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Mangawhai Community Wastewater Treatment Plant: Future Options Development

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1 Executive Summary

Kaipara District Council (KDC) have requested a high-level investigation of the impact of growth for the Mangawhai Community Wastewater Treatment Plant (CWTTP). As the Mangawhai population increases and more connections are provided, the disposal area and the CWWTP will eventually reach capacity.

The scope of this investigation was to undertake a high-level concept options investigation to determine the potential options for the future Mangawhai CWWTP. The future options considered three discharge options:

- Discharge to land via disposal field,
- Discharge to harbour/estuary,
- Discharge to sea via an ocean outfall.

For each option the required upgrades were determined with consideration to growth, discharge requirements and process requirements to achieve the discharge standards. The upgrades will allow the accommodation of a larger number of connections, from the current 2,000 to the available 7,000 connections.

- Upgrade Timelines

  Based on an assumed growth rate of 70 connections per year

  - The Mangawhai CWWTP will have reached its current capacity in 2028/9
  - 3,000 connections will be reached in 2032
  - The disposal field will reach its capacity by 2032, at about 3,000 connections.
  - Upgrade of the CWWTP required by 2032 based on biological oxygen demand (BOD) load upto 5,000 connections
  - In 2060 5,000 connections will be reached and 7,000 connections will be reached in 2089

  For a growth rate of 100 connections per year the time frame is much shorter:

  - The Mangawhai CWWTP will have reached its current capacity in 2025
  - 3,000 connections will be reached in 2028
  - The disposal field will reach its capacity by 2028, at about 3,000 connections.
  - Upgrade of the CWWTP required by 2028 based on BOD load upto 5,000 connections
  - In 2048 5,000 connections will be reached and 7,000 connections will be reached in 2068

The estimate of when population will exceed 7,000 connections is between 2089 (70 connections per year) and 2068 (100 connections per year) triggering the next upgrade (based on 10,000 connections). This timescale is > 50 years and at this time the current plant infrastructure commissioned in 2008 will require renewal, based on 60-year asset life for structures. It is not possible to provide cost estimates for this forecast with any certainty, so no further consideration of this upgrade (renewal) for 10,000 connections is made. The equipment required for 10,000 connections is sized and calculated but has not been reported on further

- Upgrade Options

  Option 1: Additional CASS and Disposal to land

  - No change to quality standards
  - Step wise upgrade to existing works in steps of 2 reactors.
  - New 123 hectares disposal field
  - New rising main

- New on-site effluent pumping storage
- Additional sand filters and UV reactors
- Upgrade sludge facility

This option is sensitive to farm availability, price and location and length of the main to the farm. Compulsory purchase may be required. The proposed option is developed for 5,000 connections and 7,000 connections. Where practical the upgrades for 5,000 connections are future proofed assets for 7,000 connections.

Option 2 : Upgrade to MBR and Harbour Discharge

- Tight Standards for nutrients, total suspended solids (TSS) and bacteria.
- Retrofit of membrane bioreactor (MBR) to existing reactors
- Future additional reactor
- Modular Membrane upgrades
- New Gravity pipe to harbour

This option is sensitive to local opinion and cultural expectations. This may require mitigation in the form of a land contact bed at point of discharge. The proposed option is developed for 5,000 connections and 7,000 connections. Where practical the upgrades for 5,000 connections are future proofed assets for 7,000 connections.

Option 3 : Additional CASS with Coastal Outfall.

- No change to quality standards
- Step wise upgrade to existing works in steps of 2 reactors
- Pumped main to Coast
- Additional sand filters and UV reactors
- Upgrade sludge facility
- Gravity Outfall approximately 2 km in length.

This option is sensitive to local opinion, tidal movements, seabed type and topography, presence of shellfisheries and public opinion. There is a high risk of substantially higher costs associated with the outfall location. The proposed option is developed for 5,000 connections and 7,000 connections. Where practical the upgrades for 5,000 connections are future proofed assets for 7,000 connections.

For all options, community engagement, a new resource consent and environmental assessment will be required.

Table 1 below shows the estimated high-level costs of the upgrade options to accommodate 5,000 and 7,000 connections. The costs provided may change during design development and detail design.

Table 1 Summary of high-level cost estimates for the various upgrade options.

	5,000 Connections	7,000 Connections
Option 1 : Additional CASS and Disposal to Land	$ 38million	$9 million
Option 2 : Upgrade to MBR and Harbour Discharge	$ 26 million	$12 million
Option 3 : Additional CASS with Coastal Outfall	$ 47 million	$9 million

2 Introduction

Kaipara District Council is in the process of future planning for growth and future needs in the Mangawhai area. As the Mangawhai population increases and more connections are provided, the existing wastewater system comes under pressure. It has been identified that the disposal area and the community wastewater treatment plant (CWWTP) will eventually reach capacity before 2030.

The upgrade of the existing Mangawhai CWWTP in a like-for-like manner will require approximately 3 times the current treatment capacity and over 120 ha of additional land disposal area. This is expected to be a substantial cost to the community, so informed decisions are needed before committing to any one disposal route.

The scope of this report is to undertake a high-level concept option investigation to determine the potential options for the future Mangawhai CWWTP. The future options will allow the accommodation of a larger number of connections, from the current 2,000 to a future 7,000 connections. The projection of when the population will reach 10,000 connections is > 50 years and at this time the current plant infrastructure commissioned in 2008 will require renewal, based on 60-year asset life for structures. It is therefore not possible to provide cost estimates for this forecast with any certainty, as such the 10,000 connections upgrade was not considered in this review. This report presents a high-level overview of possible effluent disposal options and budget cost estimates to inform KDC, and community stakeholders of the expected costs and preferred options for the future upgrades. This report only considers treatment of wastewater at the CWWTP and the disposal of high-quality effluent after treatment. A further study has commenced to look at the needs of the wastewater network and future developments

This document will form the basis for a Mangawhai Master plan to be shared with the community. The master plan will also need to consider short- and medium-term upgrades. However, it is considered that provided routine maintenance and equipment is replaced at end of life on the existing plant (e.g. pumps) that no substantial investment will likely be needed before the upgrade required to accommodate 5,000 connections.

Current strategic plans include assessment of network upgrades and potentially increasing flow to treatment works and increased capacity at Outfall pump station (PS), either by diversion of Jack Boyd Drive or additional pumping at Outfall PS. There are consequences to the treatment works, so options of network managed solutions also need consideration. With the limited capacity of the disposal field the long-term disposal strategy needs to be considered. This includes coastal outfall, harbour discharge or extended irrigation area. Each of these alternatives will have different treatment requirements.

Previous studies by WSP (2017, 2018) have identified that the current discharge limit, imposed by the disposal field, has been estimated at approximate 3,000 connections (page 4 of the WSP Opus Summary Report Contract 819, MCWWS – Feasibility Investigation, December 2017). In order to accommodate an additional 4000 connections, a suitable disposal method is required.

The environment receiving the high-quality effluent will dictate the quality parameters of the treated effluent and thus the type of treatment required. For the purpose of this high-level assessment the following discharge or disposal options will be considered:

- Disposal field (farm).
- Estuary or harbour, and
- Coastal Outfall.

3 Design Basis

3.1 Future Design Flow

Due to the nature of the catchment with variable population it is not possible to assess flow per capita. The Feasibility Investigation Summary Report Contract 819 MCCWWS December 2017 by WSP Opus identified that under non-holiday conditions the average daily flow is 300 l/connection, and at peak holiday conditions the average daily flow is 600 l/connection. It is assumed that this catchment trend will continue as Mangawhai continues to be both residential and bach accommodation. This rate reflects that water supply in Mangawhai is by individual roof tanks, and this leads to behaviours of water efficiency not seen in many areas in New Zealand.

The peak daily flow treated in 2017-2019 is 4200 m3/d. This value is to be confirmed as the highest value logged between 2016 - 2018 was 1742 m3/d but has been reported verbally by Trility to be much higher. This occurred in an off-peak period and was representative of the flows associated with a cyclone period. This is ~7 times average dry day flow. Prolonged periods of 70 l/s are recorded in extremely wet periods equivalent to 6,048 m3/d and this is the current capacity of the treatment system.

It is assumed that as the Mangawhai community expands the properties connected will remain on separate wastewater and storm water systems. For this reason, the peak flow estimate is based on 6 times dry day flow. This rate will manage exceptional conditions.

Table 2 below details the flow data that is to be used in the options investigation. Flow information is provided for 2000, 3000, 5000, 7000 and 10 000 connections. The approximate year in which the connections are predicted to contribute to the CWWTP is shown based on a growth value of 70 connections per year and 100 connections per year. The average dry weather flow (non-holiday) is based on the 300 l/connection and the dry weather maximum flow (holiday) is based on the 600 l/connection. The peak wet weather flow is based on a peak factor of 6 as described above. As the current treated water discharge capacity is limited to 70 l/s this fixes the peak wet weather instantaneous flow that can be treated at the CWWTP, any flow over and above the 70 l/s, will need additional treatment capacity. From Table 1 it can be seen that at over 3000 connections additional capacity is required.

For options development, the proposed upgrades will be hydraulically sized (piping, pumps etc.) for the peak wet weather flow, while all other equipment (e.g. reactors, tanks) will be sized using the dry weather maximum flow. Essential infrastructure such as transfer mains to the irrigation field are sized for 7000 connections peak wet weather flow. This avoids expensive future additional pipelines.

Table 2 CWWTP futures flows, based on number of connections, expected dry weather flow and peak flow.

Flow/Growth Rate	Connections				
	2,000	3,000	5,000	7,000	10,000
Year (@70 connections/yr)	2018	2032	2060	2089	2132
Year (@100 connections/yr)	2018	2028	2048	2068	2098
Average Dry Weather Flow (non-holiday)	600 m^3/d	900 m^3/d	1 500 m^3/d	2 100 m^3/d	3 000 m^3/d
Dry Weather Maximum Flow (holiday)	1 200 m^3/d	1 800 m^3/d	3 000 m^3/d	4 200 m^3/d	6 000 m^3/d
Peak Wet Weather Flow	3 600 m^3/d	5 400 m^3/d	9 000 m^3/d	12 600 m^3/d	18 000 m^3/d
Peak Wet Weather Instantaneous Flow	70 l/s	70 l/s	104 l/s	146 l/s	208 l/s
Additional Peak Capacity Required	-	-	34 l/s	76 l/s	138 l/s

As discussed earlier, this options evaluation and the associated budget costs only considers the treatment of wastewater at the CWWTP and the disposal of the high-quality effluent after treatment, no allowance has been made for the upgrades and requirement of the wastewater network.

3.2 Future Design Load

Influent monitoring of the Mangawhai CWWTP was completed via grab sample method as detailed in the Feasibility Investigation Summary Report. Table 3 below, presents the summary of the average values collected during 2013 to 2016.

Table 3 Average influent characteristics of the Mangawhai CWWTP during 2013 -2016.

