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Mangawhai Community Wastewater System

Master Plan Strategy

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CONFIDENTIAL

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for Kaipara District Council ('**Client**') in relation to developing a strategy to manage growth in Managwhai Wastewater System ('**Purpose**') and in accordance with the Panel of Professional Services Agreement, 2020]. The findings in this Report are based on and are subject to the assumptions specified in the Report and available information provided by KDC. 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.

INTRODUCTION

This document describes the current situation at the Mangawhai Community Wastewater System, (CWWS) the history of the system, the current challenges and the effects of continued growth in the community.

An interactive workshop with KDC and WSP team members was held on 3 November 2021 which considered the needs of Mangawhai and the key elements that require action to accommodate future growth.

The key outputs from the workshop were to provide this strategic plan report and provide an outline programme. The programme is summarised later in this report.

This document provides the framework and direction necessary to meet the capacity and programme driven by growth of the Mangawhai CWWS. It is envisaged that this strategy will become a live document underpinning the direction for network, treatment and disposal solutions.

HISTORY

In 2009 the Mangawhai Community Wastewater System was commissioned to serve Mangawhai and Mangawhai Heads. In the first year about 800 properties moved on from their septic tank and connected to the new system. Today over 2400 properties are connected to the system taking wastewater from homes, schools, shops, cafes, and small commercial premises.

By providing the Mangawhai Community Wastewater System (MCWWS) Kaipara District Council have removed more than 90% of the septic tanks from operation, each with their own discharge to the local area. This has improved quality of the Mangawhai Harbour. The harbour is now a safe place to swim or gather Kai, and the ecology is thriving. The harbour is the heart of Mangawhai and is beating strongly.

GROWTH

Over recent years Mangawhai has seen between 70 and 100 new connections every year, causing a rapid rise in population served. In 2021 MCWWS was determined to be serving 2,411 properties, with many more requests for connection.

The current Wastewater system, commissioned in 2009, built at the time with an expectation of additional augmentation by 2014 (Mangawhai WWTP Design Report, Water Infrastructure Group, 2009) and expected to be upgraded to 3 reactors by 2023. Growth rates have exceeded all expectations but owing to different wastewater characteristics (less flow and stronger) no direct comparison can be made in terms of houses connected between original design and current plant.

The Mangawhai Spatial Plan (2020) identifies areas of growth in Mangawhai, the most likely density and type of housing, and rate of population growth. This forecast shows over 14,000 people living in Mangawhai by 2043 (high growth forecast).
So, the challenge for Kaipara DC is to provide the necessary infrastructure to allow the growth to progress, but not to build large assets and investment that creates a financial burden on the existing community.
This plan outlines the related wastewater activities and assets needed to meet growth and when they are required to enable sufficient developer contributions and phasing can occur.

A connection is assumed to be 300 litres per day and 2.7 people at off peak season, but 600 litres per day and 5.4 people per day during peak population season. This is based on data gathered in 2018.
Growth forecast from the spatial plan is given below for off peak season, resident population:

Table 1 : Growth forecast from Mangawhai Spatial Plan

Mangawhai Population Projection (connections)	2018 - Baseline	2043
High growth	5,031(1,863)	14,466 (5,357)
Medium Growth	5,031 (1,863)	10,796 (3,998)

