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Attention: Darren de Klerk

Dear Darren

Waipukurau WWTP - cost assessment of upgrade cost vs pipeline to Waipawa for Treatment and Discharge at Waipawa – Aka Waipukurau Tipping Point Assessment

1 Summary

As part of the Waipawa and Waipukurau wastewater treatment plants (WWTP) strategy development, a capital cost and NPV analysis was undertaken to compare the relative long-term cost of operating an upgraded stand-alone WWTP at Waipukurau against the cost of consolidating treatment at Waipawa (for Waipawa, Otane and Waipukurau). The purpose of this assessment is to inform Central Hawke's Bay District Council's decision on which option to proceed with. This letter sets out the analysis done for the two options.

A comparison of capital costs and present values of the two key options has identified that 'Transfer to and Treat at' Waipawa (Option 2) is the option preferred for long term management of wastewater from Waipukurau. The following work describes the assessment and the outputs from it. A third option was assessed that assumed a significantly lower level of plant upgrade, with just modest improvements to the existing oxidation pond based plants.

2 Introduction

2.1 Background

As a result of having to address long term capability issues with its wastewater treatment plants (WWTPs) and address regional pressure and community aspirations to cease wastewater discharges to surface waters, Central Hawkes Bay District Council (CHBDC) has developed a conceptual scheme for ultimately amalgamating wastewater treatment for the towns of Otane, Waipawa and Waipukurau and discharging the treated effluent to land via rapid infiltration or beneficial land application or various combinations of both methods. It is envisaged that wastewater treatment would be centralised at Waipawa, where there is land available and where there is access to nearby land which is suitable for rapid infiltration (RI) disposal.

The distances between the towns are significant, 9km from Otane WWTP to Waipawa WWTP and around 6.5km from Waipukurau WWTP to Waipawa WWTP. The costs of transfer (conveyance) infrastructure between the sites (pipes and pumps) are therefore also significant. A key step in the preferred option selection process is to establish estimates of the whole of life cost of the transfer option as compared to the two options for retaining treatment at Waipukurau and disposing of the effluent locally. Because of ongoing consenting challenges and the costs of operating a separate, high rate plant, it has been determined, through an exercise similar to this one, that raw sewage from Otane will eventually be conveyed to Waipawa and treated in a new treatment plant there.

2.2 Treatment Standard

Through work undertaken in community engagement and scheme options development between 2018 and 2020, it has been determined that:

- Treated effluent discharges are to be removed from direct discharge to surface waterways.
- The aspirational goal of the community is for long term low rate application to land and, to the extent possible, beneficial reuse.
- That in the interim, until land application schemes become available, disposal will be via rapid infiltration to ground through silt and gravel strata in the vicinity of the rivers, whether that be Walker Rd near the Waipawa river (Waipawa) or Ford Rd adjacent the Tukituki river (Waipukurau).
- To produce an effluent that is suitable for reasonably rapid transition through the ground to the river and to provide maximum flexibility for configuring future land application schemes, it has been determined that the future treatment plants must be able to remove nutrients (biological nutrient removal, BNR) to reasonably low levels and provide a high level of disinfection.

Therefore:

- Treatment options have been developed that include BNR plants separately at Waipawa and Waipukurau (Option 1) and jointly at Waipawa (Option 2).
- A third option has been costed that looks at the probable cost of 'do minimum' upgrades to retain oxidation pond systems at Otane, Waipawa and Waipukurau (Option 3).
- The assumed level of treatment for Options 1 and 2 is that referred to as "level B" in a memorandum, Description of Treatment and Conveyance Options (Beca, June 2019) and the Basis of Design Report (Beca May 2020). This level of treatment is described as conventional biological nutrient removal with ammonia reduction to very low levels. The target average effluent quality for level B treatment is summarised in Table 1.

