REPORT

Tonkin+Taylor

Taranaki Region Organic Materials Recovery Feasibility Study

Options Assessment Report

Prepared for
South Taranaki District Council, New Plymouth District Council, Stratford District Council

Prepared by
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Executive Summary

Background

This feasibility study investigates options for how Councils in Taranaki might best manage and recover various organic material streams from across the region. The organic materials considered in the scope of this project are household food and garden waste, commercial/industrial food and garden waste and food processing waste. Agricultural slurries have been considered at a high level but their volumes not quantified. Biosolids (derived from municipal wastewater treatment process) and drilling muds are not included.

The options developed consider potential processing options (technologies) at a high level but do not address potential site locations. Specific technology solutions, funding, governance and site locations will be addressed in a future business case, after Councils have decided on a preferred option or options to investigate further.

This study summarises a review of options taking an approach that is consistent with New Zealand Treasury's 'Better Business Case' approach. This approach focuses on making sure the issue or opportunity is well defined before considering a range of options to realise the opportunity. Once the right option has been identified there is a process of planning for successful delivery, ensuring that timeline and costs reflect what is required for the project to succeed.

From the beginning of this project, Iwi and Hapū have been key partners in exploring and considering how best to manage the recovery of organic materials across the region. A separate report details the Iwi and Hapū engagement process that Councils undertook, which was facilitated by Māori co-governance and facilitation experts, Aatea.

Industry stakeholders have also been involved with a focus on confirming organic materials generated in Taranaki that require management, potential with Council controlled materials.

Current situation

Taranaki produces over 200,000 tonnes of organic material per year requiring management (Refer Figure E.1). Some commercial/industrial organic material is captured through established recovery systems including formal processing operations and informal arrangements such as stock feed. Some organic material from primary processing is applied to land and a number of waste processors in the region already effectively reprocess waste material and deliver a product to market.

A range of gaps in the current management of organic materials were identified. These include:

- Challenges
  - Lack of in-region processing options
  - Large variations in waste streams that are impacted by seasonality or contamination
  - A lack of knowledge and expertise on alternative processing options
  - High capital cost for alternative processing facilities
  - Waste management is not the core business for many industries.
- Opportunities
  - Acknowledging what is already working.
  - Economic opportunities for investment and jobs in Taranaki.
  - Large established agricultural industry (potential market for end products like compost).
  - Emissions reduction and waste minimisation potential from:
    - Recovering organic waste streams that are currently sent to landfill.

- o local facilities reducing the need for long transportation routes out of region.
- Recycling of waste through the adoption of circular economy practices to produce new products.

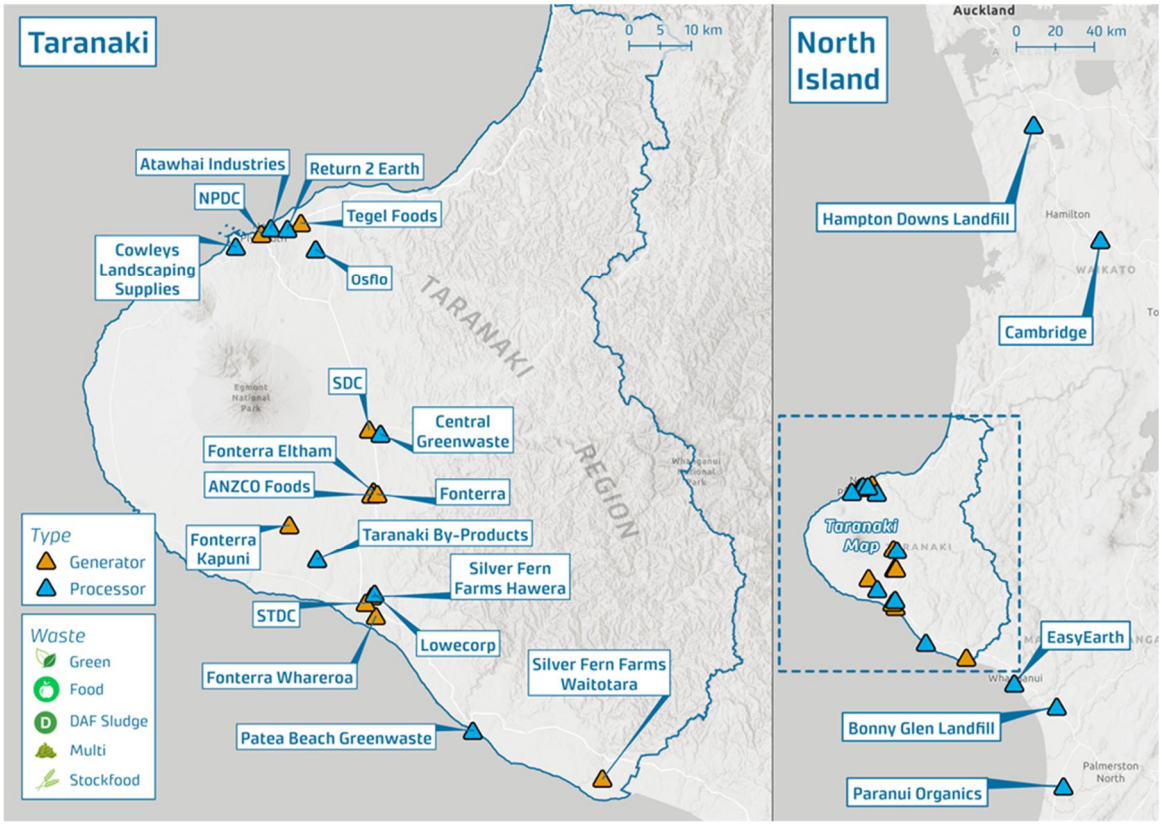


Figure E.1: Commercial/industrial waste producers and processors in the Taranaki region

Objectives

As part of defining the approach to assessing the potential options with Council staff, Iwi and Hapū and commercial/industrial stakeholders, key priorities were discussed for various recovery options. These priorities are used as a basis for criteria to evaluate options.

The list of criteria developed with Iwi / Hapū are organised under the headings of:

- Te Taiao
- Iwi and Hapū Development
- He Tangata

The Council also proposed a number of criteria (Kaunihera criteria) and partners had the opportunity to review and provide comment. The Council's proposed criteria were:

- Maximise diversion of organic material from landfill (maximising the value of organic material through recovery e.g. composting to produce a product).
- Maximise reduction in greenhouse gas emissions
- Best cost: benefit
- Improving environmental outcomes
- Improving local economy and employment opportunities

Options

In some cases, organic material can be managed at household or business level through small scale approaches typically composting or worm farming. In most cases, before materials can be processed they need to be 'collected' in some way. There are a number of options for the 'collection' of organic material from households and commercial businesses. These include:

- Council or private collections - garden waste and in some cases food organics.
- Local collection points e.g. recycling, waste and/or organics collection point for apartment buildings.
- Council or private sector transfer stations/recycling facilities.

The focus of this study is on the processing of materials. However, it is important to consider that collections are an enabler for different types of processing as the quantity, composition and quality of material collected will help to define what processing options are feasible. Similarly establishing markets for outputs of processing increases their economic viability. Although processing is the focus of this study options need to be considered in the context of the broader organic material life cycle.

The processing options identified were evaluated against the evaluation criteria noted above.

In summary while advanced treatment such as gasification, pyrolysis, mechanical biological treatment, hydrothermal liquefaction, torrefaction and biofuel could be applied they are considered high risk due to lack of existing commercial operations in New Zealand or Australia and high cost so are not considered further noting that there are more conventional processing options available.

Some options, such as home or community composting, may not form an entire solution in themselves but present an important complementary opportunity to encourage the community to recover value from material at their homes and can form part of a solution so are taken forward for further consideration below.

Consideration of Iwi and Hapū development criteria have included those options with a heavy reliance on sophisticated technology that could be an opportunity for project partners to be owners, investors or operators. Options that consider broader community outcomes such as small scale processing in partnership with community groups or Marae score well against He tāngata criteria.

Potentially viable markets for organic material derived products Taranaki are summarised in Table E.1.

Table E.1: Summary of potential viable markets

	Landscaping	Retail	Horticulture	Grassland/ Arable	Fuel	Animal Feed
Compost	ü	ü	ü	ü	û	û
Vermi-compost	ü	ü	ü	ü	û	û
Digestate[1]	û	û	ü	ü	û	û
Bark, wood chip	ü	ü	û	û	ü	û

[1] Feedstock for further processing (for example composting, vermi-composting)

	Landscaping	Retail	Horticulture	Grassland/ Arable	Fuel	Animal Feed
Mulch (bark, wood chip)	ü	ü	ü	û	û	û
Stock food	û	û	û	û	û	ü
Biogas	û	û	û	û	ü	û

Shortlist

Drawing on the analysis summarised above, options that include one or more approaches to processing materials alongside reduction and on-site management have been developed. The options identified are:

- Option 1: Do nothing – some local processing and transport out of region for processing.
- Option 2: Centralised composting facility
- Option 3: Centralised Anaerobic Digestion Facility
- Option 4: A network of commercial facilities (likely to include a combination of composting integrated with a digestion plant, enabling the maximisation of digestate.
- Option 5: A network of commercial and community facilities

The five options were evaluated against the framework noted above. The results of the assessment indicate that there is no perfect option. Each option has elements of desirable and less desirable outcomes. There are also trade-offs between of the benefits of community involvement and maximising diversion opportunities.

Carbon impacts are difficult to quantify as the impact of any solution is made up of a number of elements including the embodied carbon of the technology, transport emissions, level of diversion from landfill and potential to generate a product that displaces a carbon intensive activity (i.e. production of renewable energy). For the purposes of this feasibility assessment only high-level commentary on emissions reduction potential is provided at this stage.

Preferred option

The assessment suggests that, on balance, a network of commercial processing sites alongside community level composting (Option 5) delivers the best overall outcome. Key benefits include local community and employment opportunities and the spreading of risk across multiple facilities.

It is expected that the network would comprise:

- Several ‘commercial’ scale processors of organic materials focussed on maximising value. These are likely to be located close to major sources of feedstock. For digestion co-location with an energy user would be preferable. The data collected to date suggests potential for North Taranaki processing site(s) and a South Taranaki processing site(s).
- Multiple community scale composting operations developed in partnership with iwi/Hapū and/or community groups.
- Strong links with existing activities that aim to reduce the wastage of organic materials include reuse where appropriate. Examples include:
  - Love Food, Hate Waste and similar public education campaigns.
  - Primary processing optimisation initiatives.
  - Food Rescue initiatives (for example On the House)

- Stock food, for example EcoStock supplies.

Next steps

The next step in the project is to further define the preferred option. It is expected this will comprise a concept 'design' for the network and confirming the approach to developing each of the network components. This will involve confirming 'available' materials, setting out the approach to delivering each network component and developing enough detail to progress to procurement, design, construction and implementation for each component.

1 Introduction

Tonkin & Taylor Ltd (T+T) were engaged by South Taranaki District Council to complete a feasibility study to investigate options for how Councils might best manage and recover various organic material streams from across the region. The study was funded by the three Councils in the region, New Plymouth District Council (NPDC), Stratford District Council (SDC) and South Taranaki District Council (STDC), with STDC taking the lead coordinating role on behalf of the three Councils.

The organic materials considered in the scope of this project are household food and garden waste, commercial/industrial food and garden waste and food processing waste. Agricultural slurries have been considered at a high level but their volumes not quantified. Biosolids and drilling muds are not included because they may limit the end use (value) options for products (compost, digestate).

From the beginning of this project, Iwi and Hapū have been key partners in exploring and considering how best to manage the recovery of organic materials across the region. A separate report details the Iwi and hapū engagement process that Councils undertook, which was facilitated by Māori co-governance and facilitation experts, Aatea. A number of critical bottom lines from a Te Ao Māori viewpoint were developed from this engagement process, and these have been integrated into the assessment criteria used to develop options within this report. This report should be read alongside the summary of the engagement process drafted by Aatea.

As part of this project, Councils have also engaged with industry stakeholders across the region who are producing significant quantities of organic materials requiring management.

The scope of work for the T+T work completed for this stage of the project, documented in this report, is set out in our proposal dated 30 September 2021 (T+T reference 1018284).

Specifically, the scope of work that underlies this report comprised:

- Reviewing existing data on organic material streams from across the region, including:
  - Data and reports provided by all Councils (data underlying the Waste Assessment, Waste Management and Minimisation Plan (WMMP)and any other relevant information).
  - High level review of existing weighbridge data for the now closed Colson Road Landfill and transfer stations operated by each Council, alongside associated waste composition data.
  - Data shared by commercial organic waste generators.
  - T+T knowledge of the sector for the Taranaki Region.
- Estimating current and future waste streams
- Participating in or facilitating workshops with partners and stakeholders
- Developing feasible options for recovering organic material in the Taranaki Region
- Evaluating options (multi-criteria assessment)
- Drafting a feasibility/options report (this report)

The options developed consider potential processing options (technologies) at a high level but do not address potential site locations. Specific technology solutions, funding, governance and site locations will be addressed in a future business case, after Councils have decided on a preferred option or options to investigate further.

1.1 Study background

Taranaki produces over 200,000 tonnes of organic material per year requiring management. Some commercial/industrial organic material is captured through established recovery systems including formal processing operations and informal arrangements such as stock feed. Some organic material from primary processing is applied to land in Taranaki. A number of waste processors in the region already effectively reprocess waste material and deliver a product to market.

There are a number of historically difficult to manage and emerging organic material streams that currently need to be transported out of Taranaki for processing or continue to be landfilled (both of which are emissions-intensive activities). It is estimated that over 15,000 tonnes of organic material per year from the region is currently disposed to landfill[2,3]. The Ministry for the Environment (MfE) released a consultation document on a reforming recycling in New Zealand which includes proposals to mandate food waste collection from households and to ban commercial/industrial organic waste from landfill. This is discussed further in Section 3.1.4.

Understanding the actual volumes of organic material produced within the Taranaki region is challenging. While Councils have data on materials collected through the kerbside collection system and each of the transfer stations, there is limited data on organic material transported out of the region or processed by the private sector. To partially address this, the study has included consultation with key commercial/industrial waste generators, who create significant volumes of organic material. This consultation has not considered every source of organic material in Taranaki but was designed to be reflective of the activities related to agriculture and food processing which are prominent in the region.

1.2 Approach

1.2.1 Overall project approach

The three District Councils in the Taranaki region (STDC, NPDC and SDC) are committed to collaborating regionally to achieve efficiencies and effectiveness in waste management and minimisation. In this feasibility study, the Councils are looking to explore opportunities for how a regional approach to organic material recovery (such as aggregation of material, knowledge sharing, joint procurement, potential partnerships) can improve outcomes for the individual Councils and the communities they serve.

It is the Councils' aspiration that this project reflects a true partnership approach where Councils use a co-design approach with Iwi and Hapū partners as much as possible from the very beginning of the project, but acknowledging that full co-governance and decision-making frameworks are not yet in place . This approach has included the engagement of Aatea Solutions to design, host and consolidate information from a series of wānanga with Iwi and Hapū.

This report summarises a review of options taking an approach that is consistent with New Zealand Treasury's 'Better Business Case' approach. This approach focuses on making sure the issue or opportunity is well defined before considering a range of options to realise the opportunity. Once the right option has been identified there is a process of planning for successful delivery, ensuring that timeline and costs reflect what is required for the project to succeed. The Treasury's five case model is outlined below.

[2] Colson Road Landfill Data 2015-2019.xls
[3] 2018 Waste Assessment South Taranaki District Council

- Strategic Case - what is the reason for the project?
  Reflected in Section 2 (The current situation) and Section 3 (What are we trying to achieve);
- Economic Case - what is the preferred (best value for money) option?
  Summarising the options identification and evaluation process set out in Sections 4 and 5.
- Management Case - how will the project be delivered?
  Discussion around progression of activities to move the preferred options through pilot opportunities, scaled implementation and identification of future expansion options. This is set out in Section 6.1.
- Financial Case - what is it going to cost and what is the preferred option for funding?
  Drawing on capital and operating costs. Brief comment on funding options is provided in Section 6.2.
- Commercial Case - how will the project be procured? We have provided brief comment on procurement aspects in Section 6.

The timeline for the project is shown in Table 1.1. The timeline incorporates a number of workshops with partners and stakeholders.

Table 1.1: Overall project timeline

Late 2021/ Early 2022	Early - Mid 2022	Mid to late 2022	2023/24	2023/24 ->
Stage 1: · Iwi and Hapū organics management wānanga · Other stakeholder workshop	Stage 2: · Feasibility study completed, recommendations shared	Stage 3: · Further engagement or co-design with relevant parties	Stage 4: · Business case creation and finalisation, consenting	Stage 5: · Business & partnership models finalised, facility construction and operation
Current stages		Future stages		

1.2.2 Engagement process with Iwi and Hapū partners

Two online wānanga were held with Iwi and Hapū participants on Friday 28 January and 16 February 2022. The purpose of these wānanga was to:

1 Give an overview of the issues and opportunities for managing and recovering organic materials across the region.
2 Listen to and gain an understanding from Iwi and Hapū of their perspectives on this study and what 'excellent' would look like from Iwi and Hapū perspectives, using a Te Ao Māori worldview.
3 Identify criteria needed in assessing the options for an organic materials recovery approach.
4 Ensure the kaupapa is laid on a platform of tika, pono and māramatanga. To this end, it was asked 'What mātāpono (principles) should guide this process with Council moving forward?'

References to the outcomes of these wānanga are included in Aatea's separate report[4], which should be read alongside this report.

T+T and Council representatives attended these wānanga to discuss and explore the potential issues and opportunities with Iwi and hapū, and also to observe, focussing on listening to and hearing the thoughts and aspirations of the attendees.

T+T presented an overview of the current organic materials management approach for the region and talked through some examples of material recovery technologies that are in place elsewhere. Council staff provided background information on the project, next steps and responded to questions from participants.

The outcomes of the wānanga are reflected in the remainder of this report and in particular in the summary of the current situation, approach to evaluating options and options considered. The approach to the Iwi and hapū engagement process, and the wānanga outcomes are detailed in the Aatea Report[4].

1.2.3 Involving other key project stakeholders

A workshop was held with other key project stakeholders including representatives from each Council (including Taranaki Regional Council) and a number of commercial industrial businesses in the region that produce large volumes of organic material on 28 October 2021. This workshop was aimed at clarifying:

- what the current situation is.
- what the vision for the region is.
- any other key challenges or opportunities that stakeholders would like considered as part of the study.

The outcomes of this workshop are reflected in the remainder of this report and in particular in the summary of the current situation, approach to evaluating options and options considered.

2 Current situation (where are we now?)

2.1 Data collection and analysis

A desktop based assessment was completed using reports and data provided by all three District Councils that summarise information on organic material in each region. Information was also provided by commercial/industrial stakeholders.

Existing information on organic material reviewed included:

- Reports provided:
  - The 2018 Waste Assessment, South Taranaki District Council (developed with input from the three District Councils, providing data at a regional level)[5].
  - Taranaki Organic Waste Diversion Study, 2015[6].
- Data provided:
  - Colson Road Landfill Weighbridge data (2015 – 2019).
  - Transfer station waste tonnages.

[4] Taranaki Organic Material Recovery Facility Feasibility Study – Iwi and Hapū Engagement Process Report, March 2022
[5] 2018 Waste Assessment, South Taranaki District Council, 2018
[6] Organic Waste Diversion Study, Prepared for the Taranaki Regional Councils, Eunomia and Wastenot Consulting, 2015

- Kerbside collection waste tonnages.
- Information provided by Council staff.
- Information provided by commercial/industry waste generators in the region.
- T+T knowledge of the sector in the Taranaki Region.
- T+T knowledge of waste composition from similar regions in New Zealand.

2.2 Taranaki current waste management system

2.2.1 Council services and facilities

2.2.1.1 Collections

The Council kerbside collection service for landfill waste and organics are shown in Table 2.1.

Table 2.1: Council kerbside collection services that contain organics

Council and number of households	Size of containment and frequency of collection		
	Landfill waste	Garden waste	Food waste
NPDC	120 L bin collected fortnightly	No collections provided	23 L bin collected weekly
SDC	120 L bin collected weekly	No collections provided	No collections provided
STDC	120 L bin collected weekly	240 L bin collected fortnightly. Garden waste with a small amount of food organics accepted (FOGO). This is an opt in service only.	

