STABILITY AND SUSTAINABILITY: OPTIONS ASSESSMENT FOR WELLINGTON'S SLUDGE MINIMISATION FACILITY

Steve Hutchison (Wellington Water Ltd) and Leah Agustin (Beca Ltd)

ABSTRACT

Unstabilised sludge from Wellington City's main wastewater treatment plants (WWTPs) is currently dewatered by centrifuge and disposed of in Wellington City's Southern Landfill, where it is mixed with general waste material. The resource consent for the Landfill requires a mixing ratio for the sludge that places limitations on Wellington City's overall waste minimisation and carbon reduction targets and is currently very close to consent limits. A fundamental change to the city's current sludge management approach is therefore required – to support the sustainability aspirations and to enable the city to grow at its projected pace.

This paper presents the option assessment undertaken for the site and process permutations for the proposed Sludge Minimisation Facility (SMF). It compares the options in terms of associated end-product volumes and re-use potential, alignment with mana whenua values, complexity, environmental impacts, and whole-of-life cost. The preferred option was the establishment of a Thermal Hydrolysis, mesophilic anaerobic digestion and Thermal Drying facility at Moa Point.

This process of developing a preferred option for Wellington's future sludge management involved collaborative participation from several key stakeholders, including Ngati Toa, Taranaki Whānui, Wellington International Airport Limited (WIAL) and Southern Landfill management team. There has been unanimous support for options which substantially reduce waste to landfill and enable the path to future resource recovery.

KEYWORDS

Sludge management, waste minimisation, stakeholder engagement

PRESENTER PROFILE

Steve Hutchison is a chartered professional environmental engineer. He has a background in consulting engineering and is currently the Wastewater Chief Advisor at Wellington Water where he has been working for the past six years. Steve has an interest in all areas of wastewater engineering, particularly including treatment plant development, network planning, resource consents and has been the Wellington Water sponsor for the project described in this paper.

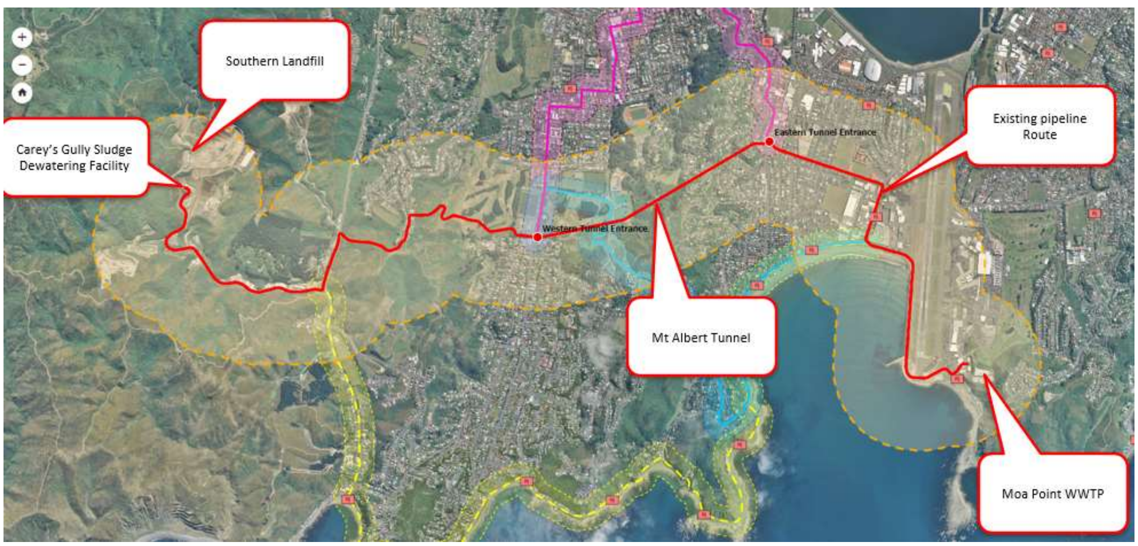
Leah Agustin is a Process Engineer with 2+ years' consultancy experience at Beca. She is particularly interested in exploring sustainability opportunities in wastewater treatment and biosolids management. She hopes to further develop her knowledge and expertise, particularly in the assessment of environmental impacts from treatment processes and the incorporation of indigenous knowledge and values in water, wastewater and biosolids management.

1 INTRODUCTION

Sewage sludge is produced as a by-product from Wellington city's two WWTPs – Moa Point and Western WWTPs. These plants are managed by Wellington Water Limited (WWL) on behalf of Wellington City Council (WCC).

Primary and waste activated sludge from the Moa Point WWTP is currently pumped through an 8.8km pipeline and dewatered by centrifuge at the Carey's Gulley Sludge Dewatering Plant (SDP) north of Ōwhiro Bay. This sludge network is outlined in Figure 1. While there are two pipelines in duty / standby configuration these both failed in January 2020 and the resultant repair was a major effort with significant cost and publicity as transporting the 1.1 million litres of sludge a day required 120 tanker loads.

Figure 1: Overview of key Wellington sludge management infrastructure, including Moa Point WWTP, Carey's Gully SDP and sludge transfer pipeline



The Western WWTP dewaters waste activated sludge by centrifuge on-site and subsequently trucks dewatered sludge to Southern landfill. This sludge from the Western WWTP is notably of smaller portion, accounting for only 4% of the total sludge production from the Wellington city WWTPs.

Originally there was a composting plant located at the Southern Landfill site that received the dewatered sludge and mixed with green waste to produce a high-quality compost. Unfortunately, that did not prove to be sustainable due to difficulties in establishing sufficient market and was decommissioned in 2008. Since then, the unstabilised dewatered sludge at approximately 25% dry solids from Moa Point and approximately 20% from Western is co-disposed in the Southern Landfill, where it is mixed with general waste. The resource consent for the Southern Landfill requires a mixing ratio of four parts general waste or bulking material for each part of sludge disposed to landfill. Due to the volatile nature of unstabilised dewatered sludge, this ratio is required to achieve suitable waste cohesion and compaction; to maintain landfill geotechnical stability and odour management.

This landfill mixing requirement places limitations on Wellington City's overall waste minimisation (WWMP, 2017) and emissions reduction targets (WCC, 2020). At the current rate of waste disposal, the existing landfill stage is expected to reach capacity around 2025. Moreover, recent failures in sludge network assets and on-going odour complaints have also highlighted key resiliency issues around existing operations.