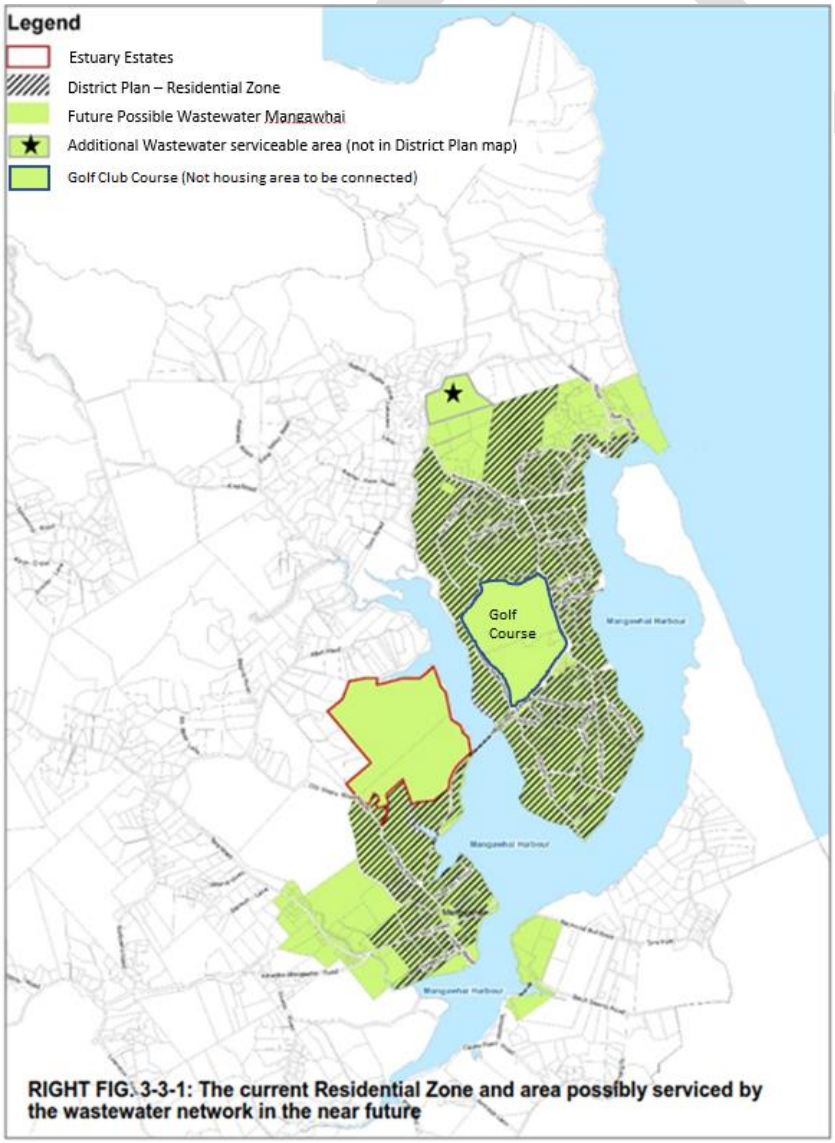

Figure 1 : Areas connected to MCWWS (grey) and areas to be connected (figure from the Mangawhai Spatial Plan)

CURRENT WASTEWATER SYSTEM

The current Wastewater system is formed by a network of gravity and pumped sewers. Many properties have historic septic tanks below the sewer levels, so the system has a large number of small on property grinder pumps to lift house wastewater to the network. No changes are proposed to these pump systems.

Mangawhai Heads is predominantly a gravity network (sewage flows downhill) but has several smaller pump stations to lift low lying areas into the network. Flow passes to Thelma Road (Outfall pump station).

Flow from the north of Mangawhai Heads passes to Thelma Road through Jack Boyd Drive (Pump Station K) to Thelma Road.

Mangawhai Village Pump Station (Pump Station VA) is the main pumping location in Mangawhai, and the rising main discharges to Thelma Road. The rising main crosses the causeway with a number of smaller pump station connections.

All flow arriving at Thelma Road is pumped to the Mangawhai Community Wastewater Treatment Plant (CWWTP). In an emergency there is some 52m^3 of storage at the pump station allowing operational response, and the pumps can pass 70 l/s to the CWWTP.
The Inlet works at the CWWTP consists of elevated screen and flow measurement, before splitting the flow into 2 of CASS (Cyclic Activated Sludge System) treatment reactors – also called the Bioreactors. In these reactors air is used to power treatment bacteria that breakdown organic matter and convert toxic ammonia to nitrate. The nature of the CASS is a cyclic process with aeration, settlement and decanting all in the same reactor. There are 2 of 900 m^3 reactors, which due to the nature of the process typically operate 60% full except in wet weather.

The treated water is decanted from the CASS at 210 l/s to a balance tank. This rate is needed to ensure that all water entering the reactor tank can leave the tank in the limited period for decanting.

Decanted effluent is balanced and pumped through 4 of modular sandfilters to remove floating solids, before mixing with sodium hypochlorite for disinfection, and then pumping to Brown Road.

Brown Road irrigation farm is 12 km from the CWWTP and is dedicated to the disposal of treated wastewater. The site consists of a 170,000 m^3 storage pond to buffer wet periods when land disposal cannot occur and has 65.5 ha under irrigation. Due to proximity of neighbours, the type and operation of irrigation varies across the site with limits due to wind direction and speed, rainfall and previous wetting cycles. This farm site is also leased to a local grazier for stock grazing coordinated with the operations team to ensure adequate separation and dry off periods. This helps manage the grass which is very prolific with the plentiful supply of water.

