

**To** The District Planning Team

**11 April 2024**

**From** Clinton Cantrell – SCO Consulting Ltd

**Subject** Private Plan Change 84: Mangawhai Hills Limited – Wastewater Infrastructure Planning

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## **1. INTRODUCTION**

**1.1** In response to Private Plan Change 84: Mangawhai Hills Limited (**PPC84**) I have been asked by the District Planning Team at Kaipara District Council (**Council**) to provide advice on issues relating to wastewater infrastructure and in particular the ability of the plan change area to be serviced by either the Mangawhai Community Wastewater Scheme (**MCWWS**), a private wastewater disposal field, or septic tanks on individual lots.

**1.2** This memorandum addresses the following matters:

- (a) How is wastewater currently treated in Mangawhai?
- (b) How much capacity is remaining in the existing treatment plant?
- (c) How much extra capacity is to be delivered over the short term (next 3 years) through any funded/ consented upgrades?
- (d) How much capacity is there in the conveyance network?
- (e) Is there sufficient existing and/ or short-term programmed capacity in both conveyancing and treatment plant to take the flows from PPC84?
- (f) If not are there any other solutions e.g. holding tanks on-site and off-peak pumping? Or a staging rule that limits the number of households to match capacity until upgrades occur?
- (g) For larger lots, what's the minimum site size required for private septic tanks – does the Northland Regional Plan set minimums?

## **2. SUMMARY**

**2.1** Mangawhai is serviced by the MCWWS. The MCWWS was first commissioned in 2009 to reduce reliance on septic tanks and improve the water quality of the Mangawhai Estuary. The existing Mangawhai Wastewater Treatment Plant (**WWTP**) has a current design capacity for around 3,550 connections (residential equivalent). As of December 2023, approximately 2,764 connections are served by the WWTP.

- 2.2** The Council requires all new development in urban Mangawhai to connect to the MCWWS, and encourages existing development to also connect, due to the improved environmental outcomes from connecting, and on the basis this will result in lower average costs. The Council is currently implementing a staged upgrade plan to address near and longer term capacity needs at the WWTP. This plan was presented to and approved by Council in October of 2023. The plan was developed by a consortium of consulting experts who completed the peer review of the 2022 master plan. This consortium includes Hunter H2O (owned by Beca) and SCO Consulting Ltd. The staged upgrade plan approved by the Council will result in the following WWTP capacity increases:
- (a) The current number of connections to the WWTP is 2,764, with a current WWTP capacity of 3,550 connections; and
  - (b) This capacity will be upgraded to 5,470 connections by 2026/2027 through the discharge of treated wastewater to the Mangawhai Golf course.
- 2.3** To ensure there is sufficient capacity in the MCWWS to provide for growth, including the growth proposed under PPC84 at the rate identified by Mangawhai Hills Ltd, the Council is actively planning to upgrade a number of aspects of the MCWWS. As noted in the Mangawhai Hills development application, the developer intends to service up to 500 lots with a private on-site wastewater treatment plant that will dispose of treated effluent via an on-site private subsurface drip irrigation system. The remaining 100 lots that can be developed within the PPC84 area will be serviced by the Mangawhai public wastewater system. I have assessed capacity to service the PPC84 area per the current developer plans, and also scenarios where the 500 lots cannot be serviced by a private centralized wastewater treatment system (e.g. due to consenting issues or a change in development plans).
- 2.4** It is my professional opinion that the PPC84 area can be adequately serviced for wastewater needs for all potential scenarios assessed with the following noted assumptions:
- (a) In the scenario where the developer services 500 properties with a centralized private on-site wastewater system, it is assumed they will be granted a resource consent from NRC and can meet the specific conditions of this consent.
  - (b) In the scenario where all 600 properties are serviced by the MCWWS, it is assumed that the pace of development (approximately 60 lots per year) would be in line with the timing of planned upgrades for the Mangawhai WWTP, conveyance network, and effluent disposal systems. It should be noted that the area where the 500 properties are planned is not part of the proposed wastewater servicing area in KDC's spatial plan. Therefore, if this scenario eventuates KDC will need to confirm the ability to service 600 properties based on development staging and the timing of planned wastewater network, treatment and effluent disposal upgrades. It is technically feasible to service the 600 properties with the public wastewater system if appropriate upgrades are implemented in time.
  - (c) In a scenario where the PPC84 area cannot be serviced by either a private wastewater system or the MCWWS, it is technically feasible to service development with private on-lot septic systems. However, this scenario would potentially impact the maximum development yield based on the required minimum lot areas for on-lot septic systems

(typically, site sizes would be a minimum of 2500m<sup>2</sup> to provide primary and secondary septic irrigation areas).

- (d) Based on the latest proposed developments plans for PPC84, my assessment of available capacity assumes the following:

**Scenario 1**

- Ultimate max development yield = 600 properties for the 218ha site
- 500 lots to be serviced by a centralized private on-site wastewater treatment system
- 100 lots to be serviced by the MCWWS

**Scenario 2**

- PPC84 area of 600 properties to be serviced by the MCWWS
- Development yield is 60 properties per year
- Total buildout to occur over a 10-year period from start of development

**Scenario 3**

- PPC84 area to be serviced on-lot septic systems

### 3. THE MANGAWHAI COMMUNITY WASTEWATER SCHEME, ITS CAPACITY, AND PLANNED FUTURE UPGRADES

#### Overview

- 3.1** The Council's planning in relation to the MCWWS treatment plant is currently summarised in a document dated 3 October 2023 titled "Mangawhai CWWTP Options Report Peer Review" completed by Beca Hunterh2o. This was a peer review of the Mangawhai WWTP master plan completed by WSP in 2022. The peer review report and associated recommended upgrade path was presented to Council in October of 2023. The peer review Strategy and recommendations has received the endorsement of Elected Members to progress this planning and implement the proposed Stage 1 upgrades. As of March 2024, the Stage 1 upgrades have been successfully installed with final commissioning expected to be completed by early April. A copy of the peer review Strategy is **attached** to this memorandum as **Attachment A**. The recommendations from this report were presented to Council in September of 2023, and are summarised in the "Mangawhai Wastewater Scheme Report" attached to this memorandum as **Attachment B**. An extract from the Minutes of the recommendations and approval by Elected Members in October of 2023 is **attached** to this memorandum as **Attachment C**.
- 3.2** The Council's planning in relation to the MCWWS wastewater network is currently summarised in the 16 Dec 2022 "Wastewater Servicing Strategy – Issue 2" report. A copy of this report is

attached to this memorandum as **Attachment D**. This report includes details around planned upgrades to the wastewater network where the PPC84 development would connect.

- 3.3** The MCWWS was first commissioned in 2009 to service Mangawhai Village and Mangawhai Heads. The key driver for commissioning the scheme in 2009 was to reduce reliance on septic tanks, and improve the water quality of the Mangawhai Estuary.
- 3.4** When the MCWWS was first commissioned in 2009, approximately 800 properties connected. As of October 2023 there were 2,764 properties connected.
- 3.5** In terms of the general layout of the PPC84 area, the proposed development plans include 500 lots to be developed as part of the northern and central part of the site, and a remaining 100 lots to be developed in the southern area of PPC84. **Attached** to this memorandum as **Attachment E** is a map showing the existing wastewater system and the proposed PPC84 development area. Also attached to my memorandum as **Attachment F** is a map showing the growth areas planned to be serviced by the Mangawhai wastewater system, including a 60ha portion of PPC84. **Attached** to this memorandum as **Attachment G** is an aerial photograph of Mangawhai WWTP. The area being addressed by PPC84 – Mangawhai Hills Ltd, site lies approximately 2.6 km southeast of the wastewater treatment plant and it is planned that growth in the site will be serviced by the MCWWS. **Attachment H** provides an aerial photo of the MCWWS wastewater collection and treatment system showing the proposed development layout for PPC84, and where any wastewater from PPC84 would likely connect into the wastewater network.
- 3.6** The Council requires all new development in urban Mangawhai to connect to the MCWWS, and encourages existing development to also connect, due to the improved environmental outcomes from connecting, and on the basis this will result in lower average costs. For existing large lots currently serviced by on-site treatment systems, Council may require connection to the public system upon subdivision of these lots.
- 3.7** The Council intends, over time, to progressively upgrade the capacity of the MCWWS from 3,000 to 3,550 (noting that at the time of this memorandum capacity of 3,550 connections has been achieved) and then 5,470 connections – as per **Attachment B**.
- 3.8** Under the Council’s infrastructure Strategy 2021-2051 the Council is planning to service all growth in Mangawhai using the MCWWS, and planning to progressively increase the capacity of the MCWWS in response to population growth.

### **How is wastewater currently treated at Mangawhai?**

- 3.9** Currently wastewater is treated via the following processes which collectively achieve a Class B level of water quality and comply with the current discharge consent limits:
- (a) Preliminary screening and grit removal.
  - (b) Biological nutrient removal via two Cyclic Activated Sludge System (**CASS**) tanks which address nutrients and organic materials, along with other wastewater constituents. This system was optimized in late 2023, which has resulted in an enhanced performance on nutrient removal making the Mangawhai plant one of the best performing of its kind in New Zealand.

- (c) Most recently an inDENSE system has been added to the CASS tanks to increase their capacity, which is the Stage 1 upgrade referenced above. This has increased the plant capacity to 3,550 connections.
- (d) A third tank has been implemented which initially serves as a peak flow balance tank, but will be converted to a third CASS tank as part of the longer-term upgrade plans. This is expected to occur in 2026/2027.
- (e) Removal of sludge which is then dewatered and hauled to a disposal site.
- (f) Final filtration with sand filters and disinfection with sodium hypochlorite.
- (g) Treated effluent is then pump approximately 12 km to the Brown Farm site where it is discharged into a large holding dam and finally irrigated to land.
- (h) Longer-term capacity upgrades planned for delivery by 2026/2027 will include the addition of ultrafiltration and UV disinfection to achieve a triple barrier disinfection system which is required as part of enhancing the quality to an A-grade water quality classification. This is in alignment with future plans to send higher quality treated effluent to the adjacent Mangawhai Golf Course for irrigation use.

#### **How much capacity is currently remaining at the WWTP?**

- 3.10** The existing treatment plant has a designed capacity for 3,000 connections, recently boosted to 3,550 connections as a result of the Stage 1 upgrade. At present there are approximately 2,764 properties connected to the treatment plant – resulting in an estimated remaining capacity for 786 connections. KDC recently completed an optimization of the current treatment plant in preparation for near-term capacity upgrades which will be implemented in mid-2024, further improving the existing treatment plant performance and effluent quality.

#### **How much extra capacity is to be delivered over the short term (next 3 years) through any funded/consented upgrades?**

- 3.11** The recently completed Stage 1 upgrades have increased the treatment plant capacity from 3,000 to 3,550 connections. This primarily consist of installing an inDENSE system, which has boosted the plant's capacity by addressing current limits on solids handling capacity in the CASS reactors. The inDENSE system was installed in March 2023, and is being commissioned now.

#### **How much capacity is there in the conveyance network? Will it need a new pump station?**

- 3.12** As shown in **Attachment H**, and wastewater from PPC84 would likely be connected into the Mangawhai wastewater network at the general location shown. Wastewater from this general area is pumped to the Mangawhai WWTP via pump station PC-VC which has approximately 90 existing connections (as per Attachment D) with planned upgrades to increase the capacity to 400 connections to service growth out to 2051.

- 3.13** The existing pump station PC-VC has a tested capacity of 7.3 l/s, which is a sufficient capacity for approximately 290 lots that are serviced by a conventional gravity sewer system (estimated Wastewater demand as per KDC & NZS4404 Standards). Assuming there are approximately 90

existing lots serviced by PC-VC, the pump station has additional capacity for another 200 lots that are serviced by gravity sewers. If the additional lots were serviced by a pressure sewer system, PC-VC has sufficient capacity to service an additional 333 lots.

**3.14** The ability to service wastewater network capacity requirements for PPC84 has been assessed against three scenarios as described above:

- (a) Scenario 1 – 500 lots to be serviced by a Mangawhai Hills Ltd private centralized WWTP and network, 100 lots to be serviced by the Mangawhai wastewater network. For this scenario there is likely sufficient capacity in the existing wastewater network to service PPC84.
- (b) Scenario 2 – all 600 lots to be serviced by the Mangawhai wastewater network. This scenario would likely trigger an upgrade requirement for PS-VC and possibly the rising main. This is technically feasible, and subject to further design assessment to confirm the physical scope and associated cost. For this scenario it is recommended to consider servicing the PPC84 area with pressure sewers to minimize the peak flows that have to be conveyed by the public wastewater network.
- (c) Scenario 3 – All PPC84 lots serviced by on-lot septic systems. For this scenario, no upgrades are required for the public wastewater system in order to service PPC84.

***Is there sufficient existing and/or short-term programmed capacity in both conveyancing and treatment plant to take the flows from PPC84?***

**3.15** This question has been assessed against the three potential scenarios for PPC84 as follows:

- (a) Scenario 1 – 500 lots serviced by a private centralized wastewater system implemented by Mangawhai Hills Ltd, 100 lots serviced by the Mangawhai public wastewater system. For this scenario, my technical opinion is that the existing wastewater treatment and network system has sufficient capacity to service 100 lots from PPC84 based on recent plant upgrades, and information provided in the referenced attachments. I have concerns about the concept proposed for the private wastewater system and associated irrigation field to service 500 lots, as I believe the required irrigation area will need to be larger than the proposed 16 ha. I am unsure if the appropriate irrigation limits and associated assessment of effects have been completed as part of the concept design of the private treatment system. I've assumed this is being addressed as part of the private wastewater system resource consent application process with Northland Regional Council.
- (b) Scenario 2 – all 600 lots from PPC84 to be serviced by the public wastewater system. For this scenario, my technical opinion is that this would require:
  - An upgrade of the wastewater conveyance network which is technically feasible;
  - Conversion of the Mangawhai WWTP balance tank to a third CASS reactor; and

- An increase to the treated effluent disposal capacity which is technically feasible.
- (c) Scenario 3 – all lots from PPC84 to be serviced by on-lot septic system. For this scenario, my technical opinion is that this would result in a total development maximum yield of less than 600 lots due to the required minimum lot areas (circa 2,000m<sup>2</sup> to 3,000m<sup>2</sup>) to provide a sufficient onsite primary and secondary irrigation field. There may be further constraints around this option in terms of reduced development yield due to close proximity of the inner harbour and the associated ecological sensitivities.

***Are there any other solutions e.g. holding tanks on-site or private treatment systems? Or a staging rule that limits the number of households to match capacity until upgrades occur?***

- 3.16** Holding tanks can be used as an interim measure but are not ideal due to issues of potential septicity, odour and corrosion risk where the flows enter the public network. This can be mitigated by arranging tanker trucks to transport the stored wastewater to the treatment plant. Staging of development is a preferred means of managing capacity limits in the near term.
- 3.17** Implementation of a private community treatment plant that would service some or all of PPC84 is an option with the following key considerations:
- (a) Ability to obtain a discharge consent and an acceptable treated effluent discharge pathway (e.g. drip irrigation, etc).
  - (b) Agreed plan for long-term treatment system ownership, operations, maintenance and consent compliance oversight.
  - (c) Ability to supply required power to operate system.
  - (d) As an option to current plan for Mangawhai Hills Ltd to implement a private treatment system for 500 lots, it is recommended that consideration be given to negotiating a developer contribution to upgrade the public wastewater system instead – as this may provide overall better value for the Mangawhai community and also reduce long-term operational and compliance risks.

**For larger lots, what's the minimum site size required for private septic tanks – does the Northland Regional Plan set minimums?**

- 3.18** I now briefly address regional council requirements for onsite wastewater disposal, in the event that there is not sufficient capacity in the MCWWS at the time of subdivision or development, and a private community treatment plant was not provided.
- 3.19** The Proposed Regional Plan for Northland 2017 contains rules for discharging treated wastewater to land. It does not specify standards for minimum lot sizes. The Operative Kaipara District Plan 2013 contains standards for minimum lot sizes as regards on-site wastewater systems that apply to residential and rural subdivision as follows:
- (a) Subdivision within the Residential Zone is a Controlled Activity if it meets the following terms for a subdivision:

- Every proposed allotment has a minimum net site area of 600m<sup>2</sup>, where a connection to reticulated wastewater infrastructure is available (excluding Network Utility Allotments); or
- Every proposed allotment has a minimum net site area of 3,000m<sup>2</sup>, where no connection to reticulated wastewater infrastructure is available (excluding Network Utility Allotments).

(b) If more than 10 lots are being created, Integrated Development subdivision is a Discretionary Activity where it complies with the following:

- Where a connection to reticulated wastewater infrastructure is available, the number of total lots obtainable shall be an average of at least 1 lot per 500m<sup>2</sup> of the parent title in the Residential Zone, with a minimum net site area of 375m<sup>2</sup> per lot; or
- Where a connection to reticulated wastewater infrastructure is not available, the number of total lots obtainable shall be an average of at least 1 lot per 3,000m<sup>2</sup> of the parent title in the Residential Zone, with a minimum net site area of 2,000m<sup>2</sup> per lot; or
- Where a connection to reticulated wastewater infrastructure is not available, but a private wastewater system is proposed to be established to serve all lots within the subdivision, the number of total lots obtainable shall be an average of at least 1 lot per 500m<sup>2</sup> of the parent title (excluding area required for wastewater or access lots) in the Residential Zone, with a minimum net site area of 375m<sup>2</sup> per lot.



**ATTACHMENT A**

# Mangawhai CWWTP Options Report Peer Review

## Executive Summary

Kaipara District Council (KDC) operates the sewerage assets for the Mangawhai area which includes sewerage reticulation, Community Wastewater Treatment Plant (CWWTP) and a transfer pipeline to the Lincoln Downs farm. The Lincoln Downs Farm is commonly referred to as Browns Farm.

The current CWWTP includes a cyclic activated sludge (CASS) process followed by filtration and chlorine disinfection. Sludge produced from the plant is dewatered on site.

Beca Hunter H2O was engaged to undertake a peer review of the upgrade options for the CWWTP. WSP previously had explored treatment options and recommended a membrane bioreactor (MBR) process with reuse on the nearby golf course. The MBR process was selected as it could produce a class A effluent required for unrestricted reuse.

Since this time a project team led by SCO consulting has been developing the overall upgrade strategy. The strategy has evolved with class A effluent being beneficially reused on the golf course. Excess effluent in winter or wet weather is planned to be discharge at a new location with a new resource consent and with some being directed to the current Browns Farm irrigation system. This will provide more operational flexibility in low irrigation demand and high flow periods.

A plant capacity assessment was undertaken to assess when the upgrade needed to occur. The current plants capacity will be exceeded by summer of 2024. There is a significant driver to address the capacity in the short term.

For the class A reuse option WSP restricted the review to one option. However, Class A can be provided in other processes configurations. Two alternative options were considered along with the MBR option which included:

- **CASS.** Expanding the existing CASS activated sludge process with extra CASS units to meet capacity combined with a downstream class A system including ultrafiltration, ultraviolet and chlorination disinfection.
- **Continuous.** Continuous activated sludge process with gravity clarifiers combined downstream with a downstream class A system including ultrafiltration, ultraviolet and chlorination disinfection. The current CASS reactors would be converted to continuous bioreactors.

For both the CASS and continuous options the inDense system was considered as a sub option. This system is used to improve the performance of systems which rely on gravity settling in the activated sludge reactor.

Of the two additional options CASS with in Dense was the preferred approach. It was less complex and used less energy and is more likely to meet the immediate capacity restriction in 2024. Therefore, the CASS option was assessed in more detail and its capital cost assessed independently by Alta.

WSP estimated the MBR option previously to be \$34.5 M by 2026. Alta's estimate was \$23.5 M by 2026 for the CASS option which represented a considerable saving. An assessment of key operating costs (power, chemicals and key replacement items) indicates the CASS option was 65% of the cost the MBR approach.

Based on a consideration of each option it was considered the CASS upgrade approach with inDense represented the most optimal approach as it:

- Reuses most of the plant infrastructure and is a well proven technology that is well known to KDC.
- Represents capital and operations cost savings.
- Does not present significant construction risk. The bioreactors structures required are already in place.
- Can be staged with progressive roll out of extra capacity and does not produce stranded assets. The CASS option is more flexible to have capacity added quicker to handle the imminent lack of capacity by 2024. The other options involve significant works which will require more time and it is likely capacity will be exceeded before the option is ready.

- Has the lowest construction commissioning risk and hence capital cost risk. There is no major change to how the process operates. The other options require significant additional recycles and process units on a small brownfield site.

Based on the operating and capital savings and other factors described above it is recommended the CASS option with inDense be adopted.

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# Glossary of Terms

|                    |  |
|--------------------|--|
| ADWF               | Average dry weather flow   |
| BOD                | Biochemical oxygen demand over 5 days                                  |
| COD                | Chemical oxygen demand   |
| DO                 | Dissolved oxygen   |
| EBPR               | Enhanced biological phosphorus removal                                 |
| CWWTP              | Community wastewater treatment plant                                   |
| MLSS               | Mixed Liquor Suspended Solids  |
| NH <sub>3</sub> -N | Ammonia as nitrogen  |
| NO <sub>3</sub>    | Nitrate  |
| NO <sub>2</sub>    | Nitrite  |
| TKN                | Total Kjeldahl nitrogen which is the ammonia and organic nitrogen only |
| TDS                | Total dissolved solids   |
| TN                 | Total nitrogen   |
| TP                 | Total phosphorus   |
| TSS                | Total suspended solids   |
| LRV                | Log reduction value  |
| PAO                | Polyphosphate accumulating organisms                                   |
| PE                 | Persons equivalent   |
| PO <sub>4</sub> -P | Phosphate as phosphorus  |
| KDC                | Kaipara District Council   |
| NO <sub>x</sub>    | Oxidised nitrogen (nitrate + nitrite) as nitrogen                      |
| SRT                | Solids retention time  |
| SVI                | Sludge volume index  |
| UV                 | Ultraviolet  |
| WAS                | Waste activated sludge   |

# 1 Project Overview

## 1.1 Background

Downer operates the Community wastewater treatment plant (CWWTP) for Kaipara District Council (KDC) which treats sewage from the towns of Mangawhai heads and Mangawhai. The treated effluent is pumped to a farm commonly referred to as Browns farm for land discharge through an irrigation system. The Mangawhai CWWTP catchment area experiences a large influx of tourists during the Christmas and New Year's period with the treatment plant beginning to exhibit symptoms of capacity exceedance during these peak tourist periods.

Previously KDC engaged WSP to conduct an options assessment to investigate the best approach to address the capacity constraints at Mangawhai CWWTP. The findings from this investigation were that the plant will reach capacity between 2025 to 2028 depending on growth. Their preferred upgrade option was to convert the cyclic activated sludge (CASS) reactors to a membrane bioreactor process (MBR) to meet the Victorian EPA guideline for water recycling. This involved conversion of the CASS reactors to continuous reactors and installation of an immersed membrane reactor.

Since this time a project team led by SCO consulting has been developing the overall upgrade strategy further. The strategy has evolved with class A effluent being beneficially reused on the golf course. However, excess effluent in winter or wet weather is planned to be discharge at a new location with a new resource consent and with some being directed to the current Browns Farm irrigation system. This will provide more operational flexibility in low irrigation demand and high flow periods.

## 1.2 Project Purpose

KDC have engaged Beca HunterH2O in collaboration with SCO to undertake a peer review of the WSP options assessment prior to further design development. This report will develop and compare treatment options and present the potential risks with each option. A capacity review and suggested way forward will also be presented which will be compared to the preferred option from WSP's options report.

## 1.3 Overview of Plant

Mangawhai is in the KDC area and the operations are managed by Downer. The operations contract consists of management of the treatment plant and the effluent discharge to Browns Farm. The treatment plant consists of the following treatment systems:

- Inlet Screening via sieve screens with capacity up to 160 L/s.
- Two CASS reactors configured as follows:
  - A hydraulically mixed selector and air mixed anoxic zone which is 22% of the volume of each CASS reactor. The third zone is a large open rectangular structure with diffused aeration installed over the entire floor area.
  - Diffused aeration and blower system to provide aeration to the anoxic (periodic) and third zone of the CASS.
  - Wasting is conducted during the settle phase via a waste pump.
  - A 4.4 m decant weir is used to decant clear effluent to the intermediate storage tank
  - Each CASS operates based on a cycle. The total cycle length is typically 4 hours consisting of 120 minutes react (aerobic), 60 minutes settle, 55 minutes decant and 5 minutes idle time prior to restarting the cycle.
- Decant storage tank that collects decanted effluent from the CASS reactors and pumps decanted effluent to the pressure filters.
- Four pressure filters with dual media with a capacity of 6.5 L/s/filter.

- Liquid chlorine is dosed into the filtered effluent to provide disinfection prior to being pumped to Browns Farm for irrigation.
- Waste sludge is collected in the sludge holding and is dewatered using a rotary drainage deck and belt filter press. The flocculant for dewatering is liquid polymer.
- A balance tank the same size as a CASS reactor.

A new balance tank and screen system has been constructed in 2022 and recently commenced commissioning in April 2023. Up to 100 L/s from the catchment is directed a new sieve screen. The balance tank is to enable the plant to periodically receive higher instantaneous flows. The balance tank is of identical dimensions to the other two CASS reactors. This tank could be readily converted to a CASS reactor if needed.

As part of Downer's operations contract there is a requirement to manage the effluent discharge at Browns Farm. This report is limited to an options assessment of the CWWTP only.

## 1.4 Overview of Key Issues

The catchment area for Mangawhai CWWTP experiences highly variable population loadings. During the Christmas holiday peak period the population in Mangawhai can be 3.5 times higher than then non tourist off peak period. Based on a capacity assessment conducted as part of this project, the plant's capacity will be exceeded in the summer of 2024. Exceedance of the capacity can cause the decant to draw solids into the decant storage tank and cause excessive backwashing of the filters or complete bypass.

WSP noted in their report that capacity is exceeded between 2025 to 2028 depending on growth.

## 1.5 Basis of Design

The section below outlines the key design basis for both influent and effluent. All options were assessed against these criteria.

### 1.5.1 Population and Flow Growth

In 2021 WSP undertook sewage quality testing from 20/12/21 to 16/1/22 to assess the load over the peak tourist period and to develop the design basis for the plant. This report included population projections. The population projections were prepared for the Mangawhai sewerage catchment by Formative and adopted by WSP. The projections are shown in Table 1. WSP combined this information in their basis of design report. These projections included a new care home and commercial area.

Formative and WSP developed flow projections based of connection projections using following basis:

- Off peak 1.33 PE/connection and 201 L/PE/d
- Peak tourist 4.88 PE/connection and 113 L/PE/d

The flow projections are provided in Table 1. These projections have been adopted for this options study.



Table 1 – Mangawhai Population and Flow Growth Projections by Formative

| Year          | Total PE |        | Dry Weather Flow (m <sup>3</sup> /d) |       | Peak Wet Weather Flow (L/s) |
|---------------|----------|--------|--------------------------------------|-------|-----------------------------|
|               | Off Peak | Peak   | Off Peak                             | Peak  | 5 x peak dry weather flow   |
| 2021          | 3,193    | 11,751 | 813                                  | 1,333 | 77                          |
| 2023          | 4,191    | 14,014 | 769                                  | 1,564 | 90                          |
| 2028          | 5,597    | 18,032 | 1,045                                | 2,051 | 119                         |
| 2033          | 6,741    | 21,774 | 1,255                                | 2,471 | 143                         |
| 2038          | 7,609    | 24,665 | 1,414                                | 2,793 | 162                         |
| 2043          | 8,266    | 26,849 | 1,534                                | 3,037 | 176                         |
| 2048          | 8,662    | 28,170 | 1,607                                | 3,184 | 184                         |
| 2051          | 8,900    | 28,963 | 1,650                                | 3,272 | 189                         |
| Ultimate 2051 | 9,164    | 29,777 | 1,695                                | 3,362 | 195                         |

### 1.5.2 Sewage Loads

We adopted the following sewage loading per PE to calculate the influent load over time to the CWWTP:

- Chemical oxygen demand (COD) 125 g/PE/d.
- Total Kjeldahl nitrogen (TKN) 12 g/PE/d.
- Total phosphorus (TP) 2.3 g/PE/d.
- Inorganic suspended solids (ISS) 8 g/PE/d.

These align with the values noted in the WSP basis of design report. Slightly different parameters have been used (i.e. COD and ISS and opposed to BOD and TSS) which better align with the requirements of process models. However, they are equivalent to the values WSP adopted.

There is no monitoring available to know what type of organics are present in the sewage. Therefore, typical domestic sewage values were used for the key COD and TKN fractions which are outlined below:

- Fraction of COD which is biodegradable and particulate = 0.2
- Fraction of COD which is unbiodegradable and soluble = 0.07
- Fraction of COD which is biodegradable and soluble = 0.15
- Fraction of TKN which is unbiodegradable and soluble = 0.03

### 1.5.3 Approach to Assessing Load Impacts over the Peak Tourist Period

To better understand the peak tourist load, Beca Hunter H2O undertook an extensive testing regime from late 2022 to early 2023. This supplemented a similar shorter review of sewage loads by WSP over 2021 to 2022. This assessment identified there is a sharp increase in load over Christmas as outlined in Table 1. However, the load is not constant and occurs for a short period and tails off in January. The results from the two sampling periods are provided in Appendix A.

The data collected to date is not comprehensive and does not cover the full tourist period. However, it provides a good basis for understanding the high load periods between Christmas and early January. To estimate the load over the whole holiday period where concentration data is not available, we have produced estimates of the concentrations for periods where data is not available. The values chosen were based on a review of available data.

While the load is high over Christmas to early January period (up to 3.5 times load increase per day), the load increase is not sustained. Activated sludge processes operate over a long solids retention time (SRT) of 15 to 20 days and short-term load increase don't often have a major impact. This presents a challenge to assess the required size of any bioreactor. Steady state modelling approaches often used in plant design will

overestimate the infrastructure size as they assume the loading is constant over many SRT periods. To overcome this, we used the Biowin dynamic simulator and modelled the sludge production to enable us to size the activated sludge process. This was undertaken at an initial 20-day SRT entering the peak period. As the load increased the SRT setting was reduced to 15 days which is acceptable for ammonia removal at the higher temperatures in December and January. This modelling indicated the plant sludge inventory increase would be in the range 1.4 to 1.7 times the level prior to Christmas. The more recent and extensive sampling in 2022 to 2023 indicated the sludge increase could be much lower near 1.3 times.

All options were sized based on a sludge inventory increase in the activated sludge plant in the order 1.5 times the off-peak inventory.

It is recommended sewage sampling continue next holiday period and extend from Christmas day to the end of the holiday period (late January). This will ensure the plant is appropriately sized based a good understanding of how the peak loads are presented to the plant over time.

## 1.6 Effluent Quality

Mangawhai CWWTP currently has a resource consent discharge agreement with the parameters detailed in Table 2. The resource consent notes the plant shall include a granular filtration system and disinfection system. The filtration system must be designed to remove helminths.

The requirements of the consent are outlined in Table 2. The average is based on the last 6 results. The median and 90%ile is based on the last 12 results.

*Table 2 – Mangawhai CWWTP Resource Consent Discharge Parameters*

| Parameter  | Units      | Median | Average | 90th Percentile |
|--|------------|--------|---------|-----------------|
| <b>Group A – Weekly Sampling</b>                     |            |        |         |                 |
| E. coli  | MPN/100 mL | 10     |         | 100             |
| <b>Total Dissolved Solids (TDS)</b>                  | mg/l       |        | 500     |                 |
| <b>Total Nitrogen (TN)</b>                           | mg/l       |        | 30      |                 |
| <b>Total Phosphorous (TP)</b>                        | mg/l       |        | 15      |                 |
| <b>Total Suspended Solids (TSS)</b>                  | mg/l       |        | 10      |                 |
| <b>Carbonaceous Biochemical Oxygen Demand (cBOD)</b> | mg/l       |        | 10      |                 |

## 1.7 Future Effluent Quality Limits

The Browns Farm irrigation fields are nearing capacity, the plan is to produce a class A effluent and reuse it on the Mangawhai Golf Club in future. Class A allows for unrestricted use of effluent. Excess effluent in wet weather or colder months may need to be discharged to the estuary with a new consent.

It is likely the nutrient levels will need to be lower than the current consent for both golf course sustainable use and estuary discharge. Estuary discharge may need to be significantly lower (i.e. < 5 mg/L TN) and require an additional treatment process at the CWWTP or processes such as artificial wetlands at the golf course prior to discharge.

We have assessed the options based on meeting an average TN of less than 10 mg/L and a degree of biological phosphorus removal (~ < 3 mg/L) as it is acceptable for irrigation. The CWWTP can be designed for a much lower median TN of 3 mg/L which is considered the limit of technology, however this presents capital cost challenges and it increases the complexity of operation.

If required additional process can be added to each plant option to improve TN and TP removal. In the case of TN this can be modifications to the MBR and continuous reactors or a bolt on Moving Bed Bioreactor (MBBR) process. Alum or iron salts can be added to the existing options to remove phosphorus in the reactors to 1 mg/L median with no impact on capacity.

It is considered to have greater community acceptance to use constructed wetlands to polish effluent if needed for discharge. If this approach is used additional processes the CWWTP will not be required.

### 1.7.1 Class A Requirements and Recommended Technology Approach

The project has adopted the requirements of the Victorian EPA guidelines for water recycling. This effluent reuse class allows for unrestricted reuse. The requirements are summarised in .

*Table 3 – Class A Victorian Health Guidelines Effluent Quality Requirements*

| Requirement                 | Class A |
|-----------------------------|---------|
| E. Coli median (CFU/100 mL) | <1      |
| BOD median(mg/L)            | <10     |
| TSS median (mg/L)           | <5      |
| pH range                    | 6 - 9   |
| Turbidity median (NTU)      | <2      |
| Virus Log Removal           | 5       |
| Protozoa Log Removal        | 3.5     |
| Bacteria Log Removal        | 4       |

A key requirement of guidelines is the whole process is to meet certain log reduction values (LRV's). LRV's are values given to each unit operation and represent the number of 10 fold reductions (i.e. 1 log = 10 times reduction and 2 log = 10 x 10 = 100 times reduction).

Three pathogens are nominated which include bacteria, protozoa and viruses. Treatment technologies remove each pathogen differently. Table 4 outlines what can be practically expected from each unit operation. The likely total LRV for two options involving membrane and granular media filtration are presented in this table.

To meet the class A LRV requirement a minimum of filtration, UV and chlorination is required. UV is required in combination with filtration and chlorination as it has an ability to easily inactive protozoa. Whereas membrane filtration and chlorination alone cannot meet the LRV for protozoa together.

Granular media filtration can struggle to achieve LRVs without significant investment in monitoring and control. LRVs can be claimed for protozoa if strict turbidity limits are met which can be hard to achieve. For example, a 2.5 log LRV for protozoa is possible with a 90%ile turbidity of < 0.3 NTU. For viruses the LRVs are typically low.

It is likely activated sludge processes with granular media filtration combined with UV and chlorination will struggle to reliably meet the class A LRV requirements. However, ultra-filtration (UF) membranes processes with either MBR or tertiary membranes, UV and chlorination will readily meet the Class A requirement. Therefore, the options in this report only considered ultrafiltration as the filtration barrier.

From our experience the capital cost of membrane versus granular media options is similar. Adopting a membrane approach provides superior LRV removal overall for a similar cost.

Table 4 – Typical LRV's for Unit Operations

| Process Treatment Stage   | LRV Virus  | LRV Protozoa | LRV Bacteria | Comment  |
|---|------------|--------------|--------------|--|
| Bioreactor  | 0          | 0            | 0            | Validation required to claim LRV- Likely 0.5 Bacteria.   |
| MBR (Mixed Liquor)  | 1.5        | 2            | 4            | MBR Can claim the listed LRV's however, can also challenge test to claim more if required.   |
| Granular media filtration (Current Operation)                           | 0          | 0            | 0            | Requires validation testing to claim protozoa or virus LRVs  |
| Pressure Filtration (UF)  | 1.5        | 2            | 4            | This covers both tertiary pressure membranes.  |
| Chlorination  | 4          | 0            | 4            | Maximum possible claim under Victorian guidelines. This can readily be achieved with free chlorination of filtered effluent.                           |
| UV Disinfection   | 0.5        | 3.5          | 3.5          | In line with UV dose as specified by suppliers to meet cryptosporidium removal. Higher doses can be used to target greater removal at much higher cost |
| <b>Total LRVs for Process Configurations versus Class A Requirement</b> |            |              |              |  |
| MBR/Tertiary Membranes + UV+ chlorine                                   | 6          | 5.5          | 11.5         | Exceeds compliance requirements  |
| Granular Media Filter + UV + chlorine                                   | 4.5        | 3.5          | 7.5          | Possible compliance issues with viruses.   |
| <b>Required Victorian Guideline Class A Requirement</b>                 | <b>5.0</b> | <b>3.5</b>   | <b>4</b>     |  |

### 1.7.1 Helminth Removal

Helminths are a parasitic worm that can infect animals exposed to irrigated with effluent. Processes that can remove the helminth ova (i.e. eggs) are required by the consent and most reuse guidelines where animals graze on irrigated land. The Victorian EPA guidelines recommend 4 log removal of helminths. The consent does not specifically quote a removal value, just the filters must remove helminths.