To support the city's sustainability aspirations and accommodate the projected population growth, a fundamental change to the existing sludge operations must take place. In response to this need, WCC asked WWL to develop a SMF to enable a significant volume reduction in sludge output and de-couple the wastewater treatment and waste management inter-dependency. By reducing the amount and composition of wastewater by-product this, WCC can implement waste minimisation initiatives which reduce the amount of solid waste sent to Southern Landfill. This in turn will reduce GHG emissions from Southern Landfill, one of WCC's major emission sources.

This paper presents the option assessment undertaken for the 16 site and process options for the proposed SMF.

2 BACKGROUND CONTEXT

2.1 WELLINGTON CITY'S JOURNEY TO WASTE MINIMISATION AND ACHIEVING NET ZERO EMISSIONS

WCC has made a commitment towards greatly reducing the amount of waste sent to Southern landfill by 2026 and achieving net zero emissions by 2050. These commitments are recorded in two key planning documentation.

1. **The Wellington Region Waste Management and Minimisation Plan** was established in 2017 as part of the Wellington region joint councils' collective vision of working together to become waste free (WWMP, 2017). The WMMP sets out a course of action for the next 10 years, with a primary regional target detailed in the WMMP is *"a reduction in the total quantity of waste sent to Class 1 landfills from 600kg per person per annum to 400 kg per person by 2026".* Due to the 4:1 mixing ratio requirements at Southern Landfill, sludge management operations currently inhibit this waste minimisation aspiration. A significant reduction in sludge outputs to landfill is therefore required achieve this 30% reduction in waste to Class 1 landfill by 2026, while adhering to existing consent conditions.

2. **The Te Atakura - First to Zero Strategy** commits Wellington City to being a zero-carbon capital by 2050 (WCC, 2020). The Waste sector is reported to comprise a smaller portion of Wellington City's overall carbon emissions at 8% (AECOM, 2020). With landfill gas capture in place at the Southern Landfill, solid waste disposal is reported to emit 72,437 tonnes CO2 equivalent (tCO_2-e) in the year 2020 alone. However, as outlined in Figure 3, 80% of WCC's corporate emissions are attributed to landfill operations.

Therefore, reaching zero carbon requires a fundamental change in solid waste management, and consequently, sludge management.

Figure 2: Wellington City's GHG gross emissions split by sector in tCO2-e (AECOM, 2020)

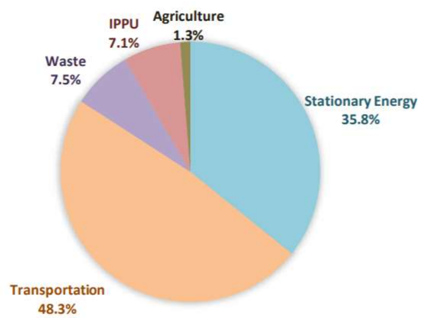
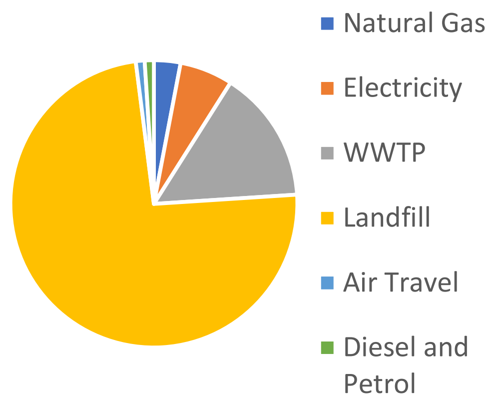


Figure 3: Overview of WCC's corporate emissions



2.2 KEY ISSUES WITH EXISTING OPERATIONS

In addition to being a key inhibitor to Wellington city's waste minimisation and net zero aspirations, the existing sludge dewatering operations presents several key challenges.

1. **Insufficient consented landfill capacity** – The resource consent for the Stage 3 Southern Landfill is expiring in April 2026; however, the existing landfill area is anticipated to be at full capacity by 2025 (WCC, 2021).

2. **Sludge transfer pipeline failure** – The existing twin sludge transfer pipelines, outlined in Figure 1, are a single point of failure for the sludge management system. The 2020 Mt Albert tunnel pipeline failure highlighted the vulnerability of the existing sludge management system. The repair works and associated temporary tanker trucking operation were major. This resulted in immense environmental, economic, and reputational damage to Wellington city (George, 2020).

3. **Odour management issues** – The existing Southern Landfill site has been subject to numerous odour complaints and requires careful ongoing operation. Odour complaints were particularly numerous during the compost plant operation between around 1999 and 2008.

4. **Sludge disposal costs –** Central government policy to increase the waste levy along with increasing Emission Trading Scheme costs on landfills will result in sludge disposal being increasingly expensive (MfE, 2020).

3 PATHWAY TOWARDS THE SOLUTION

3.1 PROJECT OBJECTIVES

To provide direction on the selection of the proposed SMF, four key project objectives were defined:

1. The volume of sludge sent to landfill is substantially reduced; to reduce landfill operational constraints in the short term, and to enable Wellington city to pursue its waste minimisation aspirations in the long term.

2. The resilience of sludge management in Wellington is secured

3. The sludge management system is safe to construct, operate and maintain.

4. The whole of life cost (TOTEX) of sludge management is minimised across the wastewater network.

Optioneering involved collaborative efforts from key project team members consisting of Wellington Water, Connect Water (CH2M Beca), Veolia (PTAG) and Latitude. Additional specialist support has also been provided by Dentons Kensington Swan, Alta Consulting, BondCM and Align.

3.2 OPTIONEERING FRAMEWORK OVERVIEW

The optioneering framework for the identification of the preferred SMF option is set out in Figure 4. This framework has been set out to ensure stakeholders were involved in the project journey to collectively work towards achieving the preferred solution.

As outlined, two optioneering workstreams were undertaken in parallel to identify process and site options shortlists. These shortlists were consolidated for further assessment in a multi-criteria assessment (MCA) workshop with key stakeholders.

Figure 4: Optioneering framework overview

3.3 SITE OPTIONS ASSESSMENT

Site options shortlisting followed a three-staged approach, as outlined below.

