Organic Waste Options Study

Report for Environment Bay of Plenty
Contract No. 2009 0302

April 2010

Report for:

Annabelle Ellis, Environment Bay of Plenty

Prepared by:

Duncan Wilson

Lisa Eve

Bruce Middleton

Approved by:

Duncan Wilson

(Project Director)

Contact Details

Eunomia Research & Consulting Ltd
PO Box 78 313
Grey Lynn
Auckland 1245
New Zealand

Tel: +64 9 376 1909
Fax: +64 9 360 5187

Web: www.eunomia-consulting.co.nz

Waste Not Consulting Ltd
PO Box 78 372
Grey Lynn
Auckland 1245
New Zealand

Tel: +64 9 360 5188
Fax: +64 9 360 5187

Web: www.wastenot.co.nz

Contents

Executive Summary

E.1.0 Background

This report has been commissioned by Environment Bay of Plenty, Tauranga City Council, and Western Bay of Plenty District Council and focuses on organic wastes currently going to landfill from the Bay of Plenty Region. Other organic wastes going to a destination considered less than ideal are also included where appropriate. Various drivers, such as government policy, legislation and local/regional management priorities, make better organic waste management a key issue for the region.

An interim report was submitted at the end of January 2010, concentrating on those parts of this report that were required to develop a Waste Minimisation Fund application.

E.2.0 Key Findings

E.2.1 Current Infrastructure

There are few processing facilities for organic waste in or near the Bay of Plenty region, and most that do exist are designed for green waste only. Several processing facilities in other regions are used, particularly those in the north Waikato and southern Auckland regions.

Disposal in the region is limited to a few landfills and cleanfills, and a large proportion of the waste stream is transported out of the region to two municipal landfills in the Waikato region.

There are a wide range of current initiatives underway or proposed for organic waste in the region. These vary from tentative proposals, to well-funded research programs, and are numerous. This is a key driver for production of a regional organic waste management strategy at some level – many private and public sector bodies are investing time and money in developing proposals and facilities that may or may not suit the needs of the region as a whole.

E.2.2 Organic Waste Estimates

The largest organic waste stream by weight is wood waste, largely from the Carter Holt Harvey and Norske Skog mills at Kawerau, and a small amount from another mill at Whakatane. Other usual organic waste streams exist such as green waste, food waste, and biosolids. These are distributed throughout the region. Kiwifruit waste, while not generally going to landfill, could be diverted for more beneficial use than at present

Sea- and lake-weed are also reasonably significant organic waste streams, occurring in the Rotorua lakes district and on the coastline in the western Bay of Plenty region.

Analysis of trends indicates that the amounts of organic wastes present in the region are most likely to increase, and are very unlikely to decrease.

E.2.3 Gap Analysis

The five priority organic waste streams identified were wood processing waste, food waste, biosolids, green waste, fruit waste, and sea- and lake-weed. Processing infrastructure currently exists in the region to deal with a proportion of the green waste only, with just small amounts of the other organic waste streams currently being processed through various methods.

E.2.4 Options

A wide range of technologies are potentially suitable to deal with the organic waste streams identified, with the following caveats:

1) Anaerobic digestion does not deal well with lignin, which comprises a large part of the processing wood waste

2) Windrow and in-vessel composting is suitable for all organic wastes but would require large amounts of green waste for structural material, and to process all the identified organic wastes through this method would require extracting all green waste from the region (including that already going to beneficial use) and possibly importing more from outside the region

3) Vermicomposting is suitable for all organic wastes and although structural/bulking material would be required, less would be required than for windrow composting

If all organic waste streams were to be included, then vermicomposting is the only processing method that would deal easily with the wood processing wastes present in the region.

A number of potential public and private sector partners were identified that are either already involved in organic waste processing in the region, or have indicated they are keen to be involved.

E.2.5 Markets

The strong presence of horticulture in the region, and the existing demand for conventional fertilisers, suggests that there is sufficient potential use for the amount of product that may result should all organic waste streams be diverted from landfill. Issues such as quality standards, price, competitiveness with conventional fertilisers, and the influence of regional and national policies all have an impact on whether markets for compost-type products would be commercially viable. There is potential to encourage the use of compost-type products instead of conventional fertilisers, given the impact that the current use of these fertilisers has on soil and groundwater quality in the region.

The potential market value for products depends on the processing technology used, quality control, and the waste streams included (particularly biosolids)

Energy production does have some potential, but this is more a longer-term option than immediately commercially viable. Future viability will depend on the influences of legislation, regional policies and energy prices.

E.2.6 Procurement Models

There are a range of procurement approaches that could be taken, ranging from the status quo to a very high level of public ownership of organic waste processing facilities. If the status quo continues, the region will likely have more organic waste processing facilities eventually, but these may not meet the priority needs identified in this report.

To prevent this situation, the information from this study could be released at least in a summary form to guide the private and public sector in their plans.

E.2.7 Options

The priority waste streams, identified earlier, are wood processing waste, food waste, biosolids, green waste, fruit waste, and sea- and lake-weed.

Processing the entire wood waste stream would potentially require all remaining organic wastes, to provide the necessary balance of nitrogen-rich wastes and structural material – indeed, using an aerobic process would mean that the entire green waste stream (including that currently being composted for beneficial use) would be required to balance just the nitrogen-rich organic wastes (food waste, biosolids, fruit waste and lake- and sea-weed).

The only technologies suitable to processing all of the priority organic waste streams identified are vermicomposting, and potentially gasification/pyrolysis. Anaerobic digestion would not cope with the high lignin content.

Based on these constraints, three scenarios were developed:

1) Centralised vermicomposting (including all priority organic waste streams)

2) Centralised anaerobic digestion (excludes the wood processing waste, on the assumption that CHH and Norske Skog choose to continue their landfill disposal option)

3) Several strategically located systems (takes in to account the existing plans in the eastern Bay of Plenty and Rotorua, and recommends that different technologies are used to suit each location. Also assumes that the wood processing waste is excluded)

Estimated costs for each scenario were presented

E.2.8 Summary and Recommendations

A large amount of organic waste is currently being sent to landfill in the Bay of Plenty region, or exported to landfills outside the region.

Short-term and long-term recommendations were made to reduce this amount of organic waste disposal. All recommendations are aimed at the establishment of a facility or facilities within or very near the region, to accommodate the types and volumes of organic waste streams identified through this study

If no action is taken, it is unlikely that significant amounts of organic waste will be diverted from landfill, and facilities may be developed by the public or private sectors that do not align with the priorities identified here

Short term recommendations include:

1) Informing and guiding by issuing a statement on organic waste management or a summary of this report

2) Influencing the development of facilities through the consents process, including a positive influence where appropriate

3) Strategic coordination within EBoP

Longer term recommendations include:

1) Strong strategic leadership on organic (and other) waste management

2) Direct involvement in procurement of organic waste processing facilities by EBoP or territorial authorities in the region, in accordance with (1) above.

1.0 Introduction

Environment Bay of Plenty (EBoP), Tauranga City Council (TCC) and Western Bay of Plenty District Council (WBoPDC) engaged Eunomia Research & Consulting Ltd (Eunomia) and Waste Not Consulting Ltd (Waste Not) to undertake a study into the options for organic waste management in the Bay of Plenty region.

EBoP and TCC are keen to reduce waste to landfill and have identified organic waste as a key waste stream in achieving this goal. A previous study undertaken in 2007[1] identified organic wastes as the fraction that offered the greatest scope for improving resource recovery in the region.

This report builds on the 2007 study to further improve understanding of organic waste volumes, sources, processing options and potential end uses in the Bay of Plenty. The outcomes are intended to facilitate the uptake of commercial opportunities that will improve recovery of organic wastes.

Other issues that may influence the management of organic wastes will be covered, such as existing collection and processing providers and current projects focusing on organic waste processing within both the private and public sectors.

1.1 Interim Report

One of the objectives of the project was to identify opportunities and potential collaboration partners for inclusion in an application to the Waste Minimisation Fund. An interim report was submitted on 29th January 2010 focusing on aspects that were considered essential to the funding application, and, therefore, did not contain the full range of information that is presented here in the final report.

The interim report covered:

- **Key Drivers.** This section provided an overview of key drivers for organic waste diversion in the Bay of Plenty Region. This includes legislative and policy drivers, economic drivers, and regional priorities. In the context of this interim report an overview and evaluation of the Waste Minimisation Fund criteria was also provided.
- **Infrastructure.** A summary of the processing and collection infrastructure currently in place was provided. Locations and key players were also identified.
- **Data.** An analysis of the types and quantities of organic wastes generated and their current disposal pathways was provided. The analysis aimed to identify the key waste streams that would be targeted.
- **Gap Analysis.** The gap analysis identified which waste streams were not currently being diverted from landfill and which presented opportunities for higher-value use.
- **Identification of Options.** A range of options were put forward to address the gaps identified in the previous section. Technology options, collection options and collaboration options were considered.
- **Evaluation of Options.** A set of criteria for evaluating the options for suitability for a Waste Minimisation Fund bid was put forward. The criteria were derived from the earlier analysis of the key drivers. A simple rating of the options against the criteria

[1] Sinclair Knight Mertz (2007), *"Waste Infrastructure Stocktake and Strategic Assessment"* report for EBoP,

was provided as a basis for further discussion and decision making around development of a Waste Minimisation Fund bid.

In summary, the interim report showed that there are very few organic waste processing facilities in the region and the range of organic wastes that are processed at these facilities is extremely limited. The existing facilities are largely open windrow composting operations, or small vermicomposting operations incorporating just one or two waste streams.

There is a large amount of organic waste produced in the region going to landfill, and there are also other organic waste streams that are managed in ways that are less than optimal.

The largest organic waste streams going to landfill are various wood wastes – largely resulting from the Tasman Mill operation in Kawerau. There are also substantial quantities of putrescible wastes and biosolids landfilled, both of which present greater environmental risks when landfilled compared to other organic wastes.

The information contained in the interim report is also presented in this final report in detail, in sections three and four.

1.2 Final Report

This final report expands on most areas of the interim report and provides greater detail, particularly regarding markets, potential future demand, and options for processing technologies and collections.

The evaluation of options is broadened to take a wider strategic view, and a basis for a structured programme of action to systematically address organic waste issues in the region is developed.

A detailed explanation of the methodology, and technical appendices are also included.

1.3 Key Drivers

1.3.1 Government Policy

1.3.1.1 New Zealand Waste Strategy (NZWS) 2002

Organic wastes are noted specifically in the NZWS 2002, and a range of targets put forward. In the context of this document the relevant targets are:

a) By December 2003, all territorial local authorities will have instituted a measurement programme to identify existing organic waste quantities, and set local targets for diversion from disposal

b) By December 2005, 60% of garden wastes will be diverted from landfill and beneficially used, and by December 2010, the diversion of garden wastes from landfill to beneficial use will have exceeded 95%

c) By December 2007, a clear quantitative understanding of other waste streams (such as kitchen wastes) will have been achieved through the measurement programme established by 2003.

It is worth noting that almost all of these target dates have now passed. A review of the targets in the waste strategy carried out in 2006[2] noted that target a) was not achieved, target b) was 'unable to be measured' and target c) was achieved ahead of the due date.

1.3.1.2 Draft Revised NZ Waste Strategy – Targets

The MfE published a discussion document proposing revised targets in March 2009[3]. This proposed significant changes to the original targets with a short term focus on establishing a baseline for total waste quantity, waste composition and quantities of key waste streams. The only target for organic waste in this document related to ensuring a system was in place for monitoring and measuring organic waste. Subsequent to the discussion document, a draft of the revised NZWS has been developed which proposes a number of targets. It is our understanding that in the current draft there are no specific targets related to organic waste. However, diversion of organic waste will clearly be a significant contributor to the higher level targets proposed. These include the following, which are proposals for discussion and not government policy:

Overall waste minimisation target:

> *By 2015, reduce the quantity of waste (tonnes) disposed to landfill per person per year by 20% relative to an established 2010 baseline.*
>
> This is an overall level of achievement against waste minimisation objective 1 and should be achieved by the actions of all those involved in waste; businesses, councils, waste operators and households and individuals.
>
> Government expects councils to set local targets that are realistic but which contribute to the overall target.
>
> *By 2012, the Ministry for the Environment will have implemented a waste monitoring and reporting programme to generate consistent data on national waste streams, including waste to cleanfills and other disposal sites (for example industrial landfills).*
>
> *By 2012, the Ministry for the Environment will work with local authorities to develop a national reporting template that councils will use to report to the Ministry on progress against their waste management and minimisation plans and other waste-related activities.*

1.3.1.3 Blue-Green Manifesto

The National Party's environmental manifesto 'A Bluegreen Vision for New Zealand'[4] sets out the current National government's views and policy approach to environmental issues including waste. The document does not outline any specific initiatives or policy intentions with respect to organic waste. In general terms however it indicates a preference for strengthening market signals to reflect the true costs of waste and enabling the market to deliver better environmental outcomes. This is consistent with a user pays approach to refuse and organic waste collection, and with ensuring price differentials that favour recovery

---

[2] Ministry for the Environment (2006) Targets in the New Zealand Waste Strategy: 2006 Review of Progress. Wellington.

[3] Ministry for the Environment (2009) Waste Minimisation in New Zealand. A discussion document from the Ministry for the Environment. Wellington.

[4] National Party (2008) *A Bluegreen Vision for New Zealand*. Discussion Paper by Hon Dr Nick Smith MP, National Party Environment Spokesperson. Wellington.

and reprocessing over disposal. Also signalled in the document is the Party's desire to strengthen national standards for the operation of waste facilities.

1.3.2 Legislation

There are a number of important pieces of legislation that impact on the management of organic waste in New Zealand. These are discussed briefly below.

1.3.2.1 The Waste Minimisation Act 2008

The Waste Minimisation Act 2008 (WMA) provides a regulatory framework for waste minimisation that had previously been based on largely voluntary initiatives and the involvement of territorial authorities under previous legislation, including Local Government Act 1974, Local Government Amendment Act (No 4) 1996, and Local Government Act 2002. The purpose of the WMA is to encourage a reduction in the amount of waste disposed of in New Zealand.

In summary, the WMA:

- Puts a levy on all waste disposed of in a landfill, initially at $10 per tonne effective as of 1st July 2009; 50% of the funds collected will be provided to Territorial Authorities to be spent on the implementation of their Waste Minimisation and Management Plans. The remainder, less any administration costs, will go into a contestable fund for waste minimisation initiatives. The levy will help dis-incentivise landfill and levy funding will potentially be available to assist organic waste diversion projects;
- Facilitates or enforces producers, brand owners, importers, retailers, consumers and other parties to take responsibility for the environmental effects of their products – from 'cradle-to-grave' through voluntary and mandatory product stewardship schemes. There may be implications for local authorities which currently deal with these products in their waste streams or who are party to voluntary programmes;
- Allows for regulations to be made making it mandatory for certain groups (for example, landfill operators) to report on waste to improve information on waste minimisation. This will impact on councils owning or operating landfills
- Clarifies the roles and responsibilities of territorial authorities with respect to waste minimisation e.g. updating Waste Management and Minimisation Plans (WMMPs) and collecting/administering levy funding for waste minimisation projects
- Introduces a new Waste Advisory Board to give independent advice to the Minister for the Environment on waste minimisation issues.

1.3.2.2 Emissions Trading Scheme (ETS)

The Climate Change (Emissions Trading) Amendment Act 2008 in its current form will require landfill owners to surrender emission units to cover methane emissions generated from the landfill. Should any future solid waste incineration plants be constructed, the Act would also require emission units to be surrendered to cover carbon dioxide, methane and nitrous oxide emissions from the incineration of household wastes. The waste sector will not formally enter the ETS until 1 January 2011, at which time voluntary reporting can occur. Mandatory reporting requirements will apply from January 2012 and emission units will need to be surrendered as of 2013.

The method for calculating emissions from landfills and incinerators is yet to be regulated[5]. This means it is not yet possible to calculate the impacts, although the net impact of the ETS

[5] The expectation is that Government will work with industry to do so during 2009 and 2010

on the waste sector is likely to be to increase the cost of landfilling. If no methane capture systems are in place in a landfill this would have the effect of increasing landfill costs by approximately $25-$30 per tonne (roughly equivalent to the price of per tonne of carbon).

Nevertheless, the impact from the ETS (particularly if combined with the impacts of the landfill levy) is likely to be to encourage more businesses to find alternatives to landfilling their waste, with a likely impact of increasing demand for recycling and organic waste diversion services. At present, however, there are no direct impacts from the ETS for organic waste facility operators. In particular there are no mechanisms by which operators of organic waste recovery facilities can enter the emissions trading market through claiming or generating emissions units or similar. Thus while landfill operators will be able to claim credits for methane capture there does not appear (at this stage) to be any mechanism to claim for material diverted.

1.3.2.3 Local Government Act 2002

Key requirements of the Local Government Act 2002 (the LGA) relate to the decision-making process territorial authorities must follow when considering present and future social, economic, environmental and cultural well being. The implications of a decision regarding waste management should be assessed according to this requirement.

The LGA also sets out the consultative process that must be followed when a Waste Management Plan, and now a Waste Management and Minimisation Plan (WMMP), is reviewed. Minor amendments are possible through the annual or other planning processes, but a 'significant' review requires that a special consultative process is carried out.

1.3.2.4 The Resource Management Act 1991 (RMA)

The RMA provides guidelines and regulations for the sustainable management of natural and physical resources. Although it does not specifically define 'waste', the Act addresses waste management and minimisation activity through controls on the environmental effects of waste management and minimisation activities and facilities through national, regional and local policy, standards, plans and consent procedures. In this role, the RMA exercises considerable influence over facilities for waste disposal and recycling, recovery, treatment and others in terms of the potential impacts of these facilities on the environment.

Under section 30 of the RMA, regional councils are responsible for controlling the discharge of contaminants into or onto land, air or water. These responsibilities are addressed through regional planning and discharge consent requirements. Other regional council responsibilities that may be relevant to waste and recovered materials facilities include: managing the adverse effects of storing, using, disposing of, and transporting hazardous wastes; the dumping of wastes from ships, aircraft, and offshore installations into the coastal marine area; and the allocation and use of water.

Under the RMA, Territorial Authorities' responsibilities include controlling the effects of land-use activities that have the potential to create adverse effects on the natural and physical resources of their district. Facilities involved in the disposal, treatment or use of waste or recoverable materials may carry this potential. Permitted, controlled, discretionary, non-complying and prohibited activities and their controls are specified within district planning documents, thereby defining further land-use-related resource consent requirements for waste-related facilities.

In addition, the RMA provides for the development of national policy statements and for the setting of national environmental standards (NES). There is currently one enacted NES that directly influences the management of waste in New Zealand – the Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins, and Other Toxics) Regulations 2004 (the NES for Air Quality). This NES requires certain landfills (i.e.

those with a capacity of more than 1 million tonnes of waste) to collect landfill gases and either flare them or use them as fuel for generating electricity. The result is increased infrastructure and operational costs for qualifying landfills, although with some costs potentially offset by the harnessing of captured emissions for energy generation.

Unless exemption criteria are met, the NES for Air Quality also prohibits the lighting of fires and burning of wastes at landfills, the burning of tyres, bitumen burning for road maintenance, burning coated wire or oil, and the operation of high-temperature hazardous waste incinerators. These prohibitions limit the range of waste treatment/disposal options available within New Zealand with the aim of protecting air quality.[6]

1.3.3 Regional Waste Priorities

Organic waste is considered a priority for the Bay of Plenty region.

Environment Bay of Plenty's Regional Land and Water Plan, operative from 1 December 2008, states that the Regional Council will:

> *"Encourage management practices which avoid the production of leachate, including:*
>
> *a) diversion of organic materials form landfills by composting, reuse of organic materials where opportunities are available, and land application of organic materials*
>
> *b) Limiting the volume of liquid or sludge wastes disposed to landfills.*

There is also a regional Waste Strategy; however, this dates from June 2004 and most target dates have passed. EBoP has indicated that a new regional waste strategy will be prepared in the near future.

Various local initiatives are underway around the region, with significant involvement from the local councils in many respects.

The region is home to several significant industrial sectors, including forestry, kiwifruit, and shipping. An emerging issue is the increasing presence of sea lettuce on the beaches of the Bay of Plenty, with nearly 1000 tonnes removed over the 09/10 summer. Significant problems have been experienced overseas with sea lettuce, although the amounts present in the region thus far have not reached this level.

1.3.4 Other Regional Priorities

1.3.4.1 Soil quality

Soils in the Bay of Plenty are largely loams derived from volcanic ash, and are usually free draining. Soils in the region tend to retain phosphate and sulphate, are frequently deficient in potassium and in some cases, in cobalt[7].

EBoP has a responsibility under the Resource Management Act to conserve soil, control contamination discharge, and (an associated responsibility) manage water quality. Particular soil conservation issues in the region, as set out in the Regional Policy Statement, include:

- Light volcanic soils that are easily eroded

---

[6] Taken from: Ministry for the Environment (2009) Waste Minimisation in Waste Management and Minimisation Planning - Guidance for Territorial Authorities, Wellington

[7] Information available from www.ebop.govt.nz – 'About our Region' interactive map; also www.teara.govt.nz 'Regional Land Use'

- Loss of this soil is accelerated by removal of vegetation, soil disturbance, drainage and compaction
- Remaining indigenous forest is lost or degraded, reducing its capacity to conserve soil
- The absence of appropriate soil conservation practices may result in unnecessary erosion
- Neglecting preventative soil conservation practices can result in environmental and financial cost
- Soil degradation can result from increased intensity of land use (such as following subdivision)[8]

To address these issues, the Regional Policy Statement proposes the adoption of sustainable land use and management practices, with a number of supporting actions. Although this document states that the region's soils appear to be in 'good health', there is concern about low soil porosity and high fertility levels where land is used for dairying, horticulture, and cropping.

The Regional Land and Water Plan also addresses land management. Objective 6 (of seven) in this Plan includes a reference to sustaining 'the life-supporting capacity of soils'[9], and the Plan includes rules relating to the application rates and timing of fertiliser (including a limit on phosphorus application). Environmental performance is to be measured through various soil health indicators – acidity/alkalinity, organic matter, organic carbon, and changes in areas susceptible to reduction in soil health.

Monitoring data shows that in 2003 the region's soil was considered to be in 'a good state' with 60.2% of land fully intact, and 2.49% of the region having bare soil. Soil health, as measured in 2006, was good for crop and horticulture areas with 23% of land being 'of concern'. However, for sheep and beef land use areas this figure was 43%, and for dairy 76% of soils were 'of concern'[10].

Recent monitoring of soil quality has shown that there are increasing levels of nutrients leaching from soils, particularly anaerobically mineralisable nitrogen and phosphorus[11]. These trends have a direct link to water quality, as these soluble nutrients end up in groundwater systems (as discussed below).

The Bay of Plenty region has been a part of the national soil monitoring programme, known as the 500 Soils Project, since its inception in 1997. National soil health monitoring shows widespread moderate compaction of soils utilised for agricultural and some horticultural uses, and a demonstrated loss of organic matter and soil structural stability as a result of cropping activities. The more intensively-used arable cropping soils showed evidence of

---

[8] Environment Bay of Plenty, 2008 *"Regional Policy Statement – Monitoring and Evaluation"* available on www.ebop.govt.nz/policies.

[9] Environment Bay of Plenty, 2009 *"Bay of Plenty Regional Water and Land Plan"*, available on www.ebop.govt.nz/knowledge-centre.

[10] Western Bay of Plenty District Council, unknown date *"Western Bay Smart Future – Indicator Data Sheet C04-01 Soil"* available on www.westernbay.govt.nz, in the absence of access to EBoP's 'Clean and Protected Environment' document (web access not currently possible).

[11] Environment Bay of Plenty media release, 18th December 2009, available on www.ebop.govt.nz

organic matter depletion and decreased aggregate stability, which has been compensated for by high levels of fertiliser applications and corresponding fertility levels. [12]

Data recorded by Statistics New Zealand in the 2002 and 2007 Agricultural Census for the Bay of Plenty region shows that total fertiliser use (i.e. annual tonnage per year for such compounds as urea, superphosphate and other nitrogen, phosphorus, or potassium-based fertilisers) for all seven BOP territorial authority areas has increased over this five-year period. Fertiliser use is highest in the Western Bay of Plenty district and increased the most from a total of 45,061 tonnes in 2002 to 59,410 tonnes in the 2007 (representing a 32% increase - refer to Appendix 7, Table c).

It appears that superphosphate fertilisers are still frequently used to add available phosphate and sulphates, along with calcium, to the soil. EBoP has produced a fact sheet on land management[13] that states:

> "Fertiliser is an effective tool for maintaining agricultural production from crops and pasture. Studies show that withholding fertiliser will result in reduced production – as much as 30% within seven years on hill country pastures."

There is no mention in this fact sheet of alternatives to petrochemical-based fertilisers.

Research into different approaches to kiwifruit orchard management has found that organic management methods (which included the application of compost products instead of artificial fertilisers) result in soils with an increased organic matter content, larger microbial mass, and better physical condition[14]. This is particularly relevant to the Bay of Plenty given the significant kiwifruit industry; however, it is likely that these benefits would be noted in other agricultural sectors also.

1.3.4.2 Groundwater quality

All of the strategies and plans mentioned above also apply to groundwater quality.

However, despite the recurring discussion of the contribution that soluble fertilisers make to declining water quality, there is little mention of finding, and encouraging, alternatives to these fertilisers.

Monitoring by EBoP shows a trend of increasing nitrogen and phosphorous levels, particularly near dairy farms. EBoP staff have stated that land uses such as dairying, horticulture, agriculture, and pastoral are particularly likely to be affecting groundwater quality, with high levels of nitrate-nitrogen found in shallower water sources such as bores.

Providing nutrients to soil through a compost product, rather than through application of mineral fertiliser, would reduce the amount of soluble nitrogen and phosphorus and, therefore, the amounts being discharged into groundwater systems.

Nitrogen and phosphorus are also major contributors to the eutrophication of the Rotorua lakes and the resulting problems with lakeweed.

---

[12] Landcare Research, Soil Horizon Newsletter, Issue 7, March 2002. www.landcareresearch.co.nz/publications/newsletters/soilhorizons/SoilHorizIssue7Mar02.pdf

[13] Environment Bay of Plenty factsheet, 2004 *"Efficient Fertiliser Use"*, available on www.ebop.govt.nz

[14] Ministry of Agriculture and Forestry, unknown date, *"Organic Technical Paper #4"*, available on www.maf.govt.nz.

1.3.4.3 Energy

An economic development strategy for the region, published by the Regional Governance Group in 2007, identified energy as one of the 13 'key areas of focus' for the region[15]. The strategy sets out the goals and priorities for sustainable economic growth in the Bay of Plenty region and was prepared by the Regional Governance Group, which is made up of representatives from business, council economic development agencies, and Environment Bay of Plenty. The group held a forum on energy issues in July 2009 that focused on security of supply and the identification of opportunities to increase local generation and energy use efficiency.

Electricity is currently generated from two resources within the region - water and geothermal energy. Some major industries also have the capacity to generate electricity from wood via furnaces and steam boilers. Geothermal steam is a major energy source for the major wood processing industries and there are five geothermal fields in the Bay of Plenty that provide heat and water for a variety of uses. While the importance of the region's hydrological and geothermal resources have long been recognised nationally and by local electric power suppliers, the region still relies on importing electricity, coal, and petroleum energy sources from outside the region to meet demand, particularly into the Western and Eastern sub-regions. The Southern sub-region is able to directly utilise hydro and geothermal sources, however, natural gas is imported and reticulated throughout the region[16].

Various agencies in the Bay of Plenty are currently consulting with the energy sector and heavy industry in the region on development of a Regional Energy Strategy. The consultation document states that the Bay of Plenty is probably New Zealand's most energy-rich region, and particularly so in sustainable energy. The aspirations set out at consultation stage are to attract investment and, in the long term, become a net exporter of electricity (potentially more than 15% of New Zealand's electricity demand), and produce more than 10% of New Zealand's liquid transport fuels[17].

The main opportunities identified at this stage include:

- Geothermal co-generation (electricity and heat)
- Transport fuel manufacture (from forest wastes – no further detail given)
- Wood fuel for heating
- Hydro and solar energy

Based on the above analysis, it would appear local markets for energy generation from biomass sources (such as anaerobic digestion) are potentially limited and requirements for energy generation are not likely to be a key driver in developing organic waste management solutions in the region.

1.3.4.4 Carbon abatement

Change in the way that organic wastes are managed in the region has the potential to make a significant contribution to carbon abatement in two main ways;

- Preventing organic waste being disposed of to landfill will reduce the amount of carbon being converted to methane and discharged as a landfill gas

---

[15] http://www.bayofconnections.com/Regional_Strategy/default.asp

[16] http://www.bayofconnections.com/Regional_Strategy/sectors/energy.asp

[17] Brian Cox, East Harbour Management Services (2009) *"Bay of Connections – Regional Energy Strategy"* available on www.eastharbour.co.nz.

- Processing the organic waste into a form that has beneficial use would instead retain the carbon in the soils of the region, improving the soil quality (as described above) and reducing the need for more synthetic fertilisers to be produced.

Converting organic wastes to compost-type products also has potential to reduce the production of non-carbon greenhouse gases, such as nitrous oxide[18].

The Ministry for the Environment states that 'increasing the amount of soil carbon' is one change in land management practices that can reduce emissions of carbon gases from the agricultural sector, and increase carbon storage[19]'.

This is clearly an area that has yet to receive significant attention, and, while there is significant potential for carbon abatement through organics management, it is not yet an important driver. It is also not clear how sequestration of carbon in soils can be incentivised and how this might work under the Emissions Trading Scheme.