Table 1: Target average treated effluent quality, Options 1 & 2

Parameter	Unit	Value
cBOD5	mg/L	15
TSS	mg/L	15
NH4-N	mg/L	2
TN	mg/L	8
SRP	mg/L	0.25
E.coli	cfu/100ml	<100

- An options study was undertaken, as part of the Concept design report (Beca June 2020) to ascertain the most appropriate biological process to deliver the required treatment standards. This concluded that the use of Intermittently Decanted Extended Aeration (IDEA) was the most suitable.

The basis of design for the concepts developed to date takes into account the aspirational (because they are not consented limits) goals above and the estimated loading upon the treatment plants. The estimated flows and loads for concept design purposes have been as shown in **Error! Reference source not found.** below. Option 2 is a summation of all three sites.

Table 2 Design basis option 1 and 3

Parameter		Waipawa + Otane 2028		Waipukurau 2028		Waipawa + Otane 2048		Waipukurau 2048	
		Average	Peak	Average	Peak	Average	Peak	Average	Peak
Flow (m^3/d)		1,343	15,447	2,630	12,402	1,392	16,010	2,785	13,134
TSS	mg/L	482	832	216	247	481	829	214	243
	kg/d	647	1,117	569	649	669	1,154	597	677
$cBOD_5$	mg/L	190	448	325	488	190	426	316	470
	kg/d	255	602	854	1,284	264	592	879	1,309
Total N	mg/L	46	68	51	76	47	64	50	73
	kg/d	62	91	135	200	65	89	139	204
Total P	mg/L	7	12	6	13	7	11	9	13
	kg/d	10	16	16	34	10	16	26	35

The estimated loads are based on loads measured to date, extrapolated out in accordance with growth projections provided by CHBDC1. The influent characterisation and trade waste measurements used to date are not ideal and currently raise significant risk around individual plant sizing due to loading uncertainty rather than due to flow uncertainty. Flows are understood more accurately.

To mitigate these concerns, further, flow weighted influent characterisation is being undertaken and rigour around trade waste monitoring is being increased.

[1] Central Hawke's Bay District Demographic and Economic Growth Directions, Economic Solutions Ltd, 2017

3 Alternatives Evaluated

3.1 Option 1: Treat Separately at Waipukurau and Discharge to Ford Road

Description

The first option, shown schematically in figure 1 below, is to build a new BNR WWTP, serving only Waipukurau, at Waipukurau for discharge at a Ford Rd

Figure 1: Option 1 - Separate treatment plants and discharge systems at Waipawa and Waipukurau

Table 3 Option 1 programme of works

Year	Activities
2020 - 2023	Interim, short term improvements at Waipawa, Otane and Waipukurau WWTPs
2020 - 2021	Otane WWTP to Waipawa WWTP pipeline and pump station New long term consent for discharge of combined Waipawa / Otane flows at Walker Rd
2020 - 2023	Pipeline and land application systems (RIBs) at Walker Road, discharge to Walker Rd RIBs
2023 - 2027	New high-rate BNR at Waipawa. Continued Waipukurau discharge to Tukituki River
2021 - 2024	Land application system – Ford Road, discharge to Ford Rd RIBs

Year	Activities
2027 - 2030	New high-rate BNR at Waipukurau. Discharge to Ford Rd RIBs

Table 4 Staging of Option 1

Stage	Year (Starting July)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Conveyance:											
1a	Otane WWTP to Waipawa WWTP. Pipeline and pump station											
1b	Waipawa WWTP to Walker Rd RIB. Pipeline and pump station.											
1c	Waipukurau WWTP to Ford Rd RIB. Pipeline and transfer pump station											
	Wastewater Treatment Plants:											
2b	Otane WWTP (minor improvements)											
2a	Waipawa WWTP											
2c	Waipukurau WWTP											
1d	Land Application Systems - Walker											
1d	Land Application Systems - Ford											