Stage 1: A desktop study was undertaken to identify an initial list of potential sites using a range of criteria, including site size and shape, access for heavy vehicles, likely noise and odour impacts on neighbours, ability to access utilities, topography and land use designation. This search focused on sites across the southern areas of Wellington. This identified groups of sites in two general areas – around the Moa Point WWTP site (Group A) and at Carey's Gully SDP (Group B).

Stage 2: Further technical analysis was then undertaken to understand site constraints to inform refined site selection. This involved a sludge transfer pipeline options analysis for Group B sites, given the expected lifespan of the pipelines is within the design horizon of the new SMF (Connect Water, 2020). During this stage, Wellington International Airport (WIAL) and Southern Landfill Management were engaged to identify key operational constraints that could be impacted by site selection. Outcomes from the discussions enabled specific locations to be pinpointed around Group A and B sites.

Stage 3: The site options were combined with shortlisted process options for multi-criteria assessment.

3.4 PROCESS OPTIONS SHORTLIST ASSESSMENT

Process options shortlisting followed a three-staged approach, as outlined below.

Stage 1: An initial long list of 25 options was developed based on a desktop study which considered a wide range of commonly available and emerging technologies across four sludge management process technology categories. An overview of potential sludge management pathways from these four categories is provided in Figure 5.

1. **Concentration Processes** – Reducing sludge volume, generally by removing water from the sludge

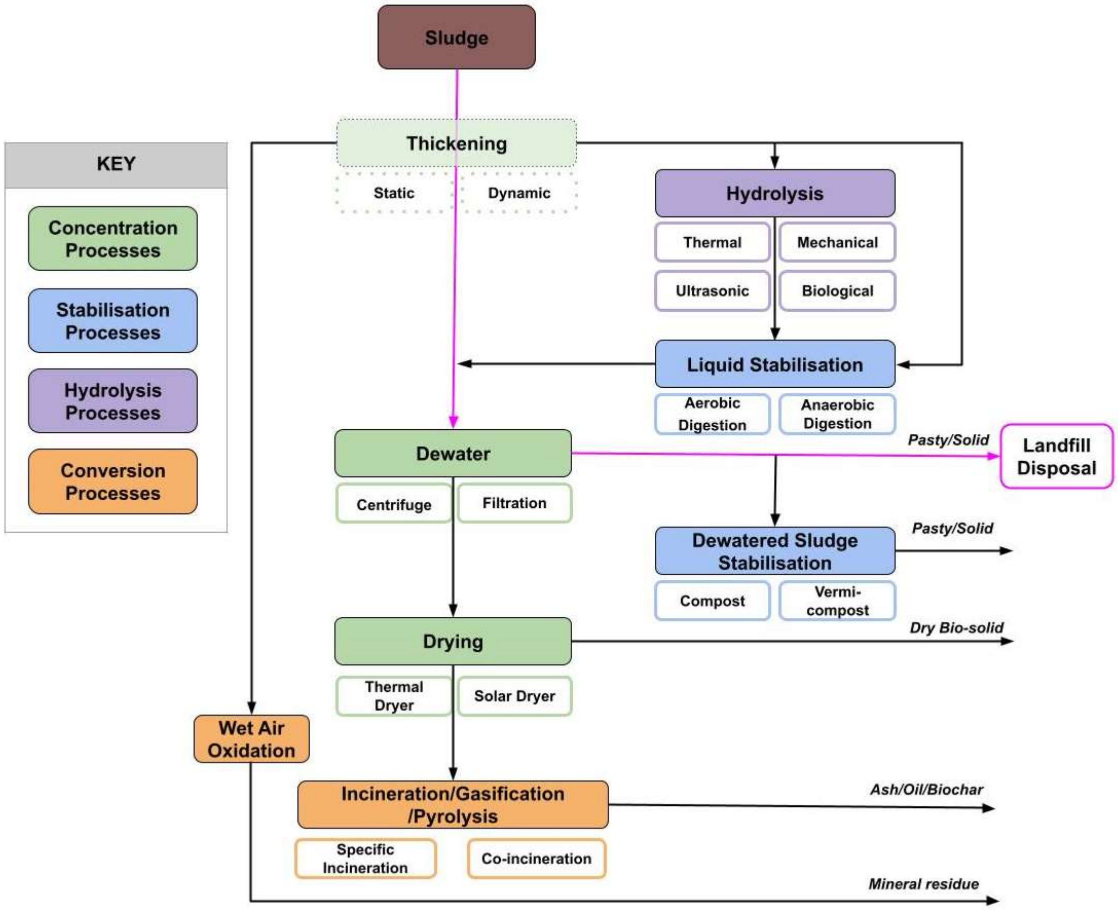
2. **Stabilisation Processes** – Stopping or stabilising biological activity, which can reduce odour emissions from further handling / disposal. By-products from stabilisation processes include biogas, which can be beneficially used as a fuel source for on-site boilers of combined heat and power (CHP) units.

3. **Hydrolysis Processes** – Treatment to support the enhanced recovery of energy or nutrients, or aid sludge reduction

4. **Conversion Processes** – Conversion of the sludge into other forms for beneficial re-use

Following this longlist identification, a workshop was held iwi representatives from Ngati Toa and Taranaki Whānui to provide background context to the Sludge Minimisation project and present the longlist of potential process options.

Figure 5: Overview of sludge management pathways



Stage 2: A fatal flaw (traffic light) analysis was undertaken to identify non-favourable long list options and identify a short list. This assessment included three key criteria:

1. **Maturity of the technology** – If the technology is not mature / well established, it would not provide for a resilient sludge management solution for Wellington. This includes technologies only available from a single global supplier that has not established in New Zealand.

2. **Dry solid content (%DS) of end-product -** High dry solids content represents a significant reduction in volume of sludge. In addition, the Wellington sludge exhibits viscoplastic behaviour at a dry solids content between 40% and 60%, making it harder to mix into other waste. This behaviour within the 40-60 %DS range is exhibited during operations in the Seaview WWTP. Thus, processes which produce an end-product greater than 60%DS is preferred.

3. **Total plant footprint -** Only processes that are able to fit within available site footprints should be considered. The estimated maximum land available is 15,000 m^2.

In addition to the above technical fatal flaw analysis, workshops were held iwi representatives from Ngati Toa and Taranaki Whānui to understand cultural concerns with sludge management that may influence process selection.

Stage 3: Following the completion of process shortlisting, a consolidated shortlist of 16 site and process option combinations, as outlined in Table 1, were taken forward to the multi-criteria assessment (MCA).