Adoption of ultrafiltration will provide effective removal and ensure this requirement is met if reuse continues to occur at Brown's Farm.

In some options below bypass of the Class A filtration system is expected to occur in wet weather. If treated flows which bypass filtration occur and the effluent is irrigated with animal present, additional helminth barriers are recommended. For Browns Farm it is recommended 25 days (allowed in the Victorian

guidelines) of pond storage be used prior to irrigation. This will mean some volume in the current dam will need to be reserved for helminth removal.

Helminth removal is not considered necessary for the golf course reuse. However, it will be achieved as the recommend class A filtration system (UF membranes) will meet the 4-log removal requirement.

## 2 Current Plant Capacity

A plant capacity assessment has concluded the plant will reach capacity in the Summer of 2024. The capacity is limited by how fast sludge can settle in the CASS. It needs to settle fast enough to avoid sludge being decanted. The high loading in the peak tourist period produces too high a solids concentration to allow effective settling.

Another concern is the sludge is bulking in nature. This can also slow the sludge settling rate. Bulking is measured using the sludge volume index (SVI) and has been historically high near 200 ml/g. Typically in most plants this is less than 150 ml/g. A separate plant audit report prepared by Beca HunterH2O addresses this issue and potential solutions to improve SVI.

## 3 Upgrade Options

### 3.1 Options Considered

The MBR option was the preferred option from the review of options completed by WSP. However, they only considered one class A option which was MBR. The filtration step needed for class A can be provided in other processes configurations other than MBR. Two alternative options were considered along with MBR which included continuing with the CASS approach and using the existing CASS reactors with gravity clarifiers. Both alternative options reuse most of the infrastructure onsite.

The three upgrade options that were considered included:

- **CASS.** The CASS activated sludge process (extra CASS units to meet capacity) combined downstream with ultrafiltration, UV and chlorination disinfection.
- **Continuous.** Continuous activated sludge process with gravity clarifiers combined downstream with ultrafiltration, UV and chlorination disinfection.
- **MBR.** Continuous activated sludge process with immersed membranes for activated sludge separation. This is known as the membrane bioreactor process (MBR). The MBR process is combined downstream with UV disinfection and chlorination disinfection.

For both the CASS and continuous options the inDense system was considered as a sub option. This system is used to improve the performance of systems which rely on gravity settling in the activated sludge reactor. The technology uses a series of hydro cyclones to select for denser floc forming bacteria. It relies on establishing biological phosphorus removal bacteria which produce denser bacteria. Overall, this process can significantly improve the sludge volume index (SVI) to values less than 90 ml/g. This ensures the sludge settles faster and increases the capacity of decant weirs or gravity clarifiers.

The inDense process is currently being trialled at Mangere WWTP and has significantly improved the SVI.

### 3.2 Configuration of Flows for each Option

The Class A processes (filtration, UV and chlorine) was sized for 2.5 x design peak ADWF. Note the sewage is designed to pass 5 x design peak ADWF to the plant. It has assumed the excess wet weather storm flow (above 2.5 times design peak ADWF) will receive secondary treatment followed by chlorine disinfection for CASS and continuous options only. This effluent which bypasses the Class A system will be suitable for grade B uses only such as Browns Farm or discharge.

CASS and continuous options can use either a storm cycle or solids contact bypass to treat storm flows and not change the size of the clarification system. This provides a degree of contact stabilisation with activated sludge at high flows. MBR cannot achieve this and either needs to bypass dilute sewage or provide membranes capable of treating all flows. In the case of MBR, membranes were provided for the full storm peak flow treatment.

#### 3.2.1 CASS Option

##### 3.2.1.1 Overview of the Option

In this option the upgrade is for continued operation of the existing CASS reactors and installation of new CASS reactors to meet capacity as detailed below in upgrade staging. The advantage of this option is that minor modifications can be made to the existing CASS reactors to increase capacity. In all options there has been a modification to increase the decant weir length from 4.4 m to 6 m to allow more process throughput. The increase in weir length increases the area of clear water zone under the weir which lowers the decant approach velocity. This enables the weir to handle more flow before sludge scouring occurs.

##### 3.2.1.2 Staging of the CASS Upgrade

CASS options with and without inDense are presented in Table 5. The upgrade can be staged by progressively adding more CASS reactors which will provide more capacity as growth occurs. The staging is outlined below.

Table 5 – Staged Upgrade Capacities for the CASS Option

| CASS   |                             | CASS with inDense                              |                         |
|--|-----------------------------|--|-------------------------|
| Number of CASS Units                           | Provides Capacity to        | Number of CASS Units                           | Provides Capacity to    |
| 2x CASS units (Current Operation)              | 2024 (2921 connections)     | 2x CASS units                                  | 2028 (3550 connections) |
| 3x CASS Units + additional Sludge Balance Tank | 2042 (5132 connections)     | 3x CASS Units + additional Sludge Balance Tank | 2047 (5464 connections) |
| 4xCASS Units                                   | Ultimate (5672 connections) |  |                         |

Conversion of the existing balance tank onsite to an extra CASS reactor will almost meet the ultimate capacity with inDense. This is a significant advantage for this option as it considerably reduces the construction of new major infrastructure on site.

Beca Hunter H2O’s calculations agree with those presented in WSP’s report of requiring four CASS reactors for 5000 connections. However, our modification of increasing the weir length will mean that three CASS units will meet 5000 connection capacity and 4 will meet the ultimate capacity at 2052.

Presented below are the staging steps for both CASS and CASS with inDense.

### CASS Staging with inDense

If inDense is implemented the following upgrades are required in the following times:

1. Refurbish the existing CASS decant weirs to increase the length and implement inDense by the end of 2024.
2. Retrofit the existing balance tank as an extra CASS system and add the class A system (UF + UV+ chlorination) and construct the golf course pump station by 2028.
3. Construct a new CASS reactor by 2047.

### CASS Only Staging

For CASS only the following upgrades are required in the following times:.

1. Refurbish the existing CASS decant weirs to increase the length and retrofit the existing balance tank as a new CASS reactor by the end of 2024.
2. Add the class A system (UF + UV+ chlorination) and construct the golf course pump station by 2028.
3. Construct a new CASS reactor by 2042.

The staging and site footprint requirements for this upgrade are presented below in Figure 1.





Figure 1 – CASS Staging and Footprint Diagram

### 3.2.2 Continuous Option

In this option the operating level of the CASS reactors will be set at the current top water and a fixed weir established. The internals of the reactor will be modified, and the size of the unaerated zone extended. The aerobic part of the reactor would aerate continuously, and mixed liquor would flow over the fixed weir to settle and separate in two new circular clarifiers. This option requires construction of 2x 20 m diameter clarifiers to separate solids. Return activated sludge (RAS) from the clarifiers will be pumped back and evenly split to each bioreactor.

It is proposed to operate this process in solids contact mode in wet weather. This involves bypassing flows above 3 times peak average design flow to a flocculation zone with sludge post the reactor and then through the clarifiers. This approach provides effective storm treatment of high flows up to 5 x peak average design flow.

Like the CASS option this option would benefit from implementation of inDense with a reduction in clarifier size from 20 to 17 m diameter being the major impact. The upgrade stages are presented below in Table 6.

*Table 6 – Staged Upgrade Capacities for the Continuous Option*

| Continuous (Clarifiers)<br>2 x 20 m diameter           |                             | Continuous (Clarifiers) inDense<br>2 x 17 m diameter   |                             |
|--|-----------------------------|--|-----------------------------|
| Number of CASS units converted to bioreactors          | Provides Capacity to        | Number of CASS units converted to bioreactors          | Provides Capacity to        |
| 2x CASS unit converted reactors and 2x 20 m Clarifiers | 2039 (4874 connections)     | 3x CASS unit converted reactors and 2x 17 m clarifiers | Ultimate (5672 connections) |
| 3x CASS unit converted reactors and 2x 20 m Clarifiers | Ultimate (5672 connections) |  |                             |

This new option presented in Table 6 provides an opportunity to convert the current intermittent process to a continuous process reuse. The advantage of this option is no further signification bioreactor construction is needed as the balance tank can be converted to a reactor.

There is the option of constructing two smaller clarifiers now (2 x 16.3 m diameter) to further stage construction at the initial stage (i.e. 2 CASS reactor and 2 clarifiers). However, this brings forward the final upgrade significantly from 2039 to 2033 for only a minor change in clarifier size.

For this option two clarifiers required for the ultimate capacity need to be constructed at the start of the construction period. This would need to occur to promptly given the current plant’s capacity is likely to be exceeded in 2024.

To deliver this option, the following stages are recommended:

1. Convert the existing balance tank as a new CASS reactor to allow for the existing CASS reactors to be converted. Refurbish the existing CASS decant weirs to increase the length.
1. Construct the clarifiers (as soon as practical).
2. Convert the existing CASS reactors to continuous reactors.
3. Add the class A system (UF + UV+ chlorination) and construct the golf course pump station by 2028.

The key disadvantage of this option compared to the CASS option is conversion of the current balance tank to a CASS reactor is required to provide capacity to construct the option. Later this CASS reactor will be redundant and be converted to a continuous reactor.

The staging and site footprint requirements for this upgrade are presented below in Figure 2.





Figure 2 – Continuous Staging and Site Footprint diagram

### 3.2.3 MBR

The supplier Du Pont worked Beca HunterH2O to develop a membrane solution for this option. The WSP options report showed the membrane system schematically, however no sizing information was provided. For this option to fully explore the complexity we sized the membrane trains with the supplier to enable us to position it on the site.

The MBR is very similar to the continuous option with the same bioreactor configuration used. The key differences are as follows:

- Finer screening to less than 2 mm is required included the need for grit removal prior to the bioreactor. A high level of redundancy of screening is required with a minimum of two screen recommended. Note only one is installed currently. This is a key warranty requirement for immersed membranes. They are subject to fouling and damage from screenings and grit that pass the inlet works.
- A much higher internal RAS flow is needed clear the immersed membranes of mixed liquor. The RAS needs to operate near 3 compared to 1 times inflow for the continuous process with clarifiers. This adds to the complexity of this option as a high flow return stream needs to be fed through a brownfield site to the current CASS structures.
- Separate to the current CASS reactor a smaller separate set of train reactor tanks needs to be constructed to house the immersed membranes. These trains need to be elevated above the current CASS reactor to ensure the trains do not overtop if the RAS pumping system fails.
- Six trains 5.1 m long by 4.1 m wide and 2.45 m deep are required for the ultimate capacity.
- A full standby generator is recommended to power the inlet works, bioreactor and membranes. This is recommended as the MBR processes will not fail safe hydraulically on power failure and the reactor can overtop.

Six MBR trains are required to provide flow turndown from peak flow (5 x peak tourist ADWF) to current minimum diurnal flow.

The bioreactor will be converted to a continuous reactor in a similar way to the continuous option with constant aeration. With MBR only two CASS reactors are required for the ultimate capacity. However, the existing balance tank will need to be converted to a bioreactor to enable it to be run as a MBR process so one other CASS reactor can be converted. The third CASS will not be required, however could function as a balance tank, or be converted to a bioreactor to provide further redundancy in future.

There is the potential to stage the membrane trains. Only 5 trains with membrane internals are required initially for loads up to 2038. With a further 6<sup>th</sup> train required after 2038. However, it is recommended the civil structure for the whole 6 trains be provided now. It will be very difficult to construct a separate small train in 2038 and integrate it with the plant.

A key challenge with the MBR trains is they will be position above the current bioreactors which are several meters above the ground. The floor of the MBR trains would be above the current ground level and require a raised structure with the floor some meters above ground level. This will present construction challenges.

In summary an MBR process while using much of the current infrastructure will require a major investment with most of the ultimate capacity required to be constructed now.

To deliver the MBR option the following upgrade staging is recommended.

1. Build the MBR trains, RAS, clean in place chemical dosing and new inlet works with fine screens and grit removal.
2. Convert the existing balance tank to a bioreactor for operation with the MBR trains.
3. Run on one bioreactor with the MBR and shut down both CASS reactors. Operations on one bioreactor is only recommended for the non-tourist period.
4. Convert on of the two CASS reactor to a bioreactor and connect it to the MBR process.
5. Add the class A system (UV+ chlorination) and construct the golf course pump station by 2028.

The staging and site footprint requirements for this upgrade are presented below in Figure 3.





Figure 3– MBR Staging and Site Footprint Diagram

### 3.3 Operations Cost Comparison

Key operating costs for each option (power, chemicals and limited maintenance items) have been developed to compare options. A summary is provided in .

Table 7 – Comparable Costs for Upgrade Options for Mangawhai CWWTP at 2033

|                     |  | CASS             | Continuous       | MBR              |
|---------------------|--|------------------|------------------|------------------|
| <b>OPEX Class A</b> | Power (\$0.2/kWh)  | \$118K/yr        | \$146K/yr        | \$159K/yr        |
|                     | Chemicals (Disinfection and clean in place)                              | \$24K/yr         | \$24K/yr         | \$33K/yr         |
|                     | Maintenance and Replacements (Membranes, Diffusers, UV Lamp replacement) | \$53K/yr         | \$54K/yr         | \$117K/yr        |
|                     | <b>Total</b>   | <b>\$195K/yr</b> | <b>\$223K/yr</b> | <b>\$309K/yr</b> |

The lowest operating cost is the CASS process. This is driven by the activated sludge process which has low energy use compared to the other two options which require more recycle pumping and other items in the case of MBR.

The MBR process represent the highest operating cost. This cost difference is due to the need to air scour the membrane trains and provide additional chemical cleaning. The clean in place requirements are higher for MBR then the UF membranes used for the other options. More chemical is required to be dosed into the larger volumetric trains of the MBR process.

All membranes have a finite life in the order of 10 years for all options considered. However, up to four times more membrane area is required for MBR due to its lower design flux need to treat all flows. Therefore, over a 10-year period the membrane replacement cost will be higher. This is reflected in the higher annualise maintenance cost below.

### 3.4 Recommended Approach and Capital Cost

Based on a consideration of each option and operations costs it was considered the CASS upgrade approach with inDense represented the most optimal approach as it:

- Reuses most of the plant infrastructure and is a well proven technology that is well known to KDC.
- Represents the lowest operations costs.
- Does not present significant construction risk. The bioreactors structures required are already in place. The balance tank has been designed with identical dimensions to the other CASS units.
- Can be staged with progressive roll out of extra capacity and does not produce stranded assets. The CASS option is more flexible to have capacity added quicker to handle the imminent lack of capacity by 2024. The other options involve significant works which will require more time and it is likely capacity will be exceeded before the option is ready.
- Has the lowest construction commissioning risk and hence capital cost risk. There is no major change to how the process operates. The other options require significant additional recycles and process units on a small brownfield site.

WSP estimated the MBR option previously to be \$34.5 M by 2026. Alta was engaged by KDC to assess the cost of the CASS option. Their estimate was \$23.5 M by 2026 which represented a considerable saving. Based on the operating and capital savings and other factors described above it is recommended the CASS option with inDense be adopted.



## 4 Summary and Recommendations

Beca Hunter H2O was engaged to undertake a peer review of the upgrade options for the Mangawhai CWWTP. WSP previously had explored treatment options and recommended an MBR process, production of a class A effluent and reuse on the local golf course.

Since this time a project team led by SCO consulting has been developing the overall upgrade strategy further. The strategy has evolved with class A effluent being beneficially reused on the golf course. Excess effluent in winter or wet weather is planned to be discharge at a new location with a new resource consent and with some being directed to the current Browns Farm irrigation system. This will provide more operational flexibility in low irrigation demand and high flow periods.

A plant capacity assessment was undertaken to assess when the upgrade needed to occur. The current plants capacity will be exceeded by summer of 2024. There is a significant driver to address the capacity in the short term.

For the Class A reuse option WSP restricted the review to one option. However, Class A can be provided in other processes configurations. Two alternative options were considered along with MBR option which included:

- **CASS.** Expanding the existing CASS activated sludge process with extra CASS units combined with downstream ultrafiltration, UV and chlorination disinfection.
- **Continuous.** Continuous activated sludge process with gravity clarifiers combined downstream with ultrafiltration, UV and chlorination disinfection. The current CASS reactors would be converted to continuous bioreactors.

For both the CASS and continuous options the inDense system was considered as a sub option. This system is used to improve the performance of systems which rely on gravity settling in the activated sludge reactor.

Of the two additional options CASS with inDense was the preferred approach. It was less complex and used less energy and is more likely to meet the immediate capacity restriction in 2024. Therefore, the CASS option was assessed in more detail and its capital cost assessed independently by Alta.

WSP estimated the MBR option previously to be \$34.5 M by 2026. Alta's estimate was \$23.5 M by 2026 for the CASS option which represented a considerable saving. An assessment of key operating costs (power, chemicals and key replacement items) indicates the CASS option was 65% of the cost the MBR approach.

Based on a consideration of each option the CASS upgrade approach with inDense represented the most optimal approach as it:

- Reuses most of the plant infrastructure and is a well prove technology that is well known to KDC.
- Represents the lowest capital and operations cost.
- Does not present significant construction risk. The bioreactor structures required are already in place.
- Can be staged with progressive roll out of extra capacity and does not produce stranded assets. The CASS option is more flexible to have capacity added quicker to handle the imminent lack of capacity by 2024. The other options involve significant works which will require more time and it is likely capacity will be exceeded before the option is ready.
- Has the lowest construction commissioning risk and hence capital cost risk. There is no major change to how the process operates. The other options require significant additional recycles and process units on a small brownfield site.

Based on the operating and capital savings and other factors described above it is recommended the CASS option with inDense be adopted.

It is recommended sewage sampling continue next holiday period and extend from Christmas day to the end of the holiday period (late January). This will ensure the plant is appropriately sized based on a good understanding of how the peak loads are presented to the plant over time.

## 5 References

EPA Victoria, Victorian guideline for water recycling, May 2021

WSP, Mangawhai Community Wastewater Treatment Plant: Future Options Development, 2019

WSP, Mangawhai Community Wastewater Treatment Plant Growth Strategy: Basis of Design for Wastewater Treatment and Disposal, August 2022

## Appendix A. Peak Period Sampling Results

### WSP Sampling over 2021-2022 Christmas Period

| Date       | Flow                | Rain' | Concentration (mg/l) |       |     |                 |      |     |    |
|------------|---------------------|-------|----------------------|-------|-----|-----------------|------|-----|----|
|            | (m <sup>3</sup> /d) | Mm/d  | BOD                  | COD   | TSS | NH <sub>3</sub> | TKN  | DRP | TP |
| 20/12/2021 | 803                 | 0     | 250                  | 640   | 247 | 59.2            | 74   | 6.9 | 10 |
| 29/12/2021 | 1,274               | 1     | 550                  | 1,400 | 628 | 85.5            | 116  | 9.4 | 13 |
| 1/01/2022  | 1,391               | 0     | 510                  | 1,400 | 645 | 86              | 110  | 10  | 13 |
| 5/01/2022  | 1,079               | 0     | 530                  | 1,600 | 667 | 87.3            | 116  | 9.4 | 14 |
| 12/01/2022 | 867                 | 0     | 230                  | 780   | 378 | 62.4            | 83.3 | 7.4 | 13 |
| 17/01/2022 | 777                 | 0     | 400                  | 1,200 | 475 | 75.8            | 96.2 | 8.7 | 13 |
| 24/01/2022 | 680                 | 4.04  | 260                  | 590   | 135 | 87.6            | 101  | 9.7 | 12 |
| 1/02/2022  | 670                 | 3.535 | 270                  | 970   | 300 | 78.5            | 92.1 | 8.4 | 11 |
| 14/02/2022 | 663                 | 0     |                      | 860   | 281 | 71.7            | 93.9 | 8   | 12 |
| 16/02/2022 | 618                 | 0     | 310                  | 1,300 | 500 | 47.5            | 74.7 | 12  | 19 |

### Beca Hunter H2O sampling over the 2022-2023 Christmas Period

| Date       | Flow              | Rain | Concentration (mg/L) |      |     |                 |      |      |  |
|------------|-------------------|------|----------------------|------|-----|-----------------|------|------|--|
|            | m <sup>3</sup> /d | mm/d | cBOD                 | COD  | TSS | NH <sub>3</sub> | TKN  | TP   |  |
| 22/12/2022 | 810               | 0    | 200                  | 570  | 142 | 57.6            | 74.2 | 9.04 |  |
| 23/12/2022 | 869               | 0    | 170                  | 530  | 163 | 57.7            | 76.8 | 10.9 |  |
| 24/12/2022 | 982               | 0    | 210                  | 630  | 169 | 61.4            | 82.9 | 10   |  |
| 25/12/2022 | 950               | 0    | 180                  | 460  | 127 | 65.6            | 73.2 | 9.8  |  |
| 26/12/2022 | 1054              | 0    | 210                  | 490  | 169 | 76              | 83.9 | 10.8 |  |
| 27/12/2022 | 1159              | 0    | 200                  | 540  | 154 | 74.9            | 82.8 | 10.6 |  |
| 28/12/2022 | 1238              | 0    | 200                  | 670  | 186 | 79.4            | 89.9 | 12.4 |  |
| 29/12/2022 | 1264              | 0    | 660                  | 1600 | 700 | 104             | 135  | 19.6 |  |
| 30/12/2022 | 1368              | 0    | 310                  | 940  | 621 | 46.4            | 82.6 | 12.5 |  |
| 31/12/2022 | 1421              | 0    | 180                  | 650  | 155 | 70              | 75.2 | 10.7 |  |
| 1/01/2023  | 1319              | 0    | 200                  | 590  | 169 | 78              | 79.3 | 10.3 |  |
| 2/01/2023  | 1232              | 0    | 510                  | 1100 | 484 | 78.6            | 89.7 | 12.4 |  |
| 3/01/2023  | 1160              | 0    | 340                  | 760  | 354 | 70.9            | 89.1 | 10.1 |  |
| 4/01/2023  | 1090              | 33   | 370                  | 830  | 435 | 62.8            | 92.2 | 11.9 |  |

**ATTACHMENT B**

# Mangawhai Wastewater Scheme Briefing – September 2023 Update

**Meeting:** Council Briefing  
**Date of meeting:** 6 September 2023  
**Reporting officer:** Anin Nama, General Manager Infrastructure Services

## Purpose | Ngā whāinga

To update Elected Members on the progress of the Mangawhai Wastewater Scheme since the last briefing in April 2023.

## Context | Horopaki

The original Mangawhai Community Wastewater Scheme (MWWS), Master Plan Strategy was presented to Council in February 2022. Shortly after the briefing, the Mangawhai Advisory Group (MAG) was established to provide advice on further refinement of the strategy. The main purpose of the MAG was to identify viable solutions for the overall scheme in response to the growth and management of the wet weather flows experienced across Mangawhai. The Master Plan Strategy was also presented to Council at their briefing in December 2022.

The strategy identified that an investment of circa \$90.5M was required over the next 10 years. Given the significant investment, staff commissioned an independent peer review to assess the master plan and conducted a value engineering assessment. The peer review has been conducted by leading experts in wastewater treatment and effluent reuse from Australia and New Zealand who have completed similar treatment system upgrades like the one proposed for Mangawhai and were successfully commissioned.

The team has been asked to confirm the lowest cost pathway for transitioning the MWWS to meet capacity for growth and enhancement of effluent quality for recycled water use at the Mangawhai Golf Course (Course). The peer review identified alternative upgrades that allow for near-term capacity upgrades with an overall capital cost savings of approximately \$20M. This upgrade also minimises construction and operational risk in transitioning the treatment plant to produce class A effluent quality suitable subsurface irrigation.

The Mangawhai wastewater upgrade solutions were presented at the Council briefing on 5 April 2023. The solutions are:

- Stage 1:
  - Optimise the treatment plant
  - Design inDENSE system
  - Implement the inDENSE system
- Stage 2:
  - Design upgrades of the inlet screen, convert the balance tank to a third cyclic activated sludge system (CASS) biological reactor unit and the second inDENSE system
  - Design the ultra-filtration system with UV disinfection system
  - Resource Consent application for the subsurface irrigation
  - Resource Consent application for Brown Road farm
- Stage 3:
  - Golf Course subsurface irrigation
  - Brown Road Farm irrigation optimisation

At the September Council meeting, approval will be sought for the design and implementation of the stage 1 works and the design of stages 2 and 3.

## **Discussion | Ngā kōrerorero**

The following items provide an update on the progress from the last Council briefing, including investigations, ongoing work to optimise the treatment plant, ensuring capacity for growth, resolving the effluent pond structural integrity, and managing the odour issues at the Brown Road Farm effluent irrigation system.

### **Growth projections and available capacity**

The existing Mangawhai Wastewater Treatment Plant (WWTP) has a design capacity for 3,000 connections (residential equivalent). To date, approximately 2,764 connections are served by the WWTP, with the plant reaching capacity by mid to late 2024.

### **Optimisation and staged WWTP upgrades**

Stage 1 works have commenced with the technical team identifying operational issues impacting the performance of the plant. Over the last three weeks, the technical team has managed to resolve these issues by optimising the plant's performance and removing the stress points. The next phase is to design and implement the inDENSE system, increasing the plant's capacity to 3,550 connections. The system allows the plant to tolerate higher flows and loads without compromising the plant's performance. The same technology is being used successfully by Watercare at their Mangere and Warkworth treatment plants. The design is planned to commence in September 2023, with construction planned for early 2024. Technical staff from Watercare are providing advice on the inDENSE system.

It is proposed that the design works (to shovel ready) commence on the stage 2 works for upgrading the inlet works, converting the balance tank to a third CASS biological reactor unit, installing the second inDENSE systems and the ultra-filtration system with UV disinfection system to produce class A effluent. The construction of the works will be delivered by Wai Tāmaki ki Te Hiku (Entity A). The upgrade will bring the capacity to 5,470 connections estimated to be sufficient to cater for growth through to 2047.

### **Disposal Brown Road Farm**

The existing Brown Road Farm will reach capacity by 2026. In addition, there have been several operational issues with the pond with residents complaining of hydrogen sulphide odour and alleged health problems due to the presence of the odour. Given this, the matter has been referred to the Public Health Medicine Specialist/ Medical Officer of Health from Ngā Tai Ora - Public Health Northland. We will update Council and continue to update residents as more information becomes available.

The pond is currently being drained under emergency works. This process has included extensive consultation, monitoring, and sampling to assess the environmental impacts on the stream where the treated wastewater is being discharged. As the pond is being drained, it has become apparent the pond liner is leaking and affecting the structural integrity of the pond. The pond will be fully drained by the end of August and repairs will commence in September 2023.

In the future, the Brown Road Farm irrigation system will be reduced, and the current spraying operation will be replaced with either a wetland system or subsurface irrigation. The long-term treated effluent disposal options will include both the Brown Road Farm and the Golf Course.

### **Mangawhai Golf Course subsurface irrigation**

It is proposed from 2026 the treated wastewater is directed to parts of the Golf Course using subsurface irrigation. Currently, several boreholes and groundwater monitoring probes have been installed and will be monitored over the next 12 months. It is proposed that the design works (to shovel ready) commence on the subsurface irrigation system. The construction of the works will be delivered by Wai Tāmaki ki Te Hiku (Entity A).

## Network upgrades

As growth occurs, new pipelines and pump stations or upgrades will be required over the next 10 - 30 years.

## Project estimate

The table below sets the estimated cost for the Mangawhai Wastewater Scheme.

| <b>Stage 1 - Mangawhai WWTP near term capacity upgrades</b>                          |   |                      |
|--|---|----------------------|
| Element  | Description   | Estimated Cost (P95) |
| inDENSE design & implementation  | Construction and commissioning of the inDENSE system                                | \$735,000            |
| <b>Sub Total</b>   |   | <b>\$735,000</b>     |
| <b>Stage 2 - Mangawhai WWTP Long-term capacity upgrades plus Class A enhancement</b> |   |                      |
| Element  | Description   | Estimated Cost (P95) |
| Design & implementation of Stage 2 upgrades  | Design of balance tank conversion to 3rd CASS unit with inDENSE, and Class A system | \$21,725,000         |
| <b>Sub Total</b>   |   | <b>\$21,725,000</b>  |
| <b>Stage 3 - Browns Farm and Golf Course effluent irrigation systems</b>             |   |                      |
| Element  | Description   | Estimated Cost (P95) |
| Concept design and consent plan development  | Concept design of golf course and Browns Farm (enhancement) irrigation systems      |                      |
| Consent application and consultation   | Consultation and consenting for golf course and enhanced Browns Farm systems        |                      |
| Detailed design  | Detailed design of golf course and Browns Farm systems                              |                      |
| Implementation   | Construction and commissioning of golf course and Browns Farm systems               |                      |
| Design & implementation of Stage 3 upgrades  |   | \$24,450,000         |
| <b>Sub Total</b>   |   | <b>\$24,450,000</b>  |
| <b>Network Upgrades</b>  |   |                      |
| Network Upgrades   |   | Estimated Cost (P95) |
| <b>Sub Total</b>   |   | <b>\$25,000,000</b>  |
| <b>Total</b>   |   | <b>\$71,910,000</b>  |

## Project implementation

It is proposed that stage 1 implementation works will be delivered by June 2024. The remaining stages 2 and 3 will be transferred to Wai Tāmaki ki Te Hiku (Entity A) to deliver.

## Next steps | E whaiake nei

The following next steps are envisaged:

1. Seek Council approval at the September 2023 meeting for the technical team to design and implement the stage 1 works and the design of stages 2 and 3.
2. Complete ongoing optimisation of the Mangawhai Wastewater Treatment Plant by the end of September 2023.
3. Complete the repairs of the Brown Road Farm's effluent irrigation dam.

**ATTACHMENT C**



## **5.2 Mangawhai Wastewater Scheme Stage 1 and 2 Approval – October 2023**

**Moved: Cr Howard**

**Seconded: Cr Lambeth**

That the Kaipara District Council:

- a) Approves stages 1 and 2 for the Mangawhai Wastewater Scheme Project, including the suppliers and individual estimated contract values as listed in Attachment J (provided in full in the public excluded agenda), for a total sum of up to \$1.705m (Excluding GST).
- b) Notes that the funding for this project has been set aside in the 2021/31 Long Term Plan and 2023/24 Annual Plan.
- c) Delegates to the Chief Executive the authority to approve the procurement plan, the professional services agreement with the consortia, and the purchase agreement with World Water Works Inc for the inDENSE system and the installation of the inDENSE by Bellcon Ltd.

**Carried**

**ATTACHMENT D**

Project Number: 1-14129.33

# Mangawhai Wastewater Modelling

## Wastewater Servicing Strategy

16 December 2022

CONFIDENTIAL





## Contact Details

### *Mark de Lange*

WSP  
12 Moorhouse Ave  
Christchurch, 8011  
New Zealand  
T: +64 3 365 0580  
M: +64 27 272 5854  
Mark.delange@wsp.com

### *Document Details:*

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### *Prepared by*

A handwritten signature in black ink, appearing to read 'Mark de Lange'.

Mark de Lange  
Engineer - Water

### *Reviewed by*

A handwritten signature in black ink, appearing to read 'Charlotte Mills'.

Charlotte Mills  
Principal Engineer

### *Approved for release by*

A handwritten signature in blue ink, appearing to read 'Richard Pearson'.

Richard Pearson  
Senior Civil Engineer



## Document History and Status

| Revision | Date       | Author        | Reviewed by     | Approved by     | Status |
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| 1        | 21/05/2022 | Mark de Lange | Charlotte Mills | Alastair King   | Final  |
| 2        | 4/10/2022  | Mark de Lange | Charlotte Mills | Richard Pearson | Draft  |
| 3        | 16/12/2022 | Mark de Lange | Charlotte Mills | Richard Pearson | Final  |

## Revision Details

| Revision | Details  |
|----------|--|
| 1        | Assessment of future development areas                       |
| 2        | Ultimate growth system performance assessment sections added |
| 3        | Upgrades phasing poster added as Appendix D                  |



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## Acronyms and Definitions

| Term             | Definition                                     | Context for this Project   |
|------------------|--|--|
| ADWF             | Average Dry Weather Flow                       |  |
| ARI              | Average Recurrence Interval                    | Estimate of the average period in years between the occurrences of a flood or rainfall event.    |
| GIS              | Geographic Information System                  | Data format of geospatial information input to modelling   |
| High DWF Profile | High Dry Weather Flow Wastewater Profile       | Calibrated dry weather wastewater discharge profile corresponding to peak summertime population. |
| Low DWF Profile  | High Dry Weather Flow Wastewater Profile       | Calibrated dry weather wastewater discharge profile corresponding to the permanent population.   |
| ICM              | Integrated Catchment Modelling                 | The modelling software used for this project (InfoWorks ICM)                                     |
| LiDAR            | Light Detection and Ranging                    | Remote sensing method used to develop ground surface used in modelling.                          |
| PDWF             | Peak Dry Weather Flow                          | Measure of peak daily flow in the wastewater network.  |
| PWWF             | Peak Wet Weather Flow                          | Measure of peak flows in the wastewater network as a result of rainfall ingress.                 |
| MCWS             | Mangawhai Community Wastewater Scheme          | Common scheme name   |
| CWWTP            | Mangawhai Community Wastewater Treatment Plant | Common wastewater treatment plant name   |
| NZTM             | New Zealand Transverse Mercator 2000           | Model coordinate system.   |
| WWTP             | Wastewater treatment plant                     | Treatment facility for all wastewater conveyed by the MCWS.                                      |



## Disclaimers and Limitations

This report (**'Report'**) has been prepared by WSP exclusively for Kaipara District Council (**'Client'**) in relation to the wastewater servicing strategy for Mangawhai (**'Purpose'**) and in accordance with the Offer of Service dated 18 March 2022. The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

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# 1 Executive Summary

WSP were engaged by Kaipara District Council (KDC) to apply the hydraulic model of the Mangawhai Community Wastewater Scheme (MCWS or the scheme) for use in planning network upgrades to accommodate growth.

## Assessment of Development Areas

As a first stage of this assessment, WSP conducted a detailed review of projected future connections to the MCWS as provided by Formative. This involved sub-dividing future growth areas and loading them to the appropriate gravity sewers and pump stations.

## Ultimate Growth System Performance Assessment

After sub-dividing the growth areas, three ultimate growth scenarios for the year 2051 were defined in the model and system performance assessment was completed for each. Three scenarios were used as a both to assess the system under a range of flow scenarios and to choose the scenario that best aligned with design flows used in design of the CCWWTP .

The three growth scenarios assessed included the following:

- **No Reticulated Water:** 2051 flows based on current per capita wastewater discharges.
- **Reticulated Water for New Development:** 2051 flows based on current per capita wastewater discharges for existing development and as per KDC’s Engineering Design Standards for new growth.
- **Catchment-Wide Reticulated Water:** 2051 flows as per KDC’s Engineering Design Standards for all properties.

A summary of modelled network performance for the three ultimate growth scenarios assessed is presented in Table 1-1.

Table 1-1: Summary of System Performance for Ultimate Growth Scenarios

| Scenario   | Scenario 1<br>(Low Flow)  | Scenario 2<br>(Medium Flow)  | Scenario 3<br>(High Flow)  |
|--|---|--|--|
| DWF Volume to<br>CWWTP (m <sup>3</sup> per<br>day)                   | 2,850   | 4,000  | 5,190  |
| WWF Volume to<br>CWWTP (m <sup>3</sup> )                             | 4,150   | 5,900  | 7,100  |
| WWF Network<br>Spill Volume (m <sup>3</sup> )                        | 26  | 292  | 596  |
| Network Deficiencies   |   |  |  |
| Campbell Park<br>Youth Camp<br>Gravity Surcharge<br>(PS-F catchment) | 160 m of surcharge<br>with 19 m <sup>3</sup> spill                    | 160 m of surcharge<br>with 22 m <sup>3</sup> spill                     | 160 m of surcharge<br>with 39 m <sup>3</sup> spill                     |
| Jack Body Drive<br>Gravity Surcharge<br>(PS-K catchment)             | 70 m of surcharge,<br>peak surcharge level<br>within 0.5 m of surface | 240 m of surcharge,<br>peak surcharge level<br>within 0.5 m of surface | 240 m of surcharge,<br>peak surcharge level<br>within 0.1 m of surface |

| Scenario   | Scenario 1<br>(Low Flow)                                    | Scenario 2<br>(Medium Flow)                                 | Scenario 3<br>(High Flow)                                   |
|--|---|---|---|
| Seabreeze Road Gravity Surcharge (PS-C catchment)                  | 210 m of surcharge, peak surcharge level > 1 m from surface | 210 m of surcharge, peak surcharge level > 1 m from surface | 290 m of surcharge, peak surcharge level > 1 m from surface |
| <b>Pump Station Deficiencies</b>                                   |   |   |   |
| No. of Pump Stations Under Capacity at PWWF                        | 7   | 6   | 8   |
| No. of Pump Stations Under Capacity Resulting in Overflows at PWWF | 1   | 2   | 3   |

**Scenario 2 was carried forward into upgrade optioneering.** The medium flow scenario was selected as it best aligns with peak inflows to the wastewater treatment plant described in the *Mangawhai CCWWTTP Growth Strategy: Basis of Design for Wastewater Treatment and Disposal* (WSP 2022).

