Circularising Organics – Decision making tool guidance

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Executive Summary

This document presents the second milestone report of the Circularising Organics project by Tonkin & Taylor Ltd for Waikato Regional Council. The aim of the project is to improve the management and recovery of organic materials. Given that this report utilises data that was collected for the Circularising Organics – Chapter 2 Situational Overview, this document should be read alongside the Situational Overview (Purchas et al., 2023).

The focus of this report (decision making tool guidance) is to:

- Provide guidance for organic materials processing.
- Present comprehensive analyses of collections and processing types for various organic feedstocks.
- Discuss the interactions between collection, processing, and market potential of different feedstocks.
- Provide the foundations for a decision-making tool that includes critical questions and considerations that can guide a procurer of organic material processing services.

Within these focus areas, the following conclusions have been drawn:

Guidance for organic materials processing: Source reduction and edible food rescue are recognized as the most favourable methods of organics materials management even before processing. Where materials do require management, onsite management of the organic materials is most favoured given the ability to reduce transport costs and associated emissions. If transport is required, a network approach for managing organic materials at an appropriate scale and location is most preferred.

Analyses of collections and processing types: Technologies utilised within a networked approach can include vermicomposting, composting (in-vessel, static pile and windrow), vermicomposting, and anaerobic digestion (wet and dry). The selection of a processing method will largely be determined by the materials that require processing, noting that this is not the only consideration.

Interactions between collection, processing, and markets: The materials that require processing tend to be a significant deciding factor when deciding on the processing approach. However, they are not the only consideration noting the interdependencies between collection, processing, and markets. The processing approach should be influenced by factors such as material type and composition, volumes of feedstocks, the collection approach, available complimentary materials, and market conditions.

Questions and considerations: As part of the Circularising Organics Project a decision-making tool **(DMM)** is to be developed. The DMM will pose a series of questions to prompt better decision making to manage organic materials. The questions posed will centre on the available materials, volume of materials, access to complementary material streams, collection processes, and available end markets. Alongside this, considerations including application rates, seasonality and costs will be raised.

1 Introduction

The Circularising Organics project aims to improve information and provide guidance to various key stakeholders with the ability to contribute to circularising organics. The focus is on processing options recognising cross linkages with how materials are collected and markets for processing outputs.

This report draws directly from the findings in Circularising Organics – Chapter 2 Situational Overview (Purchas et al., 2023).

The following is an overview of this report:

- Analyses existing regulations
- Calculates compost volumes from feedstocks
- Identifies existing businesses and facilities – collections and processing
- Sets out existing or potential markets
- Reviews compost markets, barriers and opportunities
- Discusses kerbside delivery/hardware options

This report draws on the conclusions of the Circularising Organics – Chapter 2 Situational Overview (Purchas et al., 2023). The executive summary of the Situational overview is provided in Appendix A.

In this report specific attention is given to the collection of materials, the processing approaches available for organic materials, and the markets for processing outputs. Section 2 addresses the interlinkages between collection, processing and end markets. Section 3 provides guidance on organic materials processing approaches, aimed at generators of organic materials requiring processing.

2 Feedstock, collections and processing links

The collection, processing and markets for different feedstocks cannot be considered in isolation. Therefore, options for feedstocks should be considered acknowledging the connections between collections, processing and potential markets (Figure 2.1).

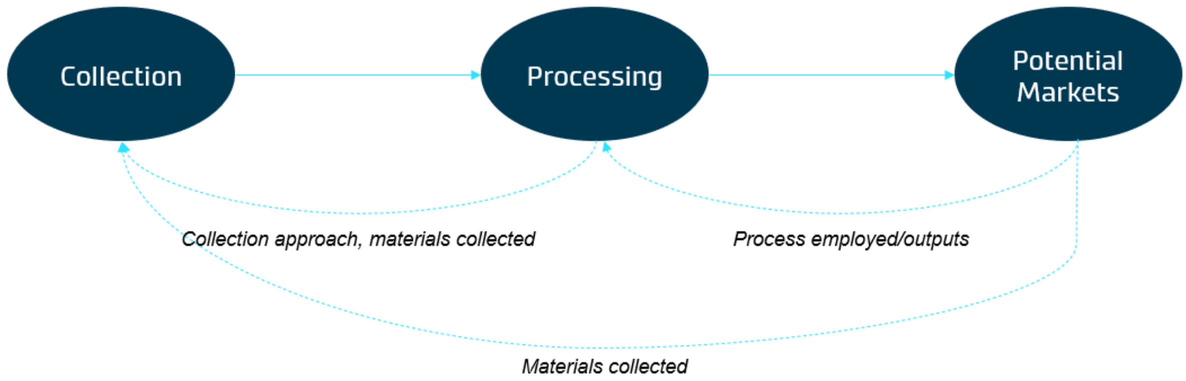

Figure 2.1: Figure highlighting connections between collections, processing and markets

2.1 Available organic materials / feedstock

Prior to the considering collection and processing options it is useful to identify the likely feedstocks. The first stage of this project - reported in Circularising Organics – Chapter 2 Situational Overview (Purchas et al., 2023), involved the identification of the current situation of organic materials within the Waikato and Bay of Plenty regions. This considered the flow of materials across the two regions from council controlled and privately controlled waste streams.

Available materials have been broadly defined as food waste, green waste, mixed food and green waste, and industrial materials (mix of by-products and waste/wastewater treatment residues). Materials that are generated and managed on farms were excluded from this work given that materials remains on farms, biodegrading and returning nutrients to the soil.