Where a food waste collection system is not currently in place food waste is being disposed as part of general waste. The opt in green waste system for STDC specifies that only 10% of the bin can be made up of food scraps.

2.2.1.2 Transfer stations

There is a network of transfer stations across the three districts that receive garden waste and allow for landfill waste drop off from households and small scale businesses. There are five transfer stations (four operated by NPDC and one operated by a private provider), seven transfer stations operated by STDC and one transfer station operated by SDC. These transfer stations are small in scale, collecting approximately 2,500 tonnes of garden waste per year between them. The locations of the region's network of transfer stations is shown in Figure 3.1.

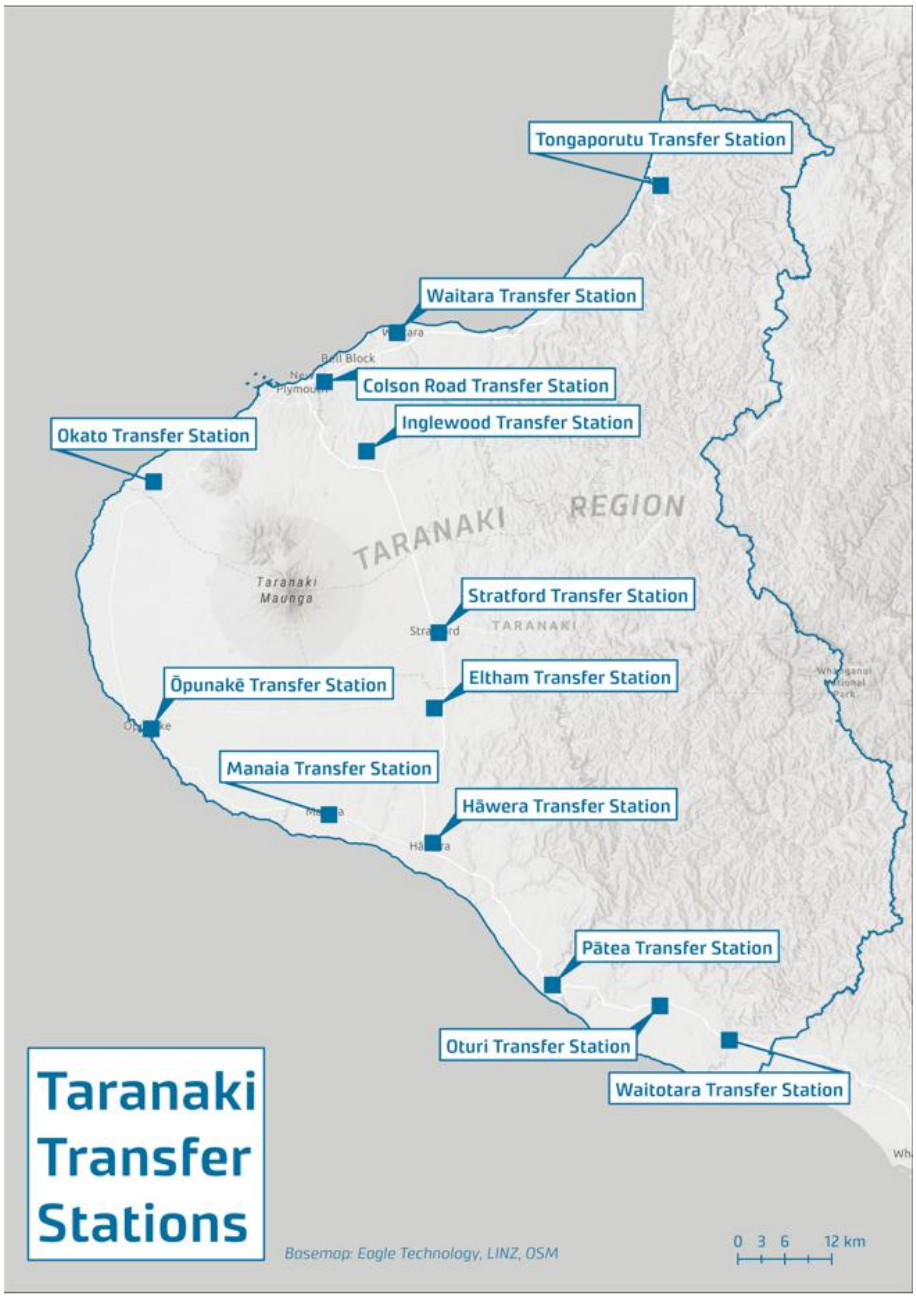


Figure 2.1: Taranaki region transfer station locations

2.2.2 Private services

A small number of private collection services are available in the district. Greenawaste are based in New Plymouth and provide a garden bag service available for drop off and collection. Central Greenawaste and Firewood are based in Stratford and offer a green waste wheelie bin collection service. Waste Management offers garden waste and food waste bins to commercial/industrial customers. Egmont Refuse and Recycling, EnviroWaste and Ingrams also offer a residential garden waste services. Easy Earth picks up organic waste from a number of small businesses in South Taranaki and composts this material in Whanganui.

Note: terminology of collection service varies for organic waste, some providers refer to a green waste and others to a garden waste collection service. Note these are the same type of collection service. It is worth noting that the acceptance criteria of materials for green/garden collections could differ by provider.

2.2.3 Processing

Options available in the region for the processing of organic material are shown in Table 2.2. Some organic material is transported out of the region for processing including materials taken to Waikato and Horowhenua.

Table 2.2: Organic processing facilities in the Taranaki region

Name	Location	Services	Materials accepted
Return 2 Earth	New Plymouth	Mulching, wood chipping	Garden waste and untreated timber
Taranaki By-products	Okaiawa	Rendering	Dead stock, by products from meat and poultry processing
Cowleys Landscaping Supplies	New Plymouth	Aerobic composting	Garden waste
Revital	Uruti	Composting, vermi-composting	Garden waste, paunch grass, bark, chicken mortalities, chicken manure, drilling mud
Lowecorp	Hāwera	Blood processing only and washing/storage /transfer of offal from the adjacent meat processing plant of Silver Fern Farms.	Blood
EcoStock	New Plymouth	Delivery of pre-consumer food waste to stock feed (mostly piggeries)	Pre-consumer food waste
Osflo	Bell Block	Composting of chicken litter into soil amendment for dairy farmers	Wood chip, chicken litter
Atawhai Industries	New Plymouth	Depackaging of food waste for stock food, mulching woody garden waste from arborist activities	Mulch, stock food
Central Greenawaste and Firewood	Stratford	Aerobic composting	Garden waste
Pig farms	Across the region	Stock feed	Food waste (unpackaged)

Revital (owned by Remediation NZ) operate a composting and vermicomposting facility at Uruti, accepting a wide range of organic materials from the region. The site has received over 100,000 tonnes of organic material (garden waste, paunch grass, bark, chicken mortalities, chicken manure, drilling mud) each year. In 2020 Revital applied for resource consents to continue operations after original consents expired in 2018. In May 2021 this application was denied due to concerns around the consideration of effects of discharges to air and water, cultural matters and stockpiled material. The uncertainty for this facility has increased the reliance on out of region options for processing some types of organic material.

2.2.4 Landfill

Colson Road Landfill was the only landfill operating in the region until the site closed in 2019. Waste from the region is now being transported to Bonny Glen Landfill, located over 180 km away from New Plymouth. Bonny Glen has a total airspace of 12.7 million m^3 and is expected to service the waste disposal needs of the surrounding region for the next 50 years. Some material, unsuitable for disposal at Bonny Glen, is transported to Hampton Downs Landfill in Waikato.

2.3 Waste quantity and composition

2.3.1 Food waste

Food waste is collected in Taranaki Region in the following ways (in no particular order of quantity produced).

- Collection of source segregated food waste from the NPDC kerbside food scraps collection service and a small component (up to 10%) of the STDC green waste service.
- Collection of residential waste in kerbside landfill waste bins that contains a component of food waste.
- Residential and commercial/industrial landfill waste that is self-hauled to a transfer station and contains a component of food waste.
- Specific sectors (i.e. hospitality, food manufacturing) can generate significant amounts of food waste that is either disposed of as landfill waste or recovered for reuse/further processing.

There are no facilities in Taranaki that are able to process food waste. Some commercial/industrial food waste streams are used as stock feed (primarily piggeries), this is occurring through direct relationships between generator and farmer or through facilitators such as Atawhai Industries and Ecostock.

Some businesses and organisations are separating their food waste at source and arranging for material to be sent for reprocessing (such as composting out of region) through collection by private operators (such as Waste Management New Zealand). Private collections may be selected where Council collection services are not available.

An overview of key food waste generation quantities and destinations is provided in Table 2.3.

Table 2.3: Food waste generation in the Taranaki Region

Source	Quantity (tonnes per year)	Destination
NPDC kerbside food scraps collection	1,500[7]	Hampton Downs Composting facility (Waikato)
Component of STDC green waste collection service	150[1]	Paranui Organics (Foxton)
Component of kerbside general waste collection (three Councils combined)	3,000[1]	Landfill
Component of Transfer Station general waste (three Councils combined)	Unknown[8]	Landfill

[7] Kerbside collection data supplied by Councils dated 2021. To estimate the organic component of kerbside general waste the composition results of the 2016 SWAP have been applied.
[8] The food organic component of general waste delivered to Transfer Stations has not been considered as part of options feasibility as there is unlikely to be a source separation option for this waste stream in the near future.

Source	Quantity (tonnes per year)	Destination
Commercial/industrial food waste (pre and post consumer)	Commercially sensitive[9]	Stock food Compost – out of region Landfill (combined with other landfill waste)

2.3.2 Garden waste

The major origins of garden waste in Taranaki Region include (but in no particularly order of quantity produced):

- Collection of source segregated garden waste from the STDC green waste bin collection service.
- Collection of residential waste from STDC, NPDC and SDC collected in bins that contains garden waste.
- Residential garden waste that is self-hauled by residents to a transfer station.
- Residential general waste that is self-hauled by residents to a transfer station and contains garden waste.
- General waste generated by the commercial/industrial sector that contains significant portions of garden waste, for example from landscaping activities. This general waste is then collected for disposal (in wheelie bins, commercial/industrial waste bins or skip bins) or self hauled to transfer stations.
- Garden waste that is collected by private sector collection services and transported to transfer stations or garden waste processing facilities.

A summary of garden waste collection in the Taranaki region is shown in Table 2.4.

Table 2.4: Garden waste generation in the Taranaki Region

Source	Estimated quantity (tonnes per year/annum)	Destination
STDC green waste collection service (garden organics)	1,500	Paranui Organics (Foxton)
STDC transfer stations	600	Paranui Organics (Foxton)
NPDC transfer stations	500	Paranui Organics (Foxton)
SDC transfer station	16	
Component of kerbside general waste collection (three Councils combined)	1,200[10]	Landfill
Component of Transfer Station General waste (three Councils combined)	Unknown[11]	Landfill
Other garden waste recovered (not through transfer stations)	Commercially sensitive	Various private processing operations

[9] Taranaki Organic Waste Diversion Study, 2015, Based off conversations with specific commercial/industrial waste generators (2021).
[10] Kerbside collection data supplied by the three Taranaki District Councils dated 2021. To estimate the organic component of kerbside general waste the composition results of the 2016 SWAP have been applied.
[11] The green organic component of general waste delivered to Transfer Stations has not been considered as part of options feasibility as there is unlikely to be a source separation option for this waste stream in the near future.

Source	Estimated quantity (tonnes per year/annum)	Destination
Other garden waste landfilled (not kerbside)	Approximately 1,000 via transfer stations[12] Commercially sensitive	Landfill

2.3.3 Other organic material

Taranaki has a large agricultural and food production sector including pig, dairy and sheep and beef farms along with dairy, poultry and red meat processing. The nature of these activities being undertaken at scale produce large quantities of organic by-products. The recovery value of many of these products has been recognised. For instance, Taranaki by-products processes approximately 110,000 tonnes per year of meat processing waste in its rendering plant located in Orewa. A large amount is sourced from the Taranaki region and some will be imported from other parts of New Zealand. Taranaki By-Products also have a rendering/processing plant at Okaiawa in South Taranaki.

Consultation with industry stakeholders focussed on materials that continue to be an issue for commercial/industrial organisations because they are not currently recovered or where organisations would be open to considering alternative recovery opportunities. Reasons for considering alternatives include looking for options that are considered better environmental practice or are located in the region (reducing transport costs and the associated emissions of long-haul transport).

It is worth noting organic material by-products from the food production sector can be susceptible to fluctuation in volumes. For instance, beef processing peaks from January to May and fallen stock increases during the dairy calving season between July and August. Poultry processing is relatively steady through the year.

One material stream generated by several primary processors is Dissolved Air Flotation (DAF) solids. Dissolved Air Flotation is a technique used to separate small bits of proteins, fats, and fibrous materials that cannot be removed by mechanical means from liquid wastewater by pumping dissolved air into the wastewater. The air creates small bubbles that rise to the surface entraining small solids, oils and greases. The solids on the surface can then be removed as a sludge (DAF solids).

2.3.3.1 Poultry processing

Tegel Foods Ltd (Tegel) owns a number of chicken farms, a feed mill, hatchery and a poultry processing plant in the Taranaki Region. The poultry processing plant has capacity to process 105,000 birds per day. Materials that can be rendered (such as offal and feathers) are sent offsite for processing at Taranaki By-Products Ltd. There is a Dissolved Air Flotation (DAF) system onsite for wastewater treatment and DAF solids are freighted to Cambridge for composting.

Some farms are serviced by Osflo for chicken litter processing. Hatchery waste[13] is a critical issue for the business at the moment as these materials were historically being sent to Revital in Uruti, which is no longer operational.

Summary of organic material streams where an alternative/improved recovery method could be considered:

- DAF solids - currently transported out of Taranaki for processing.
- Hatchery waste – no local solution in place.

[12] Draft SWAP for New Plymouth suggests an estimate of garden waste

[13] Empty shells, infertile eggs, dead embryos, fatalities, late hatchings and dead chickens.

2.3.3.2 Dairy processing

Fonterra have four dairy processing plants in the Taranaki region (Whareroa, Kapuni and Eltham – two sites). The factories produce a range of milk products including cheese, cream, milk powder, whey protein and lactic casein (milk protein).

Three of the plants (two in Eltham and one in Whareroa) generate DAF solids from wastewater treatment. The Whareroa plant is one of the biggest in the world. This material is applied to land in region, but is currently transported out of region for processing when weather conditions prevent land application.

Processed food waste includes off specification or expired packaged cheese, packaged butter and milk powder. Where possible material is diverted to stockfeed. Where diversion is not possible the material is landfilled. Smaller volumes of laboratory food waste, paper towels, agar from petri dishes and canteen waste from staff food scraps are other organic material streams produced by their site activities.

Summary of organic material streams to be considered:

- DAF solids – applied to land in region, currently transported out of Taranaki for processing when weather conditions preventing land application.
- Commercial/industrial food waste not suitable for stock food (i.e. packaged items) - currently landfilled
- Other pre-consumer food waste (lab testing food waste, off cuts) – compost or landfill used.
- Post-consumer food waste (cafeteria) - largely landfilled.
- Infrequent wastage from processing failure - currently landfilled.

2.3.3.3 Forestry and timber processing wastes

There are approximately 27,000[14] hectares of exotic forestry located in the Taranaki region. There are a number of sawmills and processors in the region including Value Timber, Clelands, Taranaki Pine and Waverley Sawmills. Port Taranaki also produces significant volumes of bark through their log handling operations.

Key waste streams include:

- Forestry residue (remaining after harvest including at skid sites)
- Wood processing residue
  - Untreated saw dust
  - Clean bark
  - Wood chip
  - Treated offcuts
  - Shavings (treated and untreated)
  - Other wood wastes

Given the maturity of the industry in Taranaki most waste streams are accounted for. Untreated bark chip or sawdust reportedly has a demand and can be sold. Outlets include industry boilers and animal bedding. Historically some of the products have been recovered and used as a bulking agent in local composting operations.

[14] https://www.trc.govt.nz/environment/farmhub/forestry/

A low proportion of material that is not treated is clean filled. Demolition and treated timber will generally be landfilled.

2.3.3.4 Red meat processing

Silver Fern Farms Ltd (Silver Fern Farms) owns meat processing plants at Tawhiti Road, Hāwera and at Wai-inu Beach Road, Waitōtara. The Waitōtara Plant processes sheep and lambs and the Hāwera Plant processes beef. Blood and materials suitable for rendering produced at both sites are taken offsite for processing.

Wastewater from the Waitōtara Plant stockyards and plant wastewater from wash downs is screened and stored in holding ponds prior to being discharged to land through spray irrigation.

At the Hāwera Plant, wastewater is screened, piped to the Hāwera municipal wastewater treatment plant and discharged via consent for ocean outfall. A DAF system is in place to treat some of the waste from meat processing. Paunch[15] and stockyard solids are screened and piled on land to create compost.

Summary of organic material streams to be considered:

- DAF solids.
- Paunch waste - informal on site composting.
- Infrequent organic material loads from processing failure – landfill disposal.

2.3.3.5 Summary of other organic material

Understanding the actual volumes of organic material produced within the Taranaki region is challenging. While Council has data on materials collected through the kerbside collection system and each of the transfer stations, there is limited data on organic material transported out of the region or processed by the private sector.

An understanding of waste volumes is important for Council in designing an approach to influencing the diversion of materials away from landfill. It is difficult to scope opportunities to separate, reuse locally and/or re-process materials without good data. To partially address this, the study has included consultation with key commercial/industrial generators who create significant volumes of organic material that are reflective of activities in the region: agriculture and food processing.

A snapshot of some of key materials and destinations of commercial/industrial quantities of organic material where known is shown in Table 2.5. The locations of these producers and some of the key processing facilities is shown in Figure 2.2.

Table 2.5: Summary of other organic material

Material	Current destinations
Poultry litter	Land applications or Osflo
Poultry by-products	Historically composted, currently unknown
Paunch grass	Stockpiled on land, historically composted
Dairy food processing waste	Landfill
Dairy food processing waste	Stock food
Meat and poultry processing waste	Taranaki By-products

[15] Partially digested grass and separated from the stomach compartment of a carcass during processing.

Material	Current destinations
DAF solids	Compost – out of region
Woody waste	Boilers, animal bedding, clean fill

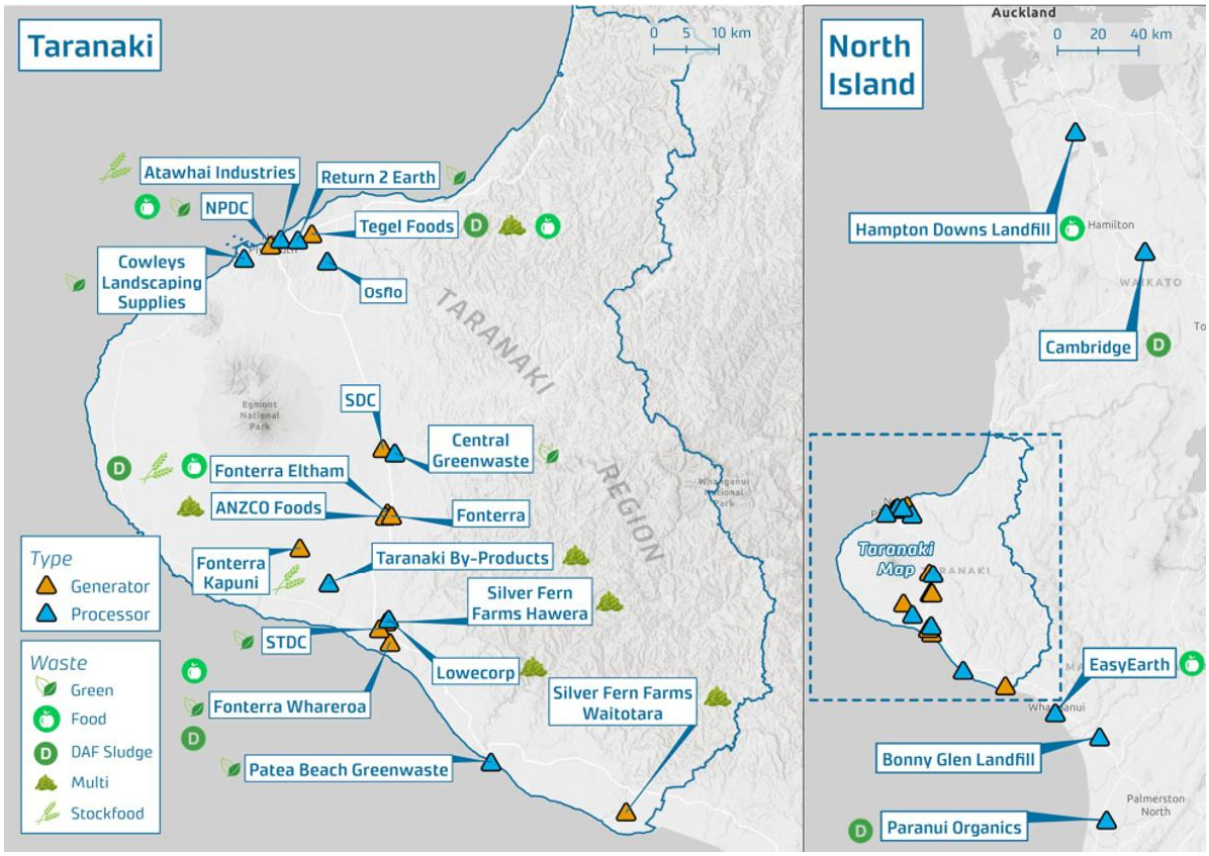


Figure 2.2: Commercial/industrial waste producers and processors in the Taranaki region

2.4 Current issues and opportunities

2.4.1 Gap analysis

The information collected indicates that organic materials are managed well in the Taranaki Region overall. However the 2018 Waste Assessment[16] stated that 23% of the materials transported to landfill from Taranaki was organic materials. This presents a significant opportunity to divert these materials and capture value through their feed, energy and/or nutrient value. This material includes organic material generated by industry disposed of as general waste, organics disposed of general waste in the kerbside collections with the highest diversion potential being kerbside food waste (for example, food waste in South Taranaki comprises an estimated 40 - 60% of kerbside landfill bins).