Year	Season	Average Concentrations [mg/l]						
		TSS	BOD5	TP	TN	NH_3-N	NO_3-N	COD
2013	Autumn/Winter	505	282	12	84	79	0.04	795
	Spring/Summer	362	245	12	89	83	0.03	588
	Christmas/New Year	401	469	15	109	101	0.05	900
	All year	443	287	12	88	82	0.04	718
2014	Autumn/Winter	362	210	14	84	73	0.02	657
	Spring/Summer	333	412	11	62	51	0.003	333
	Christmas/New Year	460	421	14	128	109	-	939
	All year	364	363	13	82	71	0.03	564
2015	Autumn/Winter	390	299	12	99	78	0.07	765
	Spring/Summer	413	336	13	102	82	0.05	696
	Christmas/New Year	444	417	14	128	110	-	966
	All year	421	311	12	97	78	0.07	795
2016	Autumn/Winter	569	333	12	80	60	0.08	938
	Spring/Summer	-	418	12	84	68	0.10	917
	Christmas/New Year	605	744	14	109	84	0.06	969
	All year	568	371	12	81	64	0.08	929
Total	Autumn/Winter	457	282	12	87	72	0.05	789
	Spring/Summer	277	353	12	84	71	0.05	634
	Christmas/New Year	477	513	14	119	101	0.03	943
	All year	**449**	**333**	**12**	**87**	**74**	**0.05**	**752**
90thpercentilevalues		**667**	**447**	**15**	**109**	**97**	**0.1**	**1050**

Further data was gathered as hourly samples for Waitangi Weekend of 6th to 9th February 2016.

The data in

Table was obtained by hourly spot sampling for a 3 day period, day time only and shows some of the variations between grab sample and a wider time window of samples. Effectively the hourly spot samples provide composite information for a plant.

Table 4 Intensive sample influent characterisation from the Waitangi Weekend grab samples.

Parameter	Mean Concentration [mg/l]	Minimum [mg/l]	Maximum [mg/l]
Total Suspended Solids (TSS)	640	300	1000
Biological Oxygen Demand (BOD)	504	330	710
Total Kjeldahl Nitrogen (TKN)	126	90	170
Ammonia (NH_3-N)	91	46	140
Total Phosphorus (TP) (assumed)	15	-	-
Carbonaceous Oxygen Demand (COD)	1900	1100	5300
Volatile Suspended Solids (VSS)	577	270	1000

These holiday weekend concentrations are typically twice those recorded for many plants in New Zealand due to the low water usage in the catchment. The ammonia is exceptionally high, and this is attributed to the high number of day visitors to the area who use little water other than that associated with toilets.

For the purpose of options development and plant sizing, the plant needs to be sized for peak holiday loading, a period which extends approximately six weeks each year. Christmas/New Year, Waitangi and Easter. The mean concentrations recorded for of the Waitangi Weekend will therefore be used for the basis of design, these values correspond fairly well with the 90th percentile values shown in Table 3. Total phosphorous was not recorded/analysed as part of the Waitangi Weekend grab samples, as such the 90th percentile value for total phosphorous has been assumed for the loading design basis. The load basis of design is summarised in Table 5.

Table 5 Load basis of design based on the mean peak load influent concentrations and maximum dry weather flow.

Connections	2000	3000	5000	7000	10000
Dry Weather Maximum Flow (holiday) [m^3/d]	1200	1,800	3,000	4,200	6,000
Total Suspended Solids (TSS) [kg/d]	768.4	1152.6	1921	2689.4	3842
Biological Oxygen Demand [kg/d]	604	907	1511	2116	3022.
Total Phosphorus (TP) [kg/d]	17.544	26.316	43.86	61.404	87.72
Total Nitrogen (TN) [kg/d]	151	227.	378	530	757
Ammonia (NH_3-N) [kg/d]	110	164	274	383	548
Nitrates (NO_3-N) [kg/d]	0.012	0.018	0.03	0.042	0.06
Carbonaceous Oxygen Demand (COD) [kg/d]	2280	3420	5700	7980	11400

4 Upgrade Timelines

4.1 Upgrade Timeline for 70 Connections per year

The Mangawhai CWWTP currently discharges treated wastewater to a 110 hectares disposal field (farm) located approximately 12 km away from the CWWTP. Due to the natural layout of the farm only 65.5 hectares of the land are available for effluent irrigation. Based on the predicted growth rate of 70 connections per year, the disposal field will reach its capacity by 2032 (at about 3000 connections) as shown in Figure 1. At this point additional land will be required for disposal or an alternative/ additional discharge location(s) will need to be available. By 2029 the CWWTP will require upgrading as it will also be organically overloaded (see Figure **Error! Reference source not found.**) and will not be able meet the required discharge consents.

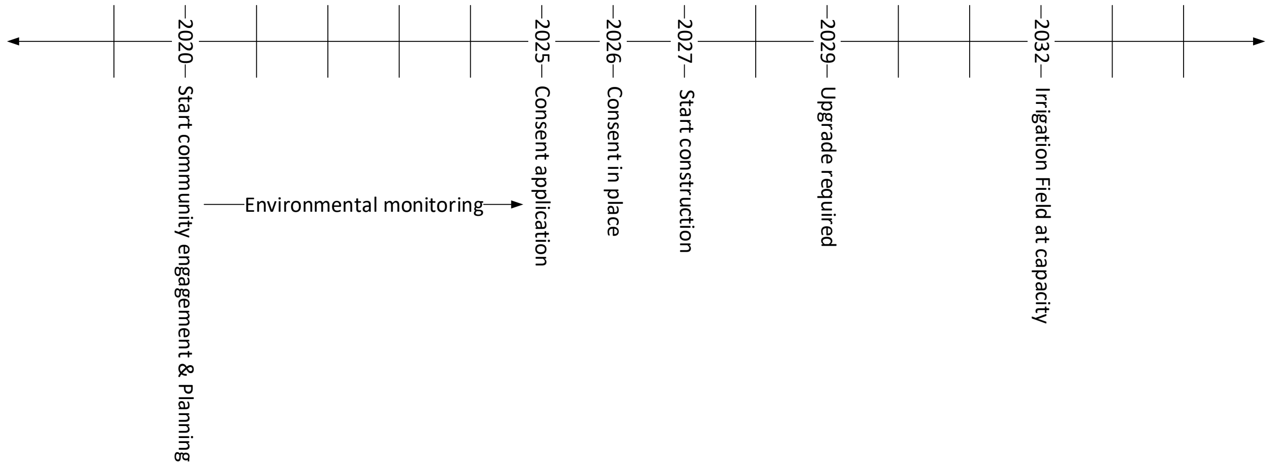

Figure 3 is an estimate of the upgrade timeline based on a growth rate of 70 connections per year. The timeline allows for early community engagement, planning, consent application with construction of the upgrades to start in 2027. The upgrade will be based on the organic load expected for 5,000 connections (2060), with some consideration for growth up to 7,000 connections (2089). At 70 connections per year, 10,000 connections will only be reached in 2132.

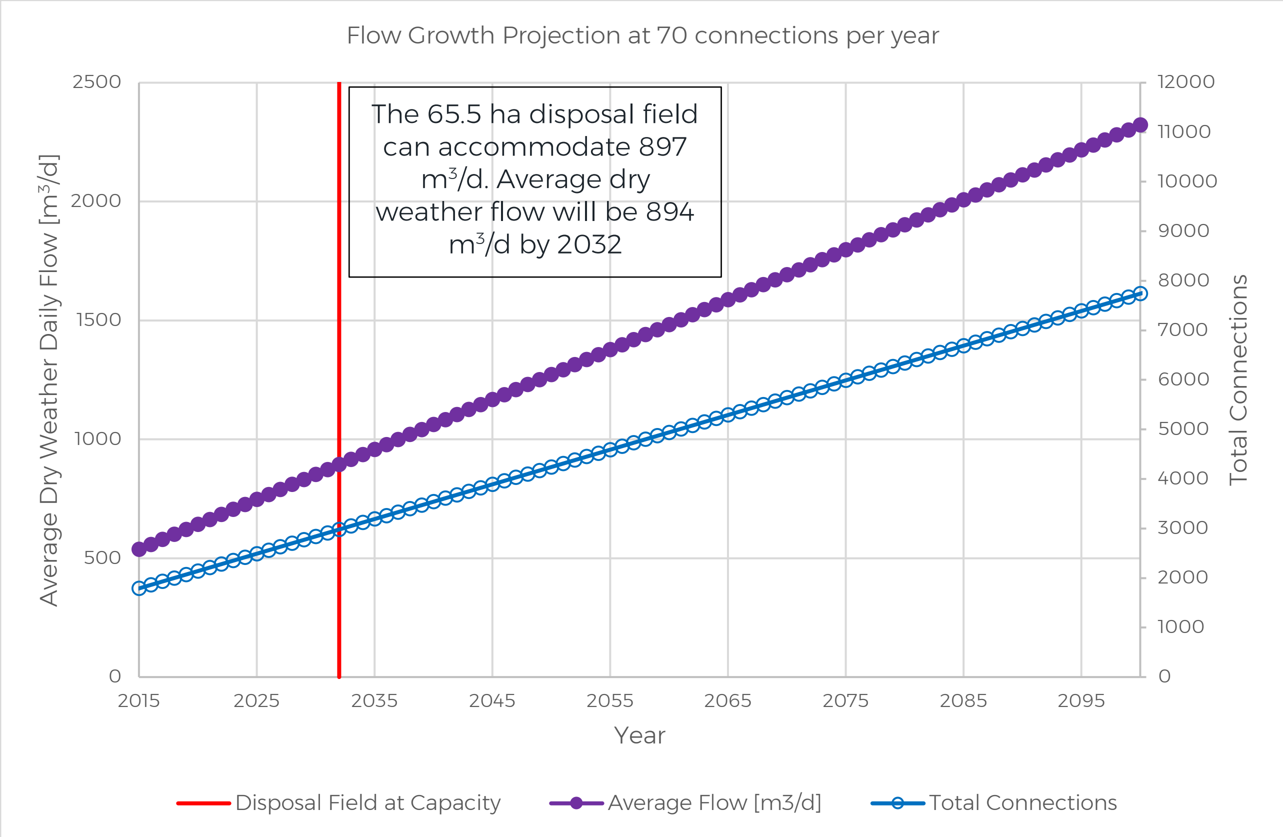

Figure 1 *Flow growth projection for the Mangawhai CWWTP based on a growth rate of 70 connections per year.*