1.3.5 Industry Standards

1.3.5.1 National composting standard

A national standard for composts was introduced in 2005. The NZS 4544: 2005 prescribes compositional requirements, compliance requirements, and sampling and testing methods for composts, soil conditioners, and mulches. The New Zealand standard was adapted from the equivalent Australian Standard, AS 4454:2003. Key modifications of the standard included the following:

- The labelling requirements have been modified to fall in line with the guidelines issued by the Ministry of Health for potting mixes.
- Limits for heavy metal contaminants and organic contaminant residues have been included in alignment with the interim values of the Biosolids Guidelines issued by the New Zealand Water and Wastes Association, 2003 (Classification a, Table 4.2 of the guidelines).
- Limits for indicator organisms have been included to ensure microbiological quality of certain categories of products.

Impeccable quality control is a prerequisite for all food-producing industries and the introduction of the New Zealand Compost Standard NZS 4454:2005 and the uptake of organic compost certifications (e.g. BioGro) are steps that should result in increasing product demand within the agricultural/horticultural sectors.

The NZS4454 standard is, however, currently a voluntary standard - there is no requirement for any composts sold in NZ to comply with the standard. There is also not widespread awareness of the existence of the standard and so there have been, up to this point, few market drivers for compost manufacturers to adopt the standard and produce certified compliant products.

No formal accreditation process has yet been established for NZS4454 product testing, although anecdotally it is understood that the standard is being used by some compost producers as an operational guide and to assess final product quality. Several operators are undertaking product standard testing via independent labs and conducting standard growth

[18] Ministry of Agriculture and Forestry, 2003 *"Abatement of Non-Carbon Dioxide Greenhouse Gas Emissions – Chapter Six Nitrous Oxide"* available on www.maf.govt.nz.

[19] Ministry for the Environment *"The Framework for a New Zealand Emissions Trading Scheme, Section 6"* available on www.mfe.govt.nz, last accessed 23 March 2010.

trials themselves[20]. Another factor that may be influencing the uptake of the compost standard across the wider organic waste processing sector, according to discussions with vermicompost producers, is its applicability to vermicompost products. Given these products typically do not go through a heat-treatment phase, some of the testing or process requirements of NZS4454 are not necessarily considered relevant to vermicompost products, given that heat-treating a vermicompost product may have a negative impact on the beneficial microbes the vermicomposting process itself introduces.

1.3.5.2 Other standards

Another certification process worth noting is the BioGro Organic Standard, given that several compost producers in or near the region are known to have obtained BioGro certification for their products. The BioGro Organic Standard is an industry standard typically used by producers of products that wish to market their products as being 'organic'. The Standard (May, 2009) includes an allowance for composts to be used in organic food production provided "*compost ingredients obtained from conventional sources must go through a hot-composting process that is acceptable to and approved by BioGro. Documentation must be obtained to ensure that such ingredients do not contain unacceptable contaminants such as pesticide residues, heavy metals, and Genetically Modified Organisms*" and follows the BioGro Compost Guide [21]. It is noted that the BioGro standard makes an allowance for vermicast products:

"Vermicasts made from low risk ingredients approved by BioGro do not have to go through a heat process".

1.3.5.3 Compost NZ

There is no stand-alone industry body representing the interests of the organic waste processing sector in NZ. This role is, however, largely fulfilled by Compost NZ, which is a sector group of the Waste Management Institute of New Zealand (WasteMINZ). As such, it has no formal structure and operates under the umbrella of WasteMINZ.

The aim of Compost NZ is to support a professional and viable industry. Its stated areas of activity include:

- Promoting the organics industry
- Providing tools to market compost products
- Developing and promoting compost quality standards and certification
- Providing a national and international information network for the organics industry
- Informing and influencing decision makers
- Identifying and encouraging strategic and commercially relevant research and development
- Actively supporting industry training

Compost NZ is currently seeking funding to undertake a scheduled review of the NZS4454 standard.

[20] Personal communication Jonathan Hannon, Compost NZ, WasteMINZ Sector Group, March 2010.

[21] http://www.bio-gro.co.nz/content/files/Appendix_B.pdf

1.3.6 Markets

The market for collected organic material is a critical component in developing more sustainable management practices around organic wastes. The commercial compost market in New Zealand has historically been supply-driven rather than demand- driven. On the supply side, compost production has occurred largely as a result of landfill diversion activities with little focus on end markets. On the demand side, the New Zealand primary sector has had little experience with commercial compost application, relying predominantly on inorganic fertilisers.

As a result of the MfE's NZ Waste Strategy 2002 increasing pressure on local authorities, food manufacturers, and the waste industry to divert more organic waste from landfill, it is expected that there will be a large increase in compost production in coming years. Stable, long-term markets will be required to utilise this material. Fortunately, the increasing supply of compost coincides with growing awareness in the primary sector of the benefits of compost application and sustainable production techniques, as well as increasing oil prices (reflected in higher fertiliser prices) and decreasing water availability.

There is still a long way to go in changing primary sector practices. Ultimately, developing stable, long-term markets that not only meet demand, but drive demand, will be essential.

Markets in the Bay of Plenty are discussed in more detail in section 7.0 of this report.

1.3.7 Accepted Practices

Although perhaps not often recognised as a driver, accepted practices and operating methods can have a significant influence on how the industry develops and what solutions are put forward. In the New Zealand context the focus has been on relatively small scale, simple, cost effective technologies and solutions. The practices and knowledge within the industry itself therefore may be a constraining factor in the development of appropriate solutions for the Bay of Plenty.

1.3.7.1 New Zealand Processing Facilities

As few councils currently collect and process food wastes, there are relatively few operational facilities capable of handling this type of material. The majority of composting operations in NZ are open windrows that compost predominantly source-separated green waste.

The key composting facilities in NZ that would be capable of handling household food waste and processing to a beneficial use product include:

Facility Operator	Location	Technology
EnviroFert	Tuakau	Forced aeration static pile covered windrows
Sustainable Waste Management	Ruakaka	CTI aerated 'compost sausage'
Waitakere City Council, Solid Waste Business Unit	Waitakere Transfer Station	VCU in-vessel composting unit (currently out of commission)
Wastebusters	Kaikoura	Horizontal Composting Unit
Living Earth	Christchurch	Custom-designed tunnel system
Capital Composting Limited	Wellington	Custom-designed tunnel

		system
Selwyn District Council	Selwyn, Canterbury	HotRot in-vessel system
Mackenzie District Council	Twizel	VCU
Rakaia Resource Recovery Group	Rakaia	Part mechanically-assisted IVC, part windrow maturation with added worms & cover
TPI	Timaru	Gore-tex® covered windrows with forced aeration

It will be noted from the above table that the range of processing systems is relatively small, and all are aerobic, in-vessel or covered systems. These types of systems, while having a number of advantages, all require the addition of green waste as a bulking agent (at least 50% by weight) if they are to compost food waste.

Notably, there are no anaerobic digestion facilities operating that are capable of processing household food wastes.

1.3.8 Waste Minimisation Fund

The Waste Minimisation Fund has been set up by the Ministry for the Environment to help fund waste minimisation projects and to improve New Zealand's waste minimisation performance through:

- Investment in infrastructure;
- Investment in waste minimisation systems and
- Increasing educational and promotional capacity.

Criteria for the Waste Minimisation Fund have been published:

1. *Only waste minimisation projects are eligible for funding. Projects must promote or achieve waste minimisation. Waste minimisation covers the reduction of waste and the reuse, recycling and recovery of waste and diverted material. The scope of the fund includes educational projects that promote waste minimisation activity.*
2. *Projects must result in new waste minimisation activity, either by implementing new initiatives or a significant expansion in the scope or coverage of existing activities.*
3. *Funding is not for the ongoing financial support of existing activities, nor is it for the running costs of the existing activities of organisations, individuals, councils or firms.*
4. *Projects should be for a discrete timeframe of up to three years, after which the project objectives will have been achieved and, where appropriate, the initiative will become self-funding.*
5. *Funding can be for operational or capital expenditure required to undertake a project.*
6. *For projects where alternative, more suitable, Government funding streams are available (such as the Sustainable Management Fund, the Contaminated Sites Remediation Fund, or research funding from the Foundation for*

Research, Science and Technology), applicants should apply to these funding sources before applying to the Waste Minimisation Fund.

7. *The applicant must be a legal entity.*
8. *The fund will not cover the entire cost of the project. Applicants will need part funding from other sources.*
9. *The minimum grant for feasibility studies will be $10,000.00. The minimum grant for other projects will be $50,000.00.*

(Source: MfE website)

Assessment criteria have also been published by the Ministry, and workshops have been held around New Zealand to explain the application process and the criteria. Those applying for funding need to remember the goal of the Fund, and ensure that their application demonstrates a contribution to these goals.

The main assessment point is likely to be what the Ministry describe as 'largest net benefit over time' e.g. amount of waste diverted from landfill per dollar of funding), alongside supporting criteria such as likelihood of success, reducing environmental harm, wider sustainability benefits, and longevity. Projects that can act as trailblazers for the rest of New Zealand will also be favoured. The Ministry strongly encourages partnership working and collaboration.

While no minimum 'match' funding has been specified, the Ministry has made it clear that projects with higher levels of match funding will be seen as demonstrating successful collaboration and a greater likelihood of success and longevity.

The first funding round opened on 1 December 2009, and applications closed at 5pm on 1 March 2010. The Ministry had indicated that they were willing to discuss potential applications, and encouraged applicants to contact them as soon as possible should this be needed.

Successful projects will commence in August 2010.

Following consideration of the findings in the interim report submitted in January 2010, EBoP and TCC prepared an application to the fund seeking support to expand the current small vermicomposting trial processing wood wastes at Kawerau, to increase the volume of waste processed, and to incorporate a wide range of other organic waste streams.

1.4 Summary of Key Drivers

There are a large number of drivers, both national and regional, that support the diversion of waste, particularly organic wastes, from landfill for environmental and economic reasons. Allied to this, and perhaps often overlooked by the waste management fraternity, are a similarly large number of drivers that support the increased use of compost products as an alternative to synthetic fertilisers – to improve soil and water quality, and help to meet regional and local strategic objectives. Ensuring that these different sets of drivers are aligned will be an important factor in driving forward organic waste diversion in the region, and this viewpoint informs much of the work undertaken in this study.

2.0 Methodology

The intent of this project has been to *'further improve the understanding of volumes, sources, processing options and potential end uses/markets for organic waste streams in the Bay of Plenty region with a view to use this information to support an application to round one of the contestable Waste Minimisation Fund 2010'*[22].

The collection of waste data generally is a challenging task. There are a wide range of organisations involved and much data is commercially sensitive. A definition of 'organic wastes' was adopted for this project to clarify exactly what data was required.

The timescales for this project, notably the requirement to submit an application to the Waste Minimisation Fund (WMF) by 1 March 2010, influenced the delivery of this project in a number of ways:

- The Christmas/New Year breaks meant contact with stakeholders was largely undertaken on an individual basis, with meetings held where possible and otherwise phone interviews undertaken.
- The focus for the project in the early stages was on those areas that were most critical in shaping an application to the WMF, including identification of the organic waste streams, evaluation of processing options and potential partners, and a strategic appraisal of the way forward.
- These completed aspects were reported to EBoP and TCC in an interim report on 29 January 2010, with the remaining areas to be completed for the final report due 31 March 2010.

Delivery was further influenced by the desire to ensure that a strategic approach was taken, so as to provide a meaningful basis on which to prioritise waste streams to target and the actions that need to follow. The methodology, therefore, included a short review of the policy context at the start of the project, to take account of the key drivers and establish priorities, and also concludes by providing a strategic analysis of the findings of the study that can lead to the development of a clear programme of action.

To address the timing issues around the deadline for applications to the WMF, the project was completed in two phases. An interim report was presented on 29 January 2010, providing outcomes that could feed into the WMF application. The interim report touched on most aspects of the project, but focused on those most likely to be critical in shaping the WMF application. This included identification of the organic waste streams, evaluation of processing options and potential partners, and a strategic appraisal of the way forward.

The second phase of the project is completed by the delivery of this final report, completing other elements of the project, and elaborating on some areas touched on in the interim report.

Specific areas of the methodology are described in more detail below.

2.1 Policy Context

The drivers for diversion of organic waste were clearly identified, including potential future drivers such as the New Zealand Emissions Trading Scheme. Regional environmental issues such as soil erosion and water quality were reviewed alongside opportunities for inter-regional cooperation.

[22] Environment Bay of Plenty 2009 Project Brief for *"Bay of Plenty Organic Waste Study"*

These policy drivers were briefly analysed to present a strategic context for the project, helping to focus the work and providing a framework for prioritising opportunities in latter stages of the project.

2.2 Identifying Organic Waste Streams

This project element builds up a picture of organic waste flows in the region and identifies where opportunities exist to divert material for beneficial use. The following steps were undertaken:

- Collation and summarising of the existing information, including information from the 'Waste Infrastructure Review and Strategic Assessment'[23], SWAP audits, local authority waste data, and other publicly available information such as EECA reports. All territorial authorities besides Western Bay of Plenty District Council were interviewed, either in person or by telephone.
- This information was significantly updated and supplemented through interviews and contact with organic waste producers, waste processors and disposers, and key stakeholders. Given the focus on identifying organic waste streams that presented opportunities to be diverted for beneficial use, more time was dedicated to identifying those organic wastes that were being sent for landfill disposal, or being disposed of in some other way that was less than optimal. A list of those contacted is provided in Appendix 1. This list was compiled by referring to regional phone directories, internet searches (such as UBD and Finda), and by following up on suggestions provided during earlier interviews with territorial authority and private sector contacts.
- Data gaps were identified;
- Extrapolations and estimates were undertaken to build up a coherent picture. The three main areas where data gaps existed and this was required were regarding disposal to cleanfills, diversion of commercial and industrial organic wastes, and biosolids disposal.

  Cleanfill disposal was partly based on real data provided by two cleanfill operators (particularly for green waste), and partly extrapolated based on national data and the authors' work on similar projects in other regions. Given the focus on organic wastes, the objective here was not necessarily to quantify the entire waste stream going to cleanfills, but rather to estimate the proportion of organic wastes going to cleanfill disposal.

  There are a large number of local informal arrangements within the commercial/industrial organic waste sector. Anecdotal evidence from various interviews suggested that a number of businesses have agreements with the agricultural sector, such as pig farmers and orchardists, for organic wastes, particularly in the more remote districts of the region (Opotiki, Kawerau and Whakatane). The estimate for organic wastes diverted from this sector is therefore likely to be low; however, as these are organic wastes already going to beneficial use the amount of effort that would be required to quantify this diversion to a greater level of detail seems unnecessary.

  Several formal arrangements exist with organic waste processors and these processors advise that they are intending to expand their collection services in the region. They have collected information (some anecdotal) that there is further

[23] Sinclair Knight Mertz, September 2007

demand for their services – indicating that there is still organic waste going to landfill from the commercial and industrial (C&I) sector. Based on this information, an amount of C&I waste has been estimated as currently going to landfill by direct means, rather than through the region's transfer stations, all of which are council-controlled.

Biosolids have been quantified to a large extent; however, not all operators managing biosolids in the region have provided detailed information. It is also not currently possible to estimate biosolids for some wastewater treatment plants, as the sludge content of settlement ponds has not been assessed for some time. However, very little of this sludge waste goes, or is expected to go, to landfill disposal, based on statements by the relevant territorial authorities. Therefore, an allowance has been made for the biosolids from commercial operators that are using landfill disposal, but not for the sludges currently stored in settlement ponds in the region.

- For each organic waste stream, key issues have been identified, including those issues which would impact on contamination levels, collection, and processing. These issues have been identified based on the authors' experience with organic wastes both in New Zealand and overseas.

2.2.1 Key data sources

Municipal landfill volumes and composition data was largely provided by the territorial authorities and held directly by Waste Not from previous projects in the region and nearby. This data included:

- SWAP data from Rotorua, Whakatane, and Kawerau districts. This data was applied to other territorial authorities where no composition data was available – Tauranga and Western Bay of Plenty were modelled from Rotorua data, and Opotiki was modelled from Whakatane data.

- Volumes of waste to landfill were provided by all territorial authorities. Tirohia Landfill staff also provided some supporting data for landfill waste volumes.

Data for monofills was generally provided by the monofill operator. For example, Carter Holt Harvey and Norske Skog provided data for both wood processing waste monofills in Kawerau. Transpacific International provided estimates for biosolid monofills in Rotorua and Western Bay of Plenty. Two cleanfill operators provided estimates for green waste accepted at their gate (although often transferred elsewhere) – green waste being the only organic waste they accept.

To supplement this data, estimates of various organic waste streams for the region or parts of the region were provided by territorial authority waste officers and various waste management companies with an interest in organic waste in the region, such as New Zealand Remediation, Industrial Vermicomposting Ltd, EnviroFert, Transpacific Industries, and Lowe Corporation.

From all data sources given above, total estimates of various organic waste streams going to landfill/cleanfill disposal were calculated for the region[24]. The organic wastes have been broken down into as many sub-categories as possible, given the information available. This has been necessary as the varying nature of organic wastes can dictate which processing options are preferable, or, indeed, even possible.

---

[24] Note that given comments on the preference for an alternative treatment option for kiwifruit waste, this organic waste stream has been included as well, although very little is currently going to landfill.

2.3 Collection Options

Existing and potential collection options for organic waste streams have been identified.

For homogenous industrial and (to a lesser extent) agricultural waste streams, collection systems are not usually critical. The focus in this section has, therefore, been on collection of organics from households and commercial premises (particularly the restaurant and hospitality industry). The following steps were taken:

- Existing collection systems identified by waste stream;
- Contact made with key service providers/potential partners;
- Collection options identified by waste stream; and
- Best practice options evaluated for key organic streams including household and commercial food waste.

This evaluation has been based on the authors' significant experience with international best practice collection systems and research.

2.4 Processing Options

The existence of appropriate organic waste processing facilities has been one of the key barriers to greater recovery of organic waste in most parts of New Zealand. Establishing such facilities will be critical for the Bay of Plenty if organic waste diversion is to be maximised. A key part of this project is to identify and recommend the most appropriate processing options based on the information described above.

The analysis of organic waste recovery options has been focused at a generic process level (for example in-vessel composting, windrow composting, vermicomposting, anaerobic digestion, pyrolysis, gasification etc). It is our view that, at this stage, in-depth analysis of potential technology providers is not likely to be of significant value. This type of assessment is best reserved until further key strategic decisions have been made, such as who will be procuring the facilities, how they will be procured (for example BOOT, DBO, CCO[25]), what inter-regional opportunities will be taken forward, etc. Added to this is the practical issue that the timeframes and resourcing for the current project preclude an in-depth assessment of proprietary technologies. Given this proviso, the following steps were undertaken:

- Generic processing options were identified, evaluated and ranked for each waste stream. The project team liaised with EBoP to agree key criteria for evaluation. Also important in this analysis was consideration of the potential for facilities to process combined waste streams;
- The scale and location of facilities was considered. Based on the analysis undertaken a broad analysis is provided of the optimum location of facilities, given transport and transfer considerations and inter-regional collaboration opportunities. The number, type, scale, and location of facilities was undertaken in the context of a number of specific scenarios that were developed as likely ways forward for organic waste management in the region. It should be noted that this analysis was on a generic basis only and that identification and evaluation of specific sites is outside the scope of the current project;

[25] DBO: design, build operate. BOOT: build, own, operate, transfer at end of contract. CCO: Council-controlled organisation.

- Potential barriers considered. An analysis is provided of any potential barriers to facility development, including planning and regulatory processes, finance and ownership (including site acquisition), and potential political considerations;
- Key products and potential issues are noted. Outputs from the key technology options have been noted and potential issues identified including, contamination, consumer acceptance, quality control, seasonal variability etc.; and
- Contact made with key stakeholders and potential impacts on existing operators noted.

The analysis aims to take a strategic view and consider how the totality of organic waste streams in the Bay of Plenty and surrounding regions can best be managed in processing terms, now and throughout the probable life of the facilities.

This analysis was completed to an interim stage to provide the basis for an application to the WMF to conduct further feasibility work on the preferred organic waste processing option. This final report expands on the analysis, largely with respect to the alternative strategic approaches to that which was prioritised for the WMF application.

2.5 Cost Evaluation

Rough order capital and operational costs have been provided for key facility types in the context of a number of key scenarios. As noted above, proprietary technologies have not been evaluated, so costings are at a broad level and based on a range of technology options.

Even if the technology, scale, feedstocks, and other factors have been determined, the actual costs of technologies will be dependent on a range of factors including:

- Who is procuring the technology (council, private sector, or some form of partnership);
- How it is being procured (BOOT, DBO, CCO etc);
- Whether site purchasing, consenting, site works etc are included in the costings; and
- How the facility will be financed.

In addition to providing rough order costings, an overview has been provided of purchasing models and an assessment of their potential suitability.

2.6 Markets and End Use

Issues around compost and organic waste treatment outputs could potentially constitute an entire separate study by themselves. Markets are possibly the most critical component in the diversion process, as, without a value-added end use, attempts at diversion are essentially meaningless. Further, if there is sufficient demand, many of the issues around diversion of organic waste would not arise, and the processing and supply of products could largely be left to the private sector. The work of this study is in many ways an attempt to bridge the gap between the supply of organic waste and the demand for the outputs of organic waste processing.

The commercial compost market in New Zealand has historically been supply-driven rather than demand-driven. On the supply side, compost production has occurred largely as a result of landfill diversion activities with little focus on end markets. On the demand side, the New Zealand primary sector has had little experience with commercial compost application, relying predominantly on petrochemical based fertilisers.

Given the above considerations, the evaluation of markets and end use focuses on existing markets while noting the potential for growth and future development. This includes the following:

- Identifying the types, quantity, and quality of end use products, including soil amendment products and energy recovery;
- Making contact with key stakeholders; and
- Evaluating key markets for products, including existing demand and potential for future growth. Where possible, the evaluation will consider quantities and market value.

2.7 Conclusions and Recommendations

A strategic evaluation of the opportunities for organic waste diversion options is provided, taking into account key priorities and drivers, opportunities for inter-regional cooperation, key stakeholders, the potential for public-private partnerships and central government support, planned and existing services and facilities, and any other significant issues or constraints. This analysis will provide a 'roadmap' for taking further action on organic waste in the region.

3.0 Current Infrastructure for Organic Waste Management in the Region

3.1 Current Organic Waste management in the Bay of Plenty region

The management, diversion, and disposal of waste in the Bay of Plenty region involves local authorities (Environment Bay of Plenty, City and District Councils) and the private sector. While organisations in each of these categories undertake discrete activities, there is also collaboration on specific issues and in some cases in providing services.

Territorial authorities (City and District Councils) have responsibilities under the Waste Minimisation Act 2008 and Local Government Act 2002 to provide for the management of waste in their city/district. This includes the responsibility to have a Waste Minimisation and Management Plan and the ability to provide services and/or regulate waste management through by-laws. A substantial proportion of household waste is collected on behalf of city/district councils around the region. Territorial authorities also issue land use consents under the Resource Management Act 1991 for waste transfer, processing, and disposal facilities

Environment Bay of Plenty (the Bay of Plenty Regional Council) sets policy on a wide range of environmental issues through the Regional Policy Statement (currently being reviewed). The Regional Policy Statement provides policy on issues including impacts of urban growth on the environment, which includes waste generation, disposal and processing in the region. Environment Bay of Plenty also monitors and enforces resource consent conditions that apply to the operation of waste facilities.

Environment Waikato (the Waikato Regional Council) sets policy for the Waikato Region through the Regional Policy Statement. This is of relevance to the Bay of Plenty region due to the disposal and processing of materials from the region in facilities such as Tirohia Landfill, near Paeroa, and North Waikato Regional Landfill (commonly referred to as Hampton Downs landfill) near Meremere.

The **private sector** plays a major role in the collection, processing, and disposal of waste from the region. With the exception of household waste collections provided by city/district councils, materials passing through the council-controlled transfer stations and a small number of other minor facilities, most materials are collected and disposed/processed by commercial operators.

3.2 Collection

There are a variety of organic waste collection systems in the region currently:

- Opotiki and Rotorua Districts do not have any private or council-provided domestic organic waste collections, with two private domestic green waste collectors in Rotorua.
- Whakatane and Kawerau Districts have a council-provided fortnightly domestic green waste collection in urban areas
- Tauranga and Western Bay of Plenty Districts do not offer a council domestic organic waste collection, but there are private green waste collection services available

There are various other organic waste collection services available in the wider region:

- Waikato ByProducts (Graham Lowe Corporation) collects high-protein organic wastes (such as fish and meat processing waste) from fish processors, supermarkets, restaurants, and butchers. They currently cover Rotorua, Tauranga, and Te Puke, providing free receptacles and collection. Small amounts are collected where this suits existing collection routes.

- New Zealand Ester Fuels collect used cooking oil from throughout the region (except Opotiki).
- Several companies, including Tank Man, Pete's Takeaways and Art's Takeaways, empty septic tanks, grease traps, and interceptors throughout the region.
- There are a number of small, ad hoc collection arrangements in the region, mainly between businesses and pig farmers.

3.3 Transfer

The only organic waste separated at transfer stations in the region is green waste:

- Opotiki District Council operates two recycling centres that accept green waste, which is transferred to the Opotiki recycling centre for shredding and used by the council or sold. There are also two community-operated recycling centres that accept some green waste, at Torere and Maraenui, where the green waste is shredded and used locally.
- Whakatane District Council accepts green waste at transfer stations in Murupara and Whakatane. This waste, along with green waste from the kerbside collection and the Council's parks department, is mulched and had been used as landfill face cover at Burma Road (closed to waste disposal at the end of 2009).
- Kawerau District Council accepts green waste at its transfer station, which, along with the green waste from the kerbside collection, is mulched and used by the council or sold.
- Tauranga City Council's two transfer stations accept greenwaste, which is processed locally by NZ Remediation into compost.
- Western Bay of Plenty District Council accepts green waste at two recycling centres in Waihi Beach and Katikati, which is transferred to H G Leach in Tirohia for composting. There is also a private green waste processing site in Omokoroa.
- Rotorua District Council accepts green waste at the Rotorua District landfill only, where some is composted for sale, and the remainder provided to mills as boiler fuel.
- Green waste is also transferred from the Jack Shaw Cleanfill in Tauriko, to Omokoroa for composting and sale.
- Some biosolids are dewatered in Whakatane and transferred to a disposal site at Pikowai.

3.4 Processing

A wide variety of organic wastes are processed, although not necessarily within the region. The table below summarises processing capabilities available.

Table 1 – Organic Waste Processing Facilities processing waste from the Bay of Plenty

Name of company/council	Waste accepted	Processing technology	Capacity (tonnes per annum)
NZ Remediation	Green waste	Windrow composting	8,000 tpa

H G Leach	Green waste	Windrow composting	Currently process 720 tpa; potential to expand significantly if required
WormTech	Pig manure	Vermicomposting in static windrows	5,200 tpa. Unable to accept more under consent conditions
Lowe Corporation	High-protein putrescible wastes	Rendering for stock feed and fertiliser	Not specified, but additional capacity available
NZ Ester Fuels	Used cooking oil	Filtered and processed to biodiesel product	Not specified, but additional capacity available
Plateau Bark & Composts	Bark and some wood processing waste	Open windrow composting	Not specified; some additional capacity available
Vitec Fertilisers	Fish processing waste	Liquified and processed to liquid fertiliser	At capacity (through choice). Currently processing 300 tpa
Daltons	Bark waste, some other wood/green wastes, sawdust	Composted	Potentially have additional capacity at Matamata but would need investigation
Brights Poultry	End-of-lay poultry	Butchered	200 tpa. Generally at capacity
Nature's Flame	Sawdust	Processed in to pellet fuel	54,000 tpa at present, and at capacity
Various	Hogged wood waste	Boiler fuel	Unknown but significant (over 400,000 tpa), and market for more
Various	Animal manure	Composted briefly and applied to ground – kiwifruit and other fruit orchards, market gardeners	Unknown; currently absorbing perhaps 300 tpa

3.5 Disposal (Including Cleanfills)

There are limited options for general waste disposal in the region, with the only open landfill in the region located in Rotorua (owned and operated by the Council). The other municipal waste landfill used in the region is H G Leach, at Tirohia. Waste is also transported to Hampton Downs in a private arrangement between EnviroWaste Services Ltd and Transpacific Industries Group NZ Ltd.

In addition, there are a number of private landfills and cleanfills around the region. All disposal options are summarised below, along with acceptance criteria. Landfills operate in accordance with the Ministry for the Environment's Waste Acceptance Criteria, whereas cleanfills accept wastes in accordance with their consents as granted by EBoP.