Within these categories organic materials including supermarket waste, biosolids, waste from dairy processing, and meat and poultry waste from processing were identified in the Waikato.

2.2 Collections

Suitable collection options for organic materials, as defined in Circularising Organics – Chapter 2 Situational Overview (Purchas et al., 2023), are:

- Milk run multi point collection (community scale).
    - Typically, a small collection vehicle e.g. a van or bike (depending on the scale of the collection), where the swapping of containers is undertaken rather than containers being emptied.
- Manual load using small bins.
    - Small bins are being more widely used across New Zealand for food only collections from households using 23 L containers or 55-65 L wheelie bins at the kerbside. A kitchen caddy is generally provided for users to enable the transfer of food organics into the larger container which will be placed out for collection.
    - These container/ bins are collected by hand (manual collection), and a custom-built vehicle will be used for containment. Because of this, it is common that two crew members are required for this type of collection service.
- Side loader (automated lifting) collection.
    - Wheelie bins of a larger size are lifted by an automated/ remote lifting system on the collection vehicle. Side loaders are suitable for wheelie bins 80 L through to 360 L and are used widely around New Zealand for non-organic collections (rubbish and recycling). They are also an option for food and green combined collections and green only collection.
- Rear loader (automated lifting) collection.
    - Suited to larger scale single source organic collection, for example green only collections with larger wheelie bins or commercial or multi-unit dwelling scale food collections.
    - Rear loaders require manual handling of the bins from the kerbside to the rear of the truck where a lift mechanism will empty the wheelie bin.
    - They may also use two or three operatives to collect the bins from the kerbside and replace them once emptied.
    - Rear load collections can handle bins from 80 L to 1,100 L (1.1 m^3).
- Front loader (automated lifting) collection.
    - Suited to larger scale commercial operations (e.g. schools, hospitals, large commercial premises), with bin capacity typically in the range 1.5 m^3 – 4.5 m^3. The truck lifts the bin

  - up and over the front of the vehicle. Front loaders are not suitable where headroom is limited and access to bins is tight.
- Transportation, i.e. bulking of materials to processing facility/ ies (suited to larger volumes of organic materials).
  - Where processing facilities are located a significant distance from the point of the collection, bulk hauling of materials is undertaken to increase the volume of materials being transported in one trip.

It is also worth noting that although not a collection approach, drop off and self-haul[1] are options which are utilised across New Zealand.

2.3 Processing

The processing options available, as defined in the Circularising Organics – Chapter 2 Situational Overview (Purchas et al., 2023), are listed below and further detail is provided within that report:

- Source reduction (reducing the amount of organic waste generated).
- Home composting.
- Community composting.
- Vermi-composting.
- Static pile composting.
- Windrow composting.
- In-vessel composting.
- Wet Anaerobic digestion[2].
- Dry Anaerobic digestion[3].

The processing methods noted above may be used in various combinations and other processing approaches are used as well. For example, wet anaerobic digestion may require dewatering of digestate prior to use or further processing and dewatered digestate could be further processed using in-vessel composting.

2.4 Potential markets

The potential markets available as outlets for products following processing are noted below. It is worth noting that further investigation into the acceptability of products by specific markets is required and also the confirmation of the size of each market.

Available markets in the Waikato are summarised at a high level in Table 2.1.

[1] i.e., Drop off materials at a collection point or processing site. Examples include dropping green waste at transfer stations or composting sites and households or businesses taking food waste to a processing facility.

[2] As discussed in the Circularising Organics Milestone 1 Report, wet anaerobic digestion process sees organic materials being fed into vessels as a liquid form to be broken down by microorganisms, producing biogas and digestate.

[3] Dry anaerobic digestion processes largely solid materials, treated in a batch or plug flow process with liquid recirculating through the digesting material.

Table 2.1: Potential markets

Markets	Available in Waikato/Bay of Plenty	Example
Community gardens	✓	Application of compost product on community gardens
Council use	✓	Application of compost product on Council owned parks and reserves
Retail	✓	Sale of compost product at retailers including garden centres and landscaping supply merchants
Horticulture	✓	Supply of compost to horticultural growers
Grassland and arable crops	✓	Supply of compost to growers of grasslands and arable crops
Biofuel (wood and shredded 'woody' green waste)	✓	Supply of biofuel for use in transportation, heating or similar applications

2.5 Suitability of feedstock for options

It is important to consider the suitability of different collection and processing options for feedstock to identify the most appropriate methods for dealing with organic material. For smaller quantities of material, a number of options exist to collect materials. As highlighted in Section 2 the materials, containment type, vehicle type and processing method interact, and cannot be considered in isolation.

Similar materials from commercial or industrial activities can be transported in bulk to a processing facility noting that similar considerations are required in terms of aligning specific containment with appropriate vehicles. This analysis is summarised in Table 2.2 and Table 2.3.

Table 2.2: Container and collection approaches and suitability by feedstock

Feedstocks	Containment and collection approaches							
	Containment type		Vehicle type					
	Manual load, small bins (23 L – 65 L)	Wheelie bins (80 L + larger skips for green waste)	No collection, managed at source	Side loader	Rear loader	Front loader (commercial applications)	Milk run, multi-point*	Bulk
Food waste	✓	~	✓	✓	✓	✓	✓	✓
Green waste	×	✓	✓	✓	✓	×	×	✓
Mixed food and green waste	×	✓	✓	×	✓	×	✓	✓
Industrial materials	×	✓	✓	✓	✓	✓	×	✓

Notes: Milk run collections are typically used for smaller scale collections and involve the swap out of containers rather than emptying on collection. Examples in New Zealand include Kaicycle in Wellington and collections of highly putrescible materials such as primary sector wastewater treatment sludges.