CAPACITY LIMITS

The Wastewater System has several capacity limits at different points in the system. These are summarised as hydraulic and organic loading with some parameters being instantaneous and others average over the year.

• Incoming Flow	Thelma Road PS 70 l/s.
• Inlet Works	CWWTP 70 l/s.
• Bioreactor Decanter	210 l/s – to allow 70 l/s max peak flow
• Sand Filters	28 l/s. This ensures that 95% of all flow is fully treated, only bypassing in wet weather.
• Transfer Pumps to Brown Road	70 l/s.
• Transfer Pipe to Brown Road	70 l/s – Pressure rating of pipe limits flow rate
• Brown Road Irrigation.	5000 m3/ha/yr. Consented Discharge Rate
• Brown Road Farm	65.5 ha in operation. – Max usable area in use. 3000 connections
• Bioreactor Capacity	2800 connections – Aeration and max. Biomass level

The figure below gives estimated timeline of capacity exceedance

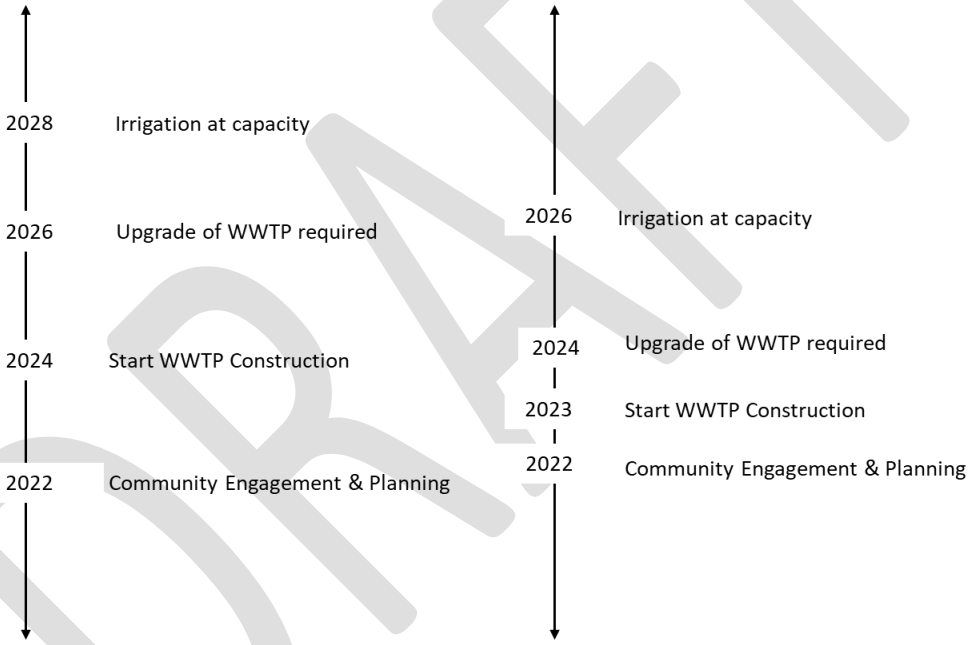

Figure 2 : Timeline for Upgrades at 70 Connection (Left) and 100 Connections/year (Right)

In 2020 there were 77 new connections. Based on connection rate continuing at this value the CWWTP will require upgrade to be complete 2024-2026 depending on growth rate. The 100 connections growth rate may be too rapid to allow assets to be consented and procured, constructed and commissioned before capacity limits are reached. The strategic approach to this issue is described below.

NETWORK STRATEGY

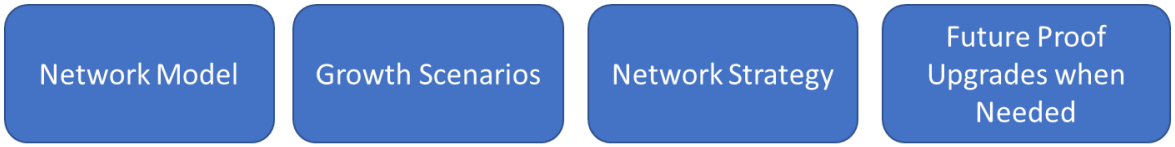

Figure 3 : Network strategy development

In 2020 WSP were commissioned to develop a wastewater network model. This is now calibrated based on measured flow, and now WSP are developing growth scenarios considering area and density of housing. These models will inform what additional capacity is needed, where and when across the system. This will enable options and costs to be developed with upgrades to the network occurring when needed in the future. All network strategy plans will be incorporated in the District Plan due end of 2022.