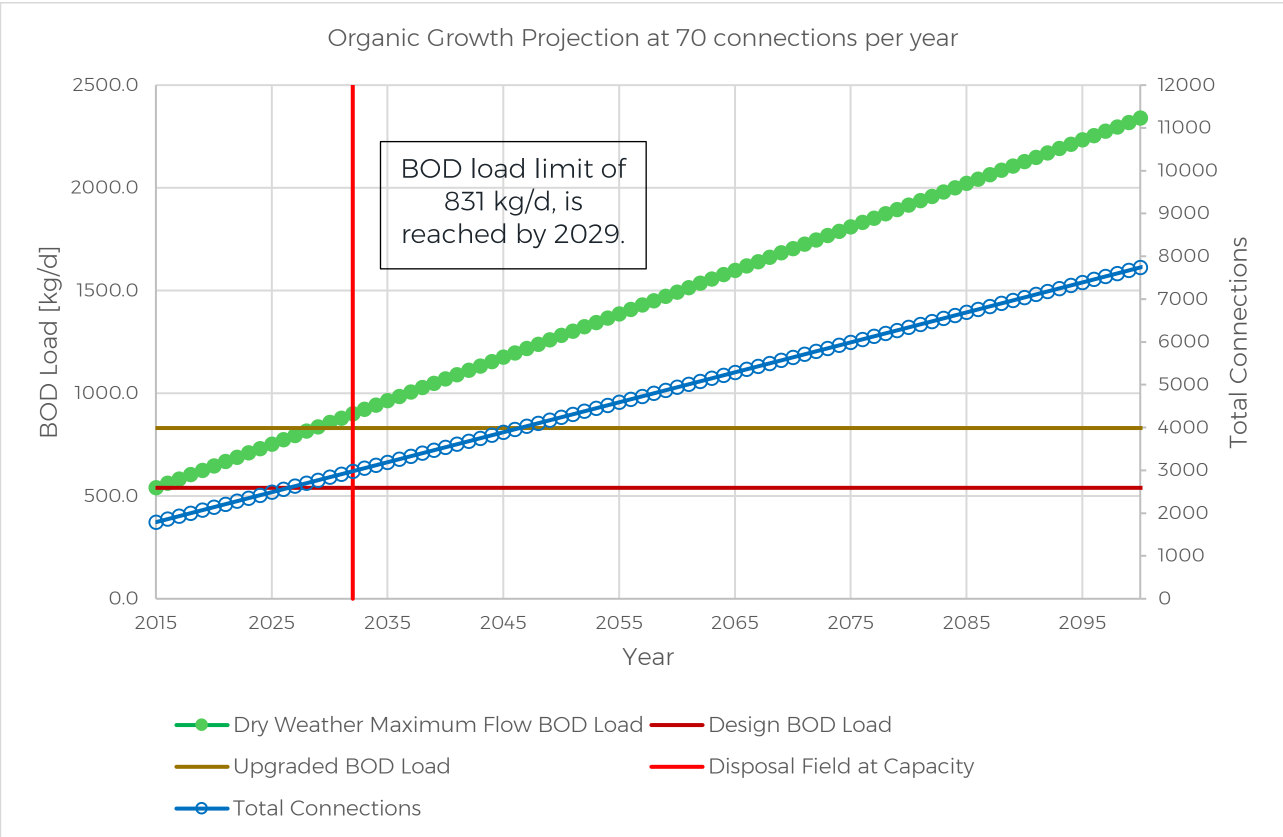

Figure 2 *Organic growth projection for the Mangawhai CWWTP based on a growth rate of 70 connections per year. By 2028*

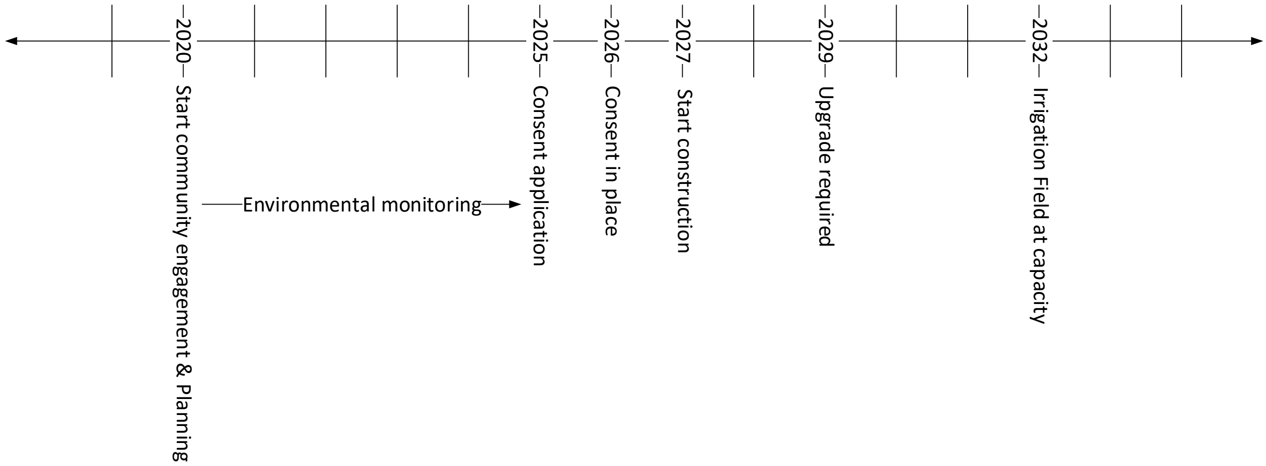

Figure 3 Estimated timeline for the required upgrades based on 70 connections per year.

In summary based on a growth rate of 70 connections per year:

- Current CWWTP at capacity (based on predicted BOD load) in 2029
- 3,000 connections will be reached in 2032
- Disposal field at capacity in 2032
- Upgrade of the CWWTP required by 2029 based on organic (BOD) load for 5,000 connections
- Start planning for further upgrades in 2048
- 5,000 connection reached at 2060
- Upgrade required by 2060 based on organic (BOD) load for 7,000 connections
- 7,000 connections reached at 2089

4.2 Upgrade Timeline for 100 Connections per year

Based on a growth rate of 100 connections per year, the disposal field will reach its capacity roughly four years earlier, in 2028 (3,000 connections) as shown in Figure 4. By 2026 the CWWTP will require upgrading as it will also be organically overloaded (see Figure 5 **Error! Reference source not found.**) and will not be able meet the required discharge consents. Figure 6 is an estimate of the upgrade timeline based on a growth rate of 100 connections per year and shows that the upgrade timeline requires the scheduled to be pulled in considerably, with planning envisioned to start in early 2020 for the upgrades required by 2026. The required upgrades will be based on the organic load expected for 5,000 connections (2048), with some consideration for growth up to 7,000 connections (2068). At 100 connections per year, 10,000 connections will be reached in 2098.

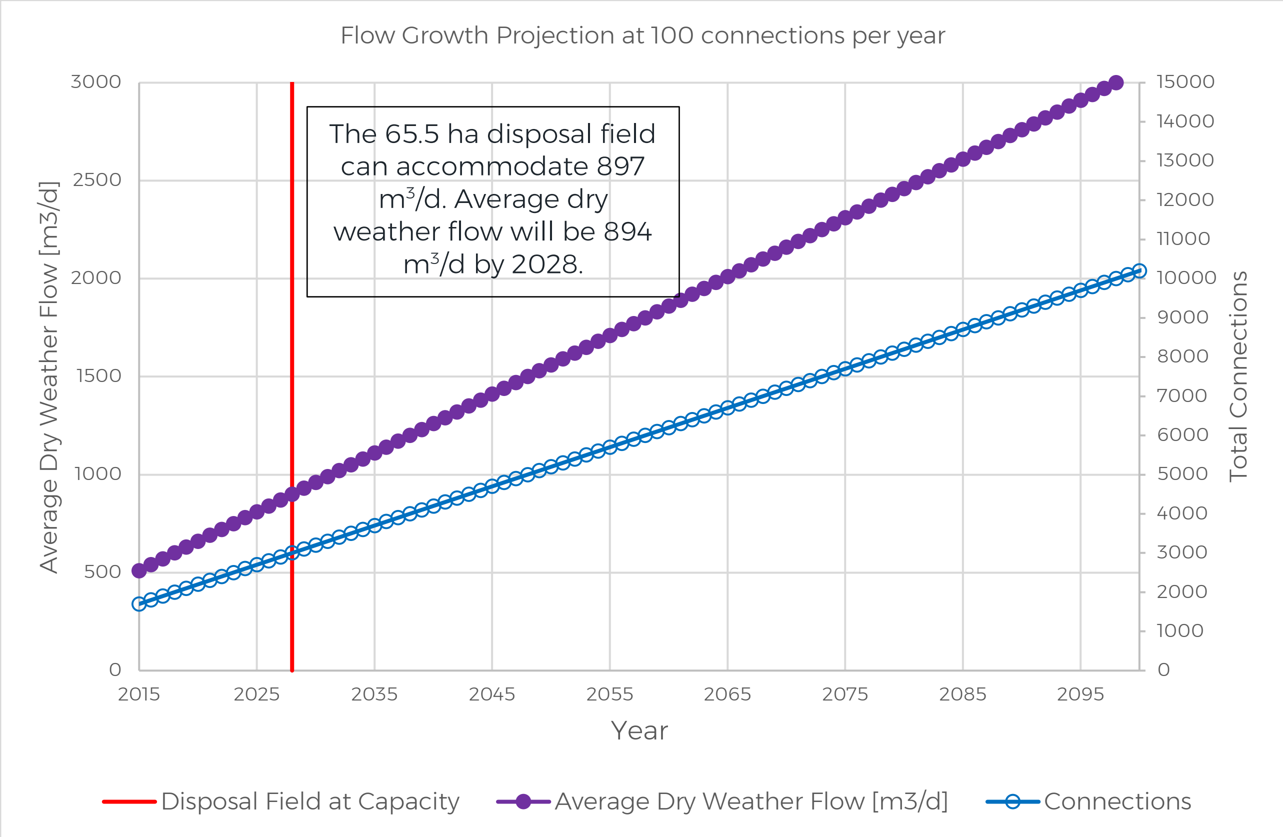

Figure 4 Flow growth projection for the Mangawhai CWWTP based on a growth rate of 100 connections per year.