Commercial food waste (cafes, restaurants) may be collected in large bins.

Table 2.3: Processing approaches, outputs and suitability by feedstock

Feedstock		Processing approaches							
		Compost		Compost, mulch	Compost		Vermi-compost	Digestate, biogas	
	Source reduction	Home composting	Community composting	Windrow composting	Aerated static pile	In-vessel	Vermi-composting	Wet AD	Dry AD
Food waste	✓	✓	✓	✓*	✓*	✓	✓	✓	✓
Green waste	✓	✓	✓	✓	✓		✓	✓**	✓
Mixed food and green waste	✓	✓	✓	✓	✓	✓	×*****	✓**	✓
Industrial materials	✓	×	✓***	✓	✓	×	✓	✓****	✓

*Small quantity as a proportion of the whole feedstock

** Soft green material – green waste which excludes branches/twigs

*** Small quantities of industrial material may be suited for community composting

**** For anaerobic digestion of industrial materials, it is important to consider pre-processing and getting an appropriate 'mixture' of materials. Additional processing requirements e.g. dewatering, or maturation, are also likely to be required before digestate can be applied to soils.

****** Vermicomposting can accept food and green waste, however soft green materials are preferred.*

2.6 Considerations

Drawing on the discussion in Section 2, considerations for collection and processing are noted in Section 2.6.1 to 2.6.3.

2.6.1 Collection - key considerations

Processing cannot be considered in isolation from the approach for collecting materials (particularly from households) and markets for processing outputs. Any consideration of processing options should take note of the following (with respect to collection aspects):

- The quantity and characteristics of organic material collected will be influenced by:
  - Collection container size – larger containers will encourage users to place more and larger vegetation where garden waste is targeted. Larger containers for food only collections may encourage users to put materials out for collection less frequently, resulting in some degradation of material prior to collection and potentially odorous feedstock arriving at the processing site.
  - Collection frequency (weekly) – the combination of collection frequency and container size defines available capacity and will have an influence on the type and quantity of material collected. Providing too much capacity may encourage users to put materials out less frequently, resulting in some degradation of material prior to collection, causing potentially odorous feedstock to arrive at the processing site.
- Capture rates will be influenced by user experience, container type, capacity and collection frequency. Key influences include convenience (e.g. wheeled containers and kitchen caddies), limiting odour, dirty bins or other unpleasant impacts on system users (frequent collections and bin liners).
- Contamination can be reduced by effective communications, providing suitable capacity (i.e. not too little or too much) and targeted enforcement contamination. Contamination can also be managed following the collection of materials; however this requires additional handling, resourcing, time and equipment.

2.6.2 Organic materials processing - key considerations

As noted above, processing cannot be considered in isolation from other components of the 'system'. This includes the impact of collection approach and markets, but also the range of materials being processed and the direct impacts of processing.

- Managing potential odour and leachate impacts – through appropriate collection arrangements and mitigations such as buffer distances around processing sites, odour containment at unloading and materials movements and appropriate water control and management arrangements.
- Bulking agent – to provide the right feedstock for effective processing including nutrient mix and physical characteristics.
  - For green waste, bulking agents are generally not required (green waste may be used as a bulking agent for other materials; for example processing food waste where composting of green waste is already undertaken).
  - For food waste a 1:3 ratio of food waste to bulking agent is typical. Examples of potentially suitable bulking agents include shredded green waste, wood chips or sawdust. In all cases the bulking agent provides carbon and allows for air circulation.
  - For mixed food and green waste, the bulking agent required will depend on the physical characteristics and nutrient make-up of the mixed feedstock.

Examples of potentially suitable bulking materials are summarised in Table 2.4.

Table 2.4: Potentially suitable bulking materials

Suitable for composting but not vermicomposting	Suitable for composting and vermicomposting
Untreated woodchip, shavings, sawdust.	Paper/cardboard (<10% of total feedstock), pulp mill solids.
Shredded hard green waste.	Shredded soft green waste (e.g. leaves).
Shredded bark.	Untreated sawdust

2.6.3 Markets - key considerations

Access to secure markets for the outputs from organic materials processing is a critical component of any successful circular economy for organic materials. The impact of collection and processing approaches on the end product are important to understand and consider when deciding on the processing approach. This is summarised in Table 2.5.

Product benefits

- The product quality and use of the final product is key to the buyer. Different processing approaches generate different product types and quality.
- Some markets will have specific requirements for the soil amendment products they will accept – particularly when it comes to horticulture, for example, where food suitable for human consumption is being grown.

Existing market presence vs new market creation

- It is key to consider whether there are existing markets available for the product/s being generated before planning for a collection of organic materials. Typically, the processor of the organic materials is the point of sale to the market/s but suppliers of organic materials for processing should understand market risk, particularly as it relates to the materials being supplied.
- In order for a long term solution to be executed, all system components need to work effectively together. This means that collection (at the kerbside or other source), processing and market considerations need to be assessed as a holistic approach.
- Markets are cost sensitive and for products produced from organic materials, these need to be priced accordingly. Products for organic materials processing are unlikely to completely replace conventional fertilisers, so pricing and marketing needs to reflect how products will fit into various growing systems.

