and North Hamilton to Pukete WWTP, South Hamilton and all other communities south east of Hamilton (including Peacockes) go to a new southern WWTP. Te Awamutu remains standalone.
Natural Environment Improvement Capability	2	A large plant has the potential to deliver higher quality discharge to the water. Increase in water quality standards create opportunity for irrigation and land based eco-system re-entry methods. Option C reduces the discharge points into water from 4 to 3. Removal of discharge location at Cambridge which is further upstream. New plant will create additional hazardous site.
Public Health Protection	3	Highest quality plant with membrane and UV technology will have improve water quality outcomes and in doing so improve public health protection
Cultural Benefits / Impacts	No assessment	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.
Flexibility, Scalability and Risk	3	Creates additional flexibility for development for future unplanned development, particularly in locations between Hamilton and Cambridge. Frees up some capacity for the Pukete facility. New Greenfields treatment plant provides the opportunity for future proofed master planning (adequate space for 100+ timeframes). Reduces septicity issues with reduced lengths of conveyance when compared to Option D.
Whole of life costs / Value for money	Not Scored	**2045** CAPEX $540 million NVP OPEX (30 yrs) $370 million **100 yrs +** CAPEX $1,020 million NPV OPEX (30 yrs) $750 million High capital costs. However costs are spread across very large population base
Sustainability and resilience	3	High potential to use sustainable technologies including potential for offsetting. Ability to capture greater labour pool skill and retain skill. Large plant has a lower chance of failure and greater consequence if a failure occurs. High potential for reuse

Cost Estimates	**2045 costs**	**100 yrs + costs**
Total Capital Costs ($) (-30% / +50%)	$540 million	$1,020 million
Total Annual Operational Costs ($)	$29 million	$54 million
Total km of conveyance	80 km	
30 Year NPV of OPEX @ 6% discount rate	$370 million	$750 million

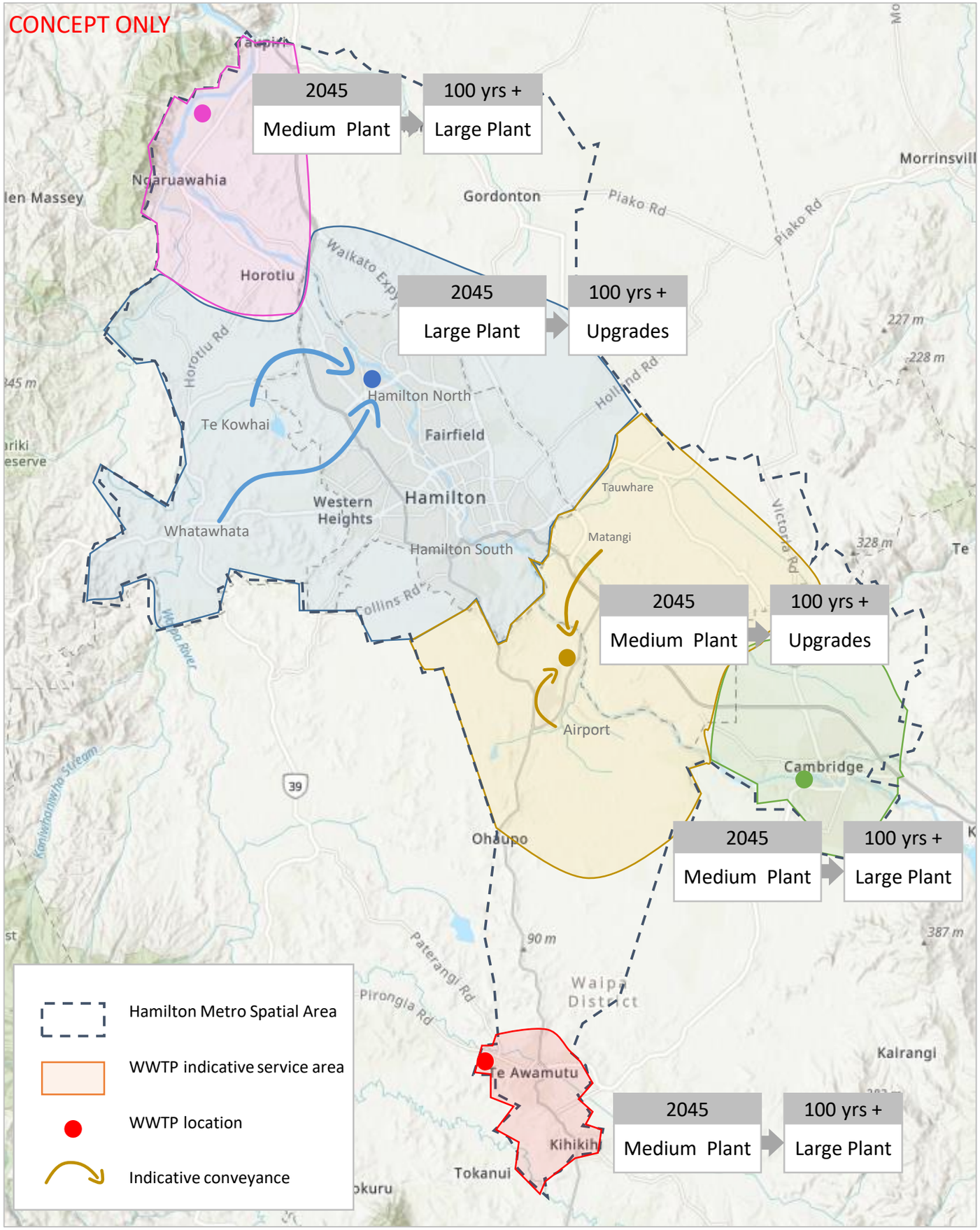
Option D: Convey all communities to a northern and southern centralised facility (Cambridge site)