There is also potential to change the management of materials currently applied to land where nutrient management requirements may require a change in approach. As noted previously in this report, local options are likely to be preferred to those that require transporting of materials out of the Taranaki Region for cost and emissions reduction reasons.

Where feasible, large scale commercial/industrial generators of organic material are diverting materials to facilities where value can be recovered. The lack of, and uncertainty related to, in-

[16] The 2018 Waste Assessment, South Taranaki District Council, 2018

region facilities have meant that generators and Council are needing to transport material large distances for processing, which is costly. A need has been identified for localised solutions in closer proximity to these generators.

In selecting options for the management of organic materials there is a risk that the focus is on the least cost options rather than maximising the value of the materials. The cost of options will be influenced by the value of products i.e. maximising value makes commercial sense. An important aspect of organic materials recovery is focussing on creating high value products that meet market requirements, this is in contrast to an approach that focusses on least cost management of organic waste.

Gaps in local processing options have been identified for the following materials:

- Household food waste (current – 1,650 tonnes per annum (TPA), future – additional 1 - 2,000 TPA[17]).
- Household garden waste (current – 2,600 TPA).
- Commercial/industrial food waste post-consumer (small quantities).
- Commercial/industrial pre-consumer food waste (small quantities).
- Paunch waste (estimated 6,500 TPA)).
- DAF solids (estimated > 20,000 TPA).
- Poultry waste - (small quantities).
- Timber waste - unknown .

2.5 Iwi and Hapū views on current state

Full commentary on Iwi and Hapū views on current state are included in the Aatea Report[4], which should be read alongside this report.

In summary, the key challenges and opportunities identified are outlined below.

- Challenges *(italicised text reflects quotes from wānanga participant comments)*:
  - *Lack of in region management of materials. Transporting our paru elsewhere into someone else's rohe is not our tikanga.*
  - *Industry must take responsibility for its waste.*
  - *Today's linear industry systems are dependent on: fossil fuels, extraction, exploitation, mass distribution of industry-produced foods, and deriving profit. Many participants noted that this type of system creates significant waste and kai that lacks nutritional value.*
  - *Māori have not benefited to the scale they ought to in the current system.*
- Opportunities *(reflecting participant comments)*:
  - *Acknowledging what is already working (kai resilience programmes, iwi kai enterprises, and other mātauranga Māori-driven environmental projects).*
  - *Mātauranga Māori is increasingly being drawn upon for approaches and solutions to environmental issues such as 'waste' management.*
  - *Opportunities to work with industries that would benefit iwi and Hapū. "There is money to be made and jobs to be had".*

[17] 3,000 tonnes available in Stratford and South Taranaki landfilled waste, typical 30 – 60% capture of available materials in kerbside collections.

2.6 Commercial/industrial and Council stakeholder views

Opportunities and issues raised in consultation with commercial/industrial stakeholders relate to both region-specific and at a more macro-level include:

- Challenges:
  - Lack of in-region processing options.
  - Small Council volumes.
  - Large transport distances between centres.
  - Large variations in waste streams that are impacted by seasonality or subject to contamination.
  - A lack of knowledge and expertise on alternative processing options.
  - High capital cost for alternative processing facilities.
  - Waste management is not the core business of many of these industries, and they would prefer to outsourcer management of their waste streams to those with the relevant expertise.
- Opportunities:
  - Large established agricultural industry (potential market for end products like compost, for example).
  - More scrutiny and increasing environmental concerns around land discharge and ocean outfall consents so there is an increased awareness of the need for viable alternatives.
  - Maximising value from organic materials recovery, for example high value soil amendments and/or biogas production.
  - Emissions reduction and waste minimisation potential from:
    - Recovering and re-purposing organic waste streams that are currently sent to landfill.
    - Local facilities reducing the need for long transportation routes out of region.

3 Objectives for organic materials in Taranaki (where do we want to get to?)

3.1 National policy and priorities

3.1.1 Regulatory framework

The key regulatory framework for the resource recovery sector in New Zealand is the Waste Minimisation Act 2008 and the Resource Management Act 1991.

- The Waste Minimisation Act 2008 sets a framework to encourage a reduction in the amount of waste generated and disposed of in New Zealand, minimising environmental harm from waste and providing economic, social and cultural benefits.
- The Resource Management Act 1991 promotes sustainable management of natural and physical resources. Although it does not specifically define ‘waste’, the RMA addresses waste management and minimisation through controls on the environmental effects of waste management.

3.1.2 New Zealand Waste Strategy

In October 2021 the Ministry for the Environment (MfE) released a consultation document on a new Aotearoa New Zealand Waste Strategy. The focus of this strategy is the guidance and direction on a collective journey towards a circular economy. A proposed priority is the reduction of emissions from organic material through:

- Reducing waste.
- Diverting organic material from landfill to recycling and composting.
- Improving and extending landfill gas capture systems.

These priorities are drawn from the report released by the Climate Change Commission in June 2021, outlining how New Zealand could meet its international emissions reduction commitments and its obligations under the Climate Change Response Act 2002 and actions that relate to waste.

3.1.3 Landfill Levy

From July 2021 the New Zealand Government will progressively increase the national waste disposal levy from $10 per tonne to $60 per tonne in July 2024. At the time of writing, the waste disposal levy is $20 per tonne. 50% of each Council's total waste levy spend is returned to them during each financial year, while the other 50% goes into the national Waste Minimisation Fund.

Revenue from the waste disposal levy is expected to be used to fund resource recovery initiatives, with MFE indicating a desire for a greater focus from Councils on improving local waste management and minimisation infrastructure. Councils are able to apply for funding for larger projects through the Waste Minimisation Fund.

3.1.4 Standardisation of kerbside waste and recycling collections

MfE is working with Councils, industry and Government to standardise kerbside collection systems across New Zealand. In March 2022, the Ministry for The Environment released a Consultation Document called Te panoni I te hangarua - Transforming Recycling[18] that addresses container return schemes, improvements to household kerbside recycling and separation of business food waste. The document seeks feedback on several proposals, those relevant to this study include:

- Standardising and enforcing the provision of kerbside food scraps collection to all urban populations by local government. This would increase the quantity of household food scraps suitable for processing generated in Taranaki, and would mean each Council would have to provide a separate food waste collection as part of their kerbside services.
- Enforcing the phasing in of source separation of food waste by businesses.
- Prohibiting disposal of food waste to landfill by businesses. This would be likely to increase the quantity of commercially sourced food scraps suitable for processing generated in Taranaki.

3.2 Regional policy and priorities

3.2.1 Waste Management and Minimisation Plans in Taranaki

The STDC 2018 Waste Assessment outlines that the three District Councils in the Taranaki region are committed to collaborating regionally to achieve effectiveness in waste management and minimisation. Key elements relevant to this study include the following goals:

- Maximise opportunities to reduce waste to landfill;

[18] Ministry for the Environment. 2022. Transforming recycling: Consultation document. Wellington: Ministry for the Environment.

- Reduce the harmful and costly effects of waste;
- Improve efficiency of resource use.

There are also target to 'Reduce the amount of organic material to landfill by 10% by 2023'.

Each of the District Councils also have a Waste Management and Minimisation Plan, adopted in 2018, that is a statutory document for promoting and achieving effective and efficient waste management and minimisation goals within each of the districts. These plans reflect the goals and target set out in the Regional Waste Assessment.

3.2.2 Other relevant local plans and priorities

3.2.2.1 Emission reduction plans

Councils in the region have signalled their intention to start work programmes to understand and respond to the challenges facing their organisations, communities and the wider district from the effects of climate change. NPDC has made progress in developing an emissions reduction plan with a goal to reduce carbon emissions by 50% by 2030. STDC is aiming to be carbon zero by 2035. Minimising emissions from the waste the District Councils manage is a key component to achieving their carbon reduction goals.

Each Council's work on climate change is underpinned by the regional roadmap in the Taranaki 2050 vision which includes goals for the region to equitably transition to a low emission economy.

3.3 Iwi-Hapū partner priorities for organic material

Full commentary on Iwi and Hapū priorities for organic material are included in the Aatea Report[4], which should be read alongside this report.

Iwi-Hapū were asked what their vision of what successful organics recovery would look like. Answers included:

- Local and regional circular economies thriving.
- Iwi driven solutions.
- Facilities would contribute to Māori and local kai resilience and sovereignty.
- Te taiao and soil health in Taranaki would improve.
- Creation of Māori employment and enterprise, particularly in the facility location/s.
- Joint decision-making as Tiriti partners is most important, and that was not currently on offer.

Participants were also asked what failure would look like. Failure was described as:

- Superficial or symbolic conclusion, tokenism so all of the kōrero is there, all of the words but no change in power.
- Sending our para up to Hampton Downs to just stick your *[waste]* in a bin and then the Council picks up. That's such a lack of responsibility as a human.
- A centralised, anaerobic digestion system that took all of the food waste and turned it into greenhouse gases. However, it is important to note that using renewable biogas generated from anaerobic digestion to decarbonise process heat currently run on fossil fuels can reduce emissions.

Please note that the above statements are directly taken from those provided in the wānanga, unless shown in brackets and italics.

Iwi and Hapū were also asked to list their "bottom lines" for the project which were listed as:

- Keeping any para local.
- Ensuring stringent monitoring of the selected Organic Materials Recovery (OMR) facilities to ensure no further harm to te taiao.
- Industry to take responsibility for their 'waste' and "pay their way".
- Local community level initiatives also be amongst the solutions.

3.4 Industry/stakeholder views

In the initial consultation workshop with industry representatives and Council, stakeholders were asked what their vision of what successful organics recovery would look like. Answers included:

- Having a reliable system that is available 24/7.
- A system that contributes to positive local outcomes.
- A system that is financially sustainable.
- A system that is run by experts who know what they are doing and do it well.
- A system that is targeted in what materials it will accept and with an end goal to maximise recovery of value through the development of a product that is saleable, rather than minimising the cost.
- A single solution may not be suitable for all waste streams.
- A system that is compliant with legislation and planning/consenting requirements, and has good environmental outcomes.
- A system that is designed using whole of life cycle thinking.
- A system that considers a use for any end products (that is transparent and considers all impacts of outputs (for example, emissions, pathogens)).
- A project that partners with Iwi and Hapū in all respects.
- A system that includes multiple solutions in different parts of Taranaki may be needed and carefully considers the transport impacts of any option.

3.5 Evaluation criteria

As part of defining our approach to assessing the potential options with Council staff, Iwi and Hapū and commercial/industrial stakeholders, we discussed key priorities for recovery options. These priorities are being used as a basis for criteria to evaluate options. These criteria have been formulated from and in consultation with Iwi and Hapū and the industry stakeholders by asking what vision these partners and stakeholders had for the study.

Draft criteria were then tested in the Wānanga where we asked Iwi and Hapū partners to prioritise the criteria. To evaluate options a range of criteria were identified by Wānanga participants and Council. In the Wānanga, participants prioritised draft criteria (from their 'bottom lines' kōrero at the preparatory hui) into 'must have, lower priority and not needed'. No criteria were considered 'not needed' and very few lower priority.

The list of criteria developed in the Wānanga are organised under the headings of:

- Te Taiao
- Iwi and Hapū Development
- He Tangata

The Council also proposed a number of criteria (Kaunihera criteria) and partners had the opportunity to review and provide comment. The Council's proposed criteria were:

- Maximise diversion of organic material from landfill.
- Maximise reduction in greenhouse gas emissions.
- Best cost: benefit.
- Improving environmental outcomes.
- Improving local economy and employment opportunities.

Additional comments from Wānanga participants included:

- Space for partnership with industry over time.
- Acknowledgment and valuing of mātauranga Māori (including maramataka).
- 'We are not looking at the true, real picture when we talk about 'cost'. The full picture and full cost. It's not just the monetary cost. It`s the cost to our connection to our taiao.'
- All industries to utilise quadruple bottom line reporting - social, cultural, environmental and economic.

The criteria ultimately developed are a combination of criteria proposed by Iwi-hapū partners and Council and are shown in Table 3.1. The views of commercial/industrial stakeholders were also taken into account in developing the criteria. The Council criteria "Employment opportunities" was not used as it is accounted for in different aspects of "Opportunity for Iwi and Hapū development" and "He tāngata" which include the prioritisation of local and community benefits.

Table 3.1: Adopted criteria for evaluation of options

Number	Criteria	Definition
1	Te Taiao	· Awa and whenua: Chosen option/s does not have a negative impact on waterways (awa) or land (whenua) · Appropriate site/s: Ensure that the site/s selected is/are appropriate for the type of organic material being processed · Keep waste from the rohe in the rohe: Waste produced in Taranaki should be processed in Taranaki · Circular systems: Organic matter is not waste. It is a resource that should be used and returned back and builds our soils · Identify significant sites for Iwi and hapū · As technology improves and it is more beneficial to the taiao we explore these options for where our para goes · Organic material location - be strategic with opportunities to collaborate together

Number	Criteria	Definition
2	Opportunity for Iwi and Hapū development	· Contributes to community resilience · Connect tangata whenua with whenua · Reduce economic/social disparity between residents · Starts from mātauranga Māori · Remove socio-economic barriers · Community-driven · Build long-term food sovereignty · Enable economic outcomes via growing Māori owned enterprises · Connect tāngata whenua with whenua, through decolonising our whakaaro, attitudes, behaviours and actions regarding organic 'waste' so move away from current government-provided systems · Create political and economic agency with Councils. Many economic opportunities could be created · Whānau, Hapū, Iwi enterprise. This will reduce economic/social disparity. It will result in taiao, kai, awa regeneration. Segues into connecting tāngata whenua with whenua · Iwi/Hapū and Council co-governance model based on producing a commercially viable product that supports community outcomes and objectives · Non-operational objectives = commercial product which supports community outcomes
3	He tāngata	· Ongoing benefits: Intergenerational benefits. Employment and educational opportunities · Local food production: Facility products contribute to local māra kai and Iwi and Hapū agri-businesses so whānau can eat nutrient-rich kai · Industry responsibility: Partnerships with industry: industry pays for their own organic materials streams to be properly recovered · Māori Hapū/ Māori community groups/ Māori enterprise services and goods procured · Local food production: Facility products contribute to local māra kai and Iwi and Hapū agri-businesses so whānau can eat nutrient-rich kai · Identify skills and qualifications needed in a facility and support Iwi/Hapū to develop uri · Needs to be intergenerational THINKING not just benefits. · One ultimate objective: centralised total waste stream facility: pyrolysis machine... biochar... · Produce electricity for sale Whānau, Hapū Iwi be part of creating the solutions R&D at local/home and community levels, and at the industry level as well
4	Diversion of organic material from landfill and recovery of products of value	· Options need to deliver increased diversion of waste from landfill and need to deliver products at a quality suitable for end markets and the risks of identified markets need to be considered
5	Greenhouse gas emissions	· The net carbon impacts need to be considered · Emissions reduction needs to be an explicit key performance indicator (KPI) for any organic materials recovery facility

Number	Criteria	Definition
6	Cost	· Cost needs to be acceptable for households and businesses – linked to capital and operational costs less any rate payer subsidy If the model includes Council or Iwi and Hapū investment, then establishment and ongoing operation costs need to be viable over the long term
7	Technology maturity	· Complexity, safety (integral to any decision making process), operational requirements and proven technology track record

Several other criteria were identified during the wānanga but considered lower priority than those noted above. These were:

- Ability for flexible infrastructure/ enable future innovations and scalability (ability to pilot or adapt if improved technologies/systems are developed).
- Options that are focussed on behaviour change, pushing responsibility back on those that generate waste.

4 Options for Taranaki (how could we get there?)

4.1 Organic material management approaches

Once produced, organic material is in many cases included as part of the residual waste stream and sent to landfill. This reflects the lack of convenient alternatives available to households and businesses. The focus of this report is identifying ways to reduce the amount of organic material ending up in landfill.

The 2018 Waste Assessment refers to the waste hierarchy as the preferred order of waste minimisation and management methods (Figure 4.1). Using this framework, the options for managing organic material in order of preference include:

- Reduce the volume of organic material e.g. through food waste minimisation projects like Love Food, Hate Waste and home composting.
- Recycling or Recovery of organic material to produce a usable product, for example mulch or compost.
- Recovery of energy using an Anaerobic Digestion process for putrescible organic material or burning of woody organic material to create a green or low emissions fuel source.
- Disposal of organic material, either at a dedicated disposal facility or a general waste landfill.

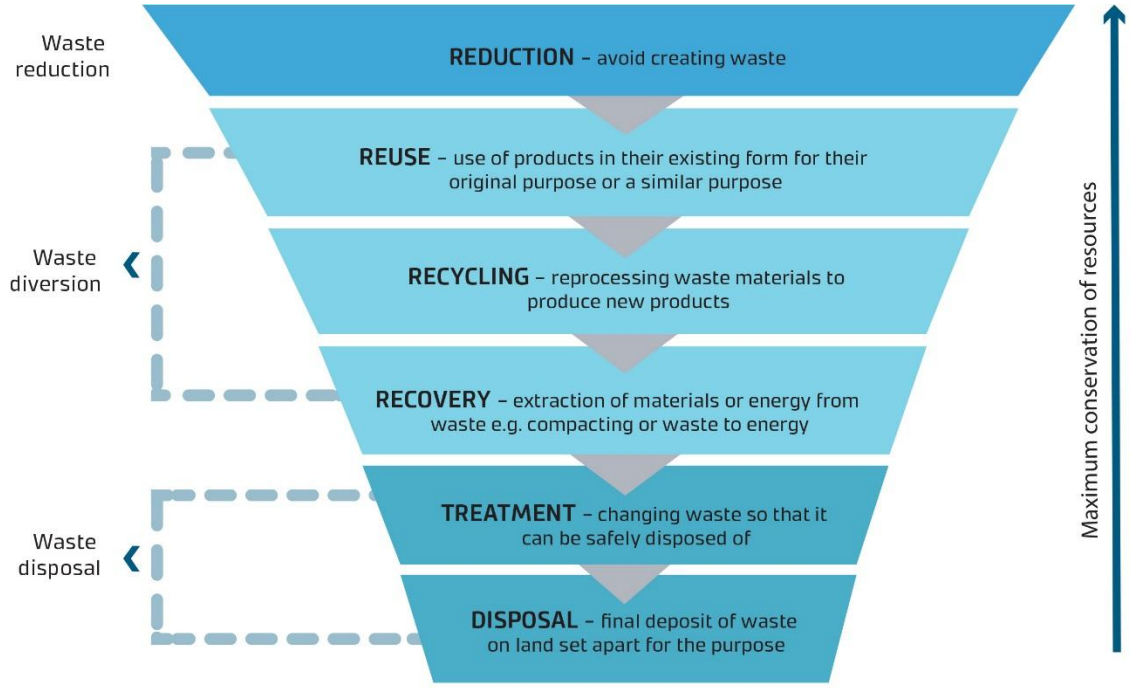


Figure 4.1: Waste hierarchy

In some cases, organic material can be managed at household or business level through small scale approaches typically composting or worm farming. In most cases, before materials can be processed they need to be 'collected' in some way. There are a number of options for the 'collection' of organic material from households and commercial businesses. These include:

- Council or private collections - garden waste and in some cases food organics.
- Local collection points e.g. recycling, waste and/or organics collection point for apartment buildings.
- Council or private sector transfer stations/recycling facilities.