Table 2.5: Options identification by organic material type – collection, processing and potential markets

Material type	Containment	Collection	Processing	Potential markets
Food waste	23L (20 – 60L)	None	Source reduction Home composting	At home use Community gardens
		Custom built vehicle Side loader Front loader (typically commercial scale) Milk run multi-point collection Bulk hauling	Community composting Vermicomposting In-vessel composting Anaerobic digestion	Community gardens (compost, in growing mix) Council use (compost, in growing mix) Retail (compost, in growing mix) Horticulture (compost, during cultivation) Grassland and arable crops (compost, during cultivation)
Green waste	240L (120 – 240L) wheelie bin	None	Source reduction Home composting	At home use (compost, in growing mix) Community gardens (compost, in growing mix)
		Side loader Rear loader Bulk hauling	Community composting Static pile composting Windrow composting In-vessel composting Anaerobic Digestion* (soft green waste and small volumes)	Community gardens (compost, in growing mix) Council use (compost, in growing mix) Retail (compost, in growing mix) Horticulture (compost, during cultivation) Grassland and arable crops (compost, during cultivation)
Food and green waste	240L (120 – 240L)	None	Source reduction Home composting	At home use Community gardens
		Side loader Rear loader Bulk hauling	Community composting Static pile composting Windrow composting In-vessel composting Anaerobic Digestion* (soft green waste and small volumes)	Community gardens (compost, in growing mix) Council use (compost, in growing mix) Retail (compost, in growing mix) Horticulture (compost, during cultivation) Grassland and arable crops (compost, during cultivation) Industrial heat or power (new or existing heat plant)

Material type	Containment	Collection	Processing	Potential markets
Industrial materials (mix of by-products and waste/ wastewater treatment residues).	Wheelie bins (80 L + larger skips)	None	On site processing (as per below)	Community gardens (compost, in growing mix) In-house use (compost, in growing mix) Retail (compost, in growing mix) Horticulture (compost, during cultivation) Grassland and arable crops (compost, during cultivation) Industrial heat or power (new or existing heat plant)
		Side loader Rear loader Front loader (typically commercial scale) Bulk hauling	Vermicomposting In-vessel composting Anaerobic digestion Aerated static pile composting Windrow composting	

3 Selecting an organic materials processing approach

The guidance here considers a range of approaches. The focus of this section is providing a purchaser of organic materials information for different processing approaches. This is not operational guidance as more detailed guidance has been published elsewhere for New Zealand. Examples of available guidance are referenced in Appendix C.

Te Rautaki Para Waste Strategy (2023) provides strategic direction for New Zealand waste systems from now to 2050 and is underpinned by the waste hierarchy as presented in Figure 3.1.

The waste hierarchy is used as a guide to prioritise activity, focussing on circular management methods before considering waste management options. Where value cannot be recovered from the materials, or there is no current market for the material the focus is on safe treatment and disposal.

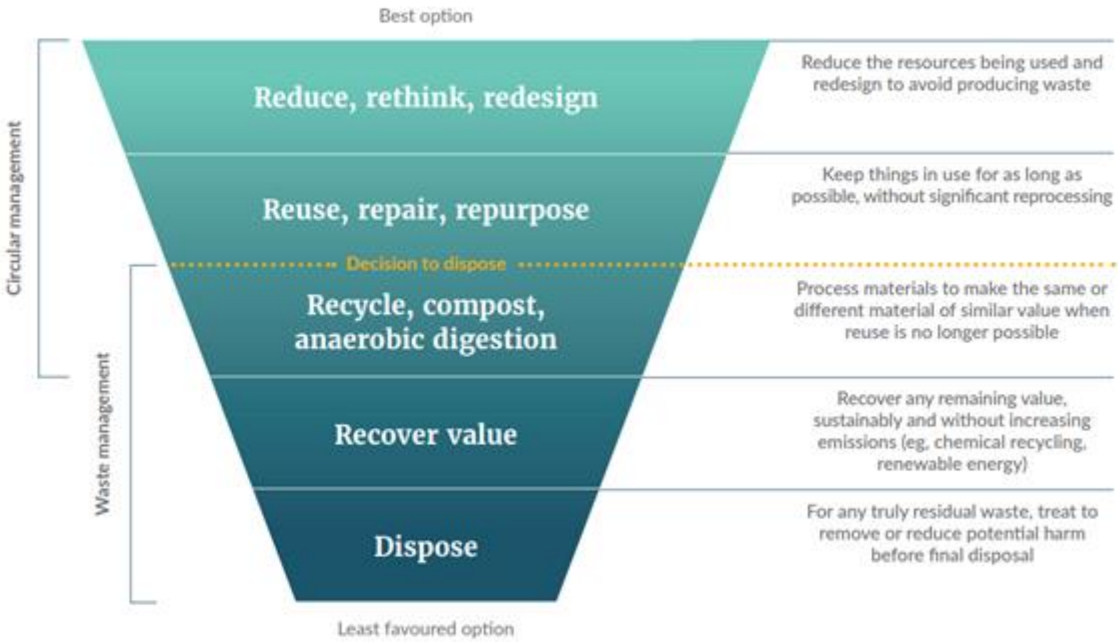

Figure 3.1: The Waste Hierarchy (Ministry for the Environment, 2023)

With the focus of this project on organics, it was decided that a hierarchy tailored for organics would be developed to support decision making. Below we have provided a tailored hierarchy (Figure 3.3.2) that has been developed based on the waste hierarchy as set out in Te Rautaki Para Waste Strategy (Figure).