SHORT TERM FLOW MANAGEMENT

Growth will not only increase the daily average flow but will see an increase in peak flows. If Building codes are enforced the daily peak increase will be around 3 x average in wet weather as rainwater tank overflows are not connected to the system and outdoors areas prevented from draining to gully traps.

The recently approved Balance Tank project will enable Thelma Road to be upgraded to 100 l/s peak flow, with a new inlet screen (to deal with higher flow), flow control system and 900 m^3 of storage. This means that more flow can pass to the CWWTP, without upgrading the CWWTP system and disposal system. The tank built will be converted to a Bioreactor when the overall capacity through the system is upgraded a few years later.

Figure 4 : 3D Model of Mangawhai WWTP with Balance Tank

The balance tank and Thelma Road upgrade will be complete end of 2022.

TREATMENT PLANT

The next stages of expansion will depend on when growth occurs. By planning now for a 5000, 7000 and 10000 connection upgrade, infrastructure and plant layout can be developed to protect footprint and enable sequential upgrade of plant. As example, the current sludge plant has sufficient capacity now, so need not be upgraded until there are 7000 connections. Over the next 20 years several treatment plant upgrades may be necessary, but to manage investment vs developer contributions these will be built in stages. The first upgrade of treatment capacity is to treat all wastewater from 5000 connections.

A previous options study (Mangawhai WWTP Options, WSP, 2019) identified a Membrane Bioreactor is a suitable solution, with the ability to get more treatment capacity in the existing reactors and able to produce a very high quality disinfected effluent. This approach means that more reactors are not needed in the near future, and expansion up to 10,000 connections can be built within the existing site designation.
The 5000 connections reactor shown on the figure below is to be constructed in 2022 and used as a balance tank initially and repurposed to treatment when disposal route is available, and balancing is not required.

Membrane Bioreactors have several key benefits:

- Very high quality effluent
- Chemical Free Disinfection
- Opportunity for Reuse
- Suitable for any disposal route
- Compact Treatment Plant
- More capacity from the existing tanks
- Modular Expansion

Figure 5 : Tank Concept Layout of CWWTP Upgrades to 10,000 connections

DISPOSAL STRATEGY

The existing Brown Road Farm land disposal area is limited to 65.5 ha land suitable for irrigation, all of which is in use. The consented capacity of this land is 5000m^3/ha/yr., the average flow of 2990 connections. Once growth reaches 3000 connections, a new disposal route is needed.

Currently all estimates for programme (presented at the end of this document) assume another farm to the West of Mangawhai, but this is expected to require a long rising main, new storage and land purchase to use. In 2022 options development and community engagement options will be developed to consider alternative disposal. Early indications show that local harbour discharge is substantially cheaper by avoiding land purchase, long rising main and irrigation storage, and system. To follow this route, it requires a very high standard of effluent. Clarks Beach and Snells Beach WWTP discharges are in a similar situation and have been consented for harbour discharge, with Membrane Bioreactor achieving low nutrient levels and making the discharge almost bacteria free. To further protect Kai, UV disinfection will reduce viruses. Another alternative will be a sea outfall pumped around Mangawhai to ocean. Community effluent reuse also gives an opportunity for disposal within the community, but still will require infrastructure for disposal in wet conditions. All disposal routes require high quality, bacteria free water. Farm, harbour or ocean or reuse will require extensive assessment of options and environmental effects, together with community engagement and resource consenting. A new disposal route is not expected to be achieved until 2028.

Effluent reuse offers the opportunity to share the high quality water produced for the irrigation of public areas, such as Mangawhai Golf Course, parks, recreation areas, or commercial applications, such as a local concrete factory, or a purple pipe system to domestic, non-potable usage. Mangawhai Golf Course are keen to reuse treated effluent and have community and iwi support for this approach. The irrigation in dry conditions at this golf course will increase the disposal of treated effluent as an annualised capacity by a further 450 connections, and could be in operation by 2024, before the Brown Road farm capacity is reached.

All disposal routes will require community engagement, options assessment and environmental assessment and resource consenting, so are expected to take 6-8 years before can be operational.