Figure 4.2 shows the generation, collection, processing and markets for the products from organic material processing. The ideal scenario reflects the concept of a circular economy where nutrients and organic matter in the organic material is used to maintain soil health and becomes incorporated into a product/s. This may include the recovery of energy as part of re-processing of materials, for example via utilisation of biogas produced through anaerobic digestion. Alternative scenarios represent a linear approach where organic materials end up alongside other waste types in a landfill or are in part destroyed to generate energy with residuals landfilled.

The focus of this study is on the processing aspect of the pathway outlined in Figure 4.2. However, it is important to consider that collections are an enabler for different types of processing as the quantity, composition and quality of material collected will help to define what processing options are feasible. Similarly establishing markets for outputs of processing increases their economic viability. Although processing is the focus of this study options need to be considered in the context of the broader organic material life cycle.

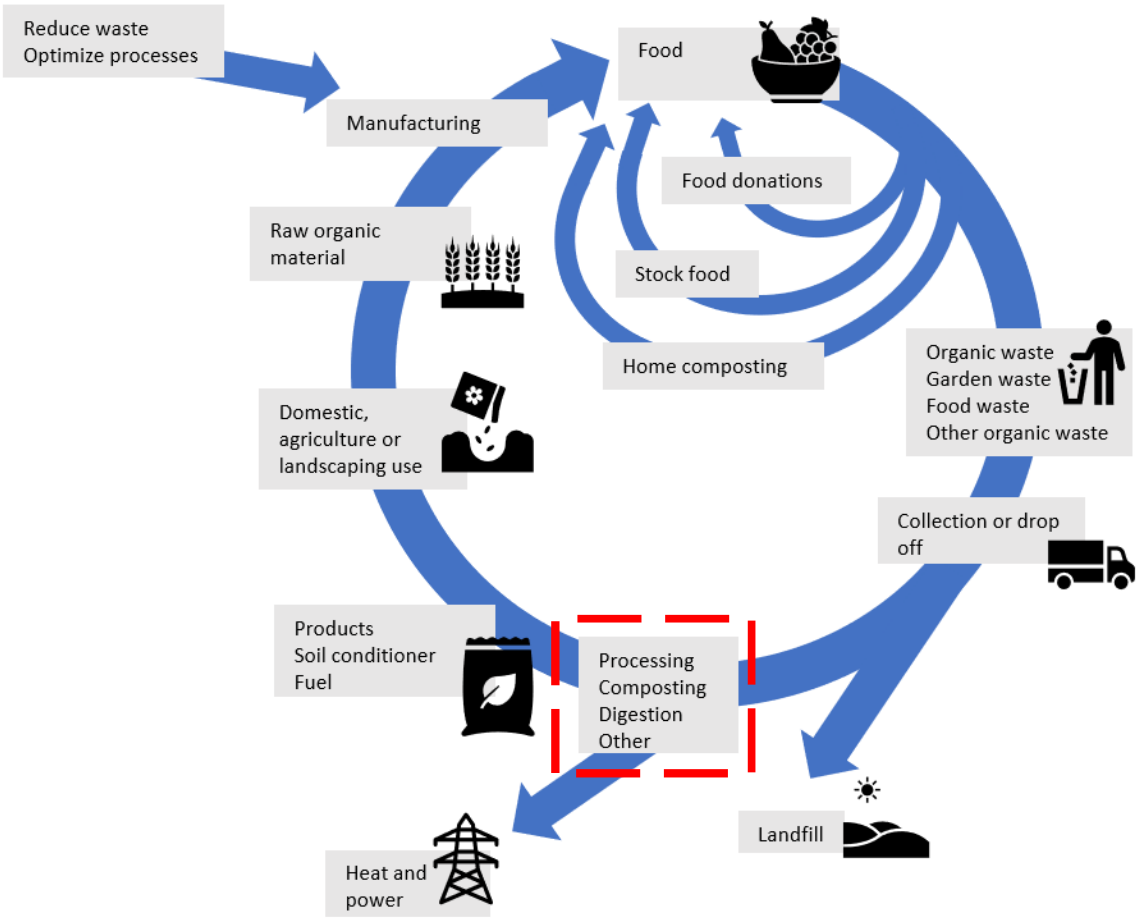


Figure 4.2: Circular and linear pathways for organic material management and use

4.2 Organic material reduction

From a Council perspective, the ideal solution is to work at the top of the waste hierarchy, avoiding the generation of garden or food waste altogether. The Love Food, Hate Waste campaign being run at a national level and supported by all three District Councils is a good example of this approach. Other examples include changing landscaping approach and process optimisation and/or by-product utilisation for primary processors.

While not reducing the generation of organic material, encouraging households or businesses to manage organic material on site or within their operation appropriately avoids the need for Council or a third party to collect, process and/or dispose of the material.

Solutions put forward for organic processing should work alongside reduction and on site management approaches where appropriate i.e. not replace current and future waste reduction initiatives but be complementary to them.

4.3 Organic material reuse

Options for reusing organic material include re-distribution of food to feed people and redistribution of food to feed animals. Organisations such as *On the House, Neighbourly* and *Kai Kitchen* already operate in Taranaki, redistributing quality food that would have otherwise gone to waste. There are also a number of organisations redistributing organic material to stock food (EcoStock, Atawhai Industries) and a number of large-scale generators that have informal arrangements with farmers.

Key considerations for organic material re-use are ensuring feedstocks are fit for purpose and safe for consumption. Stock food needs to be free of contamination and sometimes requires pre-processing (i.e. removal of packaging or cooking) before it is fit for animal consumption.

Case Study – Kai Ika Project

The Kai Ika project provides a professional filleting service from a trailer located at Z Pier at Westhaven in Auckland and at the Outboard Boating Club in Orakei. Offcuts from filleting (such as fish heads) are distributed back into the community by the Papatūānuku Kōkiri Marae in Mangere.

The inedible offal is used as fertiliser in the marae gardens. The organisation's mission is to decrease waste going to landfill, generate meaningful employment, education and increasing social, economic, cultural and environmental benefit.

Successful redistribution of food for human consumption typically involves community or charity organisations. Councils can take a role in supporting these initiatives through access to grants, providing a location for operations and making connections between key stakeholders. The scale of diversion potential is limited as only a small portion of total organic material is suitable for reuse.

4.4 Organic material collections

Key considerations for kerbside/on site collections include:

- Target materials - garden waste and/or food waste.
- Collection methodology - Container (bag, bin), collection frequency.
- Funding - rates, direct charge, universal vs optional service.
- Seasonal effects - changes in garden waste quantity, storage of food waste in warmer months.

For larger scale generators of organic materials, ongoing availability of collection and management service is important. This reflects the ongoing generation of materials and limited ability to stockpile materials if collection services are not available.

4.5 Processing technologies

There are several aspects to consider when selecting a processing approach, including:

- Processing technology - suitability for feedstock, management of product quality, management of processing impacts and technology maturity.
- Seasonal changes – there is likely to be little garden waste collected over the winter months i.e. any process will need to cope with variation in both quantity and composition.
- Contamination: likely type, source, percentage and effect on processing and product.
- Feedstock - garden, food or food and garden waste, DAF solids, what additional materials are required for effective processing and to maximise the value of output.
- Processing location - collection/transport logistics, surrounding land use, proximity to market.

- Processing operations ownership - council, partnership (Iwi Hapū, sub-regional, Council/private or fully private sector).
- Existing processing capability of the region, potential to disrupt or complement the capabilities of existing services.

For all of the processing options considered in the remainder of this section, feedstock mix is important. For biological processes the feedstock needs to provide the right nutrient mix for successful processing. Physical characteristics are also important with particle size (to support effective aeration where relevant) and water content are often important considerations. In practice this means that a mix of multiple feedstocks is the best solution, for example food waste mixed with garden waste or DAF solids mixed with bark for composting.

The capability of the operator is also important but outside the scope of this early assessment. This is a critical consideration when selecting a processor or contracted operator of an organic materials recovery system.

Similar to collections, for larger scale generators of organic materials, ongoing availability of collection and management services is important. In addition to ensuring that processing is available, the location is important with particular consideration required where transport links have the potential to be disrupted. Disruption may occur as a result of natural hazards (earthquake, floods, landslides) and/or other events such as pandemic (driver availability).

4.5.1 Composting

Open windrow composting

Open windrow composting and aerated windrow composting are typically used for the processing of garden waste. There are examples in New Zealand of this approach being used for combined food and garden or organics[19] or the processing of other putrescible materials[20].

Composting can be adopted at various scales including at home composting, community composting and commercial scale composting.

Home composting and similar solutions like worm farms, have been promoted in other countries and are used by many householders across New Zealand. While not reducing large volumes of waste, managing organic material at a household level reduces the quantity of waste that enters the waste collection system. There are a number of different products on the market ranging from simple composting bins, multi-chamber composting bins and various worm farming products.

[19] Capital Compost - open windrow composting of garden organics (private sector collections and drop off) and food organics (commercial food organics - Kai to Compost).
[20] BioRich - aerated windrow composting of garden organics (private sector collections and public drop off), food organics (informally allowed in private sector garden organics collections) and other putrescible materials.

There are a number of successful community composting initiatives operating across the country. Where successfully adopted, the integration of community composting with community gardens/urban farming has proven to be a successful model for the reuse of organic material, especially for shared community spaces (schools, maraes). These initiatives require community groups, not for profits or small private enterprises to champion programs. Opportunities for urban areas need to consider compliance with local bylaws and potential amenity impacts.

Case Study – Cultivate, Christchurch

Cultivate have been established in Christchurch since 2015 and collect 2.5-3 tonnes per week of food waste and coffee grinds from local hospitality businesses. Businesses are charged $20 per bin. This is a higher cost than commercial waste collectors, however businesses are willing to pay with the knowledge that Cultivate has a combined social mission with their profitable business model (the education and employment of those disadvantaged in the community).

Virtual networks are also being established to connect and increase the uptake of community composting initiatives. The Compost Collective uses a virtual network to connect people who wish to recycle their food scraps and other organics with their neighbours or community gardens who are already composting, worm-farming or keep farm animals. The app platform has over 6000 food waste generators and over 800 hosts (processors) across NZ.

Current composting operations in the region (such as Cowleys Landscaping Supplies) are for garden waste only.

Where garden organics composting is not managed efficiently, anaerobic conditions and thus odour can develop. This is a consideration where composting takes place in close proximity to residential properties. Effective aeration (for example regular turning) mitigates this risk but may require investment in additional equipment or infrastructure such as dedicated a compost turner, forced aeration system or odour management systems.

Examples of open windrow composting in New Zealand includes:

- Living Earth, Auckland (Puketutu Island) – open windrow composting.
- Tirohia, Waikato – open windrow composting.
- Hamilton Organics Centre, Hamilton – open windrow composting.
- Composting New Zealand, Otaihanga, Kāpiti Coast – open windrow composting.
- Capital Compost, Wellington – open windrow composting.
- Biorich, Napier – aerated windrow composting.
- Green Island, Dunedin – open windrow composting.

Examples of community composting include:

- Community Compost – Nelson – Social enterprise who collect and compost food waste from homes, businesses and events (approx. 70 TPA).
- Kai Cycle – Wellington - Urban farming and Community-scale composting (approx. 0.5 TPA).
- Cultivate – Christchurch – Social enterprise see case study above.

Considerations for open windrow composting include:

- Management of odour.
- Arrangements for turning of materials.
- Feedstock - best suited to garden waste.
- Outputs are compost (soil conditioner) suitable for residential (garden centres), council (parks and gardens) and commercial (horticultural) applications

In-vessel composting

In-vessel composting is typically employed where putrescible materials, including food waste, are being processed. While the enclosure of the composting process reduces the risk of odour impacts, in-vessel composting is typically located away from sensitive receptors and careful thought is required to manage materials reception and load out facilities as well as the composting process.

With respect to materials, in-vessel composting can be flexible with either food, garden or a combined feedstock potentially appropriate. A food only feedstock would require mixing with a carbon rich bulking agent, for example garden waste or sawdust/wood chips.

The in-vessel composting process is intended to actively manage mixing and aeration components of the composting during the initial phases of composting. Processes are typically designed for several days to weeks residence time with the product then 'matured' in conventional windrows outside. This means in addition to the infrastructure associated with the in-vessel processing space is also required for maturing on a pad with appropriate control of stormwater[21].

Examples of in-vessel composting in New Zealand includes:

- Living Earth – Christchurch (18 indoor processing tunnels processing 50,000 TPA).
- Hampton Downs, Waikato.

Considerations for in-vessel composting include:

- Management of odour including venting, materials reception and load out.
- Compost maturation - space for storing compost post the initial intensive in-vessel processing.
- Feedstock - suited to combined food and garden waste or food organics with additional carbon rich bulking agent.

Vermicomposting

Vermicomposting is also employed in some areas processing industry wastewater solids, municipal biosolids, drilling muds and food waste.

Examples of vermi-composting in New Zealand includes:

- Wormworx in Central Otago – dairy farm effluent, vineyard and orchard excess (1000 TPA).
- MyNoke in Tokoroa, Ohakune. Taupo, Matata and Putaruru – Largest plant being 25 Ha processing 70,000 TPA.

Considerations for worm farming are similar to composting with high nitrogen feedstock (such as food waste and wastewater sludges) also requiring considerable carbon rich bulking agent. Outputs are worm castings which is considered a high quality soil conditioner appropriate for horticulture and gardens.

4.5.2 Anaerobic digestion

Anaerobic digestion is a series of biological processes in which microorganisms break down biodegradable material in the absence of oxygen. It is in essence the same process by which organic material degrades in a landfill however in this context, the digestion occurs in a sealed tank.

Anaerobic digestion is suited to putrescible materials including industry wastewater solids, municipal sewage sludge and food waste. A key consideration in any anaerobic digestion process is providing a consistent feedstock to allow the microbial community in the digestor to establish. This is relatively

[21] For example, the Living Earth composting process in Christchurch (processing FOGO from household collections alongside other feedstocks) comprises an in-vessel process (approx. 7,500 m^2) and maturing area (approx. 40,000 m^2).

straightforward for large scale commercial/industrial waste generators but more challenging with inherently variable feedstocks such as household food waste. 'Shocks' in the quantity or strength of feedstock can result in process failure or overproduction of gas.

Conventional methods process low-solids feedstock producing a digestate that is dewatered to produce solid (15-20% dry solids) digestate and liquid. Solids are further processed or disposed of to landfill, liquids are typically recycled through wastewater treatment processes.

There are emerging approaches that involve pre-treatment of feedstock to enhance degradability[22] and that process very high solids in a batch style process. These are unproven in a New Zealand context and at an early stage of commercialisation internationally. In New Zealand, anaerobic digestion is common in major wastewater treatment plants. There are examples of municipal wastewater treatment plants co-digesting industrial wastewater solids. Eco Gas is developing a food waste digester in Reporoa (Waikato).

Further processing may involve dewatering, drying or composting. Drying is energy intensive[23] and typically produces a granular product suitable for soil incorporation and for some applications top dressing[24]. Composting is typically in-vessel (to manage odour) and requires a high carbon bulking agent similar to the processing of raw food organic wastes.

Dry digestion is an emerging technology that can reportedly handle a mixed garden and food organics feedstock. This technology is relatively unproven and has yet to be implemented in Australia or New Zealand for any feedstock.

Anaerobic digestion is more complex than in-vessel composting and variability in feedstocks can have significant impacts on process stability and outputs. Other potential feedstocks for digestion include waste from food processing, agricultural slurries, DAF solids, all of which are available in the Taranaki Region. However, a constant supply/ contracted volume over a relatively long time period would be required to ensure a consistent feedstock.

Case Study – Re-waste – Yarra Valley Water, Wollert, Victoria, Australia

Yarra Valley Water has been operating a food waste anaerobic digestion plant north of metropolitan Melbourne since 2017. The plant accepts 33,000 TPA of commercial food waste including fats, oil and grease, fruit and vegetable wastes, waste from animal processing facilities, restaurant and catering food wastes and brewery and dairy wastes.

The plant generates 1 MW of electricity for 100 t of food waste and supplies electricity to the adjacent Aurora wastewater sewage treatment plant and exports excess to the grid. The company is on a journey to capture value from digestate but progress on the initiative has been hindered by changes to legislation in reportable priority waste residues in Victoria.

There is no established commercial scale anaerobic digestion of food waste in New Zealand. Eco Gas Reporoa will be New Zealand's first large scale food waste to bioenergy facility accepting 75,000 tonnes per annum (TPA) of businesses and kerbside food scrap collections from around the North Island. The project is costing approximately $30 million dollars to build and is due to open in mid to late 2022.

[22] Cambi, Ultrasonic or similar pre-treatment designed to breakdown organic waste at a cellular level to improve digestability. These systems have been developed for wastewater solids processing.
[23] Selwyn District Council have recently installed a solar drying facility that is less energy intensive but requires a significant amount of space.
[24] See http://www.bioboost.co.nz/, dried biosolids from New Plymouth wastewater treatment plant.

4.5.3 Other processing options

There are other processes which can be used for the treatment of organic material. These are discussed briefly below.

Wood waste as biofuel - There are multiple examples of the use of wood waste to generate energy on wood processing sites around New Zealand[25]. There is potential for woody garden waste or the oversize fraction from compost screening to be utilised in existing facilities or a facility established to make use of that material. Major wood waste 'biofuel' users in Taranaki are Taranaki Pine and Waverley Sawmills.

Stock feed - Commercial/industrial operators in the Taranaki region have indicated that they have successfully been diverting organic by products to stock feed. In general this is achievable due to the ability to manage consistency and quality through well-defined inputs. Large scale diversion of municipal food waste to stockfeed is not generally considered feasible due to contamination issues.

Soldier fly larvae – The capability of solider fly larvae to turn a range of livestock feeds and fertiliser is well understood but application of the process at an industrial scale is yet to be established in Australasia. HATCH biosystems based in Australia have successfully gained funding to expand the company's BSF bioconversion capacity in 2022 in partnership with Cleanaway. This approach has not been implemented in New Zealand.

Hydrothermal liquefaction of wet wastes for the production of liquid fuels is an emerging technology with significant potential for application at commercial scale. This technology is not proven at a commercial scale internationally and not currently applied in New Zealand.

Gasification and pyrolysis are widely used in other countries for the treatment of a mixture of waste streams and generally for larger volumes of waste. Torrefaction is a refinement of gasification and is another emerging technology for improving the quality of material for fuel, combustion and gasification applications. There are some facilities which operate with lower volume feedstocks and focussed on specific material streams, typically urban wood waste or wood processing residues. Products include gas (for further refining or energy generation), liquid (pyrolysis oil, condensate) and solids (biochar, ash). These processes also typically generate air pollution control residues that require treatment prior to disposal as stabilised hazardous waste.

These technologies are typically applied to mixed municipal solid wastes or specific industrial waste streams internationally. There are no examples of these technologies operating at commercial scale in New Zealand, and several previous attempts to establish these plants have been unsuccessful at the consenting stage. However, there is currently a consent process underway in Fielding (Manawatū District Council) for such a plant. While gasification and pyrolysis could be applicable for the processing organic material in Taranaki, they are not considered feasible when cost and technology risk are taken into account.

Mechanical biological treatment or mechanical heat treatment (MBT or MHT) is also an option employed for managing mixed waste including organic material. This suite of technologies could be employed in Taranaki but are focussed on residual waste treatment, are costly and have yet to be implemented in New Zealand.