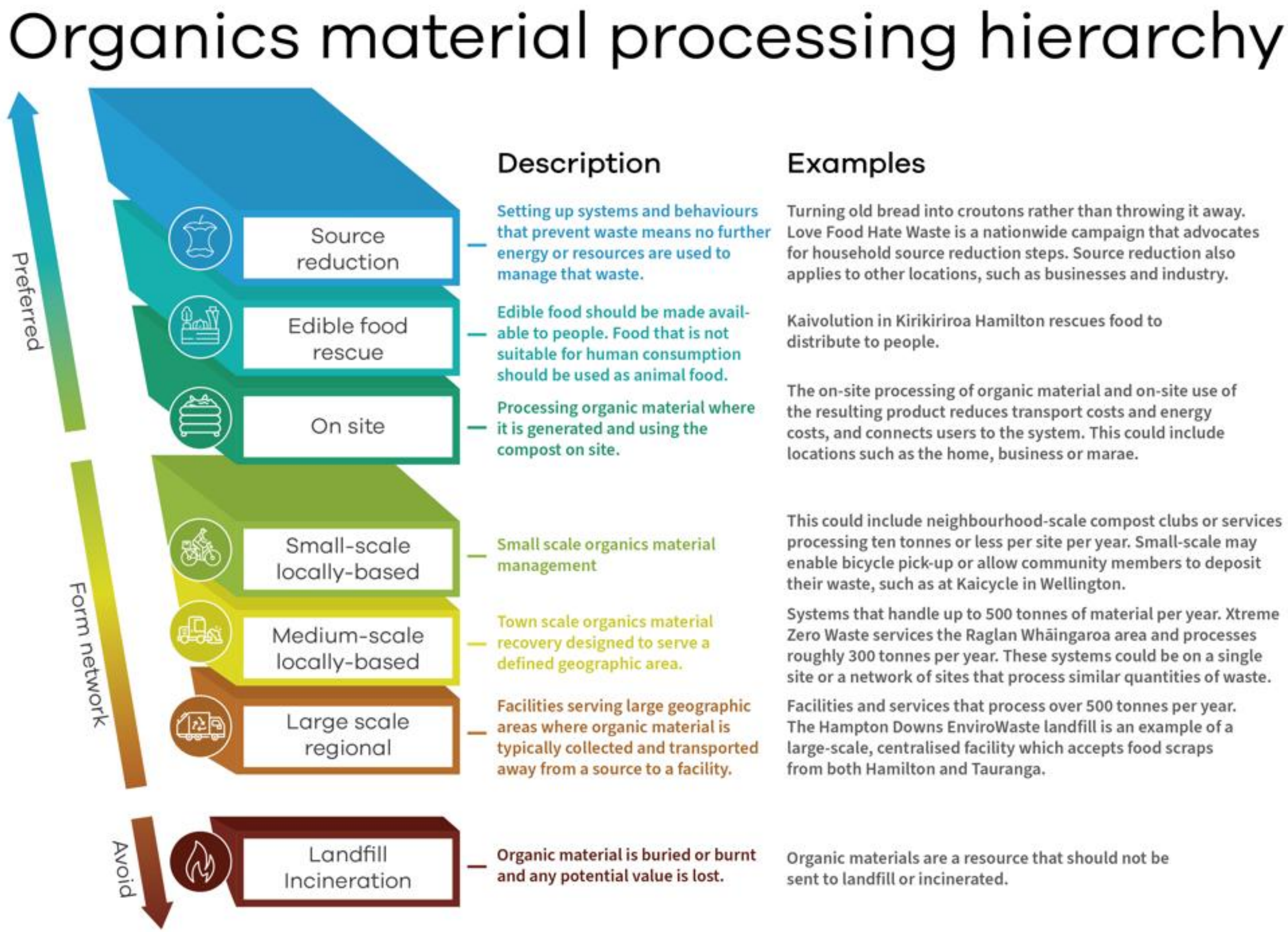

Figure 3.2: Organic materials processing hierarchy developed by the Circularising Organics project team

As alluded to in Figure 3.2, source reduction takes priority and is preferred over all other options. Once organic waste is generated, management of organics locally and onsite where organic materials are being generated is preferred. This is not always possible; therefore, the preferred approach is to build a network approach starting at a small scale and focusing on local based approaches in preference to centralised or large-scale solutions (where possible).

For further detail on the information provided below refer to Circularising Organics – Chapter 2 Situational Overview (Purchas et al., 2023). Guidance can also be found through the WasteMINZ consenting guide, VIC, EPA, NSW, the EPA permitting guide and processing information in NZS4454 as listed in Appendix C.

3.1 Source reduction and edible food rescue

Although not specifically processing, the preference is for source reduction and edible food rescue options (e.g. Go Eco Food Rescue, Food Rescue (Kaivolution)) ahead of any processing of organic materials. The optimal organic materials management strategy is to encourage reduction in organic materials, via education and engagement. Council can actively support source reduction through discouraging food waste generation without high-cost investment or infrastructure. Edible food rescue can also be supported by Council, through communications, relationship building and grant funding.

A number of primary processors across New Zealand are actively looking to optimise their processing in order to reduce wastage. This extends to identification of opportunities to use unwanted organic materials as feedstock for further processing. Examples include by-product processing in the dairy sector e.g. whey to alcohol and protein (for feed and blood and bone fertiliser) and fat recovery (for feed and for biofuel) from meat processing.