### Development of Network Upgrades and Cost Estimates

Network upgrades were developed for ultimate growth (Scenario 2) and interim growth models were developed to determine the phasing of each upgrade. Table 1-2 presents a summary of network upgrades, including phasing, priority and a 95<sup>th</sup> percentile cost estimate.

An upgrade priority has been assigned to each project. Priority rankings are defined as follows:

- **High** – Upgrade resolves a network deficiency that is predicted to result in network overflows or there is no existing reticulation to connect to.
- **Medium** – Upgrade resolves a network deficiency that is predicted to result in surcharge of the gravity network, with the maximum water level within 0.5 m of the ground surface.
- **Low** – Upgrade resolves a network deficiency that is predicted to result in surcharge of the gravity network, with the maximum water level greater than 0.5 m of the ground surface.

‘Class 5’ cost estimates have been developed for each option. These options include a 100% contingency (95th percentile estimate with an accuracy of -50% to + 100%) and are sufficient for long-term budgeting.

*Table 1-2: Summary of MCWS Upgrades and Cost Estimates*

| Growth Phase | Upgrade  | Details                                  | Cost Estimate (95 <sup>th</sup> ile, 2022 NZ Dollars) | Upgrade Priority |
|--------------|--|--|---|------------------|
| 2021-2023    | Upgrade gravity network through Campbell Park Youth Camp | 170 m of 225 PVC pipe and 2 new manholes | \$600,000   | High             |

| Growth Phase | Upgrade   | Details  | Cost Estimate (95%ile, 2022 NZ Dollars) | Upgrade Priority |
|--------------|---|--|---|------------------|
|              | Upgrade gravity network on Seabreeze Road   | 310 m of 225 PVC pipe and 4 new manholes   | \$1,100,000                             | Low              |
|              | Upgrade gravity network on Jack Boyd Drive  | 360 m of 225 PVC pipe and 8 new manholes   | \$1,300,000                             | Low              |
|              | Construct New Pumping Station to Service Mangawhai Central (PS-VD)                  | <b>Phase 1:</b> Construct new pumping station (25 L/s) and emergency storage tank (475 m <sup>3</sup> )<br><br>Construct new rising main connecting to existing PS-VA rising main (assumed 600 m of DN250 PE100, SDR 16) | \$6,800,000                             | High             |
|              | Diversion of PS-K direct to CWWTP   | Construct DN 250 pipeline from existing PS-K rising main direct to CWWTP   | \$900,000                               | Ongoing project  |
| 2023-2028    | Upgrade PS-OF and rising main   | <b>Phase 1:</b> Upgrade pumps for interim capacity (140 L/s)   | \$1,000,000                             | High             |
| 2028-2033    | Upgrade PS-VC and rising main (Required capacity = 16 L/s)                          | Construct new pumping station and emergency storage tank (150m <sup>3</sup> )<br><br>Confirm if electrics require upgrade<br><br>Upgrade rising main: 125 m of DN140 PE pipe (PE100, PN 16)                              | \$2,200,000                             | High             |
|              | Upgrade PS-VA and most upstream section of rising main (Required capacity = 60 L/s) | Instal new duty/ standby pumps<br><br>Upgrade most upstream section (DN 150) of rising main: 990m of 200mm PVC pipe (PN16)<br><br>Confirm if electrics require upgrade   | \$4,600,000                             | High             |
|              | Upgrade of Pumps at PS-K (Required capacity = 45 L/s)                               | Instal new duty/ standby pumps   | \$50,000                                | Low              |
|              | Upgrade rising main from PS-VD connection to PS-                                    | Upgrade rising main from PS-VD connection to PS-   | \$4,290,000                             | Medium           |

| Growth Phase | Upgrade  | Details   | Cost Estimate (95%ile, 2022 NZ Dollars) | Upgrade Priority |
|--------------|--|---|---|------------------|
| 2033-2038    | OF with 1100m of 300mm PVC (PN16)                                  | OF with 1100m of 300mm PVC (PN16)   |   |                  |
|              | Construct New Pumping Station to Service Mangawhai Central (PS-VD) | <b>Phase 2:</b> Upgrade pumps for ultimate flow (55 L/s)                                | \$520,000                               | High             |
|              | Upgrade PS-OF and rising main                                      | <b>Phase 2:</b> Upgrade pumping station and rising main for ultimate capacity (170 L/s) | \$6,200,000                             | High             |

## 2 Introduction

WSP recently built and calibrated a hydraulic model of the Mangawhai Community Wastewater Scheme (MCWS or the scheme) which was then applied to complete a compressive system performance assessment. Details of all previous modelling work completed by WSP are contained in the *Mangawhai Model Build, Calibration and System Performance* report (WSP 2022).

This current report provides details of modelling work completed to aid in network planning to accommodate future development in Mangawhai. Documents that have been reviewed in completing this work include the following:

- Mangawhai Wastewater Network Dwelling: Projections Methodology Technical Report (Formative 2022), see Appendix C.
- Mangawhai Community Wastewater System: Master Plan Strategy (WSP 2021)
- Kaipara District Council's Engineering Standards (KDC 2011).
- Proposed Old Waipu Road Development Wastewater Capacity Assessment memorandum (WSP 2021)

### 2.1 Network Overview

The MCWS provides servicing to approximately 2,100 primarily residential properties. There are two major catchments within the network; Mangawhai Heads and Mangawhai Village.

The majority of wastewater generated within the catchment is conveyed to the Mangawhai Community Wastewater Treatment Plant (CCWWTP) located on Thelma Road. Local reticulation throughout the scheme is a combination of pressure grinder pump systems, gravity network and small pumping stations. All pressure sewer CCWWTP ultimately discharge to the gravity network through which flows are conveyed to the CWWTTP by gravity and the 13 larger pumping stations throughout the scheme.

Figure 2-1 presents an overview of the MCWS, including the locations of key pumping stations, rising mains and the CCWWTP. Figure 2-2 presents a schematic of the connectivity of the pumping stations.



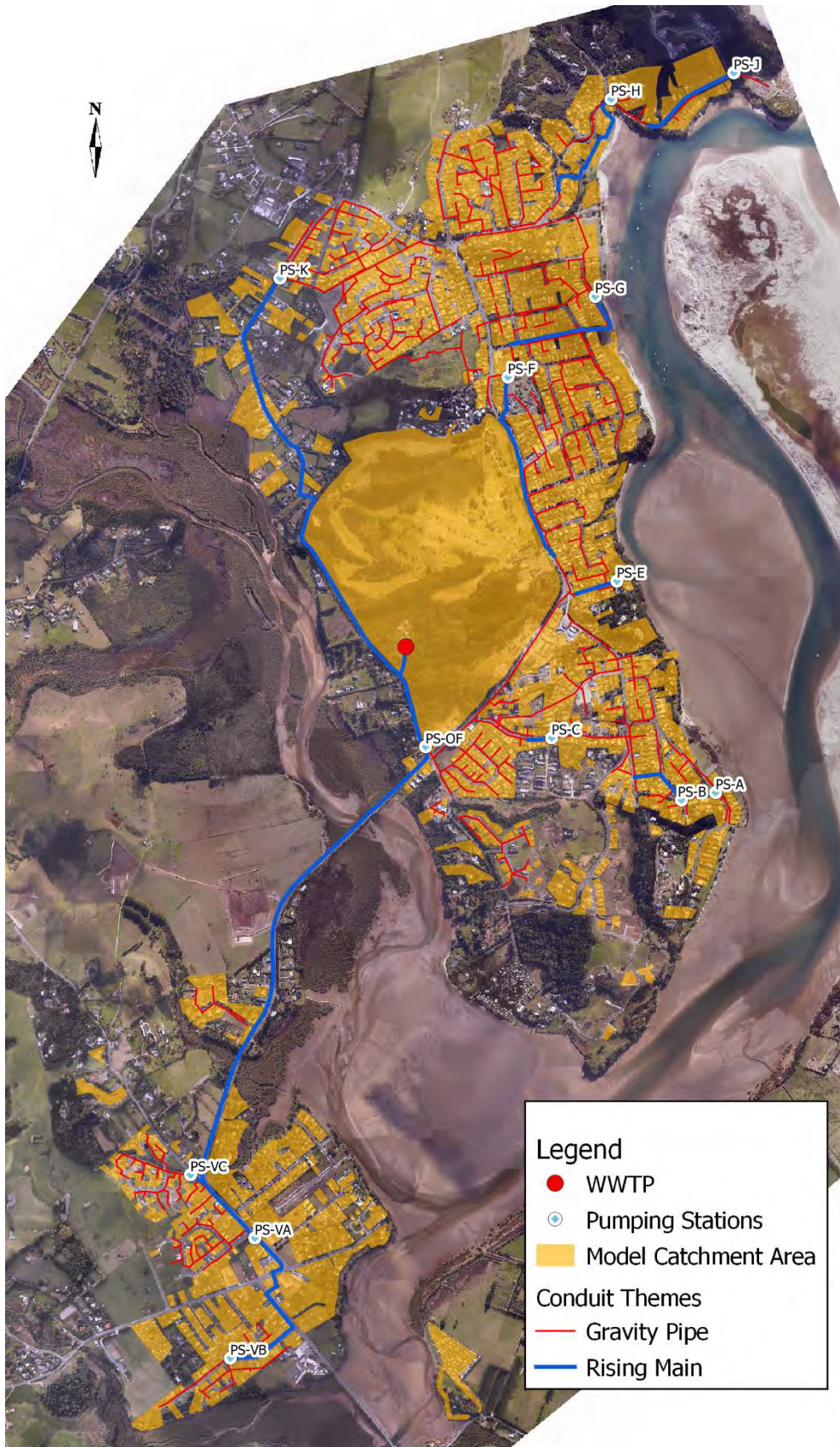


Figure 2-1: Overview of the Mangawhai Community Wastewater Scheme (pressure sewer pipes excluded)

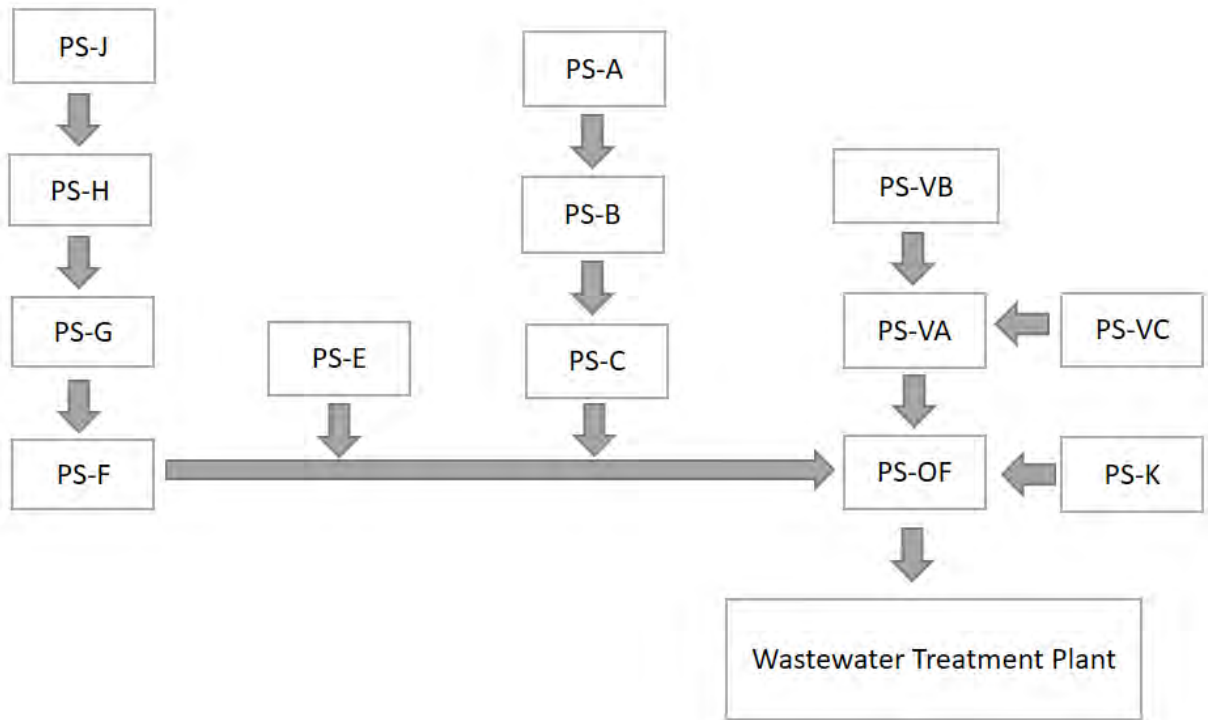


Figure 2-2: MCWS Pumping Station Connectivity Schematic



## 3 Future Growth Areas

### 3.1 Growth Areas Assessment

Growth area extents and associated future wastewater connections provided by Formative were refined in order to be incorporated into growth models. Projected future connections within each pump station catchment were provided on a yearly basis from 2021 to 2051 (Formative 2022).

The approach to extract future development areas is follows:

- GIS was used to extract areas within future pumping station catchments that are beyond the coverage of the existing network.
- New development areas were then further subdivided within pump station catchments such that local catchments could be loaded to the appropriate gravity sewers or pumping stations.
- Connection points of all subdivided growth areas into the existing network were identified (no future growth areas were connected to grinder sewer catchments but rather the nearest downstream gravity sewer or pump station).
- The number of future connections within each subdivided growth area was determined by proportionally dividing the total number of future connections in the pumping station catchment by area. This was completed for ultimate growth (2051) conditions.

### 3.2 Growth Areas Model Loading

Table 3-1 presents a summary of the number of existing and 2051 connections on a pump station catchment basis. In pump station catchments where there was an increase in the number of connections but no increase in coverage area of the pump station, growth is considered infill.

Table 3-1: Summary of Growth by Pump Station Catchment

| PS Name          | 2021 Connections | 2051 Connections | New Connections | Growth Type |
|------------------|------------------|------------------|-----------------|-------------|
| PS-A             | 99               | 118              | 19              | Growth      |
| PS-B             | 40               | 55               | 15              | Infill      |
| PS-C             | 105              | 137              | 32              | Growth      |
| PS-E             | 77               | 97               | 20              | Infill      |
| PS-F             | 154              | 232              | 78              | Infill      |
| PS-G             | 549              | 613              | 64              | Growth      |
| PS-H             | 65               | 85               | 20              | Growth      |
| PS-J             | 48               | 63               | 15              | Infill      |
| PS-K             | 491              | 1000             | 509             | Growth      |
| PS-OF/CWWTP West | 49               | 1177             | 1128            | Growth      |
| PS-OF/CWWTP East | 384              | 887              | 503             | Growth      |
| PS-VA            | 465              | 984              | 519             | Growth      |
| PS-VB            | 85               | 90               | 5               | Infill      |
| PS-VC            | 90               | 400              | 310             | Growth      |

Figure 3-1 presents an overview of loading of growth areas to this existing network. Figures 3-1 to 3-4 present close ups of loading in Mangawhai Heads and Mangawhai Village.

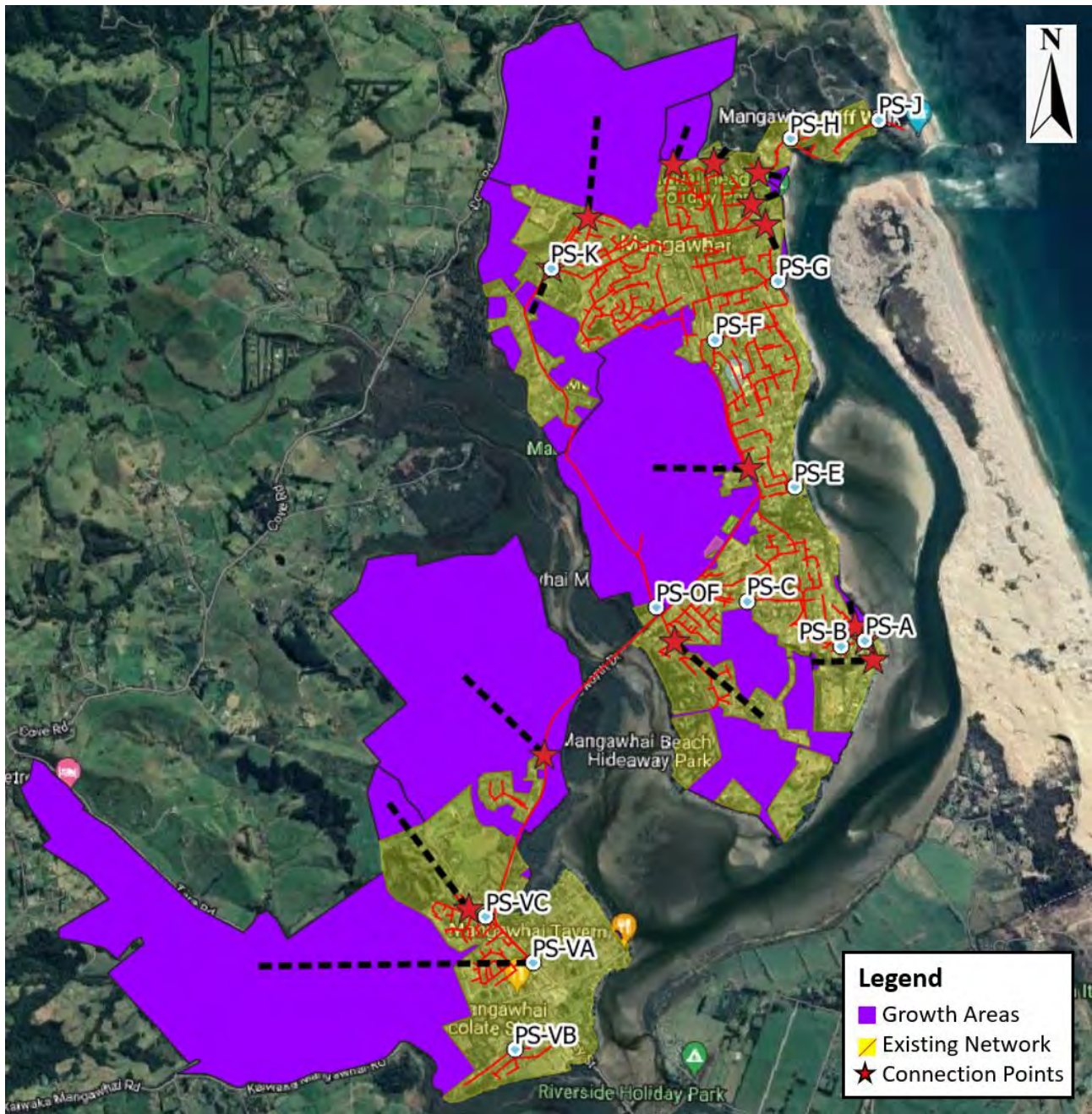


Figure 3-1: Overview of Growth Loading



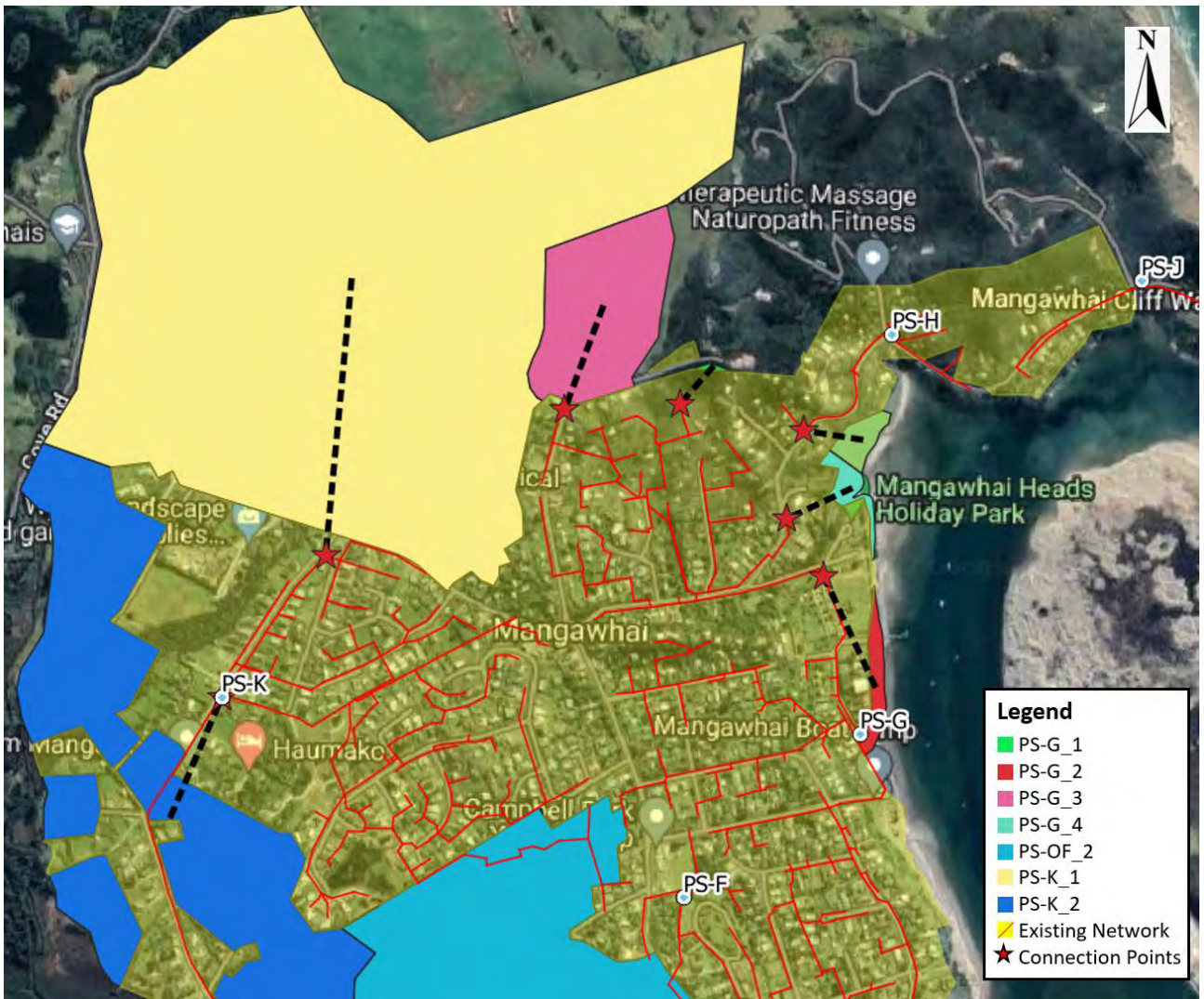


Figure 3-2: Growth Loading for North Mangawhai Heads

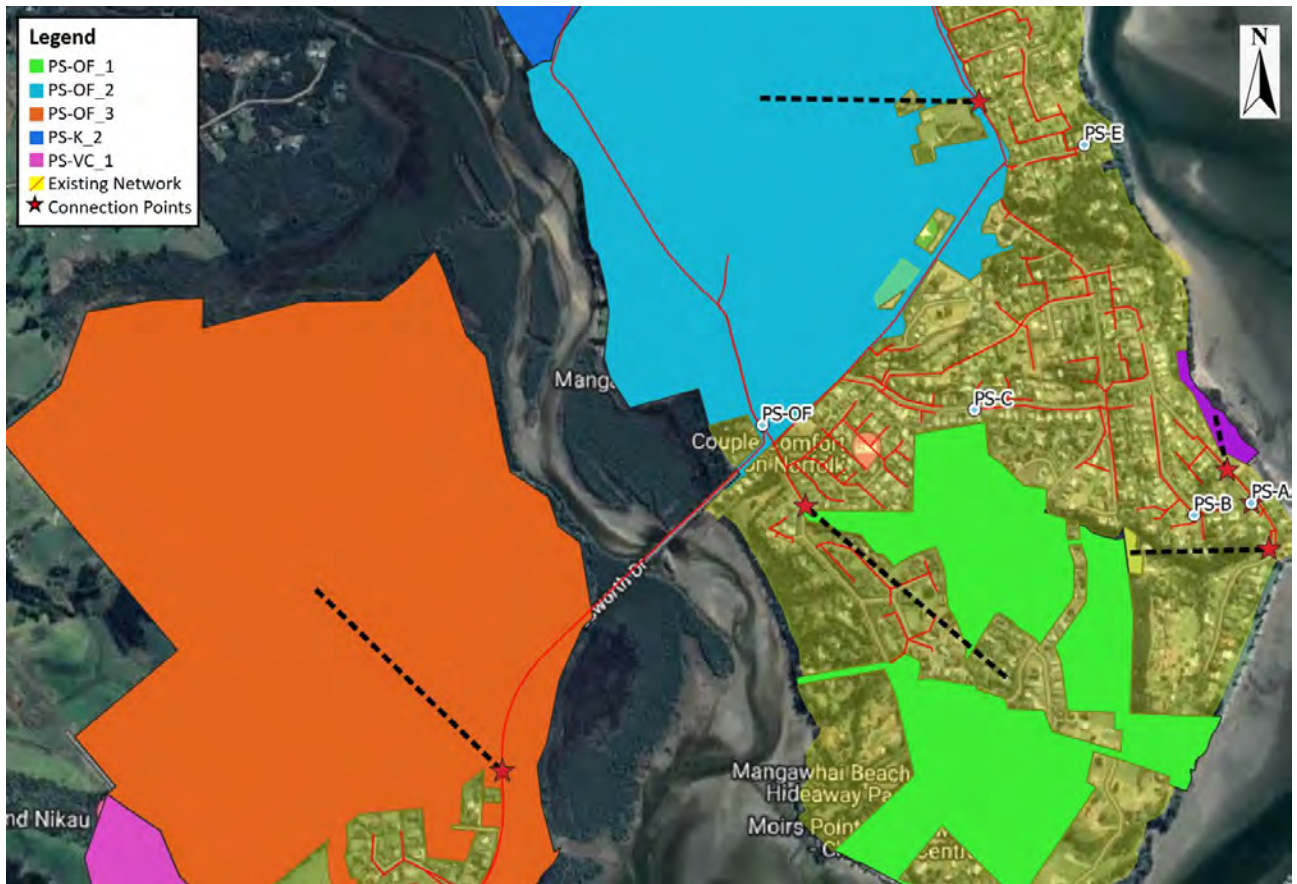


Figure 3-3: Growth Loading for South Mangawhai Heads



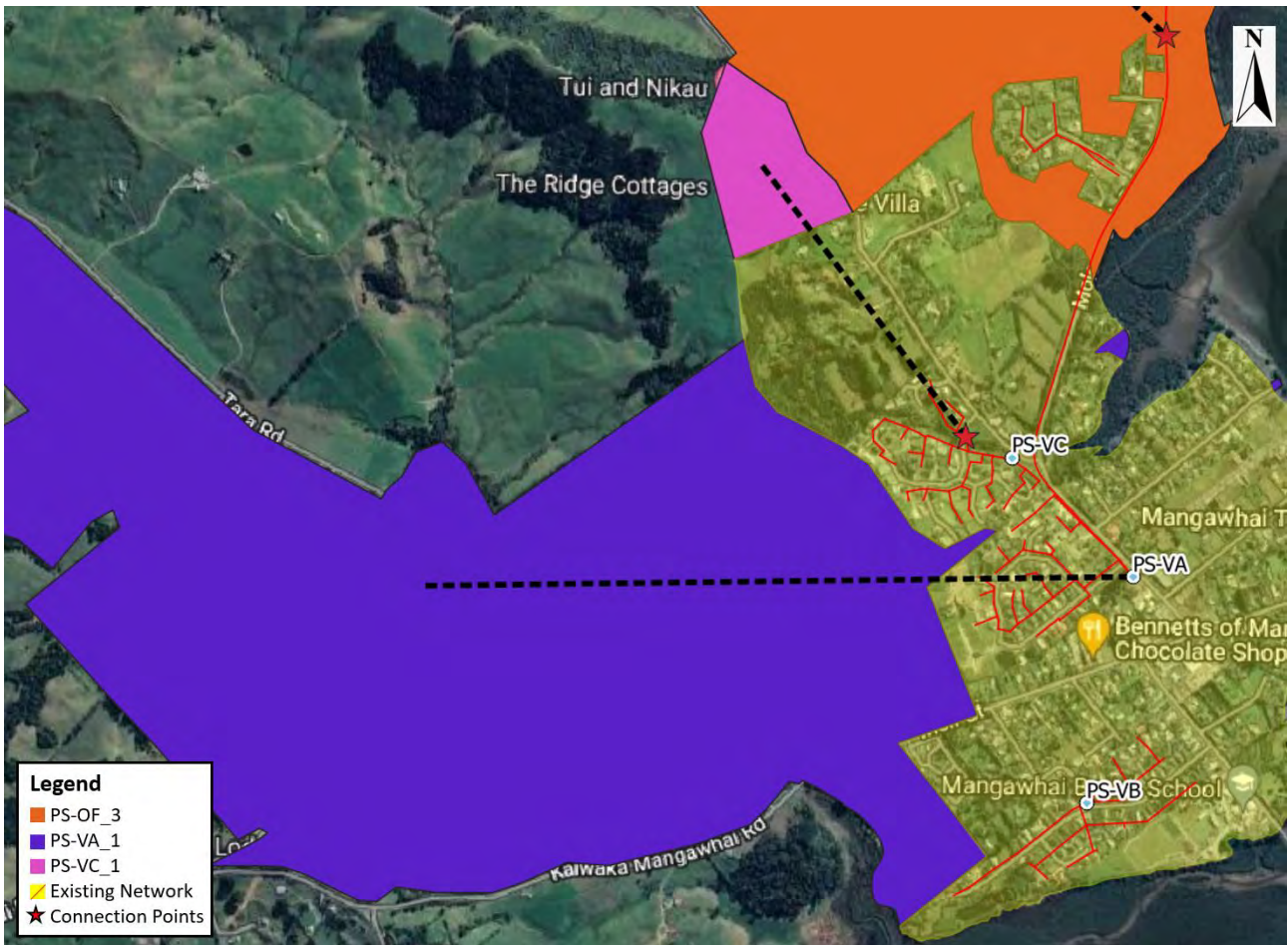


Figure 3-4: Growth Loading for Mangawhai Village

Table 3-2 presents details of the subdivided growth areas and planned connection points to the existing network.

Table 3-2: 2051 Connection Details for Network Expansion Areas

| Area ID | Pump Station Catchment | Model Connection Point | Area (Ha) | 2051 New Connections | Notes  |
|---------|------------------------|------------------------|-----------|----------------------|--|
| PS-A_1  | PS-A                   | 20100701010919         | 0.36      | 4.2                  | Area serviced by pressure sewers. Loaded to the nearest downstream gravity main. |
| PS-A_2  | PS-A                   | 20100701010902         | 1.28      | 14.8                 | Area serviced by pressure sewers. Loaded to the nearest downstream gravity main. |
| PS-G_1  | PS-G                   | 20100701010510         | 0.06      | 0.4                  | Small catchment loaded to gravity network on Kanuka Place.                       |
| PS-G_2  | PS-G                   | 20100701010843         | 0.93      | 5.9                  | Area serviced by pressure sewers. Loaded to the nearest                          |

| Area ID      | Pump Station Catchment | Model Connection Point | Area (Ha)     | 2051 New Connections | Notes   |
|--------------|------------------------|------------------------|---------------|----------------------|---|
|              |                        |                        |               |                      | downstream gravity main.  |
| PS-G_3       | PS-G                   | 20100701010635         | 8.42          | 53.4                 | Loaded to gravity network on Cullen Street.   |
| PS-G_4       | PS-G                   | 20100701011353         | 0.68          | 4.3                  | Area serviced by pressure sewers. Loaded to the nearest downstream gravity main.                  |
| PS-H_1       | PS-H                   | 20100701010806         | 0.76          | 20                   | Area serviced by pressure sewers. Loaded to the nearest downstream gravity main.                  |
| PS-K_1       | PS-K                   | 20090630124952         | 96.39         | 379                  | Loaded to gravity network on Thelma Road North.   |
| PS-K_2       | PS-K                   | PS-K_WW                | 33.06         | 130                  | Area serviced by pressure sewers. Loaded to PS-K.   |
| PS-K_3       | PS-K                   | 20120309130133         | 10.25         | 150                  | Loaded to gravity network on Anchorage Road.  |
| PS-OF_1      | PS-OF/CWWTP East       | 20160115153630         | 47.71         | 350                  | Area serviced by pressure sewers. Loaded to the nearest downstream gravity main on Estuary Drive. |
| PS-OF_2      | PS-OF/CWWTP West       | XXXX000066             | 155.73        | 1128                 | Connected to PS-VA rising main on Molesworth Drive  |
| PS-VA_1      | PS-VA                  | PS-A_WW                | 208.19        | 519                  | Area serviced by pressure sewers. Loaded to PS-VA.  |
| PS-VC_1      | PS-VC                  | 20091020155628         | 7.96          | 310                  | Area serviced by pressure sewers. Loaded to the nearest downstream gravity main on Kahu Drive.    |
| <b>Total</b> |                        |                        | <b>689.14</b> | <b>3072</b>          |   |

Table 3-3 presents details of the number of infill connections for areas where connections have increased but there is no increase in the pump station catchment area. The increased connections in these areas will be distributed evenly across the existing pump station catchments in the growth model scenarios.

Table 3-3: 2051 Connection Details for Infill Areas

| PS Name      | 2051 New Connections |
|--------------|----------------------|
| PS-B         | 15                   |
| PS-C         | 32                   |
| PS-E         | 20                   |
| PS-F         | 78                   |
| PS-J         | 15                   |
| PS-VB        | 5                    |
| <b>Total</b> | <b>165</b>           |

### 3.3 Growth Assumptions

In the above analysis and when developing growth scenarios models WSP will assume the following:

- All growth is zoned as residential and will be treated as such when modelling growth. No commercial flows have been included.
- Growth projections provided by Formative included growth in Mangawhai both within and beyond the future service area of the MCWS. Only growth within MCWS future service area will be considered in this assessment.
- Infill growth will be distributed evenly across existing pump stations catchments. Infill will only be included in catchments upstream of pump stations PS-B, PS-C, PS-E, PS-F, PS-J and PS-VB.
- The connection projections and their distribution used in this assessment are subject to the methodology and associated assumptions detailed in Formative’s report.
- Three ultimate growth scenarios will be represented in the model and performance results reviewed with KDC. Following discussion with KDC, one scenario will be selected for developing network upgrades. The three growth scenarios are:
  - **No Reticulated Water:** 2051 flows based on current per capita wastewater discharges
  - **Reticulated Water for New Development:** 2051 flows based on current per capita wastewater discharges for existing development and as per KDC’s Engineering Design Standards for new growth
  - **Catchment-Wide Reticulated Water:** 2051 flows as per KDC’s Engineering Design Standards for all properties.

## 4 Ultimate Growth System Performance Assessment

### 4.1 Growth Scenarios

Three flow scenarios were used to assess performance of the system under ultimate growth conditions. Low, medium, and high flow growth scenarios were developed as are described in Table 4-1. In each scenario, growth within areas currently serviced by the network was added to existing model subcatchments while new subcatchments were added to represent growth in areas outside of the current service area.