Assumptions made

- The conveyance route from Waipawa to Walker Road is Option A – this is a single pump station, 3.3km DN315 PE100 SDR13.6 rising main. The retention time of treated effluent is expected to be approximately 5 hours at 2018 ADWF, so odour management is not required.
- The conveyance route from Waipukurau to Ford Road is Option B2 – single pump station, 0.5km DN280 PE100 SDR13.6 rising main. Odour management is not required for this pipeline, as the retention time should be less than 1 hour at 2018 ADWF. This main will be trenched under the riverbed and laid in a heavy carrier pipe so that it is not subjected to river gravel scouring.
- Both Waipawa and Waipukurau BNR WWTPs will have the same process configuration. The intended configuration (refer Concept Design Report) is the IDEA (Intermittently decanted, extended aeration) which is a hybrid of the Sequenced Batch Reactor (a type of activated sludge plant) suitable for high levels of nitrogen removal.
- An inflow and infiltration reduction programme should be implemented at Waipukurau to mitigate the high wet weather flow peaking experienced there. Having said that, Waipukurau does appear to experience lower wet weather peaking than do the other two WWTPs.
- Some facility will be required to store or balance influent raw sewage in occasional circumstances. This can likely be established within part of the footprint of one of the existing ponds.
- A storage facility will be required to buffer treated effluent flows to the Ford Rd RIB site. This can likely be established within part of the footprint of one of the existing ponds.

3.2 Option 2: Convey to and treat at Waipawa

Description

The second option, shown schematically in figure 2 below, is to pump all raw sewage from Waipukurau for treatment at Waipawa and discharge at the Walker Rd RIB facility. A transfer pump Station and rising main built between Waipukurau and Waipawa

Figure 2: Option 2 - Combined treatment and discharge systems at Waipawa

Table 5 Programme of works for Option 2

Year	Activities
2020 - 2022	Short term improvements at Waipawa, Otane and Waipukurau WWTPs
2020 - 2021	Otane WWTP to Waipawa WWTP pipeline and pump station
2020 - 2023	Pipeline and land application systems at Walker Road – stage 1
2022 - 2026	New high-rate BNR established at Waipawa Continued Waipukurau discharge to Tukituki River
2025 - 2028	Transfer pump station and rising main Waipukurau to Waipawa
2025 - 2029	Deferred BNR capacity for Waipukurau, built at Waipawa
2027-2029	Land application systems at Walker Road – stage 2

Year	Activities
2029	Decommission Waipukurau

Table 6 Summary of staging for Option 2

Stage	Year (Starting July)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Conveyance:											
1a	Otane WWTP to Waipawa WWTP. Pipeline and pump station.											
1b	Waipawa WWTP to Walker Rd RIB. Pipeline and pump station.											
1c	Waipukurau WWTP to Waipawa WWTP. Pipeline and transfer pump station											
	Wastewater Treatment Plants:											
2b	Otane WWTP (minor improvements)											
2a	Waipawa WWTP											
2c	Waipawa WWTP (deferred works)											
1d	Waipukurau WWTP (decommissioning)											
1d	Land Application Systems - Walker Stg 1											
1d	Land Application Systems - Walker Stg 2											

Assumptions made

- Option C2 is preferred for conveyance from Waipukurau to Waipawa WWTP. That is a single pump station, 8km DN400 PE100 SDR13.6 pipeline via the river valley, crossing to the west of Walker Road to Waipawa WWTP.
- Odour management may be required as the dry weather HRT in the transfer main is likely to be in the order of 8 hours.
- The new Waipawa biological nutrient removal (BNR) WWTP will have been constructed some years earlier to cater for Waipawa and Otane flows and loads.
- Deferred works are likely to include screening capacity, a further IDEA reactor and decanter and additional UV disinfection capacity.
- The existing Waipukurau WWTP ponds will be decommissioned, sludge removed and reconfigured for wet weather flow buffering.
- An additional capital cost will be incurred in providing for the additional 2,630 m^3/day (average) of treatment at Waipawa. Depending on the accounting and assessment method used, the assigned cost could vary widely.
- A proportional additional amount of Rapid Infiltration system will need to be provided at Walker Rd for disposal of the additional 2,630 m^3/day (average), treated through Waipawa WWTP.
- Flows up to the 99th percentile will be treated/conveyed, with >99th percentile flow stored on each site. In this regard, wet weather influent buffer storage capacity will need to be configured and managed at Waipukurau. This can likely be established within the footprint of one of the existing ponds. This also means that provision will need to be made in the consents for the site for a contingency / calamity discharge (presumably through the current discharge line) should all storage facilities become exhausted.