This can be complimented by encouraging and supporting individuals to manage their organic waste at home. This takes the onus away from councils providing infrastructure and staff to collect and process materials, towards circular, local approach utilising education and engagement programs.

3.1.1 Case Study - Āmiomio Aotearoa

Āmiomio Aotearoa is a transdisciplinary, multi-partner research project funded by the Ministry for Business, Innovation and Employment (**MBIE**) and hosted by the University of Waikato. Bringing together Mātauranga Māori and science, Āmiomio Aotearoa aims to move beyond linear extract-produce-use-dispose material and energy flow models in order to optimise the value and use of products, components and materials over time.

A key focus of the project is research of niche products that will contribute to the disruption of the status quo, and to develop design processes that start from designing out waste and adding value to any residual materials from production.

3.2 Stock feed

Feeding unwanted organic materials to stock is used across New Zealand, where the food is not suitable for food rescue, but can be used for the likes of commercial piggeries. This approach is used by supermarkets and horticulture businesses.

Timely collection and/or appropriate storage is required to ensure the organic materials arrive in a suitable condition to feed to stock. Contamination is a significant concern for recipients of diverted stockfeed, typically due to plastic packaging. The types of food waste which are used for stock feed are also regulated and the feeding of untreated meat or food that has been in contact with untreated meat is illegal within New Zealand (Ministry for Primary Industries, 2023).

3.3 Onsite

The management of organic materials onsite is the next preferred option (where suitable). Processing of materials onsite can take many forms from vermicomposting, composting and small scale anaerobic digestion; with small scale referring to the approach of a single entity processing materials from their manufacturing only. Managing materials onsite reduces the transport costs and associated emissions generated for transporting the organic materials to an alternative site for processing. In most cases the process outputs (soil amendment, compost, energy) are used on site, reducing the need to bring other materials or energy on site. The appropriate processing approach should be assessed on a site-by-site basis.

3.3.1 Case Study – Fonterra Tirau

Fonterra's Tirau lactose production hub houses a biodigester to process fats and proteins in wastewater, cleaning the wastewater and creating a gas. Digestate that can be spread to paddocks and crops as fertiliser is also produced using the biodigester. The on-site biodigester provides an alternative energy source for the plant (small-scale) and allows for value to be derived from material that historically would be a cost to manage and discharge.

3.4 Network approach

Where source reduction, edible food rescue and onsite management are not appropriate, organic materials are required to be transported to an alternative location for processing. The adoption of a network approach considers the management of organic materials at a scale and location which is appropriate to the types of organic materials being generated. Therefore, it is not a one size fits all approach to a network approach for organics management. Further details can be found in work completed for Waikato Regional Council on organic materials processing adopting a network approach: Circularising Organics – Chapter 3 Localising Organics (Prince & De Vine 2023).

Section 2.5 provides detail on the processing approaches which can be undertaken either onsite, as part of a network approach or at a large scale.

3.5 Overview of processing

This section provides an overview of material processing approaches for organic materials. A discussion of standards and guidelines relevant to outputs from the various processing technologies is provided at the end of this section. However, as noted in Circularising Organics – Chapter 2 Situational Overview (Purchas et al., 2023), within New Zealand there is no regulatory framework or directive requiring producers to comply with standards relevant to the production or use of organic materials derived products. Therefore, the standards and guidelines detailed are voluntary to producers or may have been stipulated within contractual agreements with suppliers.

When considering processing options it is important to consider:

- The suitability of each processing approach for the material (refer Section 2.5).
- Product value including ability to meet relevant product standards.

- Markets for processing outputs (can the processor provide confidence that they have identified viable end markets).

3.5.1 Vermicomposting

Vermicomposting relies on the use of worms to rapidly breakdown organic material. Vermicomposting can handle a wide range of organic materials, it does however require inputs to be monitored and balanced.

The outputs from vermicomposting can include:

- A liquid (worm tea).
- Solid (worm castings or vermicast).

These outputs are nutrient dense and have a high moisture content and dense structure. Worm castings and worm tea do not require maturation prior to use.

New Zealand producers note that the outputs from vermiculture bring the following key benefits (MyNoke 2022):

- Improved soil structure.
- Nutrient replacement.
- Improve moisture retention within soil.
- Reduce the reliance on synthetic fertilisers.

Suitable applications for these outputs may include:

- Worm tea – top dressing in small quantities to be mixed in with mulch.
- Vermicast – top dressing in small quantities, blending with composts, top soils and potting mixes.

Market demand is variable with current commercial operators noting that:

- There is a growing market in retail.
- There is a variable market in horticulture due to very specific requirements for various crops.
- The demand is unknown/untested for grassland and arable crops.

3.5.2 Static pile composting

Conventional static pile composting involves placing the composting mix in ‘piles’. Composting takes place over a much longer period than turned pile methods (windrow and in-vessel composting for example). Bulking agents are an important consideration, due to the lack of turning taking place for static composting. This means that air circulates through the compost material through convention currents created as heat is generated in the composting process. If the material is too dense air cannot circulate and composting is restricted.

The quality of output materials can be poorer than for windrow or in-vessel composting due to the lack of mixing and inconsistent stabilisation through composting. This limits the use of output materials. Blending of the output compost may be required for access to markets.

Outputs from static pile composting brings the following key benefits:

- Improved soil structure.
- Nutrient replacement (less nutrient rich than compost from windrow and in-vessel composting and vermicompost.
- Improved moisture retention within soil.
- Reduces the reliance on synthetic fertilisers.