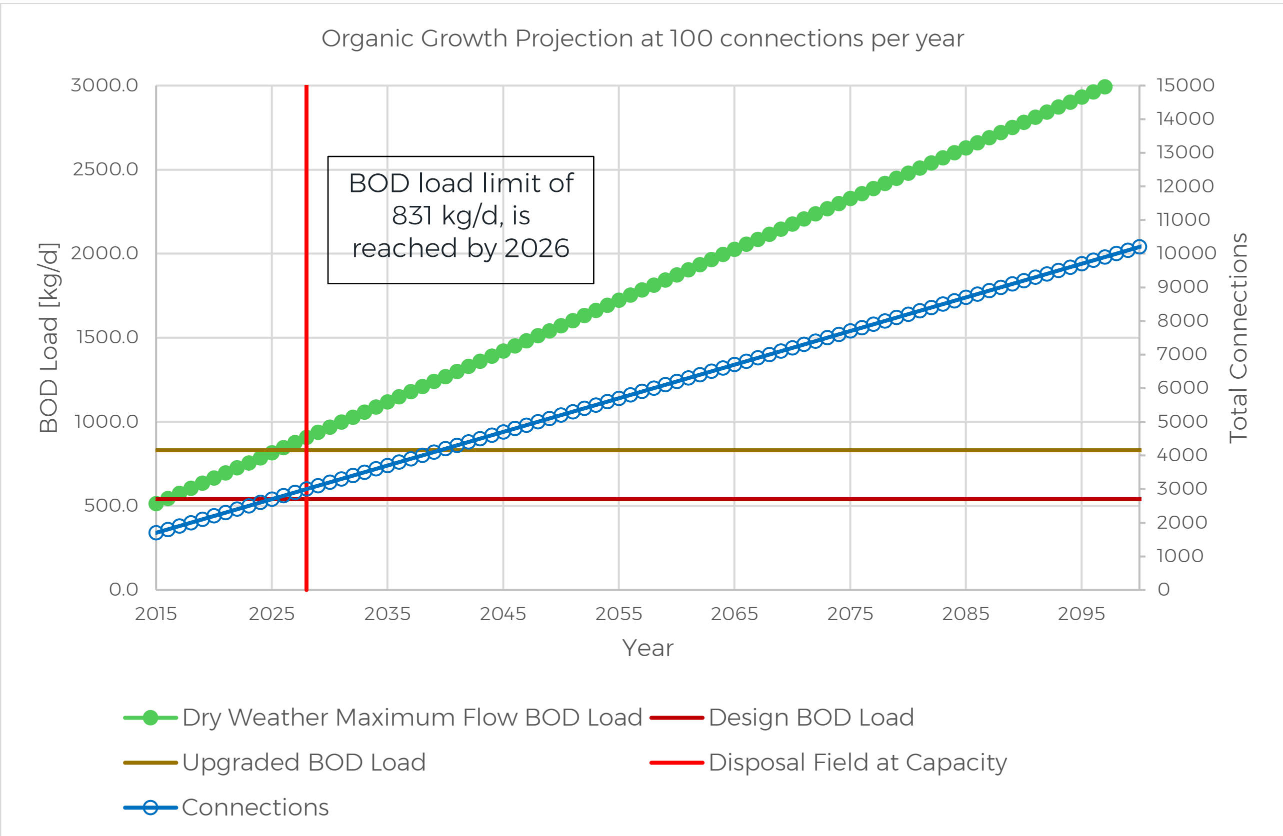

Figure 5 Organic growth projection for the Mangawhai CWWTP based on a growth rate of 100 connections per year.

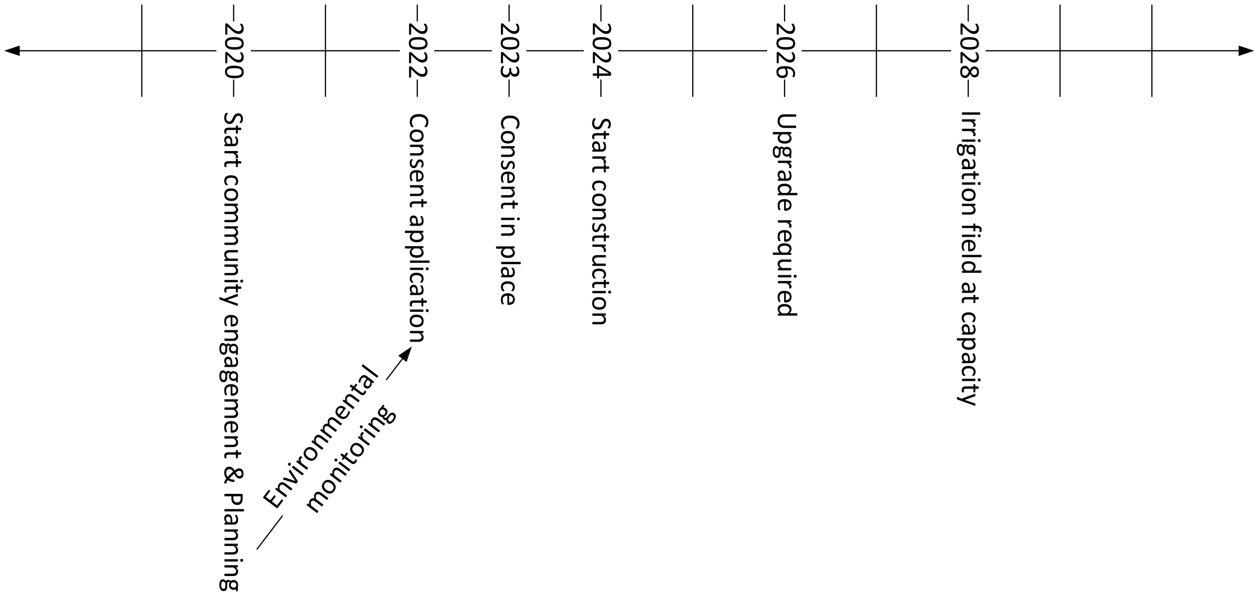

Figure 6 Estimated timeline for the required upgrades based on 100 connections per year.

In summary based on a growth rate of 100 connections per year:

- Current CWWTP at capacity (based on predicted BOD load) in 2026
- 3,000 connections will be reached in 2028
- Disposal field at capacity in 2028
- Upgrade of the CWWTP required by 2026 based on organic (BOD) load for 5,000 connections
- Start planning for further upgrades in 2036
- 5,000 connection reached at 2048
- Upgrade required by 2048 based on organic (BOD) load for 7,000 connections
- 7,000 connections reached at 2068

Therefore, the worst case for Mangawhai CWWTP is that a treatment plant upgrade is required by 2026, with irrigation capacity being exceeded by 2028. In this case construction will be required to commence in 2023 or 2024.

5 Discharge or Disposal Options

For the options development, three main discharge or disposal options were evaluated, the options considered in this evaluation were:

5.1 Disposal Field

As discussed in Section 4, for discharge via disposal field, additional land (farm) will be required for effluent irrigation purposes. For the future upgrade options assessment, it was assumed that the existing farm will remain available and additional land will be purchased to provide the additional disposal field area required. No maintenance cost of the existing are included. Based on the current consented load of 5,000 m^3/hectare·year, an additional 62 hectares of land will be required to accommodate 5,000 connections, 123 hectares in total will be required to accommodate 7,000 connections and a total of 215 hectares will be required to accommodate 10,000 connections. It is assumed that 40% of land purchased will not be suitable for irrigation due to proximity to boundaries, slope and proximity to neighbours and roads.

For the purpose of this study, it was assumed that the new farm is located 12 km away from the CWWTP. The rising mains to the new disposal field (farm) was sized to allow the total flow to be diverted to the farm if required.

5.2 Discharge to Estuary

Given the location of the CWWTP, the option to discharge to the estuary has also been evaluated. For this option it was assumed that the existing farm will remain available for disposal but another discharge option i.e. estuary needs to be available for when the farm reaches capacity. Based on the early estimates the discharge to estuary could require a much shorter rising main (~1 km) and discharge could potentially be via a gravity main, reducing the amount of treated water pumping required. Given the sensitive nature of the estuary and cultural considerations, the level of treatment required will be higher than for the other disposal options, however due to the proximity of the estuary and potential to gravitate from the CWWPT into the estuary, this option could prove viable. Figure 7 below, shows a possible routing of the discharge main down Thelma road into Mangawhai Harbour. The rising mains to the estuary was sized to allow the total flow to be diverted to the estuary if required.

Figure 7 *Possible routing to allow for discharge to the estuary/harbour.*

5.3 Coastal Outfall

The option to discharge to a coastal outfall has also been evaluated in this future options review. For this option it was once again assumed that the existing farm will remain available for disposal but another discharge option i.e. ocean, needs to be available for when the farm reaches capacity with the ability to take all flow if required. The level of treatment required for an ocean outfall has been assumed to be in line with that required for the disposal field. The rising mains required for this option has been estimated at 4 km, and an additional 2.6 km of coastal outfall (see Figure 8). The rising mains is shorter than for the disposal field, but construction of the coastal outfall will have to be compared with the cost of the disposal field.

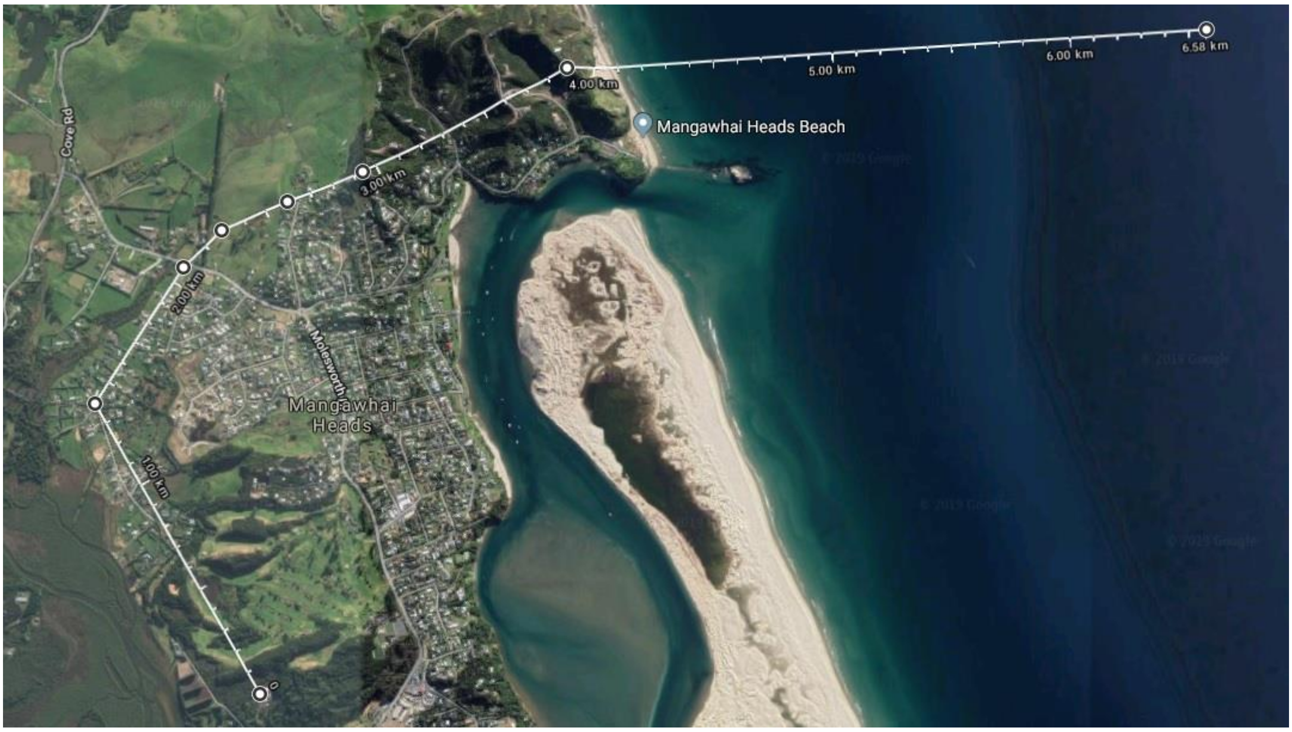

Figure 8 Possible routing to allow for discharge via ocean outfall.