- An inflow and infiltration reduction programme should be implemented at Waipukurau to mitigate the high wet weather flow peaking experienced there. Having said that, Waipukurau does appear to experience lower wet weather peaking than do the other two WWTPs.

3.3 Option 3: Treat at Waipawa, Otane and Waipukurau with Oxidation ponds

Description

The base case, for business case purposes, is to continue long term to treat wastewater in oxidation pond based systems but with moderate levels of upgrading to deal with contaminants that oxidation ponds and compatible tertiary processes are realistically able to manage. A schematic is provided in Figure 3.

In short, these minimum upgrades include: Removal of existing floating wetlands, install additional supplementary surface aeration, replace lamella clarifiers with dissolved air flotation (DAF), upgrade UV disinfection to provide higher dose rates.

Figure 3: Option 3 - Separate treatment plants, Otane and Waipawa discharges to Walker Road, Waipukurau discharge to Ford Road

This option is not expected to meet community or regional council expectations as it is unlikely to be able to remove nitrogen to sufficiently low levels. Neither is it likely to be upgraded significantly further to follow future discharge standards and national policy statements.

Table 7 Option 3 programme

Year	Activities
2020 - 2021	Otane WWTP to Waipawa WWTP pipeline and pump station
2020 - 2022	Otane WWTP minor improvements
2021 - 2024	Waipawa WWTP minor improvements
2021 - 2024	Waipukurau WWTP minor improvements
2020 - 2023	Pipeline and pump station to Walker Rd
2020 - 2023	Land application system – Walker Rd Stage 1, discharge to Walker Rd RIBs
2021 - 2024	Land application system – Walker Rd Stage 2
2021 - 2024	Pipeline and pump station to Ford Rd
2021 - 2024	Land application system – Ford Road, discharge to Ford Rd RIBs

Table 8 Staging of Option 3

Stage	Year (Starting July)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Conveyance:											
1a	Otane WWTP to Waipawa WWTP. Pipeline and pump station.											
1b	Waipawa WWTP to Walker Rd RIB. Pipeline and pump station.											
1c	Waipukurau WWTP to Ford Rd RIB. Pipeline and transfer pump station.											
	Wastewater Treatment Plants:											
2b	Otane WWTP (minor improvements)											
2a	Waipawa WWTP (minor improvements)											
2a	Waipukurau WWTP (minor improvements)											
1d	Land Application Systems - Walker Stg 1											
1d	Land Application Systems - Walker Stg 2											

Assumptions made

- Each of the existing pond systems will continue to operate.
- Otane to Waipawa and Waipawa to Walker Road follow the same conveyance routes as Option 1 and 2.
- Waipukurau to Ford Road follows the same conveyance route as Option 2.
- Waipawa and Waipukurau will probably replace the lamellas with dissolved air flotation (DAF) units, and the UV systems will be upgraded.
- If timing requires it, Otane will have new inlet screens, DAF and UV system. This is unlikely, although a short term effluent DAF treatment (using a leased DAF) is more probable. If timing allows, a preferred approach would be to convey pond treated effluent to Waipawa and put the flow from both plants through a single DAF and UV unit there.
- Peak flows >99th percentile are stored on each site for later treatment/conveyance.
- Provision for contingency discharge from each pond retained.

3.4 OPEX

To the extent possible, operating costs associated with each option have been included in the OPEX / NPV assessment. These include Operators, power, biosolids management, chemicals and maintenance.