[25] See https://www.usewoodfuel.org.nz/, examples include Christchurch City Council's biosolids drying facility, Nelson Pine Industries, CHH Tasman, Red Stag timber in Bay of Plenty, Kinleith (pulp and Paper mill), Waikato and Golden Bay Cement (Northland). Azwoods in the Tasman / nelson Region produce wood pellets for use in appropriately designed boilers.

In the UK and Europe and increasingly in Australia, combined mechanical and biological treatment of residual waste is implemented to reduce the organic fraction of waste disposed of to landfill or sent to energy from waste facilities. The output of the biological process is typically a low grade compost type product usable for landfill or mine rehabilitation or similar purposes[26]. In some cases the product is used as a 'Refuse Derived Fuel' for use in conventional waste to energy processes or advanced thermal treatment processes.

4.5.4 Landfill disposal

Continued disposal of organics to landfill currently remains an option, although MFE have indicated this may change in the near future. The landfill at Bonny Glen does have an established landfill gas capture system. The efficiency of landfill gas capture is dependent on the location of wells, age of waste and the management and operation of the site. Landfill gas collection efficiency varies significantly across landfills.

4.5.5 Processing options for each material

Not all technologies are applicable to all materials listed in the gap analysis. Applicability of technologies to each material is shown in Table 4.1.

[26] The NSW EPA re-evaluated the use of 'mixed waste organic outputs' from biological treatment processes resulting in the removal of some markets for the use of these materials in NSW. Refer https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/resource-recovery-framework/mixed-waste-organic-material

Table 4.1: Applicability of processing options to each material

PROCESS	Home compost	Compost, windrow	Compost, in vessel	Vermi-compost	Anaerobic digestion	Biofuel	Gasification, pyrolysis, torrefaction	Stock food
Food	ü	û/ü[27]	ü	ü	ü	û	ü	ü[28]
Garden	ü	ü	ü	û	ü	~	ü	û
Paunch waste	û	û/ü[27]	ü	ü	ü[29]	û	ü[30]	û
DAF solids	û	û/ü[27]	ü	ü	ü[31]	û[32]	ü[29]	û
Poultry waste	û	û/ü[27]	ü	ü	ü[33]	ü[32]	ü[29]	û
Bark, wood	û	ü	ü	û	û	ü	ü	û

[27] Okay when making up relatively small portion of total mix. Special consideration of odour management and buffer distances required.
[28] Pre consumer food waste only.
[29] Investigations of paunch waste as a feedstock for AD are limited and the minimal studies to date are inconclusive. The option may warrant further investigation but not an established processing option in Australasia to date (Bernadette K. McCabe, Peter Harris, Diogenes L. Antille, Thomas Schmidt, Seonmi Lee, Andrew Hill & Craig Baillie (2020) Toward profitable and sustainable bioresource management in the Australian red meat processing industry: A critical review and illustrative case study, Critical Reviews in Environmental Science and Technology, 50:22, 2415-2439, DOI: 10.1080/10643389.2020.1712310).
[30] Limited existing commercial facilities. Reported that further study is required to improve project economics and pilot studies conducted.
[31] DAF solids is an unconventional AD feedstock. Although it recognised that high organic content makes DAF solids an appealing option for digestion widespread uptake is limited due to issues with the feedstock relating to volatile fatty acids' accumulation and/or ammonia inhibitions.
[32] Still at research and development phase.
[33] Limited existing commercial facilities.

4.6 Evaluating the long list of processing options

The processing options summarised in Section 4.4 have been evaluated against the evaluation criteria from Section 3.5. The assessment has also considered 'available' materials drawing on the information presented in Section 2.3.

Table 4.2 presents a summary of the option evaluation. The colour coding relates to the 'performance' of the collection system component with respect to the evaluation criteria.

- Green indicates that the component supports achieving the desired outcome
- Orange indicates that the component somewhat supports the desired outcome
- Red indicates the component does not support the desired outcome.

In summary while advanced treatment such as gasification, pyrolysis, mechanical biological treatment, hydrothermal liquefaction, torrefaction and biofuel could be applied they are considered high risk due to lack of existing commercial operations in New Zealand or Australia and high cost so are not considered further noting that there are more conventional processing options available.

Some options, such as home or community composting, may not form an entire solution in themselves but present an important complementary opportunity to encourage the community to recover value from material at their homes and can form part of a solution so are taken forward for further consideration below.

Consideration of Iwi and Hapū development criteria have included those options with a heavy reliance on sophisticated technology that could be an opportunity for project partners to be owners, investors or operators. Options that consider broader community outcomes such as small scale processing in partnership with community groups or Marae score well against He tāngata criteria.

Table 4.2: Option evaluation summary

Options	Iwi and Hapū criteria			Kaunihera criteria				
	Te Taiao	Opportunity for Iwi and Hapū development	He tāngata	Diversion of organic material	Carbon impacts	Capex	Technical Risk	Short list
Home composting								Yes
Community composting								Yes
Food donations								Yes
Stockfeed								Yes
Windrow composting								Yes
In vessel composting								Yes
Aerated static pile composting								Yes
Vermiculture								Yes
Soldier fly larvae								No
Hydrothermal liquefaction								No
Anaerobic digestion								Yes
Biofuel								No
MBT and MHT								No

Options	Iwi and Hapū criteria			Kaunihera criteria				
	Te Taiao	Opportunity for Iwi and Hapū development	He tāngata	Diversion of organic material	Carbon impacts	Capex	Technical Risk	Short list
Gasification								No
Pyrolysis								No
Torrefaction								No
Application to land								No
Landfill/consented fill								Yes

4.7 Shortlist

Partners and stakeholders were clear that options that address material further up the hierarchy (i.e. waste reduction and reuse before recovery and disposal) should be prioritised. However, the level of diversion practicable for large volumes at the higher levels of the hierarchy can sometimes be limited.

Each of the options taken forward into the shortlist are presented in Table 4.2 and mapped against what materials they relate to and how each option is considered in the context of the waste hierarchy. The shortlist of options will look to combine options from Table 4.2.

The table also includes information on the characteristics of materials identified in the gap analysis. Taking a regional approach to organics material management needs to consider the mix of organic streams and their characteristics that may create opportunities or constraints in processing options. For instance, composting requires that materials high in nitrogen be balanced by materials high in carbon (referred to as the carbon to nitrogen, or C:N, ratio. Some technologies are more sensitive to contamination.

For the table we have grouped processing options (from Table 4.2) as follows.

- Home composting
- Community composting
- Food donations
- Stockfeed
- Centralised composting (windrow composting, in vessel composting, aerated static pile composting)
- Vermiculture
- Anaerobic Digestion

Table 4.3: Shortlist of options

Material	Description	Key properties	Reduction	Reuse	Recycling	Recovery	Dispose	Comment
Garden waste – residential and commercial/ industry	Vegetation such as leaves, small branches, grass clippings.	C:N ratio: High % solids: High Protein content: Low Lipids: Low Solid Contamination risk: Moderate Seasonality impact: Moderate	Adjust planting to reduce maintenance	Promote reuse/ replanting of removed plants	Home composting Community composting Centralised composting		Landfill	Can be blended with putrescible material Significant contamination risk (collections, Clopyralid).
Food waste – residential and commercial/ industrial post consumption (i.e. cafeteria waste, food and beverage)	Food waste generated by households (inedible food scraps, meal leftovers)	C:N ratio: Low % solids: High Protein content: Low Lipids: Low Solid Contamination risk: High Seasonality impact: Low	Partially available – there will always be an inedible portion	Not applicable	Home composting Community composting Centralised composting Vermiculture Anaerobic Digestion		Landfill	Will require blending with other materials for composting and vermiculture. Significant contamination risk for collections.

Material	Description	Key properties	Reduction	Reuse	Recycling	Recovery	Dispose	Comment
Food waste commercial/ industrial– pre consumption (edible)	Commercial/ industrial food waste generated by businesses during manufacture (i.e., out of spec products, damaged products)	C:N ratio: Low % solids: High Protein content: Low Lipids: Low Solid Contamination risk: High Seasonality impact: Low	System improvements	Food donations Stock food	Centralised composting Vermiculture Anaerobic Digestion		Landfill	Sometimes packaged. Will require blending with other materials for composting and vermiculture.
Food processing waste – pre consumption (inedible)	By products of food manufacturing generated by businesses during manufacture (i.e. processing waste, offcuts)	C:N ratio: Low % solids: High Protein content: Low Lipids: Low Solid Contamination risk: High Seasonality impact: Low	System improvements	Stock food	Centralised composting Vermiculture Anaerobic Digestion		Landfill	Sometimes packaged. Will require blending with other materials for composting and vermiculture.
Paunch waste	Partially digested grass and separated from the stomach compartment of a carcass during processing	C:N ratio: Low % solids: Low Protein content: Low Lipids: Low Liquid Contamination risk: Low Seasonality impact: High	Not available	Not available	Centralised composting (in some cases) Vermiculture Anaerobic Digestion		Landfill Land application	Will require blending with other materials for composting and vermiculture. Anaerobic digestion unproven for paunch in New Zealand.

Material	Description	Key properties	Reduction	Reuse	Recycling	Recovery	Dispose	Comment
DAF solids	DAF solids is small bits of proteins, fats, and fibrous materials that could not be removed by mechanical means of the Dissolved Air Floatation Process.	C:N ratio: Low % solids: Low Protein content: Low Lipids: High Liquid Contamination risk: Low Seasonality impact: High	Not available	Not available	Centralised composting Vermiculture Anaerobic Digestion – technology specific considerable limitations		Landfill	Will to require blending with other materials for composting.
Woody waste	Forestry residue, wood chip/shavings (treated, untreated), saw dust (treated, untreated), bark, soil contaminated wood products	C:N ratio: High % solids: High Protein content: Low Lipids: Low Solid Contamination risk: Low Seasonality impact: Low	Not available	Animal bedding	Centralised composting Vermiculture	Energy i.e. boilers	Landfill (treated) Consented fill (not treated)	As a bulking agent for composting if shredded/ chipped

4.8 Products and markets

4.8.1 Parks, gardens and landscaping

Council operations typically use composts and soil conditioners for landscaping (parks and gardens) and land stabilisation. Providing products of appropriate quality for supply to Council can support an 'internal market' by utilising the compost produced in the region using food and/or garden waste managed by Council. A key consideration is understanding the requirements for each use and working with the end users within each Council to specify suitable products. For example:

- Requirements for parks and reserves - growing media, landscaping, top-dressing for turf.
- Requirements for urban and rural road berms or stabilisation of slopes.

Commercial landscapers also use composts and soil conditioners with similar requirements likely to apply.

Unprocessed digestate is unsuitable for application in parks, gardens or landscaping. Digestate can be dried to provide a granule or pellet like product or combined with other materials to produce compost or similar soil conditioning product suitable for this market.

4.8.2 Retail

There is an active retail market for compost with bagged and bulk product available from landscaping, garden supplies and hardware retailers across Taranaki. The market for bagged product tends to be dominated by national suppliers (Tui, Daltons, and Living Earth) with bagged product shipped around the country and often marketed at low prices to attract customers through national chains.

Local compost producers also market directly to users with bagged and bulk materials available. Where materials are sold direct to the public logistics and marketing costs can be avoided.

Further work is required to understand current demand and the potential for compost produced from materials identified in the Study to secure market share by displacing products imported into Taranaki or growing the overall retail market for compost products.

Unprocessed digestate is unsuitable for retail sale. Digestate can be dried to provide a granule or pellet like product or combined with other materials to produce compost or similar soil conditioning product suitable for this market.

4.8.3 Horticulture and cropping

Taranaki only has a small horticulture sector. In 2019 just over 500 hectares of land was used for horticulture but this is likely to have increased since last reporting was last undertaken.

The sector is steadily growing however with the support of projects such as *Branching Out* looking at new commercial opportunities for the region's food and fibre sector. A study completed during the Branching Out project identified 207,000 hectares being potentially suitable for horticulture. Avocado and kiwifruit are some of the key diversification opportunities being recognised in the region.

Nationally horticulture is an important outlet for compost and soil conditioners. This reflects the document soil quality benefits of integrating compost and mulches into growing systems. Organic certification has become a de facto standard for this market with BioGrow and Assure Quality key certification providers.

The application rate utilised for arable land is around 28 tonne[34]-30 tonne per hectare (UK compost supplier to farmers). This same source has highlighted a lower application rate of 24 tonnes per hectare[35] for compost from in-vessel composting, likely reflecting a different nutrient profile (higher nitrogen content). Similar application rates will apply for digestate. Dried digestate, compost/soil conditioners (including those made using digestate in the feedstock mix) and unprocessed digestate are all potential suitable for horticulture and cropping.

4.8.4 Grassland

Horticulture and arable crops are not significant land uses in the Taranaki Region. There is a large area used for dairy and sheep and beef in Taranaki, approximately 200,000, 50,000 and 70,000 hectares, respectively. While soil is worked less regularly, due to the nature of its use, there is potential for compost and soil amendment use at re-sowing of pasture and also as a periodic top dressing to provide both soil structure and nutrient benefits. Depending on the original source of compost (if containing food waste) grazing breaks may be required dependant on the type of ruminant grazing.

Living Earth compost (Christchurch) has been used on grassland post grazing (note it was highlighted that forward planning was required), but the application of this compost accelerated the rate of soil reserve during pasture rotation.

Application rates to established grassland are difficult to determine and are dependent on soil requirements and limits on nutrient loading). Dried digestate, compost/soil conditioners (including those made using digestate in the feedstock mix) and unprocessed digestate are all potential suitable for grassland, most likely applied as new pasture is put down.

4.8.5 Biogas

A key reason for selecting anaerobic digestion is the ability to generate biogas that is then suitable for producing heat and/or power. Some municipal wastewater treatment plants use biogas from the digestion of wastewater solids to generate heat and in some cases power. Other potential users of biogas include horticulture (greenhouses) and industrial heat users such as primary processors (for example dairy, poultry, red meat).

4.8.6 Other

Biofuel - as noted above there are several major biofuel (wood chip, bark, shavings) users in the Taranaki area.

Stock feed - there are potential markets for stock feed in Taranaki (dairy, piggeries) for quality stock feed. Well processed materials can also be transported to other areas for sale and use.

4.8.7 Markets - Summary

Table 4.4 summarises potential viable markets for Taranaki.

[34] http://www.fgsorganics.co.uk/wp-content/uploads/2015/09/2016-FGS-Organics-brochure-to-Agriculture.pdf
[35] https://www.livingearth.co.nz/rural-testimonials/black-estate-vineyard-waipara

Table 4.4: Summary of potential viable markets

	Landscaping	Retail	Horticulture	Grassland/ Arable	Fuel	Animal Feed
Compost	ü	ü	ü	ü	û	û
Vermi-compost	ü	ü	ü	ü	û	û
Digestate	û	û	ü	ü	û	û
Bark, wood chip	ü	ü	û	û	ü	û
Mulch (bark, wood chip)	ü	ü	ü	û	û	û
Stock food	û	û	û	û	û	ü
Biogas	û	û	û	û	ü	û

5 Options assessment

5.1 Developing short listed options for Taranaki

The choice of organics processing option is usually driven by the composition of the inputs and the desired outputs. Composting is well suited to garden waste and in some locations garden waste combined with putrescible materials such as food waste. Anaerobic digestion is suited to relatively homogeneous putrescible materials including industrial wastewater solids, municipal sewage sludge and food waste. For this reason the technologies are not necessarily mutually exclusive and can work in a complimentary fashion to provide an effective organics waste management system. The process for developing options will consider hybrid solutions as well as a single technology.

Gaps in processing options have therefore been identified for the following materials:

- Household food waste (current – 1,500 TPA, future – 1000 TPA)
- Household garden waste (current – 2,600 TPA)
- Commercial/industrial food waste post-consumer
- Commercial/industrial pre-consumer food waste
- Paunch waste
- DAF solids
- Poultry waste not suitable for rendering
- Timber waste

Drawing on the analysis presented in Section 4, options that include one or more approaches to processing materials alongside reduction and on-site management have been developed. The options considered are:

- Option 1: Do nothing – continue to truck out of region for processing
- Option 2: Centralised composting facility

- Option 3: Centralised Anaerobic Digestion Facility
- Option 4: A network of commercial facilities
- Option 5: A network of commercial and community facilities

Constraints and opportunities for each option are further discussed below. This study does not address potential site locations or specific technologies as these will need to be addressed in the next stages of this project, during development of the detailed business case.

5.1.1 Option 1 – Do nothing

Continuing the status quo would mean continuing to transport organic material outside of the region for processing or disposal. This is undesirable for a number of reasons namely that:

- A lack of processing options in close proximity to the region is meaning travel distances for material are large (>300 km in some instances) and have associated negative environmental, emissions and cost impacts.
- The lack of easily accessible local or regional alternatives to landfill means diversion is too difficult and organic material continue to be disposed of as waste (also transfer out of the region).
- In the near future, it is likely that large producers of organic waste streams (Commercial/industry, industrial and Council kerbside collections) will be required by law to separate and divert organic waste from landfill. There will then be an even greater need for a processing options.
- Both regional and national strategies are aligned in having targets for the diversion of organics from landfill and there is a strong opinion from stakeholders and partners that the value from this material should be recovered in region, where possible.
- Greenhouse gas emissions resulting from organic material decomposition in landfill and transporting waste out of region for disposal are high, and need to be eliminated as much as possible for New Zealand to be able to meet our commitments under the Paris Agreement.

Currently a number of organisations transport organic material out of the region for processing. This study recognises that continuing to transport material for out-of-region processing may be a desirable option if there are facilities developed in close proximity to the region that present an environmentally beneficial means of material recovery.

5.1.2 Option 2 - Centralised facility – Composting

Composting is an established and proven technology for all of the materials considered as part of the gap analysis. Due to the presence of food and other organics an enclosed system would be required if a single facility was to address all, or a majority of, the materials identified.

The key for a successful composting operation is being able to secure the right mix of material. The gap analysis revealed that composting would require significant volumes of bulking agent to establish a successful operation. This is because the majority of materials requiring management are nitrogen rich i.e. require a source of carbon. In most cases the materials are also relatively dense meaning a bulking agent that improves aeration would also be beneficial. Within the Taranaki region there are a number of potential bulking agent sources including timber processing waste, household and Commercial/industrial garden waste and animal bedding.

For any composting operation selection of an appropriate site needs to factor in suitability for a site to manage any potential amenity impacts of operations and to avoid negative impacts on land or water. For instance, composting operation sites need to have adequate buffer distances for odour and potential impact of an unplanned discharge (through proximity to waterways). For the Taranaki

region, it is likely that this would mean locating a facility away from urban centres. Transport costs and impacts can be minimised by locating a site in close proximity to some of the large-scale organic material generators.

One potential role for Councils in a large-scale composting project could be to procure, own and operate a facility with partners. Alternatively, Councils could go to market either alone or in partnership with industry with the offer of a secure waste supply for a private company who build, own and operate a facility. Other large generators have similar options.

Key features of this option include:

- Materials will be transported to a single site for processing (aerated windrow composting, in-vessel composting or vermi-composting).
- Significant bulking (carbon rich, suitable particle size) will be required to enable effective processing where food waste is significant portion of the feedstock.
- The processing site will require careful design to manage odour for materials reception and during aeration.
- The processing site will require design to manage nutrient impacted water (from composting materials, stormwater).
- The operation will require significant capital investment, skilled operators and marketing expertise for the end product.

An overview of this option is shown in Figure 5.1.