Suitable applications for the compost may include:

- Council use (landscaping, parks).
- Retail sale.
- Commercial horticulture.
- Grassland and arable crops (depending on output quality of the finished compost).

Testing of these markets at a local level requires discussions with specific potential users. Note – preference may be given to compost derived from windrow or in-vessel composting due to the higher quality.

3.5.3 Windrow composting

Windrow composting is an aerobic, hot method of composting which breaks down organic materials in around 10-20 weeks. Materials are periodically turned (mixed) encouraging consistent composting across the feedstock and to maintain good aeration.

The nutrient content, structure and moisture retention qualities of windrowed material is lower/poorer than in-vessel output material, reflecting limitations on processing some materials.

The end compost product is a quality compost which can be blended and sold. Mulch (oversize materials) is also a likely output, where screening of the compost is undertaken to generate a consistent size of compost, for example 0-10mm, or 10-20mm (this will depend on the market being targeted). The mulch can also be used back in the process as a bulking agent (providing airflow within the material).

The main challenges for windrow composting include managing leachate and odours during operations.

Outputs from windrow composting bring the same benefits as for static pile compost products, however they are likely to be of a higher quality (see).

Suitable applications for the compost may include:

- Council use (landscaping, parks).
- Retail sale.
- Commercial horticulture.
- Grassland and arable crops (depending on output quality of the finished compost).

Testing of these markets at a local level requires discussions with specific potential users. All of these markets have a previous history of acceptance for this product across New Zealand. Horticulture has significant additional potential, subject to acceptance criteria of those likely to use the compost, i.e. further discussions would be required for specific applications.

3.5.4 In-vessel composting

In-vessel composting offers a higher order technology option to basic windrow composting. In a typical enclosed system, semi-automated aerobic hot composting takes place within a controlled environment, and supporting specific bacteria to process the organic waste within a 4-6 weeks processing period. Materials are regularly or constantly turned or agitated, and many systems actively aerate the composting material (with blowers or similar).

Getting the right input feedstock mix right (carbon and nitrogen rich materials) is important as processing is less flexible than windrow composting.

Outputs from in-vessel composting bring the following key benefits:

- Compost which is more consistently pasteurised and processed compared to windrow and static pile composting outputs.
- Improved soil structure.
- Nutrient replacement (higher than static pile and windrow composting, however less nutrient rich than vermicompost).
- Improved moisture retention within soil.
- Reduces the reliance on synthetic fertilisers.

Suitable applications for the compost may include:

- Council use (landscaping, parks).
- Retail sale.
- Commercial horticulture.
- Grassland and arable crops.

3.5.5 Anaerobic digestion

Anaerobic digestion occurs within a sealed vessel without the presence of oxygen. The process is well suited to waste materials with a higher nitrogen content and is commonly applied for wastewater solids (municipal and industrial). Anaerobic digestion may be complemented by other organic materials processing technologies, for example digestate from wet anaerobic digestion can be composted following dewatering.

For both wet and dry anaerobic digestion additional processing technologies may be required. This may include decontamination and/or homogenisation (shredding, mixing) of materials prior to digestion, as well as further processing of outputs from digestion e.g. dewatering (press, centrifuge, drying) post processing.

3.5.5.1 Wet anaerobic digestion

In a wet anaerobic digestion process (common in New Zealand), organic materials in liquid form are fed into vessels to be broken down by microorganisms to produce biogas (a carbon dioxide and methane mixture) and digestate. This approach is common for food waste internationally and applied to industrial and municipal wastewater solids across New Zealand.

Outputs from anaerobic digestion bring the following key benefits:

- Nutrient replacement (digestate – liquid or solid).
- Biogas can be used as a renewable source of methane and carbon dioxide.

Suitable applications for the outputs from anaerobic digestion may include:

- Digestate (fertiliser).
  - Council use.
  - Retail sale.
  - Grassland and arable crops.
  - Commercial horticulture.
- Biogas – use for the generation of heat and/or power.

3.5.5.2 Dry anaerobic digestion

Dry anaerobic systems are an emerging technology and are more suited to input materials with a lower moisture content. These systems circulate leachate in an oxygen free environment over solid material such as a mixed food and garden feedstock.

Outputs from anaerobic digestion bring the following key benefits:

- Nutrient replacement (digestate – liquid or solid).
- Biogas can be used as a renewable source of methane and carbon dioxide.

Suitable applications for anaerobic digestion may include:

- Digestate (fertiliser).
  - Council use.
  - Retail sale.
  - Grassland and arable crops.
  - Commercial horticulture.
- Biogas – use for the generation of heat and/or power.

3.6 Product standards

The production or use of organic material derived products is largely unregulated in New Zealand. There is no regulatory framework or directive which producers are required to comply with.

There are however a number of voluntary standards which producers use as guidelines to support production of quality products. The key standards applied in New Zealand are:

- New Zealand Standard 4454.
- BioGro (organic product).
- Asure Quality – Organic Standard (2020).
- Global G.A.P.
- Bio-Energy Association Digestate Certification Scheme (under development).

Although voluntary, some New Zealand markets or customers do specify compliance requirements for the products that they will use.

4 Decision making

A decision-making tool is to be developed as part of this project. The questions to be answered as part of this have been provided below. The purpose of these questions is to understand whether or not to implement an organics collection service, and if so, to assess guidance about the appropriate processing approach. Alongside the questions are the key considerations for the procurers of organic materials processing services navigating this process (this draws on Sections 1-3 of this report).