Table 4-1: Detailed Scenario Descriptions

| Scenario  | Growth within Current Catchment Area   | Growth Outside of Current Catchment Area   |
|---|--|--|
| <b>Scenario 1:</b><br>Low Flow (No Reticulated Water)                     | <ul style="list-style-type: none"> <li>Flow for new connections is based on current per capita flowrates within the pump station catchment and is distributed evenly across pump station catchment</li> <li>No changes to dry weather PF (calibrated diurnal pattern)</li> <li>No changes to wet weather peaking factor (calibrated wet weather response)</li> </ul> | <ul style="list-style-type: none"> <li>Flow for new connections is based per capita wastewater discharges as observed at the CWWTP (480 L/connection/day)</li> <li>Dry weather PF = 2</li> <li>Wet weather PF = 2.5</li> </ul> |
| <b>Scenario 2:</b><br>Medium Flow (Reticulated Water for New Development) | <ul style="list-style-type: none"> <li>Same as Scenario 1</li> </ul>   | <ul style="list-style-type: none"> <li>Flow based on KDC Standard (210 L/person/day, 4 people per connection)</li> <li>Dry weather PF = 2</li> <li>Wet weather PF = 2.5</li> </ul>   |
| <b>Scenario 3:</b><br>High Flow (Reticulated Water for New Development)   | <ul style="list-style-type: none"> <li>Flow based on KDC Standard (210 L/person/day, 4 people per connection)</li> <li>No changes to dry weather PF (calibrated diurnal pattern)</li> <li>No changes to wet weather peaking factor (calibrated wet weather response)</li> </ul>  | <ul style="list-style-type: none"> <li>Same as scenario 2</li> </ul>   |

Note: Scenarios 1 & 2 based on additional connections from year 2021 (time of model calibration) to 2051. Scenario based on total number of connections for the year 2051.

### 4.2 Approach to Representing Wastewater Flows

A dynamic diurnal pattern and wet weather response has been used to represent flows from growth outside of the current catchment area. This approach allows the affect of storage and flow attenuation in the network to be represented. Figure 4-1 presents peaking factors that have been applied as are described above in Table 4-1.



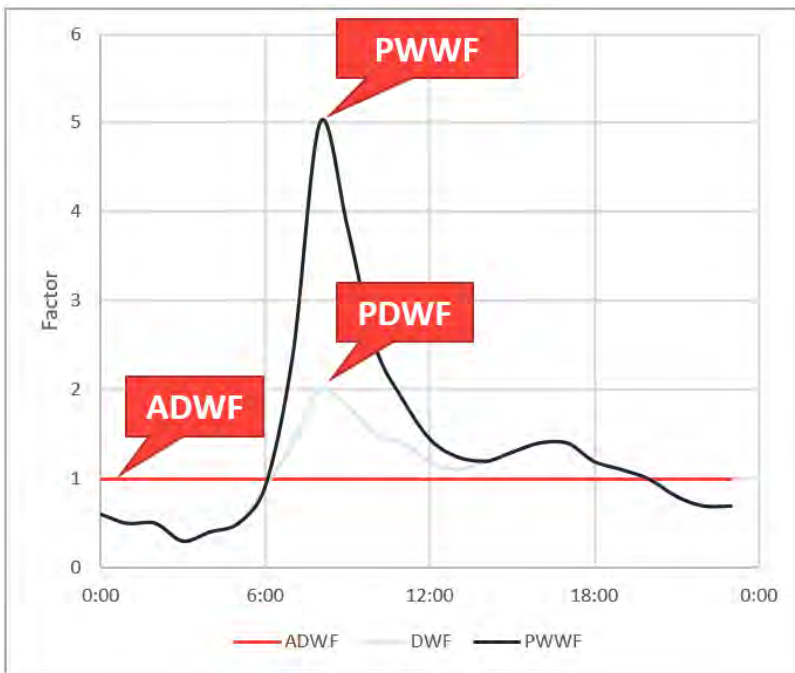


Figure 4-1: Dynamic Peaking Factors Applied in Modelling Flows from Growth Cells

### 4.3 Design Flows for Ultimate Growth

Wastewater design flows for new connections outside of the current catchment are presented below for each growth cell. Table 4-2 presents design flows for Scenario 1, Table 4-3 presents design flows for Scenarios 2 and 3.

Table 4-2: Scenario 1 Wastewater Design Flows for Growth Cells

| Growth Cell ID | Distributed Number of Connections | Average Dry Weather Flow (L/s) | Peak Dry Weather Flow (L/s) | Peak Wet Weather Flow (L/s) |
|----------------|-----------------------------------|--------------------------------|-----------------------------|-----------------------------|
| PS-A_1         | 4.2                               | 0.023                          | 0.047                       | 0.117                       |
| PS-A_2         | 14.8                              | 0.082                          | 0.164                       | 0.411                       |
| PS-C_1         | 0.4                               | 0.002                          | 0.004                       | 0.011                       |
| PS-C_2         | 5.9                               | 0.033                          | 0.066                       | 0.164                       |
| PS-C_3         | 53.4                              | 0.297                          | 0.593                       | 1.483                       |
| PS-C_4         | 4.3                               | 0.024                          | 0.048                       | 0.119                       |
| PS-H_1         | 20                                | 0.111                          | 0.222                       | 0.556                       |
| PS-K_1         | 379                               | 2.106                          | 4.211                       | 10.528                      |
| PS-K_2         | 130                               | 0.722                          | 1.444                       | 3.611                       |
| PS-K_3         | 150                               | 0.833                          | 1.667                       | 4.167                       |
| PS-OF_1        | 350                               | 1.944                          | 3.889                       | 9.722                       |
| PS-OF_2        | 1128                              | 6.267                          | 12.533                      | 31.333                      |
| PS-VA_1        | 519                               | 2.883                          | 5.767                       | 14.417                      |
| PS-VC_1        | 310                               | 1.722                          | 3.444                       | 8.611                       |

Table 4-3: Scenario 2 and 3 Wastewater Design Flows for Growth Cells

| Growth Cell ID | Distributed Number of Connections | Average Dry Weather Flow (L/s) | Peak Dry Weather Flow (L/s) | Peak Wet Weather Flow (L/s) |
|----------------|-----------------------------------|--------------------------------|-----------------------------|-----------------------------|
| PS-A_1         | 4.2                               | 0.041                          | 0.082                       | 0.204                       |
| PS-A_2         | 14.8                              | 0.144                          | 0.288                       | 0.719                       |
| PS-G_1         | 0.4                               | 0.004                          | 0.008                       | 0.019                       |
| PS-G_2         | 5.9                               | 0.057                          | 0.115                       | 0.287                       |
| PS-G_3         | 53.4                              | 0.519                          | 1.038                       | 2.596                       |
| PS-G_4         | 4.3                               | 0.042                          | 0.084                       | 0.209                       |
| PS-H_1         | 20                                | 0.194                          | 0.389                       | 0.972                       |
| PS-K_1         | 379                               | 3.685                          | 7.369                       | 18.424                      |
| PS-K_2         | 130                               | 1.264                          | 2.528                       | 6.319                       |
| PS-K_3         | 150                               | 1.458                          | 2.917                       | 7.292                       |
| PS-OF_1        | 350                               | 3.403                          | 6.806                       | 17.014                      |
| PS-OF_2        | 1128                              | 10.967                         | 21.933                      | 54.833                      |
| PS-VA_1        | 519                               | 5.046                          | 10.092                      | 25.229                      |
| PS-VC_1        | 310                               | 3.014                          | 6.028                       | 15.069                      |

#### 4.4 Commercial Flows

Commercial flows in the Mangawhai Central development have been included in the model as design flows calculated in accordance with KDC's Standards. Table 4-4 summarizes commercial flows and identified a load point for each to the model network.

Table 4-4: Mangawhai Central Commercial Flows

| Development           | Land Use                      | Design Flow (L/s) | Connection Point Description                                  | Model Node |
|-----------------------|-------------------------------|-------------------|---|------------|
| Supermarket           | Industrial - Light Water Use  | 0.11              | PS-VA rising main, just south of estuary bridge (DN 250 PVC)  | XXXX000067 |
| Commercial Building 1 | Industrial - Medium Water Use | 0.02              |   |            |
| Commercial Building 2 | Industrial - Medium Water Use | 0.04              |   |            |
| Commercial Building 3 | Industrial - Medium Water Use | 0.03              |   |            |
| Commercial Building 4 | Industrial - Medium Water Use | 0.11              |   |            |
| Commercial Building 5 | Industrial - Medium Water Use | 0.02              |   |            |
| Commercial Building 6 | Industrial - Medium Water Use | 0.02              |   |            |
| Bunnings              | Industrial - Light Water Use  | 0.21              | PS-VA rising main at approx. 78 Molesworth Drive (DN 250 PVC) | XXXX000066 |
| Mobil Petrol Station  | Industrial - Light Water Use  | 0.02              |   |            |

## 4.5 Baseline Model Updates

KDC has an ongoing project to divert flows from PS-K away from PS-OF and directly to the CCWWTP inlet works. This has been represented in the model assuming the diversion pipe will be a 225 mm MDPE pipe (internal diameter = 173 mm) to match the upstream section of rising main. This new section of pipeline is 120 m long, diverting from the existing rising main path at the entrance to the CCWWTP. Figure 4-2 presents the proposed rising main diversion as presented in WSP's *PS-K Diversion to CCWWTP memo* (WSP 2022).



Figure 4-2: PS-K Diversion Alignment (Indicative Only) (WSP 2022)

The outlet elevation of the diversion pipe to the CCWWTP has been assumed to be 21 m AD which is the same level as the outlet of the PS-OF rising main connection point. The existing outlet of the PS-K rising main to PS-OF is 13.92 m AD.

Following the proposed diversion, at full speed, pumps at PS-K have a predicted capacity of 34 L/s (WSP 2022).

## 4.6 Ultimate Growth System Performance Assessment

The following sections provide details of the system performance for the three ultimate growth scenarios described above.

### 4.6.1 Design Rainfall

As described in the *Mangawhai Wastewater Model Build, Calibration and System Performance Assessment* report (WSP 2022) the design event for the Mangawhai Heads portion of the catchment is the 10 year, 1-hour event and the design event for the Mangawhai Village portion of the catchment is the 10 year, 24-hour event (both PMP distribution). When assessing 2051 conditions climate change adjusted rainfall has been used (RCP8.5 for the period 2031-2050). 1 and 24 hour rainfall hyetographs used in assessing the ultimate growth scenarios are presented on Figure 4-3 and Figure 4-4 respectively.

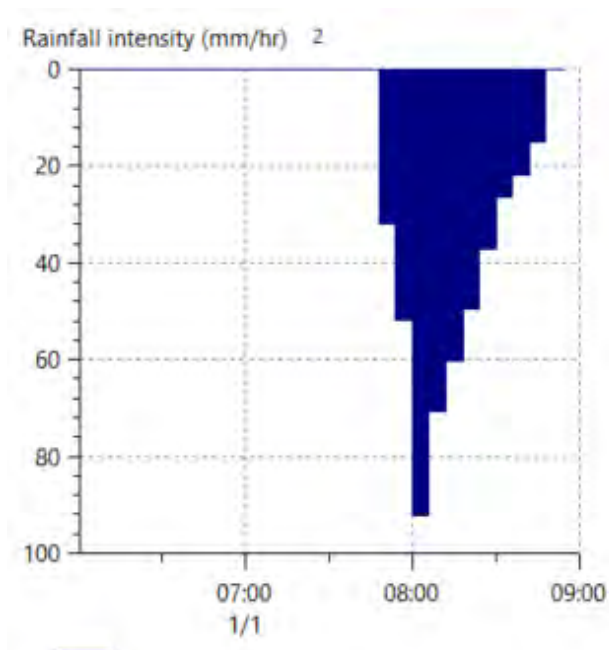


Figure 4-3: 10 Year, 1-hour Rainfall Hyetograph (RCP8.5 for the period 2031-2050)

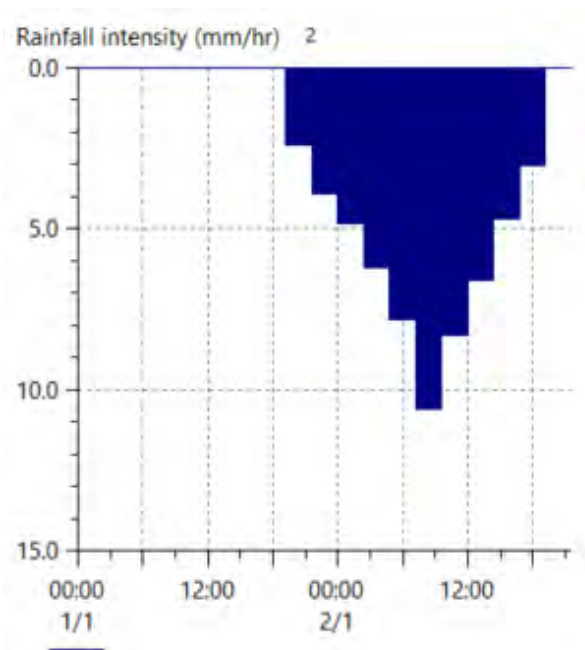


Figure 4-4: 10 Year, 24-hour Rainfall Hyetograph (RCP8.5 for the the period 2031-2050)

#### 4.6.2 Gravity Network Performance

Details of gravity network constraints, and any resulting network overflows, for each scenario are described below.

##### 4.6.2.1 Scenario 1

The following network performance issues were identified under peak wet weather flow conditions for Scenario 1:

- **Surcharge of gravity network through Campbell Park Youth Camp with Overflows Predicted:** The gravity pipe downstream of the PS-G rising main is predicted to surcharge resulting in a predicted spill volume of 19 m<sup>3</sup> (Manhole ID: 20100701011238).
- **Surcharge of Gravity Network on Seabreeze Road:** Approximately 210 m of the gravity network upstream of PS-C (manhole ID: 20100701011203 to manhole ID: 20100701011413) is predicted to surcharge due to limited pipe capacity. The maximum depth of surcharge is greater than 1 m from the surface.

##### 4.6.2.2 Scenario 2

The following network performance issues were identified under peak wet weather flow conditions for Scenario 2:

- **Surcharge of Gravity Network on Jack Body Drive:** Approximately 240 m of the gravity network upstream of PS-K is predicted to surcharge due to limited pipe capacity. No overflows are predicted however the surcharge level is within 0.5 m of the ground surface.
- **Surcharge of gravity network through Campbell Park Youth Camp with Overflows Predicted:** The gravity pipe downstream of the PS-G rising main is predicted to surcharge resulting in a predicted spill volume of 22 m<sup>3</sup> (Manhole ID: 20100701011238).
- **Surcharge of Gravity Network on Seabreeze Road:** Approximately 210 m of the gravity network upstream of PS-C (manhole ID: 20100701011203 to manhole ID: 20100701011413) is

predicted to surcharge due to limited pipe capacity. The maximum depth of surcharge is greater than 1 m from the surface.

#### 4.6.2.3 Scenario 3

The following network performance issues were identified under peak wet weather flow conditions for Scenario 3:

- **Surcharge of Gravity Network on Jack Body Drive:** Approximately 240 m of the gravity network upstream of PS-K is predicted to surcharge due to limited pipe capacity. No overflows are predicted however the surcharge level is within 0.1 m of the ground surface.
- **Surcharge of gravity network through Campbell Park Youth Camp with Overflows Predicted:** The gravity pipe downstream of the PS-G rising main is predicted to surcharge resulting in a predicted spill volume of 39 m<sup>3</sup> (Manhole ID: 20100701011238).
- **Surcharge of Gravity Network on Seabreeze Road:** Approximately 290 m of the gravity network upstream of PS-C (manhole ID: 20100701011203 to PS-C) is predicted to surcharge due to limited pipe capacity. The maximum depth of surcharge is greater than 1 m from the surface.

#### 4.6.3 Wastewater Treatment Plant Inflows

Table 4-5 presents predicted inflows to the CCWWTP for Scenarios 1 to 3 for dry weather flow and the design rainfall event.

Table 4-5: CCWWTP Inflows for Ultimate Growth Scenarios

| Scenario   |                                   | Base  | Scenario 1 | Scenario 2 | Scenario 3 |
|--|-----------------------------------|-------|------------|------------|------------|
| Average Dry Weather Volume (Peak Summertime) (m <sup>3</sup> ) |                                   | 1,120 | 2,850      | 4,000      | 5,190      |
| Wet Weather Volume 1 in 10 Year ARI (m <sup>3</sup> )          | Mangawhai Heads (1 hour event)    | 850   | 1,590      | 2,040      | 3,020      |
|  | Mangawhai Village (24 hour event) | 750   | 2,350      | 3,650      | 3,870      |
|  | Total                             | 1,600 | 3,940      | 5,690      | 6,890      |

#### 4.6.4 Pump Station Performance

Table 4-6 presents modelled pump station inflows for existing and the three ultimate growth scenarios. Cell colours indicate the following:

- **Yellow:** Peak inflows exceed pump capacity
- **Orange:** Peak inflows exceed pump capacity resulting in emergency storage being used
- **Red:** Peak inflows exceed pump capacity resulting in network overflows

Table 4-6: Pump Station Inflows for Ultimate Growth Scenarios

| PS Name | Tested Pump Capacity (L/s) | Base ADWF (L/s) | Base PDWF (L/s) | Peak Wet Weather Flow 1 in 10 Year ARI (L/s) |            |            |            |
|---------|----------------------------|-----------------|-----------------|--|------------|------------|------------|
|         |                            |                 |                 | Base   | Scenario 1 | Scenario 2 | Scenario 3 |
| PS-A    | 8.0                        | 0.3             | 5.3             | 6.3  | 6.8        | 7.7        | 10.5       |
| PS-B*   | 8.7/ 8.6                   | 0.4             | 7.9             | 12   | 13         | 11.6       | 12.9       |
| PS-C    | 10.7/ 10.7                 | 0.7             | 5.2             | 10.8   | 11.0       | 11.1       | 12.2       |
| PS-E*   | 9.5                        | 0.3             | 3.7             | 5.8  | 3.9        | 3.9        | 7.1        |

| PS Name   | Tested Pump Capacity (L/s) | Base ADWF (L/s) | Base PDWF (L/s) | Peak Wet Weather Flow 1 in 10 Year ARI (L/s) |            |            |            |
|-----------|----------------------------|-----------------|-----------------|--|------------|------------|------------|
|           |                            |                 |                 | Base   | Scenario 1 | Scenario 2 | Scenario 3 |
| PS-F*     | 36.1/ 35.8                 | 3.2             | 11.7            | 22.8   | 26.8       | 27.1       | 27.4       |
| PS-G      | 33.6/ 34.3                 | 2.4             | 8.5             | 32   | 40.8       | 31.5       | 38.4       |
| PS-H      | 6.9/ 7.3                   | 0.3             | 8.7             | 16.3   | 17.7       | 18.2       | 18.3       |
| PS-J*     | 9.5                        | 0.1             | 4.3             | 6.1  | 6.1        | 6.0        | 8.2        |
| PS-K      | 32.0/ 33.2                 | 2.3             | 11.8            | 20   | 25.1       | 29.7       | 30.0       |
| PS-OF     | 100                        | 13.0            | 103.8           | 128.4  | 126        | 142        | 150        |
| PS-VA     | 37.5/ 40                   | 3.8             | 27.1            | 34.2   | 47.6       | 52.0       | 52.6       |
| PS-VB* ** | 7.4/ 6.7                   | 0.2             | 0.5             | 1.3  | 1.4        | 1.4        | 2.4        |
| PS-VC**   | 7.3/ 6.6                   | 0.2             | 2.5             | 3.7  | 11.0       | 16.0       | 17.2       |

\* Pump capacity not tested and therefore pump capacity has been sourced from as built drawings

\*\* Pump station does not have emergency storage

It is noted in Table 4-6 that peak inflows to PS-G do not increase from the low to high flow scenarios, but rather are highest for Scenario 1 and lowest for Scenario 2. This is due to the modelled timing of pump cycles at upstream pump station and in pressure sewer catchments (which have been represented simplistically). This only occurs for a short duration and does not represent a capacity constraint in the network (no rise in the wet well level is predicted).

Scenario specific details of pump station capacity constraints and resulting network overflows are described below.

#### 4.6.4.1 Scenario 1

The following network performance issues were identified under peak wet weather flow conditions for Scenario 1:

- **PS-OF Under Capacity:** The sum of peak inflows to PS-OF is 126 L/s (tested pump capacity = 65 L/s) for the 1 hour event. No overflows are predicted however both emergency storage tanks at PS-OF are used.
- **PS-VC Under Capacity with Overflows Predicted:** Peak predicted inflows are 11.0 L/s (tested pump capacity = 7 L/s) resulting in a predicted spill of 7 m<sup>3</sup> from a manhole on Old Waipu Road (Manhole ID: 20091020152523)

#### 4.6.4.2 Scenario 2

The following network performance issues were identified under peak wet weather flow conditions for Scenario 2:

- **PS-OF Under Capacity with Overflows Predicted:** The sum of peak inflows to PS-OF is 142 L/s (tested pump capacity = 65 L/s) for the 1 hour event. Both emergency storage tanks at PS-OF are used and two manholes on Estuary Drive are predicted to overflow with a spill volume of 106 m<sup>3</sup> (manhole IDs: 20100701011433 and 20100701011439).
- **PS-VA Under Capacity with Overflows Predicted:** Peak predicted inflows are 52.0 L/s (tested pump capacity = 40 L/s) resulting in a predicted spill of 1.7 m<sup>3</sup> from the wet well and emergency storage (old wet well).



- **PS-VC Under Capacity with Overflows Predicted:** Peak predicted inflows are 16.0 L/s (tested pump capacity = 7 L/s) resulting in a predicted spill of 163 m<sup>3</sup> from a manhole on Old Waipu Road (Manhole ID: 20091020152523)

#### 4.6.4.3 Scenario 3

The following network performance issues were identified under peak wet weather flow conditions for Scenario 3:

- **PS-OF Under Capacity with Overflows Predicted:** The sum of peak inflows to PS-OF is 150 L/s (tested pump capacity = 65 L/s) for the 1 hour event. Both emergency storage tanks at PS-OF are used and two manholes on Estuary Drive are predicted to overflow with a spill volume of 350 m<sup>3</sup> (manhole IDs: 20100701011433 and 20100701011439).
- **PS-VA Under Capacity with Overflows Predicted:** Peak predicted inflows are 52.6 L/s (tested pump capacity = 40 L/s) resulting in a predicted spill of 5.5 m<sup>3</sup> from the wet well and emergency storage (old wet well).
- **PS-VC Under Capacity with Overflows Predicted:** Peak predicted inflows are 17.2 L/s (tested pump capacity = 7 L/s) resulting in a predicted spill of 201 m<sup>3</sup> from a manhole on Old Waipu Road (Manhole ID: 20091020152523).

### 4.7 Ultimate Growth System Performance Assessment Conclusions

A summary of network performance for the three ultimate growth scenarios assessed is presented in Table 4-7.

Table 4-7: Summary of System Performance for Ultimate Growth Scenarios

| Scenario  | Scenario 1  | Scenario 2   | Scenario 3   |
|---|---|--|--|
| DWF Volume to CWWTP (m <sup>3</sup> per day)                | 2,850   | 4,000  | 5,190  |
| WWF Volume to CWWTP (m <sup>3</sup> )                       | 4,150   | 5,900  | 7,100  |
| WWF Network Spill Volume (m <sup>3</sup> )                  | 26  | 292  | 596  |
| Network Deficiencies  |   |  |  |
| Campbell Park Youth Camp Gravity Surcharge (PS-F catchment) | 160 m of surcharge with 19 m <sup>3</sup> spill                 | 160 m of surcharge with 22 m <sup>3</sup> spill                  | 160 m of surcharge with 39 m <sup>3</sup> spill                  |
| Jack Body Drive Gravity Surcharge (PS-K catchment)          | 70 m of surcharge, peak surcharge level within 0.5 m of surface | 240 m of surcharge, peak surcharge level within 0.5 m of surface | 240 m of surcharge, peak surcharge level within 0.1 m of surface |
| Seabreeze Road Gravity Surcharge (PS-C catchment)           | 210 m of surcharge, peak surcharge level > 1 m from surface     | 210 m of surcharge, peak surcharge level > 1 m from surface      | 290 m of surcharge, peak surcharge level > 1 m from surface      |
| Pump Station Deficiencies                                   |   |  |  |

| Scenario   | Scenario 1 | Scenario 2 | Scenario 3 |
|--|------------|------------|------------|
| No. of Pump Stations Under Capacity at PWWF                        | 7          | 6          | 8          |
| No. of Pump Stations Under Capacity Resulting in Overflows at PWWF | 1          | 2          | 3          |

The following additional system performance issues were identified under existing conditions in the *Mangawhai Model Build, Calibration and System Performance* report (WSP 2022):

- Limited emergency storage (less than 8 hours dry weather flow following pump failure) was identified at pump stations PS-B, PS-F, PS-G, PS-OF and PS-VA. Limited storage at these sites will be exacerbated by growth, and additional pump stations not listed here will likely have insufficient storage capacity under ultimate flows
- At pump stations PS-B, PS-F and PS-H, network asset data indicates the overflow to storage level is below the lowest upstream manhole lid level resulting in overflows before storage is used.

**Scenario 2 was carried forward into upgrade optioneering.** This was agreed at a workshop with KDC held on 7 July 2022. The medium flow scenario was selected as it best aligns with peak inflows to the CCWWTP described in the *Mangawhai CCWWTP Growth Strategy: Basis of Design for Wastewater Treatment and Disposal* (WSP 2022). For the peak week in 2051 the predicted inflows to the CCWWTP presented in this document are 3,362 m<sup>3</sup>.



## 5 Network Upgrades Development

Table 5-1 presents a summary of network deficiencies that were identified in the year 2051 for Scenario 2. In developing upgrade alternatives, an additional capacity constraint was identified at PS-K following the upgrade of the gravity sewer on Jack Boyd Drive, in that peak inflows exceed pump capacity. This deficiency is included in Table 5-1 and was considered when developing upgrades.

An *Upgrade Priority* has been assigned to each deficiency as follows:

- **High** – Deficiency is predicted to result in network overflows or there is no existing reticulation to connect to.
- **Medium** – Deficiency is predicted to result in surcharge of the gravity network with the maximum water level within 0.5 m of the ground surface.
- **Low** – Deficiency is predicted to result in surcharge of the gravity network with the maximum water level greater than 0.5 m of the ground surface.

Table 5-1: Network Deficiencies Carried Forward to Upgrade Optioneering

| Deficiency ID | Network Deficiency   | Trigger   | Upgrade Priority |
|---------------|--|---|------------------|
| MP-1          | Undersized gravity network through Campbell Park Youth Camp  | <b>Existing</b> , gravity network is under capacity when upstream pumping station (PS-G) is running at full speed         | High             |
| MP-2          | Undersized gravity network on Seabreeze Road   | <b>Existing</b> , exacerbated by <b>growth cells</b> PS-A_1 and PS-A_2 coming online, and infill growth in PS-C catchment | Low              |
| MP-3          | Undersized gravity network on Jack Boyd Drive  | <b>Growth</b> cell PS-K_1 coming online   | Medium           |
| MP-4          | PS-VC and rising main undersized   | <b>Growth</b> cell PS-VC_1 coming online  | High             |
| MP-5          | PS-VA and rising main undersized   | All growth cells in Mangawhai Village coming online & upgrade of PS-VC (see MP-4)   | High             |
| MP-6          | No current wastewater servicing in Mangawhai Central and PS-OF undersized to service ultimate growth | <b>Growth</b> cell PS-OF_1 coming online (connecting to PS-VA rising main) and catchment wide <b>growth</b> (PS-OF)       | High             |
| MP-7          | PS-K undersized  | Upgrade of gravity sewer on Jack Boyd Drive (MP-3) and <b>growth</b> cells PS-K_1 and PS-K_2 coming online                | Low              |

### 5.1 Upgrade Criteria

The following criteria were used in developing network upgrades:

- **New Gravity Pipes:** Sized to flow 70% full during PWWF, with a minimum pipe cover of 600 mm.
- **Pump Station Upgrades:** Capable of conveying PWWF or no increase in wet well level at PWWF (only applied at sites with pumping stations or pressure sewer catchments in contributing catchment).
- **Pump Station Rising Mains:** Sized to have a maximum velocity of 0.6 – 1.8 m/s. It was assumed upgraded rising mains will be the same material as existing pipes.
- **Pump Station Emergency Storage:** Gravity storage chamber capable of holding twelve hours average dry weather flow (based on full catchment development, as per KDC Engineering Standards).

## 5.2 Upgrade Cost Estimates

For each upgrade an indicative cost estimate has been developed. As the options presented in this report require substantial refinement, and may change during detailed design, there is a high level of uncertainty associated with these estimates. For the purposes of long-term budgeting, cost estimates have been developed using a methodology used by Alta Consulting. This same methodology was recently applied to assess options for the long-term disposal of effluent from the CCWWTP (Alta Consulting, 2022).

The cost estimates are suitable for a high-level options study with only a preliminary estimate of scope, known as a 'Class 5' estimate with an accuracy of -50% to +100%. As each project is developed in more detail, the cost estimate can be refined and resultingly the accuracy will increase. Figure 1-1 present classifications of cost estimate classes as provided by Alta Consulting.

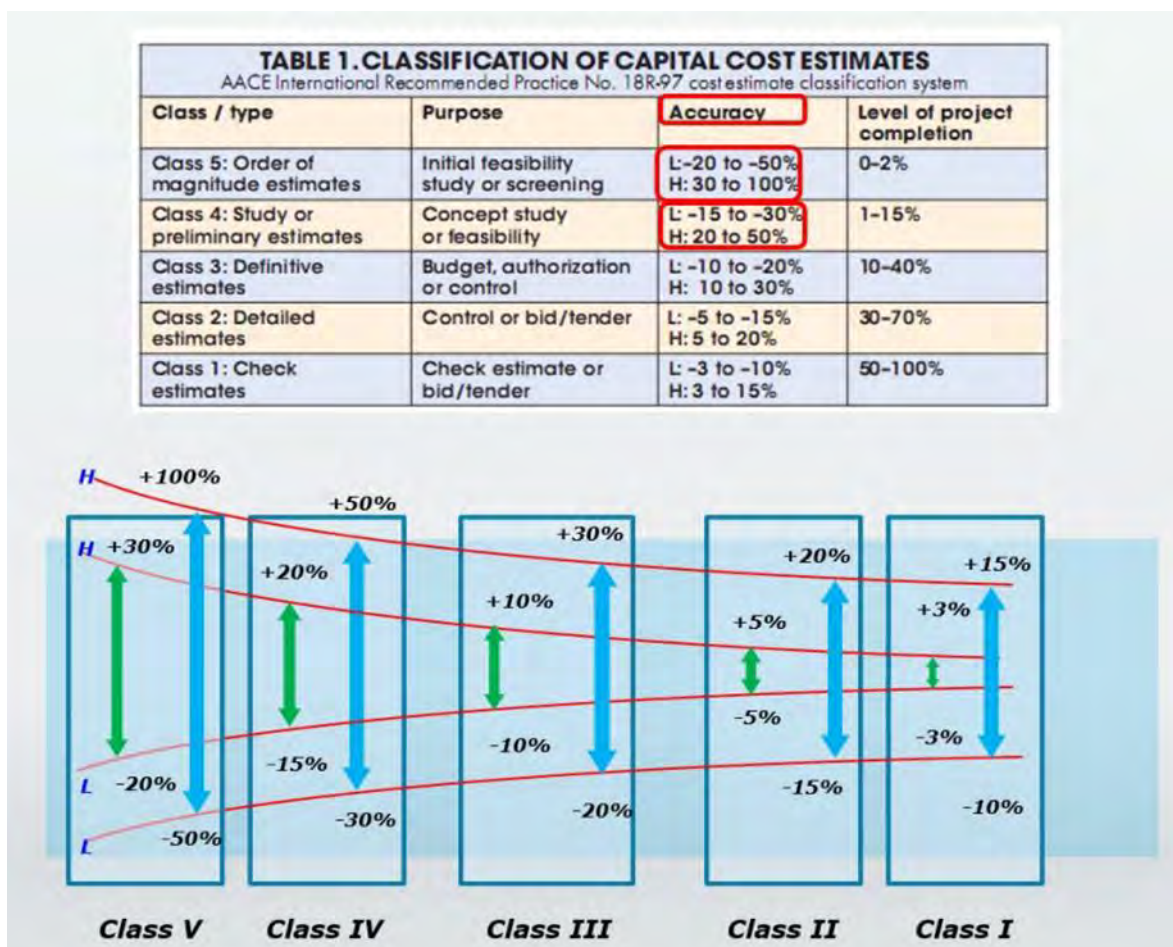


Figure 1-1: Diagram of Cost Accuracy with Level of Estimation (Alta Consulting, 2022)

A Schedule of Prices for all projects is contained in Appendix B. Project Base Estimates represent the cost of project delivery including design, construction, equipment and KDC inputs. The Project Expected Estimate is the expected cost of the project, with a 40% contingency margin of safety. The 95%ile Project Estimate is the level of cost expected with a 95% certainty, and is the Project Expected Estimate with an additional 60% contingency (total contingency of 100% as per Class 5 estimate).

The 95%ile Project Estimate values for each project are presented in this section, rounded to the nearest \$ 100,000.

### 5.3 Upgrade Descriptions

The following sections provide details of network upgrades that have been developed to resolve each network deficiency described in Table 5-1.

#### 5.3.1 MP-1: Upgrade Gravity Network Through Campbell Park Youth Camp

Table 5-2 presents details of the network upgrade to resolve the capacity constraint in the gravity network through Campbell Park Youth Camp. Figure 5-2 presents a plan view of upgrade MP-1.

Table 5-2: Upgrade MP-1 Details

|  |   |
|--|---|
| <b>Upgrade ID</b>                              | MP-1  |
| <b>Deficiency</b>                              | Gravity network through Campbell Park Youth Camp does not have capacity when upstream pump station (PS-G) is running at full speed resulting in overflows |
| <b>Upgrade Priority</b>                        | High: 22 m <sup>3</sup> manhole spill predicted (Manhole ID: 20100701011238).   |
| <b>Trigger</b>                                 | Existing  |
| <b>Upgrade Details</b>                         | Install 170 m of new 225 mm PVC pipe and 2 new manholes (Average depth = 3.1 m)   |
| <b>Cost Estimate (95%ile, 2022 NZ Dollars)</b> | \$600,000   |



Figure 5-2: Upgrade MP-1 Plan View

### 5.3.1 MP-2: Upgrade Gravity Network on Seabreeze Road

Table 5-3 presents details of the network upgrade to resolve the capacity constraint in the gravity network on Seabreeze Road. Figure 5-3 presents a plan view of upgrade MP-2.

Table 5-3: Upgrade MP-2 Details

|   |   |
|---|---|
| Upgrade ID                              | MP-2  |
| Deficiency                              | Gravity network on Seabreeze Road undersized resulting in surcharge   |
| Upgrade Priority                        | Low: Maximum predicted water level is greater than 1 m from ground surface  |
| Trigger                                 | Existing, exacerbated by growth cells PS-A_1 and PS-A_2 coming online, and infill growth in PS-C catchment  |
| Upgrade Details                         | Install 310 m of 225 mm PVC pipe and 4 new manholes (Manhole 20100701010711 to PS-C)<br><br>Some pipe inverts along Seabreeze Road were not indicated in KDC GIS and therefore have been inferred. Survey may be required to confirm if this upgrade is required. |
| Cost Estimate (95%ile, 2022 NZ Dollars) | \$1,100,000   |



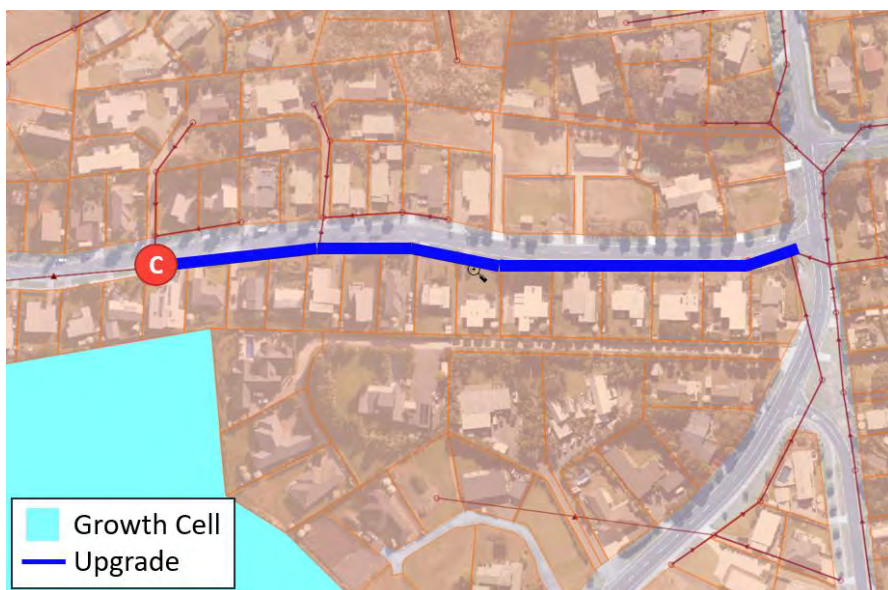


Figure 5-3: Upgrade MP-2 Plan View

### 5.3.1 MP-3: Upgrade Gravity Network on Jack Boyd Drive

Table 5-4 presents details of the network upgrade to resolve the capacity constraint in the gravity network on Jack Boyd Drive. Figure 5-4 presents a plan view of upgrade MP-3.