Table 1: Shortlist of site and process options

Group A: Moa Point Site	Group B: Carey's Gully Site
Thermal Dryer (TD) Only	TD only
Mesophilic Anaerobic Digestion (MAD) + TD	MAD + TD
Lysis-Digestion (LD) + TD	DLD + TD
Digestion-Lysis-Digestion (DLD) + TD	MAD + Composting
TD + Gasification	TD + Gasification
Incineration	Incineration
Wet Air Oxidation (WAO)	WAO
Autothermal Anaerobic Digestion (ATAD) + TD	ATAD + TD

3.5 MULTI-CRITERIA ASSESSMENT FOR PREFERRED OPTION

The MCA workshop was held in July 2020 to determine the preferred option for the SMF. The basis of the MCA was collaboratively developed by the project team, WCC and iwi stakeholders. Each MCA participant was requested to rank each criterion from (1 = least / less important, 5 = most / very important) and provide any additional feedback on the interpretation of each criterion. This confirmed the definition and scoring basis of the assessment criteria outlined in Table 2.

It is noted that there was a high level of consistency in how important the criteria were to each workshop participant, with only a couple of significantly different views. These nuances are incorporated in the alternative weightings for the MCA outlined in Table 2.

3.5.1 DESIGN BASIS FOR ASSESSMENTS

Prior to the MCA workshop, the core project team facilitated a workshop to confirm the definition and scoring basis of each assessment criterion.

The quantitative assessments detailed in the subsequent sections are based on a 50-year design horizon between 2023 to 2073 (.id Community, 2020). Based on an assessment of existing data, the 2073 design is expected to serve a population size of 248,548. With this population growth, the estimated peak week sludge flow is 147 tonnes dry solids (tDS) / week or 17,544 m^3/week (as ~1% DS raw sludge).

It is important to note that while initial qualitative and quantitative assessments have been done by the technical design team ahead of the workshop, the overall scoring is reflective of feedback from key workshop participants. MCA scoring ranged from 1 to 10 (1 = lowest / least favourable to 10 = highest / most favourable).

The presented alternative weightings are as follows:

- Alternative Weighting 1 - for sensitivity analysis, weighted towards core project objectives and comments from participants
- Alternative Weighting 2 - for sensitivity analysis, 100% towards core project objectives.
- Alternative Weighting 3 - for sensitivity analysis, Environmental and Mana Whenua Values at 100%.
- Alternative Weighting 4 - for sensitivity analysis, Environmental and Mana Whenua Values at 60%.

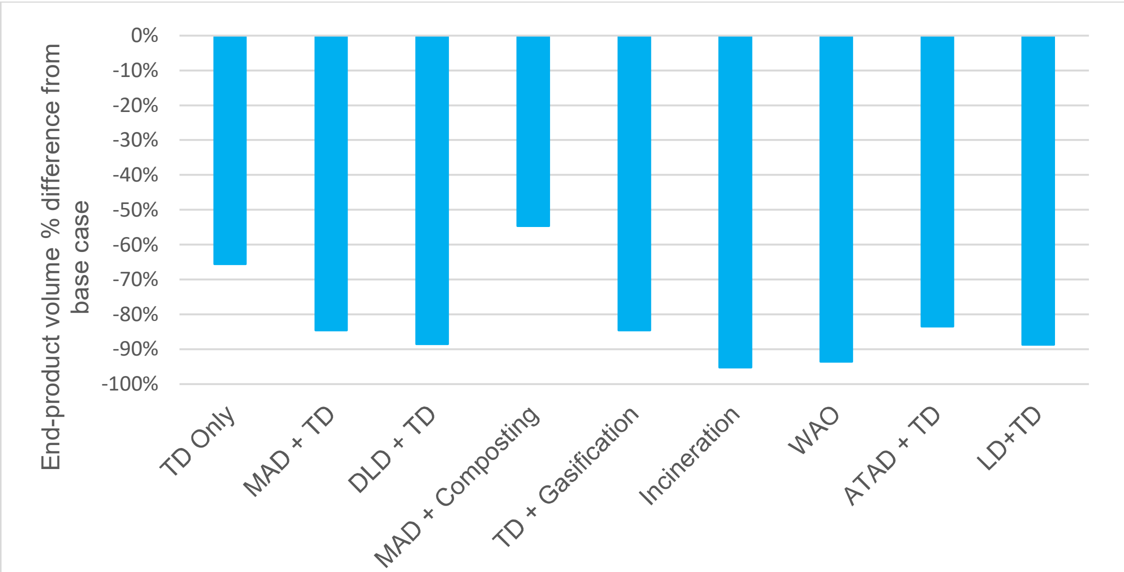
Table 2: Overview of MCA criteria for determining preferred option

Criteria	Description	Baseline Weighting	Alternative Weighting 1	Alternative Weighting 2	Alternative Weighting 3	Alternative Weighting 4
Sludge Minimisation and Re-use Potential	The degree to which the solution reduces the mass of sludge going to landfill and enables a pathway to future beneficial re-use	21%	35%	33%	0%	20%
Mana whenua values	The degree to which the solution meets mana whenua values / principles relevant to this project.	20%	20%	0%	50%	25%
Operational & Technological Complexity	The degree of complexity of the solution, including operability, engineering complexity, and technological risk.	21%	5%	33%	0%	10%
Environmental Impacts	Environmental impacts, in terms of GHG emissions, social impacts, ecological effects, and degree of difficulty in obtaining consent	17%	20%	0%	50%	35%
Whole of life cost	Relative total capital and operating cost for the project, and ability to stage project.	21%	20%	33%	0%	10%

3.5.2 CRITERIA 1: SLUDGE MINIMISATION AND RE-USE POTENTIAL

Scoring for this sub criterion has been based on the sludge mass reduction in comparison to the base case dewatering operation. This scoring is irrespective of the site options. Calculations are based on simulation outputs from the Veolia OCEAN Software.