It is reasonable to assume that there is no incremental operator input required for treating an additional 0.2MLD (Otane) in a WWTP with a combined throughput of 3.5MLD (all 3 towns). However, a standalone WWTP for Otane will have a significant OPEX labour input for travel, grounds work, cleaning, calibration, preventative maintenance, sampling, testing, QA programme, sludge management, consent management and general scheme management. The following are key OPEX parameters used in the assessment.

Table 9 Assumptions made for OPEX costs

Cost	Detail / Comment
Cost of power	$0.30/kW.hr
Cost of Operator	$141,000 per FTE per annum grossed up for salary plus overheads
Number of Operators	The assessed operator and staff input for the pipeline has been 1.5FTE operators, per plant, for individual treatment plants and 2.0FTE for a combined plant. These operator numbers would also be sufficient for normal day to day management of the RIB fields.
Maintenance	1.25% (of Civil CAPEX) was allowed for civils, 3% for mechanical and electrical
Contingency	OPEX contingency allowances have not been included at this time.

3.5 Net Present Value Assessment

A Present Value analysis has been undertaken so that both the initial CAPEX and long term total cost of ownership of each of the options can be considered. The NPV calculation uses the CAPEX and OPEX values estimated separately then adds them, taking into account the cost of borrowing and the 'time value' of money.

Table 10 Assumptions made for NPV calculations

Accounting Parameter	Detail / Comment
Cost of Capital	3.5%pa
Inflation allowance	2.5% pa
Evaluation period	30 years
NB: CHBDC have advised use of a lower cost of capital and higher annual inflation than used on previous NPV analysis	

4 Results

Table 11 summarises the outcome of the CAPEX, OPEX and NPV comparisons:

Table 11 Summary of CAPEX, OPEX and NPV for each of the options

Metric	Treat at Waipukurau & Waipawa - Option 1	Treat at Waipawa – Option 2	3 Separate Oxidation Ponds – Option 3
CAPEX – Most Likely	$54.6M	$50.8M	$29.6
CAPEX – P95	$62.6M	$58.4M	$34.9M
Annual OPEX & renewals*	$0.97M	$0.97M	$0.97M
30 year NPV	$105M	$96M	Not done

*Year 1 OPEX

Key differences between the two schemes are summarised in Table 12

Table 12 Key differences between the schemes

Metric	Treat at Waipawa	Treat at Waipawa & Waipukurau
Number of WWTPs	1	2
Conveyance	8 km	0.5 km
Discharge locations/RIB sites/discharge consents	1	2
CAPEX	-	+$4M
NPV	-	+$9M

5 Operational Considerations

Table 13 compares operational configurations, which do have cost implications, but which are worth highlighting and comparing separately.

Table 13 Comparison of operational aspects for each of the options

Issue	Option 1	Option 2	Option 3
Number of plants	2 WWTPs	1 centralised WWTP	3 Separate WWTPs.
Operators	1.5 FTE per site + RIB operation, so 4 FTE total Requires duplication of routine tasks Requires Diploma level training for at least 3 people because of the complexity of the processes	2 FTE = RIB operation, so 2.5 FTE total Only one set of routine maintenance tasks: calibration, lube, adjustment etc Diploma level training for at least 2 Technicians	0.5 FTE per site
Performance	Operator pride in sites. Two sites drive operator competition for results. Chances for optimisation & fine-tuning whereas with ponds, what you get is what you get.	Operator pride in the site Chances for optimisation & fine-tuning whereas with ponds, what you get is what you get.	What you see is what you get. DAFs would provide a benefit in terms of TSS, Organic N, disinfection and particulate BOD.
Consents	2 x Discharge to RIB consents 2 x extreme events consents 3 x contingency overflows	1 x Discharge to RIB consents 1 x extreme event consent 1 contingency overflow	2 Discharge to RIB consents 2 x extreme events consents 3 x extreme events consents
Monitoring & Lab	Duplicated Operational and Consents monitoring, analysis and reporting	Operational and Consents monitoring, analysis and reporting	Duplicated Consents monitoring, analysis and reporting
Odour	Ongoing odour risk at Waipukurau. Risk of actual offensive odour is not high for an IDEA plant but the high percentage of trade waste will heighten the risk. Risk should be lower than for option 3.	Centralising at Waipawa, out in the countryside will minimise the risk of odour complaints.	Ongoing odour risk at Waipukurau and Otane. This option presents the highest risk of ongoing odour complaints, particularly as both loading and immediately adjacent development increase.
HAZCHEM	2 Facilities + Otane conveyance odour dosing	1 Facility + Otane conveyance odour dosing	2 facilities required