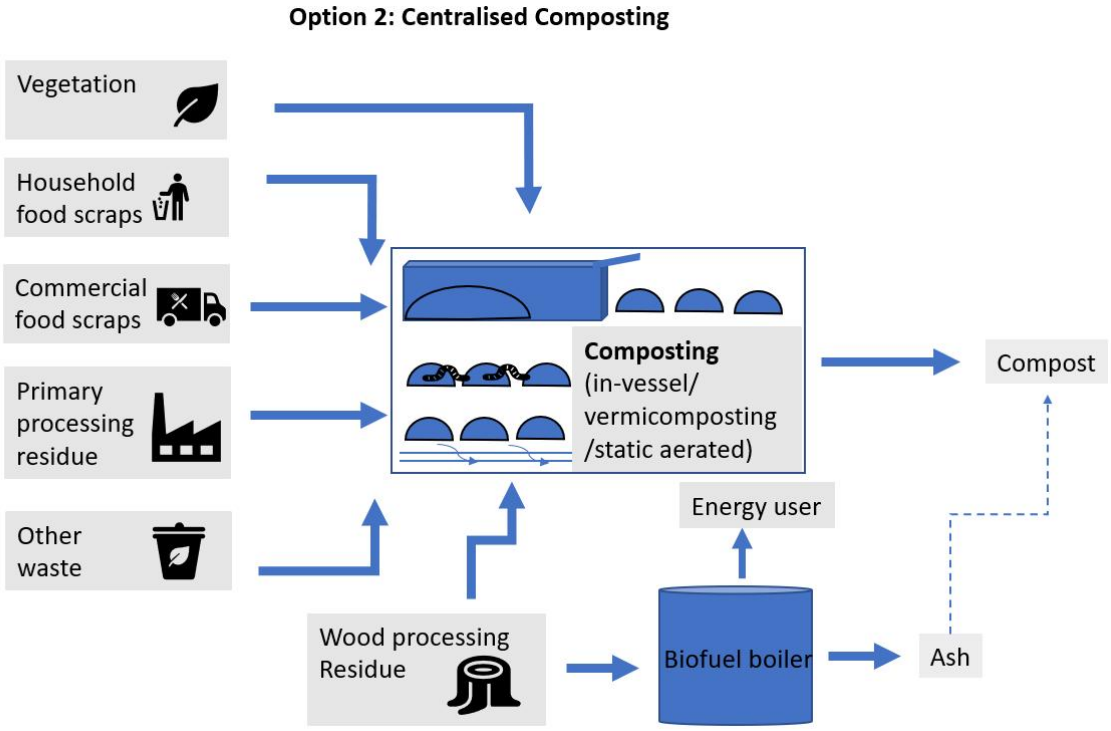


Figure 5.1: Overview of centralised composting options

Capital cost for a centralised composting for Taranaki is highly dependent on the approach adopted. Low technology approaches will require a significant amount of land (increasing capital cost) while heavily engineered solutions (enclosed composting, forced aeration) reduce land requirements but increase capital and operational costs.

Based on publicly available information on recent composting developments in New Zealand it is expected that a centralised composting site[36] would require in the order of $30-50M for development, dependent on the size, scale and complexity of the operation. Processing costs (allowing for cost of capital, revenue for product sales and profit margin) are expected to be in the range $50 - $100 per tonne.

5.1.3 Option 3: Centralised facility – Anaerobic Digestion

For the Taranaki Region, the digestion of food organics can either take place in a dedicated facility or in a combined facility with additional feedstock.

There is currently 1,500 TPA available of New Plymouth District Council food waste that could be available for a dedicated anaerobic digestion facility. There is potential to add an estimated 1,000 TPA in the future should kerbside food waste collection be adopted by the two remaining Councils.

The low tonnages available would mean that for this solution to be viable Council sourced material would need to be combined with other material to provide a consistent feedstock and be economically viable at scale. Other material suitable for anaerobic digestion includes:

- Commercial/industry sources of food waste.
- Paunch waste (potential but not widely adopted).
- DAF solids (potential but need to carefully consider fat loading rate).

A key consideration in any anaerobic digestion process is to get a consistent feedstock to allow the microbial community in the digestor to establish. The addition of DAF solids to achieve volumes suitable for processing presents a risk if the sludge is a large proportion of the overall feedstock (as is the case in Taranaki). DAF solids contains a high proportion of lipids and only so much of this material can be accepted before the fat loading rate inhibits digestor efficiency.

Residential kerbside and post-consumer food waste also have the potential to introduce physical contaminants (e.g. packaging) and variability in the feedstock. There is a lack of existing facilities across Australasia that digest post-consumer food waste, because the high contamination rates associated with the waste stream are a key risk.

Anaerobic digestion technologies vary in their capacity to accept different materials and there are various pre-treatments that can be applied to overcome some of the processing challenges. These pre-treatments add cost but, in some cases, improve digestion effectiveness.

Choosing a location for a centralised facility should consider proximity to waste sources and proximity to a user for the outputs (biogas and digestate). Proximity to waste sources would suggest a location close to New Plymouth (the largest population centre) or Eltham and surrounds (where a concentration of food processing plants are located). The additional benefit of looking at Eltham and surrounds would be locating a digestor where one of the businesses could use the biogas generated for heat or to generate electricity. The resulting digestate could be dewatered and used as a soil amendment without further processing but is likely to require further processing to be acceptable to agricultural or landscaping markets. Further processing may involve dewatering, drying and/or composting.

[36] Comprising an enclosed composting process and space for maturing compost after the initial high rate composting stage. This is based on recent pricing quoted for relocation of the Christchurch facility.

Drying is energy intensive[37] and typically produces a granular product suitable for soil incorporation, and for some applications, top dressing[38]. Composting of digestate is typically in-vessel (to manage odour) and requires a high carbon bulking agent similar to the processing of raw food organics.

The role of Council in an anaerobic digestion project could be to procure and operate a facility with project partners. Alternatively, the Council could go to market with the offer of a secure waste supply for a private company who own and operate a facility. Other large generators have similar options with potential to use biogas generated by the process.

Key features of this option include:

- Materials will be transported to a single site for processing (anaerobic digestion).
- The materials are likely to require some pre-processing to provide a consistent feedstock for the digestion process.
- The processing site will require careful design to manage odour for materials reception and working with digestate.
- The processing site will require design to manage nutrient impacted water (from materials acceptance, stormwater).
- Digestate is likely to require further processing before use to manage nutrient availability when applied to land.
- The operation will generate power and/or provide heat through the combustion of biogas e.g. for primary processing.
- The operation will require significant capital investment, skilled operators and marketing expertise.

An overview of this option is shown in Figure 5.2.

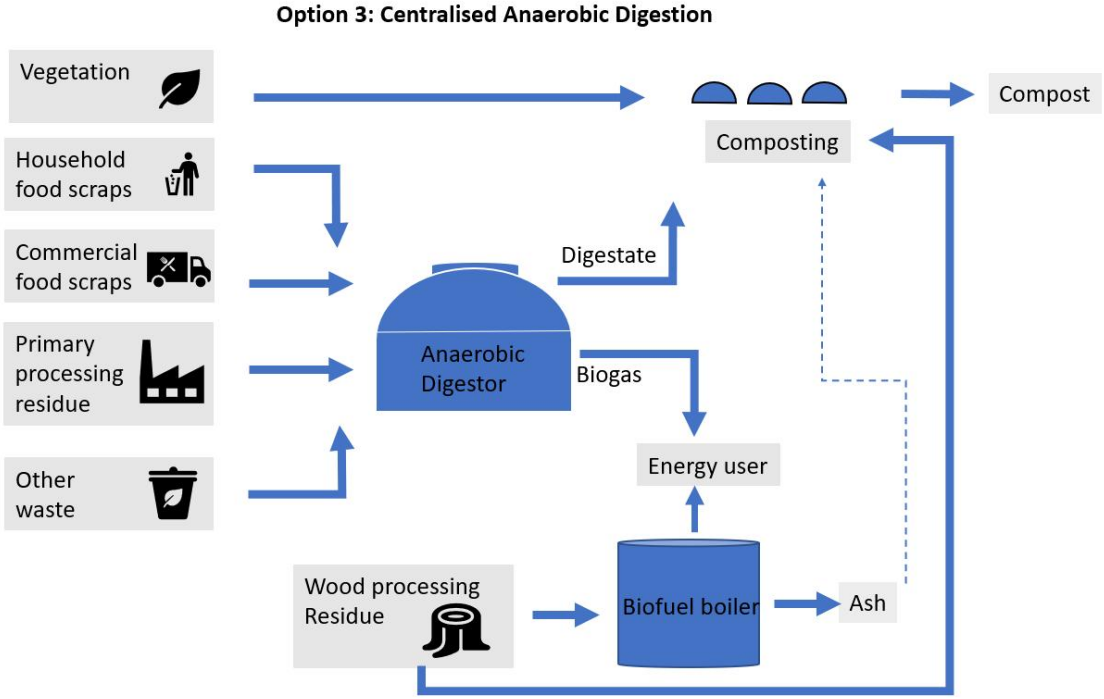


Figure 5.2: Overview of centralised anaerobic digestion option

[37] Selwyn District Council have recently installed a solar drying facility for wastewater solids that is less energy intensive but requires a significant amount of space.

[38] See http://www.bioboost.co.nz/, dried biosolids from New Plymouth wastewater treatment plant.

Capital cost for a centralised digestion facility for Taranaki is highly dependent on the approach adopted including energy use and arrangements for management and use of digestate.

Based on publicly available information regarding the Eco Gas development in New Zealand it is expected that a centralised site would require in the order of $20-30M for development. There is also likely to be capital and operating costs associated with feedstock pre-treatment and digestate management – composting, drying or other process. The figures noted in Section 5.1.2 provide an indicator of likely costs. Processing costs (allowing for cost of capital, digestate management, revenue for energy and profit margin) are expected to be in the range $50 - $150 per tonne.

5.1.4 Option 4 - Commercial network of multiple facilities

A key challenge for organics waste recovery in Taranaki is the relatively large distances between centres. This option considers that a network of smaller facilities may be more appropriate than any one centralised facility. These facilities could use any technology (variations of composting and AD) specific to what is best suited to locations and proximity to feedstocks.

The map below (Figure 5.3) shows the concentration of materials available for recovery in the Taranaki region. Key concentrations of material are located in New Plymouth, Eltham and Hāwera. Transfer stations consolidate only small volumes of garden waste and with large travel distances between.

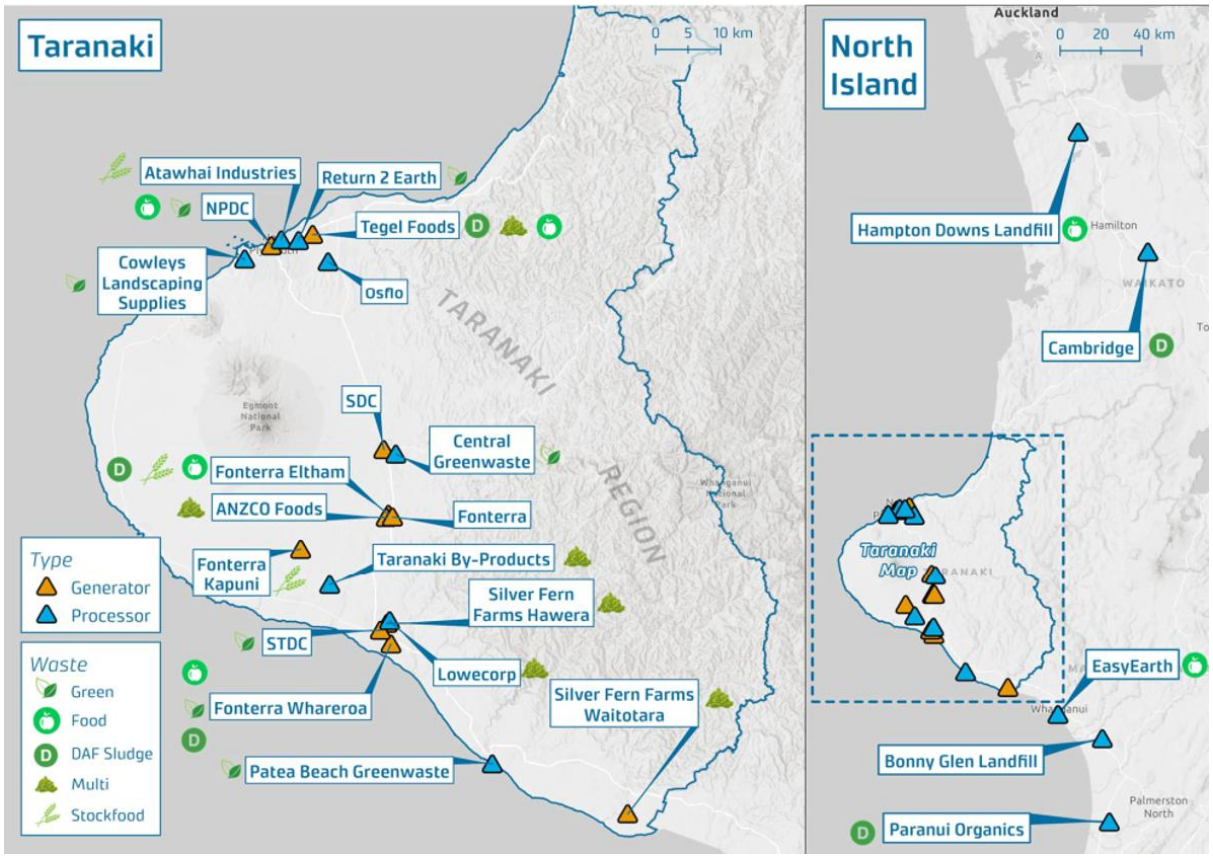


Figure 5.3: Concentration of materials available for recovery in the Taranaki region (identified by the gap analysis)

Key features of this option include:

- Materials will be transported to two or more sites for processing (aerated windrow composting, in-vessel composting, vermi-composting and/or anaerobic digestion).

- Significant bulking (carbon rich, suitable particle size) will be required to enable effective composting, vermi-composting.
- Each processing site will require careful design to manage odour for materials reception and during aeration.
- Each processing site will require design to manage nutrient impacted water (from composting materials, stormwater).
- Digestate (from anaerobic digestion) is likely to require further processing before use to manage nutrient availability when applied to land.
- A digestion operation will generate power and/or provide heat e.g. for primary processing.
- Each operation will require significant capital investment, skilled operators and marketing expertise.
- A network of facilities may provide greater future-proofing and resilience when compared with one centralised facility reducing the impact of process failure or disruptions to the transport network.

An overview of this option is shown in Figure 5.4.

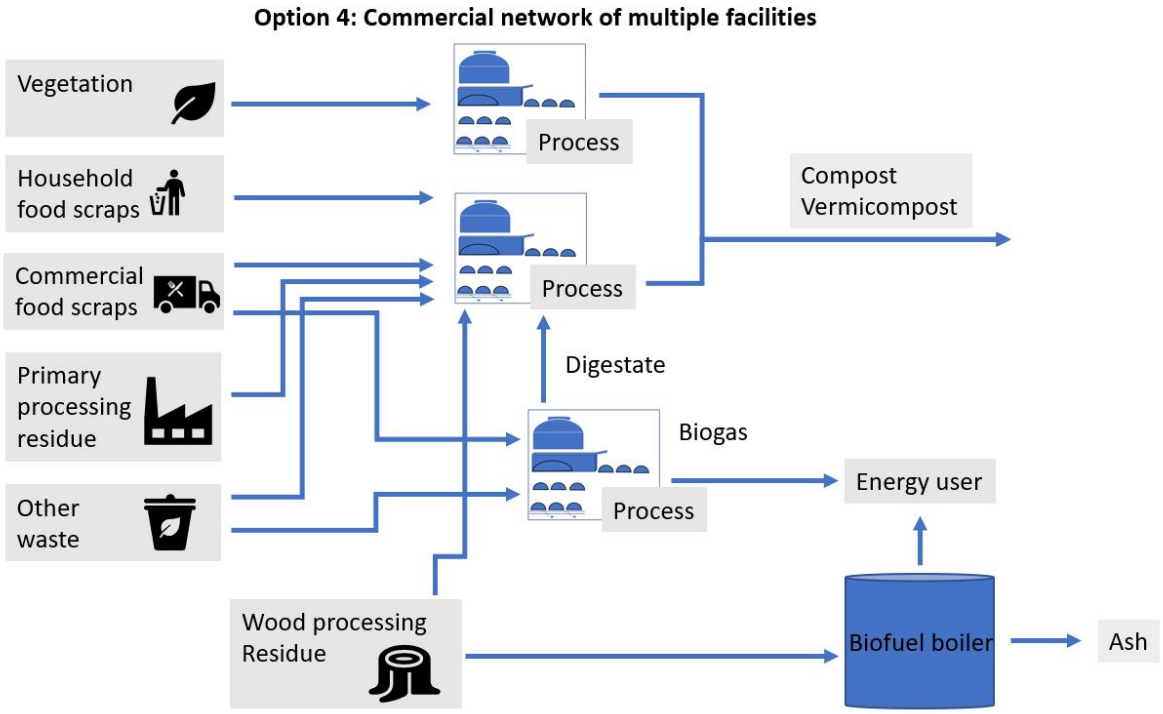


Figure 5.4: Overview of commercial network of multiple facilities

Capital cost for a network of processing facilities for Taranaki is highly dependent on the approach adopted including: number of sites or facilities, technologies selected, proximity of potential biogas energy-users and arrangements for the use of digestate and marketing of compost or vermi-cast.

In general, it is expected that, for the same amount of feedstock, capital costs will be higher due to the need to replicate supporting infrastructure and two or more sites. Operational costs at each site are likely to be broadly comparable but at the higher end of the expected range due to less benefits from scale. There may be potential to share some resources, for example environmental management and marketing. Transport costs to the facilities will be lower for waste generated nearby.

5.1.5 Option 5 - Commercial and community network of multiple facilities

There was clear messaging from study partners that community ownership of the recovery of value from organic materials and responsibility for one's own waste should be a focus of this study. Opportunities for Taranaki to integrate this thinking into an approach for material recovery could include:

- Investment in encouraging further uptake of home composting.
- Supporting organics material recovery and processing at community facilities (schools and marae.
- Supporting the establishment of organics recovery in partnership with community gardens (where material is recovered and used onsite).
- Supporting community owned centralised facilities (operating as social enterprises) where organic material is recovered.

Other benefits of community scale composting may include support for local food production/food resilience, local employment and volunteer opportunities and participants having increased knowledge of the waste they produce at a household level.

Limitations of community facilities most often relate to scalability and identification of project partners/governance models that ensure a quality and consistency of service. There are examples of many successful enterprises across New Zealand that have adopted a community approach to organics recovery but each relates to a champion organisation or individual needing to drive the project, with Council support occurring retrospectively.

Because of these limitations, community scale processing is unlikely to be suitable for all of the materials identified. This does not preclude community scale initiatives having a role in addressing some materials, particularly those from households, community groups and smaller scale commercial activities where the combined quantities are relatively low.

Key features of this option include:

- Materials from large volume generators including Council collections will be transported to a two or more sites for processing (aerated windrow composting, in-vessel composting, vermi-composting and/or anaerobic digestion).
- In some communities, materials will be dropped off or 'locally collected' for composting at community gardens or community facilities. Compost will be used locally – in the community garden or shared with the community.
- For composting, significant bulking (carbon rich, suitable particle size) will be required to enable effective composting, vermi-composting.
- Each larger scale processing site will require careful design to manage odour for materials reception and during aeration.
- Each processing site will require design to manage nutrient impacted water (from composting materials, stormwater).
- Digestate (from anaerobic digestion) is likely to require further processing before use to manage nutrient availability when applied to land.
- A digestion operation will generate power and/or provide heat e.g. for primary processing.
- Each operation will require significant capital investment, skilled operators and marketing expertise.

An overview of this option is shown in Figure 5.5.