Table 5-4: Upgrade MP-3 Details

|   |  |
|---|--|
| Upgrade ID                              | MP-3   |
| Deficiency                              | Gravity network on Jack Boyd Drive undersized resulting in surcharge                 |
| Upgrade Priority                        | Medium: Maximum water level is within 0.5 m of ground surface                        |
| Trigger                                 | Growth cell PS-K_1 coming online   |
| Upgrade Details                         | Install 360 m of 225 mm PVC pipe and 8 new manholes (Manhole 20090630124952 to PS-K) |
| Cost Estimate (95%ile, 2022 NZ Dollars) | \$1,300,000  |



Figure 5-4: Upgrade MP-3 Plan View

### 5.3.2 MP-4: Upgrade PS-VC and Rising Main

Table 5-5 presents details of the network upgrade to resolve the capacity constraint at PS-VC. Figure 5-5 presents a plan view of upgrade MP-4.

Table 5-5: Upgrade MP-4 Details

|  |   |
|--|---|
| <b>Upgrade ID</b>                              | MP-4  |
| <b>Deficiency</b>                              | PS-VC undersized resulting in overflows   |
| <b>Upgrade Priority</b>                        | High: 163 m <sup>3</sup> spill predicted from manhole on Old Waipu Road (Manhole ID: 20091020152523)  |
| <b>Trigger</b>                                 | Growth cell PS-VC_1 coming online   |
| <b>Upgrade Details</b>                         | Full upgrade of PS-VC, including upgrade of pumps for PWWF (16 L/s), construction of new 2.25 m diameter wet well and construction new emergency storage tank (150 m <sup>3</sup> ).<br><br>Upgrade rising main with 125 m of DN140 PE pipe (Assumed: PE100, PN 16 at depth of 1.2 m) |
| <b>Cost Estimate (95%ile, 2022 NZ Dollars)</b> | \$2,200,000   |



Figure 5-5: Upgrade MP-4 Plan View

### 5.3.3 MP-5: Upgrade PS-VA and Rising Main

Table 5-6 presents details of the network upgrade to resolve the capacity constraint at PS-VA. Figure 5-6 presents a plan view of upgrade MP-5.

Table 5-6: Upgrade MP-5 Details

|   |   |
|---|---|
| Upgrade ID                              | MP-5  |
| Deficiency                              | PS-VA undersized resulting in overflows   |
| Upgrade Priority                        | High: 1.7 m <sup>3</sup> spill predicted from emergency storage tank  |
| Trigger                                 | Growth cells in Mangawhai Village coming online and upgrade of PS-VC (MP-4)   |
| Upgrade Details                         | Upgrade of pumps for PWWF (60 L/s)<br>Upgrade most upstream portion of rising main with 990m of 200 mm PVC pipe (Assumed: PN16, at depth of 1.2 m). See Appendix A for rising main sizing calculations. |
| Cost Estimate (95%ile, 2022 NZ Dollars) | \$4,600,000   |





Figure 5-6: Upgrade MP-5 Plan View

### 5.3.1 MP-6: Upgrade of PS-VA Rising Main, PS-OF Pumps and PS-OF Rising Main

There is no current wastewater servicing in Mangawhai Village (growth cell PS-OF\_2), with existing developments along Molesworth Drive connecting directly to the PS-VA rising main through small bore pressure sewer systems. Three alternatives for servicing growth in Mangawhai Village were evaluated, including:

- Construction of a new pumping station (PS-VD) outletting to the PS-VA rising main
- Construction of a new pumping station (PS-VD) outletting to PS-OF
- Construction of a new pumping station (PS-VD) outletting directly to the CWWTP

Through a workshop with KDC staff, serving Mangawhai Village through the PS-VA rising main was selected as the preferred option. This alternative consists of three components, including upgrade of the most downstream portion of the PS-VA rising main (MP-6-1), the construction of a new pump station and rising main (MP-6-2), and upgrade of PS-OF pump station and rising main (MP-6-3). The upgrade of PS-OF is required due to growth in Mangawhai Village and elsewhere in the catchment. Figure 5-7 presents a plan view of MP-6, highlighting the upgrade components. Table 5-7 to Table 5-9 present details of the network upgrade required to provide servicing to Mangawhai Village.



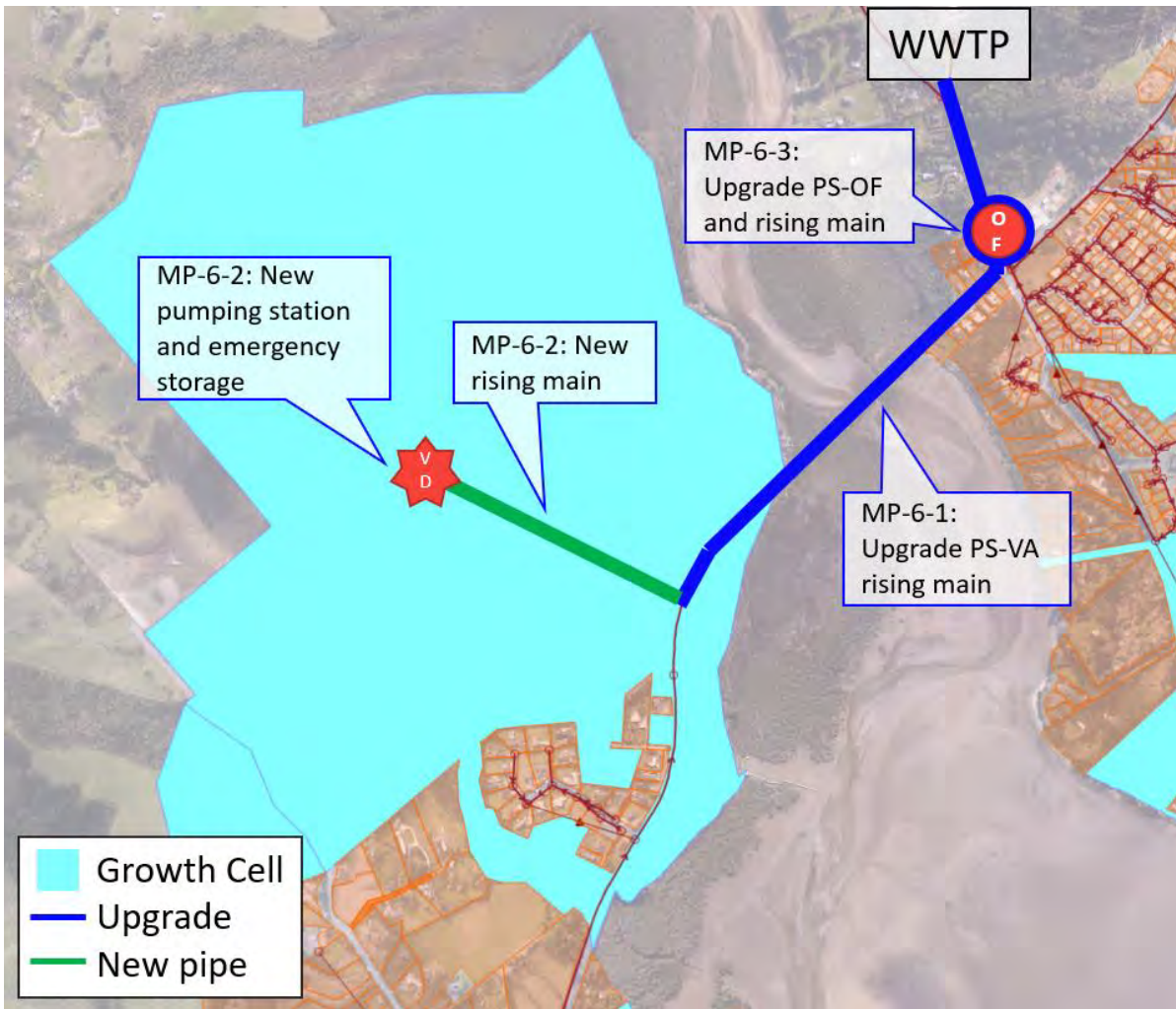


Figure 5-7: Upgrade MP-6 Plan View

Table 5-7: Upgrade MP-6-1 Details

|   |   |
|---|---|
| Upgrade ID                              | MP-6-1  |
| Deficiency                              | Peak velocity the most downstream section of the PS_VA rising main is above desired range   |
| Upgrade Priority                        | Medium: Peak rising main velocity is 2.0 m/s  |
| Trigger                                 | Construction of new pump station (PS-VD) connecting to PS-VA rising main  |
| Upgrade Details                         | Upgrade the most downstream section of PS-VA rising main with 1100 m of 300 mm PVC (Assumed: PN16 at depth of 1.2 m). See Appendix A for rising main sizing calculations. |
| Cost Estimate (95%ile, 2022 NZ Dollars) | \$2,000,000   |

Table 5-8: Upgrade MP-6-2 Details

|   |   |
|---|---|
| Upgrade ID                              | MP-6-2  |
| Deficiency                              | No current servicing  |
| Upgrade Priority                        | High: No current servicing  |
| Trigger                                 | Growth cell PS-OF_2 coming online   |
| Upgrade Details                         | Construct new pumping station (PS-VD) with capacity for PWWF (55 L/s), construct new emergency storage tank (475 m <sup>3</sup> ) and construct new rising main (Assumed: 600 m of PE100, SDR 16 pipe at depth of 1.2 m). See Appendix A for rising main sizing calculations. |
| Cost Estimate (95%ile, 2022 NZ Dollars) | \$11,600,000  |

Table 5-9: Upgrade MP-6-3 Details

|   |  |
|---|--|
| Upgrade ID                              | MP-6-3   |
| Deficiency                              | PS-OF undersized resulting in overflows  |
| Upgrade Priority                        | High: Substantial overflows predicted (106 m <sup>3</sup> prior to upgrade of PS-VA)   |
| Trigger                                 | Catchment wide growth  |
| Upgrade Details                         | Upgrade of pumps at PS-OF for PWWF (170 L/s)<br>Upgrade rising main with 440m of DN400 PE pipe (Assumed: PE100, SDR 16 at depth of 1.2 m). See Appendix A for rising main sizing calculations. |
| Cost Estimate (95%ile, 2022 NZ Dollars) | \$7,200,000  |

### 5.3.2 MP-7: Upgrade PS-K

Table 5-10 presents details of the network upgrade to resolve the capacity constraint at PS-K.

Table 5-10: Upgrade MP-7 Details

|                  |   |
|------------------|---|
| Upgrade ID       | MP-7  |
| Deficiency       | PS-K undersized   |
| Upgrade Priority | Low: Maximum predicted water level is greater than 1 m from ground surface  |
| Trigger          | Growth cells PS-K_1 and PS-K_2 coming online and upgrade of gravity sewer on Jack Boyd Drive (MP-3).                                |
| Upgrade Details  | Upgrade of pumps at PS-K for PWWF (45 L/s), no rising main updated is required. See Appendix A for rising main sizing calculations. |
| Cost Estimate    | \$50,000  |

|                                 |  |
|---------------------------------|--|
| (95%ile,<br>2022 NZ<br>Dollars) |  |
|---------------------------------|--|

## 6 Network Upgrades Phasing

Interim growth scenarios were defined in the model to determine the phasing of the network upgrades described in Section 5. The percentage of the ultimate number of wastewater connections within each pump station catchment that come online for each interim growth phase were sourced from Formative’s report and are presented in Table 6-1 (Formative 2022).

Table 6-1: Assumed temporal distribution of Mangawhai dwelling growth (Figure from Formative 2022)

| PS Catchment      | Percentage of Ultimate Connections Coming Online |         |         |         |         |         |           |
|-------------------|--|---------|---------|---------|---------|---------|-----------|
|                   | 2021-23  | 2023-28 | 2028-33 | 2033-38 | 2038-43 | 2043-48 | Post 2048 |
| PS-A              | 50%  | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-B              | 50%  | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-C              | 50%  | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-E              | 50%  | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-F              | 20%  | 40%     | 40%     | 0%      | 0%      | 0%      | 0%        |
| PS-G              | 30%  | 30%     | 40%     | 0%      | 0%      | 0%      | 0%        |
| PS-H              | 50%  | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-J              | 50%  | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-K              | 15%  | 20%     | 20%     | 20%     | 20%     | 5%      | 0%        |
| PS-OF/CWWT P West | 4%   | 21%     | 24%     | 20%     | 12%     | 10%     | 6%        |
| PS-OF/CWWT P East | 5%   | 19%     | 18%     | 14%     | 10%     | 10%     | 6%        |
| PS-VA             | 10%  | 10%     | 17%     | 17%     | 17%     | 17%     | 12%       |
| PS-VB             | 10%  | 30%     | 40%     | 20%     | 0%      | 0%      | 0%        |
| PS-VC             | 13%  | 22%     | 22%     | 22%     | 21%     | 0%      | 0%        |

Table 6-2 presents a summary of network performance for interim growth scenarios and highlights when a network upgrade is triggered. It is noted that the construction of PS-VD and upgrade of PS-OF have both been broken up into two phases. The construction of PS-VD (MP-6-2) consists of the following phases:

- **Phase 1:** Construction of a new pumping station, rising main and emergency storage sized for ultimate growth. Interim pumps installed for with capacity of 25 L/s.
- **Phase 2:** Upgrade of pumps for ultimate PWWF (55 L/s).

The upgrade of PS-OF (MP-6-3) consists of the following phases:

- **Phase 1:** Upgrade of pumps for interim capacity of 140 L/s.
- **Phase 2:** Upgrade of pumps, wet well and rising main for ultimate PWWF (170 L/s).

Table 6-2 also presents upgrade costs for each project in 2022 NZ Dollars. A detailed breakdown of all costs is summarised in Appendix B.

Table 6-2: Summary of Upgrades Phasing and Cost Estimates

| Upgrade ID | Upgrade  | Upgrade Priority | Cost Estimate (95%ile, 2022 NZ Dollars)                              | Interim Growth Phase  |                                   |  |  |         |         |           |  |
|------------|--|------------------|--|---|-----------------------------------|--|--|---------|---------|-----------|--|
|            |  |                  |  | 2021-23   | 2023-28                           | 2028-33  | 2033-38  | 2038-43 | 2043-48 | Post 2048 |  |
| MP-1       | Upgrade gravity network through Campbell Park Youth Camp | High             | \$ 600,000   | <u>Upgrade</u><br>Existing constraint   |                                   |  |  |         |         |           |  |
| MP-2       | Upgrade gravity network on Seabreeze Road                | Low              | \$1,100,000  | <u>Upgrade</u><br>Existing constraint   |                                   |  |  |         |         |           |  |
| MP-3       | Upgrade gravity network on Jack Boyd Drive               | Low              | \$1,300,000  | <u>Upgrade</u><br>Existing constraint   |                                   |  |  |         |         |           |  |
| MP-4       | Upgrade PS-VC and rising main                            | High             | \$2,200,000  | No rise in wet well level at PWWF   | No rise in wet well level at PWWF | <u>Upgrade</u><br>7m <sup>3</sup> spill volume         |  |         |         |           |  |
| MP-5       | Upgrade PS-VA and upstream section of rising main        | High             | \$4,600,000  | No rise in wet well level at PWWF   | No rise in wet well level at PWWF | <u>Upgrade</u><br>1.2 m rise in wet well level at PWWF |  |         |         |           |  |
| MP-6-1     | Upgrade most downstream section of PS-VA rising main     | <u>Medium</u>    | \$2,000,000  |   |                                   |  | <u>Upgrade</u><br>Rising main vel. > 1.8 m/s after PS-VD upgrade |         |         |           |  |
| MP-6-2     | Construct PS-VD and rising main                          | <u>High</u>      | <u>Stage 1:</u><br>\$6,800,000<br><br><u>Stage 2:</u><br>\$4,800,000 | <u>Upgrade Stage 1</u><br>Construct PS sized for ultimate growth, with interim pump |                                   |  | <u>Upgrade Stage 2</u><br>PWWF exceeds interim pump capacity     |         |         |           |  |

| Upgrade ID | Upgrade                       | Upgrade Priority | Cost Estimate (95%ile, 2022 NZ Dollars)                              | Interim Growth Phase                 |   |                                      |  |   |         |           |  |
|------------|-------------------------------|------------------|--|--------------------------------------|---|--------------------------------------|--|---|---------|-----------|--|
|            |                               |                  |  | 2021-23                              | 2023-28   | 2028-33                              | 2033-38  | 2038-43   | 2043-48 | Post 2048 |  |
|            |                               |                  |  | capacity of 25 L/s                   |   |                                      |  | Upgrade pumps to capacity of 55 L/s and upgrade PS-VA rising main to CWWTP                            |         |           |  |
| MP-6-3     | Upgrade PS-OF and rising main | High             | <u>Stage 1:</u><br>\$1,000,000<br><br><u>Stage 2:</u><br>\$6,200,000 | 0.5 m rise in wet well level at PWWF | <u>Upgrade Stage 1</u><br>Overflow to storage at PWWF<br><br>Upgrade pump capacity to 140 L/s |                                      |  | <u>Upgrade Stage 2</u><br>2m rise in wet well at PWWF<br><br>Upgrade pumps and rising main to 170 L/s |         |           |  |
| MP-7       | Upgrade PS-K                  | Low              | \$50,000   | No rise in wet well level at PWWF    | No rise in wet well level at PWWF   | 0.3 m rise in wet well level at PWWF | <u>Upgrade</u><br>1 m rise in wet well level at PWWF |   |         |           |  |
| MP-8       | PS-K diversion                | High             | \$900,000  | Diversion of PS-K direct to CWWTP    |   |                                      |  |   |         |           |  |

## 7 Assumptions, Limitations and Recommendations

### 7.1 Model Limitations

- Catchments serviced by small bore pressure systems have been modelled simplistically using assumptions to replicate the peak flow and storage provided by individual pump units. Pressure systems have not been explicitly represented in the model and therefore capacity of these systems cannot be assessed. Details of assumptions that have been used in assessing these catchments are presented in the *Mangawhai Wastewater Model Build, Calibration and System Performance Assessment* report (WSP 2022).
- Pipe inverts in the model network have largely been assumed or inferred.
- As noted in the *Mangawhai Wastewater Model Build, Calibration and System Performance Assessment* report (WSP 2022), although the model has been calibrated to three wet weather events a substantial flow response was only observed for one event at most sites. This results in reduced confidence that the wet weather response for large rainfall events is represented.
- All network upgrades have been developed using the “high” dry weather flow profile. This profile represents wastewater flow during the peak summertime population in Mangawhai (calibration period from 28/12/2020 to 4/01/2021).

### 7.2 Exclusions

- Upgrades to small bore pressure sewer systems have not been considered in this assessment.
- Required upgrades to emergency storage have not been considered in this assessment. The *Mangawhai Wastewater Model Build, Calibration and System Performance Assessment* report noted that pump stations PS-A, PS-B, PS-C, PS-E, PS-F, PS-G, PS-H, PS-K, PS-OF and PS-VA do not meet emergency storage requirements as outlined in KDC’s Engineering Standards under existing conditions (WSP 2022),

### 7.3 Costing Assumptions

- The 95%ile Project Estimates are presented for all upgrades. This is the project Base Estimate, representing the cost of project delivery including design, construction, equipment plus a 40% contingency margin of safety and a further 60% contingency for the 95%ile Project Estimate (total contingency of 100% as per Class 5 estimate) as per Alta Consulting’s methodology (Alta Consulting 2022).
- All cost estimates are in 2022 NZ Dollars.
- Costs associated with working in a coastal / low lying area have not been considered in base estimates, where temporary works and trenching costs could be higher to accommodate dewatering and shoring of trenches, etc.
- The need for upgrade of electrical systems at pump stations has not been assessed in the base estimate and the existing systems were assumed to be sufficient when developing costs. There is a risk that upgrade of the local power network is required to facilitate upgrades, particularly at the higher flow pump stations.

### 7.4 Model Maintenance

The ongoing maintenance of a hydraulic model is critical to its successful use as a tool for both design and operational applications.

The key pre-requisites for keeping the model up to date are:

- 1) The introduction of a system to log all on-going changes to pumping stations, system upgrades/ renewals and new properties that are connected to the network.

- 2) The ability to validate the models created, initially at a strategic level using data recorded at pumping stations, the CWWTP and rain gauges (currently no rainfall gauges installed within the catchment), thus providing an indication of the degree of continued calibration within defined limits.

Suggested timescales for key milestones in a typical model maintenance programme are presented in Table 7-1 below. However, the timescales will be dependent on the rate of change in the network. Networks such as Mangawhai with high growth should be revisited more frequently than networks where there is little change in population or assets.

*Table 7-1: Typical Hydraulic Model Maintenance Programme*

| <b>Task</b>                               | <b>Frequency</b>   |
|---|--|
| Review and undertake asset update         | 3 monthly - annually   |
| Review and undertake update of population | 6 monthly - annually   |
| Validation check                          | 6 monthly - 2 years  |
| Full recalibration                        | As indicated by outcome of validation checks or every 5-10 years |



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# Appendix A

## Rising Main Performance and Upgrade Sizing Calculations

| Upgrade ID | Rising Main     | Existing Pump Rate (L/s) | Upgraded Pump Rate (L/s) | Existing Rising Mains                |                    |                              |                                    |                   | Upgraded Rising Mains                |                    |                                   |
|------------|-----------------|--------------------------|--------------------------|--------------------------------------|--------------------|------------------------------|------------------------------------|-------------------|--------------------------------------|--------------------|-----------------------------------|
|            |                 |                          |                          | Details                              | Internal Diam. (m) | Existing Peak Velocity (m/s) | Upgraded Pumps Peak Velocity (m/s) | Upgrade Required? | Details                              | Internal Diam. (m) | Peak Velocity After Upgrade (m/s) |
| MP-4       | PS-VC           | 7.3                      | 16                       | 110mm PE<br>(Assumed: PE100, SDR 16) | 0.0894             | 1.16                         | 2.55                               | Yes               | DN140 PE<br>(Assumed: PE100, PN 16)  | 0.114              | 1.57                              |
| MP-5       | PS-VA Section 1 | 40                       | 60                       | 150mm PVC<br>(Assumed: PN16)         | 0.1668             | 1.83                         | 2.75                               | Yes               | 200mm PVC<br>(Assumed: PN16)         | 0.2184             | 1.60                              |
|            | PS-VA Section 2 | 40                       | 60                       | 200mm PVC<br>(Assumed: PN16)         | 0.2184             | 1.07                         | 1.6                                | No                | N/A                                  | N/A                | N/A                               |
|            | PS-VA Section 3 | 40                       | 60                       | 250mm PVC<br>(Assumed: PN16)         | 0.2699             | 0.7                          | 1.05                               | No                | N/A                                  | N/A                | N/A                               |
| MP-6-1     | PS-VA Section 3 | 40                       | 114.8                    | 250mm PVC<br>(Assumed: PN16)         | 0.2699             | 0.7                          | 2.01                               | Yes               | 300mm PVC<br>(Assumed: PN16)         | 0.3252             | 1.38                              |
| MP-6-2     | PS-VD (New)     | N/A                      | 55                       | N/A                                  | N/A                | N/A                          | N/A                                | Yes               | DN250 PE<br>(Assumed: PE100, SDR 16) | 0.2034             | 1.69                              |


| Upgrade ID | Rising Main     | Existing Pump Rate (L/s) | Upgraded Pump Rate (L/s) | Existing Rising Mains           |                    |                              |                                    |                   | Upgraded Rising Mains     |                    |                                   |
|------------|-----------------|--------------------------|--------------------------|---------------------------------|--------------------|------------------------------|------------------------------------|-------------------|---------------------------|--------------------|-----------------------------------|
|            |                 |                          |                          | Details                         | Internal Diam. (m) | Existing Peak Velocity (m/s) | Upgraded Pumps Peak Velocity (m/s) | Upgrade Required? | Details                   | Internal Diam. (m) | Peak Velocity After Upgrade (m/s) |
| MP-6-3     | PS-OF (Phase 1) | 65                       | 140                      | 300mm PVC (Assumed: PN16)       | 0.3252             | 0.78                         | 1.69                               | No                | N/A                       | N/A                | N/A                               |
|            | PS-OF (Phase 2) | 65                       | 170                      | 300mm PVC (Assumed: PN16)       | 0.3252             | 0.78                         | 2.05                               | Yes               | 400mm PVC (Assumed: PN16) | 0.3252             | 2.05                              |
| MP-7       | PS-K            | 32                       | 45                       | 225 PE (Assumed: PE100, SDR 16) | 0.1829             | 1.22                         | 1.71                               | No                | N/A                       | N/A                | N/A                               |

# Appendix B

## Upgrade Costing Details

Mangawhai Wastewater Network Ugrades 2021 - 2051  
Schedule of Prices

| PS Name            | Upgrade Description - Design and Construction   | Unit | Rate            | QTY  | Base Estimate           | Expected Estimate       | 95th Percentile Est     | Detail Design Estimate | Construction            | Project ID       | Assumptions   |
|--------------------|---|------|-----------------|------|-------------------------|-------------------------|-------------------------|------------------------|-------------------------|------------------|---|
| PS-VC              | Upgrade wet well (dia.1.8m and invert 5m)   | LS   | \$ 195,000.00   | 1    | \$ 195,000.00           | \$ 273,000.00           | \$ 390,000.00           | \$ 58,500.00           | \$ 136,500.00           | MP-4             | 30% estimate for condition assessment to determine extent of upgrade required               |
|                    | Construct new emergency storage tank  | No.  | \$ 494,000.00   | 1    | \$ 494,000.00           | \$ 691,600.00           | \$ 988,000.00           | \$ 148,200.00          | \$ 345,800.00           | MP-4             | 30% estimate for detail design<br>Assumed emergency stroage volume = 15m m3 (12 hours ADWF) |
|                    | Duty/standby pumps with 16L/s capacity  | No.  | \$ 91,000.00    | 2    | \$ 182,000.00           | \$ 254,800.00           | \$ 364,000.00           | \$ 27,300.00           | \$ 154,700.00           | MP-4             | 2x new pumps<br>30% estimate for detail design  |
|                    | Confirm electrics if upgrade is required  | LS   | \$ 50,000.00    | 1    | \$ 50,000.00            | \$ 70,000.00            | \$ 100,000.00           | \$ -                   | \$ 50,000.00            | MP-4             | Estimate for condition assessment only  |
|                    | Rising main upgrade DN140 PE PE100 PN16   | m    | \$ 1,560.00     | 125  | \$ 195,000.00           | \$ 273,000.00           | \$ 390,000.00           | \$ 468.00              | \$ 194,532.00           | MP-4             | 30% estimate for detail design  |
| PS-VA              | Duty/standby pumps with 60L/s capacity  | No.  | \$ 260,000.00   | 2    | \$ 520,000.00           | \$ 728,000.00           | \$ 1,040,000.00         | \$ 78,000.00           | \$ 442,000.00           | MP-5             | 2x new pumps<br>30% estimate for detail design  |
|                    | Confirm electrics if upgrade is required  | LS   | \$ 50,000.00    | 1    | \$ 50,000.00            | \$ 70,000.00            | \$ 100,000.00           | \$ -                   | \$ 50,000.00            | MP-5             | Estimate for condition assessment only  |
|                    | Confirm wet well if upgrade is required   | LS   | \$ 50,000.00    | 1    | \$ 50,000.00            | \$ 70,000.00            | \$ 100,000.00           | \$ -                   | \$ 50,000.00            | MP-5             | Estimate for condition assessment only  |
|                    | Rising main upgrade DN200 PE PE100 PN16   | m    | \$ 1,690.00     | 990  | \$ 1,673,100.00         | \$ 2,342,340.00         | \$ 3,346,200.00         | \$ 501,930.00          | \$ 1,171,170.00         | MP-5             | 30% estimate for detail design  |
|                    | Rising main upgrade DN300 PE PE100 PN16   | m    | \$ 1,950.00     | 1100 | \$ 2,145,000.00         | \$ 3,003,000.00         | \$ 4,290,000.00         | \$ 643,500.00          | \$ 1,501,500.00         | MP-6-1_2 Stage 2 | 30% estimate for detail design  |
| PS-VD              | New pumping station with capacity of 25L/s  | No.  | \$ 455,000.00   | 2    | \$ 910,000.00           | \$ 1,274,000.00         | \$ 1,820,000.00         | \$ 273,000.00          | \$ 637,000.00           | MP-6-1_2 Stage 1 | 2x new pumps<br>30% estimate for detail design  |
|                    | New pumping station with capacity of 55L/s  | No.  | \$ 130,000.00   | 2    | \$ 260,000.00           | \$ 364,000.00           | \$ 520,000.00           | \$ 78,000.00           | \$ 182,000.00           | MP-6-1_2 Stage 2 | 2x new pumps  |
|                    | New emergency storage   | LS   | \$ 1,560,000.00 | 1    | \$ 1,560,000.00         | \$ 2,184,000.00         | \$ 3,120,000.00         | \$ 468,000.00          | \$ 1,092,000.00         | MP-6-1_2 Stage 1 | 30% estimate for detail design<br>Assumed emergency stroage volume = 475m3 (12 hours ADWF)  |
|                    | New downstream rising main DN250 PE, PE100 PN16   | m    | \$ 1,755.00     | 500  | \$ 877,500.00           | \$ 1,228,500.00         | \$ 1,755,000.00         | \$ 263,250.00          | \$ 614,250.00           | MP-6-1_2 Stage 1 | 30% estimate for detail design  |
|                    | Upgrade downstream section of rising main from PS-VA, DN300 PE, PE100 PN16  | m    | \$ 1,950.00     | 500  | \$ 975,000.00           | \$ 1,365,000.00         | \$ 1,950,000.00         | \$ 292,500.00          | \$ 682,500.00           | MP-6-1_1         | 30% estimate for detail design  |
|                    | Upgrade pumps station at PS-OF to include 140L/s capacity   | No.  | \$ 260,000.00   | 2    | \$ 520,000.00           | \$ 728,000.00           | \$ 1,040,000.00         | \$ 156,000.00          | \$ 364,000.00           | MP-6-1_3 Stage 1 | 2x new pumps<br>30% estimate for detail design  |
|                    | Upgrade pumps station at PS-OF to include 170L/s capacity   | No.  | \$ 780,000.00   | 2    | \$ 1,560,000.00         | \$ 2,184,000.00         | \$ 3,120,000.00         | \$ 468,000.00          | \$ 1,092,000.00         | MP-6-1_3 Stage 2 | 2x new pumps<br>30% estimate for detail design  |
|                    | Upgrade upstream rising main to PS-OF DN300 PE, PE100 PN16  | m    | \$ 1,950.00     | 800  | \$ 1,560,000.00         | \$ 2,184,000.00         | \$ 3,120,000.00         | \$ 468,000.00          | \$ 1,092,000.00         | MP-6-1_3 Stage 2 | 30% estimate for detail design  |
|                    | Tee connection DN300 - DN250 with reducer DN300 - DN200, PE100 PN16 fittings with DN250 and DN200 Non-return valves | No.  | \$ 39,000.00    | 1    | \$ 39,000.00            | \$ 54,600.00            | \$ 78,000.00            | \$ 11,700.00           | \$ 27,300.00            | MP-6-1_2 Stage 1 | 30% estimate for detail design  |
| PS-G(F)            | Upgrade WW main to DN225 PE, PE100 PN16 at 3.1m depth with 2 x new manholes   | m    | \$ 1,755.00     | 170  | \$ 298,350.00           | \$ 417,690.00           | \$ 596,700.00           | \$ 89,505.00           | \$ 208,845.00           | MP-1             | 30% estimate for detail design  |
| PS-K_1 (K)         | Upgrade WW main to DN225 PE, PE100 PN16 at 2.6m depth with 8 x new manholes   | m    | \$ 1,755.00     | 360  | \$ 631,800.00           | \$ 884,520.00           | \$ 1,263,600.00         | \$ 189,540.00          | \$ 442,260.00           | MP-3             | 30% estimate for detail design  |
| Seabreeze (C)      | Upgrade WW main to DN225 PE, PE100 PN16 at 1.1m depth with 4 x new manholes   | m    | \$ 1,755.00     | 310  | \$ 544,050.00           | \$ 761,670.00           | \$ 1,088,100.00         | \$ 163,215.00          | \$ 380,835.00           | MP-2             | 30% estimate for detail design  |
| PS-K               | Upgrade PS-K 45L/s  | No.  | \$ 12,600.00    | 2    | \$ 25,200.00            | \$ 35,280.00            | \$ 50,400.00            | \$ 3,780.00            | \$ 21,420.00            | MP-7             | 2x new pumps<br>15% estimate for detail design  |
| PS-K Diversion     |   |      |                 |      | \$ 460,750.00           | \$ 645,050.00           | \$ 921,500.00           |                        |                         | MP-8             | As per WSP memo dated 9 August 2022 (rounded in estimate)                                   |
| <b>Grand Total</b> |   |      |                 |      | <b>\$ 15,315,000.00</b> | <b>\$ 21,441,000.00</b> | <b>\$ 30,630,000.00</b> | <b>\$ 4,378,608.00</b> | <b>\$ 10,911,192.00</b> |                  |   |



Appendix C  
Mangawhai Wastewater  
Network Dwelling  
projections methodology  
technical report (Formative)



# **Mangawhai Wastewater Network**

**Dwelling projections methodology technical report**

**Prepared for Kaipara District Council**

**Final**

**13 January 2022**

#### Authors

Derek Foy

[derek@formative.co.nz](mailto:derek@formative.co.nz)

021 175 4574

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# 1 Introduction

## 1.1 Background

Kaipara District Council (“KDC”) has engaged WSP to prepare a wastewater model for Mangawhai to inform management and design decisions for the town’s wastewater network. That model will break down the Mangawhai area into catchments, with each catchment draining to a specific wastewater pump station and then into a specific section of rising main.

A core input to the model will be the current and future number of dwellings located in each catchment, including a timing of when growth is expected to occur. This will allow KDC to appropriately design and size components of the network to ensure both present and future needs are met. KDC has commissioned Formative Limited to provide dwelling projections for the defined Mangawhai wastewater catchments.

## 1.2 Objective

The objective of the project has been to produce a set of dwelling projections for use in KDC’s wastewater model for Mangawhai. The objective of this report is to describe the methodology used to produce the dwelling projections.

## 1.3 Caveat

This report relates to dwelling projections, and not to wastewater connections. Although there is some relationship between dwelling numbers and wastewater connections in many areas, this is not a 1:1 relationship across all of Mangawhai. There are a number of dwellings in Mangawhai now that are not connected, even inside the defined wastewater catchment areas. Unconnected dwellings in Mangawhai fall into three categories:

- ❖ Those outside the wastewater catchment who do not now, and are not anticipated for the foreseeable future, have access to the wastewater network.
- ❖ Dwellings inside the wastewater catchment but for which no connection is yet available. These tend to be dwellings towards the rural fringe of Mangawhai that are anticipated to have wastewater infrastructure extended to them in the future, but are not currently serviced.
- ❖ Dwellings inside the wastewater catchment that could be connected have not yet connected to the wastewater network.

To reiterate, the data in this report does not relate to wastewater connections.