1. What are the materials?
   - Single stream materials.
   - Combined stream materials.

2. Where are the materials sourced? (this can impact the potential for contamination and also whether a single or combined stream is suitable)
   - Kerbside collections
   - Businesses e.g. Cafés
   - Industrial scale food processing i.e. large-scale factories
   - Primary sector by-products e.g. dairy, meat processing

3. What is the volume of materials proposed for collection?
   - Household, commercial or industrial scale – this provides context on the likely quantities of organic materials and whether at source options or a network approach would be available.
   - For example – commercial scale processing approaches which allow for large volumes of organic materials.

4. Are there any complementary material streams available for collection?
   - Timber/ wood (depending on the source and may be introduced by the processors to aid the processing approach (e.g. a bulking agent).
   - This question enables the consideration of broader organic materials which may be generated from other sources.
   - Additional streams that may improve digestion performance, efficiency or gas yield where anaerobic digestion is proposed.
   - Additional streams that may improve product (compost, vermicompost) characteristics e.g. nutrient content/mix.

5. Is a collection service the most appropriate approach? Would drop off locations/ hubs, transfer stations also be required?

6. What is the proposed processing approach?
   Based on the selected materials for collection and processing approach, the following outputs will be generated:
   - Processing approaches relevant to the target materials, quantities, collection approach and available complimentary materials will be listed.
   - Static pile and windrow composting will not be suitable options for food only collections for example.

7. What potential end markets are available?
   The potential end markets presented will reflect the answers to the previous questions.

- For each of the end markets displaced application rates, seasonality and costs would require further confirmation.
- Prompts will be provided to guide further discussion with potential end users/ market research.

Following completion of the questions – guidance on the considerations for materials and markets is provided.

- Considerations for material inputs.
- Considerations for markets.

Applicability

This report has been prepared for the exclusive use of our client Waikato Regional 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.

Tonkin & Taylor Ltd
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Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
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Appendix A - Executive summary from: Circularising Organics – Chapter 2 *Situational Overview (Purchas et al., 2023)*

This report provides factual information to support Waikato Regional Council's Circularising Organics project. The purpose of the Circularising Organics project is to improve information and provide guidance to various key stakeholders with the ability to contribute to circularising organics.

The focus of this report is to:

- Analyse existing regulations
- Calculate compost volumes from feedstocks
- Identify existing businesses and facilities – collections and processing
- Set out existing or potential markets
- Review compost markets, barriers and opportunities
- Kerbside delivery/hardware options

Analysis of existing regulations: Themes from recent central government strategies and existing legislation focus on New Zealand's transition towards a low-emissions and low-waste society. New Zealand standards for organic materials indicate that there is a lack of regulatory framework for organic materials derived products, leaving standards as voluntary or determined by market expectations. The absence of strict regulations offers both flexibility and challenges for industry stakeholders in an evolving policy environment.

Calculation of compost volumes from feedstocks: Understanding the dynamics of compost production will provide a basis for decision-making in the later stages of the project. Desktop information supported by on-the-ground conversations indicated that there is more than 370,000 tonnes of organic materials generated per year available in the Waikato. It is important to recognise that the quality and volume of the compost produced varies; systems require maintenance and management to produce better quality outputs, and inputs vary depending on season and rainfall patterns.

Identify existing businesses – collection and processing: Identifying existing collectors and processors of organic materials is crucial for identifying potential collaborators, optimising processes, and leveraging existing infrastructure. Aerated static pile composting, anaerobic digestion, in-vessel composting, windrow composting and vermicomposting have all been established in the Waikato, Bay of Plenty and Auckland regions. High level estimates indicate that more than 200,000 tonnes of organic materials are processed in the region per year.

Set out existing or potential markets: A strong understanding of the market for organic materials is essential to establish sustainable and economically viable solutions for circularising organics. Some of the key benefits from utilising the processed organic material outputs include soil amendment (improved soil structure, nutrient replacement and improved moisture retention), but also as an input for stock feed, and alternative fuels (transport fuels and industrial heat). The value and use of the processed organic materials differs substantially depending on the type, location, quality and quantity of materials.

Review of compost markets, barriers, and opportunities: The combination of public perception, increasing landfill costs, and demand for outputs have resulted in a large opportunity to grow the market for products derived from organic materials. The most significant barrier to the production of compost type products is access to a steady supply of feedstock which is free from contamination. Industries including horticulture and agriculture are familiar with compost type products and understand the benefits of these products. Markets emerging for products including digestate are being established, and are expected to grow as quality standards and guidelines for application are established.

Most crucially, quality outputs from organics processing rely on quality inputs. Quality inputs will be impacted by variables include, but not limited to collection frequency, aeration of materials, access to depackaging for commercial food wastes, and seasonality.

Kerbside delivery/ hardware options: In New Zealand, organic materials at a household and commercial scale are generally collected via 23L food organics **(FO)** bins, 80-240L food and garden organics bins **(FOGO),** and 240-480L green waste only **(GO)** bins. Trucks with custom-built containment, or trucks fitted with an automated/ remote lifting system are most often used for the kerbside collection of organic materials from households. Where large quantities of materials are generated, organic materials may be collected in 660L – 4.5m^3 bins. These larger bins require rear or front loader vehicles to be used.

Appendix B - Reference list

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Appendix C - Organic materials processing guidance

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Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

He taiao mauriora **Healthy environment**

He hapori hihiri **Vibrant communities**

He ōhanga pakari **Strong economy**

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