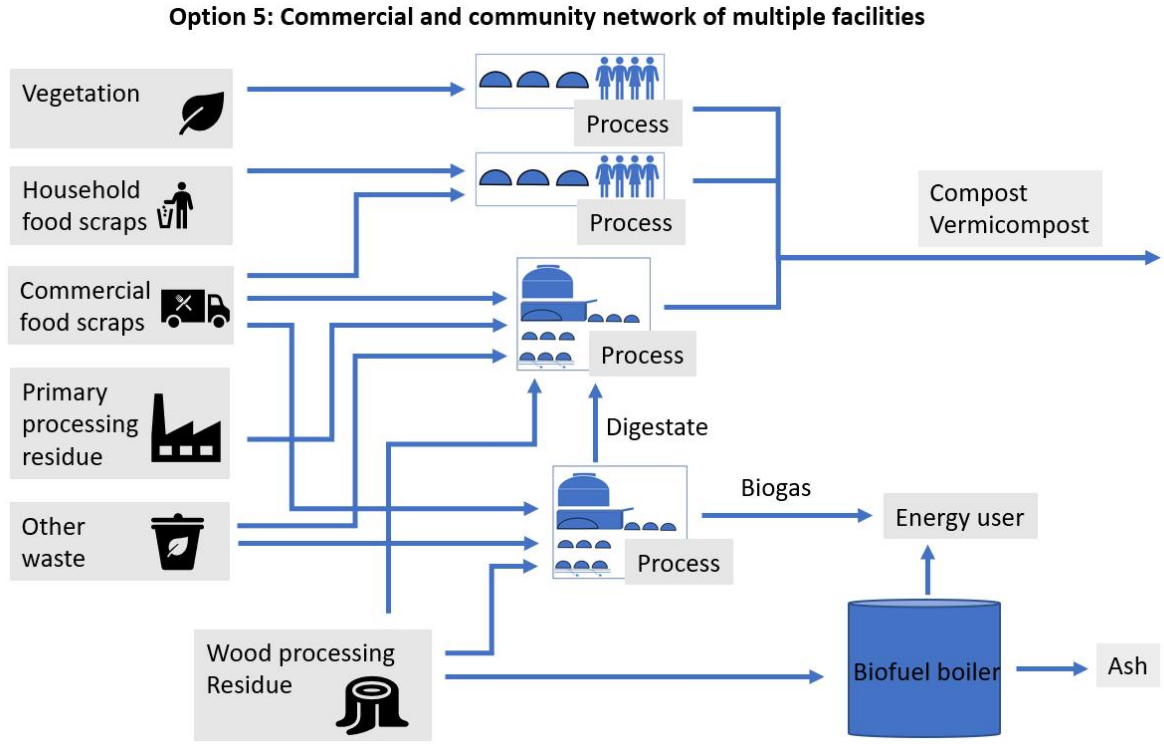


Figure 5.5: Overview of commercial and community network of multiple facilities

Capital cost for a network of processing facilities including community scale initiatives for Taranaki is highly dependent on the approach adopted, including number of sites or facilities, technologies selected, proximity of biogas energy users and arrangements for the use of digestate and marketing of compost or vermi-cast.

In general, it is expected that for the commercial facilities and the same amount of feedstock capital costs will be higher due to the need to replicate supporting infrastructure and two or more sites. Operational costs at each site are likely to be broadly comparable but at the higher end of the expected range due to less benefits from scale. There may be potential to share some resources, for example environmental management and marketing. Transport costs to the facilities will be lower for facilities located close to source materials.

Community scale facilities could be relatively low cost (for relatively small throughput). Localised processing of material is likely to reduce costs for collection although the focus may be on areas that are not serviced by commercial or Council collections.

Subject to further consideration in a Detailed Business Case, it is anticipated that there will be a facility servicing northern Taranaki including New Plymouth and surrounds. This facility would be expected to manage food waste, garden waste and some commercial/industrial wastes. This mix of materials suggests an enclosed composting operation would be most appropriate.

With a range of commercial industrial organic materials generated in south Taranaki (from Eltham to Waitōtara) locating one or more facilities in this area would reduce transport costs. If an anaerobic digestion process is implemented there are multiple potential users of heat produced using any biogas generated.

The research completed for this report suggests that DAF solids (meat processing and dairy) and paunch are the key materials available for processing. These could be supplemented by liquid waste streams that are more conventionally processed via anaerobic digestion. Further work is required to determine whether the mix of these streams and other available materials is appropriate for

anaerobic digestion. The digestate from an anaerobic digestion process is likely to require further processing prior to use. Subject to further analysis in a Detailed Business Case, developing a composting process (and associated end markets) suitable for processing the main available feedstocks and also any future digestate from anaerobic digestion is feasible approach for South Taranaki.

Community scale initiatives rely on a motivated core of people to coordinate and actively manage activity. This means it is difficult for Councils to establish community scale initiatives without active partners in the community. There is potential for Council's to provide technical support, suitable locations and/or seed funding for community led initiatives were considered appropriate.

5.2 Options assessment outcomes

A summary of the options assessed in Section 5 against the evaluation criteria in Section 3.5 is provided in Table 5.1. An expanded table with further detail on options assessed against criteria is shown in Appendix A.

Colour coding relates to the 'performance' of the collection system with respect to the evaluation criteria:

- Green indicates that the component supports achieving the desired outcome;
- Orange indicates that the component somewhat supports the desired outcome;
- Red indicates the component does not support the desired outcome.

The results of the assessment indicate that there is no perfect option. Each option has elements of desirable and less desirable outcomes. There are also trade-offs between of the benefits of community involvement and maximising diversion opportunities.

Carbon impacts are difficult to quantify as the impact of any solution is made up of a number of elements including the embodied carbon of the technology, transport emissions, level of diversion from landfill and potential to generate a product that displaces a carbon intensive activity (i.e. production of renewable energy). For the purposes of this feasibility assessment only high-level commentary on emissions reduction potential is provided at this stage.

In summary:

The status quo avoids capital investment but incurs significant cost (for transport) and is contrary to a desire to manage materials within the region where possible. It is also in conflict with the government proposals to mandate the separation and diversion of organic waste from landfill, the three District Councils' waste minimisation targets in their WMMPs, and their emissions reduction targets. The significant transport component of this approach also presents a risk where transport links are disrupted, for example through natural hazards or an 'economic' disruptor like Covid reducing the availability of drivers. There is also a risk of reputational damage to Councils and commercial/industrial organic waste producers, given the increasing public focus on their environmental and sustainability organisational performance measures, and increasing concerns around waste and emissions reduction in our communities.

A centralised composting digestion scenario enables diversion of the key materials identified in this study. A significant increase in the quantity of compost or vermicast will require development of new local markets and/or export of materials to markets elsewhere in New Zealand. Centralising processing means there will still be significant transport costs with materials generated at both ends of the region. A centralised composting process is likely to be enclosed, employ aeration and have relatively complex control systems. This will require specialised operators and ongoing external specialist support for successful operation.

A centralised anaerobic digestion scenario enables diversion of the key materials identified in this study. The biogas generated could be used to provide heat energy and power to decarbonise heat processes for a primary processor or other major energy-user in the region. The additional revenue from energy is potentially offset by the need to further process digestate to make it suitable for use as a biofertiliser. Centralising processing means there will still be significant transport costs with materials generated at both ends of the region. A centralised digestion process will require specialised operators and ongoing external specialist support for successful operation.

A network of commercial processing sites will enable diversion of the key materials identified in this study. The benefits for composting or anaerobic digestion are similar to those noted above. Having multiple facilities can reduce transport costs with materials processed and used closer to where they are generated, and may increase resilience and reduce the risk from having one facility only. A network means there is potential for both composting and anaerobic digestion to be implemented in Taranaki. Digestion and complex composting processes will require specialised operators and ongoing external specialist support for successful operation.

A network of commercial processing sites alongside community level composting will enable diversion of the key materials identified in this study. The biogas generated from any anaerobic digestion facility could be used to provide heat energy and power to decarbonise heat processes for a primary processor or other major energy-user in the region. The additional revenue from energy is potentially offset by the need to further process digestate to make it suitable for use as a soil amendment. Having multiple facilities can reduce transport costs with materials processed and used closer to where they are generated. Digestion and complex composting processes will require specialised operators and ongoing external specialist support for successful operation. Local, community scale composting operations provides low cost and low impact solutions for some materials and would be complementary to the larger industrial-scale facilities – predominantly dealing with household and community facility food scraps and garden waste.

Key limitations of the options assessment, given the stage of the project being feasibility stage only, are that:

- Scoring against criteria will depend on what technology is ultimately adopted (i.e. number of sites, type of composting, configuration of network of processing options) - this level of detail is not available at this stage in the project.
- Carbon impacts have been assessed at a high level for the following:
  - Embodied energy considers the energy required to create the materials and/or equipment required for the different technologies being applied. Embodied energy also includes the carbon associated with transportation in getting materials and/or equipment to New Zealand.
  - Transport emissions associated with the transport of waste materials from their location of creation to the location of processing or disposal.
  - Process emissions consider the impact of carbon emissions created through the processing and/or disposal of the waste.

Potential for carbon offsets considers the outputs following processing and the impact of these products and their ability to replace a fossil fuel derived product.

Table 5.1: Summary of shortlist options assessment

Criteria[39]	Option 1: Do nothing	Option 2: Centralised facility composting	Option 3: Centralised facility AD	Option 4: Commercial network of multiple facilities	Option 5: Commercial and community network of facilities
Te Taiao · Low score: Low alignment with criteria (see Report Section 3.5 for full list) · High score: High alignment with criteria (see Report Section 3.5 for full list)	Overall score: Low reflecting management of organics out of region, unlikely to comply with future legislation.	Overall score: Medium reflecting a local solution in-region producing market ready product. Careful consideration of potential effects to awa and whenua. Less flexibility once developed and requires long term commitment of input materials.	Overall score: Medium reflecting a local solution (contained so potential impacts to awa and whenua more easily managed). A need for digestate management. Less flexibility once developed and requires long term commitment of input materials.	Overall score: Medium reflecting local flexible solutions recovering value from organics, balanced with need to manage potential impacts of composting to awa and whenua.	Overall score: Medium reflecting local flexible solutions recovering value from organics, balanced with need to manage potential impacts of composting to awa and whenua.
Opportunity for Iwi and Hapū development · Low score: Low alignment with criteria (see Report Section 3.5 for full list) · Low score: High alignment with criteria (see Report Section 3.5 for full list)	Overall score: Low reflecting overall lack of current opportunities for Iwi and Hapū development.	Overall score: Low reflecting opportunity for Iwi and Hapū development through potential co-ownership/operation/co-governance, but limited to a single facility.	Overall score: Low reflecting opportunity for Iwi and Hapū development through potential co-ownership/operation/ co-governance but limited to a single facility.	Overall score: Medium reflecting opportunity for Iwi and Hapū development through potential co-ownership/operation/co-governance through multiple facilities.	Overall score: High reflecting integration of complementary industry-level and community-driven initiatives.
He tāngata · Low score: Low alignment with criteria (see Report Section 3.5 for full list) · High score: High alignment with criteria (see Report Section 3.5 for full list)	Overall score: Low reflecting current reliance on out of region solutions.	Overall score: Medium reflecting opportunities available but limited (single facility requiring strong external expertise).	Overall score: Medium reflecting opportunities available but limited (single facility requiring strong external expertise).	Overall score: Medium reflecting focus on local solutions but absence of community-driven initiatives.	Overall score: High reflecting integration of complementary industry-level and community-driven initiatives.
Diversion of organic material from landfill and recovery of products of value · Low score: Limited diversion of waste from landfill and end products are difficult to find markets for · High score: High diversion opportunity of waste from landfill and end products are easy to identify markets for	Overall score : Low reflecting the lack of convenient in region processing options to encourage diversion uptake.	Overall score: High reflecting opportunity to process a wide range of materials in significant quantities.	Overall score: High reflecting opportunity to process a wide range of materials in significant quantities.	Overall score: High reflecting opportunity to process a wide range of materials in significant quantities.	Overall score: High reflecting opportunity to process a wide range of materials in significant quantities as well as service smaller communities, marae, individual households.
Carbon impacts · Low score: High net carbon impact · High score: Low net carbon impact	Overall score : Low reflecting transport emissions, continued landfilling and smaller diversion achievements.	Overall score: Medium reflecting complexity between offsetting transport and process emissions with opportunities to divert waste from landfill.	Overall score: High reflecting containment of processing emissions and opportunity to generate renewable energy.	Overall score: Medium reflecting local solutions with lower transport emissions but offset by process emissions from composting (note AD in network has opportunity to produce renewable energy and offset fossil fuel improving carbon outcomes).	Overall score: High reflecting local solutions with lower transport emissions and lower embodied energy of infrastructure.

[39] Green indicates that the component supports achieving the desired outcome;
Orange indicates that the component somewhat supports the desired outcome;
Red indicates the component does not support the desired outcome.

Criteria[39]	Option 1: Do nothing	Option 2: Centralised facility composting	Option 3: Centralised facility AD	Option 4: Commercial network of multiple facilities	Option 5: Commercial and community network of facilities
Cost · Low score – Capital and ongoing costs are high and potentially less viable · High score – Capital and ongoing costs are lower and therefore likely to be more viable	Overall score: Medium reflecting minimal capital investment but large and increasing ongoing transport costs.	Overall score: Low reflecting large capital investment.	Overall score: Low reflecting large capital investment.	Overall score: Low reflecting capital investment required for multiple facilities.	Overall score: Medium reflecting moderate capital investment required but reduced operational costs (less waste to process through focus on upstream impacts (reduction, recovery).
Technical Risk · Low score – Technical complexity, operational requirements are higher and technology has less local proven track record · High score - – Technical complexity, operational requirements are lower and technology has local proven track record	Overall score: High reflecting current ongoing and established processing options.	Overall score: Medium/High reflecting the high adoption of technology across NZ and Australia and applicability to a wide range of material inputs.	Overall score: Low/medium reflecting the low level of adoption across NZ and Australia and technology sensitivity to material input compositions and volumes.	Overall score: Low/medium reflecting the likely incorporation of AD and associated technological risks but reduced risk by establishing multiple sites.	Overall score: Medium/High reflecting prominence of similar successful initiatives around New Zealand.

5.3 Preferred option(s)

The assessment presented in Section 5.2 suggests that on balance, a network of commercial processing sites alongside community level composting delivers the best overall outcome. Key benefits include local community and employment opportunities and the spreading of risk across multiple facilities.

It is expected that the network would comprise:

- Several 'commercial' scale processors of organic materials focussed on maximising value. These are likely to be located close to major sources of feedstock. For digestion co-location with an energy user would be preferable. The data collected to date suggests potential for North Taranaki processing site(s) and a South Taranaki processing site(s).
- Multiple community scale composting operations developed in partnership with iwi/Hapū and/or community groups.
- Strong links with existing activities that aim to reduce the wastage of organic materials include reuse where appropriate. Examples include:
  - Love Food, Hate Waste and similar public education campaigns.
  - Primary processing optimisation initiatives.
  - Food Rescue initiatives (for example On the House)
  - Stock food, for example EcoStock supplies.

6 High level plan for implementing preferred option (s)

6.1 Project delivery

The next step in the project is to further define the preferred option. It is expected this will comprise a concept 'design' for the network and confirming the approach to developing each of the network components. This will involve confirming 'available' materials, setting out the approach to delivering each network component and developing enough detail to progress to procurement, design, construction and implementation for each component.

6.1.1 Project team and governance

Key project team members will include:

- To be defined - Project Oversight;
- To be defined - Project Manager; and
- To be defined - Technical Support.

6.1.2 Project activities

Confirm approach

While there is a lot of existing activity processing organic materials to deliver value to Taranaki there are still gaps in the network that have been identified. These gaps are a mix of materials processed out of the Taranaki Region and materials where the material generators are planning to change the current management approach.

The combined impact of these 'gaps' is the potential to develop a network of processing facilities to manage a range of materials. The analysis presented in this report suggests at least two 'commercial' scale facilities servicing northern and southern Taranaki.

Commercial scale processing typically requires significant investment in processing infrastructure. This means that at minimum investors need confidence in feedstock (accepted for a gate rate) and markets for their products. This report has noted commercial scale feedstock comprising Council materials (garden waste, food waste) alongside commercial streams such as primary processing residues. There are several approaches to achieving the establishment of commercial scale processing in an area.

1 Directly invest in processing infrastructure.
2 Commit to providing feedstock, creating a secure revenue and material stream for a processor to build on.
3 Make use of existing facilities processing capacity at prevailing market rates.

Each generator of organic material (including Councils) will need to determine their approach, selecting from the three high level options noted above. Where several organisations decide to adopt a similar approach there is an opportunity to collaborate on project development activities. There are also likely to be opportunities to leverage larger quantities of material to achieve economies of scale.

The preferred option provides for community scale initiatives focussed on local household and small commercial organic materials. These initiatives are typically established by a core group who are both knowledgeable and enthusiastic. These initiatives also tend to have multiple objectives with community development/cohesion, local employment and food security often featuring alongside organic material recovery. There is potential for Councils to support community scale initiatives (part) funding establishment, capability development and/or ongoing support.

Councils, Iwi/Hapū partners and industry stakeholders will need to confirm and agree their respective preferred approach to be adopted in taking the project forward before progressing with additional analysis.

There are 2 main pathways to achieve this:

- Pathway 1. Approach the market seeking solutions for dealing with the combined organic materials 'available' in Taranaki, via a partnership-based procurement process, using the feasibility study to help focus procurement outcomes. Essentially, this would involve offering the combined organic materials available in Taranaki to the market, so that the market can address the infrastructure gaps.
- Pathway 2: If Pathway 1 was unsuccessful, Councils could lead the development of a Detailed Business Case, undertaking further analysis comparing Council's direct financial investment in establishing infrastructure themselves against working with private sector organic materials processors who would build, own and operate the infrastructure (Pathway 1 above).

Confirm available materials

The work completed for this study has started to quantify organic materials available for processing across Taranaki. This information will need to be further developed and refined in the next stage of the project focussing on understanding current arrangements including:

- Current costs to each organisation (transport and processing).
- The quantity of organic materials each organisation would commit to providing to the market, and for what period of time.
- More detailed material characteristics including any contaminant issues for each material.
- Future projections e.g. new wastewater treatment developments producing additional solids, changes in primary processing/production.

As noted above, each of the larger organic material generators will need to determine their preferred approach to securing ongoing management of their materials. If/when these generators 'commit' their materials to a coordinated approach, this would then provide the base load to go to market for the desired processing facilities.

It is important to note that the decision to commit may not necessarily deliver the lowest cost option with other benefits identified in this report including resilience, emissions reductions, local economic development and managing materials in Taranaki.

Pathway 1 - Organics recovery network – seek market solutions for combined organic waste management

Councils will work with the industry stakeholders to negotiate a Partnership Agreement, Memorandum of Understanding or similar arrangement to collaborate on seeking market solutions for organic materials management. The objective is to provide significant scale and lock-in interested parties and their respective committed materials to enable the private sector to invest in providing solutions that address the objectives identified in this study. Councils will also continue to work with Iwi and Hapū partners to clarify their desired role and their preferred level of involvement.

It is anticipated that the next steps in this process will involve

- Developing a preliminary Procurement Plan (to inform the partnership agreement negotiations)
- Undertaking negotiations on the details of the partnership arrangements.
  - Preferred procurement approach and processes
  - Delivery governance, including how to manage co-governance type decision making.
  - Ongoing management of recovery activities for organic materials.
- Completing detail procurement planning
- Procurement
  - Focussed on broad outcomes as specified by partnership participants, likely to reflect the evaluation criteria set out in Section 3.5.
  - Seeking solutions that maximise the recovery potential and end-product value of organic materials generated in Taranaki.
  - To be determined, but potentially including a Registration of Interest Process with shortlisted parties proceeding to more detailed proposals and/or negotiations.
  - Provision for one or more suppliers/facilities.
  - Provision for committed and 'additional' future materials.

Pathway 2 - Organics recovery network – Detailed Business Case and implementation

Develop detailed project plan:

- A detailed Project Plan will be developed covering:
  - *Detailed Business Case including development of a concept for the network and for each facility;*
  - *Developing a procurement plan - for development, operations and/or materials acceptance;*
  - *Detailed design for the initial recovery facility addressing the yard, vehicle movements, materials storage and processing (depending on approach adopted);*
  - *Facility construction (depending on approach adopted);*
  - *Market development (depending on approach adopted):*

- *To attract suitable organic materials for processing;*
- *For facility products; and*
- *For potential future products.*

· Detailed Business Case development

A Detailed Business Case will be prepared to inform a decision whether to invest. This will:

- *Develop a full concept plan for the network and each facility.*

  A concept plan will be developed for the proposed facility covering key activities on site including materials acceptance, processing, product storage and load out. The concept will provide for future development including adjusting capacity or further processing for specific materials or products.

  Consider capital and operations costs including collection/logistics for feedstock materials, processing costs and equipment and operational costs for getting products to market (potentially including application/soil incorporation technology.

- *Preliminary site considerations*

  Consider requirements for the identified commercial scale processing options and potential locations in Taranaki. It is expected that this will be informed by early and ongoing engagement with Iwi and hapū looking at Council-owned sites that might be suitable for each facility type. Each Council will review land ownership in the proposed geographical area for each facility and discuss directly with the relevant Iwi and hapū whether any of our Council-owned land could be suitable for further investigation/ development.