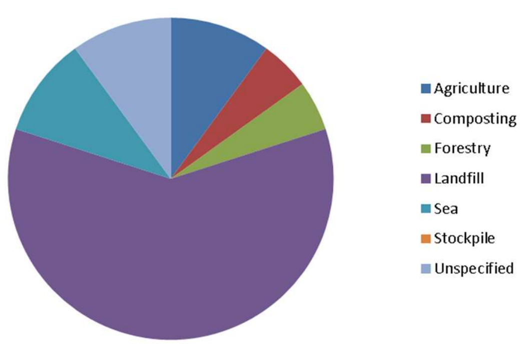
Figure 6: End-product volume, comparison against existing dewatering options



It is important to note that biosolids re-use in New Zealand is not common. As outlined in Figure 7, landfill disposal remains the most prominent biosolids end-use. The more successful examples of successful biosolids re-use are related to agricultural application. This, however, is not applicable for cities such as Wellington, with very minimal agricultural market.

The basis of scoring for this re-use potential has instead been based on residual volatile solids (%VS) in the end-product. This %VS serves as a proxy for the end-product's performance against the Biosolids Guidelines stabilisation ratings (NZWWA, 2003). A lower %VS indicates a more stabilised sludge which can be beneficially utilised once the market has been established. %VS outputs are comparable to the end-product volume results.

Figure 7: Biosolids end-use in New Zealand (CH2M Hill 2015)



Once the SMF is successfully commissioned, we hope to shift the focus of the end-product from a ‘compliance focus’ against Biosolids Guidelines, to a ‘product development focus’ for beneficial re-use (Tinholt, 2021). However, for the purposes of this stage of the project a conservative end disposal route of landfill has been assumed, with opportunity to develop re-use to follow later.

3.5.3 CRITERIA 2: MANA WHENUA VALUES

The following mana whenua values / principles considered in this project include:

- Use of processes that align to traditional Māori values and methods of human waste management.
- Ability to harness and use the resources for the sludge to give them another life.
- Embodiment of kaitiakitanga, through having a positive impact on the environment and our communities
- Potential impacts on areas of settlement (marae, papakainga), use (food gathering areas), wāhi tapu, statutory acknowledgements and sites of significance.

Mana whenua values are strongly correlated to environmental impacts, with great consideration towards the overall health and wellbeing of our surrounding environment. Process options which have a great potential to emit harmful by-products to the atmosphere, such as incineration, are scored the lowest. Conversely, process options such as digestion, which mimic traditional methods of human waste management and emit least harmful substances, are scored the highest.

Key resiliency issues, such as the sludge transfer pipeline failure, has also been a key consideration, when considering the principle of kaitiakitanga. Carey’s Gully options, which require the operation of the sludge transfer pipeline, are therefore scored lower due to the culturally and environmentally abhorrent consequences of untreated sludge flows to sea, and contingency raw sludge trucking as a result of pipeline failure.

3.5.4 CRITERIA 3: OPERATIONAL & TECHNOLOGICAL COMPLEXITY

This sub-criterion is based on the complexity of the process option throughout its life cycle, i.e. from complexity in design and construction, to complexity in operations and maintenance. More complex process, less familiar process technologies such as WAO are scored the least.

3.5.5 CRITERIA 4: ENVIRONMENTAL IMPACTS

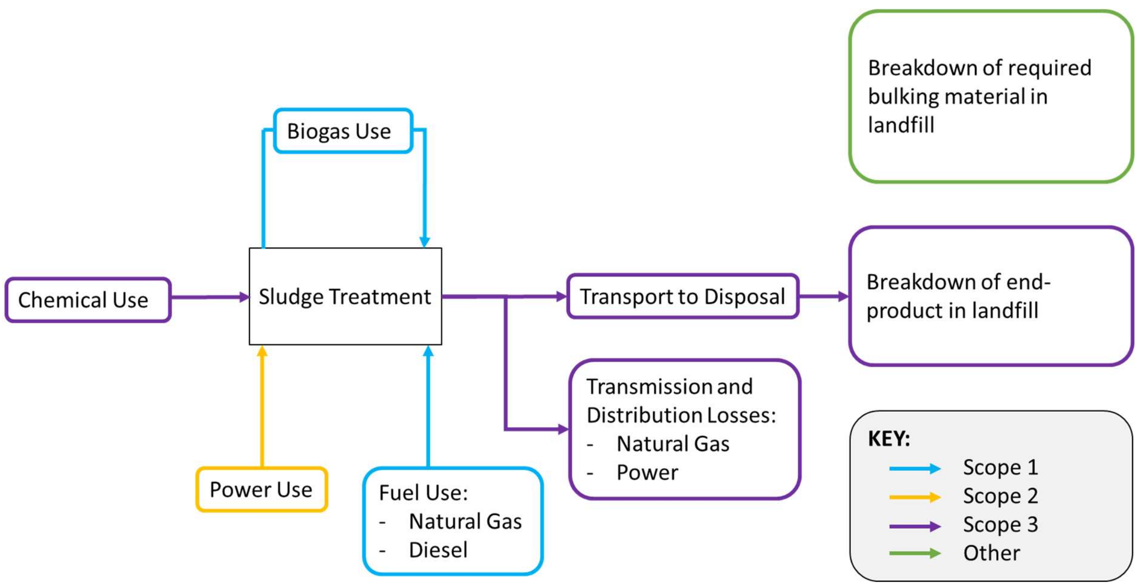
Environmental impacts have been assessed against several parameters for the MCA. The focus of this section is the quantitative assessment of operational GHG emissions.

GHGs included in this assessment are nitrous oxide (N_2O) Methane (CH_4) and non-biogenic Carbon Dioxide (CO_2), converted and expressed as ‘tonnes of carbon dioxide equivalent’ (tCO_2-e). Biogenic CO_2 emissions have been discounted from international GHG accounting inventories as they do not represent transfer of carbon from the lithosphere to atmosphere. Assessment of the operational GHG emissions utilised key guidelines from the Ministry for the Environment (MfE, 2020) and the Intergovernmental Panel on Climate Change (IPCC, 2019).

An overview of the operational GHG assessment boundary is provided in Figure 8. This model has been developed in accordance with the ISO 14064-1:2018 standard. According to the ISO standard, Scope 1 emissions (biogas, fuel use) are emissions owned or controlled by the SMF operations. Scope 2 emissions (power use) are indirect emissions from imported / purchased energy. Scope 3 emissions (transport, chemical use, transmission and distribution losses, breakdown of end-product in landfill) are indirect emissions that occur in the value chain of the SMF.