Key features of the option		Option D also conveys all communities north of Hamilton and North Hamilton to Pukete WWTP, South Hamilton and all other communities south east of Hamilton to an upgraded southern WWTP at the existing Cambridge site. Te Awamutu remains standalone.
Natural Environment Improvement Capability	2	A large plant has the potential to deliver higher quality discharge to the water. Increase in water quality standards create opportunity for irrigation and land based eco-system re-entry methods. Option D reduces the discharge points into water from 4 to 3. Discharge location further upstream.
Public Health Protection	3	Highest quality plant with membrane technology will have improve water quality outcomes and in doing so improve public health protection
Cultural Benefits / Impacts	No assessment	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.
Flexibility, Scalability and Risk	2	Future unplanned development opportunities are more limited than Option C, given the conveyance will not span a wider region (facility in a central location verse facility to the south). Frees up some capacity for the Pukete facility. Cambridge WWTP site has sufficient space for foreseeable requirements. A brownfields site, located on the banks of the Waikato River has greater risk and constraints than a greenfield site. Do not have to consent a new site.
Whole of life costs / Value for money	Not Scored	**2045** CAPEX $580 million NVP OPEX (30 yrs) $380 million **100 yrs +** CAPEX $1,080 million NPV OPEX (30 yrs) $760 million Higher capital costs. However costs are spread across very large population base
Sustainability and resilience	2	High potential to use sustainable technologies including potential for offsetting. Ability to capture greater labour pool skill and retain skill. Large plant has a lower chance of failure and greater consequence if a failure occurs. Limited potential for industrial reuse given its location.