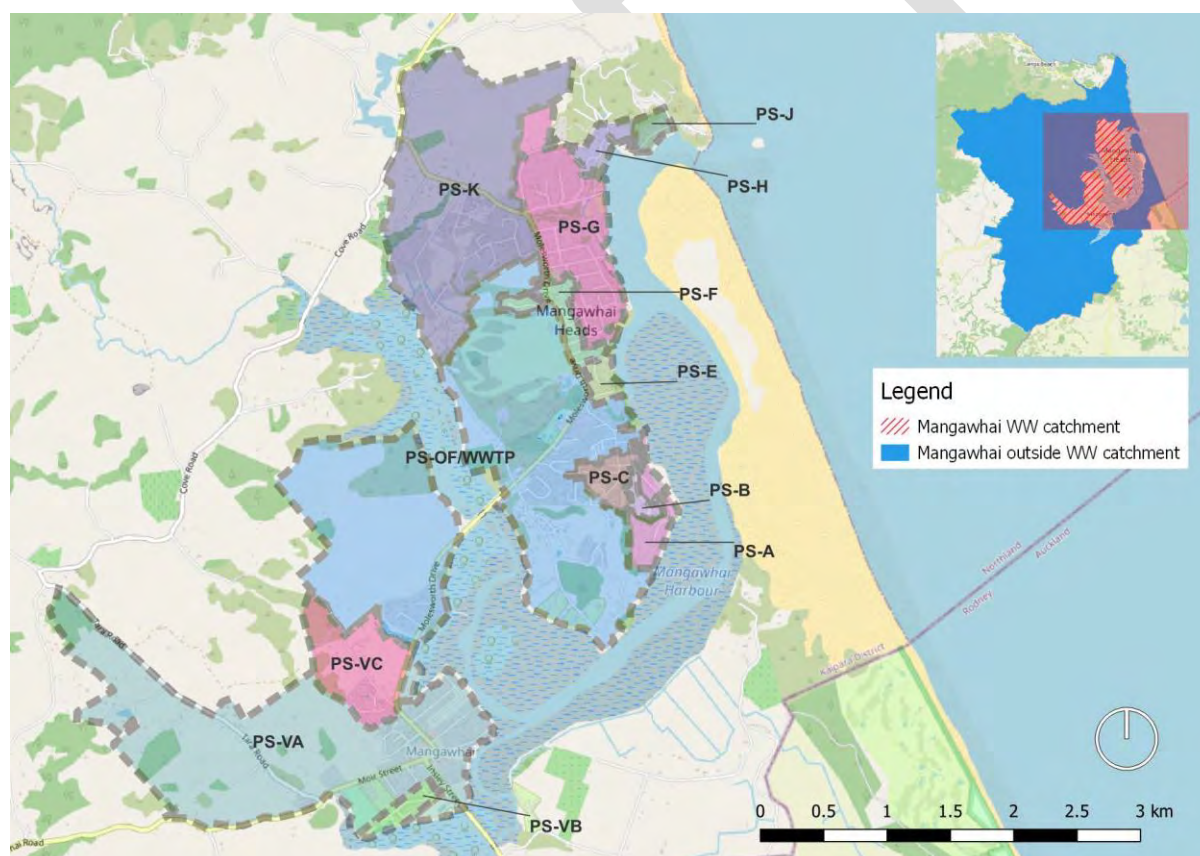


## 2 Scope

### 2.1 Geography

‘Mangawhai’ is defined for the purposes of this exercise as the area covered by the three Statistical Area 2<sup>1</sup> units (“SA2”) that together make up Mangawhai. Those three SA2s are: Mangawhai, Mangawhai Heads, and Mangawhai Rural. The core focus of the dwelling projections are those dwellings located in a geographic subset of those three SA2s. That subset is the area identified in the WSP catchments as being serviced as part of the Mangawhai wastewater network, which area is split into 14 pump station catchments (“PSC”) (the main body of Figure 2.1).

Figure 2.1: Mangawhai wastewater catchments spatial extent



Also included in the projections produced is a residual 15<sup>th</sup> catchment, which covers the area that is inside the three Mangawhai SA2s but that is not serviced as part of the Mangawhai wastewater network (the blue shaded area in Figure 2.1’s inset map). Note that Figure 2.1 shows only 14 catchments, and for utility purposes the single large PS-OF/WWTP defined by WSP has been split in

<sup>1</sup> A spatial area defined as part of New Zealand’s Statistical Standard for Geographic Areas 2018 (SSGA2018). SA2s replaced the area unit geography, and generally have a population of 1,000–3,000 residents, although less than that in rural areas.

these projections to two parts, divided by the estuary. Those two parts are called PS-OF/WWTP West (which includes Mangawhai Central) and PS-OF/WWTP East (the Mangawhai Heads part of the catchment).

Most Statistics NZ data is published at a Statistical Area 1<sup>2</sup> (“SA1”) level, and SA1 data was used in this assessment. SA1 boundaries do not correlate with the wastewater catchment boundaries for Census data on dwelling numbers by type and location within Mangawhai, and GIS assessment of the relationship between dwelling location and PSC was undertaken to estimate counts to PSC, as described in section 3.2.

## 2.2 Demographic units

KDC’s adopted demographic projections are those derived by Infometrics, and are projections of population and household numbers. The dwelling projections described in this report are consistent with those Infometrics projections, but differ in two main ways:

- ❖ Occupied dwelling counts tend to exceed household counts in a given geographic area, as they do in Mangawhai (by 3-4%). There are usually more occupied dwellings than households because included among them are usually some dwellings vacant awaiting new owners or tenants to move in, and properties vacant for renovation, as well as properties vacant long term.
- ❖ The total dwelling projections provided by Formative include both permanent residences and dwellings not permanently occupied, including those used as holiday homes. By contrast, Infometrics’ household projections only consider permanently occupied dwellings. In the 2018 Census there were 1,080 “unoccupied dwellings – empty dwelling” in Mangawhai. Further description of the dwelling types used is provided below.

For the purposes of these projections we distinguish between “Permanently occupied dwellings” (“PODs”) and “Not permanently occupied dwellings” (“NPODs”).

### 2.2.1 PODs

Permanent dwellings are those classified as being in the Census categories “Occupied dwelling” and “Unoccupied dwelling – residents away”. A dwelling is defined as an:

---

<sup>2</sup> A spatial area defined as part of New Zealand’s Statistical Standard for Geographic Areas 2018 (SSGA2018). SA1s are a similar geographic scale to meshblocks although are defined so as to allow the release of more low-level data than is available at the meshblock level. SA1s generally have a population of 100–200 residents.



- ❖ “Occupied dwelling” if it was occupied at midnight on census night, or at any time during the next 12 hours,<sup>3</sup> and so may include some holiday homes that were occupied on Census night. That share is likely to be relatively small, given the mid-week timing of Census (Tuesday 6 March) outside school and public holidays after the end of summer. For the purposes of these projections it has been assumed that occupied dwellings are permanently occupied, and not holiday homes.
- ❖ “Unoccupied dwelling – residents away” where occupants of a dwelling are known to be temporarily away and are not expected to return on, or before, census night.<sup>4</sup>

### 2.2.2 NPODs

Dwellings that are not PODs are considered to be NPODs for this assessment. NPODs are those defined by Statistics NZ as “Unoccupied dwelling – empty dwelling”, which may also include some permanently unoccupied dwellings that are never occupied, either permanently or for holidays:

*An unoccupied dwelling is classified as 'empty' if it clearly had no current occupants and new occupants are not expected to arrive or move in on, or before, census night. Unoccupied dwellings that are being repaired or renovated are defined as empty dwellings. Unoccupied dwellings including private and non-private dwellings, baches, and holiday homes are defined as empty dwellings. A dwelling is classified as having 'residents away' where occupants of a dwelling are known to be temporarily away and are not expected to return on, or before, census night.<sup>5</sup>*

This assessment excludes dwellings under construction, which are considered to not yet be dwellings, and so will form part of future supply once they are completed.

---

<sup>3</sup> <http://datainfolplus.stats.govt.nz/Item/nz.govt.stats/2f72bbd8-4374-4730-9137-5cc865167e98>

<sup>4</sup> <http://datainfolplus.stats.govt.nz/Item/example.org/67c2dc89-809d-40b0-ac43-f78eb3295699>

<sup>5</sup> <http://datainfolplus.stats.govt.nz/item/nz.govt.stats/8ecb3abd-fa5c-4150-bff4-c2df010b3447/3/>

## 3 Data sources

This section summarises the data sources that were used in developing the projections. The data sources identified below were used in GIS and spreadsheet form, and interpreted in conjunction with multiple other layers to provide an indication of the potential location and amount of current and future developable residential capacity in Mangawhai.

### 3.1 Population and household projections

Population and household projections were sourced from KDC's adopted demographic projections. These were derived by Infometrics, and were provided in a spreadsheet format by KDC<sup>6</sup> and accompanied by a technical report.<sup>7</sup> The projections received are SA2 level population and household projections from 2013 to 2051. As described earlier, there are three SA2s in Mangawhai (Mangawhai, Mangawhai Heads, and Mangawhai Rural). The household projections were used to derive dwelling projections.

### 3.2 Census dwellings and household counts

Census, the main source of data that quantifies dwelling counts, publishes data only to an SA1 level.<sup>8</sup> Because SA1 boundaries do not correlate with Mangawhai's wastewater catchment boundaries, to establish baseline dwelling counts by PSC we have assessed the proportion of residential dwellings (PODs and NPODs) in each SA1 that are located in each PSC.

For this assessment the distribution of Census dwellings to PSC was made using the distribution of all buildings of greater than 70m<sup>2</sup>.<sup>9</sup> The location of buildings is available to a point level, and so is one indication of the spatial distribution of dwellings within an area. This assessment assumed that each non-commercial building<sup>10</sup> represents exactly one dwelling,<sup>11</sup> and those dwellings were mapped in GIS and intersected with both PSCs and SA1s. This yields a matrix of building count by PSC<sup>12</sup> and SA1,<sup>13</sup> and therefore the share of buildings in each SA1 that are in each pump station's catchment. That share was then applied to Census SA1 totals for both PODs and NPODs. This assumes that PODs and NPODs

---

<sup>6</sup> Received as "Kaipara pivot v2.xlsx", on 19 October 2021

<sup>7</sup> "Population Projections 2018-2051 Kaipara District Council", October 2020, Infometrics

<sup>8</sup> <https://www.stats.govt.nz/information-releases/statistical-area-1-dataset-for-2018-census-updated-march-2020>

<sup>9</sup> 70m<sup>2</sup> was chosen so as to avoid including small ancillary residential buildings such as sheds and standalone garages as dwellings

<sup>10</sup> Classification of buildings to residential or non-residential was undertaken using Google Streetview and aerial photo imagery

<sup>11</sup> And so does not account for any joined dwellings such as duplexes and apartments

<sup>12</sup> n=14

<sup>13</sup> n=26

within each SA1 are distributed identically across the PSCs. A subset<sup>14</sup> of the dwelling count matrix is shown in Figure 3.1 for illustrative purposes.

The output of this process is an estimation of Census dwellings to PSCs.

**Figure 3.1: Dwelling count by SA1 and PSC (subset, for illustrative purposes)**

| SA1                                 | PS-A  | PS-B  | PS-C  | PS-E  | PS-F  | PS-G  | PS-H  | PS-J  | Other PSCs | Not in a PSC | Total |
|-------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|------------|--------------|-------|
| <b>Count of buildings &gt;70sqm</b> |       |       |       |       |       |       |       |       |            |              |       |
| .....                               | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .....      | .....        | ..... |
| 7001105                             | -     | -     | -     | -     | -     | 66    | 62    | 39    | .....      | 26           | 193   |
| 7001106                             | -     | -     | -     | -     | -     | 220   | -     | -     | .....      | -            | 220   |
| 7001107                             | -     | -     | -     | -     | 63    | 129   | -     | -     | .....      | -            | 192   |
| 7001108                             | -     | -     | -     | 77    | 38    | 20    | -     | -     | .....      | -            | 204   |
| 7001109                             | -     | -     | 32    | -     | -     | -     | -     | -     | .....      | -            | 151   |
| 7001110                             | 94    | 40    | 56    | -     | -     | -     | -     | -     | .....      | -            | 243   |
| 7001111                             | 5     | -     | 17    | -     | -     | -     | -     | -     | .....      | -            | 121   |
| .....                               | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .....      | .....        | ..... |
| <b>Share of buildings &gt;70sqm</b> |       |       |       |       |       |       |       |       |            |              |       |
| .....                               | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .....      | .....        | ..... |
| 7001105                             | 0%    | 0%    | 0%    | 0%    | 0%    | 34%   | 32%   | 20%   | .....      | 13%          | 100%  |
| 7001106                             | 0%    | 0%    | 0%    | 0%    | 0%    | 100%  | 0%    | 0%    | .....      | 0%           | 100%  |
| 7001107                             | 0%    | 0%    | 0%    | 0%    | 33%   | 67%   | 0%    | 0%    | .....      | 0%           | 100%  |
| 7001108                             | 0%    | 0%    | 0%    | 38%   | 19%   | 10%   | 0%    | 0%    | .....      | 0%           | 100%  |
| 7001109                             | 0%    | 0%    | 21%   | 0%    | 0%    | 0%    | 0%    | 0%    | .....      | 0%           | 100%  |
| 7001110                             | 39%   | 16%   | 23%   | 0%    | 0%    | 0%    | 0%    | 0%    | .....      | 0%           | 100%  |
| 7001111                             | 4%    | 0%    | 14%   | 0%    | 0%    | 0%    | 0%    | 0%    | .....      | 0%           | 100%  |
| .....                               | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .....      | .....        | ..... |

### 3.3 Wastewater connections

Current wastewater connections were provided as a GIS shapefile by KDC.<sup>15</sup> The shapefile includes fields that count the number of commercial and residential connections on each property, and whether there is the option for each property to have a new (commercial or residential) connection. The shapefile also contains a valuation number, which is a unique identifier which allows a link to be drawn to a list of KDC properties.

<sup>14</sup> The matrix does not show all SA1s, or all PSCs.

<sup>15</sup> Mangawhai\_Properties\_Wastewater\_Connections.shp GIS file sourced from Kaipara District Councils property rating database; Magiq.

### 3.4 Properties

We were provided with a list of all properties in Mangawhai.<sup>16</sup> That list was used as a cross-check on the count of properties in each PSC, and to provide a measure of the area of each property, to assist in the assessment of additional potential development yield.

### 3.5 Airbnb listings

Airbnb listings in Mangawhai were used to verify the number of NPODs to PSC level. The process to achieve this was to map Airbnb data<sup>17</sup> to point location using coordinate data contained in the dataset. The Airbnb data mapped was entire homes (excluding private rooms in a dwelling), which is equivalent to a subset of NPODs that are available on the Airbnb platform. That data was used to check that Airbnb dwellings were, in all catchments, less than the estimates Census count of NPODs derived using the process described in section 3.2. In total within the PSCs 'entire home' Airbnbs account for 20% of all NPODs.

### 3.6 Spatial plan capacity estimates

The Mangawhai Spatial Plan<sup>18</sup> was used to inform capacity estimates and anticipated growth areas, interpreted in conjunction with the draft District plan zones. Figures 3.4.6 and 3.4.7 in the Spatial Plan were used to provide an indication of the possible magnitude and location of future growth, although Spatial Plan information was interpreted in the context that the Spatial Plan relates to a 30 year horizon, and not all capacity it anticipates will necessarily eventuate, and that which may not yield developable land for many years.

### 3.7 Draft District Plan zones

The draft Kaipara District Plan zones<sup>19</sup> were used as an aid to understanding the potential location and quantum of dwelling capacity that might be provided for in Mangawhai. Those zones are not yet publicly available, and are subject to change as the draft District Plan proceeds.

### 3.8 Wastewater catchments

Catchments were supplied by KDC, having been defined by WSP. A technical explanation of the catchments was provided in a WSP memo "Mangawhai Wastewater Network Future Catchment

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<sup>16</sup> "Kaipara\_District\_Properties" layer in a supplied geodatabase

<sup>17</sup> <http://insideairbnb.com/get-the-data.html>

<sup>18</sup>

<https://www.kaipara.govt.nz/uploads/spatial%20planning/Mangawhai/CUR%20Mangawhai%20Spatial%20Plan%20Report%20DRAFT%202020%2006%2015%20SM.pdf>

<sup>19</sup> Version current as of receipt 27 October 2021

Delineation” (22 November 2021),<sup>20</sup>with an accompanying GIS shapefile.<sup>21</sup> The catchments defined are shown graphically in Figure 2.1 and in greater detail in Appendix 1.

### 3.9 Building footprints

Building footprints were used to estimate the distribution of Census dwellings within each SA1, to apportion dwellings to PSCs. The building footprints used were sourced from the LINZ WFS service.<sup>22</sup> That spatial distribution process is described in section 3.2.

### 3.10 Aerial photography

Aerial photography was used to assist in interpretation of building types, the location of new buildings (which in some cases due to currency may differ from footprint data) and vacant lots. Aerial photography used included Google Satellite and LINZ NZ Aerial Imagery.

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<sup>20</sup> Which we understand may have been subject to some minor and inconsequential text changes, and was potentially to be reissued in final form

<sup>21</sup> Wastewater connection data was sourced from KDC’s property rating database; Magiq

<sup>22</sup> Dataset ID 101290, called “NZ Building Outlines”, from <https://data.linz.govt.nz/layer/101290/webservices/>, last updated 14 June 2021, although exact date of capture of Mangawhai data is unavailable.

## 4 Approach

This section describes the process employed to calculate the dwelling demand projections for this project.

### 4.1 Dwellings baseline (2021)

The beginning point of the projections is to establish the number of dwellings in Mangawhai, by PSC, for the base year (2021). The number of dwellings in 2021 was set as the largest of:

- ❖ the number of residential wastewater connections
- ❖ the number of residential buildings larger than 70m<sup>2</sup>
- ❖ total dwellings (PODs and NPODs) counted in the Census

No single one of those variables will accurately describe the number of dwellings in Mangawhai, because within the PSCs:

- ❖ there are properties that have dwellings but no wastewater connection
- ❖ there have been changes in dwelling numbers since each of the datasets were produced
- ❖ some properties have more than one dwelling
- ❖ some properties may have a dwelling that is smaller than 70m<sup>2</sup>, while others will have non-dwellings that are larger than 70m<sup>2</sup>.

The conclusion of that assessment is estimates of the number of dwellings in each PSC in 2021, with 2021 taken as the base year of the assessment. That estimate is that there are 2,701 dwellings in the PSCs, and a further 1,079 dwellings that are not in PSCs, but are in the study area (the three Mangawhai SA2s), for a total of 3,780 dwellings in all of Mangawhai (Figure 4.1). The process for estimating the share of all dwellings in each PSC that are PODs and NPODs is provided in section 3.2.

The 2,701 dwellings in the PSCs:

- ❖ compares to a Census 2018 count of 2,560 dwellings, 2,507 residential buildings of 70m<sup>2</sup>+, and 2,510 residential wastewater connections
- ❖ includes 1,853 PODs, and 981 NPODs. Outside the PSCs there are a further 945 PODs, and 134 NPODs.

Note that for the PS-OF/WWTP catchments, the 2021 dwelling estimate was derived for the singular catchment, and then split to the two sub-catchments.

Figure 4.1: Estimated 2021 PSC dwelling counts

| PSC                  | Residential WW connections | Count of residential buildings >70sqm | Census dwellings | Max. of these 3 (applied as 2021 dwelling estimate) |
|----------------------|----------------------------|---------------------------------------|------------------|---|
| PS-A                 | 79                         | 99                                    | 94               | 99  |
| PS-B                 | 38                         | 40                                    | 38               | 40  |
| PS-C                 | 104                        | 105                                   | 101              | 105   |
| PS-E                 | 66                         | 77                                    | 74               | 77  |
| PS-F                 | 86                         | 145                                   | 154              | 154   |
| PS-G                 | 511                        | 541                                   | 549              | 549   |
| PS-H                 | 65                         | 62                                    | 64               | 65  |
| PS-J                 | 48                         | 39                                    | 40               | 48  |
| PS-K                 | 491                        | 361                                   | 408              | 491   |
| PS-OF/WWTP West      | 25                         | 58                                    | 42               | 49  |
| PS-OF/WWTP East      | 406                        | 375                                   | 380              | 384   |
| PS-VA                | 421                        | 465                                   | 462              | 465   |
| PS-VB                | 85                         | 66                                    | 64               | 85  |
| PS-VC                | 85                         | 74                                    | 90               | 90  |
| Out of catchment     | -                          | 1,079                                 | 1,049            | 1,079   |
| <b>Total all</b>     | <b>2,510</b>               | <b>3,586</b>                          | <b>3,609</b>     | <b>3,780</b>  |
| <b>Total of PSCs</b> |                            |                                       |                  | <b>2,701</b>  |

\* orange cells: calculated as total for PS-OF/WWTP total, and then split

## 4.2 Dwelling projections

Those baseline dwelling estimates are the first (2021) year in the dwelling projections. Future years were calculated by growing 2021 dwelling counts for all of Mangawhai, and then distributing that growth spatially. The projections of total dwelling numbers are calculated by summing the projections of PODs and NPODs as described in this subsection.

### 4.2.1 Permanent occupied dwelling projections

The dwelling projections are constrained by the household projections provided by Infometrics. To project total dwelling numbers in Mangawhai (PSCs and outside the wastewater catchment) our assessment calculates the growth in households that is projected each five year intercensal period, then factors that up to equate to an equivalent number of dwellings growth in that period, using the most recent (2018) ratio of dwellings to households in each SA2.<sup>23</sup> That current ratio is assumed to

<sup>23</sup> 1.03 dwellings per household | Mangawhai, 1.04 in Mangawhai Heads, and 1.01 in Mangawhai Rural.



hold constant into the future, resulting in the aggregate all of Mangawhai dwelling (PODs) projections shown in Appendix 2.

#### 4.2.2 Non-permanent occupied dwelling projections

The Infometrics household projections are synonymous with (although slightly different to) PODs, but do not make any provision for NPODs, because NPODs do not accommodate households. Projections of NPODs (i.e. predominantly holiday homes) are therefore calculated separately, as explained below.

Within each PSC the share of all dwellings that are PODs and NPODs is estimated, for the base year, using Census data, as explained in section 3.2. The base year (2021) occupation structure is shown in Figure 4.2.

**Figure 4.2: Mangawhai share of dwellings by occupation type (2021)**

| PSC                  | PODs       | NPODs      | Total dwellings |
|----------------------|------------|------------|-----------------|
| PS-A                 | 56%        | 44%        | 100%            |
| PS-B                 | 55%        | 45%        | 100%            |
| PS-C                 | 66%        | 34%        | 100%            |
| PS-E                 | 54%        | 46%        | 100%            |
| PS-F                 | 62%        | 38%        | 100%            |
| PS-G                 | 52%        | 48%        | 100%            |
| PS-H                 | 46%        | 54%        | 100%            |
| PS-J                 | 46%        | 54%        | 100%            |
| PS-K                 | 74%        | 26%        | 100%            |
| PS-OF/WWTP West      | 82%        | 18%        | 100%            |
| PS-OF/WWTP East      | 71%        | 29%        | 100%            |
| PS-VA                | 86%        | 14%        | 100%            |
| PS-VB                | 89%        | 11%        | 100%            |
| PS-VC                | 87%        | 13%        | 100%            |
| Out of catchment     | 88%        | 12%        | 100%            |
| <b>Total all</b>     | <b>74%</b> | <b>26%</b> | <b>100%</b>     |
| <b>Total of PSCs</b> | <b>69%</b> | <b>31%</b> | <b>100%</b>     |

We have assessed trends in dwelling occupation structure over time, in relation to settlement size, focussed on coastal settlements north of Auckland that are attractive to holiday home owners. That research enables us to conclude that as that type of settlement grows in size, the share of NPODs decreases, and the share of PODs increases. That change has been evident over the last intercensal period (2013-2018) and across most comparable settlements. That intuitively makes sense, given that

a larger settlement will accommodate a larger base of retail and service businesses, making it more attractive (and viable) to live permanently in a location.

Based on that assessment the assumption is made that the proportion of all dwellings in the Mangawhai PSCs that are PODs will increase from the current 69% by 1% every 5 years, reaching 72% in 2028, 74% in 2038, and 76% in 2048 (on average, across all of the PSCs). Some PSCs will experience a greater increase in the share of PODs than others. The three PSCs in southern Mangawhai (PS-VA, PS-VB, and PS-VC) all have high shares of PODs now, at 86-89%), and therefore relatively little room for that share to increase further. The research undertaken also indicates that in comparable coastal settlements at least 10-15% of all dwellings are likely to be NPODs. In other parts of Mangawhai where POD shares are lower, there is greater potential for the share of NPODs to increase. The assumed shares of PODs are shown in Figure 4.3.

**Figure 4.3: Share of dwellings that are PODs**

| PSC                  | 2021       | 2023       | 2028       | 2033       | 2038       | 2043       | 2048       |
|----------------------|------------|------------|------------|------------|------------|------------|------------|
| PS-A                 | 56%        | 57%        | 57%        | 58%        | 58%        | 59%        | 59%        |
| PS-B                 | 55%        | 55%        | 56%        | 57%        | 57%        | 58%        | 58%        |
| PS-C                 | 66%        | 67%        | 68%        | 68%        | 69%        | 70%        | 70%        |
| PS-E                 | 54%        | 54%        | 55%        | 55%        | 56%        | 56%        | 57%        |
| PS-F                 | 62%        | 63%        | 63%        | 64%        | 64%        | 65%        | 66%        |
| PS-G                 | 52%        | 52%        | 53%        | 53%        | 54%        | 54%        | 55%        |
| PS-H                 | 46%        | 47%        | 47%        | 48%        | 48%        | 49%        | 49%        |
| PS-J                 | 46%        | 47%        | 47%        | 48%        | 48%        | 49%        | 49%        |
| PS-K                 | 74%        | 75%        | 76%        | 77%        | 77%        | 78%        | 79%        |
| PS-OF/WWTP West      | 82%        | 83%        | 83%        | 84%        | 85%        | 86%        | 87%        |
| PS-OF/WWTP East      | 71%        | 72%        | 73%        | 73%        | 74%        | 75%        | 75%        |
| PS-VA                | 86%        | 88%        | 88%        | 88%        | 88%        | 88%        | 88%        |
| PS-VB                | 89%        | 91%        | 91%        | 91%        | 91%        | 91%        | 91%        |
| PS-VC                | 87%        | 89%        | 89%        | 89%        | 89%        | 89%        | 89%        |
| Out of catchment     | 88%        | 89%        | 89%        | 89%        | 89%        | 89%        | 89%        |
| <b>Total all</b>     | <b>74%</b> | <b>75%</b> | <b>76%</b> | <b>77%</b> | <b>78%</b> | <b>79%</b> | <b>79%</b> |
| <b>Total of PSCs</b> | <b>70%</b> | <b>71%</b> | <b>72%</b> | <b>73%</b> | <b>74%</b> | <b>75%</b> | <b>76%</b> |

The number of NPODs is calculated as the number of PODs divided by the proportion of dwellings that are PODs (in each year-PSC pair). Those resulting NPOD projections were subjected to several cross-checks to ensure outputs were reasonable. Those checks indicated that:

- ❖ Aggregate growth across all Mangawhai NPODs is projected to be 30-35 dwellings per year in the 2020s, decreasing to 20-30 in the 2030s. That is consistent with trends over

the period 2006-2018, with a declining number of new NPODs observed over that period.

- ❖ Growth in NPODs in the range of coastal settlements north of Auckland (from Tutukaka in the north to Snells Beach in the south) has been in the order of 100 NPODs per year, implying an initial (and potentially ongoing) market share of NPOD growth in Mangawhai of around 30%. That also is consistent with recent trends.

## 4.3 Spatial allocation of growth

Having calculated the total POD and NPOD growth in Mangawhai, the final stage of the assessment was to spatially allocate that growth within Mangawhai. That allocation includes areas outside the PSCs. That spatial allocation involved several steps, as described below.

### 4.3.1 Dwelling capacity estimates

To accommodate growth a PSC must have capacity to do so, and PSCs with little capacity are unlikely to accommodate much growth. Because a number of the PSCs are geographically small, and largely fully developed with few or no vacant residential lots, they are unlikely to experience many net additional dwellings. There may be some replacement of older dwellings with large new ones, particularly in higher value parts of the town along the coastal fringe (e.g. PS-A, PS-E, and PS-G), however that replacement is unlikely to yield a net increase in dwelling numbers. There is some infill potential in those smaller catchments, however they lack the more significant potential of PSCs where there are large greenfields areas.

The potential to accommodate additional dwellings was assessed:

- ❖ By reviewing the additional capacity estimates produced as input to the Mangawhai Spatial Plan. That data was provided in spreadsheet form,<sup>24</sup> and then mapped by us, to allow summation to PSC.
- ❖ From our independent visual inspection of vacant capacity from Google Streetview and aerial photography, which was assisted by policy-based contributions from Paul Waanders (District Planner).<sup>25</sup>

From that assessment it was concluded that there is very limited potential (less than 30 dwellings) for net additional dwellings (PODs or NPODs) in the following seven PSCs: PS-A, PS-B, PS-C, PS-E, PS-H, PS-J, and PS-VB. Two PSCs (PS-F and PS-G) had greater potential (50-60 dwellings), although are largely

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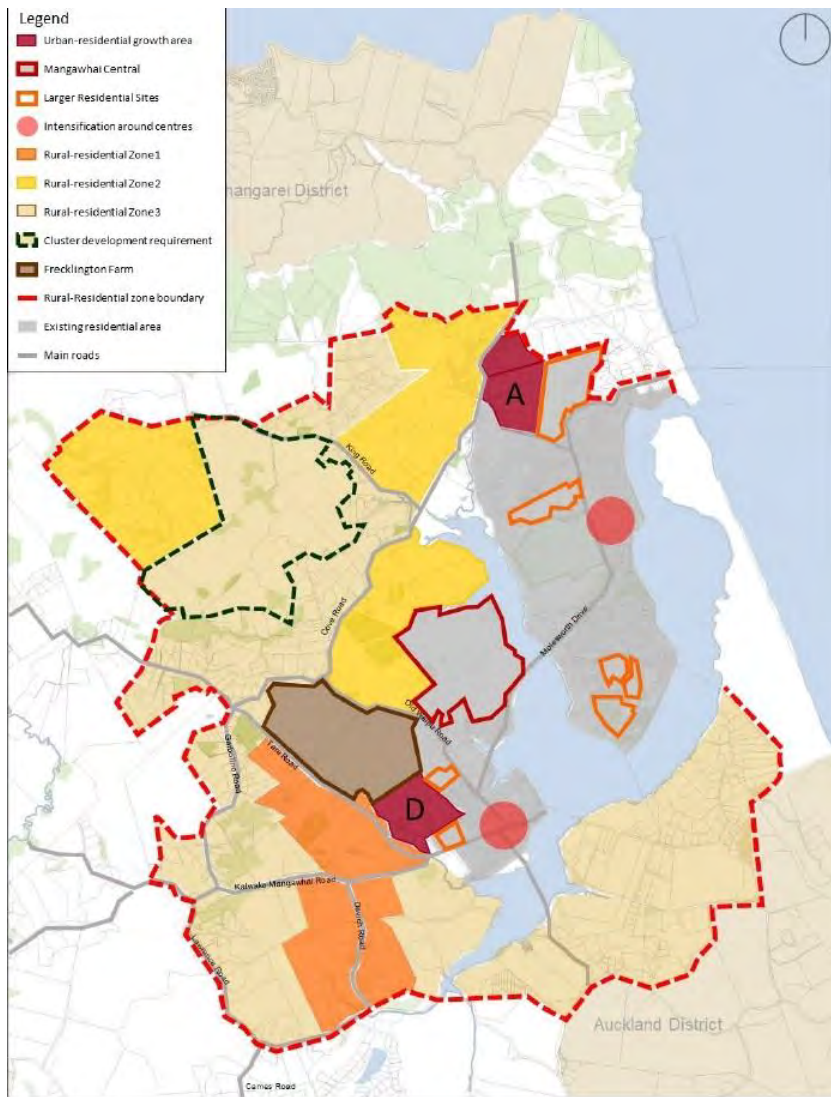
<sup>24</sup> Mitch Filtered - 20170414 Rating Data w zoning w capacities.xlsx

<sup>25</sup> Including in relation to Mangawhai Central, and the status of Plan Change 78, the status and interpretation of the Mangawhai Spatial Plan, and current progress on draft District Plan policy, including minimum lot sizes by zone and location.

fully developed already. The other four PSCs have the most significant potential for additional dwellings. Those five PSCs are:

- ❖ PS-K: the largely rural area in the north-west of Mangawhai Heads on the road north to Langs Beach (taking in Gumdiggers Lane and Jack Boyd Drive). This PSC includes Area A in Figure 4.4, one of two 'growth pockets' identified in the Spatial Plan, and anticipated by that Plan to provide for a potential of 302 lots in conjunction with Area D, and one of only two new areas with the emphasis on infill.
- ❖ PS-OF/WWTP: the largest PSC by area, extending from north of the golf course all the way south to the estuary and Estuary Drive, and taking in Mangawhai Central on the western side of the estuary, and a large part of the undeveloped area in Mangawhai Heads.
- ❖ PS-VA: the south-western-most part of Mangawhai that is located north of the Kaiwaka-Mangawhai Road. This is a geographically large PSC, and includes Area D (Figure 4.4) which is anticipated by the Spatial Plan to provide for a potential of 302 lots in conjunction with Area A. Much of the future growth area within this PSC is identified in the Spatial Plan as Rural Residential Zone 1 (minimum 0.4-0.8ha).
- ❖ PS-VC: this is the PSC in between Mangawhai Central and the Mangawhai shops, on the western side of Molesworth Drive. The PSC is sparsely populated at present, but located within the area that is anticipated to accommodate both infill dwellings and new dwellings on lots that are zoned but vacant.

Figure 4.4: Mangawhai Spatial Plan, Figure 3.4.7 (Preferred growth option)



In addition to the areas inside the PSCs, the area outside the PSCs is also anticipated by the Spatial Plan to accommodate some future growth, on large lot Rural Residential zoned parcels. The dwelling capacity available in each zone was checked against Spatial Plan estimates of total additional capacity by location type (e.g. ‘Zoned but not built’, Infill, Minor Dwellings, rural-residential, etc.)<sup>26</sup> to ensure that the capacity assumed for this assessment was less than the Spatial Plan’s capacity. A key finding of this assessment was that to provide for the level of growth projected by Infometrics, which equates to about 3,050 additional dwellings (PODs and NPODs) in the period 2021-2051, only 66% of the Spatial Plan’s capacity (4,643 dwellings)<sup>27</sup> would need to be taken up. That confirms that the allocation assumed is reasonable, and achievable, in the context of the Spatial Plan’s anticipation.

<sup>26</sup> From Figure 3.4.6 in the Spatial Plan

<sup>27</sup> Figure 3.4.6 in the Spatial Plan

The dwelling capacities assumed are summarised in Figure 4.5, where the dominance of four PSCs is evident. The capacity identified there is less than the Spatial Plan capacity, as it identifies only enough capacity to accommodate anticipated 30 year growth, and so does not identify as much ‘Zoned but not built’ and Infill capacity, for example.

**Figure 4.5: Mangawhai PSC net additional dwelling capacity estimates (as at 2021)**

| PSC                  | Additional dwelling capacity estimate |
|----------------------|---------------------------------------|
| PS-A                 | 15                                    |
| PS-B                 | 10                                    |
| PS-C                 | 27                                    |
| PS-E                 | 14                                    |
| PS-F                 | 58                                    |
| PS-G                 | 54                                    |
| PS-H                 | 12                                    |
| PS-J                 | 9                                     |
| PS-K                 | 413                                   |
| PS-OF/WWTP West      | 1,015                                 |
| PS-OF/WWTP East      | 495                                   |
| PS-VA                | 472                                   |
| PS-VB                | 6                                     |
| PS-VC                | 276                                   |
| Out of catchment     | 308                                   |
| <b>Total all</b>     | <b>3,184</b>                          |
| <b>Total of PSCs</b> | <b>2,876</b>                          |

### 4.3.2 Timing

Once the anticipated level of dwelling growth has been allocated spatially to the PSCs (and balance area outside the PSCs), the final stage in the process was to allocate growth over time. For this process it was assumed that the PSCs with little net additional dwelling capacity would have that capacity taken up evenly over the period to 2028, reflecting an imminent pressure on land availability, and the attractiveness to establish dwellings on existing lots in established areas. In practice this development may be phased over a longer time, however the small amount of growth assumed will mean that a longer actual phasing of that growth will be of little negative consequence for wastewater planning, and faster, rather than slower, assumed development will be conservative in that the assumption will not understate when any infrastructure upgrades would be required.

Assumptions relating to the staging of growth in PSCs with greater capacity are more important. Once the smaller PSCs have been allocated their share of growth, the balance of growth anticipated by the Infometrics-based projections must be spread across the remaining PSCs. That allocation was done broadly pro-rata to capacity of each of the six PSCs, and based on the assumption that each PSC would



experience consistent growth over time, until dwelling capacity is exhausted. The assumed temporal distribution of dwelling growth is shown in Figure 4.6. That development phasing was assumed to apply to both PODs and NPODs.