Issue	Option 1	Option 2	Option 3
Biosolids	Equal production with Option 2. But two dewatering and load-out facilities required.	Equal production with Option 1. But one dewatering and load-out facility required.	Long term build-up of sludge in ponds resulting in very expensive desludging programme every 15 years or so.
Seasonal Issues	Pond seasonal issues largely eliminated. E.g massive algal blooms	Pond seasonal issues largely eliminated. E.g massive algal blooms	Seasonal issues remain
Sites	Ease of maintenance of smaller operational sites Control of vectors is simplified vs ponds	Lowest overall site maintenance requirement Control of vectors is simplified vs ponds and two sites Potential to release the majority of Waipukurau site area for other council purposes / activities	Still have to maintain two large and one small operational pond sites
Resilience	A major plant/process failure at one site will have a lower pollution potential that failure of a single combined site	A major plant/process failure at the treatment plant will have a greater pollution potential (than Option 1). However, with less components and fewer operators than a two plant scheme, the probability of a major failure is reduced. With a larger mass of domestic wastewater, the single plant will be better (than Option 1) buffered against potential toxic shock from trade waste dischargers.	Likelihood of long term, chronic consent contravention is greater than for the other two options.

6 Summary and Recommendations

Three core options have been considered for the future treatment and disposal of wastewater at and from Waipukurau. These include:

- Continuing at the site but with improved tertiary treatment,
- Continuing at the site but in a new, high rate activated sludge plant (IDEA) that is capable of removing nitrogen to relatively low levels, and
- Conveying raw wastewater to Waipawa to be treated and discharged there together with wastewater from Otane and Waipawa.

Waipukurau treated effluent from the first two options would likely be discharged via rapid infiltration beds at Ford Rd on the north side of the river. Treated effluent from the third option would be discharged in rapid infiltration beds at Walker Rd, Waipawa.

Of the two activated sludge-based options, Option 2, which includes a centralised treatment and disposal system at Waipawa, has been assessed to be the most attractive on a capital cost basis and on a 30-year NPV basis. The most likely (P50) and P95 capital cost estimates are $51M and $58M respectively and the 30-year NPV is $96M. These reflect $4M and $9M favourable benefits over Option 1. Section 4 provides more detail of the costs and further detail again is presented in the Concept Design Report (Beca 2020).

Although it would not meet the requirements of the regional council or the aspirations of the communities, Option 3 has been included to demonstrate the likely 'do minimum' costs in relation to Options 1 and 2.

Option 2 is preferred. It is recommended the Option 2 scheme is developed for conveyance of raw wastewater from Waipukurau to Waipawa for treatment and disposal and reuse. It is recommended that the option is progressed forward for the purposes of:

- Funding approval.
- Confirmation of the consenting strategy and progressing with preparation of consent applications and supporting documentation.
- Firming up the strategy for asset development, procurement and installation (e.g staging) for the new facilities.
- Obtaining route surety, easements etc for the conveyance pipeline between Waipukurau and Waipawa

It is unlikely that sufficient funding is or will become available, in the short term, to undertake this considerable change to the management of Waipukurau wastewater. It is likely that:

- Interim consent renewals or amendments will be required for continued operation (say 7 to 10 years) of the pond based system at Waipukurau and for continued discharge to the Tukituki River system.
- Some interim upgrades are likely to be required to the Waipukurau WWTP to, within reason, improve performance prior to the change. For example, the following could be considered: installation of DAF, additional supplementary aeration, additional UV capacity.

Yours sincerely

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on behalf of

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