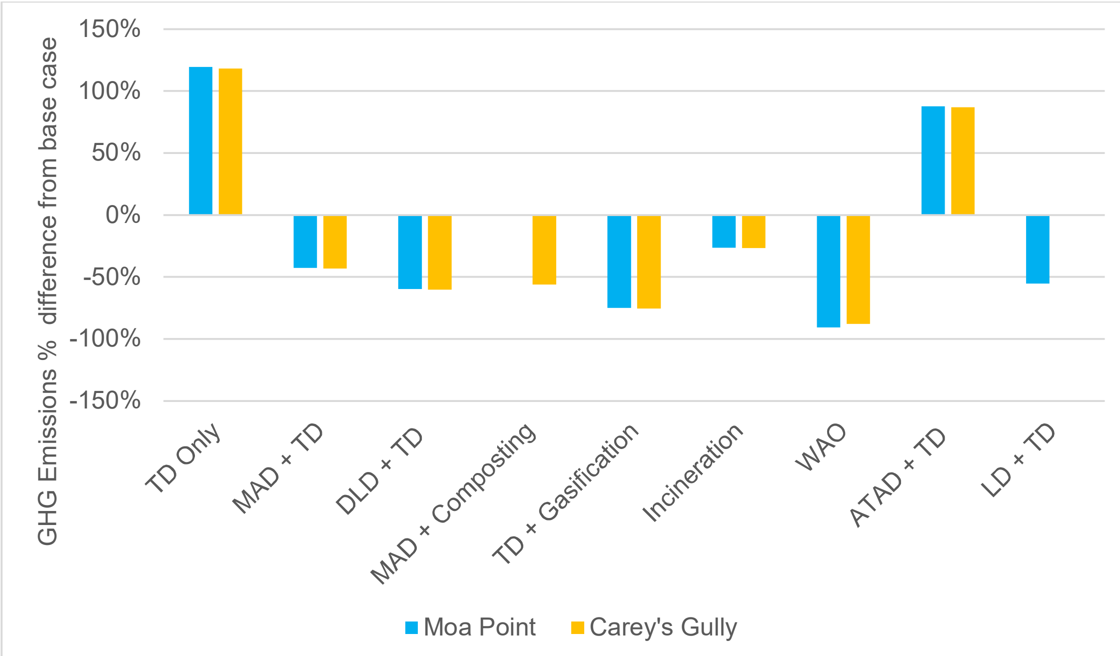
Global warming potential (GWP) of the GHGs are based on a 100-year time horizon (IPCC, 2007). Emission factors (EFs) established for the operational GHG estimation of each emission source have been sourced from inventories published by MfE (MfE, 2020) and Infrastructure Sustainability Council of Australia (ISCA, 2017).

Figure 8: Operational carbon assessment reporting boundary



When assessing the options against the existing dewatering operations, all shortlisted options, with the exception of TD only and ATAD+TD, provide an improvement in overall operational emissions (refer Figure 9). A substantial portion of the operational emissions are attributed to Scope 3 emissions, particularly the breakdown of end-product in landfill.

Figure 9: Operational GHG emissions, comparison against existing dewatering options



While the operational GHG emissions form a crucial part of assessment of environmental impacts, additional qualitative measures have also been taken into consideration during the MCA scoring. These include social, ecological, and landscape and visual impacts.

3.5.6 CRITERIA 5: COST

Two key sub criteria were considered for the cost criteria. These were:

1. The whole of life costs (TOTEX) of the options.

2. Ability to stage the project to minimise financial burden. This was a binary scoring system of 1 to 10 (1 = unable and 10 = able)

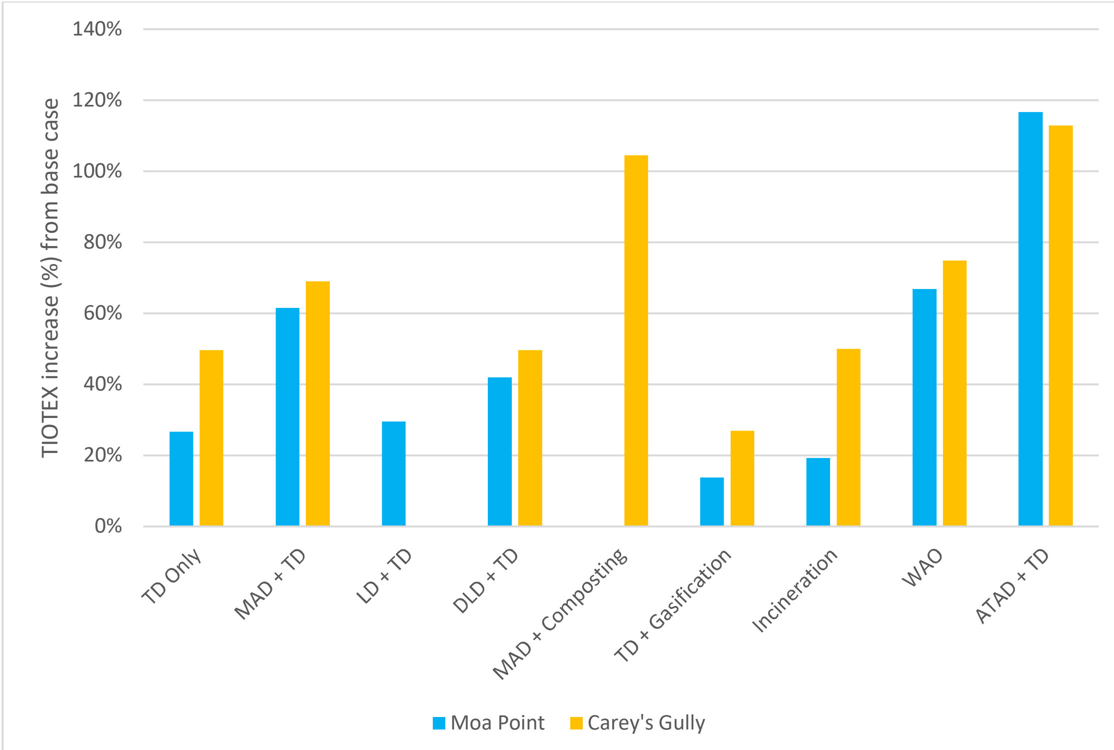
A net-present value (NPV) analysis was undertaken to determine the (TOTEX) of the options. Specifically, the TOTEX accounted for:

- **Capital cost estimates**, which included high level estimates for the physical plant, buildings, other structures and civil works, to which percentages for contractor margins, professional services and contingencies have been applied. The capital cost estimates also include high level estimates for land acquisition.