**Figure 4.6: Assumed temporal distribution of Mangawhai dwelling growth**

| PSC              | 2021-23 | 2023-28 | 2028-33 | 2033-38 | 2038-43 | 2043-48 | Post 2048 |
|------------------|---------|---------|---------|---------|---------|---------|-----------|
| PS-A             | 50%     | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-B             | 50%     | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-C             | 50%     | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-E             | 50%     | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-F             | 20%     | 40%     | 40%     | 0%      | 0%      | 0%      | 0%        |
| PS-G             | 30%     | 30%     | 40%     | 0%      | 0%      | 0%      | 0%        |
| PS-H             | 50%     | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-J             | 50%     | 50%     | 0%      | 0%      | 0%      | 0%      | 0%        |
| PS-K             | 15%     | 20%     | 20%     | 20%     | 20%     | 5%      | 0%        |
| PS-OF/WWTP West  | 4%      | 21%     | 24%     | 20%     | 12%     | 10%     | 6%        |
| PS-OF/WWTP East  | 5%      | 19%     | 18%     | 14%     | 10%     | 10%     | 6%        |
| PS-VA            | 10%     | 10%     | 17%     | 17%     | 17%     | 17%     | 12%       |
| PS-VB            | 10%     | 30%     | 40%     | 20%     | 0%      | 0%      | 0%        |
| PS-VC            | 13%     | 22%     | 22%     | 22%     | 21%     | 0%      | 0%        |
| Out of catchment | 14%     | 20%     | 20%     | 15%     | 16%     | 15%     | 0%        |

The output of that process is projections of dwelling numbers from 2021 to 2051, by PSC, for PODs and NPODs, as presented in the next section.

## 5 Mangawhai dwelling projections

The dwelling projections derived from the above process are shown in Figure 5.1, and in full detail in Appendix 3. Those projections are that dwelling numbers in Mangawhai will double (+95%) in the period 2021-2051, with growth being concentrated inside the PSCs, and greater for NPODs than PODs. Those detailed projections are also provided in an accompanying spreadsheet.

**Figure 5.1: Mangawhai dwelling projections**

|      | PODs    |             |                 | NPODs   |             |                 | Total dwellings |             |                 |
|------|---------|-------------|-----------------|---------|-------------|-----------------|-----------------|-------------|-----------------|
|      | In PSCs | Out of PSCs | Total Mangawhai | In PSCs | Out of PSCs | Total Mangawhai | In PSCs         | Out of PSCs | Total Mangawhai |
| 2021 | 1,853   | 945         | 2,798           | 848     | 134         | 981             | 2,701           | 1,079       | 3,780           |
| 2023 | 2,137   | 989         | 3,125           | 920     | 121         | 1,041           | 3,057           | 1,109       | 4,166           |
| 2028 | 2,718   | 1,050       | 3,768           | 1,073   | 128         | 1,202           | 3,792           | 1,178       | 4,970           |
| 2033 | 3,322   | 1,112       | 4,434           | 1,201   | 136         | 1,337           | 4,523           | 1,248       | 5,771           |
| 2038 | 3,819   | 1,158       | 4,977           | 1,272   | 141         | 1,414           | 5,092           | 1,299       | 6,391           |
| 2043 | 4,206   | 1,207       | 5,414           | 1,315   | 147         | 1,463           | 5,522           | 1,355       | 6,876           |
| 2048 | 4,456   | 1,253       | 5,709           | 1,326   | 153         | 1,479           | 5,782           | 1,407       | 7,188           |
| 2051 | 4,605   | 1,281       | 5,887           | 1,332   | 156         | 1,489           | 5,938           | 1,438       | 7,376           |

## 6 Recommendations

The following recommendations are made to provide Council officers with guidance on the potential research that could be undertaken in the future.

First, the resident population and household projections are a key input into this assessment. The future is inherently uncertain, which means that the population and household projections may not match the actual growth that occurs. We consider that Council officers should assess the performance of the projections on an annual basis, and if growth exceeds the projections that the assessment in this report could be updated. Also, it is likely that KDC will commission new population and household projections in the coming two to three years which could also trigger the need for an update to this assessment. However, if growth tracks at a level similar to the population and household projections then there would not be a need to update the assessment.

Second, this report has assessed the number of dwellings in each catchment and does not assess whether they are served by infrastructure now or in the future. Given the current infrastructure some of these dwellings cannot be connected into the wastewater system. If there was more time available, it would be possible to develop an estimate of the number of dwellings in each catchment that *could* be served at each period. This would require an understanding of the potential role out of new infrastructure and a property level assessment. This potential research could be investigated when this study is updated in the future, which would provide a better understanding of demands on the infrastructure system, rather than assuming all dwellings can be served at all points in time.

Third, from our discussions with Council officers it is apparent that there are number of points in the system where there could be capacity constraints. Specifically, the addition of pipes to connect new dwellings to the wastewater system is only one part of the equation, with other capacity constraints at the pump station level, the treatment plant and the dispersal field. This research has assessed key drivers of demand (residents and holiday homes), but does not assess the supply side aspects. Our understanding is that the capacity in some parts of the system is close to capacity and that new capacity is being constructed in the coming years. Given the tight nature of supply, as compared to demands, it may be prudent to update undertake annual reviews of connection numbers and to consider this report on an annual basis until the new capacity is completed.

Finally, the baseline number of dwellings was estimated using a range of datasets. The final number of dwellings that has been used in this study is conservatively high, as it will include some dwellings that are connected to wastewater and others that are not. Therefore, it is considered that the change in dwellings between each point in time will provide the best understanding of the number of potential new connections. Specifically, the baseline number of dwellings should not be taken as the current number of dwellings that are connected to the system.

# Appendix 1 Wastewater catchment maps

Figure A1.1: Catchments PS-A, PS-B and PS-C

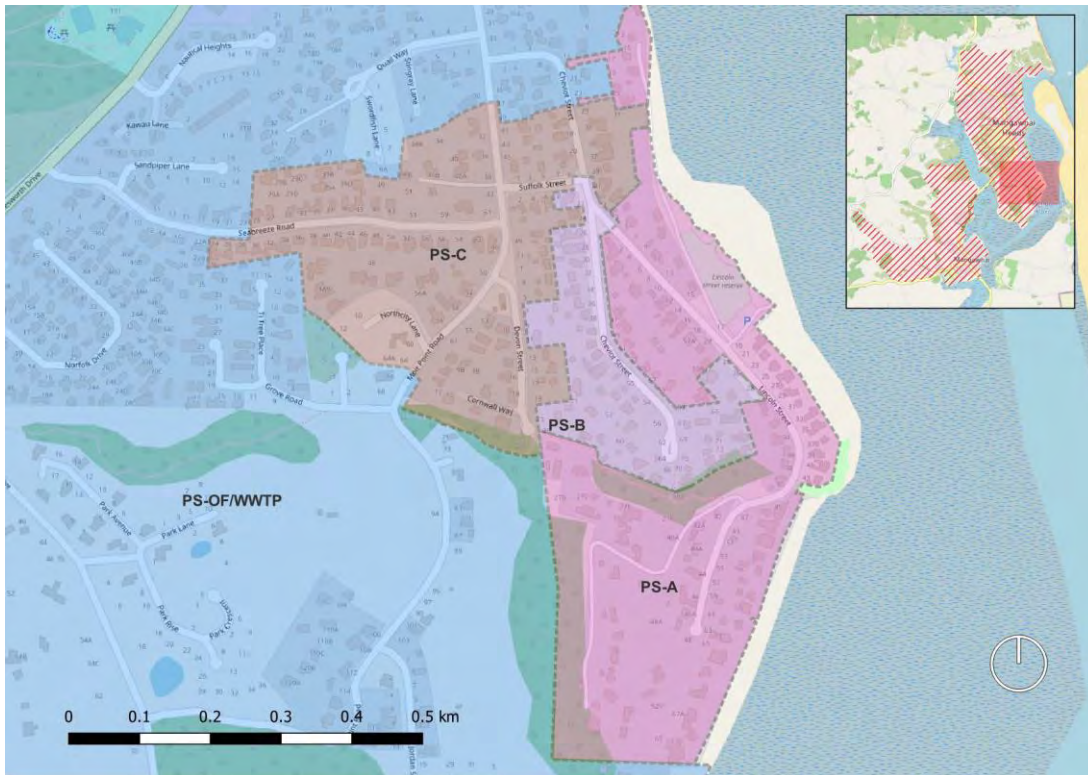


Figure A1.2: Catchments PS-E and PS-F





Figure A1.3: Catchments PS-G and PS-K

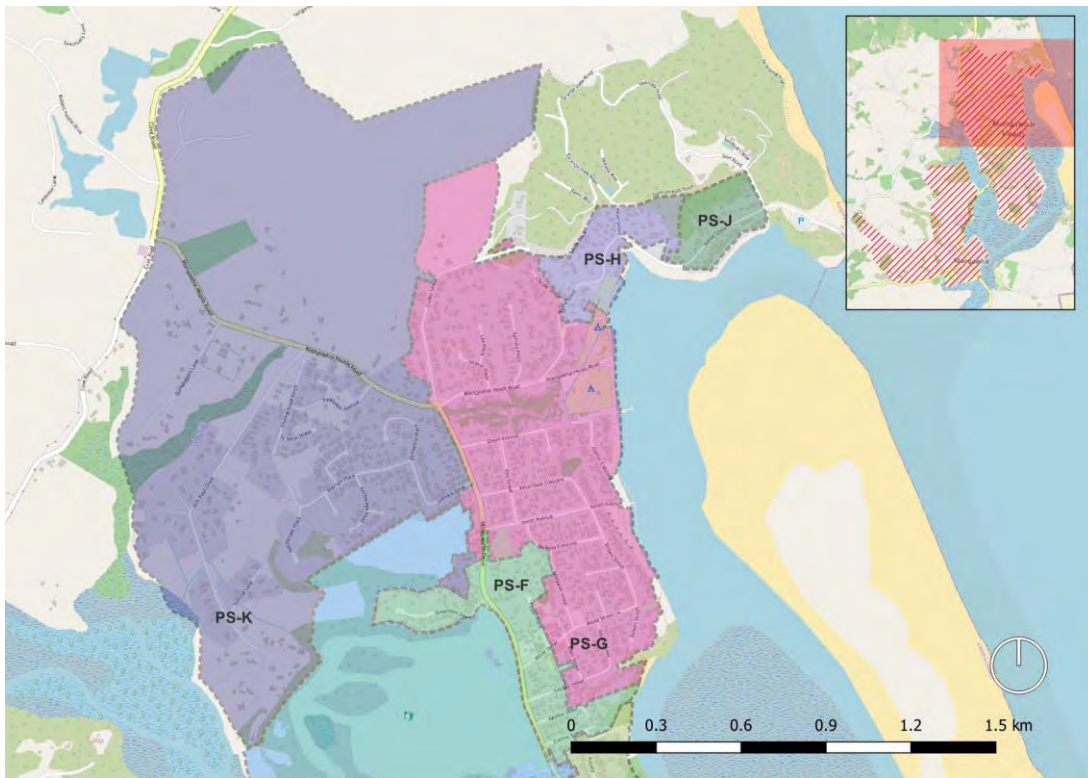
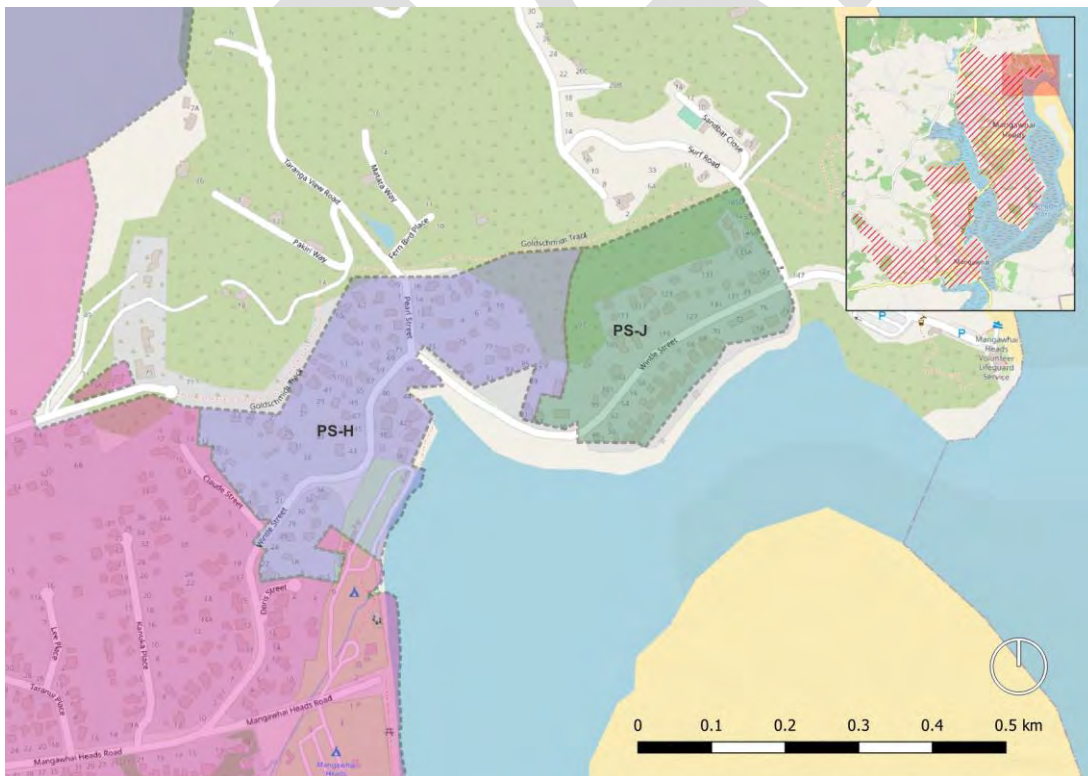


Figure A1.4: Catchments PS-H and PS-J



**Figure A1.5: Catchment PS-OF/WWTP**

Note: the single large PS-OF/WWTP defined by WSP has been split in these projections to two parts, divided by the estuary. Those two parts are called PS-OF/WWTP West (which includes Mangawhai Central) and PS-OF/WWTP East (the Mangawhai Heads part of the catchment).

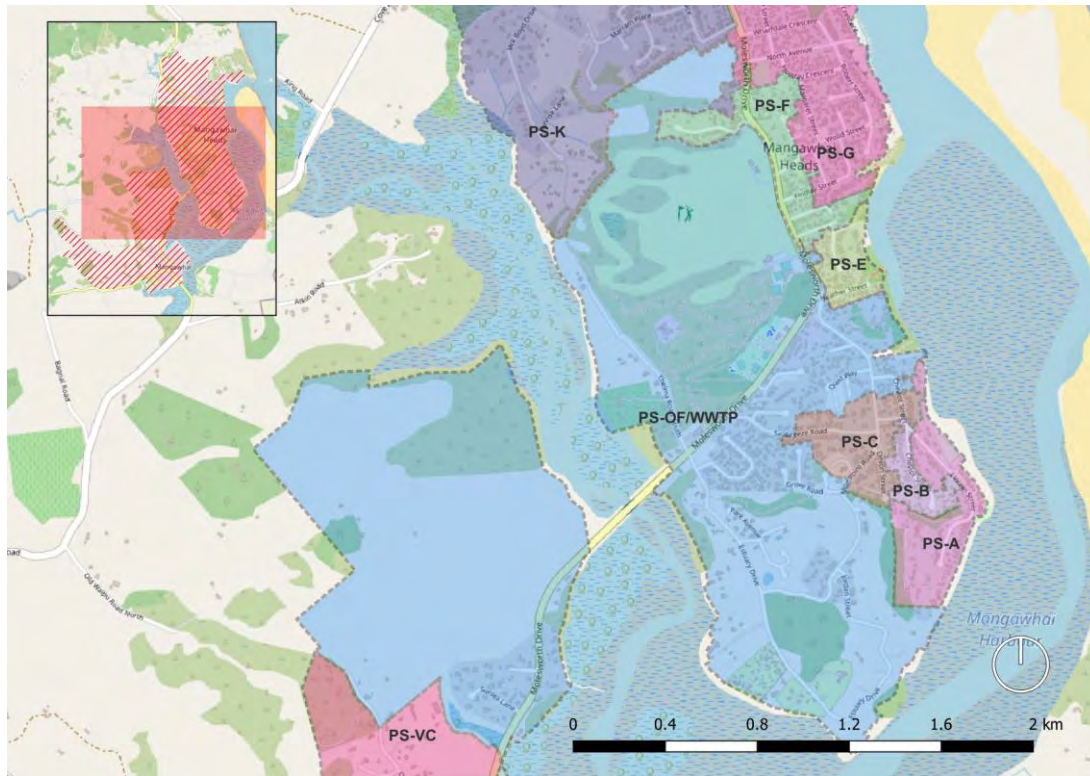
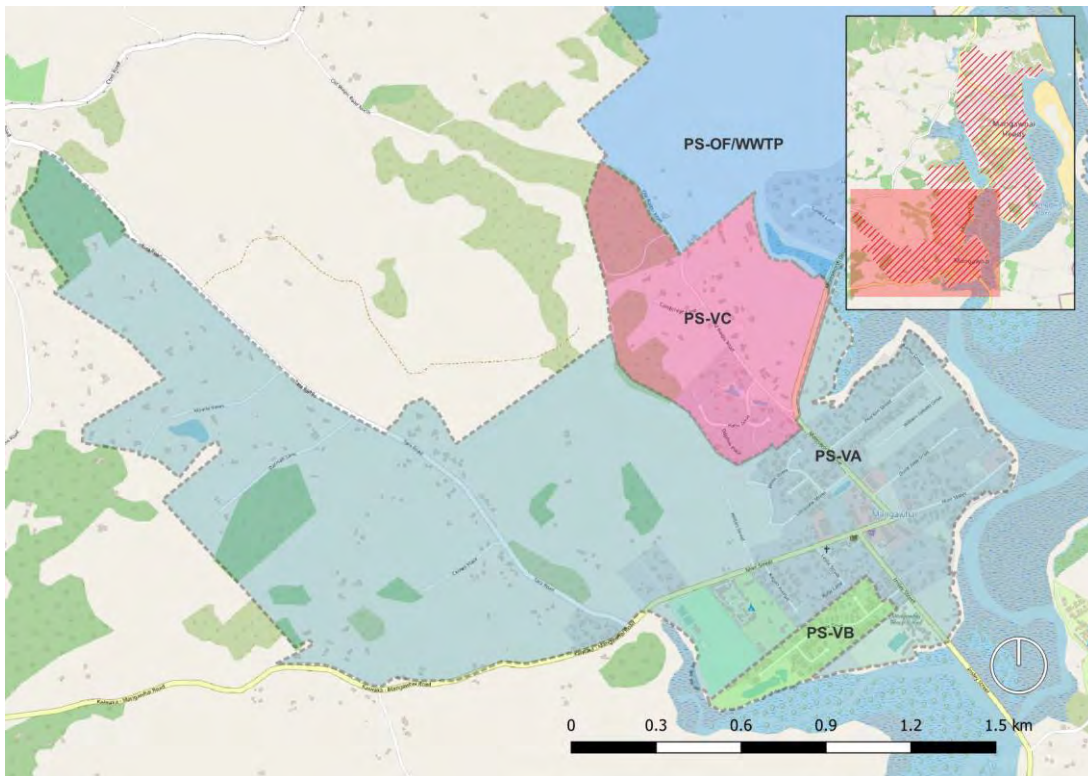


Figure A1.6: Catchments PS-VA, PS-VB and PS-VC



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## Appendix 2 Infometrics household projections

The Infometrics household projections for the three Mangawhai SA2s are shown in the following table, together with the derived aggregate dwelling projections for all of Mangawhai (PODs only, excludes NPODs) that are used as the basis for the PSC dwelling projections.

| Year | Infometrics household projections |                 |                 |                 | Dwelling projections |
|------|-----------------------------------|-----------------|-----------------|-----------------|----------------------|
|      | Mangawhai                         | Mangawhai Heads | Mangawhai Rural | Mangawhai total |                      |
| 2021 | 552                               | 1,091           | 1,077           | 2,719           | 2,796                |
| 2022 | 599                               | 1,149           | 1,128           | 2,876           | 2,961                |
| 2023 | 648                               | 1,208           | 1,181           | 3,037           | 3,126                |
| 2024 | 684                               | 1,257           | 1,224           | 3,166           | 3,254                |
| 2025 | 720                               | 1,305           | 1,267           | 3,291           | 3,382                |
| 2026 | 756                               | 1,351           | 1,308           | 3,415           | 3,510                |
| 2027 | 791                               | 1,398           | 1,349           | 3,537           | 3,639                |
| 2028 | 827                               | 1,444           | 1,390           | 3,661           | 3,765                |
| 2029 | 859                               | 1,491           | 1,438           | 3,787           | 3,899                |
| 2030 | 890                               | 1,538           | 1,488           | 3,916           | 4,032                |
| 2031 | 923                               | 1,586           | 1,538           | 4,046           | 4,165                |
| 2032 | 955                               | 1,633           | 1,588           | 4,177           | 4,299                |
| 2033 | 988                               | 1,681           | 1,638           | 4,307           | 4,432                |
| 2034 | 1,014                             | 1,721           | 1,681           | 4,417           | 4,541                |
| 2035 | 1,041                             | 1,760           | 1,723           | 4,524           | 4,648                |
| 2036 | 1,067                             | 1,798           | 1,765           | 4,630           | 4,757                |
| 2037 | 1,092                             | 1,835           | 1,806           | 4,733           | 4,866                |
| 2038 | 1,118                             | 1,872           | 1,846           | 4,835           | 4,975                |
| 2039 | 1,141                             | 1,903           | 1,878           | 4,922           | 5,063                |
| 2040 | 1,165                             | 1,934           | 1,910           | 5,008           | 5,149                |
| 2041 | 1,188                             | 1,964           | 1,941           | 5,093           | 5,238                |
| 2042 | 1,211                             | 1,993           | 1,972           | 5,176           | 5,324                |
| 2043 | 1,233                             | 2,023           | 2,003           | 5,259           | 5,411                |
| 2044 | 1,245                             | 2,033           | 2,040           | 5,318           | 5,470                |
| 2045 | 1,256                             | 2,043           | 2,078           | 5,377           | 5,530                |
| 2046 | 1,267                             | 2,053           | 2,115           | 5,434           | 5,589                |
| 2047 | 1,277                             | 2,063           | 2,152           | 5,492           | 5,647                |
| 2048 | 1,288                             | 2,072           | 2,189           | 5,549           | 5,706                |
| 2049 | 1,295                             | 2,078           | 2,223           | 5,597           | 5,766                |
| 2050 | 1,303                             | 2,085           | 2,257           | 5,644           | 5,826                |
| 2051 | 1,310                             | 2,091           | 2,291           | 5,692           | 5,885                |

# Appendix 3 Detailed dwelling projections

Figure A3.1: Mangawhai permanent occupied dwelling projections


| Year      | PS-A | PS-B | PS-C | PS-E | PS-F | PS-G | PS-H | PS-J | PS-K | PS-OF/WWTP |      | PS-VA | PS-VB | PS-VC | Non-PSC | Total | Total PSCs |
|-----------|------|------|------|------|------|------|------|------|------|------------|------|-------|-------|-------|---------|-------|------------|
|           |      |      |      |      |      |      |      |      |      | West       | East |       |       |       |         |       |            |
| 2021      | 55   | 22   | 69   | 41   | 95   | 284  | 30   | 22   | 364  | 40         | 273  | 402   | 76    | 78    | 945     | 2,798 | 1,853      |
| 2022      | 59   | 24   | 76   | 45   | 101  | 292  | 33   | 25   | 395  | 62         | 284  | 426   | 76    | 96    | 967     | 2,962 | 1,995      |
| 2023      | 63   | 27   | 83   | 48   | 107  | 300  | 36   | 27   | 426  | 85         | 296  | 449   | 77    | 114   | 989     | 3,125 | 2,137      |
| 2024      | 64   | 28   | 86   | 50   | 111  | 303  | 37   | 28   | 443  | 127        | 314  | 459   | 77    | 126   | 1,001   | 3,254 | 2,253      |
| 2025      | 66   | 29   | 88   | 51   | 116  | 307  | 39   | 29   | 459  | 170        | 333  | 468   | 77    | 138   | 1,013   | 3,383 | 2,369      |
| 2026      | 67   | 30   | 91   | 52   | 121  | 310  | 40   | 29   | 476  | 213        | 351  | 478   | 78    | 150   | 1,025   | 3,511 | 2,486      |
| 2027      | 69   | 31   | 94   | 54   | 125  | 313  | 41   | 30   | 492  | 255        | 370  | 487   | 78    | 163   | 1,038   | 3,640 | 2,602      |
| 2028      | 70   | 32   | 96   | 55   | 130  | 316  | 42   | 31   | 509  | 298        | 389  | 496   | 78    | 175   | 1,050   | 3,768 | 2,718      |
| 2029      | 70   | 32   | 96   | 55   | 135  | 321  | 42   | 31   | 525  | 347        | 407  | 512   | 79    | 187   | 1,062   | 3,902 | 2,839      |
| 2030      | 70   | 32   | 96   | 55   | 139  | 325  | 42   | 31   | 542  | 395        | 424  | 528   | 79    | 199   | 1,075   | 4,035 | 2,960      |
| 2031      | 70   | 32   | 96   | 55   | 144  | 329  | 42   | 31   | 558  | 444        | 442  | 545   | 80    | 211   | 1,087   | 4,168 | 3,081      |
| 2032      | 70   | 32   | 96   | 55   | 149  | 334  | 42   | 31   | 575  | 493        | 460  | 561   | 80    | 223   | 1,099   | 4,301 | 3,202      |
| 2033      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 591  | 541        | 478  | 577   | 81    | 236   | 1,112   | 4,434 | 3,322      |
| 2034      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 608  | 582        | 492  | 593   | 81    | 248   | 1,121   | 4,543 | 3,422      |
| 2035      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 624  | 623        | 506  | 609   | 81    | 260   | 1,130   | 4,651 | 3,521      |
| 2036      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 641  | 663        | 520  | 625   | 81    | 272   | 1,139   | 4,760 | 3,621      |
| 2037      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 657  | 704        | 534  | 641   | 82    | 284   | 1,149   | 4,869 | 3,720      |
| 2038      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 674  | 744        | 547  | 657   | 82    | 296   | 1,158   | 4,977 | 3,819      |
| 2039      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 691  | 768        | 557  | 673   | 82    | 308   | 1,168   | 5,065 | 3,897      |
| 2040      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 707  | 791        | 567  | 689   | 82    | 319   | 1,178   | 5,152 | 3,974      |
| 2041      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 724  | 814        | 577  | 705   | 82    | 331   | 1,188   | 5,239 | 4,052      |
| 2042      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 740  | 838        | 587  | 721   | 82    | 343   | 1,197   | 5,326 | 4,129      |
| 2043      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 757  | 861        | 597  | 737   | 82    | 354   | 1,207   | 5,414 | 4,206      |
| 2044      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 761  | 881        | 606  | 753   | 82    | 354   | 1,216   | 5,473 | 4,256      |
| 2045      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 765  | 902        | 616  | 769   | 82    | 354   | 1,226   | 5,532 | 4,306      |
| 2046      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 769  | 922        | 625  | 785   | 82    | 354   | 1,235   | 5,591 | 4,356      |
| 2047      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 773  | 942        | 635  | 801   | 82    | 354   | 1,244   | 5,650 | 4,406      |
| 2048      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 777  | 963        | 644  | 817   | 82    | 354   | 1,253   | 5,709 | 4,456      |
| 2049      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 781  | 983        | 653  | 833   | 82    | 354   | 1,263   | 5,768 | 4,506      |
| 2050      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 786  | 1,003      | 663  | 849   | 82    | 354   | 1,272   | 5,827 | 4,556      |
| 2051      | 70   | 32   | 96   | 55   | 153  | 338  | 42   | 31   | 790  | 1,024      | 672  | 866   | 82    | 354   | 1,281   | 5,887 | 4,605      |
| 2021-2031 | 15   | 10   | 27   | 14   | 49   | 45   | 12   | 9    | 194  | 404        | 169  | 143   | 4     | 133   | 142     | 1,369 | 1,228      |
| 2021-2051 | 15   | 10   | 27   | 14   | 58   | 54   | 12   | 9    | 425  | 984        | 399  | 464   | 6     | 276   | 336     | 3,088 | 2,752      |

Figure A3.2: Mangawhai non-permanent occupied dwelling projections

| Year      | PS-A | PS-B | PS-C | PS-E | PS-F | PS-G | PS-H | PS-J | PS-K | PS-OF/WWTP |      | PS-VA | PS-VB | PS-VC | Non-PSC | Total | Total PSCs |     |     |
|-----------|------|------|------|------|------|------|------|------|------|------------|------|-------|-------|-------|---------|-------|------------|-----|-----|
|           |      |      |      |      |      |      |      |      |      | West       | East |       |       |       |         |       |            |     |     |
| 2021      | 44   | 18   | 36   | 36   | 59   | 265  | 35   | 26   | 127  | 9          | 111  | 63    | 9     | 12    | 134     | 981   | 848        |     |     |
| 2022      | 46   | 20   | 38   | 38   | 61   | 269  | 38   | 28   | 135  | 13         | 113  | 62    | 8     | 13    | 127     | 1,011 | 884        |     |     |
| 2023      | 48   | 22   | 41   | 41   | 64   | 274  | 41   | 30   | 142  | 18         | 115  | 62    | 8     | 15    | 121     | 1,041 | 920        |     |     |
| 2024      | 49   | 22   | 42   | 42   | 66   | 275  | 42   | 31   | 146  | 26         | 121  | 63    | 8     | 16    | 122     | 1,073 | 951        |     |     |
| 2025      | 50   | 23   | 43   | 43   | 68   | 277  | 43   | 32   | 150  | 34         | 127  | 64    | 8     | 18    | 124     | 1,105 | 981        |     |     |
| 2026      | 51   | 24   | 44   | 44   | 71   | 279  | 44   | 33   | 154  | 43         | 133  | 66    | 8     | 20    | 125     | 1,137 | 1,012      |     |     |
| 2027      | 52   | 24   | 45   | 45   | 73   | 280  | 46   | 34   | 158  | 51         | 139  | 67    | 8     | 21    | 127     | 1,169 | 1,043      |     |     |
| 2028      | 53   | 25   | 46   | 46   | 75   | 282  | 47   | 35   | 162  | 59         | 145  | 68    | 8     | 23    | 128     | 1,202 | 1,073      |     |     |
| 2029      | 52   | 25   | 46   | 45   | 78   | 285  | 47   | 35   | 166  | 67         | 151  | 70    | 8     | 24    | 130     | 1,229 | 1,099      |     |     |
| 2030      | 52   | 25   | 46   | 45   | 80   | 287  | 46   | 34   | 170  | 76         | 156  | 73    | 8     | 26    | 131     | 1,256 | 1,124      |     |     |
| 2031      | 52   | 25   | 45   | 45   | 82   | 290  | 46   | 34   | 174  | 84         | 162  | 75    | 8     | 27    | 133     | 1,283 | 1,150      |     |     |
| 2032      | 52   | 25   | 45   | 45   | 84   | 293  | 46   | 34   | 178  | 93         | 167  | 77    | 8     | 29    | 134     | 1,310 | 1,175      |     |     |
| 2033      | 52   | 24   | 45   | 45   | 87   | 295  | 46   | 34   | 182  | 101        | 173  | 79    | 8     | 31    | 136     | 1,337 | 1,201      |     |     |
| 2034      | 51   | 24   | 45   | 44   | 86   | 294  | 46   | 34   | 185  | 107        | 177  | 81    | 8     | 32    | 137     | 1,352 | 1,215      |     |     |
| 2035      | 51   | 24   | 44   | 44   | 86   | 293  | 46   | 34   | 189  | 113        | 180  | 84    | 8     | 34    | 138     | 1,367 | 1,229      |     |     |
| 2036      | 51   | 24   | 44   | 44   | 85   | 292  | 45   | 34   | 192  | 119        | 184  | 86    | 8     | 35    | 139     | 1,383 | 1,244      |     |     |
| 2037      | 51   | 24   | 44   | 44   | 85   | 291  | 45   | 34   | 195  | 125        | 188  | 88    | 8     | 37    | 140     | 1,398 | 1,258      |     |     |
| 2038      | 50   | 24   | 43   | 44   | 84   | 290  | 45   | 33   | 199  | 131        | 191  | 90    | 8     | 38    | 141     | 1,414 | 1,272      |     |     |
| 2039      | 50   | 24   | 43   | 44   | 84   | 288  | 45   | 33   | 202  | 133        | 193  | 92    | 8     | 40    | 143     | 1,424 | 1,281      |     |     |
| 2040      | 50   | 24   | 43   | 43   | 83   | 287  | 45   | 33   | 205  | 136        | 195  | 95    | 8     | 41    | 144     | 1,433 | 1,289      |     |     |
| 2041      | 50   | 24   | 43   | 43   | 83   | 286  | 45   | 33   | 208  | 138        | 197  | 97    | 8     | 43    | 145     | 1,443 | 1,298      |     |     |
| 2042      | 50   | 24   | 42   | 43   | 83   | 285  | 44   | 33   | 211  | 140        | 199  | 99    | 8     | 44    | 146     | 1,453 | 1,307      |     |     |
| 2043      | 49   | 23   | 42   | 43   | 82   | 284  | 44   | 33   | 215  | 143        | 201  | 101   | 8     | 46    | 147     | 1,463 | 1,315      |     |     |
| 2044      | 49   | 23   | 42   | 43   | 82   | 283  | 44   | 33   | 214  | 144        | 203  | 103   | 8     | 46    | 149     | 1,466 | 1,317      |     |     |
| 2045      | 49   | 23   | 42   | 43   | 81   | 282  | 44   | 33   | 213  | 145        | 205  | 106   | 8     | 46    | 150     | 1,469 | 1,320      |     |     |
| 2046      | 49   | 23   | 42   | 42   | 81   | 281  | 44   | 33   | 213  | 147        | 206  | 108   | 8     | 46    | 151     | 1,473 | 1,322      |     |     |
| 2047      | 49   | 23   | 41   | 42   | 81   | 280  | 44   | 32   | 212  | 148        | 208  | 110   | 8     | 46    | 152     | 1,476 | 1,324      |     |     |
| 2048      | 48   | 23   | 41   | 42   | 80   | 278  | 44   | 32   | 212  | 150        | 210  | 112   | 8     | 46    | 153     | 1,479 | 1,326      |     |     |
| 2049      | 48   | 23   | 41   | 42   | 80   | 277  | 43   | 32   | 211  | 151        | 211  | 114   | 8     | 46    | 154     | 1,482 | 1,328      |     |     |
| 2050      | 48   | 23   | 41   | 42   | 79   | 276  | 43   | 32   | 210  | 152        | 213  | 117   | 8     | 46    | 155     | 1,486 | 1,330      |     |     |
| 2051      | 48   | 23   | 40   | 41   | 79   | 275  | 43   | 32   | 210  | 154        | 214  | 119   | 8     | 46    | 156     | 1,489 | 1,332      |     |     |
| 2021-2031 | 8    | 7    | 10   | 9    | 23   | 25   | 11   | 9    | 47   | 75         | 51   | 12    | -     | 1     | 16      | -     | 1          | 301 | 302 |
| 2021-2051 | 4    | 5    | 5    | 6    | 20   | 10   | 8    | 6    | 83   | 145        | 104  | 56    | -     | 1     | 34      | 23    |            | 507 | 485 |