Cost Estimates	**2045 costs**	**100 yrs + costs**
Total Capital Costs ($) (-30% / +50%)	$580 million	$1,080 million
Total Annual Operational Costs ($)	$27 million	$55 million
Total km of conveyance	100 km	
30 Year NPV of OPEX @ 6% discount rate	$380 million	$760 million

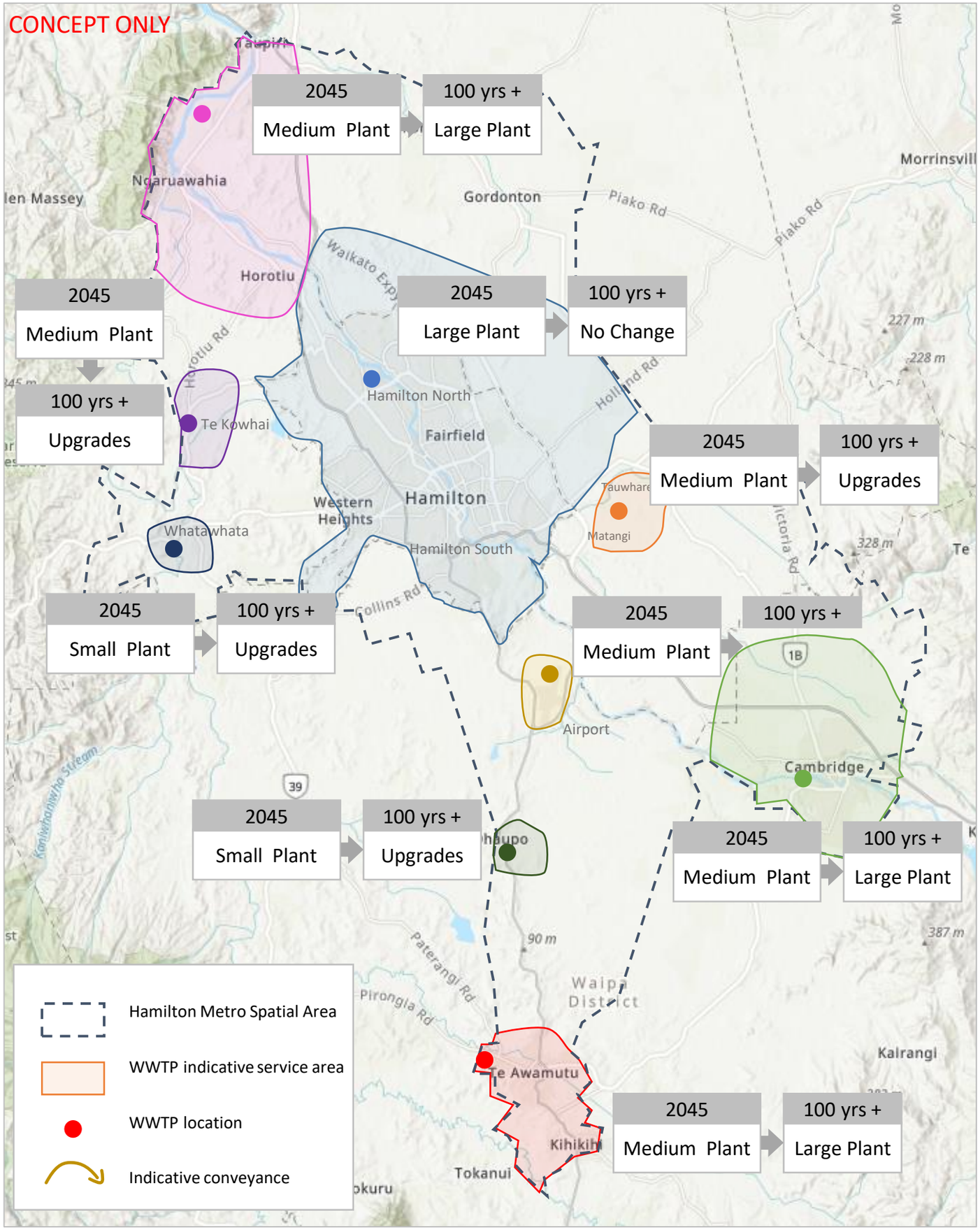
Option E: Five wastewater facilities to cater for the whole metro spatial area including a new southern facility near the airport.