The Ministry for the Environment's 2002 guide to cleanfills defines 'cleanfill' as:

> *"Material that when buried will have no adverse effect on people or the environment. Cleanfill material includes virgin natural materials such as clay, soil and rock, and other inert materials such as concrete or brick that are free of:*
>
> - *combustible, putrescible, degradable or leachable components*
> - *hazardous substances*
> - *products or materials derived from hazardous waste treatment, hazardous waste stabilisation or hazardous waste disposal practices*
> - *materials that may present a risk to human or animal health such as medical and veterinary waste, asbestos or radioactive substances*
> - *liquid waste."*

EBoP's Regional Water and Land Plan defines cleanfill as:

> *"...natural materials such as clay, soil, rock and such other materials as concrete, brick or demolition products that are free of:*
>
> *(a) combustible or putrescible components (including green waste) apart from up to 10 percent by volume untreated timber in each load*
>
> *(b) hazardous substances or materials (such as municipal waste) likely to create leachate by means of biological or chemical breakdown*
>
> *(c) any products or materials derived from hazardous waste treatment, stabilisation or disposal processes."*

Table 2 – Disposal Options for the Bay of Plenty

Operator	Facility	Wastes accepted	Capacity
Rotorua District Council	Municipal Landfill, SH 30, Rotorua	Non-hazardous residential, commercial and industrial waste, including special wastes (although bylaw may be reviewed to exclude these in future)	Consented to 2030
Whakatane District Council	Municipal Landfill, Burm Road, Whakatane	Closed December 2009	Closed December 2009
H G Leach	Municipal Landfill, Tirohia	Non-hazardous residential, commercial and industrial solid waste, including special wastes. Sludges with less than 20% solid by weight are prohibited.	Consented to approx 2035
EnviroWaste Services Ltd	Municipal landfill, Hampton Downs,	Non-hazardous residential, commercial and industrial solid waste, including special	Consented to 2030

	North Waikato	wastes. Sludges with less than 20% solid by weight are prohibited.	
Carter Holt Harvey – 'Tasman'	Monofill, Kawerau	Primary and secondary solid wastes from Tasman site (Carter Holt Harvey, Norske Skog, SCA)	Consents currently being renewed
Carter Holt Harvey – Whakatane	Monofill, Kawerau	Processing wastes from CHH Whakatane only	2035 approx
Jack Shaw	Cleanfill, Tauriko	Consented for clean fill, green waste and construction waste; also vermiculture leachate (although not active)	TBA
Addisons	Cleanfill, Welcome Bay, Tauranga	Consented for clean fill, green waste and construction waste	Consents recently expired
Poike Block trust	Cleanfill, Tauranga	Cleanfill, demolition and construction waste	Consents recently expired

Figure 1– Location of key organic waste processing facilities and waste disposal facilities in or near the Bay of Plenty region

Removed for now

3.6 Current Initiatives

There are a number of initiatives underway in the region focusing on organic waste at present.

3.6.1 Waste 2 Gold

Rotorua District Council is part-funding Scion Research to develop a technology that will process biosolids into useful energy and chemicals. Limited information regarding this technology, which is only vaguely described, has been provided, with terms such as 'deconstruction' and 'wet oxidation' used. Without more information it is not possible to comment in any detail on the potential of the technology. RDC has advised that they are investing $500,000 per annum into this project, and anticipate having a trial process running by the end of 2010. If this is successful, a full-scale facility could be in place within two years.

RDC and Scion intend that this technology will have the ability to process all biosolids for the district into useful products. However, various industry scientists have suggested that the process is likely to still result in some waste product, which could then require special disposal due to high concentrations of heavy metals and other contaminants.

Scion also believes the technology has potential for application to organic wastes in general, and has calculated the financial benefits of the process over landfill disposal as being around $450 per tonne.

Scion has made an application to the Waste Minimisation Fund to assist in developing this technology further.

3.6.2 Whakatane District Council

Whakatane District Council has allocated funds in their 2009 LTCCP for an organic waste processing facility. This is intended to accept green and food wastes, from both domestic and commercial sources within the District, and a small amount from elsewhere (such as Opotiki or Kawerau). WDC intends to have the facility, and a collection of domestic and commercial food waste, operating by the end of 2010. WDC has made an application to the Waste Minimisation Fund to assist in developing this facility.

3.6.3 Norske Skog/Carter Holt Harvey

Carter Holt Harvey has been investigating several methods to dispose of wood processing waste other than to landfill. Two of these are underway at the Norske Skog/Carter Holt Harvey 'Tasman' site in Kawerau. Primary solids are briefly composted and then either a) mixed with bark and composted further producing a compost product, or b) mixed with biosolids and vermicomposted. This latter processing system has only been running since November 2009, and so outcomes are not yet definite; however indications so far are that a vermicomposting product can successfully be produced with few odour problems.

3.6.4 Opotiki District Council

In an attempt to resolve issues with a septic tank clearance operator in its district, ODC has been working with the operator to find an alternative solution to his current use of the Council's treatment facility. ODC advises that this project is unlikely to make much progress over the next few months.

3.6.5 LakeLand Steel

This company, based in Rotorua, has been investigating the potential to process fine wood waste (sawdust and chips) through pyrolysis. The company advises that this is still at trial stages, and probably has most potential as a processing technology for CCA-treated wood waste.

3.6.6 Others

Several waste or organic waste management companies have indicated that they are investigating the Bay of Plenty region with a view to potential investment. These include:

- NZ Remediation
- Transpacific Industries
- EnviroFert

4.0 Estimates of Organic Wastes in the Region

This section provides estimates of the quantities of organic waste being managed in the Bay of Plenty. In making these estimates, this report focuses on quantifying the amount of organic waste being disposed of to landfill and cleanfill. Organic wastes diverted from landfill or cleanfill disposal through various methods have also been quantified where possible.

The quantity of waste to landfill is relatively straightforward to determine, as there are only two municipal landfills in the region: Rotorua District Sanitary Landfill and Whakatane District Burma Road Sanitary Landfill, both of which are owned by the respective local authorities. Although Whakatane District Council is now closed for general waste (as of December 2009), shredded green waste was being used for landfill face cover and some green waste from the District is still at the site as they work through the landfill closure process.

A number of privately-owned landfills operate within the region, accepting industrial waste streams from only a few sources. In most cases, the owners of the landfills have been able to provide accurate figures. All other waste to landfill from the region goes to Tirohia and Hampton Downs landfills.

The quantity of waste to cleanfill is less straightforward to ascertain. Many cleanfills with current consents from EBoP apparently no longer operate[26], and those that do operate don't keep detailed records of waste composition or tonnages. A few operators commented that, as far as organic waste management is concerned, they already divert a proportion of green waste from their facilities, although wood waste is still often accepted as part of mixed construction waste.

4.1 Overview

To establish the quantity of organic waste from the region going to municipal landfills, it is usually necessary to quantify the total amount and composition of all waste going to these disposal sites.

The municipal landfills in use to the end of 2009 were in Whakatane, Rotorua, Tirohia, and Hampton Downs (North Waikato). The quantities of waste transported to these landfills (measured in tonnes), and estimates of composition, are given below for the 2009 calendar year. In most cases, composition is based on Solid Waste Analysis Protocol Surveys carried out at the disposal sites. Where this is not the case, additional explanation has been provided in the methodology section.

Table 3 – Summary and Composition of the Region's Waste going to Municipal Landfills

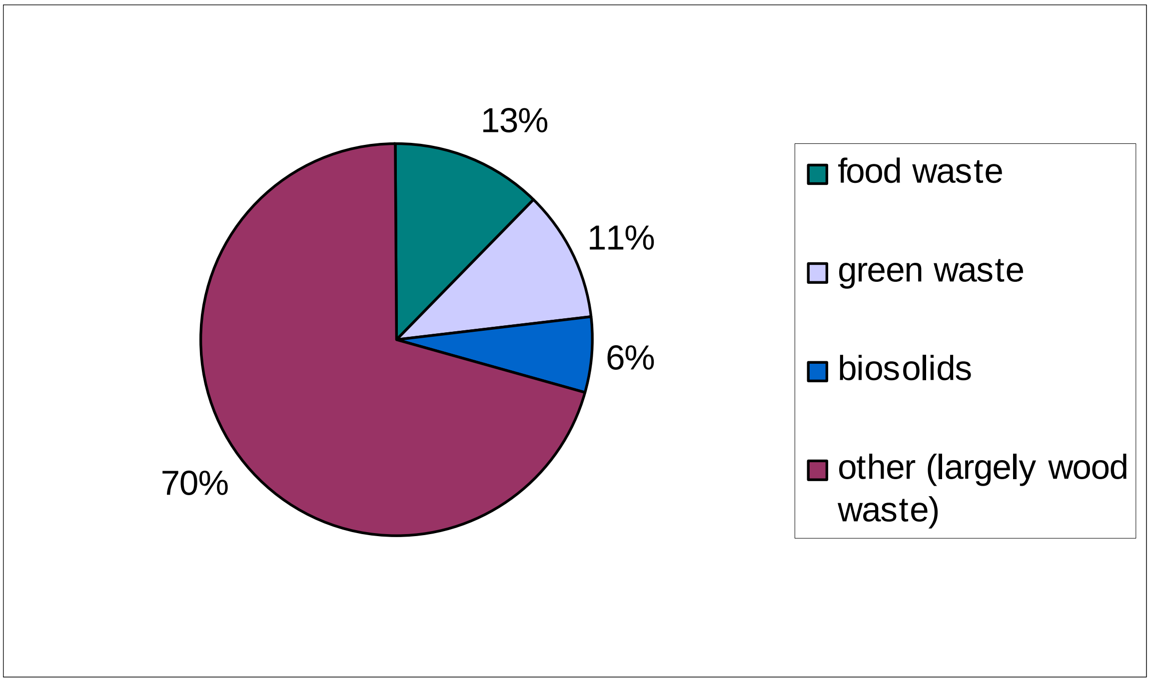
Disposal Facility	Source	Quantity (tonnes per annum)	Composition
Whakatane District Council Municipal Landfill	Whakatane District	19,970	23% food waste 10% green waste Plus 4,500 tonnes of green waste used as landfill cover

[26] The operator of one cleanfill initially responded that it depended how much and what we wanted to get rid of; but then stated they weren't taking any more waste.

Rotorua District Council Municipal Landfill	Rotorua District	65,000	12% food waste 8% green waste 15% biosolids
Hampton Downs	Tauranga City and Western Bay of Plenty District	74,000	12% food waste 8% green waste
Tirohia Landfill	Opotiki District	1200	23% food waste 10% green waste[27]
	Tauranga City and Western Bay of Plenty District	380	12% food waste 8% green waste
	Kawerau District	1590	31% food waste 4% green waste
TOTAL		**162,140**	**13% food waste** **11% green waste** **6% biosolids**

The overall composition of organic wastes to municipal landfills in the region is shown below.

Figure 1 – Components of Organic Waste going to Municipal Landfills



Previous estimates for waste to municipal landfills per capita have been much higher than that provided in this report, as illustrated in Table 4.

[27] SWAP results for Whakatane District have been used in absence of any other information

Table 4 – Previous estimates for municipal waste (total and per capita)

	2002	2003	2004	2005	2006	2009
Municipal waste (tonnes per annum)	152,000	148,000	156,000	180,000	193,000	162,140
Municipal waste per capita (tonnes per capita per year)	0.617	0.592	0.615	0.700	0.740	0.587

- Figures for 2002 – 2005 are based on data collected by Responsible Resource Recovery Limited
- The figure for 2006 is from a report by Sinclair Knight Mertz, which also references the 2002 – 2005 figures[28]

Possible explanations for the contrast in the 2009 figure to previous estimates include:

- Double counting of some council waste streams in years prior to 2009
- Some inclusion of non-municipal waste in years prior to 2009
- Genuine reduction in waste to landfill per capita between 2006 and 2009, which is possible given national and international trends (see section 4.10 for more discussion)

4.2 Organic Waste Summary

Of primary importance to this project is the amount of organic wastes in the region, particularly the proportion that is currently going to landfill or other non-optimal management options.

Table 5 – Summary of organic waste disposal for the region

Organic Waste to Landfill/Cleanfill		
Type of waste	**Source**	**Quantity (tonnes per annum)**
Wood waste (including processing waste)	Mainly Kawerau/Whakatane, construction waste largely Tauranga	112,500
Food waste	Throughout the region	22,500
Green waste	Throughout the region	12,000
	Throughout the region – landfill cover	4,500
Biosolids	Throughout the region	20,000
TOTAL		**171,500**

[28] Sinclair Knight Mertz (2007) *"Waste Infrastructure Review and Strategic Assessment"*, report for Environment Bay of Plenty

Table 6 – Summary of organic waste diversion for the region

Organic Waste Diverted		
Type of waste	**Location**	**Quantity (tonnes per annum)**
Wood waste	Mainly Kawerau and Rotorua	370,000[29]
Food waste (including fruit)	Throughout the region	52,830[30]
Green waste	Throughout the region	12,250
Biosolids	Te Puke (to Kawerau)	1,000[31]
TOTAL		**436,080**

Table 7 – Summary of all organic waste for the region

Summary of Organic Waste	
Organic waste to landfill/cleanfill	171,500
Organic waste diverted	436,080
Total organic waste in the region	611,580
Percentage currently diverted from landfill/cleanfill	71%

Table 8 – Source of organic waste disposal streams

District/sub-region	Wood Processing Waste (tonnes, % of total)	Food waste (tonnes, % of total)	Biosolids (tonnes, % of total)	Green waste (tonnes, % of total)
Kawerau	92,000 (82%)	497 (2%)	0	63 (.4%)
Opotiki	0	271 (1%)	0	118 (.7%)
Western BoP/ Tauranga	4,500 (4%)	10,696 (48%)	5,000 (25%)	5,950 (36%)
Rotorua	0	7,540 (34%)	10,000 (50%)	5,200 (32%)
Whakatane	16,000 (14%)	3,496 (16%)	5,000 (25%)	5,016 (31%)

Notes: due to rounding figures do not exactly total to figures in Table 5.

Biosolids for Whakatane and Western BoP/Tauranga are estimates.

[29] This is probably higher due to additional but unquantified woody material being used in biomass boilers.

[30] There are a number of small operations in the region processing putrescible waste, and so this figure may well be revised upwards as more information is received

[31] This is an estimated annual figure, as the vermicomposting trial taking the biosolids has only been running for a few months.

The figure below shows the approximate geographical location of the organic wastes listed in Table 8 above.

Figure has been removed.

A brief analysis of the above figures shows that the quantities of organic waste both to cleanfill/landfill and organic waste diverted are dominated by wood waste from Kawerau and Rotorua. These wastes account for 67% of the landfilled material and 93% of the diverted material. Apart from wood wastes the main organic wastes being sent to landfill are putrescible waste, biosolids, and green waste.

Each waste stream is discussed in more detail below.

4.3 Wood Waste

This is the largest single organic waste stream with over 480,000 tonnes produced in the region annually, and 112,500 tonnes of that going to landfill. These waste streams are largely from the Carter Holt Harvey and Norske Skog operations in Kawerau and Whakatane, where wood is processed in to various paper/board products including kraft pulp, newsprint, and board for cartons. Carter Holt Harvey and Norske Skog operate a joint venture at the 'Tasman' Kawerau site, which manages all of the solid and liquid waste treatment for that site. SCA are co-located at the Kawerau 'Tasman' processing site, and produce sanitary paper products. They also use the treatment processes managed by the joint venture, but produce very little waste – in the order of 1,000 tonnes per annum.

Approximately half of the waste from the Tasman site is a direct waste product from the various processing systems known as 'primary wastes', which is dry and solid in nature with high lignin content. The remainder, called 'secondary wastes', arises from the dewatering of the liquid wastes from the processes, and comprises wet solids (about 30% solids) from a series of settlement ponds. A small portion (8%) of the waste is wood wastes from the Carter Holt Harvey mill in Whakatane.

Currently, the majority of the wood processing waste is disposed of in two private monofills, owned and operated by Carter Holt Harvey and located on Carter Holt Harvey land in Kawerau.

Between 20 to 30% of the primary waste can be composted on the Tasman site[32]. Some of this material is then mixed with bark, and sold as compost or potting mix. There is also a vermicomposting trial underway on the Tasman site incorporating the primary solids,which are mixed with biosolids from the Te Puke waste water treatment facility.

Table 8 – Breakdown of the wood waste stream

Source	Type	Treatment	Quantity (tonnes per annum)
Norske Skog and Carter Holt Harvey, 'Tasman' site, Kawerau	'Primary solids' from wood processing	Composted	10,000
		Landfilled	43,000
	'Secondary solids' from wood processing	Landfilled	48,000
	Bark and wood waste	Used as boiler fuel at	300,000

[32] One of the operations using composted primary solids is in the early stages, so an annual tonnage can only be estimated at this stage.

		Tasman and Kinleith mills	
SCA Hygiene Australasia, Kawerau	Fibre production waste	Landfilled	1,000
Carter Holt Harvey Whakatane	Bark and wood waste	Landfilled	10,000
	Fibre production waste	Landfilled	6,000
General construction waste	Untreated timber	Landfilled or cleanfill	4,500

4.3.1 Issues

- Besides the obvious issues relating to this amount of organic waste going into landfill and creating methane and leachate as the waste breaks down, Norske Skog and Carter Holt Harvey are both aware of the public perception regarding the environmental impacts of their operations, particularly as they are currently renewing their resource consents. There is long-standing local concern about liquid discharges into the Tarawera river from both the landfill, and the settlement ponds where the secondary solids are formed. Both organisations are keen to find an alternative to landfill for these wastes, and have been trialling different processes at both the Tasman and Kinleith mills.
- Both the primary and second solids have a high carbon content. To process this material into a useful soil amendment product would require balancing the carbon with nitrogen sources – thus the inclusion of the biosolids (which are rich in nitrogen) from Te Puke in the vermicomposting trial.
- There are no significant collection issues for this waste stream. The vast majority of material is generated in a small area within the Kawerau District. The processing sites are also well-served by rail and road links, making it feasible to transport in material from outside the area, particularly given that existing transport needs are for material to leave the region offering the potential for backfilling loads.
- The current cost of disposal for wood processing wastes is low, as the monofills are owned and operated by the waste generators. If their current resource consents are granted as proposed by EBoP, the landfills will have a 25 year life from 2013[33]. This could present an economic barrier to developing alternatives – however CHH and Norske Skog are interested in diverting material from landfill. Partly this is motivated by cost, and an alternative would need to be feasible from this perspective. However, public perception is also a concern, given the perceived issues regarding their resource consents.

4.4 Green Waste

Green waste is generated by householders, parks and garden operations, landscapers and developers, orchards, and other activities across the region. Nearly half of the region's green waste is already being mulched and/or composted around the region, or just outside the

[33] Norske Skog and CHH are in preparations for hearings at the Environment Court regarding their resource consent applications.

region with WBoPDC's green waste going to a green waste processing operation at Tirohia landfill. While there is still some capacity for increased green waste diversion, this is limited within current facilities and would also rely on capturing the green waste that is currently in the residual waste stream. Not all areas of the Bay of Plenty have green waste collection services available. A proportion of additional green waste will be captured as Whakatane District Council changes its management practices from landfill cover to composting sometime during 2010.

The main issues in respect of processing green waste relate to collection systems, and the ability to extract the green waste from the residual waste system, including cleanfill disposal.

There are a limited number of Council-provided green waste collections in New Zealand. Of those that do collect green waste, the majority combine it with food waste. For various reasons, this may not be the best option:

- Green waste can be diverted from on-site management, such as home composting, resulting in an overall increase in the waste stream;
- More frequent collections are required due to the presence of putrescible waste;
- Contamination is more common and harder to detect;
- All of the garden and food waste collected must be processed to the standards required for putrescible waste. This typically requires in-vessel systems, which are capable of controlling odours, vermin, vectors (such as flies or birds), and destroying pathogens[34]. This makes processing more expensive.

In general, green waste is the most straightforward organic waste to manage. Currently, the vast majority of green waste that is generated in the region but not diverted from the residual waste stream is going to Tirohia or Hampton Downs landfills at municipal waste charges (apart from the small amount diverted at cleanfills), so finding an alternative cheaper processing option shouldn't be difficult – if the collection issues can be resolved.

4.5 Pre- and Post-consumer Food Waste (excluding Fruit and Sea/Lake Weed waste)

Almost one-third of the food waste from the region is already diverted to various processing operations in north Waikato or south Auckland, or to local pig farmers. There is potential for more to be recovered, and, to this end, several operators are currently increasing their collection capacity and frequency in the region.

However, according to the waste processors, none or very little of this waste is from domestic sources.

An estimated 22,500 tonnes per annum of putrescible waste is still going to landfill disposal at Tirohia and Hampton Downs landfills and Rotorua District Council's landfill.

A very small and unquantified proportion of domestic putrescible waste is currently recovered through home composting or vermicomposting.

[34] Windrow systems may in some circumstances be used to compost food waste but these require careful management to ensure the necessary standards are met and will generally need to be at remote sites to mitigate the effects of potential odour and vector issues.

Diverting this waste from the residual waste stream would require domestic and commercial food waste collections[35].

Although processing putrescible wastes presents more challenges than green waste, it could still be feasible to find an alternative processing option that is reasonably competitive with landfill disposal. Putrescible wastes produce large amounts of methane and contribute to the generation of leachate as they break down anaerobically in landfills, and so are considered a high priority waste due to potential environmental harm.

4.6 Biosolids

The figure of around 20,000 tonnes per annum for biosolids in the region is likely to be an underestimate, largely because some councils are not aware of their current biosolid volumes and not all private operators have provided data. The current situation for each of the councils in the region is noted briefly below:

- **Whakatane District Council** has an unknown quantity of dewatered biosolids that will soon require a solution. The wastes are currently being quantified and analysed, and this will largely dictate the possible management methods available.
- **Opotiki District Council** is working with a septic tank waste collector in the District to find an alternative management option for this waste. Currently the operator uses the Council's waste water treatment facility, at very low cost. The Council sees this as an inequitable situation for the District and would like to develop a user-pays system with the waste collector. Other biosolids from the District are fully processed at the Council's facility.
- **Rotorua District Council** is investing in a three-year research project led by Scion Research. The eventual outcome is intended to be a facility that will process all biosolids from the District and produce energy. A waste product will still eventuate but this is unlikely to be suitable for any destination other than landfill. The amount of waste product will depend on the efficiency of the process – Scion is aiming for an 80% reduction in volume. Currently, Rotorua District's biosolids are going to the Rotorua District Council municipal waste landfill.
- **Western Bay of Plenty** produces around 870 tonnes of dewatered biosolids per year[36], with a proportion of this currently incorporated into a vermicomposting trial run by Carter Holt Harvey at its site in Kawerau. The biosolids are mixed with primary wastes from the Tasman mill complex, vermicomposted in open air windrows. and the remainder disposed of by a private biosolids operator.

  One other wastewater treatment plant in the District, located at Katikati, had an estimated 2700m^3 of sludge in two settlement ponds at July 2008. The sludge was removed from the ponds in 2009 and will stabilise on site for several years before being removed for beneficial re-use. The final wastewater treatment plant, at Waihi Beach, is yet to be cleared. Dewatering and disposal options are being investigated.

---

[35] Based on international experience, particularly research carried out by the Waste & Resources Action Programme in the UK – it is very difficult to divert significant amounts of food waste from the residual waste stream through home composting, due to participation rates and concerns from householders about composting certain food wastes such as dairy and meat products.

[36] Western Bay of Plenty District Council, 2008 *"Water and Sanitary Services Assessment"* available on www.westernbay.govt.nz.

- **Tauranga City Council** produce biosolids at two wastewater treatment plants at Chapel Street and Te Maunga, which are currently being transported to Hampton Downs landfill.

One key issue with biosolids management is the value of the end product. There are cultural and social concerns in New Zealand about using soil improvers that contain biosolids. Public perception is that, because they are derived from human sewage, they are unhygienic and iwi have strong cultural barriers against using human sewage for food production. If these concerns cannot be managed, this means that any product containing biosolids can only go to an end use for growing food for stock consumption, non-edible plant production, or forestry. There have been suggestions that biosolids could be sterilised; further discussion with iwi and other community groups would be required to establish whether this would allay their concerns.

The NZ Guidelines for Safe Application of Biosolids to Land[37] (2003) classifies biosolids products according to the 'stabilisation grade' achieved either via the wastewater treatment process itself (e.g. treatment of resulting sewage sludge via a high-pH dose) or via a subsequent processes (e.g. hot-composting), in addition to contamination levels. The 'stabilisation grade' – either Grade A or B – is assigned according to the methods used to treat the sewage sludge and the levels of pathogens present. Biosolids are also assigned a 'contaminant grade' (either Grade a or b) that relates to the concentrations of heavy metal and other organic-compound parameters present. A biosolids product that achieves a Grade Aa is therefore most suitable for appropriate land applications and presents the lowest risk. It is not known what grade applies to the various biosolid waste streams in the region currently.

Of perhaps greater concern in respect of biosolids is that the material can contain high quantities of contaminants such as heavy metals, PCBs[38], bromated flame retardants, dioxin and other persistent organic pollutants, such as pesticides and industrial chemical residues. The concentration of these materials will depend on the level of commercial and industrial effluent discharged to sewer. Therefore, biosolid contaminant levels will vary according to location, with more urban areas exhibiting higher levels of wastewater contamination.

4.7 Fruit Waste

Fruit waste (part of the putrescible waste stream) is largely from the kiwifruit industry, which is a major industry in the region and still growing. Presently 95% (42,750 tonnes per annum) of the fruit waste is disposed of as stock food, with the remainder (2,250 tonnes) landfilled[39].

While only a small proportion of this waste stream is currently going to landfill, the stock food requirements in the region are unreliable as demands from farmers vary seasonally and are dependent on weather conditions and the costs of other stock feeds. Kiwifruit is not seen by farmers as an ideal stock food, and at times the fruit waste is essentially dumped on land. Further, companies involved in marketing kiwifruit overseas (such as Zespri) are concerned at the image this waste management system presents, and are keen to find alternatives ways to deal with the waste that can add value to their product[40], such as producing packaging or fuel

37 http://www.waternz.org.nz/documents/publications/books_guides/biosolids_guidelines.pdf

38 Polychlorinated Biphenyls

39 Provided by Zespri International from previous confidential research

40 Scion (2008) "Waste 2 Gold – Feasibility Study for Zespri : Final Report" provided confidentially by Zespri Ltd

products. An alternative that provides a fertiliser product for the kiwifruit industry may also be a favourable option[41].

The challenge in finding an alternative management method for the fruit waste would be demonstrating the added value to the kiwifruit marketing companies. Cost of treatment is not necessarily the primary issue in this context.

4.8 Lake/Sea Weed Waste

The Bay of Plenty region has unique problems with waterweed waste, with the Rotorua Lakes management issues and the increasing presence of 'sea lettuce' on the region's beaches. Nearly 1000 tonnes of sea lettuce have been removed from the region's beaches so far this summer (09/10), and recently 4,500 tonnes of lake weed were removed from Lake Rotorua. So far most of the weed material has been disposed of to land, with 90% of the sea lettuce spread on kiwifruit orchards. The remainder has been sent to landfill.

While the amounts involved are not high, and are irregular (particularly in the case of lake weed), this is a difficult waste material to manage. Land-spreading results in odour issues, which are a concern near residential areas, and public perception of this as a disposal method is not positive[42]. Recent trials with sea lettuce indicate that the simplest way to break down this material is by composting or vermicomposting, mixed in fairly low quantities with other structural, higher carbon content organic wastes.

There are high levels of public concern regarding sea lettuce in particular, and this has been the subject of public meetings in the region over the 2009/10 summer.

4.9 Data Gaps/Issues

There are two main issues with the data presented here.

4.9.1 Cleanfills

Throughout New Zealand, data for cleanfills is difficult to obtain and is usually estimated rather than being based on actual measurement. There are three main cleanfills operating in the region that may potentially be accepting organic wastes as part of their operation, as their consent specifically allows 'green waste' alongside cleanfill and construction waste. All other cleanfills currently consented by EBoP are either not operational, or accept purely roading waste, which would have a very low organic fraction.

Of the three cleanfills, one was able to provide estimates for the amount of organic waste coming in to the site (including diversion to composting). Another is unable and/or unwilling to estimate volumes, but has been assumed to be similar to the first. The third was unwilling to discuss the project at all and no information was provided.

Estimates have been made for the amount of waste going to these three cleanfills, and the proportion of organic waste has also been estimated. The total for waste to cleanfill for the

---

[41] Bioform Ltd (2010) "Eco-efficiency of the Zespri System: Distributed Biogas Production and Nutrient Recycling" provided in draft by Zespri Ltd

[42] This is based on conversations with several people around the region – although residents are being asked to use the weed as compost in their gardens, there is reluctance given overseas reports of dangerous side effects (eg, a man in France overcome by the gases emitted from a one metre deep pile of sea lettuce).

region is low, but this is unsurprising considering a number of cleanfills have not been pursued as the chances of them accepting any organic waste is very low.

Diverting organic waste from cleanfills is a complex enforcement issue, and one not quickly resolved.

4.9.2 Commercial/Industrial Organic Waste Diversion and Disposal

Due to the large number of informal local arrangements involving these organic wastes, it has been impossible to quantify all organic waste diverted. Anecdotal evidence suggests that a number of restaurants, butcheries, fruit and vegetable shops, and supermarkets have agreements with local pork farmers and orchardists for their organic waste. This is particularly the case in the more distant parts of the district (Whakatane, Kawerau, and Opotiki). The estimate for organic wastes diverted from this sector is therefore likely to be low.

Operators involved in formal collections of organic wastes from the commercial and industrial sector (such as Lowe Corp) have advised, however, that there is additional organic waste that could be diverted from the region[43], and for this reason several of the operators are planning to expand their collection capacity and coverage.

Based on their feedback and anecdotal evidence, an additional small amount of C&I organic waste has been estimated as currently going to landfill by direct means, rather than through the council-controlled transfer stations.

4.10 Potential Future Trends

Factors that may affect future organic waste management include population and household growth in the region, economic growth, markets for recycled organic products, changes in lifestyle and consumption, and central government policy and legislation. This last factor has been discussed in detail already in this report; other factors are covered here.

4.10.1 Population & household growth

In 2009, the Bay of Plenty region had an estimated population of 275,930[44]. The population of the region has been growing steadily over the last twelve years at an average rate of 1.3% per year. This has meant a population increase of 15.9% - equivalent to an additional 39,300 people. The region's population is projected to increase a further 10 to 36% by 2031, depending on various scenarios – meaning an additional 25,900 to 96,400 residents in the region in this time[45].

All other factors being equal, this level of population growth will result in an increase in waste generally, including a proportional increase in organic waste.

The level of population growth will not, however, be spread evenly throughout the region, with some areas experiencing greater pressures than others. Regional growth strategies predict that much of the population growth will continue to be around the Tauranga and Western Bay of Plenty areas[46]. Research for the 'SmartGrowth' strategy for this sub-region has found that

---

[43] This is based on the number of inquiries that they have received from potential customers since they started their collections in the region

[44] Calculated by summing normally resident population estimates from all territorial authorities.