RISKS AND CONTINGENCY

What if Growth Occurs Early?

There are many undeveloped plots in Mangawhai, and several developments expected to bring housing and commercial units online. The rate of construction cannot be controlled by KDC, but estimates based on historic growth are 70 to 100 connections per year.
So, if we get more houses now, we will see an increase in peak flow when storms occur. The balance tank will enable more flow to pass to the CWWTP but not needing additional treatment capacity in the short term. If the total number of connections exceed the capacity of the Bioreactors, then the balance tank can be controlled to drop some of the daily load to the tank and return it later at night when the daily peak has passed. This may be needed for 1-2 weeks in the peak summer period only. Careful operation of the WWTP is needed to manage the short term extra load but can be accommodated by increased operator attendance and procedures.

The Mangawhai Golf Course provides around 450 more connections capacity on the disposal field.

This means that the additional disposal, balance tank and CWWTP upgrade plans can be made to cope with a greater rate of growth should it occur.

How do we fund this?

Funding to meet the costs of upgrade due to new development will be gathered by developer contributions. As the workstreams develop towards clear future solutions, the costs will be known, and the contribution can be increased if needed. If an additional 1000 connections were to occur, then the developer contributions of over $20m would be required to fund just the treatment plant upgrade. A review of the developer contribution will be made once the network strategy is known to ensure adequate funding for all areas of upgrades – network and CWWTP.

What if Mangawhai has a potable water supply in future causing water usage to increase?

There are no plans currently to bring potable water to every house in Mangawhai. This may of course change in a few years, so the current capacity estimates are based on Mangawhai continuing with roof tank supply. The worst case scenario is that potable water will occur, but this will be after the 5000 connections upgrade, which means that capacity will be reached a few years earlier but still more than 10 years away. To provide long term robust infrastructure the sensitivity of this effect will be considered in Network, CWWTP and Disposal sizing.