6 Discharge Consents and Standards

6.1 Treatment Quality Required – Disposal Field

The effluent quality targets for the disposal field were based on the current resource consent and are shown in Table 6. Parameters included are: E.coli; Total Dissolved Solid (TDS), Total Nitrogen (TN), Total Phosphorous (TP), Total Suspend Solids (TSS) and Carbonaceous Biochemical Oxygen Demand (cBOD). These are in line with current land disposal standards.

Tighter Phosphorus standards may be required in line with the current trends for nutrient removal, but this may be managed by the use of chemical dosing within the existing treatment plant if required.

Table 6 Mangawhai CWWTP resource consent discharge parameters.

Parameter	Units	Median	Average[1]	90th Percentile
E.coli	MPN	10		100
Total Dissolved Solids (TDS)	mg/l		500	
Total Nitrogen (TN)	mg/l		30	
Total Phosphorous (TP)	mg/l		15	
Total Suspended Solids (TSS)	mg/l		10	
Carbonaceous Biochemical Oxygen Demand (cBOD)	mg/l		10	

[1] Average consent parameters are based on a rolling average sampling programme.

6.2 Treatment Quality Required – Discharge to Estuary

The effluent quality targets for disposal to estuary/harbour were based on the resource consent of the Clark's Beach Wastewater Treatment Plant. This recent Watercare project has been through environmental assessment and community engagement with discharge to a similar watercourse. The resource consent allows treated wastewater from the Clarks Beach WWTP to be discharged to Waiuku Estuary, in the South Manukau Harbour. The resource consents require that the wastewater discharged will achieve the treatment parameters set out in Table 7.

This site has been selected as a basis for this options review due to the similar nature of receiving watercourse and the cultural needs that was determined by Environment Court in 2018.

Table 7 Discharge treatment parameters for discharge to Waiuku Estuary from Clarks Beach WWTP.

Parameter	Units	Median	92nd Percentile Limit
Carbonaceous Biochemical Oxygen Demand (cBOD)	mg/l	5	20
Total Suspended Solids (TSS)	mg/l	5	20
Total Nitrogen (TN)	mg/l	5	20
Total Ammoniacal Nitrogen (NH_4-N)	mg/l	1	20

The treatment parameters in Table 7 do not include a Total Phosphorous limit, for Clarks Beach nitrogen is the limiting nutrient in the receiving environment, as there is sufficient phosphorous available in the coastal waters relative to nitrogen, that the addition of further phosphorous will not result in further algal blooms. However, normally estuarine discharge of effluent is subject to tight limits on nitrogen and phosphorus. European Union (EU) standards require 10 mg/l annual average for total nitrogen to estuarine discharge. This is due to the enclosed and shallow water body that will be subject to eutrophication that will diminish the ecology, aesthetics and recreational and cultural value of the harbour. In anticipation of this need a Total Phosphorous limit of 1 mg/l has been included as an annual average concentration.

The nitrogen and phosphorus standards may be load based which can change the effective quality required. This is driven by the receiving water requirements and cannot be estimated without environmental monitoring.

The Clarks Beach WWTP discharge consent does not include a target for E.coli, although the WWTP design makes provision for Ultra Violet (UV) disinfection. For the purposes of this evaluation the target for E.coli has been assumed to be the same as the National Policy Statement for Freshwater Management (Attributes B) which requires a median concentration of <130 cfu/100ml and 95th percentile concentration of <1000 cfu/100 ml. The Clarks Beach WWTP discharge is required by the Resource Consent to have membrane filtration which will achieve < 10 cfu/100ml E Coli and additionally provide UV disinfection for additional removal of viruses. This is to protect the local shellfishery.

6.3 Treatment Quality Required – Coastal Outfall

The effluent quality targets for disposal via coastal outfall are based on the current resource consent for disposal to land and are shown in Table 6 in Section 6.1 above. Many New Zealand coastal discharge resource consents are less stringent than these standards, but a principal of ensuring effluent can be discharged to land disposal whenever possible drives the quality selected.

6.4 Future Discharge Standards

The announcement of a National Regulator and National standards for the resource consents may change the requirements from those stated in this document. The values presented above are typical standards being required for similar discharges in New Zealand and Internationally and will be determined based on the receiving environment. This will be subject to an Environmental Impact Assessment to determine final standards.

The standards identified in this document served as the basis of design for the CWWTP, should other standards develop (in several years, but within the time frame of these upgrade) these must be assessed at that time.

For disposal to land, the impact of tighter nitrogen and phosphorous standards will require an increase in biological treatment and the use of chemical dosing. Should this occur, the additional capacity anticipated for up to 7,000 connections will be brought earlier.

With the higher degree of treatment required for the local discharge (estuary), it is unlikely that tighter standards will be imposed within 20 years. However, should this be a requirement the additional capacity anticipated for up to 7,000 connections will be brought earlier.

Both treatment processes discussed below can be easily modified to deal with tighter standards.

7 Upgrade Options

7.1 Upgrade for Discharge to Disposal Field

For the option of discharging to a disposal field, it was assumed that the effluent quality targets as described in the current consent has to be achieved (see Section 6.1). As the current CWWTP meets the consent requirements, this option aims to capitalise on the existing plant and knowledge of the process, by merely expanding the plant in a modular fashion to accommodate future growth. The aim for this option is to use a Cyclical Activated Sludge System (CASS), consisting of two reactors to treat the wastewater to within the required effluent quality targets. These units are ideally suited to the seasonal variation seen at Mangawhai as a reactor can easily be taken out of service during low season and returned to duty before peak demand.

The modular approach is to increase the capacity of the plant, merely by adding additional modules (or equipment) based on the sizing of the existing plant. As such, the existing equipment is used to size the required upgrades, by determining the additional capacity required based on the predicted growth (see Figure 1 and Figure).

The number of equipment units and where relevant the size of the equipment is determined for 5,000, 7,000 and 10,000 connections. Whilst this modular approach is acceptable for a high-level options review, more detailed design will need to be developed as the project develops, to provide greater certainty in sizes and cost estimation.

Future-proofing of the plant is considered: for the 5,000 connections upgrade certain equipment units will be sized to accommodate 7,000 connections. This includes the flow splitter chambers, inlet works structure, transfer pipelines and intermediate tanks where it is cost effective to upgrade for future (tanks in particular). Not all tanks and pipes and equipment will be provided at this stage, but rather the facility in layout, blank flange connection and similar to aid upgrade.

The estimate of when population will exceed 7,000 connections is between 2089 (70 connections per year) and 2068 (100 connections per year) triggering the next upgrade (based on 10,000 connections). This timescale is > 50 years and at this time the current plant infrastructure commissioned in 2008 will require renewal, based on 60-year asset life for structures. It is not possible to provide cost estimates for this forecast with any certainty, so no further consideration of this upgrade (renewal) is made. The equipment required for 10,000 connections is sized and calculated but has not been reported on further

7.1.1 5,000 Connections Upgrade

To enable continued discharge to land, via disposal field, for up to 5,000 connections (2060 or 2048) the following upgrades are proposed:

- *Purchase additional 123 hectares of farm or land for disposal field (meets 7000 requirements).*
- *Install new 450 mm (internal diameter) 12 km rising main from the CWWTP to the disposal field (meets 7000 requirements).*
- *Install 2 new larger screens in duty/standby based on flow for up to 5,000 connections. Provide flange connections and facility for future screen for up to 7,000 connections.*
- *Build and install 2 new additional CASS reactors, with all ancillary equipment (e.g high efficiency aeration, decanter etc.).*
- *Install 3 new RAS pumps for the new CASS reactors (Duty/Duty/Standby)*
- *Install 3 new WAS pumps for the CASS reactors (Duty/Duty/Standby).*
- *Build an additional blower room, with 5 new blowers with sufficient capacity for the two new CASS reactors. Blower room will be large enough to accommodate the additional blowers and equipment required for 7,000 connections.*
- *Demolish the existing odour filter and install a larger odour filter based on requirement for 5,000 connections.*
- *Demolish the existing return pump liquor station and install a larger pump station based on the requirements for 7,000 connections (Pumps sized for 5,000 connections).*
- *Add an additional Intermediate Tank, WAS Tank and Treated Water Tank based on the requirements for 7,000 connections.*
- *Build an additional sludge dewatering building, the building will contain equipment for sludge dewatering at 5,000 connections, however it will be large enough to accommodate the additional equipment required for 7,000 connections.*
- *Install 3 additional Treated Water Pumps and a new Hypochlorite Dosing System based on 5,000 connection. The base slabs for the pumps and dosing systems will be designed to accommodate the additional equipment required for 7,000 connections.*
- *Build a new access road to allow for chemical offloading and sludge collection.*

Figure 9 shows the proposed layout for the 5,000 connections upgrade for discharge via disposal field. The equipment or areas highlighted in red indicate equipment aimed at accommodating 5,000 connections, while the areas in blue indicate areas of future proofed assets for 7,000 connections. Proposed layout aims to minimise encroachment on the embankment to the east of the CWWTP to limit earthworks and retaining walls.

Figure 9 Proposed layout of the 5,000 connections upgrade required by 2028 or 2032, depending on the connection rate assumed. Areas in red cater for 5,000 connections only, where areas in blue allow for future staging, by allowing sufficient capacity or space for the 7,000 connections upgrade.

7.1.2 7,000 Connections Upgrade

As the upgrades proposed for 5,000 connections aims to future-proof the CWWTP, the upgrades required for 7,000 connections are not as onerous. Therefore, to enable continued discharge to land, via disposal field, for up to 7,000 connections (2089 or 2060) the following upgrades are proposed:

- *Build and install 2 new additional CASS reactors, with all ancillary equipment (e.g. high efficiency aeration, decanter etc)*
- *Install 3 new RAS pumps for the new CASS reactors (Duty/Duty/Standby)*
- *Install 3 new WAS pumps for the CASS reactors (Duty/Duty/Standby).*
- *Install 5 new blowers in the existing blower room with sufficient capacity for the 2 new CASS reactors.*
- *Install a new larger odour filter based on requirement for 7,000 connections.*
- *Install 6 new additional sand filters and 1 new UV reactor to accommodate the flow for 7,000 connections.*
- *Install the additional sludge handling equipment (belt-filter etc.) to the existing sludge handling building.*
- *Install 1 new additional Treated Water Pumps.*

Figure shows the proposed layout for the 7,000 connections upgrade for discharge via disposal field. The equipment or areas highlighted in yellow indicate where upgrades or equipment are required to accommodate 7,000 connections.