[45] Ministry for Social Development, 2009 *"Regional Indicators – Bay of Plenty region"* available at www.socialreport.msd.govt.nz.

[46] www.smartgrowth.org.nz.

80% of the population growth in this area will result from migration, with a significantly older population than the national average. By 2051, the sub-region is expected to be home to 5.2% of the national population (up from 3.4% currently) – the fourth most populated region in New Zealand.

Household growth is, of course, primarily a function of population growth. However, since 1986 the number of households has been increasing at a greater rate than population due to a trend towards smaller household and family sizes[47]. This will have an impact on waste generation due to the fact that more waste per capita is generated from smaller households than from larger ones[48].

4.10.2 Economic Growth

Economic growth has traditionally been correlated with waste production. Higher levels of economic activity lead to greater production and consumption of goods and this in turn can lead to higher quantities of waste.

A common measure of economic growth is Gross Domestic Product (GDP). Data from one territorial authority in New Zealand experiencing strong growth in population and household numbers (in the Auckland region) showed a correlation of 0.956 between GDP and waste quantities collected by the authority, including a drop in waste quantities in 2008.

In the current recessionary economic climate, GDP growth has fallen sharply and, at the end of 2009, NZ had experienced 5 consecutive quarters of negative economic growth. Economic forecasts vary, however, with some predicting an extended period of weak growth[49] before the economy recovers to previous historical levels.

In terms of planning for waste facilities and services it is important to ensure demand is met and so it is prudent to take a more optimistic view. Below are GDP forecasts to 2016 which indicate a return to growth of around 3% per annum by 2010.

Table 1: GDP and GDP Growth to 2016

	2009	2010	2011	2012	2013	2014	2015	2016
GDP ($m)	33,010	34,140	35,329	36,151	37,248	38,378	39,542	40,439
GDP Growth	-2.71%	3.42%	3.48%	2.33%	3.03%	3.03%	3.03%	2.27%

Source: Goldman Sachs JB Were

On the basis of the correlation noted above, the trend in GDP indicates a reduction in waste in 2009 will be followed by a return to historical levels of waste growth.

4.10.3 Markets

Markets for recycled organics products are analysed in detail in section 7.0.

---

47 http://www.stats.govt.nz/publications/populationstatistics/nz-family-and-hhold-projections-2001-2021.aspx

48 For example 2 people living in separate households as opposed to a single household will require duplication of a range of goods from microwave ovens through to furniture, as well as tending to consume greater quantities of packaging, (due to smaller serving sizes) newspapers, cleaning products etc.

49 http://www.nzherald.co.nz/economy/news/article.cfm?c_id=34&objectid=10580231&pnum=2

Factors that could change market dynamics in future include:

- The existence of other waste management facilities in the region or nearby – whether for organic wastes or otherwise. EBoP already works closely with Environment Waikato and should be able to identify any future impacts on this region from activities undertaken in the Waikato. New facilities in the Bay of Plenty region are currently largely up to the free market to decide, although EBoP will get involved at the resource consent stage. A publicly-available organic waste management strategy for the region could reduce any potential negative impacts from the development of new waste management facilities.
- Changes in manufacturing practices in the region – particularly in the forestry and wood pulp/paper industry. There is no indication that Norske Skog and Carter Holt Harvey, the two main companies involved, are planning any major changes to their manufacturing process. Other main industries in the region, such as the AFFCo Rangiuru processing plant and the Fonterra dairy plant at Edgecumbe, similarly have no plans to make changes to their processes.

  There is a chance that fish processing could change, as it has done in the past[50], to reflect a consumer preference for fillets over whole fish. Currently, fish processing waste is around 15% of what it might be were fillets being produced – a difference of around 700 tonnes per annum. This is not considered a significant difference in the larger context of organic waste flows in the region, and would probably be absorbed by Lowe Corp.
- Territorial authorities and wastewater management – there is no indication that the various territorial authorities are planning to make any significant changes to their existing waste water treatment systems
- The kiwifruit industry is expected to maintain its presence in the region, with perhaps a slight growth – although this is difficult to predict in current economic conditions[51]. More significantly, however, international markets for organic kiwifruit are very strong, and so it is expected that more kiwifruit orchards in the region will make the conversion to organics. This has significant implications for the processing of organic wastes, particularly with respect to certification under such systems as BioGro.

4.10.4 Changes in lifestyle and consumption

Household waste growth is not just a New Zealand phenomenon. In 1997 OECD countries produced 540 million tonnes of MSW annually (approximately 500kg per person). Waste grew at an average annual rate of 1.8% between 1980 and 1985, 3.6% between 1985 and 1990, and 1% between 1990 and 1997[52]. A report by the OECD[53] noted the following driving forces behind current and projected household consumption patterns:

1. Rising per capita income
2. Demographics (more working women, more single person households, larger retirement population)

---

[50] Personal communication with Kevin Wylie from Sanford Ltd

[51] Personal communication with Alistair Mowat from Zespri International Ltd.

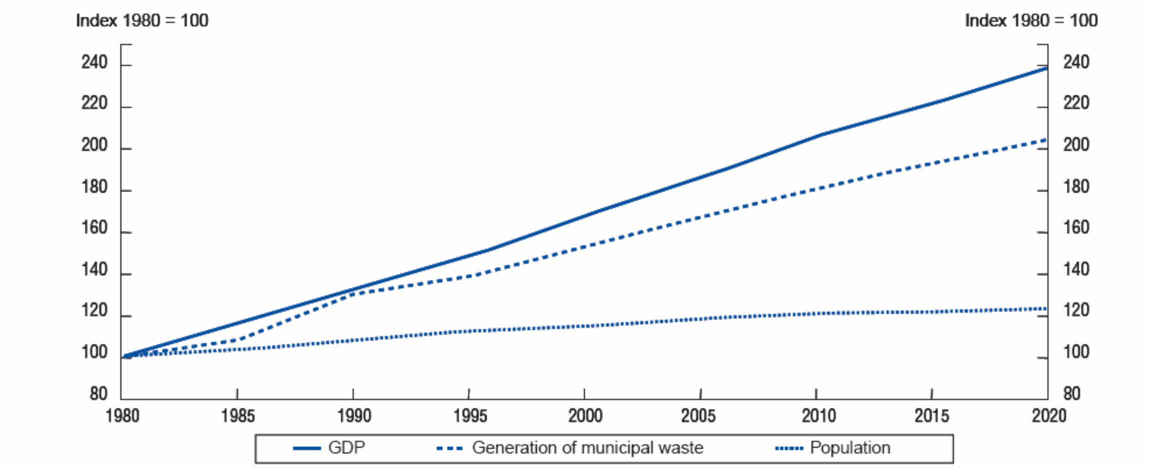
[52] Towards Sustainable Household Consumption? Trends and Policies in OECD Countries, OECD 2002, p 53

[53] ibid, p12.

3. Accompanying changes in lifestyles leading to individualised buying patterns
4. Shift towards more processed and packaged products
5. Higher levels of appliance ownership
6. Wider use of services and recreation
7. Technology
8. Institutions and infrastructure that create the prevailing conditions faced by householders

Figure 2 below shows the growth in municipal waste plotted against GDP and population. The chart shows that waste has tended to increase at a rate slightly below GDP but noticeably above the level of population growth.

Figure 2: Municipal Waste Generation, GDP and Population in OECD countries 1980 - 2020



Source: OECD 2001.

A study by the US Environmental Protection Agency (EPA)[54] compared levels of GDP, population growth, and consumer spending as measures to predict waste arisings. The study used historical data to establish the predictive accuracy of these measures and found the best predictor of waste arisings levels to be consumer spending.

Research from the UK suggests that underlying the longer-term pattern of household waste growth is an increase in the quantity of materials consumed by the average household and that this, in turn, is driven by rising levels of household expenditure[55].

While the impacts of the recent recession may result in reduced consumer spending over the short term, the expectation is that the trend of increasing consumption will continue to hold over the medium term.

---

[54] EPA, 1999. National Source Reduction Characterisation Report For Municipal Solid Waste in the United States

[55] Eunomia (2007), *Household Waste Prevention Policy Side Research Programme*, Final Report for Defra, London, England

5.0 Gap Analysis

5.1 Introduction

Consideration of the current organic wastes and existing processing options highlights certain waste streams that are currently difficult to treat, or are not managed optimally.

The key waste streams that fall in to this category are:

- Wood-processing waste – 117,000 tonnes per annum to landfill
- Food waste – 22,000 tonnes per annum to landfill
- Biosolids – at least 20,000 tonnes per annum to landfill
- Green waste – 20,000 tonnes per annum to landfill
- Fruit waste – 45,000 tonnes per annum largely to stock food
- Lake and sea weed – 5,500 tonnes intermittently

There is currently no, or very little, infrastructure to deal with any of these waste streams, other than green waste, within the region. A proportion of these wastes is being disposed of to land, although this is a fairly ad hoc solution and relies on a willing recipient.

Each of these waste streams can be assessed against basic criteria, specifically:

- Volume
- Potential for environmental harm
- Achievability of alternatives
- Public concern

5.2 Wood Processing Waste

This waste stream originates mainly around Kawerau, with a small amount arising from the CHH board mill in Whakatane, and is comprised of the ‘primary’ and ‘secondary’ processing wastes from production of pulp, paper, and board products.

Volume: **High** - at 117,000 tonnes per annum this is the largest single organic waste stream going to landfill in the region.

Potential for environmental harm: **Moderate** - while the primary solids are relatively stable, the secondary solids are less so, with high alkalinity

Achievability: **High** – although Norske Skog and CHH have a reasonably low-cost disposal option at present, they are sensitive to environmental issues, particularly as they are working through the process of renewing their resource consents. The two organisations are working together actively to develop a better alternative to landfill disposal.

Public concern: **Moderate** – public perception of the operations is mixed, and particularly negative regarding discharges into the Tarawera River. Public awareness is high at present, given the current resource consent process.

5.3 Food Waste

Volume: **Moderate** - the second largest organic waste stream going to landfill.

Potential for environmental harm: **High** – putrescible waste produces large amounts of methane when decomposing anaerobically in landfills. As food waste decomposes relatively quickly, much methane is generated before any gas collection systems become effective.

Achievability: **Low** – there are significant collection barriers, as diverting significant amounts of putrescible waste from landfill would require a region-wide domestic and commercial collection system. This would probably require input from all local authorities in the region. Putrescible wastes are also one of the more challenging wastes to process.

Public concern: **Low** – not aware of any significant public concern regarding putrescible wastes going to landfill

5.4 Biosolids

Volume: **Moderate** – about the same as putrescible wastes, and potentially higher as more biosolids are quantified and/or wastewater treatment technologies and processes change.

Potential for environmental harm: **High** - Biosolids may contain relatively high levels of contaminants such as heavy metals, PCBs, bromated flame retardants, dioxin and other persistent organic pollutant residues (e.g pesticides).

Achievability: **Moderate** – there is already one trial underway incorporating biosolids, and alternative technologies are being developed. The various operators involved in biosolids are keen to find alternatives that have low economic impacts for them.

Public concern: **Low** – there seems little public awareness of biosolid management issues, although there has been some media coverage in Rotorua of the Scion research project.

5.5 Green Waste

Volume: **Moderate** – slightly less than putrescible wastes and biosolids.

Potential for environmental harm: **Moderate** – green waste breaks down more slowly in a landfill than putrescible wastes for example and, while still producing some methane, this is more likely to be captured by any landfill gas systems.

Achievability: **Low** – diverting significantly more green waste from landfill than at present would probably require a regional collection system or at the least strict separation and management at transfer stations, involving all local authorities, and strict controls on cleanfill operators.

Public concern: **Low**

5.6 Fruit Waste

Volume: **High** – the second largest waste stream, although little of it is currently going to landfill

Potential for environmental harm: **Low** - only a small proportion of the waste is going to landfill

Achievability: **Moderate** – marketing companies for kiwifruit are motivated to find an alternative for kiwifruit waste. However, processing the waste into a soil-improving product seems to be a less-preferable option for them.

Public concern: **Low**

5.7 Lake and Sea Weed

Volume: **Low -** the smallest waste stream

Potential for environmental harm: **High –** not only is this a highly putrescible waste and so would produce methane in a landfill, the weed also causes general concern by its presence in the environment.

Achievability: **Moderate** – weed waste has proved difficult to process and, for best results in composting or vermicomposting, would need to be combined with other wastes.

Public concern: **High** – sea lettuce especially is becoming a growing concern, particularly as there have been high volumes this summer (09/10). The public is aware of international stories about the potential health problems sea lettuce can cause, and may be reluctant to use the weed as a garden compost as a result – although they are also very concerned about it remaining on the foreshore.

5.8 Summary

Waste stream	Volume (tonnes per annum)	Environmental harm	Achievability	Public concern
Wood processing waste	High (117,000)	Moderate	High	Moderate
Food waste	Moderate (22,000)	High	Low	Low
Biosolids	Moderate (20,000 plus)	High	Moderate	Low
Green waste	Moderate (20,000)	Moderate	Low	Low
Fruit waste	High (45,000)	Low	Moderate	Low
Lake and sea weed	Low (5,500 intermittently)	High	Moderate	High

6.0 Options to Address Gaps

6.1 Processing Technology Options

For all organic wastes not within council control, the price of an alternative processing technology compared to landfill is normally the key factor determining feasibility. Potential exceptions to this are Zespri, who are exposed to perceptions of international markets, and possibly, to a smaller extent Carter Holt Harvey/Norske Skog, who are currently working through renewal of their resource consents.

The table below summarises potential technologies, capacity, waste processing capabilities, and approximate costs per tonne.

Table 9 - Summary of technologies, capacity and indicative costs

Technology	Capacity (tonnes per annum)	Waste Processing Capabilities	Indicative costs[56]
Home composting	Estimate 350kg per household per year	Suitable for garden wastes & food wastes, excluding meat. Other home organic waste management technologies, including wormfarms and bokashi, can process food wastes more effectively.	Promotional and education costs for councils. Compost bins typically cost $80 -$150 for householders to purchase
Windrow composting	Potentially limitless given enough space	Garden waste, bark, manures,	$50 - $80 per tonne
Vermicomposting	Potentially limitless given enough space	Almost any organic wastes, although cooked food waste, high protein wastes, biosolids and other organic sludges can result in odour problems. These can be resolved by adding bulking agents or covering.	$40 - $80 per tonne
Static aerated windrow composting (covered)	Potentially limitless given enough space – the Gore® system used in Timaru has a recommended maximum of 160,000 tpa	Garden waste, bark, manures, biosolids and other organic sludges, food wastes (requires approximately 50% 'bulking agent')	$70 per tonne for Gore®
In-vessel composting	2,000 tpa and upwards – the facility in Christchurch is designed for 65,000 tpa	Garden waste, bark, manures, biosolids and other organic sludges, food wastes (requires approximately 50% 'bulking agent')	$60 - $90 per tonne
In-vessel mechanical composting	HotRot®: 300 – 50,000 tpa Rotocom®: 600 – 37,000 tpa	Garden waste, bark, manures, biosolids and other organic sludges, food wastes (requires approximately 50% 'bulking agent')	$80 - $100 per tonne

[56] NB. These are indicative gate fee costs only. Actual costs will be dependent on a range of factors including facility size, land and site development costs, markets etc.

Anaerobic Digestion	Economic minimum approximately 10,000 tpa	Food waste, sludges, biosolids, food processing wastes. Some 'dry' processes require bulking agent	$90 - $200 per tonne
Gasification & Pyrolysis	Generally operated at small scales (10 -50,000 tonnes)	Homogenous high carbon content organic wastes such as wood wastes, crop stalks etc	$100+ per tonne

Appendix 5 contains a more detailed technical appraisal of the key processing options.

6.2 Collection Options

The types of collection system employed can have an important impact on material composition, tonnage, and quality. It is important, therefore, that when considering either processing or collection systems, the interaction of these systems is kept in mind and that systems are integrated to the greatest extent possible.

6.2.1 Household collections

When collecting organic waste from households there are two basic types of systems:

- Systems that collect garden and food waste together (in the same container)
- Systems that collect garden and/or food waste separately (in different containers, and most commonly on separate vehicles)

Within these two basic types of systems there are a wide range of configurations based around the following parameters:

- The type and size of roadside containment
- The provision of in-kitchen containment (if collecting kitchen waste) - and the type of containment provided (e.g. caddies, liners etc)
- The frequency of collection
- The precise materials accepted (e.g. meat, bones, nappies, etc)
- The type of collection vehicle used
- Residual refuse collection system configuration (bags/bins, frequency, user charges or rates funded etc)

These different systems and system configurations can have a profound effect on not only the quantity of material collected, but its quality (i.e. contamination levels), cost, and householder satisfaction.

Appendix 6 contains a more detailed discussion of the relative impact of each of these issues on system performance.

Table 10 – Summary of impact on system performance

	Advantages	Disadvantages
Food and garden co-mingled	• One collection container for households • Only one collection vehicle required for both organic streams • Garden waste in the residual can be targeted • If material is to be processed in an aerobic system, green waste will be required in any case	• Garden waste currently managed in the property is drawn into the system (this can be upwards of 200kg per household per year) • Larger more expensive trucks are required to manage the additional material • Council must pay for the processing of the additional material • All material collected must be treated as if it was food waste

		(more expensive than windrowing) • Collections must be frequent (weekly) to prevent kitchen waste becoming odorous • Contamination is higher and more difficult to control
Food only	• Food only collections are generally more effective at capturing food waste compared to co-mingled systems • Small inexpensive non-compacting vehicles can be used for collection • Contamination can be easily spotted and householders educated • Separate streams allow operators more control over process parameters • Garden waste not drawn into the system • Material can be anaerobically digested	• Garden waste in the residual is not directly targeted • Householders may require extra collection bins if green waste collections are offered

In broad terms there are a number of principles that emerge in regards to the design of high-performing systems:

1. There must be a good incentive for householders to use the systems. This can take the form of:
    a. user pays refuse collections (which provide the most direct incentive and are generally considered to be most effective in promoting alternatives to disposal, provided the pricing is correctly targeted);
    b. less frequent collection of residual waste, such as fortnightly collections. This type of system will provide some incentive where food waste collections are more frequent as it provides a motivation to avoid material becoming odorous;
    c. bag-based collections. These can provide an incentive through householders wishing to avoid dog strike and vermin and so being more reluctant to place food waste in rubbish bags.
    d. Bans on organic waste in the residual

    Large bins, frequent collections, convenient systems and service, and free collections for refuse all minimise the incentive to separate out food waste.

2. The food waste collection service must be very user-friendly. Food waste can be potentially off-putting for householders to deal with –especially if it involves cleaning of dirty bins caked with rotten food. A service that enables householder to have an experience that is odour free, convenient and easy to use, does not attract vermin, and has no or low direct cost is essential if participation in the service is to be maximised and sustained. The most effective systems, therefore, tend to be those that provide ventilated caddies with liners, which reduce odours and mess, and where food waste is collected frequently.
3. Thirdly, for a system to be cost effective it must minimise collection costs and provide the opportunity for overall organic waste collection and processing, as well as total waste management costs, to be optimised. Although collection costs will be dependent on a wide range of factors and the 'best' system will likely be different in each situation, in general, systems that collect food waste separately and use small low-cost collection vehicles tend to outperform other systems on a cost basis. There are a number of reasons for this:
    - Separate collection provides the opportunity to either not collect garden waste or to charge for its collection. There is substantial evidence to show that collecting garden waste for free results in additional garden waste being attracted into the municipal waste collection system. This is material that then must be paid for by the council to collect and process, but which was not being paid for previously. A user-pays system for garden waste can also recover any additional cost.
    - Small collection vehicles are low-cost and efficient in terms of pick up
    - Separate collection of material maximises processing options and enables processors to control inputs to their composting processes
    - Manual collections of food waste enables easier and better quality control resulting in superior diversion rates and more saleable final product
    - If food waste systems are sufficiently effective in capturing material, then the frequency of residual collections can be reduced and the savings used to offset the costs of separate collection.
4. In environmental terms, systems that process organic material through anaerobic digestion (AD) are likely to be preferable to in-vessel or windrow aerobic composting processes. This is because, while all systems can produce soil amendment, AD has the advantage of recovering energy (with the associated carbon benefits). In cost terms AD is likely to be competitive with aerobic processes when full system costs are accounted for[57] because of the ability to process only the source-separated food waste without requiring additional green waste to be processed at higher cost.

6.2.2 Commercial collections

Collection services for commercial organisations are generally undertaken at the initiative of the private sector. This means that, in effect, where there is a commercially-viable alternative to disposal for a material, collection operators will generally provide that service. Waste such as fish and meat waste is collected for rendering, fats are collected for tallow production, and food processing wastes, such as bakery wastes, supermarket fruit and vegetable wastes, are collected for stock food. A recent survey conducted for Enterprising Manukau on food waste producers in the Auckland region found that, of the food processing businesses surveyed,

[57] This is the finding for the UK where financial incentives exist for the generation of renewable energy through Renewable Obligation Credits. The situation is likely to be different in the NZ context.

approximately 95% of the organic wastes produced were going to beneficial use (principally stock food)[58]. The main commercial organic waste stream not generally being diverted is catering waste from the hospitality industry. Management of this waste is more difficult. The presence of contamination and meat waste renders it unsuitable for stock food without significant additional processing, and so it must be composted or anaerobically digested. To date there have not been the appropriate facilities for processing this material in New Zealand.

Where appropriate processing facilities exist, collection is relatively straightforward and the precise type of service offered will depend on the requirements of the customers. A pilot programme currently being established in Auckland offers wheeled bin pickups, with either biodegradable liners supplied or regular bin washing, on one or two day collection frequencies. The indicative cost of the service is expected to be $10-$17 per pickup.

6.2.3 Transfer options and issues

One of the factors that requires consideration is transfer and transport of collected organic material to the processing facility(s). It is likely, initially at least, that there will be a limited number of facilities capable of processing collected organic waste (in particular food waste). If food waste is collected from more than one locality, or if the facility is located at a distance from the collection areas, the collected material will require bulking and transport to the facility.

There are no significant technical issues with the transfer and transport of this material, provided that the transfer facilities have the necessary consents for acceptance of collected food waste. Our understanding is that the issues are principally management issues, and that as long as the processes are in place to manage any potential negative impacts, there are no significant legislative or regulatory barriers.

Key transfer management issues include the following:

- **Odour control.** To control odours may require enclosed space for the transfer to take place. Also material should not be stored on site for any significant length of time[59]
- **Vector control.** The material must be stored and transferred in such a way so as to prevent access by birds, rats and other vermin. The most effective management tools are likely to be for the transfer to take place in a enclosed space, for any material spills to be cleaned immediately, transfer areas to be kept clean, and for any storage or transfer containment to be designed in such a way as to prevent access by vermin,
- **Leachate control.** If material is not stored on site for any length of time and is not compacted then leachate issues should be minimal. To prevent any negative impacts, transfer should take place on a sealed pad that drains to sewer (or onsite treatment).

The principal issue for transport of material is to control leachate. This will require transport in sealed containment systems. The weight of loads can also be an issue if food waste is

---

[58] Waste Not Consulting (2009) Food & Beverage Sector Organic Waste Survey. Report for Enterprising Manukau

[59] this will depend on temperature, and on the nature of the material (for example food waste mixed with garden waste is less likely to become anaerobic and the garden waste enables airflow through the material, whereas dense food waste or sludges may be problematic). In general if material is moved off site within 24 -48 hours this would be adequate. It may also be important for the receiving facility that material does not arrive there in an anaerobic (odorous) state, and so this could present an imperative to deliver the material with minimal delay.

collected separately. Food waste is quite dense – (approximately 600 – 700kg /m^3 when it settles in a vehicle) and this means careful attention needs to be paid to vehicle loadings when transporting this material.

6.3 Collaboration Options and Opportunities

One of the aims of this study is to identify potential partners, including waste producers or processors and local authorities, that may be interested in working with EBoP on further developing the options for organic waste management. Potential partners are outlined below.

Issues considered in discussion of each potential partner includes:

- Ability to deal with priority wastes
- Knowledge and involvement with preferred processing technologies
- Potential for partnership working (e.g. Rotorua is already committed to a path)
- Is EBoP intervention required
- Potential to expand to include other waste streams
- Markets for end product
- Location
- Cost/cost share

6.3.1 Norske Skog and Carter Holt Harvey

As generators of the largest single organic waste stream in the region, Norske Skog and CHH are logical potential partners. They have demonstrated their interest in finding an alternative to landfill disposal for their wood processing wastes – of which there are very large amounts.

Neither of these companies have any in-depth knowledge regarding waste management. However their vermicomposting trial is being run in partnership with a local composting operator and a vermicomposting expert. They are not committed to any particular processing technology, but are very cost-conscious. It may be necessary to also involve a waste processing partner in any collaborative effort.

We consider there is strong potential to work in partnership with Norske Skog and CHH. They are keen to find alternatives to landfill, and have the added advantage of an existing large site with the potential to accommodate a processing facility.

At the moment, although the two companies are working closely on looking for an alternative, they are not making rapid progress. In part this may be due to issues they have experienced in obtaining consents. At a minimum, working to find ways to streamline the consent process may be an appropriate focus for developing closer working relationships between the processors and EBoP.

A solution developed in conjunction with Norske Skog and CHH would also logically incorporate wastes from SCA and the CHH Whakatane mill. The nature of the waste, with its high carbon content, would demand input of nitrogenous waste from elsewhere in the region to fully divert this waste stream from landfill and still produce a useful product from the process.

Producing a high-quality product from this waste stream will be dependent on what other wastes are mixed with it. Using biosolids, as in the present trial, will likely restrict end use to growing stock food – a high volume, low value market.

Although the Tasman complex is located at a distance from sources of some other wastes in the region, it does have the advantage of frequent rail services with the potential to backload organic wastes on the trains. Other advantages of this location are the long-term existence of industry in the area, available space, and relative isolation. These factors, alongside the availability of land in the area (largely owned by CHH), could make this a relatively low-cost exercise.

6.3.2 New Zealand Remediation (Revitalfert)

NZ Remediation operates the composting facility in Te Maunga, Tauranga. The company currently processes around 8,000 tonnes of organic wastes and sells around 4,000 tonnes of Bio-gro certified product in the region each year. In addition, Revitalfert, as the parent company, operates a vermicomposting and composting facility in Taranaki.

NZ Remediation is an organic waste processor and has dealt with a range of waste types at the Taranaki facility, and produce a product with strong market value. They have not yet had much involvement with wood processing wastes.

NZ Remediation would be very keen to work in partnership with EBoP and TCC. However, they have indicated that they are very interested in developing a facility in the region even without public sector involvement, and that this would not depend on public funding (e.g. a Waste Minimisation Fund application). They do still have issues with locating a potential site, and this could be an area where the public sector (whether a local or regional council) could assist to bring this proposal to fruition more quickly.

6.3.3 Industrial Vermicomposting Ltd

IVL have an increasing presence in the region and in organic waste processing generally, with involvement in the Tasman Mill vermicomposting trial, lead delivery for the Kinleith Mill vermicomposting trial, and the recent granting of a consent for a vermicomposting operation located at Lake Rotoehu. This last operation has consent for 18,000 tonnes per annum of paper fibre (probably to be sourced from Carter Holt Harvey Whakatane) and lake weed.

The operations manager for IVL, Michael Quintern, one of the three key partners, is qualified in organic waste processing to a doctorate level and has significant experience in this field in Europe and in New Zealand.

IVL, like NZ Remediation, are very keen to work in partnership with EBoP and any territorial authority in the region. Their interest is largely in vermicomposting as opposed to other forms of organic waste processing.

6.3.4 Whakatane District Council

Whakatane District Council has allocated funding in its LTCCP (2009) for an organic waste treatment facility and intends to have a collection service and processing facility in place within the next 12 months. Details are still being finalised (e.g. contracting partners, technology providers etc).

The facility will be designed to accommodate 8,000 tonnes per annum of organic wastes from the District and nearby regions. WDC is expecting the feedstock will be largely domestic food and green waste with some post-consumer waste included. It is likely to be a covered, static aerated windrow system. WDC advises that a site has been located for the facility - a closed quarry currently hosting a concrete-crushing operation. Odour is not expected to be an issue due to isolation, and there is potential to expand the facility to accommodate more waste. Other waste processing facilities will be co-located there, including a recycling centre, bulking station and potentially a landfill. WDC has established a partnership with the landowner.

An organic waste collection would be introduced to provide feedstock for the facility; probably a combined food and green waste domestic collection, with a chargeable option for businesses. WDC are strongly committed to this project, given the recent closure of its local landfill in Burma Road and the potential to divert a reasonable proportion of the District's wastes from Tirohia landfill – saving both disposal and transport costs.

This project is very likely to go ahead without any direct involvement from EBoP. However, the size and type of the facility WDC have in mind would not accommodate any other waste streams other than those targeted. WDC has indicated that there would be additional space at the site and they would consider expanding the facility to accommodate more waste volumes and types. This would probably be on a gate fee basis.

WDC has established firm potential markets for the product, which is probably as soil improver for stock feed (maize). They are still to decide on a potential third partner in the project, which would probably be an organic waste processor or general waste management company.

The location has similar drawbacks to the Tasman site in Kawerau in that it is at fair distance from the main population centres in the region; but once again the site does have access to a rail head and road transport.

6.3.5 Transpacific/Waste Management

Transpacific Industries already have a presence in the BoP region through various contracts (such as waste services for WDC and acquisitions (such as TankMan, collecting septic tank waste and other sludges). WDC have suggested that Waste Management/Transpacific might be a logical tri-partite partner for their organic waste processing facility.