Figure A3.3: Mangawhai total dwelling projections

| Year      | PS-A | PS-B | PS-C | PS-E | PS-F | PS-G | PS-H | PS-J | PS-K  | PS-OF/WWTP |      | PS-VA | PS-VB | PS-VC | Non-PSC | Total | Total PSCs |
|-----------|------|------|------|------|------|------|------|------|-------|------------|------|-------|-------|-------|---------|-------|------------|
|           |      |      |      |      |      |      |      |      |       | West       | East |       |       |       |         |       |            |
| 2021      | 99   | 40   | 105  | 77   | 154  | 549  | 65   | 48   | 491   | 49         | 384  | 465   | 85    | 90    | 1,079   | 3,780 | 3,780      |
| 2022      | 105  | 44   | 114  | 83   | 162  | 561  | 71   | 53   | 530   | 76         | 397  | 488   | 85    | 109   | 1,094   | 3,973 | 3,973      |
| 2023      | 111  | 49   | 124  | 89   | 171  | 574  | 77   | 57   | 568   | 103        | 411  | 511   | 84    | 129   | 1,109   | 4,166 | 4,166      |
| 2024      | 114  | 50   | 128  | 91   | 177  | 579  | 79   | 59   | 589   | 153        | 435  | 522   | 85    | 143   | 1,123   | 4,327 | 4,327      |
| 2025      | 116  | 52   | 131  | 94   | 184  | 584  | 82   | 61   | 610   | 204        | 460  | 532   | 85    | 156   | 1,137   | 4,488 | 4,488      |
| 2026      | 118  | 54   | 135  | 96   | 191  | 588  | 84   | 62   | 630   | 255        | 485  | 543   | 85    | 170   | 1,151   | 4,649 | 4,649      |
| 2027      | 121  | 55   | 139  | 98   | 198  | 593  | 87   | 64   | 651   | 306        | 509  | 554   | 86    | 184   | 1,165   | 4,809 | 4,809      |
| 2028      | 123  | 57   | 143  | 101  | 205  | 598  | 89   | 66   | 671   | 357        | 534  | 565   | 86    | 197   | 1,178   | 4,970 | 4,970      |
| 2029      | 123  | 57   | 142  | 101  | 212  | 605  | 89   | 66   | 692   | 414        | 557  | 583   | 87    | 211   | 1,192   | 5,130 | 5,130      |
| 2030      | 123  | 57   | 142  | 100  | 219  | 612  | 89   | 66   | 712   | 471        | 581  | 601   | 87    | 225   | 1,206   | 5,290 | 5,290      |
| 2031      | 122  | 57   | 142  | 100  | 226  | 619  | 88   | 66   | 732   | 528        | 604  | 619   | 88    | 239   | 1,220   | 5,450 | 5,450      |
| 2032      | 122  | 57   | 142  | 100  | 233  | 626  | 88   | 65   | 753   | 585        | 628  | 638   | 88    | 252   | 1,234   | 5,610 | 5,610      |
| 2033      | 122  | 56   | 141  | 100  | 240  | 633  | 88   | 65   | 773   | 643        | 651  | 656   | 89    | 266   | 1,248   | 5,771 | 5,771      |
| 2034      | 122  | 56   | 141  | 100  | 239  | 632  | 88   | 65   | 793   | 689        | 669  | 674   | 89    | 280   | 1,258   | 5,895 | 5,895      |
| 2035      | 121  | 56   | 141  | 100  | 239  | 631  | 88   | 65   | 813   | 736        | 686  | 692   | 89    | 293   | 1,268   | 6,019 | 6,019      |
| 2036      | 121  | 56   | 140  | 99   | 238  | 630  | 88   | 65   | 833   | 782        | 704  | 711   | 90    | 307   | 1,279   | 6,143 | 6,143      |
| 2037      | 121  | 56   | 140  | 99   | 238  | 629  | 87   | 65   | 853   | 829        | 721  | 729   | 90    | 321   | 1,289   | 6,267 | 6,267      |
| 2038      | 121  | 56   | 140  | 99   | 238  | 627  | 87   | 65   | 873   | 876        | 739  | 747   | 90    | 335   | 1,299   | 6,391 | 6,391      |
| 2039      | 121  | 56   | 140  | 99   | 237  | 626  | 87   | 65   | 893   | 901        | 751  | 765   | 90    | 348   | 1,310   | 6,488 | 6,488      |
| 2040      | 120  | 56   | 139  | 99   | 237  | 625  | 87   | 64   | 912   | 927        | 762  | 784   | 90    | 361   | 1,322   | 6,585 | 6,585      |
| 2041      | 120  | 56   | 139  | 98   | 236  | 624  | 87   | 64   | 932   | 952        | 774  | 802   | 90    | 374   | 1,333   | 6,682 | 6,682      |
| 2042      | 120  | 56   | 139  | 98   | 236  | 623  | 87   | 64   | 952   | 978        | 786  | 820   | 90    | 387   | 1,344   | 6,779 | 6,779      |
| 2043      | 120  | 55   | 139  | 98   | 235  | 622  | 86   | 64   | 971   | 1,004      | 798  | 838   | 90    | 400   | 1,355   | 6,876 | 6,876      |
| 2044      | 120  | 55   | 138  | 98   | 235  | 621  | 86   | 64   | 975   | 1,025      | 809  | 857   | 90    | 400   | 1,365   | 6,939 | 6,939      |
| 2045      | 119  | 55   | 138  | 98   | 235  | 620  | 86   | 64   | 978   | 1,047      | 820  | 875   | 90    | 400   | 1,375   | 7,001 | 7,001      |
| 2046      | 119  | 55   | 138  | 98   | 234  | 618  | 86   | 64   | 982   | 1,069      | 831  | 893   | 90    | 400   | 1,386   | 7,064 | 7,064      |
| 2047      | 119  | 55   | 138  | 97   | 234  | 617  | 86   | 64   | 985   | 1,090      | 842  | 911   | 90    | 400   | 1,396   | 7,126 | 7,126      |
| 2048      | 119  | 55   | 138  | 97   | 233  | 616  | 86   | 64   | 989   | 1,112      | 854  | 930   | 90    | 400   | 1,407   | 7,188 | 7,188      |
| 2049      | 118  | 55   | 137  | 97   | 233  | 615  | 86   | 63   | 992   | 1,134      | 865  | 948   | 90    | 400   | 1,417   | 7,251 | 7,251      |
| 2050      | 118  | 55   | 137  | 97   | 233  | 614  | 85   | 63   | 996   | 1,156      | 876  | 966   | 90    | 400   | 1,427   | 7,313 | 7,313      |
| 2051      | 118  | 55   | 137  | 97   | 232  | 613  | 85   | 63   | 1,000 | 1,177      | 887  | 984   | 90    | 400   | 1,438   | 7,376 | 7,376      |
| 2021-2031 | 23   | 17   | 37   | 23   | 72   | 70   | 23   | 18   | 241   | 479        | 220  | 154   | 3     | 149   | 141     | 1,670 | 1,670      |
| 2021-2051 | 19   | 15   | 32   | 20   | 78   | 64   | 20   | 15   | 508   | 1,128      | 503  | 519   | 5     | 310   | 359     | 3,596 | 3,596      |



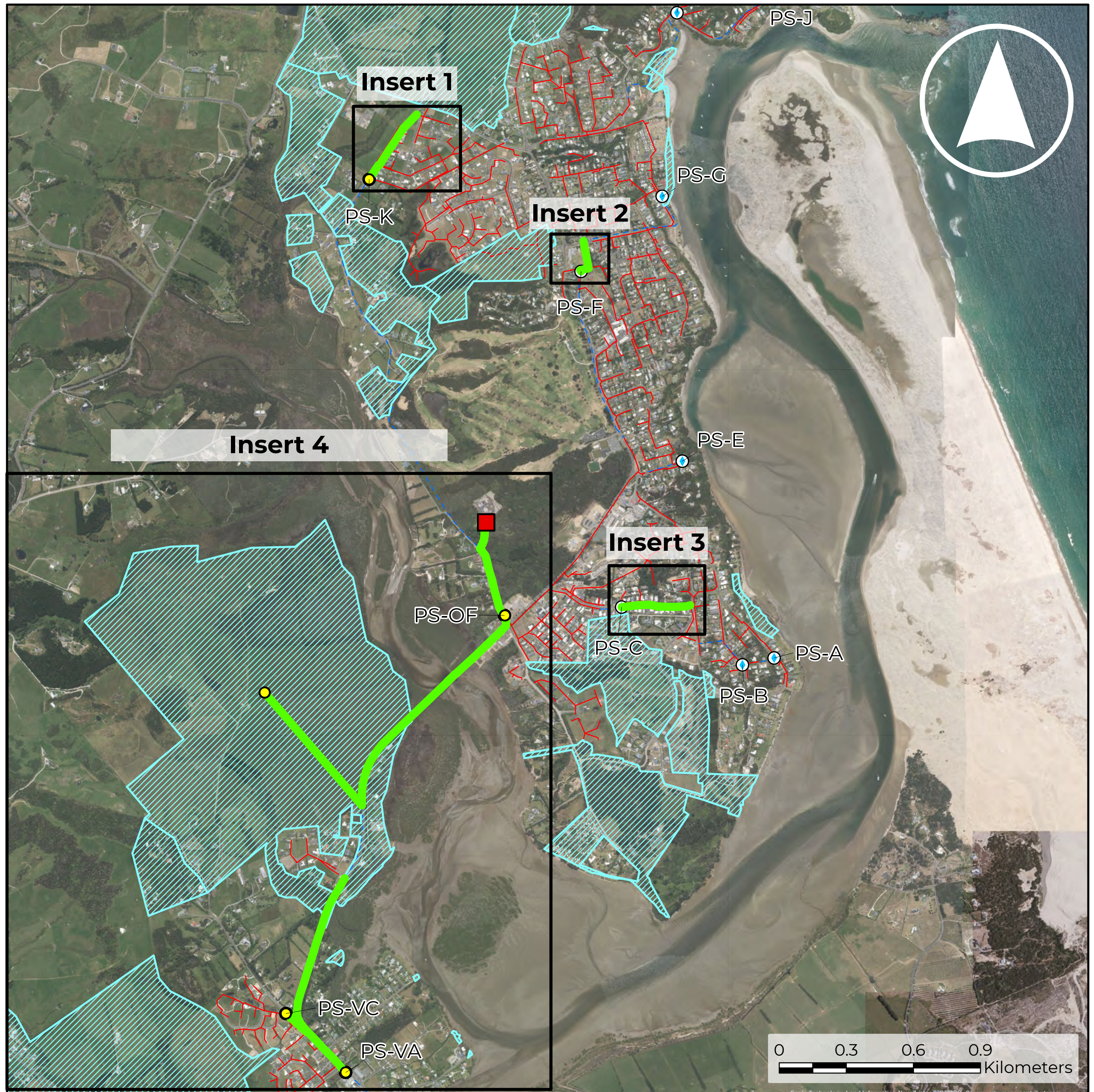
Appendix D  
Mangawhai Community  
Wastewater Network  
Upgrades Poster





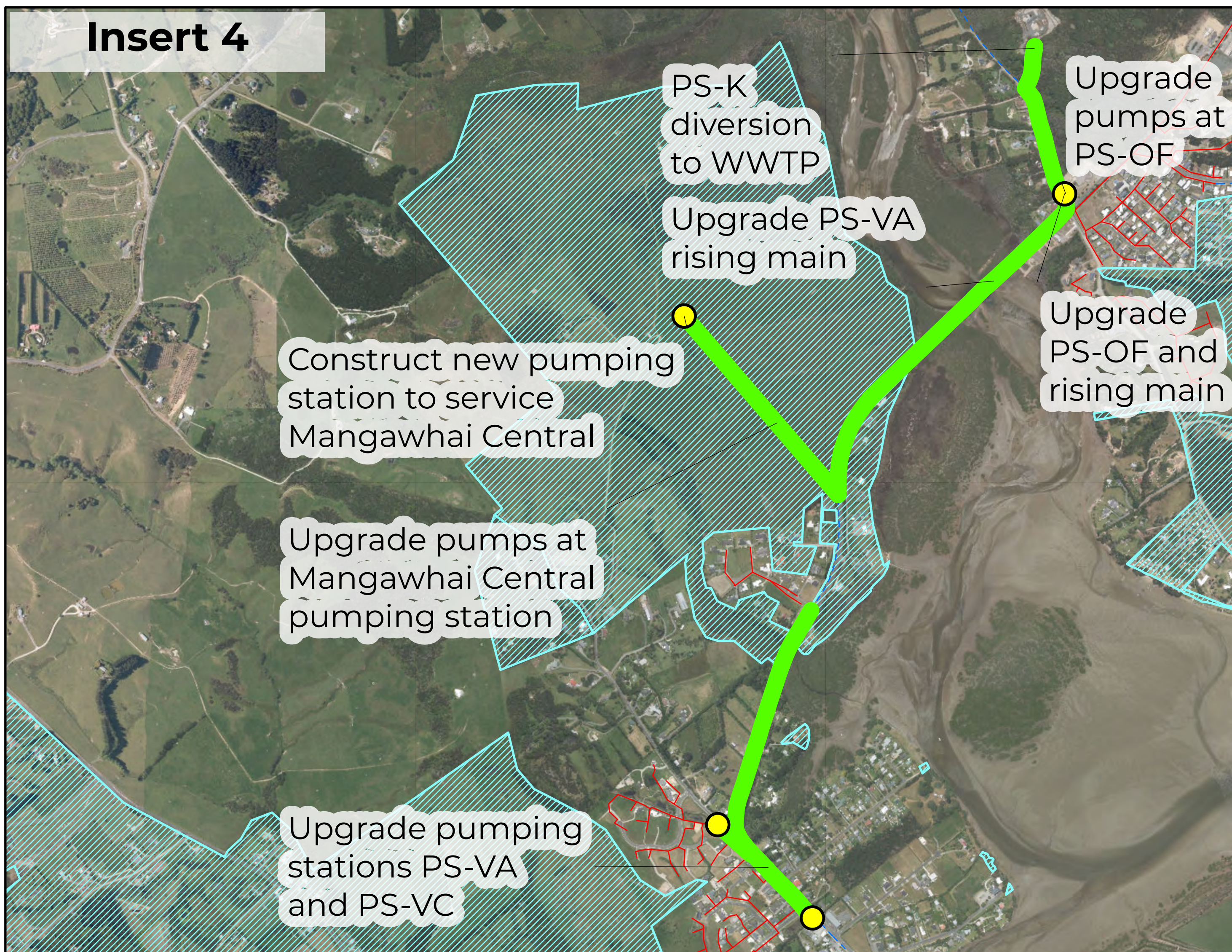
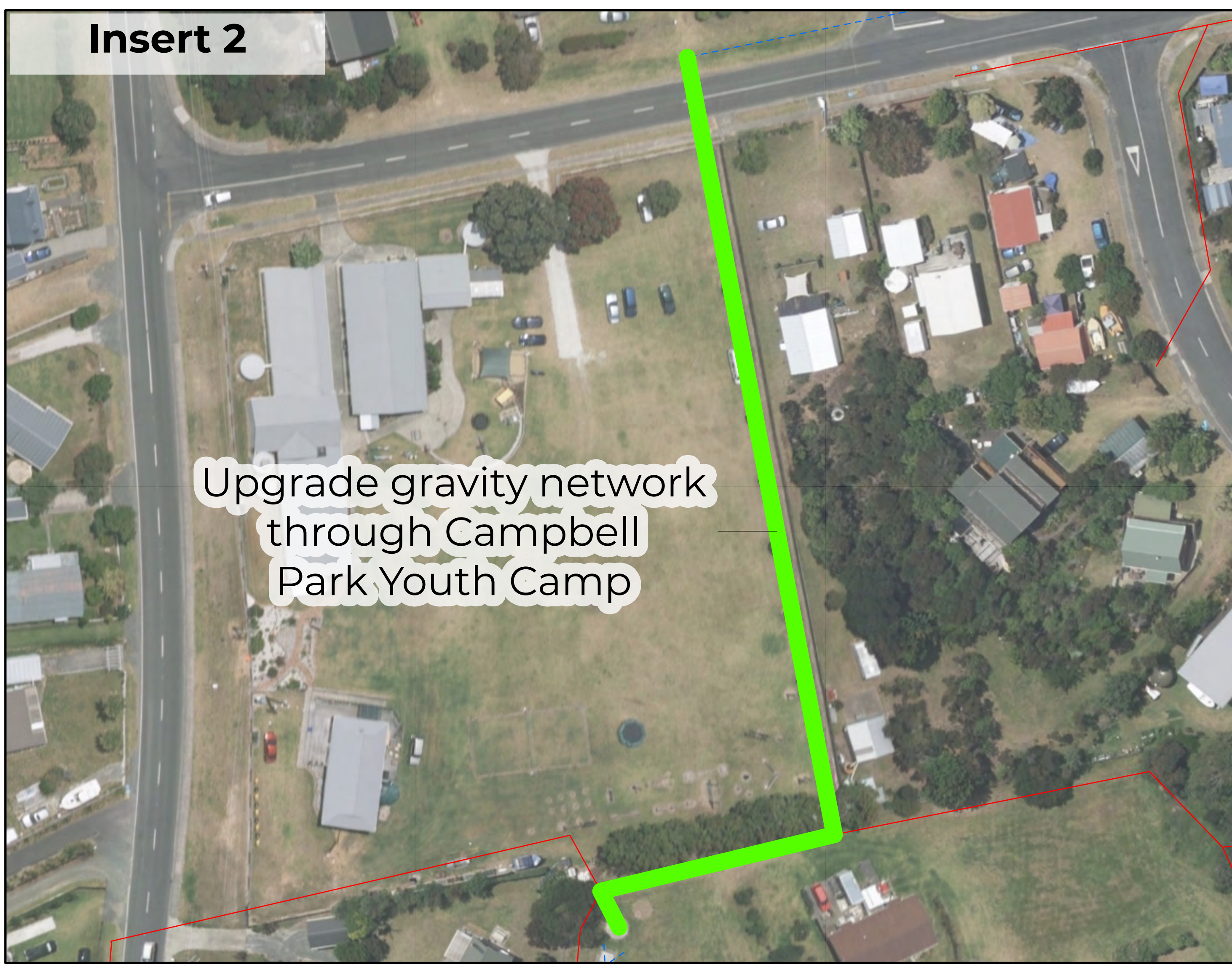
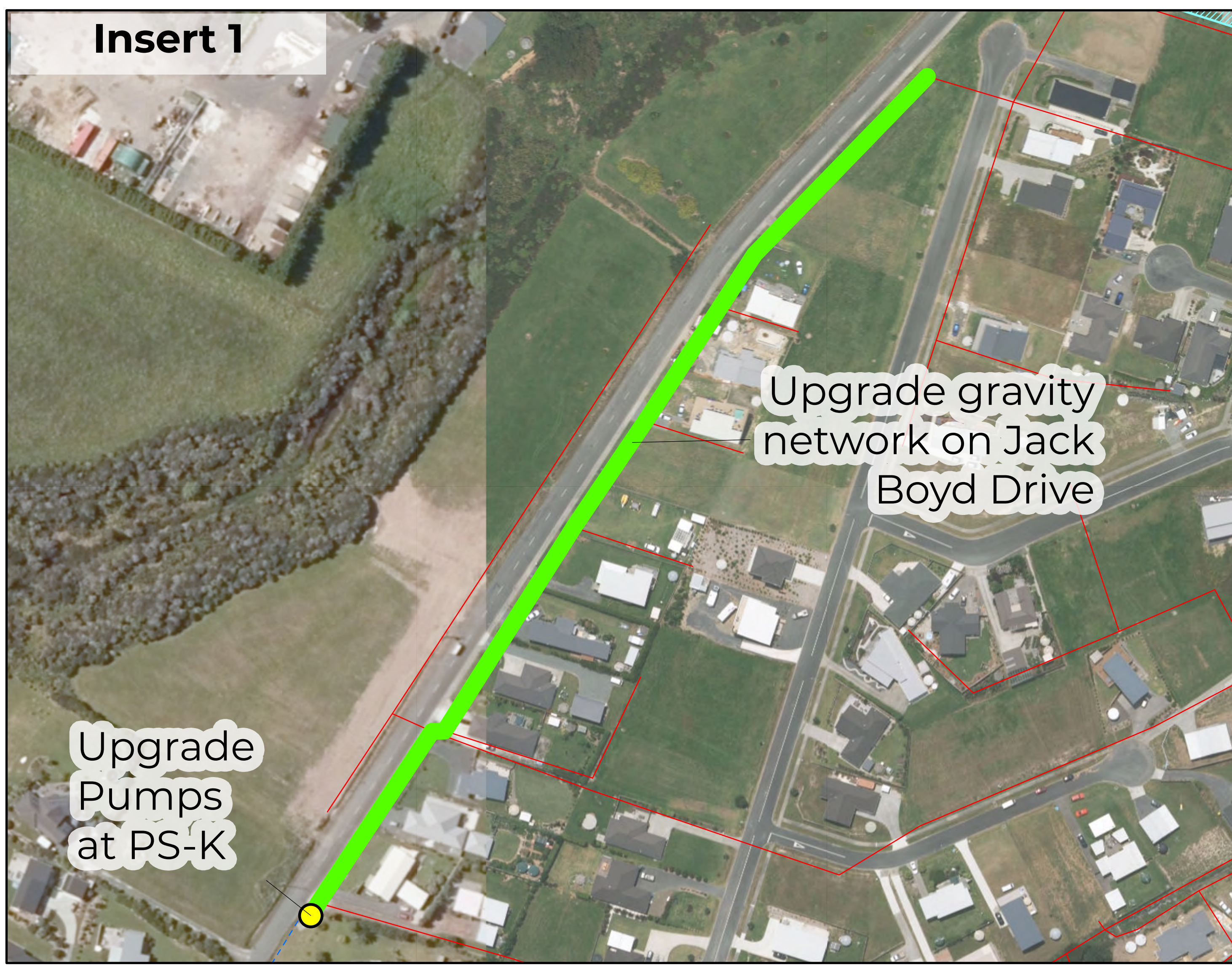
Kaipara te Oranganui  
**KAIPARA**  
 DISTRICT  
 Two Oceans Two Harbours

# Mangawhai Community Wastewater Network Upgrades

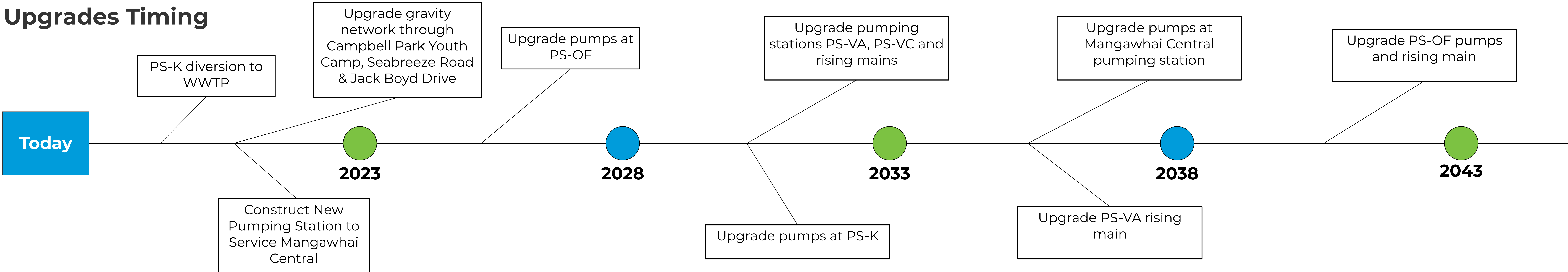


**Legend**

- Existing Network
  - Gravity Sewer
  - Rising Main
- Pumping Stations
- Mangawhai Community Wastewater Treatment Plant
- New Development Areas



## Upgrades Timing



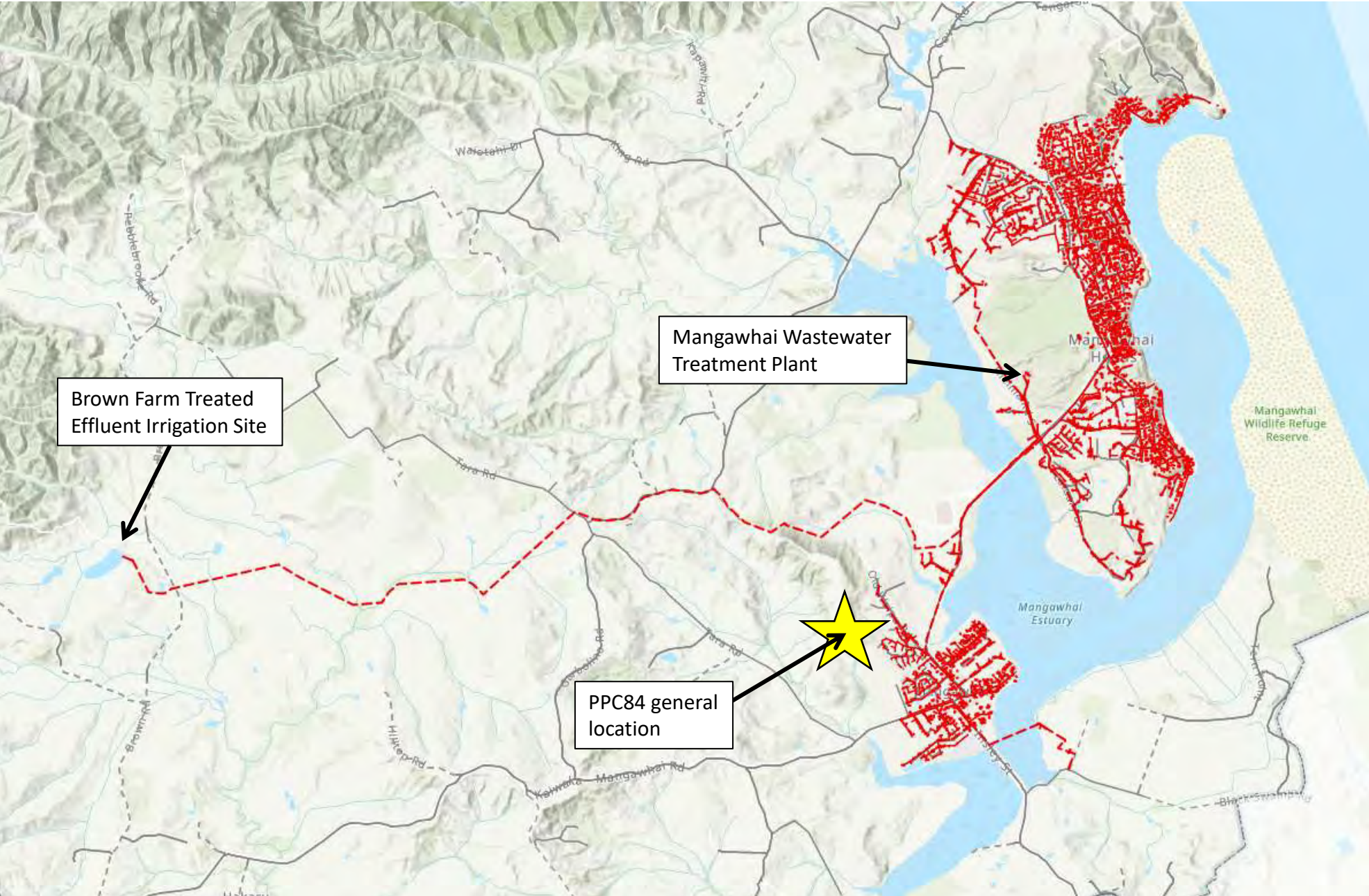


wsp

[wsp.com/nz](http://wsp.com/nz)

**ATTACHMENT E**

Attachment E – Existing wastewater system and PPC84 general location



**ATTACHMENT F**



Attachment F – Current residential zone and area possibly serviced by the wastewater network in the near future (KDC Spatial Plan)

Mangawhai Hill Ltd 160ha area currently not included in wastewater service area planning

60ha area of PPC84 included in wastewater service area planning

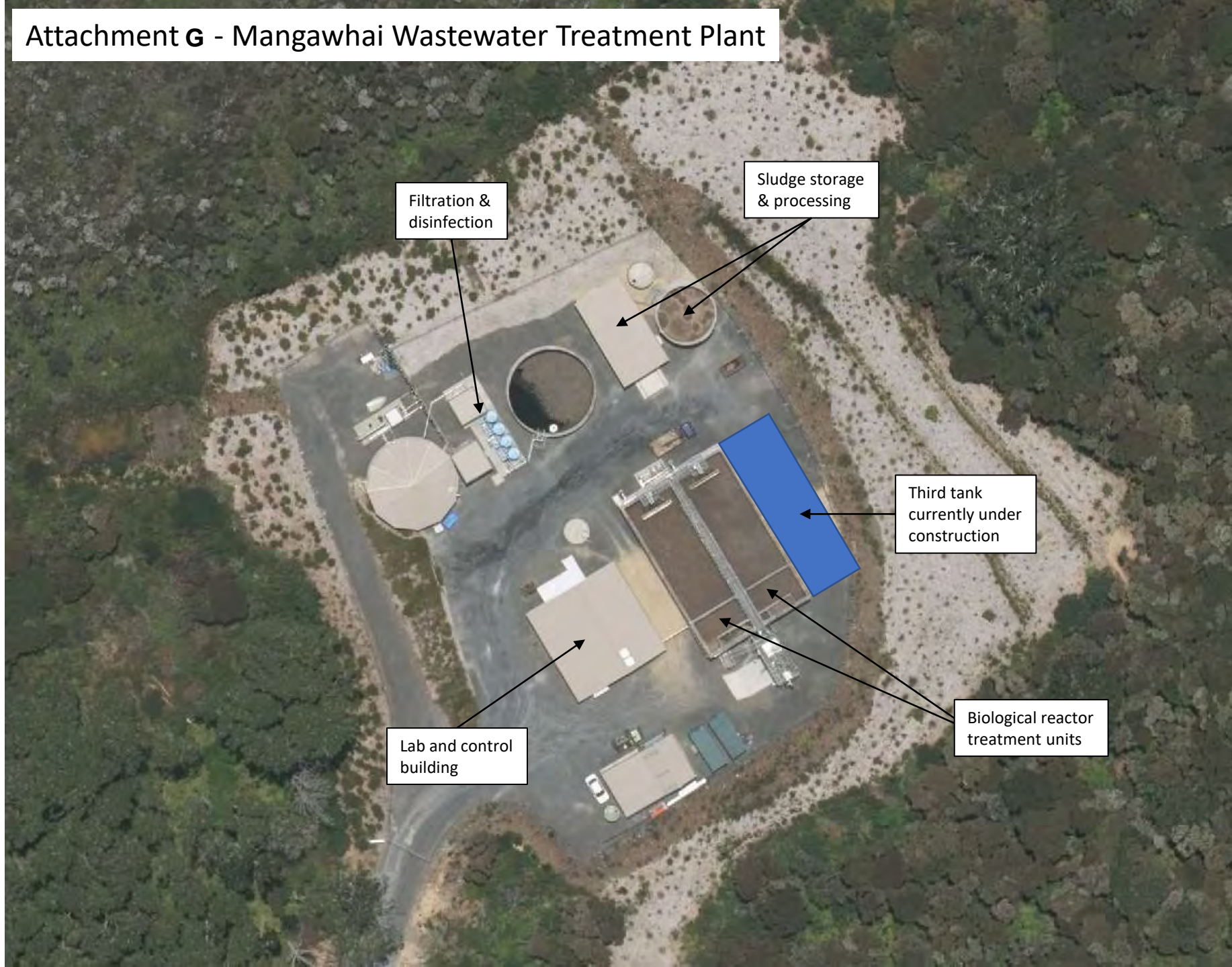


- Legend**
- Estuary Estates
  - District Plan - Residential Zone
  - Future Possible Wastewater Mangawhai
  - Additional Wastewater serviceable area (not on District Plan map)

**ATTACHMENT G**



# Attachment G - Mangawhai Wastewater Treatment Plant



Filtration & disinfection

Sludge storage & processing

Third tank currently under construction

Lab and control building

Biological reactor treatment units

**ATTACHMENT H**

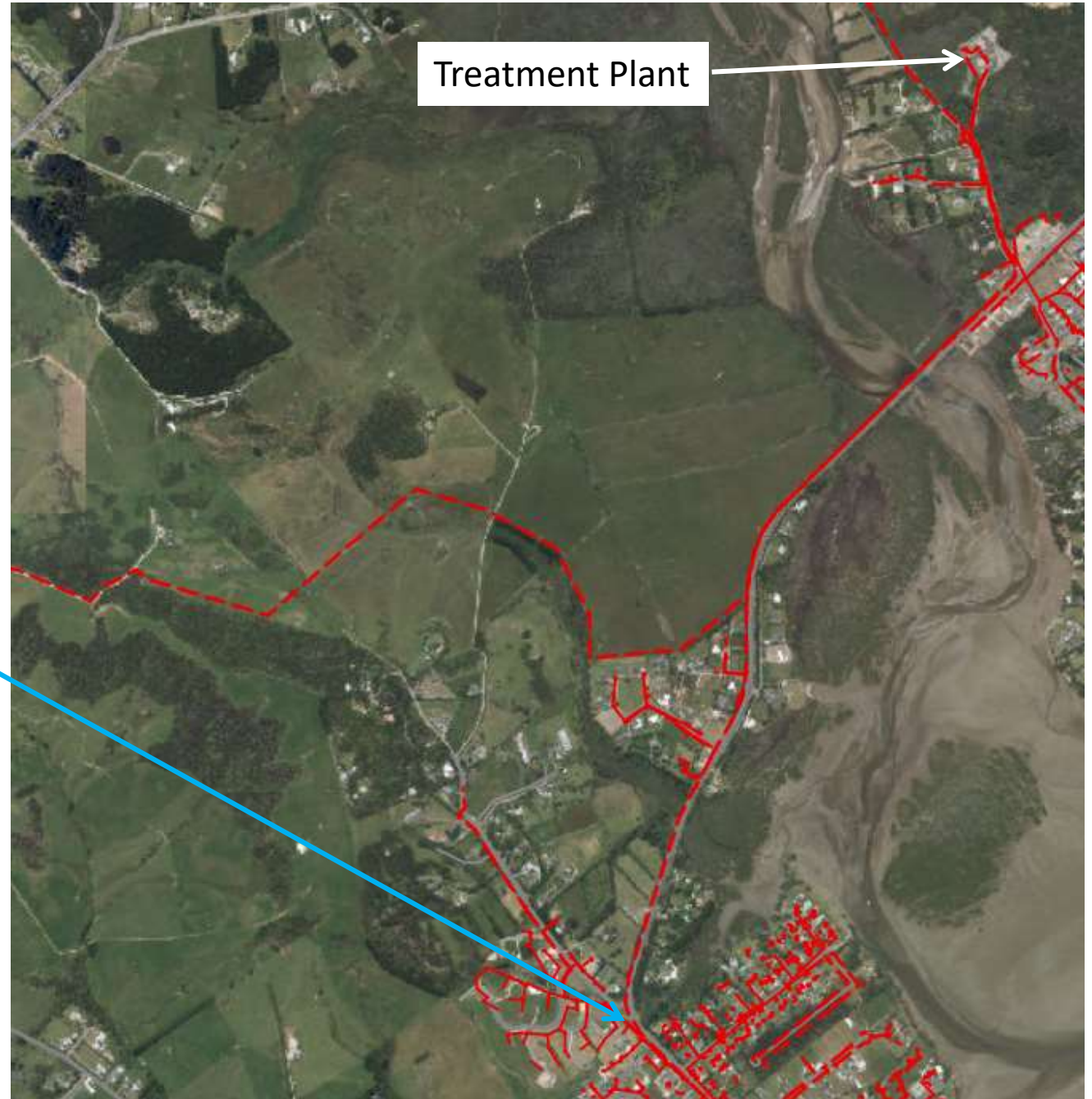


# Attachment H



### Legend

- Plan Change Area
- Indicative Primary Road
- Indicative Secondary Road
- Existing Roads / Connections
- Western by-pass link / collector road
- Indicative lineal Open Space
- Streams
- Indicative community Hub
- Opportunities for active Open Space
- Existing Native Vegetation
- Additional Native Revegetation (incl southern slopes)
- Riparian Restoration
- Proposed Residential Area (subject to Plan Change)
- Existing Residential
- Institutional (Church and Cemetery)



Treatment Plant

**ATTACHMENT I**

## **Attachment I**

### **Qualifications and Experience of Clinton Cantrell**

My name is Clinton Cantrell. I am the Director of Sustainable Community Outcomes Consulting Ltd (SCO Consulting), based in Auckland, New Zealand. SCO Consulting specializes in Three Waters engineering consulting including water, wastewater and stormwater infrastructure systems and the environments they operate within.

I hold a Bachelor of Civil Engineering degree from the University of Florida, and completed post graduate studies in Environmental Engineering at Wayne State University (Michigan). I have over 30 years of international and national experience in engineering, focusing on planning and upgrades to three waters systems including wastewater network and treatment systems.

I am presently Director and majority owner of SCO Consulting based in Auckland, New Zealand. I provide technical oversight and direction for all SCO projects and the clients we service, which includes Kaipara District Council. Prior to establishing SCO Consulting in 2019, I was the Water Sector Director for Tonkin and Taylor – overseeing the growth and development of the water engineering business, and providing leadership and oversight for strategic projects. Prior to joining Tonkin and Taylor, I held global technical leadership roles for large engineering consultancies including MWH (Stantec) and AECOM. I have worked on small to large scale wastewater projects and programmes across the globe, and have led some of the largest and most complex wastewater projects in New Zealand including Watercare's Central Interceptor and Mangere Wastewater Treatment Master Plan.

In my current role as a technical advisor and expert for Kaipara District Council, I provide overall technical leadership for project involving the assessment and upgrades to the Mangawhai Wastewater Treatment Plant (**WWTP**) and the effluent disposal systems including Browns Farm and the option of irrigating the Mangawhai Golf Course with treated effluent.

I led an independent engineering peer review of the Mangawhai WWTP upgrades master plan completed in 2022 by WSP, and have more recently worked with a KDC appointed consortium of consulting experts to confirm a revised/staged upgrade plan for the Mangawhai WWTP which includes options for effluent disposal/irrigation at the Mangawhai Golf Course.