Figure 10 *Proposed layout of the 7,000 connections upgrade required by 2060 or 2089, depending on the connection rate assumed. Areas in yellow indicate the additional equipment required for the 7,000 connections upgrade.*

7.1.3 Key Assumptions

Below is a list of the key assumptions made for this upgrade option:

- *The existing treatment processes at the Mangawhai CWWTP is adequate to meet the discharge consent and sizing of the new equipment is based on the existing equipment sizes.*
- *Food-to-mass (F/M) ratio 0.1 (for this option the F/M was merely used to verify if the plant loading is in the acceptable range)*
- *The new disposal field is 12 km from the CWWTP*
- *The new rising main was sized for the total flow at 7,000 connections, a raising main of 450 mm internal diameter.*
- *The routing of the rising main is not known but will trenched and buried 3 m below the ground.*

7.1.4 High-Level Cost Estimate for Discharge to Disposal Field

A high-level cost estimate for the option to Discharge to Disposal Field was completed, based on the details listed above. The costs provided may change during design development and detail design.

The upgrade to accommodate up to 5,000 connections is estimated to cost $ 38 million At worst case, this upgrade will be required as early as 2026 based on a growth rate of 100 connections per year. The estimate is based on budget costs and current pricing, no allowance has been made for the upgrades and requirement of the wastewater network.

The additional spent required to upgrade the CWWTP to accommodate up to 7,000 connections is estimated to cost $ 9 million. At worst case, this upgrade will be required by 2048 based on a growth rate of 100 connections per year.

Summaries of the high-level cost estimates are in Appendix A.

7.2 Future Upgrade for Discharge to Estuary

In order to discharge to the estuary, a higher degree of treatment will be required as nutrient removal (nitrogen and phosphorus) and suspended solids removal are required over and above the E.coli limits. In order to sustainably achieve the effluent requirements proposed in Section 6.2, a new treatment process is required. A membrane biological reactor (MBR) is therefore proposed for this upgrade option. MBRs are similar to other nutrient removal activated sludge processes, however membranes are used to separate the suspended solids from the treated water. MBRs can operate at much higher suspended solids concentrations (5,000 – 10,000 mg/l) compared to conventional activated sludge reactors (2,000 – 3,000 mg/l). This results in a much smaller footprint for the actual reactors. Membranes can also be selected to achieve very low bacterial limits, < 5 E coli/100ml being typically cited. (see Clarks Beach WWTP in Section 6.2), however as for the Clarks Beach WWTP, UV disinfection have been included after the membranes for additional removal of viruses to prevent transmission through shellfish.

The Mangawahi CWWTP could be retrofitted fairly easily to operate as MBRs, by using the existing CASS reactor tanks, and adding external membranes for solids removal. MBRs are however more energy intensive, as they require more air to maintain sufficient dissolved oxygen at higher mixed liquor suspended solids (MLSS) concentrations, and since the membranes required compressed air as part of their normal cleaning and maintenance cycles. In addition to this, membranes require routine cleaning with hypochlorite and citric acid (or similar). MBRs can however be installed as packaged plants, with all the additional equipment required pre-assembled as part of the membrane system and are typically modular which allows for fast and easy expansion when required.

For this option, the number of equipment pieces and the size of the equipment was determined for 5,000, 7,000 and 10,000 connections. As MBRs can operate at much higher suspended solids concentrations, the existing reactor tanks can be used for much higher loads before additional reactor tanks will be required. Future-proofing was also considered for this upgrade option, most of the equipment, tanks and building areas in the 5,000 connections upgrade make allowance for the anticipated growth, e.g. membrane building has been sized based on 7,000 connections but only enough membranes for 5,000 connection will be installed for the 5,000 connections upgrade.

The estimate of when population will exceed 7,000 connections is between 2089 (70 connections per year) and 2068 (100 connections per year) triggering the next upgrade (based on 10,000 connections). This timescale is > 50 years and at this time the current plant infrastructure commissioned in 2008 will require renewal, based on 60-year asset life for structures. It is not possible to provide cost estimates for this forecast with any certainty, so no further consideration of this upgrade (renewal) is made. The equipment required for 10,000 connections is sized and calculated but has not been reported on further

7.2.1 5,000 Connections Upgrade

To enable the Mangawhai CWWTP to discharge to estuary, the following upgrades are proposed for the 5,000 connections upgrade:

- *Install 1 km rising main from the CWWTP to the Mangawhai harbour.*
- *Install new 450 mm (internal diameter) 1 km rising main from the CWWTP to the Mangawhai harbour (meets 7000 requirements).*
- *Install 2 new larger screens in duty/standby based on flow for up to 5,000 connections. Provide flange connections and facility for future screen for up to 7,000 connections.*
- *Install 3 new RAS pumps (Duty/Assist/Standby) and 2 new WAS pumps (Duty/Standby).*
- *Internal modifications of existing CASS reactors to MBR including diffusers, anaerobic zones, anoxic zones and anoxic mixers.*
- *Build an additional blower room, with 2 new blowers, building will be large enough to accommodate another 2 blowers. Space for 7000 connections.*
- *Demolish the existing odour filter and install a larger odour filter based on requirement for 5,000 connections.*
- *Demolish the existing odour filter and install a larger odour filter based on requirement for 5,000 connections.*
- *Install 3 new UV reactors (Duty/Assist/Standby) to accommodate the flow for 5,000 connections, base slab for UV reactors to be sized for4 UV reactors.*
- *Modify Intermediate Storage Tank for use as an additional WAS Tank.*
- *Add an Treated Water Tank based on the requirements for 7,000 connections. Note Treated Water Tanks are only required if pumping of effluent is required for discharge.*
- *Build and additional sludge handling building, the building will contain equipment for sludge handling at 5,000 connections, however it will be large enough to accommodate the additional equipment required for 7,000 connections.*
- *Install 3 additional Treated Water Pumps based on 5,000 connection. The base slabs for the pumps designed to accommodate the additional equipment required for 7,000 connections. The Treated Water Pumps could potentially be removed from this option if the treated water can be discharged by gravity to the Mangawhai Harbour. They have however been included at this stage of evaluation.*
- *Build a new access road to allow for chemical offloading and sludge collection.*

Figure 11 shows the proposed layout for the 5,000 connections upgrade for discharge to estuary. The equipment or areas highlighted in red indicate equipment aimed at accommodating 5,000 connections only, while the areas in blue indicate areas of future proofed assets for 7,000 connections. The membranes used in this option evaluation can be purchased as packaged plants that come in modules of 6. For the 5,000 connections upgrade, 3 packaged plants or blocks are required, however the last block will only need 2 modules to be installed. If the plant becomes hydraulically limited between the 5,000 connections upgrade and the 7,000 connections upgrade, additional modules can be installed in the last membrane block in the areas indicated with “R” for reserved.

Figure 11 *Proposed layout of the 5,000 connections upgrade required by 2028 or 2032, depending on the connections. Areas in red cater for 5,000 connections only, where areas in blue allow for future staging, by allowing sufficient capacity or space for the 7,000 connections upgrade.*

7.2.2 7,000 Connections Upgrade

As the upgrades proposed for 5,000 connections aims to future-proof the CWWTP, the upgrades required for 7,000 connections are not as onerous. Therefore, to enable continued discharge to estuary (Mangawhai Harbour) for up to 7,000 connections (2089 or 2060) the following upgrades are proposed:

- *Install additional biological reactor to expand total volume of biological reactors available., including diffusers, anaerobic zones, anoxic zones and anoxic mixers.*
- *Install 1 additional blower in the existing blower room.*
- *Install 1 new additional RAS pump.*
- *Install a new larger odour filter based on requirement for 7,000 connections.*
- *Install the additional sludge handling equipment (belt-filter etc.) to the existing sludge handling building.*
- *Install 1 new UV reactor on the existing UV reactor slab.*
- *Install another 4 membranes modules in the existing membrane block and install another membrane block with 1 module.*
- *Install 1 new additional Treated Water Pumps.*

Figure shows the proposed layout for the 7,000 connections upgrade for discharge via disposal field. The equipment or areas highlighted in yellow indicate where upgrades or equipment required to accommodate 7,000 connections.

Figure 12 Proposed layout of the 7,000 connections upgrade required by 2060 or 2089, depending on the connection rate assumed. Areas in yellow indicate the additional equipment required for the 7,000 connections upgrade.

7.2.3 Key Assumptions

Below is a list of the key assumptions made for this upgrade option:

- *The targeted MLSS concentration for the MBR is 7,500 mg/l*
- *Food-to-mass (F/M) ratio 0.1, for this option the F/M at the 7,500 mg/l was used to evaluate if the existing reactors can be used for the 5,000 connections upgrade and the 7,000 connections upgrade.*
- *The existing reactor tanks can be modified to include an anoxic zone (10% of the reactor volume) and an anaerobic zone (20% of the reactor volume) for nitrogen and phosphorus removal.*
- *The membranes will be modular, and additional units can be added as flow increases.*
- *Membranes surface area was calculated on peak wet weather flow with a flux of 25 LMH.*
- *Membranes will be provided with all ancillary equipment (clean-in-place chemical dosing systems, blowers or compressors for air scouring etc)*
- *The CWWTP will discharge into Mangawhai Harbour through a new rising main (with the potential for a gravity main) of 1 km.*
- *The new rising main was sized for the total flow at 7,000 connections, requires a raising main of 450 mm (internal diameter).*

– *The routing of the rising main is not confirmed but will trenched and buried 3 m below the ground.*

7.2.4 Preliminary Cost Estimate for Discharge to Estuary

A high-level cost estimate for the option to Discharge to Estuary was completed, based on the details listed above. The costs provided may change during design development and detail design.

The upgrade to accommodate up to 5,000 connections is estimated to cost $ 26 million. At worst case, this upgrade will be required as early as 2026 based on a growth rate of 100 connections per year. The estimate is based on budget costs and current pricing, no allowance has been made for the upgrades and requirement of the wastewater network.

The additional spent required to upgrade the CWWTP to accommodate up to 7,000 connections is estimated to cost $ 12 million At worst case, this upgrade will be required by 2048 based on a growth rate of 100 connections per year.

Summaries of the high-level cost estimates are in Appendix A.

7.3 Coastal Outfall

As discussed in Section 6.3, the effluent quality targets for disposal via coastal outfall were based on the current resource consent for disposal to land. As the effluent quality is the same the upgrades required for the discharge to ocean outfall are similar those detailed in Section 7.1. The only difference between the two options are the actual discharge location and the distances to these locations. For this option, it has been assumed that the discharge will be via an coastal outfall. The rising mains required for this option has been estimated at 4 km, and an additional 2.6 km of coastal outfall. The coastal outfall makes this option cost prohibitive as this is costly from a design and construction point of view, but may be preferred by the community.

All other assumptions and sizing estimates for the 5,000 connections upgrade and the 7,000 connections upgrade are the same as for Discharge to Disposal Field.