Transpacific Industries are keen to be more involved in organic waste processing in the region. They have a key processing facility in the Auckland Region, with their part-ownership of Living Earth Ltd, which processes a large proportion of the Auckland region's green waste.

As well as a more general interest in organic wastes, Transpacific Industries also have a particular interest in management of biosolids as a result of the 'Tankman' operations. They have advised that plans are underway for a new dewatering and biosolids treatment facility around Tauranga (likely Te Maunga). Staff in the region are very keen to find an alternative solution for biosolids that would avoid the need for disposal.

6.3.6 Other Councils in the region

- **Tauranga City Council** have already indicated their support for an organic waste processing project, and are interested in diverting more organic waste from their domestic waste collections.
- **Western Bay of Plenty District Council** work closely with TCC.
- **Opotiki District Council** are small and limited in resources, but are already working with a septic tank operator in their area as described earlier. Almost half of Opotiki residents use septic tanks; and they would like to introduce a user-pays facility to deal with this waste.
- **Rotorua District Council** are investing heavily in the development of a new technology in partnership with Scion Research. This is intended largely to deal with their biosolids, although putrescible waste may be incorporated. This is a three year

project, into its second year, and is planned to provide the technology for a $7.5M facility.

- **Kawerau District Council** is interested in the outcomes of this project, and a Kawerau DC engineer has been providing some support to the vermicomposting trial at the Tasman site. KDC have also indicated that they would be interested in an alternative option for their cardboard and paper waste that reduces their transport costs.

6.3.7 H G Leach

As well as operating Tirohia landfill, the main municipal landfill serving the region, H G Leach also have a small composting operation at their site in Tirohia. This operation incorporates both open windrow composting for shredded green waste, and three 25m^3 vertical composting units which currently process poultry waste from the local region (outside EBoP boundaries). H G Leach are the only potential collaboration partner who does not already have a physical presence in the region.

The manager at the site advises that they would be happy to accept more green waste at the site, and that they have capacity to expand their current windrow composting operation. However the VCUs present them with some difficulties, and managing the process is time-consuming relative to the amount of waste that is processed in this way. Therefore H G Leach would be reluctant to increase their capacity of VCU processing ability. They would consider composting material other than green waste (such as putrescible/food wastes) should this material become available. Odour has low potential to be an issue, with the nearest neighbour approximately one km away from the existing composting site. Tirohia is the only site managed by H G Leach that carries out any significant quantity of composting.

Tirohia is reasonably close to the northern parts of the Bay of Plenty by road; however transport distances and costs from districts such as Opotiki, Whakatane, and Kawerau are considerable and have been one motivating factor for waste reduction efforts (Opotiki) and the construction of alternatives (Whakatane).

6.3.8 EnviroFert

EnviroFert's main facility is located in Tuakau, North Waikato. They have recently been conducting a trial vermicomposting/composting process for food waste, and were awarded consent from Environment Waikato for this process in late 2009. EnviroFert are the only potential collaboration partner who are not already present in the BoP region in a processing context, although they do market soil improvement products to the region.

EnviroFert have indicated that they are already interested and see potential for organic waste processing in the Bay of Plenty. Their business plans include potential facilities in Hamilton, Rotorua, and another BoP location. Their green waste processing facility in Tuakau is well established and processes a substantial proportion of the Auckland region's greenwaste. EnviroFert advise that there are strong markets in the Bay of Plenty for their product already. They will probably establish a presence in the Bay of Plenty in some way without involvement from EBoP; however this would depend on their assessment of the business case and any potential projects with EBoP support would likely influence their decision.

There have been suggestions that they consider Tuakau to be their primary processing site, and that initially at least other locations would be more basic processing facilities with the majority of their operation still taking place in Tuakau.

6.3.9 Scion

Scion is a Crown Research Institute, and one of their key priorities is to 'accelerate growth of the bioeconomy'.

Currently Scion is developing a method of treating biosolids from sewage treatment plants, discussed earlier in this report (3.7.1), and believe that their technology will accommodate all organic wastes. Scion is intending to apply to MfE for funding to further develop and test the technology, and would welcome partners in their funding application.

As a scientific research institute, Scion must have significant resources in organic waste management and are investing heavily in the development of this proprietary technology. However, as it is commercially sensitive, it is not possible to obtain enough detail regarding the technology to assess its potential against other collaborative options. It is also difficult to ascertain what the end products or byproducts will be; although Scion advise that their financial modelling suggests a $450 per tonne net benefit through avoided treatment and disposal costs and income.

It is certain that Scion will continue to work on this technology without EBoP involvement, particularly as one of EBoP's district councils (Rotorua) is heavily involved. EBoP would also need to ascertain what benefit would be received from any investment and support.

Scion are based in Rotorua and so are close to the forestry industry (which they are strongly focused on) and are based within the Bay of Plenty. However, they do seem to be focused on high technology solutions.

6.3.10 Zespri

Zespri is an industry body representing one of the major users of fertilisers in the region, and one of the major producers of organic waste (although little of this currently goes to landfill).

Several research projects have been completed recently for Zespri investigating alternative management methods for kiwifruit waste, targeting options that would provide additional positive marketing opportunities internationally.

Zespri are not waste managers but have been provided with a range of technical opinions on various management options for kiwifruit waste. Several of these seem to be quite high-tech solutions[60], [61] although Zespri advise that they are more recently looking into the potential for production of a fertiliser for use on the kiwifruit orchards.

It is likely that Zespri will eventually proceed with some kind of project involving kiwifruit waste, but it is impossible to tell at the moment whether this would easily incorporate into a regional strategy for managing organic waste.

Were EBoP to discuss their proposed way forward with Zespri (once this is established), we believe that they would be interested in cooperating with a regional solution that could incorporate their fruit waste, as long as the end product is something that could be applied back to kiwifruit orchards.

---

[60] Scion (2008) "Waste 2 Gold – Feasibility Study for Zespri : Final Report" provided confidentially by Zespri Ltd

[61] Bioform Ltd (2010) "Eco-efficiency of the Zespri System: Distributed Biogas Production and Nutrient Recycling" provided in draft by Zespri ltd

7.0 Market Dynamics

This section presents an analysis of end-use markets for the 'recycled organic products' that might be generated from various organic waste processing scenarios.

For the purpose of this analysis, the 'recycled organic products' are grouped as the following two general products:

- solid and liquid soil amendments (i.e. composts, vermicomposts, various associated soil amendment blends, and anaerobic digestion (AD) digestate). These products are referred to as "compost-type products" for the purpose of this section; and
- energy generated from an AD process (i.e. biogas), or from technologies such as gasification and pyrolysis, or Scion's proprietary technology.

Compost, mulch, and various soil amendment blends (both liquid and solid) would be produced by all organic waste processing technologies (e.g. composting, vermicomposting and AD processes), whereas energy would be generated from AD or advanced thermal or chemical processes only.

Determining markets for these key recycled-organic outputs and products could constitute an entire separate study in itself. Given the necessarily limited scope of this study, a high-level analysis has instead been conducted which draws on findings from two previous Auckland-based studies and associated data[62]. Product benefits, potential demand, end-use markets and product value are discussed for the two organic-waste derived product groups. Previous research findings are summarised and statistics presented, in addition to a brief analysis of key market opportunities and potential risks relating to the Bay of Plenty region.

Ideally organic waste processing and collection systems should be driven by strong market demands, rather than from a waste management/minimisation impetus alone. This has not been the case in recent years however, where supply of waste materials appears to have out-weighed the demand for products[63].

The supply of organic waste materials in the region has been covered in earlier sections of this report. The five key organic waste streams generated in the region that have potential for more beneficial use are identified as wood processing wastes, food wastes, biosolids, green waste, fruit waste, and lake and sea weed. Together these amount to over 225,500 tonnes of organic waste per year.

---

[62] Two key research studies which investigated organic waste processing options and end-use markets are referenced in this section. These studies were commissioned in 2004 and 2009 by the Auckland Organic Waste Working Group (OWWG) which is made up of waste management council staff representing Auckland's councils. The reports are referenced in this section as: URS (2004). Regional Options for Food Waste Composting – Market Issues. Report prepared for the OWWG by URS Consulting; and Morrison Low (2009). Regional Organic Waste Report for Organic Waste Working Group - Investigation into Options for Beneficial Processing of Food Waste (2009). Unpublished. Report prepared for the OWWG by Morrison Low in association with Eunomia Research and Consulting Ltd.

[63] The decommissioning of Living Earth's biosolids composting operation in Wellington, and a greenwaste invessel-composting operation in Auckland (operated by Perry Environmental at Waitakere City Council's transfer station) are two examples where organic waste supply out-weighed the demand for the products. While it is noted that product demand was not the sole reason for these operations to cease, it was inevitably a contributing factor.

The demand for recycled organic waste products as a group must come from specific end-users, including farmers, land developers and energy users. Potential end-use markets for compost-type products and energy sources derived from organic wastes are discussed below.

It will be the demand and value that these end-use sectors ultimately place on the recycled-organic products that will help to make organic waste collections and processing systems become economically viable. The value that these end-users place on recycled-organic products relates to numerous factors, including existing market forces and product use (e.g. the comparative cost of artificial fertilisers and current farming practices and product use), product value and quality, and numerous political influences (e.g. regional, national or sector-based strategies that promote the use of compost-type products for soil health).

7.1 Product benefits

7.1.1 Compost-type product benefits

Compost-type products derived from recycled organic materials offer numerous benefits to soil health. These benefits are summarised as follows:

- Physical benefits (e.g. soil structure, moisture retention)
- Chemical benefits (e.g. pH, cation-exchange-capacity, nutrients)
- Biological benefits (e.g. beneficial soil micro-organisms, earthworms, disease suppression)[64].

The benefits soil amending products bring to soils will differ depending on numerous factors, including the type of product applied to the soil. For example, a liquid product will not necessarily provide the same structural and physical benefits as a solid compost product, but could instead offer other benefits in regards to potential soil microbiological improvements and/or application efficiencies.

Costs for synthetic fertilisers have been rising, with superphosphate increasing by 50% between April 2008 and June 2009[65]. If this trend continues, then there are potentially also cost benefits to be gained by supplementing fertiliser use with compost-type products.

7.1.2 Energy generation benefits

Generating energy from organic wastes through a centralised anaerobic digestion facility could generate a source of local energy that would benefit the key community the facility serves, or which could be fed into the grid or converted for use in vehicles. Energy generated from such a processing plant would bring both environmental and economic benefits,. Were a centralised anaerobic digestion plant to be developed within the Bay of Plenty region, the location of such a facility will dictate which communities potentially benefit from a locally-produced energy source.

[64] URS (2004). Regional Options for Food Waste Composting – Market Issues. Report prepared for the OWWG by URS Consulting

[65] Research carried out for the Organic Waste Working Group in 2009.

7.2 Potential Markets

7.2.1 Compost-type products

While there is scant data available on the demand for compost-type products in New Zealand, the largest market for these products is typically recognised to be in the agricultural and horticultural sectors. However, relative to the use of conventional fertilisers and soil amendments in these sectors, the use of compost-type products appears to be minimal.

Emerging regional and national pressures, such as those discussed earlier in this report, including water conservation and preserving soil health, might be expected to increase the demand from this sector for compost-type products over time.

In the 2004 research conducted on compost markets in the Auckland, Waikato and Bay of Plenty regions[66], approximately 20 end user groups were identified representing an extensive range of existing and potential markets for compost products. The end users range from domestic users of bagged compost, to fruit and vegetable farmers, to forestry. Local government also features as an existing and potential key user of compost products, for applications such as topsoil/soil amendments for road and construction work; landscape plantings in parks, reserves and cemeteries; landfill cover; or ground covering to retain moisture, reduce erosion and filter stormwater in civil construction works.

Markets that were considered to be small but have potential for growth and development included:

- horticulture
- organic farming
- bio-agricultural farming (a mixture of conventional and organic farming)
- forage and field crops
- Council's parks, reserves and public works departments - so long as the product meets council specifications then this option could provide a good starting market and relatively high-volume user for compost-type products. As with any compost product, appropriate land application methods would need to be followed to protect the health of workers handling the material and park/reserve users.

Existing markets that still offered potential for growth included kiwifruit and avocadoes, particularly given moves in the industry towards organic production. Recent discussions with organic waste processors in the Bay of Plenty and Auckland regions for this study regarding their existing target markets generally support these 2004 findings. These processors currently target specific horticultural sectors, in particular the kiwifruit sector, and view these as key markets with further potential to realise. The prevalence of growers in the Bay the Plenty region (in particular kiwifruit and avocado growers throughout most coastal areas of the region) are likely to provide a good longer term market. Quality controls would need to be high to ensure that products are sufficiently mature, pathogen free and contain acceptably low weed seeds.

Other horticultural crops, including corn and maize, were also identified by the 2004 study as being existing markets that have greater potential. While dairying is considered a small existing market for compost products, this sector is considered to be a large potential volume market for compost use in the future. Market optimism was also partly due to the stated

---

[66] URS (2004). Regional Options for Food Waste Composting – Market Issues. Report prepared for the OWWG by URS Consulting

intention of Fonterra to have a significant percentage of its contributing farms certified organic (URS, 2004). The Waikato region would be the likely market for such applications given the high presence of dairy farming in the Waikato compared to the Bay of Plenty region.

The residential market is generally accepted as being saturated. The product also needs to be bagged rather than sold in bulk.

Application to forests is another potential higher volume but lower cost market. This would most likely be an option for compost-type products containing biosolids but may not be overly profitable or useful for high-value composts. It is worth noting that forestry operators in the region have also commented on historical difficulties gaining consents to apply biosolids to forestry land.

7.2.1.1 Analysis of agricultural land and fertiliser use in Bay of Plenty

Specific statistics for the Bay of Plenty region are available from the 2002 and 2007 Agricultural Census results. The data from both are presented in Tables a, b and c in Appendix 7. Analysis of these results provides a general picture of the type of potential compost end-users in the Bay of Plenty region, given that compost-type products derived from organic wastes can supplement fertiliser use and agriculturally productive land can be targeted. It is noted that strong agricultural land-based markets also exist in areas outside of the region, such as within the adjacent Waikato region.

A comparison of the 2002 and 2007 data shows that total fertiliser use (i.e. annual tonnage per year for such compounds as urea, superphosphate and other nitrogen, phosphorus or potassium-based fertilisers) has increased across all seven BOP territorial authority areas over this five-year period. Fertiliser use is highest in the Western Bay of Plenty district and increased the most from a total of 45,061 tonnes in 2002 to 59,410 tonnes in the 2007 (representing a 32% increase).

Other key points are as follows:

- While the 2007 Census provided no data for the Kawerau District, the results for Rotorua, Western Bay of Plenty and the Whakatane districts all show large areas of land is used for grain, seed, fodder and general horticultural production.
- Significant land area is used in the Western Bay of Plenty District for general horticultural production (12,440 ha), compared to the national average (2390 ha per territorial authority). Horticultural land in this district is dominated by kiwifruit production, with a large number of kiwifruit farms in this district (1,497) which is the highest number across all other districts in New Zealand and significantly higher than the national average per territorial authority (77). Regionally, Western Bay of Plenty District has the highest number of farms per territorial authority (2,787), followed by Whakatane (420), Rotorua (279), Opotiki (267), and Tauranga (174). No data are available for Kawerau but given the nature of the district, it is very unlikely that there would be a significant number of kiwifruit farms in the area.
- Maize is a crop commonly grown in the Whakatane district, as shown by the 2002 and 2007 statistics which indicate the district has the highest number of 'grain' farms in the region as well as the largest land area used for 'grain, seed and fodder cropland'.
- Rotorua and Western Bay of Plenty districts have the highest levels of fertiliser use across the region (followed by Whakatane), with the majority of products being used at quantities similar to national averages. Urea and phosphate fertilisers are used at higher levels in Rotorua compared to the rest of the region's districts and the national average. Given the high number of farms and area used for agricultural production

(and associated fertiliser use), these two districts (Rotorua and Western Bay of Plenty) would be key areas to target for compost-type product sales.

The statistics regarding fertiliser use in each of the region's districts correlate generally with agricultural land production area and farm numbers. The relatively large fertiliser usage shown for the five districts indicates that the soils within these districts are likely to have been heavily worked and the original nutritional value depleted. The ability of compost application to reduce chemical fertiliser use, and the resulting cost reduction, is likely to appeal to both organic and non-organic farmers within these areas.

7.2.2 Energy generation markets

As outlined earlier in section 1.3.4.3, an increase in regional energy production has been identified as an economic development priority. Although the production of fuel has been included as an area for development, the draft strategy currently under consultation identified wood wastes as a key source for production of transport fuels. There is no further detail provided as to how the wood wastes are to be converted into transport fuels.

This does suggest however that the production of biogas (which could have an end use as a transport fuel, among other potential uses) could also achieve the desired outcomes for the region, and therefore there does appear to be a regional strategic demand for local energy generation through waste processing.

The energy source generated from an anaerobic digestion process is biogas, which is a mixture of mainly methane and carbon dioxide with small amounts of water vapour, nitrogen, hydrogen sulphide, and traces of volatile organic acids. Typical production rates are 111 m_3/tonne wet food waste[67]. The potential markets for this energy source will therefore depend on the physical location of the facility given the need to, ideally, utilise the energy locally.

According to the 2009 OWWG report, possible uses for biogas are:

- Replacement of fossil fuel in burners for boilers, heaters, dryers.
- Clean up of the gas to pipeline quality and injection into the natural gas "grid".
- Clean up of the gas to pipeline quality and use as vehicle fuel (CNG).

Depending on the scale of the facility, the biogas can also be converted into an electricity source using co-generation. This option, together with the piped natural gas and CNG options listed above, are relatively capital intensive. The necessity to site a facility near an industrial or commercial operation that can directly utilise the bio-gas supply as a substitute for fossil fuel is therefore important.

7.3 Product value

7.3.1 Compost-type products

The value of compost-type products will vary considerably around the country, depending on the balance between supply and demand as discussed above. As an indication, high quality compost produced from waste can have a value of up to $80 per m^3, although around $30 to $40 per m^3 could be considered an average value[68]. Understandably, these rates may be

[67] Morrison Low and Eunomia, research carried out for the OWWG, 2009

[68] As above

lower for some bulk markets. Additional costs may be incurred for some products where new markets must be developed.

The 2004 OWWG composting study included an inventory of compost and vermicompost product types and values. The prices listed below demonstrate the potential increase in value from combining standard composting with vermicomposting practices (URS, 2004).

- Unscreened Organic (BioGro) Compost $35/m³
- Screened Organic (BioGro) Compost $39/m³
- Revital Compost 10 (90 % Compost, 10 % Vermicast) $56.75/m³
- Revital Compost 20 (80 % Compost, 20 % Vermicast) $73.00/m³
- Revital Compost 30 (70 % Compost, 30 % Vermicast) $86.20/m³
- Revital Vermicast $208.00/m³.

A local vermicast supplier is receiving around $350 per tonne for their product; and other producers were being paid up to $400 per tonne by farmers and market gardeners[69].

While product quality standards (i.e. NZ Compost Standard NZ:4454 and BioGro Compost Standard) have been developed for New Zealand in recent years with the intention to maximise the range and value of markets for compost-type products, it is noted that the New Zealand Compost Standard is not widely used by compost processors as it does not as yet have an official accreditation process in place[70]. In the absence of achieving a product quality standard, the value of New Zealand compost-type products are therefore instead typically influenced by the processing controls and techniques used (e.g. temperature monitoring, vermicomposting stage), types of input feedstocks, performance data and marketing information, the reputation of producer, etc. Anecdotal feedback from compost suppliers nationally indicates that one factor that can influence the product value and public perception significantly is accreditation to a standard such as BioGro – even though the consumer is probably not a certified organic producer themselves. BioGro appears to have more consistent brand recognition and positive perception than the NZ Compost Standard.

The type of waste used as feedstock will have a significant impact on potential markets and product value, as will the amount and type of contamination present. This is particularly an issue with biosolids - heavy metals, persistent pesticide residues, or pathogenic contamination in processed biosolids will limit its applications, aside from other social and/or cultural perceptions that may also place additional barriers to its use. This potentially limits the use of a product using biosolids as the feedstock to stock food or non-food plant uses; generally high volume and low value markets.

Plastic or other inorganic contamination in compost-type products (if not removed upfront or screened out after processing) will also affect the appearance of the compost product and its marketability, as would the presence of live weed seeds if adequate temperatures were not achieved during the hot-composting stage.

7.3.2 Energy value

The economic value attributed to biogas generated from an anaerobic digestion process will depend on the use it is put to (i.e. biogas used for direct heating, piped as a natural gas, used as a compressed natural gas fuel, or converted to electricity) and the price of the alternative.

---

[69] Personal communication with Greg Walker, WormTech, and Colin McPike, Organic Waste Solutions.

[70] Personal communication with Jonathan Hannon, Compost NZ, WasteMINZ Sector Group.

Use as a direct replacement fuel in a burner for producing steam or heat requires little in the way of treatment, apart from removal of free water droplets and particulates. Assuming a natural gas price of $20/GJ, 1 m^3 biogas has a value of approximately 47.4 cents if used to replace natural gas[71].

One cubic metre of biogas will produce about 2.2 kWh of electricity worth about 40 cents at retail prices[72]. Biogas, however, normally requires removal of hydrogen sulphide to less than 200ppmv before it can be used in a co-generating engine.

In order to be used as vehicle fuel (i.e. CNG), biogas need to be cleaned of nearly all other gases except methane, compressed to about 2000 PSI pressure, and stored at that pressure. The overall cost of such a facility is dependent on the scale, and commercial adoption has been largely restricted to a few EU countries where significant government subsidies make it financially viable. It is commonly accepted that a petrol price of about $2.20/litre is required for financial viability[73].

7.4 Market risks

Aside from organic waste collection and processing factors, the market development of compost-type products in the region will be dependent on a range of factors, including:

- product quality and reputation of processor
- suitability of input feedstocks when used for various applications (i.e. biosolids-derived composts compared to food waste)
- distance to markets
- ability of products to be accepted by end-users as a substitute or supplement for conventional fertilisers.

Risks associated with establishing markets for energy generated from AD will relate primarily to the location of the facility and the associated local energy demands.

7.5 Market analysis summary

It is expected that the strongest markets in the Bay of Plenty region for compost-type products will be within the horticultural sectors – specifically kiwifruit growers. Based on agricultural production statistics, the key horticultural markets are located in the Western Bay of Plenty, Rotorua, and Whakatane districts, although it is recognised that the adjacent Waikato region is likely to have strong market potential also.

Previous research has also highlighted local government as being a key end-user of compost-type products (e.g. parks, reserves, civil construction, erosion control applications etc). While these local government markets may require relatively high-volumes of product, they are unlikely to provide the same income level as other higher-value horticultural applications.

It is noted that compost-products derived from biosolids may have more limited applications depending on the processing technique used, quality of inputs and community acceptance of the product.

---

[71] Research carried out for the OWWG, 2009, Eunomia and Morrison Low

[72] Research carried out for the OWWG, 2009, Eunomia and Morrison Low

[73] Research carried out for the OWWG, 2009, Eunomia and Morrison Low

Depending on the location of an anaerobic digestion facility, markets for the energy produced from the facility will be either via the direct use of biogas at the site's location or would require more capital-intensive measures in order to produce electricity or fuel.

8.0 Overview of Procurement Models

The current lack of facilities for processing organic waste in the region is a significant barrier to increased diversion, and therefore increasing the processing potential in the region or nearby is essential before more organic wastes can be diverted from landfill.

There are a variety of models for procurement of organic waste processing facilities, ranging from very little public sector involvement to complete public sector ownership. A range of scenarios are discussed here, ordered in terms of public sector involvement (from minimal to maximum).

This discussion focuses on the procurement of fairly large-scale organic waste processing facilities, which could be used by both the public and private sectors within the region. The discussion does not extend to the procurement processes by which individual parties (such as a waste producer like Fonterra) might access these facilities on an ongoing basis at an agreed gate fee.

8.1 Free Market Approach

This is essentially what currently exists in the region. There is little strategic influence from government (national, regional or local) on organic waste processing facilities, beyond the requirement for the regional authority to give consent for various facilities and to enforce compliance with these consents.

There is little partnership working in the private sector, although the joint venture between Norske Skog and Carter Holt Harvey at the Tasman site in Kawerau is a notable exception to this.

Waste producers generally identify waste streams that require managing and then identify the most economical option available in the open market to manage those wastes. Although some companies such as Fonterra are beginning to approach waste management on a national level, this work is still at fairly early stages and the capital investment required to upgrade plant and machinery means that changes to processes producing wastes and the way those wastes are managed changes slowly. In many cases, the poor relative economics of diverting organic wastes from landfill may mean that organic waste streams are instead combined with residual waste and landfilled. This is the case even with large organic waste producers, such as Norske Skog and Carter Holt Harvey.

Waste processors (which in some cases may be the territorial authority) respond to the requirements of waste producers, but are beginning to approach waste management more strategically across the region and between regions. The increasing presence of large national companies, such as Transpacific International who have significantly increased their involvement in biosolids and waste water treatment in the region through acquisition, has meant that higher capital investment is under consideration when new facilities are constructed in the region.

Under this approach, locating waste facilities is initially the role of the waste processor, with the regional council only having the opportunity to approve or deny the resource consent application. There is little opportunity for the regional council and the private waste sector to work together strategically to locate waste facilities and identify optimum locations for facilities in the region. There is also little support for waste processors who seek to establish organic waste processing facilities in the region; as these consent applications are treated the same as any other application even though there are potentially significant benefits for the region.

8.2 Free Market Approach - Clear Strategic Framework

One option for EBoP to pursue in the short term is to establish a clear strategy for organic waste management (or indeed waste management in general) within the region. This strategy could make it clear which solutions EBoP prefer, and provide an informative basis for waste processors to design and locate their facilities in the region.

An organic waste management strategy could be based on the information set out in this report; although ideally this would be a wider strategy addressing all waste streams. It would not necessarily prevent applications that do not strictly fit within the framework for types and locations of required facilities in the region (particularly as some may be designed with inter-regional waste movement in mind) but this would provide a transparent basis on which the private sector and territorial authorities can base their plans and subsequent resource consent applications.

It may worth investigating whether it is possible for the regional council to prioritise resource consent applications that contribute to the delivery of the regional waste management strategy.

Beyond the strategic framework, it is left to the market to deliver the requirements outlined. These needs may be met by a territorial authority or by the private waste management sector, or as a partnership between the two which could also include the regional council (public private partnerships are discussed in more detail below). The clear disadvantage with this approach is a relative lack of control over what actually happens – the private sector may well have different priorities to EBoP, and so may not act to fulfil the key objectives set by the strategic framework. This is in essence the flip side of the same coin – that this approach does not require significant action by EBoP.

8.3 Regional Strategic Framework – Local Procurement

A further step once a regional strategic framework has been completed is for territorial authorities to then take the lead in procuring the necessary organic waste processing facilities. Territorial authorities could be supported by the regional council in developing specifications and procurement models for the facilities.

This procurement process in itself could take a number of forms.

8.3.1 Traditional Procurement

This approach aligns with the common current approach to contract out waste services. These contracts are usually based on the civil engineering contract[74] NZS3910 – although the MfE's *Guidance Principles: Best Practice for Recycling and Waste Management Contracts* (2007) notes that this has "shortcomings for waste and recycling contracts".

The territorial authority, as the contracting party, would take the regional organic waste strategy and from this develop the basic parameters and scope of the service(s) to be provided. Contracts for processing facilities would usually be for a reasonably lengthy period, e.g. 8 to 15 years.

Once responses to the tender process have been received, offers from the market would be assessed against the agreed evaluation criteria and a decision made.

---

[74] NZS 3910 - Ministry for the Environment (2007) *"Guidance Principles: Best Practice for Recycling and Waste Management Contracts"* working draft available at www.mfe.govt.nz

This is obviously a very simplified description of the process, and within this there is potential for much variation and the inclusion of 'partnering' or 'alliancing' approaches - however the basic steps taken remain the same.

The disadvantage is that it is next to impossible to consider all eventualities particularly in an emerging field such as organic waste processing, and allow for these in the specifications. A facility of this kind will also probably accept wastes from customers other than the territorial authority, and so agreements on income and risk sharing are necessary.

This procurement and contract model is more suited to a service contract, rather than one which requires significant financial investment from one or both parties. Where more significant financial investment is required, a more formal partnership approach is more likely; as in the following examples.

8.3.2 Public-Private Partnerships

These partnerships usually revolve around the form of financial investment that the private sector partner is making. These can include build, own, operate and transfer (BOOT) and design, build, own/operate (DBO) contracts.

The advantage of these contracts for a local authority is the private sector investment that can be accessed, based on the certainty of a long term consistent income. Contracts can be very tightly specified, or can be more outputs-based in which case the private sector is asked to propose their favoured technology to achieve the outputs required.

To attract reasonable investment from the private sector, BOOT and similar styles of contracts need to be longer than most current waste management service contracts. In a recent New Zealand example Auckland City Council and Manukau City Council signed a 14 year BOOT contract with Visy.

One risk with a contract of this nature is that the councils involved are essentially confined to the technology that's chosen when the contract is tendered. Although some variation can be allowed for in the contract documents (such as modifications to allow the inclusion of new materials in a MRF) the basic technology remains the same and this also dictates the collection methodology used.

For this reason, it is essential that the procurement is backed by a well-researched and developed strategic framework.

It can also be a risk to enter in to a contract based on a technology that has not been proven locally, and so the technologies involved in these contracts have usually been in use for some time and are no longer at the cutting edge of innovation.

8.3.3 Council-controlled organisations

For some territorial authorities (TAs), contracting is almost coming full circle with services being delivered on a reactive basis and closely managed in-house. Some TAs in New Zealand have short-cut that circle, and still provide services through a business unit or directly in-house. There are a range of options, with varying levels of management and financial involvement in the operation of the organisation involved.