- **Operating cost estimates**, which included high level estimates of energy use, chemical use, labour costs, sludge transportation and disposal costs, and maintenance costs of the assets. These are based on high level modelling of each option.

The estimated TOTEX increase from existing dewatering operations are outlined in Figure 10

Figure 10 TOTEX, comparison against existing dewatering operations



3.5.7 MCA RESULTS

Based on the MCA workshop discussions, the highest scoring option taken forward for concept design is the Moa Point DLD + TD option. Figure 11 provides a summary of the overall weighted scoring against the five criteria, based on the baseline weighting agreed with the workshop participants. Sensitivity analysis on the top three options are provided in Figure 12.

Figure 11: Summary of MCA results based on baseline weighting

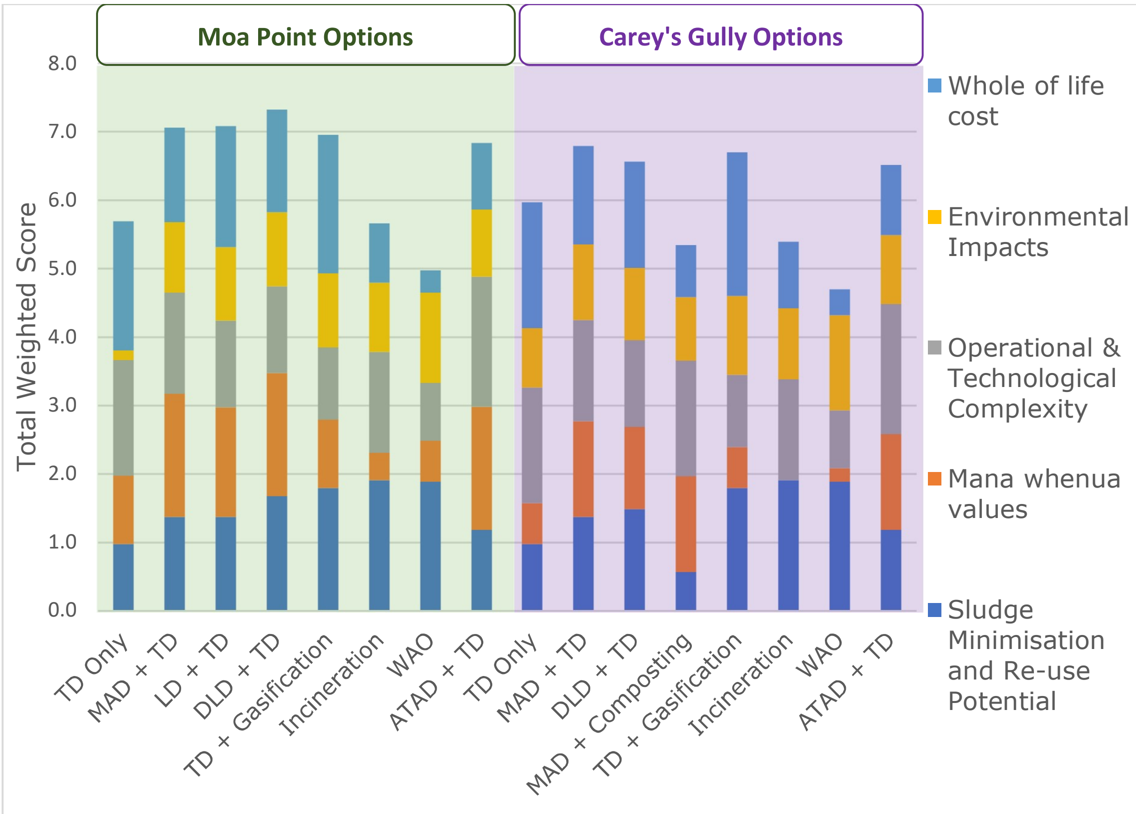
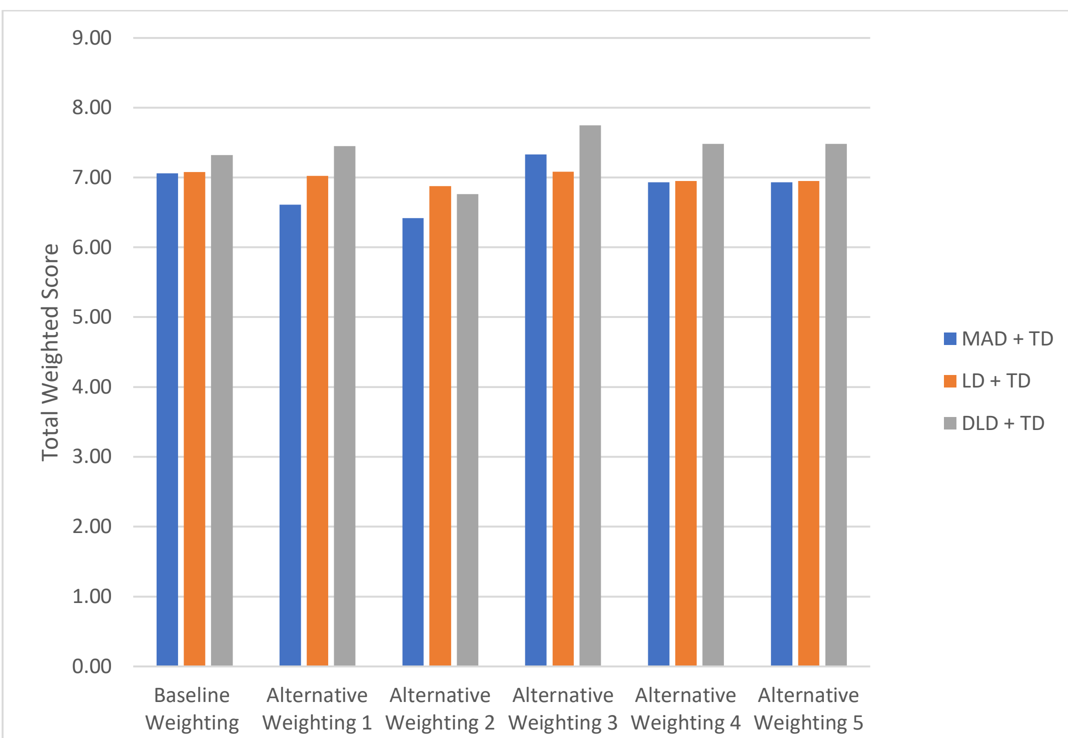