Key features of the option		Option E includes a new facility to cater for the southern and eastern communities (including the airport, Ohaupo, Matangi and Tauwhare). Cambridge remains as a standalone facility. Te Awamutu remains as a standalone facility. Te Kowhai and Whatawhata to convey to Pukete facility.
Natural Environment Improvement Capability	1	The potential quality of the discharge is slightly less than Options B, C and D for medium sized plants. Discharge points to the river increase as an additional discharge is required at a new location. New plant to the south will make a new site hazardous.
Public Health Protection	3	Highest quality plant with membrane technology will have improve water quality outcomes and in doing so improve public health protection
Cultural Benefits / Impacts	No assessment	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.
Flexibility, Scalability and Risk	1	Option provides development opportunities between Hamilton and Cambridge. A new plant to the south can be custom built and therefore easier for this facility to adapt to growth and land use changes. Reduces septicity issues with reduced lengths of conveyance when compared to Option D and Option B. There is a requirement to consent a new location and a new discharge point. This option has the potential to form part of a staged approach.
Whole of life costs / Value for money	Not Scored	**2045** CAPEX $380 million NVP OPEX (30 yrs) $370 million **100 yrs +** CAPEX $780 million NPV OPEX (30 yrs) $570 million Lower capital cost. However, costs are spread across smaller population servicing base. Meaning some areas have high costs for smaller populations
Sustainability and resilience	1	Limited potential to use sustainable technologies. Difficulty retaining and to attracting skill and labour requirements. Greater likelihood of failure but lower consequence. Limited potential for reuse

Cost Estimates	**2045 costs**	**100 yrs + costs**
Total Capital Costs ($) (-30% / +50%)	$380 million	$780 million
Total Annual Operational Costs ($)	$30 million	$41 million
Total km of conveyance	50 km	
30 Year NPV of OPEX @ 6% discount rate	$370 million	$570 million

Option F: Upgrades of BAU including new facilities at Whatawhata, the airport and Ohaupo



Key features of the option		Option F includes smaller standalone facilities and upgrades at the existing facilities and two new facilities at Whatawhata and Ohaupo. With the next 100 years most medium plants will need to be upgraded to large.
Natural Environment Improvement Capability	0	There will be minor positive impacts to river quality from the BAU overtime. More remote areas will still rely on septic tanks. Land discharges may also impact groundwater. Greater number of hazardous sites. Greater potential for land discharge
Public Health Protection	2	Individual upgrades to the existing plants and servicing Whatawhata and Ohaupo will have health improvements More remote areas will rely on septic tanks which has a greater risk of failure.
Cultural Benefits / Impacts	No assessment	Two hui's were undertaken on the 26th February and the 5th March to discuss the alternative options and assessment of options. Iwi groups in attendance were generally supportive of the current assessment of the options. There was emphasis placed on proceeding with an option which provides best for awa outcomes and providing a solution which will benefit future generations. Some iwi and mana whenua indicated a strong preference for a centralised treatment facilities. Some also sought to maintain a catchment based approach based on the source of waste generated.
Flexibility, Scalability and Risk	-1	Small standalone facilities will have a capacity limitations and will require additional level of upgrades as population grows. Does not cater for any other unplanned development. There is a greater agility to respond to growth. However this works up to the maximum capacity of a small plant. Three new sites will require consenting.
Whole of life costs / Value for money	Not Scored	**2045** CAPEX $340 million NVP OPEX (30 yrs) $360 million **100 yrs +** CAPEX $730 million NPV OPEX (30 yrs) $560 million Lower capital cost. However, costs are spread across smaller population servicing base. Meaning some areas have high costs for smaller populations
Sustainability and resilience	1	Very limited potential to use sustainable technologies. Difficulty retaining and to attracting skill and labour requirements. Greater likelihood of failure but lower consequence. Very limited potential for reuse.

Cost Estimates	**2045 costs**	**100 yrs + costs**
Total Capital Costs ($) (-30% / +50%)	$340 million	$750 million
Total Annual Operational Costs ($)	$26 million	$40 million
Total km of conveyance	10 km	
30 Year NPV of OPEX @ 6% discount rate	$260 million	$560 million

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