Accurate costs for the sea outfall are not included in this estimate, but estimates are based on two recent projects. Army Bay, Watercare for approx 2.7 km tunneled through a hill, and 1.7 km of sea outfall, with all contract on costs was $31 million (costs for client and feasibility studies are not included in this figure). This was 1000 mm tunnel with 800 PE pipeline throughout including 400 m diffuser section. The second example is a 2018 cost estimate for the Akaroa Ocean Outfall. The cost provided in the Stantec feasibility is $19 million for 11 km of 250 PE pipeline on the sea bed. No oncosts are provided.

The actual point of outfall discharge will be dependent on bathymetric and dispersion studies. An estimated cost from previous experience is that this feasibility may cost $2m. The actual cost of outfall will be dependent on the sea bed, currents and route. Depending on all of these factors, the delivered cost of outfall will be between $9 million and $24 million.

7.3.1 Preliminary Cost Estimate for Discharge to Sea

A high-level cost estimate for the option to Coastal Outfall was completed, based on the details listed above. The costs provided may change during design development and detail design.

The upgrade to accommodate up to 5,000 connections is estimated to cost $ 47 million. At worst case, this upgrade will be required as early as 2026 based on a growth rate of 100 connections per year. The estimate is based on budget costs and current pricing, no allowance has been made for the upgrades and requirement of the wastewater network.

The additional spent required to upgrade the CWWTP to accommodate up to 7,000 connections is estimated to cost $ 9million. At worst case, this upgrade will be required by 2048 based on a growth rate of 100 connections per year.

Summaries of the high-level cost estimates are in Appendix A.

8 Summary of Findings

Upgrade Timelines

Based on an assumed growth rate of 70 connections per year

- The CWWTP will require upgrade before 2029.
- The Mangawhai CWWTP will have reached its current treatment capacity in 2029
- 3,000 connections will be reached in 2032
- The disposal field will reach its capacity in 2032, at about 3,000 connections.
- In 2060 5,000 connections will be reached and 7,000 connections will be reached in 2089
- Hydraulic demand for peak flow may require an upgrade before this time.

For a growth rate of 100 connections per year the time frame is much shorter:

- The CWWTP will require upgrade before 2026
- The Mangawhai CWWTP will have reached its current capacity in 2026
- 3,000 connections will be reached in 2028
- The disposal field will reach its capacity in 2028, at about 3,000 connections.
- In 2048 5,000 connections will be reached and 7,000 connections will be reached in 2068
- Hydraulic demand for peak flow may require an upgrade before this time.

Upgrade Options

To continue business as usual i.e. discharging to land and wastewater treatment via CASS an additional disposal field will be required. Based on the predicted growth a new irrigation area of 123 hectares will be required to accommodate up to 7,000 connections. The upgrades required for 5,000 and 7,000 connections are based on the existing CWWTP and existing equipment sizes. Where possible the 5,000 connections upgrade has included a degree of future-proofing to allow for easier expansion at 7,000 connections. For the 5,000 connections the preliminary estimated cost of upgrades is $ 38 million and for second stage upgrade to 7,000 connections the preliminary estimated cost for the upgrades is $ 9 million. The costs include the cost of the new irrigation field and a new 12 km raising main (450 mm internal diameter). The costs exclude any upgrades required to the wastewater network.

In order to discharge to the estuary (Mangawhai Harbour), a higher level of treatment will be required. A new treatment process is therefore required to ensure adequate nutrient removal, solids removal and pathogen removal. The proposed process is a membrane bioreactors (MBRs). MBRs allow for the same or better level of treatment on smaller footprint and can potentially be retrofitted onto the existing CASS reactor tanks. MBRs tend to be modular which makes future expansion easy, as additional modules can be added as the throughput of the plant increases. MBRs are however energy and operationally intensive and could results in higher operating costs when compared the existing CASS reactors. For this upgrade option it might be possible to gravitate the treated effluent from the CWWTP into the harbour, therefore negating the use of the Treated Water Pumps. Where possible the 5,000 connections upgrade has included a degree of future-proofing to allow for easy expansion at 7,000 connections. For the 5,000 connections the preliminary estimated cost of upgrades is $ 26 million and for second stage upgrade to 7,000 connections the preliminary estimated cost for the upgrades is $12 million. The costs exclude any upgrades required to the wastewater network.

To discharge the treated water via coastal outfall would require the same level of treatment that is being proposed for discharge via disposal field. As such the upgrades required are the same with the same level of staging and/or future-proofing. The only difference is the length of the rising main assumed for this option and the coastal outfall. The coastal outfall makes this option cost prohibitive, based on the capital cost estimates, as this a costly from a design and construction point of view, but may be preferred by the community. For the 5,000 connections the preliminary estimated cost for the upgrades is $ 47 million and for second stage upgrade to 7,000 connections the preliminary estimated cost for the upgrades is $ 9 million. The costs include the cost of the coastal outfall.

9 Recommendations

The following recommendations are to be considered to enable better decision making and future panning for the Mangawahi CWWTP:

- Update the upgrade cost estimates after validation process is completed.
- Include operating costs for all three upgrade options,
- Complete either a TOTEX or NPV evaluation of the options.
- The study has been prepared assumng the disposal field can accept 5000m3/day (as per consented load). The actual capacity of handlign this load should be confimred by onsite investigation.
- No modelling of the network is avaialble. Peak flow data has been derived base don the inflow monitoring at the WTTP. Modelling of the neteork is reccomned to better understand the impact of the new connection on the peak load and attenutation provide by the netowrk (if any).

Appendix A
Budget Cost Estimate Summaries

Project Estimate

Project Name: Mangawhai CWWTP High Level Future Options Review: Discharge to Land @ 5000 Connections

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	**Nett Project Property Cost**	0	0	0
	Project Development Phase			
	-Consultancy Fees	0	0	0
	-Client Managed Costs	0	0	0
B	**Total Project Development**	0	0	0
	Pre-Implementation Phase			
	-Consultancy Fees (Detailed Design)	2,103,548	631,064	420,710
	-Client Managed Costs	262,943	78,883	52,589
C	**Total Pre-implementation**	2,366,491	709,947	473,298
	Implementation Phase			
	Implementation Fees			
	-Consultancy Fees (MSQA)	1,682,838	504,851	336,568
	-Client Managed Costs	210,355	63,106	42,071
	-Consent Monitoring Fees	105,177	31,553	21,035
	Sub Total Base Implementation Fees	1,998,370	599,511	399,674
	Physical Works			
1	Environmental and Compliance	4,920,000	1,476,000	984,000
2	Earthworks	172,027	51,608	34,405
3	Ground Improvements	0	0	0
4	Drainage	0	0	0
5	Pavement and Surfacing	878,015	263,404	175,603
6	Bridges and Structures	3,010,227	903,068	602,045
7	Retaining Walls	500,000	150,000	100,000
8	Mechanical	2,460,969	738,291	492,194
9	Electrical and Control	472,200	141,660	94,440
10	Piping	5,016,127	1,504,838	1,003,225
11	Landscaping	0	0	0
12	Commissioning	100,000	30,000	20,000
13	Preliminary and General	3,505,913	1,051,774	701,183
	Sub Total Base Physical Works	21,035,477	6,310,643	4,207,095
D	**Total construction**	23,033,847	6,910,154	4,606,769
E	**Project base estimate** (A+C+D)	25,400,339		
F	**Contingency** (Assessed/Analysed)	(A+C+D)	7,620,102	
G	**Project expected estimate**	(E+F)	33,020,440	
Nett Project Property Cost Expected Estimate			0	
Project Development Phase Expected Estimate			0	
Pre-implementation Phase Expected Estimate			3,076,439	
Implentation Phase Expected Estimate			29,944,002	
H	**Funding risk** (Assessed/Analysed)		(A+C+D)	5,080,067.7
I	**95th percentile Project Estimate**		(G+H)	38,100,508
Project property cost 95th percentile estimate				0
Investigation and reporting 95th percentile estimate				0
Design and project documentation 95th percentile estimate				3,549,737
Construction 95th percentile estimate				34,550,771
Date of estimate	19/11/2019	**Cost Index (Qtr/Year)**		
Estimate prepared by	L Mulder	**Signed**		
Internal peer review by	A Springer	**Signed**		
External peer review by		**Signed**		
Estimate accepted by Client		**Signed**		
Note:	(1) These estimates are exclusive of escalation and GST.			

Project Estimate

Project Name: Mangawhai CWWTP High Level Future Options Review: Discharge to Land @ 7000 Connections

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	Nett Project Property Cost	0	0	0
	Project Development Phase			
	-Consultancy Fees	0	0	0
	-Client Managed Costs	0	0	0
B	Total Project Development	0	0	0
	Pre-Implementation Phase			
	-Consultancy Fees (Detailed Design)	488,239	146,472	97,648
	-Client Managed Costs	61,030	18,309	12,206
C	Total Pre-implementation	549,269	164,781	109,854
	Implementation Phase			
	Implementation Fees			
	-Consultancy Fees (MSQA)	390,591	117,177	78,118
	-Client Managed Costs	48,824	14,647	9,765
	-Consent Monitoring Fees	24,412	7,324	4,882
	Sub Total Base Implementation Fees	463,827	139,148	92,765
	Physical Works			
1	Environmental and Compliance	100,000	30,000	20,000
2	Earthworks	39,427	11,828	7,885
3	Ground Improvements	0	0	0
4	Drainage	0	0	0
5	Pavement and Surfacing	210,144	63,043	42,029
6	Bridges and Structures	1,522,994	456,898	304,599
7	Retaining Walls	0	0	0
8	Mechanical	1,640,769	492,231	328,154
9	Electrical and Control	299,200	89,760	59,840
10	Piping	156,127	46,838	31,225
11	Landscaping	0	0	0
12	Commissioning	100,000	30,000	20,000
13	Preliminary and General	813,732	244,120	162,746
	Sub Total Base Physical Works	4,882,393	1,464,718	976,479
D	Total construction	5,346,221	1,603,866	1,069,244
E	Project base estimate (A+C+D)	5,895,490		
F	Contingency (Assessed/Analysed)	(A+C+D)	1,768,647	
G	Project expected estimate	(E+F)	7,664,137	
Nett Project Property Cost Expected Estimate			0	
Project Development Phase Expected Estimate			0	
Pre-implementation Phase Expected Estimate			714,050	
Implentation Phase Expected Estimate			6,950,087	
H	Funding risk (Assessed/Analysed)		(A+C+D)	1,179,098.0
I	95th percentile Project Estimate		(G+H)	8,843,235
Project property cost 95th percentile estimate				0
Investigation and reporting 95th percentile estimate				0
Design and project documentation 95th percentile estimate				823,904
Construction 95th percentile estimate				8,019,331
Date of estimate	19/11/2019	Cost Index (Qtr/Year)		
Estimate prepared b	L Mulder	Signed		
Internal peer review	A Springer	Signed		
External peer review by		Signed		
Estimate accepted by Client		Signed		
Note:	(1) These estimates are exclusive of escalation and GST.			