Council-controlled organisations (CCOs) can be for-profit or non-profit, but the TA must have a controlling share in the organisation, whether through voting rights or management. A council-controlled organisation which is intended to make a profit is termed a council-controlled trading organisation. The advantages of in-house services, or a CCO, are similar to those of a cost-plus arrangement, with the added responsibilities of health and safety, staff management and maintenance of vehicles and facilities.

Transwaste Canterbury Ltd, operating the Kate Valley landfill, is a good example of a council-controlled organisation where the 'council' holding a 50% share is in fact a group of TAs from the Canterbury Region.

The Royal Commission review of Auckland region governance recommended that waste management for the new Auckland Council would be best delivered through a CCO[75].

There is little public appetite for local authorities to provide perceived 'high-risk' services or facilities through such a direct relationship such as a CCO, and councils are also seen as being poor at achieving commercial objectives and at making a profit. This perception could make life difficult for a TA that is keen on a more unusual waste management solution but also wants to retain the control and flexibility that a CCO arrangement provides – and for this reason they may often end up in a BOOT or design-build-operate arrangement instead.

8.4 Regional strategic framework – Regional Procurement

All of the above procurement models could also be followed with EBoP and the TAs procuring one or more organic waste processing facilities jointly, for the region as a whole.

Once again this would require a very well-researched and developed organic waste strategy, that took in to account the existing commitments of the various TAs in the region – such as Rotorua District Council's partnership with Scion, and Whakatane District Council's plans for a windrow composting facility near Whakatane.

8.5 Funding Options

Funding the construction of an organic waste processing facility depends largely on the procurement process followed.

With most public/private sector procurement arrangements, the initial investment is essentially made by the supplier, although charges to the public sector and other clients will be geared to recover both that investment and any financing costs involved.

The exception to this is a council-controlled organisation, where the public sector partners provide a proportion of the investment and retain an ongoing financial interest in the facility during its life.

In general, funding options for facilities like these are restricted to:

- Funding from within public sector budgets – approved through long term council community plans and confirmed through annual plans
- Funding from ring-fenced waste management funds – such as the proportion of the Waste Levy which is returned to territorial authorities on a per-capita basis
- Borrowing funds, with the cost of finance serviced by public sector budgets
- Applying for funding from central government, through the contestable Waste Minimisation Fund (next round expected in late 2010);

Or, where there is no public sector involvement in the process of locating and building a facility –

- Borrowing funds, with the cost of finance recovered through gate fees charged to any private or public sector customer using the facility.

---

75 www.royalcommission.govt.nz/web/part4/21_council_organisations_and_council_controlled_organisations.html

8.6 Conclusions

The procurement and funding route chosen will depend on a number of factors including the strategic approach that is decided upon by EBoP. Until further decisions are made on which options to pursue and how these are integrated with strategic priorities such as waste minimisation, and soil and groundwater quality it is not possible to recommend any particular approach to procurement.

9.0 Options

9.1 Key Waste Streams to Target

The key waste streams are discussed in detail in section 4.0 of this report.

Waste streams have been prioritised based on:

- Volume
- Environmental harm
- Achievability - alternative options, relative cost
- Public concern

The priority waste streams identified are:

- Wood processing waste – 117,000 tonnes per annum to landfill
- Putrescible waste – 22,000 tonnes per annum to landfill
- Biosolids – at least 20,000 tonnes per annum to landfill
- Green waste – 16,000 tonnes per annum to landfill
- Fruit waste – 45,000 tonnes per annum largely to stock food
- Lake- and sea-weed – 5,500 tonnes intermittently, largely to land

9.1.1 Summary of each waste stream

Wood processing waste is the largest single waste stream by far, although it is less damaging in landfills than putrescible and biosolid wastes. It presents significant advantages as it is produced within a small geographical area, only a small number of waste producers are involved, there is available space for processing, and the waste producers are reasonably motivated to find an alternative to landfill disposal (economics dependent).

Food waste is more damaging in landfills than the wood processing waste; however as a waste stream it is much smaller and diverting this waste from landfill would require all the territorial authorities in the region to introduce some form of organic waste collection scheme.

Biosolids are also quite a damaging material in landfills, and would be easier to divert from landfill than food wastes. However, biosolids present additional challenges in producing a valuable end product and cultural/social issues would need to be investigated further.

Green waste is relatively inert in landfills compared to the various putrescible wastes, and a fair proportion of this is already diverted from landfill. Increasing this proportion would be challenging particularly as cleanfill management is a key issue.

Fruit waste is the second largest waste stream, but is not presently being disposed of to landfill. However the waste producers are motivated to find more productive ways to manage this waste.

Lake and sea weed is not a high volume waste stream, and little of this waste is currently going to landfill. However public concern is high and there is potential for this waste stream to increase in future.

9.1.2 Prioritising waste streams

Based on our analysis of the waste streams by the criteria above, we believe that the order in which the waste streams are presented above is the rough order of priority.

However it should be noted that for technical reasons, prioritising the wastes in this way does not necessarily exclude any of them from a future processing system. These reasons are discussed later in this section however one key reason is that the largest waste stream, wood processing waste, requires a balance of nitrogen-rich wastes to easily process this into a useful product. Assuming that this may be in the ratio of 3:2 or 2:1; this would suggest that processing the entire 117,000 tonnes of wood processing waste would require at least 39,000 to 58,500 tonnes of other wastes – potentially the entire remaining organic waste stream from the region.

9.2 Processing Options Overview

Processing options are discussed in detail in section 6, and in Appendices 3 and 4.

There exist a number of technologies that are capable of processing a mix of the above identified priority waste streams. In practical terms in-vessel composting systems that process the material aerobically are the most well-established in New Zealand. They are likely to be the most 'bankable' for processing a mixed organic stream, as they are the best proven and consequently have the lowest risk attached. There may however be a number of feedstock issues that mean that other technology options need to be considered – at least for certain elements of the organic waste stream. In particular, aerobic systems require structural material such as woody garden wastes to ensure sufficient airflow through the composting pile. The wood processing wastes, which make up the largest proportion of the organic wastes to landfill identified in this study, have high carbon content but are not likely to be sufficiently structural to process alongside solely putrescible material in an aerobic system.

Processing the nitrogen rich material (including putrescibles, biosolids, fruit waste and lake/sea weed) in aerobic systems would require more than the 20,000 tonnes of green waste currently being sent to landfill (and indeed more than the entire 32,000 tonnes of green waste identified as being available in the region).

This means that if all of the organic waste streams identified are to be diverted from landfill other processing options such as vermicomposting, anaerobic digestion and potentially gasification or pyrolysis may need to be considered. However, the wood processing waste is high in lignin and is not suitable for an anaerobic digestion system.

Currently, trials are underway for the wood processing waste focusing on vermicomposting. Basic windrow composting has also been tested, but due to the lack of structure in the material it has not been very successful to date.

9.3 Processing Scenarios

Based on the key factors that have been identified in this report, three scenarios have been developed for organic waste processing in the Bay of Plenty. These scenarios represent three broad, practical approaches to take forward organic waste management in the region. The scenarios are not exhaustive, and there are a number of potential variations within each. They should be taken to be indicative rather than absolute options for how the organic waste agenda could be progressed. In brief they are as follows:

- Scenario 1: centralised vermicomposting
- Scenario 2: centralised anaerobic digestion

- Scenario 3: Several Strategically Located Systems

These scenarios are discussed further in the following subsections. Simple high level costings are presented for each of the scenarios. Undertaking detailed costings was outside the scope of the current report and so those presented here should be taken as indicative only. The costings include operational and capital costs and indicative transport costs. They do not include costs of land, consent costs, income from sale of products, or operator profit. The costings are based on discussions with industry operators as well as on information held by Eunomia from other studies we have undertaken.

9.3.1 Scenario 1: Centralised Vermicomposting

This scenario is targeted at dealing with the largest organic stream: wood processing waste, alongside other putrescible streams.

Scenario 1 is essentially the same scenario that was taken forward in a funding application to the Waste Minimisation Fund. The key features are discussed in the following subsections:

9.3.1.1 Location

There are two possibilities for sites for this scenario: one is at the CHH/Norske Skog site, and the other is at the Whakatane District Council site in Awakeri where WDC plan to locate a number of waste facilities including a composting operation. Both are located in relatively close proximity and have similar advantages in terms of space, access to feedstocks, and access to transport links (including rail).

9.3.1.2 Materials targeted

This scenario targets the largest quantities of waste of any of the scenarios. Its key feature is that it includes wood processing wastes from the Tasman (Kawerau) and Whakatane mills, which represent the largest organic waste streams in the region. In addition most putrescible wastes are able to be incorporated into the process.

Key waste streams	tonnage breakdown	Source/Location
Wood processing waste - primary solids	43,000	Kawerau
Wood processing waste - secondary solids	48,000	Kawerau
Fibre production waste	1,000	Kawerau
Fibre production waste	6,000	Whakatane
Subtotal wood fibre	*98,000*	
untreated timber	4,500	General
Bark and wood waste	10,000	Whakatane
Subtotal timber and bark	*14,500*	
Biosolids	20,000	general

Food waste	22,500	general
Fruit waste	45,000	general
Sea/lake weed	5,500	Half Rotorua and remainder coastal
Subtotal putrescibles	*93,000*	
Total	**205,500**	

9.3.2 Processing technology

The material would be vermicomposted. As discussed, vermicomposting has a number of unique features which mean it is the most suitable technology to process the mix of waste streams noted above. In particular it does not require high levels of structural material (although some is required to avoid anaerobic conditions developing). This is critical as there would appear from our investigations to be insufficient structural material readily available to enable aerobic composting of the above materials. Also, unlike anaerobic digestion, vermicomposting is able to handle the high lignin content of the wood processing wastes.

The climate in the Bay of Plenty is appropriate for vermicomposting, and a number of smaller facilities already exist in the area.

The potential difficulties with vermicomposting are that a larger scale facility does not yet exist in New Zealand, and is relatively uncommon internationally. However there is significant local expertise, the technologies are currently being trialled in the area, and it is a technology that could have wide application throughout New Zealand for organic wastes.

For the purposes of developing costs we have assumed a relatively low-tech approach utilising open air windrows. As it is potentially a very large operation we have assumed a relatively high level of control will be required over site impacts such as leachate, odour and vermin, and that this will require the use of hard standing, leachate collection and treatment, windrow covers, as well as ancillary equipment such as blending, feeding, and screening equipment. Buildings on site may include reception areas, storage areas for processed material, and administration areas

9.3.3 Capital costs

9.3.4 Annual operating costs/gate fees

Gate fees which would cover all capital and operating costs, but which make no allowance for income from sale of materials, would be expected to be in the order of $40-$60 per tonne. If stable markets are able to be established this cost may come down, particularly as vermicompost products such as vermicasts and vermiliquid can potentially achieve high prices in the market due to their high levels of nutrient availability.

At the above gate fees annual costs for a facility capable of processing 200,000 tonnes per annum would be in the order of $8,000,000 to $12,000,000.

It is likely however that not all of the materials identified above would be captured by the facility. A smaller facility processing in the order of 125,000 tonnes per annum would have annual costs of between $5,000,000 and $7,500,000.

9.3.5 Transport costs

Although the facilities would potentially be located close to the largest single source of materials (the wood processing wastes), the other materials such as food and fruit wastes, and biosolids would require transporting to the facility. This is equivalent to approximately half of the material that would be processed by the facility. Rough order costs were modelled for road transport[76] of these materials from Tauranga/Western Bay of Plenty, Rotorua, Whakatane, and Opotiki.

Transport costs for 100,000 tonnes of material from throughout the Bay of Plenty to Kawerau would be in the order of $1,500,000 – equivalent to approximately $15 per tonne.

9.3.6 Discussion

This scenario is highly contingent on CHH/Norske Skog's involvement and ongoing commitment to the project, particularly in financial terms. CHH and Norske Skog are currently disposing of the material in their private landfill at a nominal operational cost of $6 per tonne. They are likely to view a gate fee of up to 10 times their current costs as not economically viable, and so for the project to proceed may require significant negotiation around gates fees, ownership, use of the site etc. As a gate fee of $40 is very cost competitive with landfill and other processing options there may be an opportunity to transfer some of the costs onto the gate fees charged for other materials taken to the site in order to provide a discount to CHH/Norske Skog.

The most compatible collection systems for organic wastes under this scenario would be separate food and garden waste collections with the food wastes transported to the central facility and the garden waste processed locally in low cost windrows.

9.3.7 Scenario 2: Centralised anaerobic digestion

In the event that CHH/Norske Skog do not wish to commit to the scenario 1 vermicomposting project (or similar), one other option is to aim to process putrescible material (food waste, biosolids, fruit wastes etc) through anaerobic digestion (AD). AD is a potentially suitable technology for these waste streams as it does not require the addition of bulking agents (which, as has been noted, are in relatively short supply in the region). If an AD process is to be procured, it is most likely that the relatively high capital cost and the need for economies of scale would mean that a centralised facility would be most viable. In this scenario green waste would be processed at local windrow based facilities. These local facilities are assumed to be privately operated and have not been included in the modelling.

9.3.7.1 Location

The location for this facility will logically be near where the largest sources of the materials are. Our analysis suggests that excluding the wood processing wastes, about 2/3 of the material that is likely to be appropriate for anaerobic digestion is in the Tauranga/Western Bay of Plenty area. Locating the facility in the south-eastern part of this area is likely to be most efficient in terms of reducing transport distances and costs for materials. No specific sites have been identified but this is the approximate location that has been assumed in the modelling.

---

[76] It is noted that the sites have easy access to rail transport and this is likely to be an option for bulk haulage of material to the site, particularly as there is an opportunity to 'back load' material onto rail cars taking products from the mills. This option has not been investigated further at this time however.

9.3.7.2 Materials targeted

This scenario targets the putrescible streams. It includes the following streams.

Key waste streams	tonnage breakdown	Source/Location
Biosolids	20,000	general
Food waste	22,500	general
Fruit waste	45,000	general
Sea/lake weed	5,500	Predominantly Rotorua and coastal areas
Total	**93,000**	

9.3.8 Processing technology

A 'wet' process AD technology has been assumed for this scenario. This type of technology does not require any structural material and so is well suited to the putrescible streams noted above.

Although AD technology is well proven world wide there are no plants of significant scale in New Zealand and so supply and support for the technology is limited.

In modelling the technology we have assumed two facility sizes: 90,000 tonnes and 60,000 tonnes. These options represent maximum and mid-level captures for the putrescible material. Both facilities cover sites works, reception areas and buildings, digestors and control equipment, ancillary equipment including weighbridge and loader, design and commissioning. No allowance is made for on-site generation or gas clean up plant and equipment.

9.3.9 Capital costs

Capital costs for a 90,000 tonne facility would be in the order of $35 million, while capital costs for a 60,000 tonne facility would be in the order of $26 million.

9.3.10 Annual operating costs/gate fees

Gate fees which would cover all capital and operating costs, but which make no allowance for income from sale of outputs could be expected to be in the order of $90 per tonne. If stable markets are able to be established this cost may come down. There is potential income from energy generated from the bio-gas as well as sale of the liquid and solid digestate outputs (although these may require further processing or mixing with greenwaste compost materials)

Annual costs for a facility capable of processing 90,000 tonnes per annum would be in the order of $8,100,000.

It is likely however that not all of the materials identified above would be captured by the facility. A smaller facility processing in the order of 60,000 tonnes per annum would have annual costs of approximately $5,000,000.

9.3.11 Transport costs

Although the facilities would potentially be located close to the largest sources of materials, other materials from other parts of the region such as food and fruit wastes, and biosolids would require transporting to the facility. This is equivalent to approximately a third of the material that would be processed by the facility. Rough order costs were modelled for road transport[77] of these materials to Tauranga/Western Bay of Plenty from Rotorua, Whakatane, and Opotiki.

Transport costs for 30,000 tonnes of material from throughout the Bay of Plenty to Western Bay of Plenty would be in the order of $550,000 – equivalent to approximately $18.50 per tonne.

9.3.12 Discussion

Procurement of a central facility is likely to require a high level of involvement from the public sector to initiate and may require ongoing public sector involvement.

Establishing stable markets for the process outputs is also likely to be a key factor in making this a viable option.

It should also be noted that while the capital and operating costs for this type of technology are relatively high, it does not require structural material such as green waste. This can be processed more economically in local windrow operations. This is likely to improve the economics in terms of overall system costs.

The most compatible collection systems for organic wastes under this scenario would be separate food and garden waste collections with the food wastes transported to the central facility and the garden waste processed locally in low cost windrows.

9.3.13 Scenario 3: Several strategically located systems

This scenario envisages a number of systems located throughout the region each with a smaller catchment, and building to a large extent on existing initiatives. Suggested locations for the facilities would be Whakatane, Tauranga/WBoP, and Rotorua. Different technologies could be employed at each of the facilities depending on the waste streams targeted in the area and the parties involved.

For the purposes of the current exercise it is assumed that the facility planned by Whakatane District Council at Awakeri proceeds and is capable of handling organic wastes from the Whakatane, Opotiki and Kawerau (excluding wood processing waste) catchments. Similarly Rotorua District Council are working on a technology with Scion research for processing biosolids and potentially other putrescible material. It is assumed that this project proceeds to operational status and that green waste is processed locally in simple windrow systems.

This leaves the Tauranga and Western Bay of Plenty area as the area requiring additional processing capacity for putrescible materials. This scenario therefore focuses on development of a single facility for this part of the region.

9.3.13.1 Location

No specific site has been identified for this facility. It has been assumed the facility could be located somewhere between Tauranaga and Te Puke.

---

[77] It is noted that the sites have easy access to rail transport and this is likely to be an option for bulk haulage of material to the site, particularly as there is an opportunity to 'back load' material onto rail cars taking products from the mills. This option has not been investigated further at this time however.

9.3.13.2 Materials targeted

This scenario targets both the putrescible and garden waste streams. It includes the following :

Key waste streams	tonnage breakdown	Source/Location
Biosolids	23,000	general
Food waste	9,000	general
Garden waste	6,000	general
Sea/lake weed	1,000	coastal
Additional garden waste	10,000	households
Total	**49,000**	

9.3.14 Processing technology

A 'tunnel' type system is modelled for this scenario. This is one of the more cost effective processing technologies and is relatively well proven in New Zealand with large facilities in Wellington and Christchurch. There are many other types of aerobic in-vessel composting systems however which may perform at least as well, and these should be investigated if it is decided to proceed with this scenario.

The tunnel type systems require a mix of at least 50% garden waste or similar to provide sufficient bulking agents to keep the process aerobic. Garden waste and putrescible input material is mixed to provide a consistent blend, and then fed into the tunnels – usually with a front end loader. The tunnels are then sealed and the material is kept aerated through vents in the floor. Temperature and moisture are monitored through probes, and any leachate drained off and collected for treatment. Exhaust gases are usually treated through a biofilter. Material is kept in the tunnels to undergo primary composting (usually for 3-4 weeks) before being removed and left to cure in windrows.

The need for structural material is likely to pose a constraint on the size of the facility. Our analysis suggests there would be insufficient bulking agent to be able to process fruit wastes, and if biosolids are targeted additional sources of bulking agent are likely to be required. On the assumption that additional structural material could be found (potentially brought in from existing windrow processes, or from other areas such as Rotorua) a facility size of 60,000 tonnes is modelled. This size of facility should be capable of handling most of the food and biosolids generated in the area (but not fruit wastes).

9.3.15 Capital costs

Capital costs for a 60,000 tonne facility would be in the order of $11.5 million.

9.3.16 Annual operating costs/gate fees

Gate fees which would cover all capital and operating costs, but which make no allowance for income from sale of outputs could be expected to be in the order of $80 per tonne. If stable markets are able to be established this cost may come down. There may be issues with markets for composts made from biosolids.

A facility processing in the order of 60,000 tonnes per annum would have annual costs of just under $5,000,000.

9.3.17 Transport costs

The facility would be located in reasonable proximity to most sources of materials (unless materials are transported from outside the district). Transport costs would therefore be relatively minimal and would be expected to be less than $200,000 or about $3.30 per tonne.

9.3.18 Discussion

This type of facility could be procured either with a high level of public sector involvement or potentially by working with a private sector operator that wishes to establish a similar type of facility in the area.

As with the other scenarios, establishing stable markets for the process outputs is also likely to be a key factor is making this a viable option.

Compatible collection systems for organic wastes under this scenario could be either separate food and garden waste collections or comingled food and garden collections. Whichever system, as a large quantity of garden waste is required, it would be logical to offer 'free' (ie not user pays) garden waste collections in order to maximise the capture of this material and ensure sufficient structural material for the process.

10.0 Summary and Recommendations

This study has concluded that there is a large amount of organic wastes currently going to landfill in the Bay of Plenty region, or transported out of the region for disposal. There are however few processing facilities in or near the region that could divert organic wastes from landfill.

Therefore, although there is significant potential to reduce waste to landfill in the region by diverting organic wastes, this could only be achieved to any large extent by the establishment of an additional facility, or facilities, in or near the region. Any facility that is established would need to be suitable for the priority organic waste streams that have been identified through this study, and would need to address the regional and national issues identified here with respect to marketing the end product.

Recommendations have been grouped into

a) Immediate and relatively straightforward actions that can be largely completed by the parties involved in this study; and

b) More strategic actions that may require the involvement of others, both public and private sector.

If the status quo continues, it is unlikely that significant amounts of organic wastes will be diverted from landfill in the short term. There is also the chance that facilities could be developed by the public or private sector that do not address the priority issues or waste streams identified in this study.

10.1 Short-term Recommendations

10.1.1 Informing and guiding organic waste management

We have become aware through the research for this study that there are a large number of public and private sector organisations that are at various stages in planning organic waste processing facilities for the region. Currently, these facilities are being planned in a near vacuum of strategic leadership and openly available information about organic wastes in the region.

We consider it would be advantageous for the information in this report is released, at least in a summary form, to the public and private sectors to inform their plans.

Ideally this would be supported with a brief statement from those involved in this project on their preference for organic waste management in the future.

10.1.2 Consents

A number of organisations who were interviewed for this study commented that they may have extended their existing organic waste management activities, or instigated new projects, were the consenting process more straightforward. Some of those involved in organic waste management nationally have a view that the Bay of Plenty region is one in which it is more difficult and time-consuming to gain consents for organic waste processing facilities or similar.

While it is not being suggested that EBoP should be more lenient on those who intend to divert organic waste from landfill, it does seem that there is potential for a more proactive and expedient approach to the consenting process, where facilities are planned that are in line with the region's strategic objectives for organic waste.

Closer working between those involved in consents at EBoP and the waste management officers may be all that is required to achieve more efficient outcomes in the consenting process.

10.1.3 Strategic Coordination

It was noteworthy that although many EBoP strategies and plans mention the harmful effects that soluble synthetic fertilisers can have on soil and water quality in the region, there is very little mention of the potential for organic wastes to be processed in to compost-type products, and thus reduce the need for these synthetic fertilisers.

Once again this could no doubt be resolved by closer working between those responsible for soil quality, and the waste management team at EBoP. A number of actions listed in the various plans and strategies aimed at improving soil health (such as educating farmers about more sustainable ways to manage their soil) could benefit significantly from involvement of the waste management team, and vice versa.

There is significant synergy between the goals for soil and water quality, and the desire to reduce waste going to landfill. The Bay of Plenty has the potential to make huge improvements in both respects if the two areas can be better coordinated.

An approach such as this would also go a long way to addressing some of the issues identified here regarding markets for compost-type products in the region.

10.2 Longer-term Recommendations

10.2.1 Strategic Waste Management

EBoP can take an even stronger lead on waste management issues than that described in section 10.1.1 above. As well as sharing the information and outlining preferences for future management, EBoP could go further and develop a comprehensive waste management strategy for the region that includes a clear sense of priority and direction for organic wastes.

At the very least, the information and proposals contained in this report could be discussed with the various territorial authorities involved with a view to developing a regional organic waste management strategy.

An organic waste management strategy should pick up many of the issues identified in this report including the alignment of strategic objectives across soil quality, groundwater and waste, and attempt to ensure that district council plans for collection (and possibly processing) of organic wastes align with any plans for regional facilities. A regional organic waste management strategy would also seek to set clear priorities and goals that would provide clarity for private sector companies wishing to establish organic waste processing and or collection operations in the region.

While not perhaps their core role, EBoP has produced a regional waste strategy before and has indicated they may be able to do so again. At the moment all territorial authorities in the region should be working through their Waste Management and Minimisation Plans, supported by waste assessments, as required by the Waste Minimisation Act. These waste assessments should include commercial and industrial wastes, as well as the domestic waste streams territorial authorities are more used to dealing with. Collating this information across the region should enable the development of a comprehensive regional waste strategy.

As a regional strategy (whether focusing on organic wastes, or dealing with all waste streams) would require the involvement and perhaps even agreement of all territorial authorities, this is not seen as something that could be completed short-term.

Waste Management and Minimisation Plans are due to be completed by mid-2012, and so waste assessments should be completed well before this date. This may be a recommendation that EBoP could pick up during their next financial year.

10.2.2 Organic Waste Processing Facilities

Obviously one long-term action that would have a direct impact on diverting organic wastes from landfill is the construction of an organic waste processing facility or facilities.

Recommendations have been made here for several approaches that could be taken, including procurement routes, collection options, technologies, and markets. EBoP and their partners may wish to ensure that the gap in processing facilities in the region is filled – in which case some kind of direct involvement from the public sector is probably required.

Further detailed discussion would be necessary on the various approaches that are possible, and if it is decided to pursue any of the scenarios to develop organic waste processing facilities. In particular it will be important, in considering the processing facility options to simultaneously evaluate collection system, transport and transfer options and consider the whole system costs and impacts.

A.1.0 Acknowledgements

AFFCO Rangiuru	Shane Ellis
Carter Holt Harvey	Murray Parrish, Nick Eynon-Richards, Mark Tito
Environment Bay of Plenty	Annabelle Ellis, Bruce Gardiner
Envirofert Ltd	Gary McGuire
Environment Waikato	Marianna Tyler
Fonterra	Spring Humphreys, Karen Leov
H G Leach	Steven Hill
Industrial Vermicomposting Ltd	Michael Quintern
Kawerau District Council	Tom McDowall
Lakeland Steel	Doug Stewart
Lowe Corporation	Gordon Henderson
NZ Ester Fuels	Andre Hammond
NZ Remediation	Kerry O'Neill
Norske Skog	Henare Kapa, Chris Bruns
Opotiki District Council	Jim Finlay, Ian Castles
Opus Consultants	Peter Askey
Plateau Bark & Compost	John Fell
Port of Tauranga	Terry James
Rotorua District Council	Peter Dine
Scion Research	Trevor Stuthridge
Sanford Ltd	Kevin Wylie

SCA Tissue Ltd	Geoff Burns
Tauranga City Council	Nick Roozenburg, Murray Kliskey
Transpacific Industries Ltd	Ryan Moloney
Vitec Fertilisers	Tom Mason
Whakatane District Council	Haydn Read
Worm Tech NZ Ltd	Greg Walker
Zespri	Alistair Mowat, Rosstan Mazey

A.2.0 Glossary

Biosolids — Solids from waste water treatment – including those from settling ponds and septic tanks.

Business/Commercial Waste — Non-household waste. This is predominantly waste generated by private sector business or commercial enterprises but may also include waste from government offices, schools, community organisations etc.

C&D Waste — Waste materials from the construction or demolition of a building, including the preparation and / or clearance of the property or site.

C&I Waste — Waste materials from a commercial or industrial source – as opposed to domestic (householder) waste.

Cleanfill — (From the MfE Guide to the Management of Cleanfills, MfE, 2002) Material that when buried will have no adverse effect on people or the environment. Cleanfill material includes virgin natural materials such as clay, soil and rock, and other inert materials such as concrete or brick that are free of:

- combustible, putrescible, degradable or leachable components
- hazardous substances
- products or materials derived from hazardous waste treatment, hazardous waste stabilisation or hazardous waste disposal practices
- materials that may present a risk to human or animal health such as medical and veterinary waste, asbestos or radioactive substances
- liquid waste.

A cleanfill is any landfill that accepts only cleanfill material as defined above.

Diverted materials — means any thing that is no longer required for its original purpose and, but for commercial or other waste minimisation activities, would be disposed of or discarded

Domestic Waste — Waste from households.

Domestic Kerbside Refuse Collections — Kerbside refuse collections offered by councils or private waste operators to householders and small businesses

Green Waste — See explanation for 'organic waste'.

Hazardous Wastes — The most common types of hazardous wastes include:

- Organic liquids, such as those removed from septic tanks and industrial cesspits
- Solvents and oils, particularly those containing volatile organic compounds

- Hydrocarbon-containing wastes, such as inks, glues, and greases
- Contaminated soils (lightly contaminated soils may not require treatment prior to landfill disposal)
- Chemical wastes, such as pesticides and agricultural chemicals
- Medical and quarantine wastes
- Wastes containing heavy metals, such as timber preservatives
- Contaminated packaging associated with these wastes.

Landfill	A disposal facility as defined in s7 of the Waste Minimisation Act (2008), excluding incineration
Local Authority	A regional council or territorial authority
Monofill	The deposition on land of 'cleanfill' type material of a single uniform composition. Monofills are commonly the outputs of an industrial process.
Municipal Solid Waste	Waste disposed of to landfill comprising domestic waste and council collected waste from commercial activities.
Organic waste	The term "organic waste" in the context of this report refers to the putrescible waste category used in the Solid Waste Analysis Protocol[78] (SWAP). This includes garden waste (more commonly known as "green waste"), food scraps and commercial organic wastes such as food-processing waste. Some other wastes may biodegrade in landfill but are identified separately in SWAP audits. This includes paper, cardboard and untreated wood. For the purposes of this study, wood waste has been included. Paper and cardboard has generally been excluded, as recycling this material is generally a better management option than any kind of composting.
Recovery	(a) means extraction of materials or energy from waste or diverted material for further use or processing; and (b) includes making waste or diverted material into compost
Recycling	means the reprocessing of waste or diverted material to produce new materials
Territorial Authority	A city council or a district council
Transfer station	A general term for a facility where waste is consolidated, possibly processed to some degree, and transported to another facility for disposal, recovery or reuse.