Figure 12: Sensitivity analysis on top three options from baseline weighting



3.5.8 FURTHER CONCEPT WORK POST-MCA

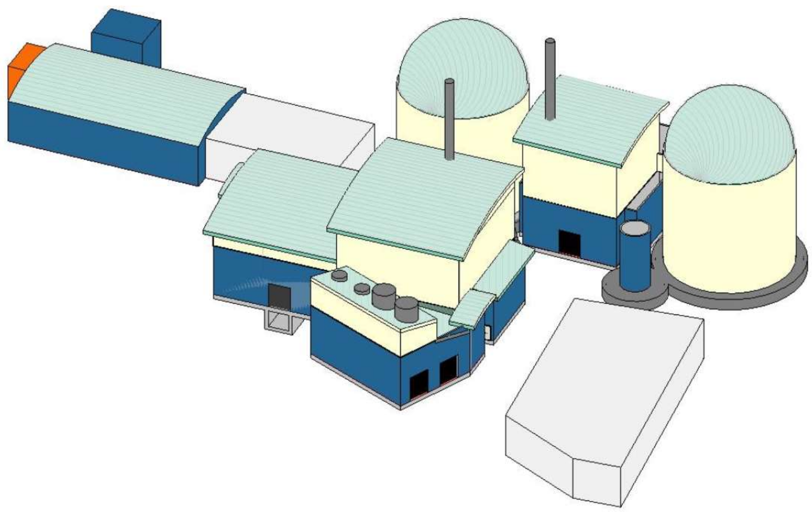
Following the MCA assessment, further investigation and development was undertaken on this option. It was identified that this option could be refined and optimised without significantly impacting the key outcomes achieved by this option, especially the nature and amount of sludge. The refined option is to install LD + TD, which removes the first digester stage in the process. This was identified because:

- The size of the plant required for Wellington is close to the crossover point at where DLD becomes financially viable, and therefore either process option would be feasible.
- It alleviates some major site constraints, in particular, not requiring the additional digester stage avoids having to relocate a medical supply facility of national significance adjacent to the proposed site (Anon, 2009).

4 PROPOSED SOLUTION: LYSIS-DIGESTION AND THERMAL DRYING FACILITY

The proposed solution is a LD + TD facility to be located adjacent to Moa Point WWTP. This solution has been presented to the Moa Point residents, and subsequently, has formed a key part of WCC's Long Term Plan for 2024-2034. A concept view for the proposed SMF is shown below.

Figure 13: Concept level model for proposed LD + TD Facility



From the process schematic in Figure 14, three key components majorly contribute to the overall stability and volume reduction of the plant. These are outlined below.

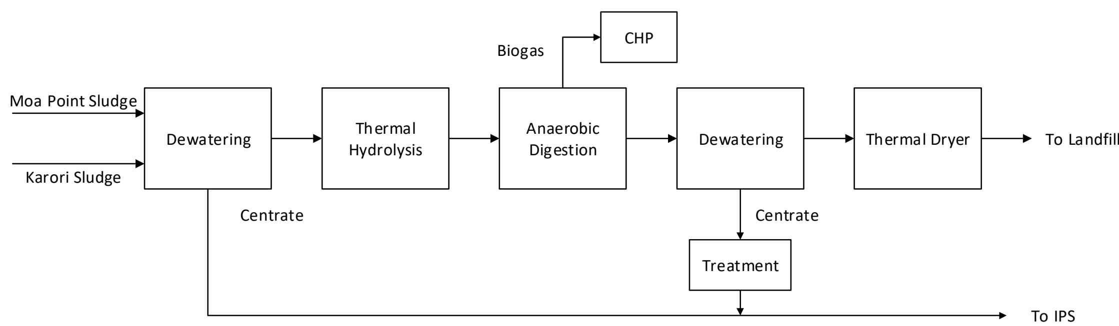
1. **Thermal hydrolysis process (THP)-** THP essentially 'pressure cooks' the sludge, resulting in the destruction of the cellular material within the sludge and an increase in sludge 'digestibility'. Enhancement of the digestion process means that more biogas is generated for beneficial use and the end-product is stabilised to grade A standards. There are no operating THP

facilities in New Zealand at present, although Watercare are planning a similar size facility at Rosedale WWTP.

2. **Mesophilic Anaerobic digestion (MAD)** – This process utilises an oxygen-deficient tank to store and heat sludge for a period of 15 to 20 days. During this period, bacteria within the tanks breakdown the organic material within the sludge, resulting in a lower volume, more stabilised sludge. This process also produces biogas for use as thermal energy source and for combined heat and power (CHP) use.

3. **Thermal drying** – After the THP and MAD stages, the treated sludge is volume is significantly reduced by removing the excess water from the sludge to a very dry, well stabilised product of around 90% dry solids.

Figure 14: Process schematic for LD + TD facility



5 CONCLUSIONS

As a response to Wellington City's waste minimisation and GHG emissions reduction aspirations, optioneering was undertaken for the establishment of a SMF to reduce overall sludge volumes going to landfill. This optioneering process involved collaborative partnerships within the core project team and active engagement with key stakeholders. From a longlist of 25 process options and 2 main site options, the identified proposed solution is a LD + TD facility consisting of thermal hydrolysis, anaerobic digestion, and thermal drying processes. These processes produce a low volume, highly stabilised end-product and a beneficial biogas by-product. By doing so, Southern Landfill's constraints on general waste disposal are no longer constrained by the amount of sludge to landfill, therefore allowing further waste minimisation initiatives to be actuated.

The project is currently progressing into the resource consenting and delivery procurement phase. Funding for the project is being arranged by Wellington City Council, with negotiations with Crown Infrastructure Partners underway to use the Infrastructure Funding Financing mechanism.

We believe that the comprehensive optioneering and investigation phase described in this paper has led to the development of a robust and appropriate solution for Wellington city.

6 ACKNOWLEDGEMENTS

We would like to acknowledge the collective efforts of the core project team from Wellington Water, Connect Water (CH2M Beca), Veolia (PTAG) and Latitude. A special thanks to Chris French, for his review of the paper and leadership throughout the project.

We would also like to acknowledge key stakeholders from Ngati Toa, Taranaki Whānui, WIAL and Southern Landfill who have provided valuable inputs throughout our optioneering journey.

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