Project Estimate

Project Name: Mangawhai CWWTP High Level Future Options Review: Discharge to Estuary @ 5000 Connections

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	Nett Project Property Cost	0	0	0
	Project Development Phase			
	-Consultancy Fees	0	0	0
	-Client Managed Costs	0	0	0
B	Total Project Development	0	0	0
	Pre-Implementation Phase			
	-Consultancy Fees (Detailed Design)	1,427,620	428,286	285,524
	-Client Managed Costs	178,453	53,536	35,691
C	Total Pre-implementation	1,606,073	481,822	321,215
	Implementation Phase			
	Implementation Fees			
	-Consultancy Fees (MSQA)	1,142,096	342,629	228,419
	-Client Managed Costs	142,762	42,829	28,552
	-Consent Monitoring Fees	71,381	21,414	14,276
	Sub Total Base Implementation Fees	1,356,239	406,872	271,248
	Physical Works			
1	Environmental and Compliance	100,000	30,000	20,000
2	Earthworks	27,000	8,100	5,400
3	Ground Improvements	0	0	0
4	Drainage	0	0	0
5	Pavement and Surfacing	2,000,235	600,070	400,047
6	Bridges and Structures	989,713	296,914	197,943
7	Retaining Walls	250,000	75,000	50,000
8	Mechanical	7,161,686	2,148,506	1,432,337
9	Electrical and Control	522,075	156,623	104,415
10	Piping	696,127	208,838	139,225
11	Landscaping	0	0	0
12	Commissioning	150,000	45,000	30,000
13	Preliminary and General	2,379,367	713,810	475,873
	Sub Total Base Physical Works	14,276,203	4,282,861	2,855,241
D	Total construction	15,632,442	4,689,733	3,126,488
E	Project base estimate (A+C+D)	17,238,515		
F	Contingency (Assessed/Analysed)	(A+C+D)	5,171,554	
G	Project expected estimate	(E+F)	22,410,069	
Nett Project Property Cost Expected Estimate			0	
Project Development Phase Expected Estimate			0	
Pre-implementation Phase Expected Estimate			2,087,895	
Implentation Phase Expected Estimate			20,322,175	
H	Funding risk (Assessed/Analysed)		(A+C+D)	3,447,703.0
I	95th percentile Project Estimate		(G+H)	25,857,772
Project property cost 95th percentile estimate				0
Investigation and reporting 95th percentile estimate				0
Design and project documentation 95th percentile estimate				2,409,109
Construction 95th percentile estimate				23,448,663
Date of estimate	19/11/2019	Cost Index (Qtr/Year)		
Estimate prepared b	L Mulder	Signed		
Internal peer review	A Springer	Signed		
External peer review by		Signed		
Estimate accepted by Client		Signed		
Note:	(1) These estimates are exclusive of escalation and GST.			

Project Estimate

Project Name: Mangawhai CWWTP High Level Future Options Review: Discharge to Estuary @ 7000 Connections

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	Nett Project Property Cost	0	0	0
	Project Development Phase			
	-Consultancy Fees	0	0	0
	-Client Managed Costs	0	0	0
B	Total Project Development	0	0	0
	Pre-Implementation Phase			
	-Consultancy Fees (Detailed Design)	675,472	202,642	135,094
	-Client Managed Costs	84,434	25,330	16,887
C	Total Pre-implementation	759,906	227,972	151,981
	Implementation Phase			
	Implementation Fees			
	-Consultancy Fees (MSQA)	540,378	162,113	108,076
	-Client Managed Costs	67,547	20,264	13,509
	-Consent Monitoring Fees	33,774	10,132	6,755
	Sub Total Base Implementation Fees	641,699	192,510	128,340
	Physical Works			
1	Environmental and Compliance	100,000	30,000	20,000
2	Earthworks	19,713	5,914	3,943
3	Ground Improvements	0	0	0
4	Drainage	0	0	0
5	Pavement and Surfacing	210,144	63,043	42,029
6	Bridges and Structures	991,994	297,598	198,399
7	Retaining Walls	0	0	0
8	Mechanical	3,480,095	1,044,029	696,019
9	Electrical and Control	506,550	151,965	101,310
10	Piping	170,439	51,132	34,088
11	Landscaping	0	0	0
12	Commissioning	150,000	45,000	30,000
13	Preliminary and General	1,125,787	337,736	225,157
	Sub Total Base Physical Works	6,754,722	2,026,417	1,350,944
D	Total construction	7,396,421	2,218,926	1,479,284
E	Project base estimate (A+C+D)	8,156,327		
F	Contingency (Assessed/Analysed)	(A+C+D)	2,446,898	
G	Project expected estimate	(E+F)	10,603,225	
Nett Project Property Cost Expected Estimate			0	
Project Development Phase Expected Estimate			0	
Pre-implementation Phase Expected Estimate			987,878	
Implentation Phase Expected Estimate			9,615,347	
H	Funding risk (Assessed/Analysed)		(A+C+D)	1,631,265.4
I	95th percentile Project Estimate		(G+H)	12,234,491
Project property cost 95th percentile estimate				0
Investigation and reporting 95th percentile estimate				0
Design and project documentation 95th percentile estimate				1,139,859
Construction 95th percentile estimate				11,094,631
Date of estimate	19/11/2019	Cost Index (Qtr/Year)		
Estimate prepared b	L Mulder	Signed		
Internal peer review	A Springer	Signed		
External peer review by		Signed		
Estimate accepted by Client		Signed		
Note:	(1) These estimates are exclusive of escalation and GST.			

Project Estimate

Project Name: Mangawhai CWWTP High Level Future Options Review: Coastal Outfall @ 5000 Connections

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	Nett Project Property Cost	0	0	0
	Project Development Phase			
	-Consultancy Fees	0	0	0
	-Client Managed Costs	0	0	0
B	Total Project Development	0	0	0
	Pre-Implementation Phase			
	-Consultancy Fees (Detailed Design)	3,741,194	1,122,358	748,239
	-Client Managed Costs	311,766	93,530	62,353
C	Total Pre-implementation	4,052,960	1,215,888	810,592
	Implementation Phase			
	Implementation Fees			
	-Consultancy Fees (MSQA)	1,995,303	598,591	399,061
	-Client Managed Costs	249,413	74,824	49,883
	-Consent Monitoring Fees	124,706	37,412	24,941
	Sub Total Base Implementation Fees	2,369,423	710,827	473,885
	Physical Works			
1	Environmental and Compliance	1,500,000	450,000	300,000
2	Earthworks	172,027	51,608	34,405
3	Ground Improvements	0	0	0
4	Drainage	0	0	0
5	Pavement and Surfacing	874,451	262,335	174,890
6	Bridges and Structures	2,594,540	778,362	518,908
7	Retaining Walls	500,000	150,000	100,000
8	Mechanical	2,368,566	710,570	473,713
9	Electrical and Control	458,700	137,610	91,740
10	Piping	12,216,127	3,664,838	2,443,225
11	Landscaping	0	0	0
12	Commissioning	100,000	30,000	20,000
13	Preliminary and General	4,156,882	1,247,065	831,376
	Sub Total Base Physical Works	24,941,293	7,482,388	4,988,259
D	Total construction	27,310,716	8,193,215	5,462,143
E	Project base estimate (A+C+D)	31,363,676		
F	Contingency (Assessed/Analysed)	(A+C+D)	9,409,103	
G	Project expected estimate	(E+F)	40,772,779	
Nett Project Property Cost Expected Estimate			0	
Project Development Phase Expected Estimate			0	
Pre-implementation Phase Expected Estimate			5,268,848	
Implentation Phase Expected Estimate			35,503,931	
H	Funding risk (Assessed/Analysed)		(A+C+D)	6,272,735.2
I	95th percentile Project Estimate		(G+H)	47,045,514
Project property cost 95th percentile estimate				0
Investigation and reporting 95th percentile estimate				0
Design and project documentation 95th percentile estimate				6,079,440
Construction 95th percentile estimate				40,966,074
Date of estimate	19/11/2019	Cost Index (Qtr/Year)		
Estimate prepared b	L Mulder	Signed		
Internal peer review	A Springer	Signed		
External peer review by		Signed		
Estimate accepted by Client		Signed		
Note:	(1) These estimates are exclusive of escalation and GST.			

Project Estimate

Project Name: Mangawhai CWWTP High Level Future Options Review: Coastal Outfall @ 7000 Connections

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	Nett Project Property Cost	0	0	0
	Project Development Phase			
	-Consultancy Fees	0	0	0
	-Client Managed Costs	0	0	0
B	Total Project Development	0	0	0
	Pre-Implementation Phase			
	-Consultancy Fees (Detailed Design)	507,568	152,270	101,514
	-Client Managed Costs	63,446	19,034	12,689
C	Total Pre-implementation	571,014	171,304	114,203
	Implementation Phase			
	Implementation Fees			
	-Consultancy Fees (MSQA)	406,054	121,816	81,211
	-Client Managed Costs	50,757	15,227	10,151
	-Consent Monitoring Fees	25,378	7,614	5,076
	Sub Total Base Implementation Fees	482,189	144,657	96,438
	Physical Works			
1	Environmental and Compliance	100,000	30,000	20,000
2	Earthworks	39,427	11,828	7,885
3	Ground Improvements	0	0	0
4	Drainage	0	0	0
5	Pavement and Surfacing	210,144	63,043	42,029
6	Bridges and Structures	1,522,994	456,898	304,599
7	Retaining Walls	0	0	0
8	Mechanical	1,801,840	540,552	360,368
9	Electrical and Control	299,200	89,760	59,840
10	Piping	156,127	46,838	31,225
11	Landscaping	0	0	0
12	Commissioning	100,000	30,000	20,000
13	Preliminary and General	845,946	253,784	169,189
	Sub Total Base Physical Works	5,075,678	1,522,703	1,015,136
D	Total construction	5,557,868	1,667,360	1,111,574
E	Project base estimate (A+C+D)	6,128,882		
F	Contingency (Assessed/Analysed)	(A+C+D)	1,838,664	
G	Project expected estimate	(E+F)	7,967,546	
Nett Project Property Cost Expected Estimate			0	
Project Development Phase Expected Estimate			0	
Pre-implementation Phase Expected Estimate			742,318	
Implentation Phase Expected Estimate			7,225,228	
H	Funding risk (Assessed/Analysed)		(A+C+D)	1,225,776.3
I	95th percentile Project Estimate		(G+H)	9,193,322
Project property cost 95th percentile estimate				0
Investigation and reporting 95th percentile estimate				0
Design and project documentation 95th percentile estimate				856,521
Construction 95th percentile estimate				8,336,802
Date of estimate	19/11/2019	Cost Index (Qtr/Year)		
Estimate prepared by	L Mulder	Signed		
Internal peer review by	A Springer	Signed		
External peer review by		Signed		
Estimate accepted by Client		Signed		
Note:	(1) These estimates are exclusive of escalation and GST.			

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