[78] Ministry for the Environment Solid Waste Analysis Protocol, 2002

Waste	Waste means: (a) means any thing disposed of or discarded; and (b) includes a type of waste that is defined by its composition or source (for example, organic waste, electronic waste, or construction and demolition waste); and (c) to avoid doubt, includes any component or element of diverted material, if the component or element is disposed of or discarded

A.3.0 Acronyms

AD	Anaerobic Digestion
ATT	Advanced Thermal Treatment
BOOT	Build, Own, Operate, Transfer
CCO	Council Controlled Organisation
CNG	Compressed Natural Gas
CHH	Carter Holt Harvey
DBO	Design, Build, Operate
EBoP	Environment Bay of Plenty
EPA	Environmental Protection Agency (US)
ETS	Emissions Trading Scheme
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IVC	In-vessel Composting
LGA	Local Government Act (2002)
LTCCP	Long Term Council Community Plan
MBT	Mechanical Biological Treatment
MHT	Mechanical Heat Treatment
MfE	Ministry for the Environment
MSW	Municipal Solid Waste
NES	National Environmental Standard
NZWS	New Zealand Waste Strategy
OECD	Organisation for Economic Co-operation and Development
RDC	Rotorua District Council
RDF	Refuse Derived Fuel

RMA	Resource Management Act (2002)
SWAP	Solid Waste Analysis Protocol
TA	Territorial Authority (city or district council)
TCC	Tauranga City Council
WBoPDC	Western Bay of Plenty District Council
WDC	Whakatane District Council
WMF	Waste Minimisation Fund
WMMP	Waste Management and Minimisation Plan
WRAP	Waste & Resources Action Programme (UK)

A.4.0 Summary of Waste Sources/Processing

Waste source	Waste Type	Amount recovered (tonnes per annum)	Recovery process	Amount disposed (tonnes per annum)	Destination
Tasman Mills (includes Norske Skog, Carter Holt Harvey and SCA)	Wood processing waste – dry	10,000	Composting or vermicomposting on site	44,000	Local landfill
	Wood processing waste – wet			48,000	Dewatered and landfilled locally
	Bark and wood waste	300,000	Largely used as boiler fuel either locally, or at Kinleith mill. Small proportion composted		
Carter Holt Harvey Whakatane Board Mill	Bark and wood waste	TBA	Sent to CHH Kawerau	10,000	Landfill in Kawerau
	Recovered fibre from processing			6,000	Landfill in Kawerau
Tauranga city and Western Bay of Plenty district	Green waste	8,000	Composted locally	5,920	Landfilled at Tirohia
	Putrescible (food) waste			8,880	Landfilled at Tirohia
	Biosolids	1,000	Vermicomposted, Tasman facility (Kawerau)	3,600	To monofill

Rotorua District	Green (and some wood) waste	6,000	Mulched	5,200	To Rotorua District Council landfill
	Putrescible (food) waste			3,600	To RDC landfill
	Biowaste			8,500[79]	To RDC landfill
Whakatane District	Green waste	300	Mulched (Murupara)	4,500	Face cover, WDC landfill Burma Road
	Putrescible (food) waste			3,500	Landfill – currently Tirohia
Kawerau District	Green waste	750	Mulched	60	Tirohia landfill
	Putrescible (food) waste			493	Tirohia landfill
Opotiki District	Green waste			118	Tirohia landfill
	Putrescible (food) waste			271	Torohia landfill
Kiwifruit industry	Predominantly fruit waste	42,500	Stock feed	2,500	Landfill
Port of Tauranga	Bark waste	TBA	Composted by Daltons		
Sanford Ltd	Fish processing waste	170-800tpa (higher end at the moment)	To Lowe Corp and rendered		
Tankman	Clear septic tanks around the region			5720	Disposal at one of three sites around the region

[79] This may be low – other estimates have been as high as 10,000 tpa.

Various poultry farms	Putrescible (poultry) waste – end-of-lay birds	200 50	Vanderbrinks – butchery LoweCorp – rendered	Unknown	Dumped to land
Supermarkets, butcheries, restaurants	Putrescible (protein-rich) waste	2080	LoweCorp – rendered		
Restaurants, cafes	Putrescible (liquid oil) waste	1000	Converted to biodiesel product		
Fish processors	Putrescible (fish) waste	300	Converted to liquid fertiliser		
Orchards and market gardeners	Putrescible (poultry manure) waste	200	Composted		
Pork farm	Putrescible (pig manure) waste	5200	Vermicomposted		
Construction & Demolition waste	Untreated timber			4500	Cleanfills
Various commercial & industrial sources	Putrescible waste Green waste	 1200	 composted	2800	Landfills
Various sawmill operations	Wood waste	60,000	Produces fuel for pellet fires		
Rotorua lakes, and sea shore throughout the region	Putrescible waste (lake and sea weed)	5,000	Spread to land	500	Landfill[80]

[80] Not that this is not an annual figure; weed has not been cleared annually in the past.

A.5.0 Technical Summary of Processing Options

A.5.1 Application to Land

This is an extremely low cost option and has been used in the past, particularly for weed disposal. However arrangements are generally ad hoc, and there is the risk of odour issues as the waste decomposes. Some biowastes are also spread on land following a de-watering process.

A more formalised land application process could potentially be developed for some wastes such as wood processing waste, some biowastes, and weed waste. To minimise odour issues, this would need to be isolated from residential areas. There are also significant barriers in gaining resource consent for this type of operation – Norske Skog and CHH have both indicated that they would like to make use of land spreading to a larger extent but have been prevented from doing so by consent problems.

Usually application to land follows a brief and fairly basic period of windrow composting.

A.5.2 Aerobic Composting

A.5.2.1 Home Composting

This is an extremely low cost option, but it is unlikely that all householders will compost at home and this does not accommodate the non-domestic organic waste.

A.5.2.2 Windrow composting

Aerobic composting in windrows with regular mechanical turning is a common, low cost, option in New Zealand, mainly for green waste processing. The final product has value as a soil improver and the process generally results in low odour issues. Minimising odours relies on good material preparation and aeration during the composting process.

To produce the optimum end product, composting can take many weeks and a lengthy curing time is essential.

Locating composting sites at a distance from residential areas prevents most issues with odour, and removes the need for costly covers and aeration. Rural areas also usually have more space available for sufficient composting and maturing phases. Windrow composting is not usually suitable for putrescible wastes, due to odour issues, although these can be less of a concern in rural areas.

Windrow composting would also be appropriate for the drier wood processing wastes, although the material would require more initial management to achieve a good composting process.

A.5.2.3 Static aerated windrow composting

Static composting (as opposed to regular turning) in piles and rows requires mechanical aeration, and the windrows or piles are also usually covered with dry organic matter or with an artificial cover. Aeration and covering increases the cost of processing; however a covered, static, aerated process is more suitable for putrescible wastes than standard windrow composting, as odour issues are more easily controlled and the composting process can be faster. Negative pressure can also be used to capture air flows, which can then be treated to remove any odours.

A.5.2.4 In-vessel composting

As a completely enclosed and closely monitored composting system, in-vessel composting (IVC) is appropriate for a much wider range of organic wastes including biowastes and putrescible waste. The increased facility and management costs of IVC systems are balanced by the ability to place the facilities almost anywhere, as odour issues can be completely controlled.

The output from IVCs still benefits from a curing period, but this is shorter than for other composting methods described above.

IVCs are usually larger scale facilities due to the minimum costs involved in providing reception bays and management systems. In the Bay of Plenty's case, the benefits of being able to process some wastes (such as biowastes and putrescible wastes, which are produced across the region) very close to the source would need to be balanced against the cost benefits realised by locating a facility in a rural location, where costly infrastructure is unlikely to be required.

IVC includes technologies such as vertical composting units, and mechanically-assisted enclosed systems.

A.5.3 Vermicomposting

Vermicomposting uses special worms (usually Tiger Worms, *Eisenia foetida*) to process organic material (mainly softer organic wastes) and produce a high quality soil amendment product. When the waste material passes through the worms' gut the nutrients become more bio-available, with many times more (for example) nitrogen and phosphorous available than normal top soil. As a result the output is becoming sought after by farmers and market gardeners who may pay up to $400 per tonne[81]. Worm composting is also a promoted option for home composting, particularly suited to households with small sites or limited amounts of greenwaste.

Worms used for commercial vermicomposting are housed in beds which can be either enclosed or set up as open windrows. The worms feed on a layer of slightly decomposed material 5 to 10cm below the surface, leaving behind the 'castings' which are a rich soil-like substance. Most worm farms are fed with layers of material at the top and worm castings are harvested at the bottom (although there are variations on this theme such as a horizontal continual flow system). Worm farms also produce a liquid (vermi-liquid or worm tea) which can be diluted about 1:8 and used as a direct application plant food. Many medium-scale commercial operators carefully balance the inputs to their vermicomposting systems to minimise liquid outputs, and will add any liquid back to the system to be fully processed by the worms.

Vermicomposting produces a higher quality product than standard composting processes as described above. It also reduces the volume of the waste by up to two thirds, compared to composting which can reduce volume by one third.

So far in New Zealand vermicomposting has taken place in fairly small scale operations, although several trials are taking place around the country with the intention of developing larger scale facilities. An Australian firm, Vermitech31, has established relatively large scale operations processing sewage sludge. Vermicomposting is most suitable for high nutrient value waste streams, such as sewage sludge, primary processing wastes, and kitchen wastes; where it is desirable to add value to the materials. A number of large scale

---

[81] Personal communication with Colin McPike, Organic Waste Solutions; a vermicomposting operation within the Bay of Plenty currently charges up to $350 per tonne.

operations have been set up around the world, but the science and practice of vermicomposting is still developing with respect to large scale operations

Organic waste streams most suitable to vermicomposting include biowastes, food wastes, and some pre-consumer processing waste; although these wastes are usually combined with a bulking and carbon-rich material to ensure best operation. Worms are relatively sensitive to the types of feedstocks and careful blending of materials is required to avoid stressing or killing the worms, or ending up with retained unprocessed organic waste. Small quantities of bulking agents (up to 30 percent) are required for food waste to avoid the process becoming anaerobic. Worms are usually fed a pre-processed mixture of organic materials – either pre-composted material or raw material that has been blended to ensure the right ph and moisture balances, aeration structure and carbon to nitrogen ratio (20-25:1).

The main potential issue with vermicomposting is pathogens, particularly if biowastes are included in the feedstock. Killing pathogens that may be contained in organic wastes requires temperatures of at least 55°C for three days, which cannot be achieved in normal vermicomposting (as this would kill the worms). High temperatures are also required to kill many weed seeds and some plant seeds. To resolve these issues, some kind of heat treatment process may be required to ensure that the highest value product can be realised. Normally this would increase the cost of vermicomposting as an overall process; however there may be cheaper alternatives. Some of these alternatives are being investigated further in the case of the CHH/Norske Skog trials (liquid from the process is not affected by this consideration and may still have good market value).

Odour control can be an issue with vermicomposting, as EBoP will be aware from existing operations in the region. This depends on the feedstock to a large extent, ensuring proper aeration through the use of bulking agents, and the ideal mix of nitrogen and carbon in the feedstock minimises this risk. Other options for odour control include covering the waste with dry organic matter (as occurs in the existing CHH/Norske Skog trial) or an artificial cover, and ensuring that there is sufficient distance between the processing site and any residential properties.

A.5.4 EM Bokashi

A.5.4.1 Description

EM stands for effective microorganisms, and Bokashi is a Japanese word which translates as "fermented organic matter". The technology of EM was developed during the 1980s in Japan and has become well established globally, used in more than 120 countries around the world in a range of applications including agriculture, composting, bio-remediation, septic tanks and household use.

EM is a mixture of organism groups, and has been described as a multi-culture of coexisting anaerobic and aerobic beneficial micro-organisms[82]. Main species involved in EM are;

- Lactic acid bacteria
- Photosynthetic bacteria
- Yeasts
- Actinomycetes
- Fermenting Fungi

---

[82] Daly & Stewart, 1999

The theory is that this combination of organism groups contain various organic acids due to the presence of lactic acid bacteria, which is a strong sterilising compound and suppresses harmful micro-organisms, enhances the decomposition of organic matter and also has the ability to suppress disease-inducing organisms (Higa, 1996). Proponents claim that when used in waste systems EM will improve the efficiency of biological systems, and in the process reduce smell, and compete against harmful pathogens in the waste. It is also claimed that nutrients, particularly nitrogen, are retained by the EM-Bokashi and do not escape into the atmosphere as greenhouse gases. The nitrogen is largely organically bound in (i.e. less is mineralised), which reduces leaching into ground water.

The most common application of EM Bokashi is in the household. Food waste is placed by the householder in an airtight bucket, and a layer of EM Bokashi 'bran' is sprinkled on top. The dry 'bran' is an organic (high carbon) material such as rice or wheat bran that has been inoculated with a fermented organic material made from molasses, water and the EM microorganisms. It is possible for householders to make EM, but more usually it is purchased when needed.

Figure 3 *Bokashi Bucket and 'Bran'*

In this anaerobic environment, the EM-Bokashi ferments the food waste, effectively 'pickling' or preserving it and preventing it from rotting. This is said to eliminate odour or the attraction for flies. When the bucket is full, it is left for at least one week to ferment the food waste inside. The fermentation results in breaking lignin (fibers) in the food waste. This process is claimed to preserve vitamins, amino acids, and antioxidants and make them more bio-available.

Once the material has matured it can be dug into the garden or added to a compost pile. The materials inside the buckets break down within two weeks after being buried in the ground or incorporated into an existing composting pile (it is not recommended to plant anything for two weeks after digging the material in).

A.5.4.2 Example Technology Providers

- New Zealand Nature Farming Society
- Bokashi NZ Ltd

A.5.4.3 Suitability for treatment of municipal organic waste

There are a number of potentially very interesting aspects to the Bokashi process if it were to be applied to the municipal scale. In such a system householders could be supplied with Bokashi buckets and EM inoculated 'bran', and if householders did not wish to use the material at home they could set it out for collection, either separately or added in to a garden waste collection service. This could have a number of advantages including the following:

- The process preserves food waste material enabling it to be stored for much longer than untreated food waste. This means that it could be collected less often (for example fortnightly), saving on collection time and costs.
- The Bokashi-treated material can potentially be processed in a windrow composting system, or even applied directly to land as a soil amendment, significantly reducing or even eliminating processing costs associated with in-vessel treatment technologies.
- It is claimed that adding Bokashi to a composting process reduces the need for turning, reducing processing costs and fuel use in the composting process
- Promoters of Bokashi systems claim enhanced nutrient value for the outputs compared to material that is treated through a composting process. If this is the case and the material is perceived by farmers or potential users to have agricultural benefits then there is the possibility for the outputs to have good market value.

Savings from the collection and processing systems could be partially applied to the 'front end' of the system (i.e. the householder) in terms of investing in education, support and effective user friendly systems. It is possible that such as system could prove, on balance, to be a cost effective alternative.

It should be noted however that the above benefits are, at this stage, more theoretical than real. The application of Bokashi, while well established at a household level, has not been trialled or implemented at a municipal scale. New Zealand is said to be at the forefront of efforts to apply the technology at larger commercial scales, and so there appears to be little international experience that can be drawn on.

In addition there are a number of question marks that exist in respect of the technology: These include:

- The ability of the process to reduce pathogen risk. In order to effectively kill pathogens (harmful micro-organisms including communicable diseases), the accepted treatment for food waste is for it to be processed at a minimum of 55°C for at least 3 days. Bokashi systems, which are a cold process, do not achieve this, and it is not yet clear the degree to which the system effectively treats pathogens.
- There is still significant work being done to understand the impact of Bokashi as a soil amendment. Until there is more data available markets are likely to be restricted.
- There is a lack of track record for Bokashi systems operating at significant scale, and it is not known what issues and costs are likely to be involved in scaling up the technology.
- Operation of the system correctly requires a reasonable level of householder knowledge and commitment. There is the risk that if material that has not been correctly treated (e.g. where insufficient EM Bokashi has been applied or the container is insufficiently anaerobic) is placed into the municipal collection system it may result in the processing system exceeding its operational parameters (e.g. if untreated food waste is added to windrows this could constitute vector, odour and health risks).

On balance the EM Bokashi system, while appearing to have interesting potential, is not yet sufficiently proven for application at a scale beyond that of the household.

A.5.5 Anaerobic Digestion

A.5.5.1 Description

Anaerobic digestion (AD) involves the biological degradation of organic material in the absence of air, often with the addition of water to turn the waste into a slurry. 'Biogas' is generated, which is a mixture of carbon dioxide and methane, with trace amounts of less pleasant compounds. Methane is effectively natural gas so can be used to generate energy. It can either be used directly, for the production of electricity and/or heat, or it can be purified and compressed to power vehicles. When the gas is burned, methane is converted to carbon dioxide, and some acid gases (sulphur dioxide and nitrogen). Newer applications include its use in stationary fuel cells.

There are a number of options for the design of digesters; they can be either:

- Mesophilic (35 - 40 °C) or thermophilic (50 - 55 °C);
- Dry (> 15 % dry solids) or wet (< 15 %);
- Two phase (acidification + methanisation) or single phase (combined);
- Codigestion (solid waste + other substrate) or solid waste digestion (only waste);
- Mixed/residual waste (no separate collection) or biowaste only (separate collection of organics), though the rest of this section concentrates on the latter only.

After the digestion process has finished, a residue remains which can either be:

- Spread directly on land; though there may be good reasons for caution in this respect(related to the activity in the remaining material, and its potential to be phytotoxic);
- Pressed to separate the liquid and solid, with the liquid being used as fertiliser and the solid being further 'matured' (composted) to stabilise the product for use as compost; and
- Pressed to separate the liquid and solid, with the liquid being treated (as waste water) and the solid being further 'matured' (composted) to stabilise the product for use as compost.

Some of the liquid can usually be usefully recirculated in the process.

Anaerobic digestion processes require some energy input. However, they can also generate energy on-site, meaning that the heat generated by combustion of biogas can be used to power the process (which requires elevated temperatures to operate). Generally, studies highlight the benefits of anaerobic digestion relative to composting, but digestion processes are not so well suited to treating lignin-rich biowastes, such as most woody materials and some types of paper and board.

Traditionally, digestion processes have been considered as more expensive than composting processes. However, the gap between the two appears to be converging with improvement in process controls, and the introduction of tighter process control measures for facilities processing putrescible wastes.

A.5.5.2 Example technology suppliers

- Kompogas (Germany)
- Waste Solutions (Dunedin NZ)
- BTA (Germany)

- Dranco (Belgium)

A.5.5.3 Waste stream suitability

Food wastes. Highly suitable. The high moisture and nitrogen content means this stream is well suited to digestion. Contamination with plastic bags and solids (e.g. bones) can create operational difficulties in some processes. The high salt content of food waste can lead to issues in the use of outputs if these are not diluted.

Mixed waste. International facilities are operating successfully as part of a broader MBT operation.

Wood wastes. Notwithstanding the particle size and moisture content of wood falling far outside the acceptance criteria of AD facilities, the lignin within wood's cellular structure means this material is particularly slow to degrade and not of use for such an application.

Organic sludges. Highly suitable; good track record with large number of facilities operating internationally on a wide range of organic wastes and sludges from domestic, commercial and industrial sources. Organic waste types include biosolids, dairy shed effluent, manures, and food processing wastes.

A.5.6 Other Energy Recovery Methods

This category includes technologies such as pyrolysis[83], gasification, and incineration.

A large number of proprietary technologies exist for treatment of residual waste streams. Many of these technologies claim to be unique processes, and while they may have unique characteristics, they are for the most part variations on one of a number of principal technologies, or are combinations of the technologies. It is beyond the scope of the present report to evaluate and report on all of the different proprietary technologies available and so we have restricted our analysis to the principal technologies, and noted some typical variations/combinations of these technologies.

A.5.6.1 Typical combinations

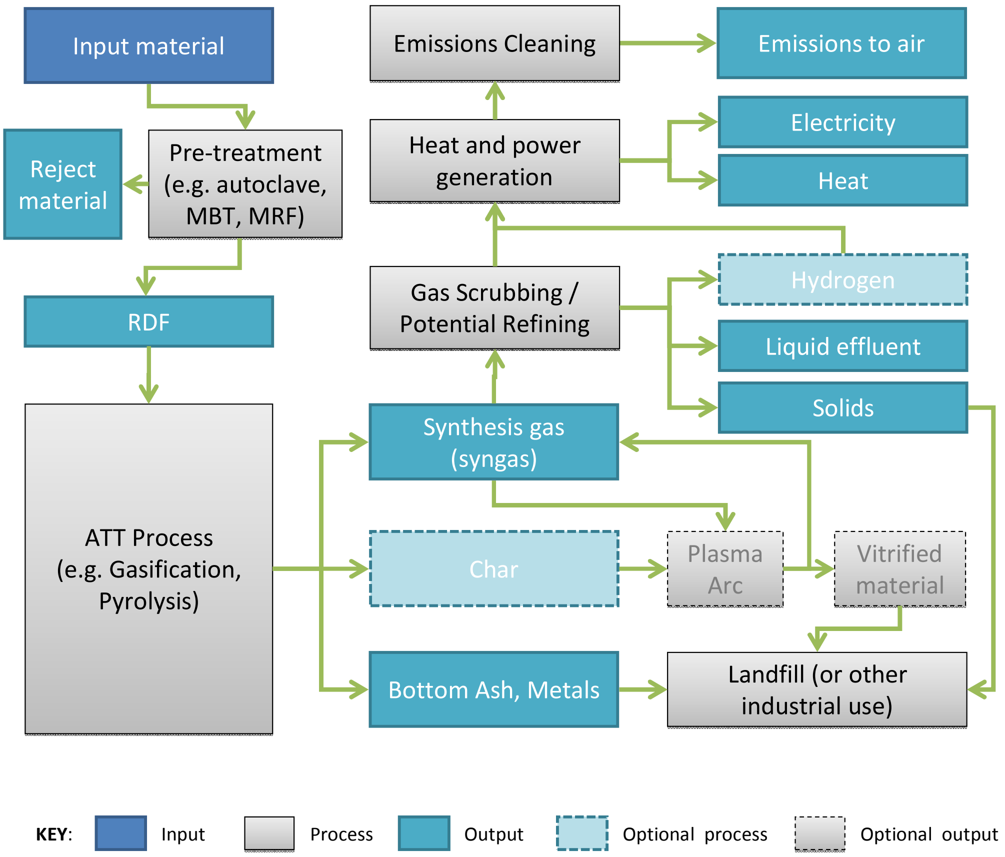
Advanced thermal treatments (ATT) such as gasification, pyrolysis and plasma arc technology require reasonably homogeneous input streams for the process to function effectively. This means that either the waste stream has to be homogenous to begin with (for example waste wood chippings) or some form of pre-treatment of the waste is required. These types of technologies are therefore often paired with pre-treatment in the form of autoclaving or mechanical biological treatment (MBT). A pyrolysis reactor may often be combined with a subsequent gasification step or, either of these technologies may also be combined with plasma arc technology (plasma gasification or plasma pyrolysis) to further break down the solid (char), liquid (tar) and gaseous (synthesis gas) outputs into a valued combustible output gas.

The gaseous outputs of these technologies will then invariably require cleaning before the synthesis gas (often referred to as syngas) can be put to use. It is possible to put the gas through a further thermal stage to enrich the hydrogen content before separating for potential use in fuel cell technology. The flue gas generated (from whichever technology combination) will require emissions scrubbing before it can be discharged to air. A generic process

---

[83] We note that there is talk of a trial pyrolysis system using sawdust in the Rotorua area. We are advised that this is targeted at treated timber rather than raw sawdust, which is more generally used by pellet fuel manufacturers.

diagram is shown below to illustrate the potential concept for ATT type facilities (please note that any given process is likely to differ in some way from the example illustrated below).



Based on Enviros (2007) *Advanced Thermal Treatment of Municipal Solid Waste*, Report for Defra as part of the New Technologies Supporter Programme

A.5.7 Autoclave

A.5.7.1 Description

Autoclaving is essentially a sterilisation technology and is commercially proven in a variety of other industries, such as hospitals and sterilisation of quarantine wastes. There are two key variations upon the core concept which use either steam or direct heat to treat waste. The technology is often referred to as resembling a large ‘pressure cooker’. As a result, the energy requirement to heat the waste is a key parameter for autoclaving technologies, but varies according to the exact approach undertaken.

Autoclaving is sometimes referred to as mechanical heat treatment (MHT). The suppliers of this type of technology have focused on treatment of mixed municipal solid waste (MSW) primarily because it improves the material characteristics for closed loop recycling (through cleaning and sterilisation) and it can produce a consistent output for ease of handling and subsequent processing.

Even with this focus there are very few facilities operating commercially anywhere in the world for the treatment of MSW, with North America being the main centre of this technology[84]. The small number of facilities means that it is difficult to evaluate both its effectiveness and commercial viability in this context.

Though specific applications may vary, waste is loaded into an autoclave vessel (typically a rotating drum) which is then sealed and the waste is heated, using steam, to 150°C for approximately one hour under pressure. This has the effect of cooking the waste, a process which causes plastics to soften and flatten, paper, food waste and other fibrous material to break down into a fibrous mass, and glass bottles and metal objects to be cleaned and labels etc to be removed. The processed mixed waste is then typically passed through a materials recovery facility to separate out the recyclable materials and remove any contaminants leaving a sterilised fibrous organic floc, sometimes referred to as 'celluosic biomass'.

According to suppliers of the technology, because the heat in the autoclave (up to 150°c) changes the physical characteristics of the waste, both recovery rates and the quality of recyclable materials are higher than for MBT technologies. This is especially important for plastics, as a greater tonnage of cleaner material may be available for processing into higher value applications. The potential for feedstock recycling (i.e. turning bottles back into bottles) typically delivers much greater greenhouse gas (GHG) benefits than secondary applications. Our contact with technology providers has shown, however, that whilst this may be true for dense plastics, such as PET and HDPE, it is not the case for plastic films, which under high temperatures form into solid 'balls' that trap putrescible contamination meaning they cannot be recycled into similar products. As a result, if not sent to landfill, autoclaved plastic films could either be manufactured into lower value applications such as 'plaswood' or sent for manufacturing of synthetic diesel.

The core goal of autoclave processes is usually to recycle some of the inputs and to produce a fuel either with consistent characteristics or with a very high biomass content, which comprises the putrescible, cellulose and lignin elements of the waste stream. Despite this however, autoclaving MSW can still result in significant tonnages of biodegradable material being sent to landfill. This takes place because of the mechanical separation of an oversize, reject fraction, which removes both non-biodegradable waste and biodegradable materials, such as garden waste and textiles/shoes. Furthermore, the higher the specification biomass content desired for the fuel, the greater the reject stream to landfill. Autoclaving does not reduce the biodegradability of the waste to any great effect. After exiting the core plant, this reject stream could undergo a brief maturation phase, which would also allow for moisture loss prior to landfill.

A.5.7.2 Example technology providers

- Wastesaver /Clean Earth Solutions[85] (New Zealand /USA)
- Rotoclave (USA)
- Sterecycle (UK)
- Estech (recently taken over by VT Group) (UK)

---

[84] There is one operational plant in the UK, a Sterecycle plant in Yorkshire that can process 100,000 tonnes per annum of MSW. In the last year however a number of such plants have been planned or had contracts awarded in the UK including: an Enpure plant in Derwenthaugh Ecoparc, in Newcastle, which will process 320,000 tonnes of solid waste, VT Group has plans for 3 plants in Glasgow processing 100 – 150,000 tonnes per annum, and a plant operated by Cleanaway, in Rainham, East London which will process up to 160,000 tonnes per annum.

[85] These technologies use the Eley process

A.5.7.3 Waste stream suitability

Mixed wastes. The technology is essentially designed as a pre-treatment process for mixed wastes to reduce the waste to different components which can then be recovered through additional processes. It enables higher value recyclable materials such as glass, cans and plastics to be more effectively recovered in a material recovery facility following processing.

As noted the process reduces the organic fraction to a 'cellulosic biomass' which can subsequently be used to produce a Refuse Derived Fuel (RDF)[86] or directly converted through a process such as gasification to a syngas, used to produce ethanol, used to substitute fossil fuels in cement kilns or landfilled. We continue the assessment of these technologies in the next section.

Organic wastes. We are not aware of any autoclave based processes being used to exclusively treat source separated organic wastes. In any case, there would appear to be little value in doing so since the aim of the process is to produce a high biomass fuel from a mixed waste stream.

Autoclaving can however be used to sterilise particular wastes such as high risk animal by-products to reduce pathogen and virus risks prior to subsequent disposal.

A.5.8 Mechanical Biological Treatment (MBT)

A.5.8.1 MBT aerobic stabilisation

This is a method in which waste is 'composted' either before or after it has been subjected to some mechanical sorting to remove recyclable materials. Similar sorting technology is used here as for the autoclave facilities.

During the degradation process air is sucked into the waste, giving rise to emissions of:

- Carbon dioxide;
- Ammonia,
- Dust (particulate matter);
- Volatile organic compounds; and
- A small amount of nitrous oxide (in some cases).

The sucking action draws air into a system for cleaning the raw gas. The mass of the material is reduced since the degradation process, which takes the material to temperatures in excess of 60°C, drives off moisture, and effectively converts some of the solid carbon in the waste into carbon dioxide gas.