STRATEGY PROGRAMME

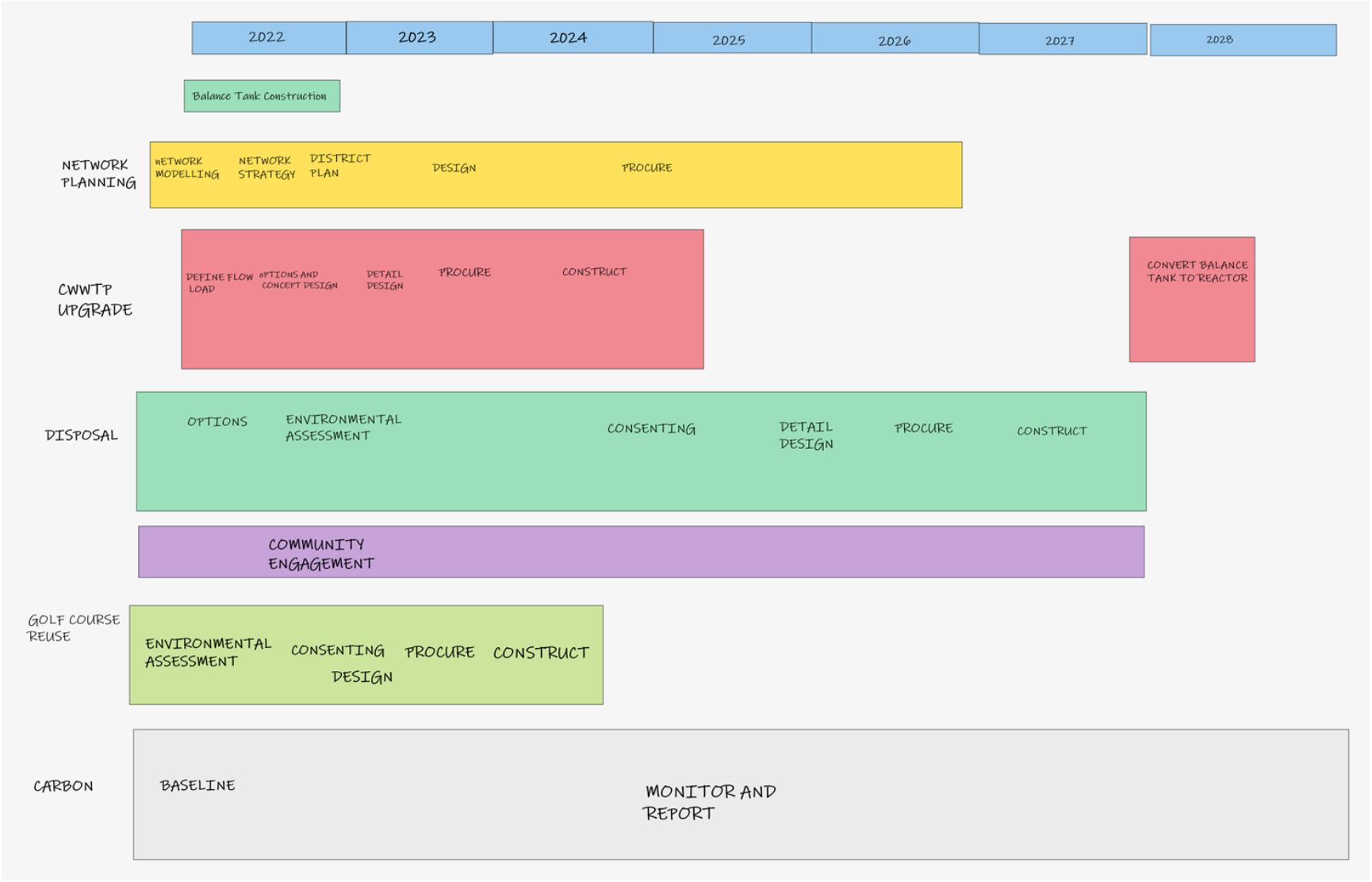

Figure 6 : Strategy Programme

PROGRAMME

As identified in this strategy above a number of steps towards the ultimate solution can be beneficial and achievable in the short term that will provide additional capacity in the MCWWS allowing for a greater level of growth. The figure below shows a comparison of timeline for 100 connections per year, and 100 connections per year with strategy

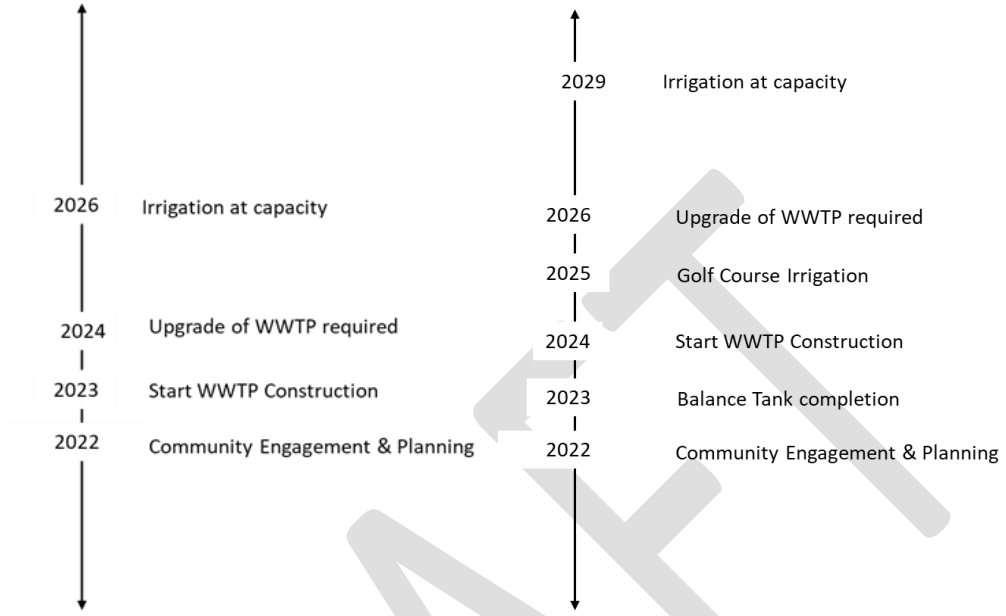

Figure 7 : Comparison of population drive timeline (left) and strategy mitigation timeline (right) for 100 connections/year

NEXT STEPS

For KDC to stay ahead of growth in the Mangawhai community it is necessary to work on several areas simultaneously. Key first steps in 2022 are

- Confirm Growth forecasts and Actual Capacity – monitoring of flow and load over holiday period 2021/2
- Develop Network Strategy
- Commence construction of balance tank.
- Progress environmental assessment and consent application for Golf Course Reuse
- Update LTP
- Prepare Community Engagement Strategy
- Consider disposal and treatment options
- Engage with community on possible treatment and disposal options

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