- *End product market development*

  Early engagement with existing and potential end markets for biogas and soil amendments (compost, vermi-cast, digestate) focussed on key requirements. This should include consideration of product certification, application methods, macro and micro nutrients and timing of supply.

- *risk (threats and opportunities),*
- *funding,*
- *project management; and*
- *procurement.*

The Detailed Business Case will adopt the Better Business Case framework, making use of the material presented in in This document as a preliminary Strategic Case and developing an assessment of the best value for money option(s) focussing on cost and risk.

At this point the proposal will need to be formally considered by potential investors, for example Councils, industry stakeholders and Iwi/Hapū.

· Procurement planning

A procurement plan will be developed and implemented for appointing an operator for the network or individual facilities. The plan will need to consider the relationship with existing organic materials processors, the role of the contractor(s) in detailed design, the contractor's role in market development and sale of product including sharing of profits (if proposed).

· Market development

Establishing an ongoing market development process with an initial focus on securing long term, viable markets for key products. To be successful this needs to be focussed on end market requirements (for example product certification, application methods, macro and

micro nutrients, timing of supply). This process should build on early end market engagement and development during the development of the Detailed Business Case as noted above.

- Detailed design and construction of the facility(ies).

  Design of materials acceptance, processing, product storage, water management, odour management. Key consideration will include safety, ground conditions, weighbridge, charging, vehicle and materials movements on site, logistics associated with getting materials to site and product to market.

- Establish operations (TBC)
  - *Facility Construction; and/or*
  - *Procure an operations contractor or contractors.*
  - *Establish receipt and processing of target materials.*

6.2 Funding

Funding will be required to develop proposals for Council, partner and Stakeholder consideration. This activity will be covered under existing funding using Council and specialist advisors where required.

Subject to a detailed business case funding may be required for:

- Developing one or more commercial scale processing facilities;
- Developing one or more community composting hubs;
- Market development – for the processing of materials and for products generated through the network.

In all cases it is expected that capital will be funded by user charges over the life of the assets. The Business Case will consider how the initial capital outlay is funded - for example by potential service providers, via new Council debt or drawing on Council cash reserves.

There may be potential to seek funding contribution for an organic materials recovery network through the Ministry for the Environment's Waste Minimisation Fund. This is subject to priorities for funding, the funds available and the funding allocation decisions made by the Minister for the Environment.

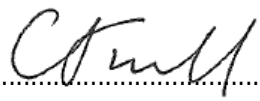
7 Applicability

This report has been prepared for the exclusive use of our clients South Taranaki District Council, New Plymouth District Council, Stratford District Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

In particular, we have not made any attempt to allow for the potential impact of COVID-19 in this estimate. Also, supply chain disruptions are currently having quickly-changing effects on construction costs and schedules. We recommend you seek up-to-date specialist economic advice on what budgetary allowances you should make for escalation, including for any potential changes in construction costs and timing in relation to both COVID-19 and supply-chain issues.

Tonkin & Taylor Ltd

Report prepared by:



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Glossary

Aatea	Aatea Solutions Limited
Assure Quality	Provider of organic certification for soil amendment products New Zealand
Biogro	Provider of organic certification for soil amendment products New Zealand
C:N ratio	The carbon to nitrogen ratio – a key consideration for effective composting.
DAF / DAF solids	Dissolved Air Flotation, a technique used to separate small bits of proteins, fats, and fibrous materials that cannot be removed by mechanical means from liquid wastewater by pumping dissolved air into the wastewater. DAF solids are removed from wastewater by skimming material from the top of the treatment wastewater.
Food waste	Unwanted food including food scraps, vegetable peel and spoiled or food otherwise unsuitable for consumption.
Garden waste	Unwanted vegetation including leaves, grass clippings, plants and branches. Also referred to as green waste.
MBT	Mechanical Biological Treatment (refer Section 4.5.3))
MfE	The New Zealand Ministry for the Environment
MHT	Mechanical Heat Treatment (refer Section 4.5.3)
NPDC	New Plymouth District Council
SDC	Stratford District Council
STDC	South Taranaki District Council
T+T	Tonkin & Taylor Limited
TPA	Tonnes per annum
WMMP	Waste Minimisation and Management Plan

Appendix A: Detailed options assessment

Appendix A Table 1: Detailed options assessment

Criteria[40]	Option 1: Do nothing	Option 2: Centralised facility composting	Option 3: Centralised facility AD	Option 4: Commercial network of multiple facilities	Option 5: Commercial and community network of facilities
Te Taiao · Low score: Low alignment with criteria (see Report Section 3.5 for full list) · High score: High alignment with criteria (see Report Section 3.5 for full list)	Low scoring elements · A portion of organic material is disposed of as waste to landfill (Bonny Glen) and value is not returned to soil. · Organic material is transported out of region due to no in region landfill. · Transportation of material (NPDC food waste) up to Hampton Downs is outside of the region. · Hampton Downs is considered a site of importance to project partners. · This option is unlikely to comply with future legislation that MFE are proposing High scoring elements: · None Overall score: Low reflecting management of organics out of region.	Low scoring elements: · Requires careful consideration of location and management of potential effects to awa and whenua. · Centralised infers large capex (investment upfront for infrastructure required for processing, excludes operational costs) meaning less flexible than other options (once built feedstock must be maintained to provide return on investment). High scoring elements: · Process is aimed at using organic waste as a resource and returning value to soils. · Material managed within the region. Overall score: Medium reflecting a local solution in region producing market ready product. Careful consideration of potential effects to mana and whenua. Less flexibility once developed and requires long term commitment of input materials.	Low scoring elements: · Digestate management has been an issue for previous facilities and needs to be carefully managed to prevent impacts to awa and whenua through land application. · Digestate requires further processing before value is returned to soils. · Less flexible than other options (once built feedstock must be maintained). High scoring elements: · Material managed within the region. · AD processing is contained reducing potential impacts to awa or whenua. · Organic matter utilised as a resource. Overall score: Medium reflecting a local solution (contained so potential impacts to awa and whenua more easily managed). A need for digestate management and less flexibility once developed and requires long term commitment of input materials.	Low scoring elements: · Requires careful consideration of location and management of potential effects to awa and whenua for each facility. · Multiple facilities mean multiple sites across the region need to be managed for potential environmental impacts (i.e. odour) although acknowledging individual impacts of each facility will be smaller High scoring elements: · Material managed within the region. · Smaller facilities may be more flexible in nature (i.e. can be responsive to improvements in approaches/technology/risk). Overall score: Medium reflecting local flexible solutions recovering value from organics, balanced with need to manage potential impacts of composting to awa and whenua.	Low scoring elements: · Requires careful consideration of location and management of potential effects to awa and whenua for each facility. · Multiple facilities mean multiple sites across the region need to be managed for potential environmental impacts (i.e. odour) although acknowledging individual impacts of each facility will be smaller High scoring elements: · Material managed within the region. · Small scale community facilities are more likely to be focused on composting – generating a market ready material (returning value to soils). · Smaller facilities may be more flexible in nature (i.e. can be responsive to improvements in approaches/technology/risk). Overall score: Medium reflecting local flexible solutions recovering value from organics, balanced with need to manage potential impacts of composting to awa and whenua.

[40] Green indicates that the component supports achieving the desired outcome;
Orange indicates that the component somewhat supports the desired outcome;
Red indicates the component does not support the desired outcome.

Criteria[40]	Option 1: Do nothing	Option 2: Centralised facility composting	Option 3: Centralised facility AD	Option 4: Commercial network of multiple facilities	Option 5: Commercial and community network of facilities
Opportunity for Iwi and Hapū development · Low score: Low alignment with criteria (see Report Section 3.5 for full list) · Low score: High alignment with criteria (see Report Section 3.5 for full list)	Low scoring elements: · Limited local processing. · Iwi and Hapū development is not currently a component of the organic material management system in Taranaki. · Limited scale to existing community driven initiatives. · Limited opportunity for Iwi and Hapū and Council co-governance in current organic material management system in Taranaki. High scoring elements: · None Overall score: Low reflecting overall lack of current opportunities for Iwi and Hapū development.	Low scoring elements: · Some approaches require complex technology with reliance on external expertise. · Opportunities for Iwi and Hapū development limited to a single facility. · Relatively high capital expenditure for a single facility. High scoring elements: · Iwi and Hapū opportunity to be investors/owners/operators. · Iwi and Hapū and Council co-governance model options available. Overall score: Low reflecting opportunity for Iwi and Hapū development through ownership/operation/governance, but limited to a single facility.	Low scoring elements: · Some approaches require complex technology with heavy reliance on external expertise. · Opportunities for Iwi and Hapū development limited to single facility. High capital expenditure for a single facility. High scoring elements: · Iwi and Hapū opportunity to be investors/owners/operators. · Iwi and Hapū and Council co-governance model options available. Overall score: Low reflecting opportunity for Iwi and Hapū development through ownership/operation/governance but limited to a single facility.	Low scoring elements: · Some approaches require complex technology with heavy reliance on external expertise. High scoring elements: · Expenditure split across multiple facilities – lower investment per facility with the potential for Iwi investment. A higher combined investment across the facilities would be expected. · Iwi and Hapū and Council co-governance model options available. Overall score: Medium reflecting opportunity for Iwi and Hapū development through ownership/operation/governance through multiple facilities.	Low scoring elements: · None High scoring elements: · Opportunity to develop community lead projects and facilities. · Opportunity to connect tangata whenua with whenua. · Community driven alongside commercial activity. · Iwi and Hapū and Council co-governance model options available. Overall score: High reflecting integration of community driven initiatives.
He tāngata · Low score: Low alignment with criteria (see Report Section 3.5 for full list) · High score: High alignment with criteria (see Report Section 3.5 for full list)	Low scoring elements: · Currently organic material management is the role of private industry and Councils and employment benefits are sometimes out of region. · Intergenerational outcomes not recognised. · Knowledge sharing and upskilling is absent from current system as occurs out of region. High scoring elements: · Industry are responsible for identifying organic material recovery/disposal options and are not subsidised by Council (although Council will never subsidise this anyway)(currently transporting out of region or landfilling). Overall score: Low reflecting current reliance of out of region solutions.	Low scoring elements: · Less focus on solutions at a home/community level. High scoring elements: · Could work to identify skills and qualifications needed in a facility and support Iwi and Hapū to develop uri. · In-region options returning value to soils · Industry are responsible for identifying organic material recovery/disposal options and are not subsidised by Council Overall score: Medium reflecting opportunities are available but limited (single facility requiring strong external expertise).	Low scoring elements: · Less focus on solutions at a home/community level. High scoring elements: · Could work to identify skills and qualifications needed in a facility and support Iwi and Hapū to develop uri. · In region options returning value to soils · Industry are responsible for identifying organic material recovery/disposal options and are not subsidised by Council Overall score: Medium reflecting opportunities are available but limited (single facility requiring strong external expertise).	Low scoring elements: · Less focus on solutions at a home/community level. High scoring elements: · Local solutions - returning value to soils in local areas. · Flow on benefit effects of facility (i.e. employment/partnership opportunities) spread across different/multiple parts of the region. · Industry are responsible for identifying organic material recovery/disposal options and are not subsidised by Council Overall score: Medium reflecting focus on local solutions but absence of community driven initiatives.	Low scoring elements: · None High scoring elements: · Education opportunities through community initiatives. · Community level facilities are easier to integrate with community food growing initiatives, helping to drive circular economy outcomes. · Whānau, Hapū and Iwi are part of creating the solutions. · Industry are responsible for identifying organic material recovery/disposal options and are not subsidised by Council Overall score: High reflecting integration of community driven initiatives.

Criteria[40]	Option 1: Do nothing	Option 2: Centralised facility composting	Option 3: Centralised facility AD	Option 4: Commercial network of multiple facilities	Option 5: Commercial and community network of facilities
Diversion of organic material from landfill and recovery of products of value · Low score: Limited diversion of waste from landfill and end products are difficult to find markets for · High score: High diversion opportunity of waste from landfill and end products are easy to identify markets for	Low scoring elements: · Transport of waste out of region (low current cost of landfill) is disincentivising organic diversion. · For some materials it is difficult to identify a processing option (even considering out of region options). High scoring elements: · None Overall score : Low reflecting the lack of convenient in region processing options to encourage diversion uptake.	Low scoring elements: · High volumes of bulking material required for processing to enable the diversion of high volume, nitrogen rich Commercial/industrial waste or household food waste. High scoring elements: · Opportunity to partner with industry and recover many different streams of material in large volumes. · Applicable to a wide range of materials. Overall score: High reflecting opportunity to process a wide range of materials in significant quantities.	Low scoring elements: · Risk of not achieving the required mix or volumes of materials to support AD in region (i.e. significant portion of DAF solids compared to other materials). High scoring elements: · Opportunity to partner with industry and recover many different streams of material in large volumes. Overall score: High reflecting opportunity to process a wide range of materials in significant quantities.	Low scoring elements: · Competing for bulking agents when diverting high volumes of nitrogen rich Commercial/industrial waste or household food waste. · May be more difficult to address some of the more significant volumes of Commercial/industrial waste in smaller facilities through the lack of ability to get the correct mix of inputted feedstock/material. High scoring elements: · Opportunity to partner with industry and recover many different streams of material in large volumes. Overall score: High reflecting opportunity to process a wide range of materials in significant quantities.	Low scoring elements: · Community-led facilities are often limited in scalability and will not address industry organic material. · Commercial/industrial recovery can manage larger volume material streams. High scoring elements: · Combination of community (often remote) and commercial network that can address some of the more significant volumes of Commercial/industrial waste. · Opportunity to partner with industry and recover many different streams of material in large volumes. Overall score: High reflecting opportunity to process a wide range of materials in significant quantities as well as service smaller communities.

Criteria[40]	Option 1: Do nothing	Option 2: Centralised facility composting	Option 3: Centralised facility AD	Option 4: Commercial network of multiple facilities	Option 5: Commercial and community network of facilities
Carbon impacts · Low score: High net carbon impact · High score: Low net carbon impact	Low scoring elements: · Embodied energy in infrastructure established to process materials. · Transport emissions increased as materials are transported out of region. · Process emissions: Medium/High as some materials are disposed of as waste in landfill generating methane. Other materials generate emissions from composting. · Diversion carbon impact: Medium/low reflecting that some materials continue to be landfilled. · Potential for offsets: Low High scoring elements: · None Overall score : Low reflecting the transport emissions, continued landfilling and some diversion achieved.	Low scoring elements: · Embodied energy: High as complex large-scale equipment is shipped from overseas (depending on type of composting adopted). · Transport: Medium as materials need to be transported across the region to a single facility rather than out of the region. · Process emissions: Medium/High due to release of uncontained emissions (i.e. nitrous oxides) but lower than landfill. High scoring elements: · Diversion carbon impact: High as large-scale composting has significant capacity to divert large volumes of waste from landfill or from being transported long distances out of region. · Potential for offsets: Medium through substituting fossil fuel based soil mineral additives through the use of compost and contribution to soil carbon. Overall score: Medium reflecting balancing of factors between offsetting transport and process emissions with opportunities to divert waste from landfill.	Low scoring elements: · Embodied energy: High as complex largescale equipment is shipped from overseas. · Transport: Medium as materials need to be transported across the region to a single facility rather than out of region. High scoring elements: · Diversion carbon impact: High through significant capacity to divert large volumes of waste from landfill or transported long distances out of region. · Potential for offsets: High through generation of renewable energy sources (e.g., biogas) that can displace burning fossil fuels for process energy/heat. · Process emissions: Low through the ability to contain potential emissions during the digestion process. Overall score: High reflecting containment of processing emissions and opportunity to generate renewable energy.	Low scoring elements: · Embodied energy: High reflecting establishment of infrastructure across multiple sites. · Transport: Low as facilities are built to service local areas. · Process emissions: Medium (technology dependent). High scoring elements: · Diversion carbon impact: Medium through available capacity to divert large volumes of waste from landfill or from being transported long distances out of region. Although may be more difficult to address some of the more significant volumes of Commercial/industrial waste in smaller facilities through the lack of ability to get the correct input of feedstock materials suitable for the process which is eventually proposed. · Potential for offsets: Medium/High (technology dependent, increasing if AD is part of the solutions). Overall score: Medium reflecting local solutions with lower transport emissions but offset by process emissions from composting (note AD in network has opportunity to produce renewable energy and offset fossil fuel improving carbon outcomes)	Low scoring elements: · Embodied energy: Medium reflecting the mixture of small-scale and large-scale infrastructure. · Transport: Low as facilities are built to service local areas · Process emissions: Medium (technology dependent) High scoring elements: · Diversion carbon impact: Medium through significant capacity to divert large volumes of waste from landfill or from being transported long distances out of region. Although may be more difficult to address some of the more significant volumes of Commercial/industrial waste in smaller facilities through the lack of ability to get the correct feedstock mix. · Potential for offsets: Medium/High (technology dependent, increasing if AD is part of the solutions) Overall score: High reflecting local solutions with lower transport emissions and lower embodied energy of infrastructure.

Criteria[40]	Option 1: Do nothing	Option 2: Centralised facility composting	Option 3: Centralised facility AD	Option 4: Commercial network of multiple facilities	Option 5: Commercial and community network of facilities
Cost · Low score – Capital and ongoing costs are potentially less viable · High score – Capital and ongoing costs are lower and therefore likely to be more viable	High scoring elements: · Minimal capital investment required. Low scoring elements: · Operational costs high (transport). Overall score: Medium reflecting minimal capital investment but large ongoing transport costs.	Low scoring elements: · Capital cost is likely to be high. High scoring elements · Operational cost moderate – high with ongoing transport off set by recovery of material value. Overall score: Low reflecting large capital investment.	Low scoring elements: · Capital cost is likely to be very high. High scoring items: · Operational cost moderate – high with ongoing transport off set by recovery of material value including energy. Overall score: Low reflecting large capital investment.	Low scoring elements: · Capital cost is likely to be high. High scoring elements: · Operational cost low -moderate with reduced transport and recovery of material value. Overall score: Low reflecting capital investment required for multiple facilities.	Low scoring elements: · Capital cost is likely to be high. High scoring elements: · Operational cost low - moderate with reduced transport and increased recovery of material value. Overall score: Medium reflecting moderate capital investment required but reduced operational costs (less waste to process through focus on upstream impacts (reduction, recovery)).
Technical Risk · Low score – Technical complexity, operational requirements are higher and technology has less local proven track record · High score - – Technical complexity, operational requirements are lower and technology has local proven track record	Low scoring elements: · None High scoring elements: · Established system, however some stakeholders have highlighted they are struggling to identify processors for all materials. · Straightforward technology widely used across Australia and NZ. · Landfilling is not sensitive to changes in volume or contamination. Overall score: High reflecting established processing options.	Low scoring elements: · Environmental compliance an issue when technology not operated correctly or poor choice of site for technology. · Large amounts of bulking agent required. High scoring elements: · Straightforward technology widely used across Australia and NZ. · A single solution for Taranaki. · Applicable to a wide range of materials. · Material inputs flexible (not as sensitive to changes in volumes and composition as other technologies). · Sensitive to contamination. Overall score: Medium/high reflecting the high adoption of technology across NZ and Australia and applicability to a wide range of material inputs although dependent on specific composting technology.	Low scoring elements: · Although facilities are very common overseas there are only a small number of facilities operating in Australasia (<3) that take food organics. · Technology sensitive to changes in volume and composition. · Risk of not accepting the current mix of materials in region (i.e. significant portion of DAF solids compared to other materials). High scoring elements: · None Overall score: Low/medium reflecting the low level of adoption across NZ and Australia and technology sensitivity to material input compositions and volumes.	Low scoring elements: · Although AD facilities are very common overseas there are only a small number of facilities operating in Australasia (<3) that take food organics. · AD - technology sensitive to changes in volume and composition. · AD - risk of not achieving the current mix of materials in region (i.e. significant portion of DAF solids compared to other materials). High scoring elements: · Composting is a straightforward technology widely used across Australia and NZ, two or more solutions for Taranaki. · Technical risk spread across multiple sites/solutions. Overall score: Low/medium reflecting the likely incorporation of AD and associated technological risks but reduced risk by establishing multiple sites.	Low scoring elements · Operational success requires organisational/community/business collaboration to ensure success of initiative High scoring elements · Straightforward technology widely used across Australia and NZ, multiple solutions and scales for Taranaki. Overall score: Medium/High reflecting prominence of successful initiatives around New Zealand.

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