The primary focus is assumed to be that of making the material less likely to generate landfill gas when it is landfilled. The ultimate aim is to reduce this to such low levels that the residual problem of gas generation in landfills can be dealt with through natural (and enhanced natural) processes. This is the case in Germany where only bio-stabilised waste is accepted at landfill, and as a consequence, no landfill gas management is required.

There are many facilities of this nature across Europe. However experience of this type of process for residual wastes outside of Europe is limited. In the UK there is only one plant currently operating in Leicestershire. Several others, however, are currently under construction or in planning, in Lancashire, Manchester and Norfolk.

---

[86] Also sometimes referred to as solid recovered fuel (SRF)

A.5.8.2 MBT Anaerobic Digestion (AD)

There are a number of MBT configurations in which the process of anaerobic digestion is employed. Anaerobic digestion is a process of biologically degrading materials in the absence of oxygen. This produces a 'biogas' which is rich in methane as well as carbon dioxide and traces of other gases including hydrogen sulphide.

Where AD is used as one of the biological treatment steps in an MBT plant, then some form of separation of materials to produce a fraction which is almost wholly suitable for digestion is usually necessary.

There are two reasons why this is desirable:

1. The costs of constructing and operating a digester tend to be related to the throughput of volatile solids and the rate of their destruction. If the feedstock material is less concentrated in the biological volatile solids, then the size of digester required to achieve a given rate of volatile solids destruction is necessarily larger, thereby increasing costs;
2. Whether the digester is a 'high' or 'low' solids unit, the unit still needs to move the feedstock through the facility (and preferably cause some mixing thereof). The more contraries (e.g. stones, plastic bags) there are in the material in the digester, the more wear and tear there will be on the equipment. This will lead to higher maintenance costs and more down-time at the facility (and hence, higher costs).

For these reasons, AD will almost always be deployed as part of MBT systems based around a 'splitting' concept.

The complexity of this splitting could (and does) vary across facilities. Less complex splitting processes might, for example, compensate for the less complex separation through deploying complex pulping machinery (which often accounts for a significant part of capital expenditure associated with the AD system).

In addition to the biogas and recyclables, AD processes produce a solid output which will usually undergo additional biological treatment and in some cases additional mechanical treatment (depending on the final destination of the stabilised output). The aim is either to produce a fuel or stabilised material similar to that produced by the aerobic stabilisation processes.

Operational performance associated with these types of facilities has been quite variable but system reliability is now improving.

A.5.8.3 MBT Bio-drying

In this process, once again, an aerobic 'composting' process is used. However, there is a key difference. Instead of the material being stabilised (through trying to maintain the biological degradation process over a reasonable period of time), in this case, the intention is to dry the material. Essentially, the airflow through the waste is increased, and whilst in the stabilisation process, the mass of material is kept moist to assist degradation; in this case, the intention is to dry the material out and use it as a refuse derived fuel (RDF).

The key difference relative to the stabilisation approach is that because the aim is to increase the calorific value of the material, the principle objective is a drying of the material using both the heat generated by the degradation process and the airflow from the sucking action of the fans drawing air into the biofilter. Essentially, the airflow is increased (relative to the basic stabilisation case), and the total treatment time is much reduced.

There are two principle approaches. In the first – the "whole waste" approach – the separation of materials for recycling occurs prior to the biological treatment. In the second – the "splitting approach" – the separation occurs subsequent to the biological phase.

The first approach is exemplified by what is probably the best known MBT system in the UK, the BioCubi system provided by EcoDeco. This system shreds the incoming waste and then lays it out on an aerated floor in an enclosed windrow-type formation. The dried material is then subject to some separation of materials for recycling before the RDF is prepared for use either on or off-site.

The second "splitting" approach is very common in continental Europe (although far less so in the UK, and elsewhere). Essentially, the material is subjected to various processes of screening, sometimes combined with some size reduction, to split the material into what one may characterise as being a 'large-size, low-density, high calorific value' fraction and a 'small size, high density, principally organic, low calorific fraction'. The former is reserved for use as a fuel, the latter is typically stabilised prior to landfilling through an intensive treatment, followed by a maturation period. An example of such a facility is that of Kufstein in Austria.

It possible to 'convert' a process whose principle objective is stabilisation into one which seeks to generate an RDF. This, therefore, makes an MBT quite adaptable in respect to the potential of a plant to evolve over time form having one principle purpose to another.

A.5.8.4 Waste stream suitability

Mixed waste. Highly suitable.

A.5.9 Gasification & Pyrolysis

Gasification and pyrolysis are advanced thermal treatment processes which, because they take place in an atmosphere which is relatively starved of oxygen, do not lead to complete combustion of waste as happens in the case of incineration. Pyrolysis takes place when heat is provided to a fuel source in the virtual absence of oxygen, creating a gas, tars and a residual solid char. Gasification is a process which takes place in the presence of a limited amount of air or oxygen sufficient to maintain the operating temperature and typically at slightly higher temperature to maximise the conversion of the fuel to syngas. The gases produced by pyrolysis and gasification processes, once cleaned, have significant fuel value; alternatively the gas, tar and char can be used for synthesis of chemicals. Some processes effectively combine pyrolysis and gasification phases in the treatment of waste.

There are a growing number of processes available which treat RDF (produced as part of a broader waste management system) through pyrolysis or gasification. These technologies are not well suited to use on unprepared waste; some degree of fuel preparation tends always to be needed.

A.5.9.1 Gasification

Gasification, though it has been used in various forms for the thermal conversion of wood for many decades, remains a relatively novel technology in its application to the treatment or disposal of waste.

It involves the partial oxidation of waste. This means that oxygen is added but the amounts are not sufficient to allow the fuel to be completely oxidised and for full combustion to occur. The temperatures employed are typically in the range 750°C to 1,000°C. The main product of value is a syngas, which contains carbon monoxide, carbon dioxide, hydrogen, methane and longer chain hydrocarbons, water vapour, tar and other pollutants. The calorific value of this syngas will depend upon the gas blown through the gasifier (whether air, oxygen or in some applications steam), the composition of the input waste to the gasifier, the temperature, residence time and configuration of the gasifier, as well as the subsequent gas refining stages. The low calorific value and multi-gas nature of the syngas means that most systems have been developed to use the syngas onsite for heat and electricity production rather than upgrading the gas for export to gas grids, use in vehicles etc. The other output produced by gasification is a solid, non-combustible 'char' of which there are limited applications other than use as an aggregate substitute.

An advantage to gasification over conventional thermal treatment is that using the syngas is potentially more efficient than direct combustion of the original solid fuel (convention incineration typically achieves sub 25% efficiency) because it can be combusted through more efficient technology (gas engines or potentially gas turbines), used to produce methanol (which can be used as a vehicle fuel substitute), or even be refined for use in fuel cells (though we have not seen evidence that the costs are anything but prohibitive). In addition, on a tonne-for-tonne basis, gasification can be expected to produce a lower volume of exhaust gas than conventional combustion and, assuming the gas may be scrubbed to a similar standard, results in lower emissions overall. Accordingly, a higher concentration of the corrosive elements such as chlorine, mercury and potassium can be expected in the ash (but other things being equal this is surely preferable to discharging higher emissions to air).

Gasification of fossil fuels is currently widely used on industrial scales to generate electricity where the efficiency advantages of large gas turbines (typically around 40%) are used to good effect. For homogenous wood wastes there are a number of worldwide examples of gasifiers using gas engines (much like a diesel engine, mid efficiency – around 30%), but relatively few gasifiers operating on waste feedstocks use anything other than a lower efficiency boiler/steam turbines approach (typically with a net efficiency sub 20%).[87] However, almost any type of organic material can be used as the raw material for gasification, such as wood, biomass, or even plastic waste. In general, the more homogenous the feedstock (or more selective the pre-treatment process for mixed wastes) the more successfully the system can be coupled to gas engines.

In the UK gasification has received significant recent attention in the municipal waste market as a potential alternative to incineration. One demonstration facility is operating in the UK on MSW or MSW-derived feedstocks (the Energos facility on the Isle of Wight).[88] A handful of facilities are operating at commercial scale within the EU, although these are not always treating a mixed waste stream. A number of high-temperature facilities are operating in Japan, though it is difficult to assess such technologies as environmental standards and reporting is not as critical as in the EU. In many cases, gasification technologies are planned to treat refuse-derived fuels (RDF)[89] from MBT or autoclave facilities, as is the case for the facility planned for the East London Waste Authority in the UK.

Performance data, or perhaps more importantly operational track record, is therefore perhaps less reliable than that for incineration.

---

[87] A number of Thermoselect plants in Japan operate waste gasifiers coupled to gas engines, but we note that this may only be possible due to lower environmental standards than elsewhere. The Thermoselect plant previously operating in Karlsruhe Germany, ceased to operate in 2004 for an unpublicised range of technical and commercial reasons.

[88] Permission has been granted for the construction of a Novera / Enerkem gasification facility in East London and several more are at various stages within the planning process. Issues still however hound these technologies; the Compact Power pyrolysis/gasification facility in Avonmouth, Bristol has gone through changes in ownership and has had to withdraw from funding from the UK New Technologies Demonstrator Programme.

[89] Also often known as solid-recovered fuels (SRF)

A.5.9.2 Example Technology Providers

- Novera (UK)
- Energos (Norway)
- Enerkem/Novera (Spain)
- FERCO (USA)

A.5.9.3 Waste stream suitability

Wood wastes. Gasification works well with clean or primary wood (for instance Babcock & Wilcox Volund, operating at Harboore, Denmark on forestry wood). It is potentially also suitable for use on woody/carbon rich agricultural feedstocks such as stalks and husks.

However there has been relatively little international success with dirty waste woods (the failed London-based Bedzed facility being one such example). Paints and pollutants in treated wood tend to cause unpredictable effects in the gasifier and cause difficulties for syngas preparation and cleanup; a consequence is variable syngas production which makes gas engine use impractical and the clean up of emissions more difficult.

Food and Garden Wastes: The use of gasification for processing food waste is unproven and (if such a system were forthcoming) is likely to be unreliable and expensive compared to more widely used technologies. Indeed, the process would require some form of additional fuel preparation (potentially autoclave although adequate provision would need to be given to ensure the resultant moisture content is suitable) which would add to costs.

The chemical characteristics of food and garden waste are also less suitable for thermal treatment compared to wood fuels or fuels manufactured from mixed waste. Other things being equal, the lower carbon content of organic waste will reduce the potential syngas yield, and the higher nitrogen content will be likely to lead to increased oxides of nitrogen created from the fuel. In a world where gasification technology suppliers are struggling to design, market and successfully operate gasifiers to high standards on easier fuels, then to apply the technology to organic waste would be fraught with risk.

Mixed waste. If it is being considered to recover value from organic wastes that remain in the mixed municipal or commercial waste streams, gasification type technologies may have a role to play. Gasification is potentially well suited to incorporation in a wider waste management system where MBT or autoclave produces a relatively clean and homogenous fuel product such as RDF. Such a system has a number of benefits over other 'whole' waste management systems. The MBT or autoclave stages can achieve the benefits associated with materials recycling. Gasification can then be operated as a relatively small scale technology for the prepared fuel fraction. Assuming the RDF is to be used for electricity production, higher conversion efficiencies can then be achieved by gasification and syngas use in gas engines in comparison to standard combustion/steam boiler systems. Cement kilns, however, may also be an outlet for RDF.

A.5.9.4 Pyrolysis

Pyrolysis technologies are invariably personified in the same camp as gasification. Indeed both pyrolysis- and gasification-type chemical reactions will occur in both technologies. The difference is that pyrolysis is the thermal degradation of a substance in the absence of oxygen, whereas gasification involves the provision of a limited amount of oxygen to allow sufficient combustion to occur to maintain the operating temperature. Pyrolysis then is endothermic (that is it absorbs heat) and consequently an external heat source is required to maintain the operational temperature. Typically, relatively low temperatures of between 300°C to 850°C are used during pyrolysis of materials such as MSW. Again, the products of pyrolysis are a solid residue and a syngas, though more of the chemical energy will remain in the solid phase. This solid residue (sometimes described as a char) is a combination of non-combustible materials and carbon. The syngas may be used in the same manner as that from gasification (typically directly for energy production), though it will contain a higher content of oils, waxes and tars. The syngas typically has a net calorific value (NCV) of between 10 and 20 MJ/Nm3 (higher than that from gasification due to a lower content of carbon dioxide and the avoidance of dilution from nitrogen in the air used in air blown gasifiers. If required, the condensable fraction can be collected by cooling the syngas, potentially for use as a liquid fuel.

The char produced from a pyrolysis process contains significant amounts of carbon. This is a hazardous waste but could be used as coal replacement in certain combustion applications or as a gasifier feedstock. It may alternatively be further processed for production of particular chemicals (such as carbon black, used widely for printing). Only if the carbon content is fully reduced (typically through gasification or combustion) can the final residue be recycled as a secondary aggregate.

A.5.9.5 Example technology providers

- Mitsui Babcock (Japan)
- Foster Wheeler (Finland)
- Techtrade/Wastegen (Germany)
- Ethos/Compact Power (UK)

A.5.9.6 Waste stream suitability

Pyrolysis is not a stand alone piece of technology; it requires fuel preparation to match the moisture and physical characteristics to specified standards, further thermal stages are needed, and significant post treatment processing needs to occur (gas clean up etc). The suitability of this technology is much the same as the assessment given above for gasification.

A.6.0 Technical Summary of Organic Waste Collection Options

A.6.1 Household Organic Waste Collections

A.6.1.1 Overview

Kerbside collection systems for food waste are an integral part of any systems that attempt to divert organic waste from the municipal residual waste stream. They can have a profound effect on the quantity of materials collected, the quality of those materials, and on the overall costs of the organic waste collection and processing system.

There are a wide range of organic waste collection system permutations. It is outside the scope of this report to describe or evaluate a full range of collection system options or to comment on what is most likely to be suitable for an Auckland wide approach. Instead the focus in this section is to highlight the key performance parameters of organic waste collection systems and how collection systems may impact on the viability of a regional approach to organic waste processing. This includes how they might influence the quantities of materials collected, the quality of those materials and the overall system costs.

The work here focuses on food waste collection, although garden waste collections are also considered in terms of co-collection of food and garden waste. It should be noted that there are other factors which may be important considerations in the selection of a food waste collection system, but which are outside the scope of the current report. These include:

- Health and Safety
- The impact on private garden bag/bin operators
- Integration with existing refuse and recycling systems
- Residents preferences
- The desire to promote home composting and other organic waste prevention initiatives

A.6.1.2 Description of Options

The key parameters in respect of organic waste collections are as follows:

- Whether food should be collected together with garden waste or separately
- What type of containment to use
- The frequency of collection
- Any charges applied to the collection services

In addition there are a number of other factors outside of the organic waste collection system itself which can influence organic waste collection performance, and which are worth considering in this context. These include:

- The frequency of rubbish collection services

- The type of containment of refuse collections
- Any charges applied for waste collection
- The frequency and quality of communications

The impact of each of these parameters is discussed in the following subsections.

A.6.1.3 Separate vs Co-collection of Food Waste with Garden Waste

In separate collection systems food waste is collected on its own using separate containment. In a co-collection system food and garden waste are collected in the same container and on the same vehicle.

A.6.1.4 Participation and Capture

If food waste is collected as a single stream, then the quantities collected are straightforward to determine. However food waste is often collected alongside other material such as green waste, and the lack of good composition data makes it difficult to estimate food waste quantities in these collection systems.

The following table shows participation and capture rates for a range of systems and studies that collect food waste separately[90]:

Scheme/Study	Participation Rate	Capture Rate	Kg per participating hh/wk	Kg per hh/wk
Italy (aggregated data)	80%-90%	75%	3.5	2.96
Catalonia (Spain)	80%		3.7	2.96
WRAP food waste trial (UK)[91]	41% to 83% (average 63%)	62%	2.41	1.53
Bristol UK			2.69	1.52
Ealing trials (UK)	36%	27%	3.11	1.13
Christchurch food waste trials (2002)	23% (opt in)		4.0	

The following table shows participation and capture rates for a range of systems and studies that collect food waste together with garden waste:

Scheme/Study	Participation Rate	Capture Rate	Kg per participating hh/wk	Kg per hh/wk
Christchurch organic trial (2005)	97% (garden & food waste)		2.4	1.85
Timaru 3 bin system	75% (garden & food) 59% food only		3.46	2.59

---

[90] Participation rate refers to the proportion of households using a service (usually within a 3-4 week period). Capture rate refers to the proportion of the material available in the waste stream that is pulled out or 'captured' by the separate collection system.

[91] These trials cover 19 local authorities

North Shore MGB Trials (2003)	53% (food and garden) 42% food only	55% (est)	4.01	1.68
Burnside food waste trial (South Australia)	60% (food only)	36.3%		
Bexley Trial (UK)	39%	31%	2.38	0.74
Composting operator estimates (UK)[92]		10%		0.38

The above data illustrates that there is a wide range of performance for both separately collected and co-collected food waste systems. Adding to the difficulties in interpreting the above figures is the uncertainty over how some of the figures have been arrived at. The best data for separately collected systems comes from the WRAP trials in the UK. This data suggests a 63% average participation rate and a capture rate across all systems of approximately 62%. The best data for the co-collected systems comes from the North Shore trial in 2003. This suggests a participation rate of 42% for food waste[93] but a capture rate of 55% of food that was going to residual[94].

A.6.1.5 Key Issues and Risks

Separate collection of food waste can result in higher collection costs if garden waste is also collected (but separately) as two collection systems must effectively be provided. However this is not necessarily the case as separate collection can enable system configurations that result in lower overall system costs compared to separate collection: garden waste can be collected less frequently and charged for, and the garden waste that is collected can be processed in cheaper windrow systems (as opposed to having to utilise more expensive in-vessel systems for all the collected material).

Co-collection of food and garden waste restricts the flexibility of management systems in a number of ways:

- As it is desired to encourage diversion of food waste out of the residual waste stream, collections of food and garden will tend to be provided at no charge. This only applies if the food & garden waste are collected from the same container.
- Collection of food waste is best done weekly to avoid odour issues etc. Collecting less frequently will result in lower participation and capture of food waste.

[92] Estimates were obtained from the London Waste ECO park composting plant, and Greenfinch in Shropshire which suggest a 5% minimum figure over the summer months and a maximum 15% figure during winter. If this is averaged over the year it would suggest that for a typical 200kg/hh/yr capture rate for green and food about 10% of this or 20kg would be food waste.

[93] The North Shore trial demonstrated a participation rate of 53% for both food and green waste. An audit of the bins showed 20% of bins with green waste only, indicating that 80% of the households using the service used it for food waste (i.e.42%).

[94] There are a number of possible explanations as to why the capture rate is significantly higher than the participation rate: it is likely that households that participated are those with the largest quantity of food waste to dispose of. Added to this those that chose not to participate are likely to include households with in-sink disposal units and households that home compost their food waste and so contributed little food waste to the residual waste stream

- Free and frequent collection of garden waste tends to result in large quantities of garden waste being collected that were not previously in the household collection system[95]. This is material that must be collected and processed that was not previously, resulting in extra potential expense for the council. This can be constrained by providing smaller bin sizes.

- All the material collected must be processed in more expensive in-vessel type systems (this aspect may be exacerbated by the additional garden waste attracted into the system).

- It is harder to control contamination in co-collection systems. Contamination is harder to see when mixed with garden waste and wheeled bin systems also make spotting contamination more problematic (particularly with automated lift systems).

A.6.1.6 Containment

Containment can have a significant impact on participation in a food waste collection service and hence on capture rates. The most significant factor is the provision of in-house containment in addition to roadside containment. In house containment adds convenience for householders and if the containment is well designed it can help to reduce odours and mess. The main options for in-house containment include the following:

- Householder provides their own

- Solid sided caddy (typically 7-10 litres)

- Solid sided caddy with liners (either paper sacks or compostable plastic liners)

- Ventilated caddy with liners (either paper sacks or compostable plastic liners)

Data suggests that the best performing systems are those which supply caddies with liners. Italy and Spain which have participation rates over 80% predominantly use ventilated caddies with liners. The WRAP trials in the UK which showed participation rates averaging around 63% used predominantly solid sided caddies with liners. Similarly the Burnside Trial in South Australia used ventilated caddies with liners and had a 60% participation rate. Householders report a preference for liners in surveys, for example the 2005 Christchurch trial provided liners for the latter part of the trial and 85% of households preferred the biodegradable liners to lining bins with newspaper[96].

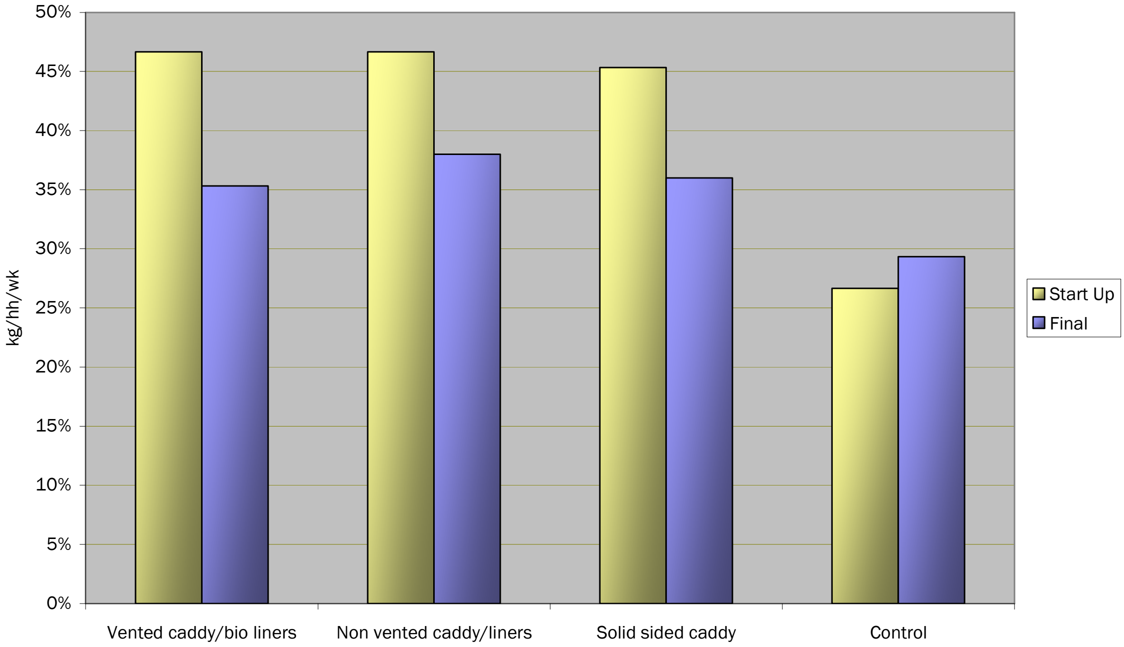
An independent study conducted in the UK by Eunomia[97] attempted to quantify the impact of different containment systems. The results of the study suggest that systems that use a caddy will have higher participation levels than those where no caddy is used. This is illustrated in the figure below:

---

95 UK data suggests this to be around 200kg per household per year on average. Data from the North Shore trials suggests a figure of around 260kg per year, while figures from Timaru indicate around 230 kg per household per year.

96 Moore T. (2005) Trial Kerbside Collection of Household Organic Waste in Christchurch. Presentation to Waste MINZ Conference

97 Eunomia (2006) Kitchen Waste Collections: Optimising Container Selection. (UK)



The chart above shows that participation for all caddy systems were higher than the control group. Participation amongst the control group however remained steady throughout the trial while all caddy systems exhibited a drop from their initial high starting point. The solid sided caddy with liners performed the best overall with a final participation rate of 38% being recorded[98]. These results suggest that systems that use a caddy will have approximately 30% better participation levels than those where no caddy is used.

In terms of capture rates the study showed that over the course of the trial, compared to using a solid sided caddy alone, using liners resulted in 36% greater capture of material when used in a ventilated caddy system and 22% greater capture of material when used with a solid sided caddy.

A.6.1.7 Key Issues and Risks

Provision of caddies adds cost to the system, although this is a relatively small one-off capital cost (indicative costs are around $8-9, although bulk rates are likely to be less).

Using liners will add cost to the collection system. The costs of compostable plastic (cornstarch) liners has dropped in recent years and is likely to drop further in New Zealand - especially if large municipal scale quantities are ordered. Currently the price for a 7 litre liner is in the order of 10c per bag. If the equivalent of two bags per week were supplied to households (104 per year) this would add approximately $10 per household to collection costs.

There are also costs and logistical issues associated with providing the liners to the householders, as well as issues of higher contamination due to use of what appear to be similar bags – eg 'degradable' supermarket shopping bags.

---

[98] This is consistent with results from a trial in Preston (UK), and a doorstep survey in Ealing (UK)which both found a slight preference among householders for the solid sided caddy. Anecdotally it appears that householders regard the vented caddy as a bit flimsy and are not confident that it will not leak.

A.6.1.8 Frequency of Collection of Food Waste

The majority of food waste schemes for which we have data collect the food waste weekly. Virtually all schemes that collect food waste separately do so at least weekly[99]. Fortnightly collections of food waste usually occur when the material is co-collected with garden waste. Data available from these sources regarding the quantities and participation rates for food waste are generally less reliable as composition analyses are required to estimate the amount of food waste. The available data suggests the following captures.

	Fortnightly collection of food	**Weekly collection of food**
Kg / household / annum RANGE	10 – 60	60 - 120
Kg / household / annum Approx AVERAGE	20	80
Estimated capture rate (approx)	10%	40%

Based on D Hogg (2008) *Organics – Upping the Ante*, Presentation to WasteMINZ Conference 2008, Marlborough Convention Centre, Blenheim

10.2.2.1 Key Issues and Risks

Collection of food waste less than weekly can be off-putting for householders due to the increased risk of flies, odour and vermin, and collection bins being unpleasant to clean. This can lead to substantially lower capture rates as noted above. WRAP best practice research states quite strongly that food waste should be collected weekly for these reasons. This is likely to be even more important in Auckland where weather is hotter, the warm periods last longer, and because there are not always the cold periods during winter that are sufficient to reduce populations of rats, cockroaches, flies etc.

10.2.3 Charges

Because it is generally desirable to encourage food waste to be diverted from the residual waste stream, food waste collection tends not to be directly charged for[100]. Collection of garden and food waste as different streams enables the garden waste to be charged for. Not only does this enable cost recovery on the garden waste element but it serves to constrain the amount of additional garden waste material that is brought into the municipal waste collection system.

A.6.1.9 Frequency of Rubbish Collection

There is good evidence to suggest that the relative frequency of the rubbish collection can have significant impact on the effectiveness of food waste collection schemes. Where rubbish collection is less frequent than the food waste collection, participation and capture in the food waste scheme is higher, and vice versa.

---

[99] We are aware of at least one scheme in the UK which collects food waste fortnightly but there is no data currently available from this authority.

[100] One exception is Mackenzie District in Canterbury which collects compostable materials (including food waste) in a plastic bag for which there is a 60c charge. Recyclable materials are in a separate bag and also charged at 60c while residual waste is charged at $1.20 per bag.

The clearest data showing this comes from the WRAP trials in the UK, where most food waste collection systems were essentially the same and the only difference between the schemes was in the refuse collection service. Data from the study is shown in the following table:

Scheme/Study	Participation Rate	Capture Rate	Kg per participating hh/wk	Kg per hh/wk
Fortnightly Rubbish Collection	66%	66%	2.58	1.7
Weekly Rubbish Collection	61%	59%	2.30	1.4

As is shown in the table, the WRAP trial data shows an average of 12% higher capture rates for weekly food waste collections when they are accompanied by fortnightly refuse collections.

In addition to the above data the WRAP trial found that food waste collections supported by fortnightly refuse collections had relatively stable participation and capture rates throughout the trial while those accompanying weekly refuse collections declined over the course of the trial. This suggests that the differential shown above could therefore increase further over time.

10.2.3.1 Key Issues and Risks

Reduction of refuse collection frequency or capacity can carry a degree of political risk. Householders often perceive it as a service reduction and with fortnightly collections, raise concerns relating to odour, vermin, and health risks. Although now widespread in the UK (over 50% of local authorities have fortnightly refuse collections), they have been the subject of constant media attention and local citizen action groups. Despite the negative perceptions there has been little evidence to substantiate these concerns however and most of these concerns can be effectively addressed through the provision of frequent food waste collections.

A.6.1.10 Rubbish Collection Containment

There is also evidence to suggest that the type of containment used for residual waste can influence the quantity of material collected in food waste scheme. Bags are viewed as less secure and more prone to dog-strike and vermin than bins, therefore householders are more motivated to use the food waste service (provided it offers a solid bin-based alternative). The WRAP study found a difference between the capture rates where weekly refuse services are provide in bags and where they are provided in bins. In the trial, areas with weekly collections of bags had approximately 12% higher capture rates compared to those with weekly collections of bins.

10.2.3.2 Key Issues and Risks

As noted above bags provide less secure storage for residual waste and can have associated litter and street scene issues. Again however this can be addressed (at least partially) through the provision of good food waste collection services.

A.6.1.11 Charging for Rubbish Collections

User pays charges for rubbish collections provide a strong incentive for householders to divert their food waste from the residual. Evidence suggests that while most forms of charging will have an impact, weight based charges are likely to be most effective at encouraging diversion.

A Dutch study, by Dijkgraaf and Gradus (2004)[101], looked at data from the Netherlands Waste Management Council (AOO) for 1998, 1999 and 2000 to estimate the effects of different charging schemes. The study suggested the following[102]:

- Weight-based schemes reduce total waste by 38%;
- Sack-based schemes with charges also placed on compostable waste reduce total waste by 36%. Where compostable waste is not charged for, the reduction in total waste is 14% (the difference in the two is reflected mainly in the quantity of material collected separately from the kerbside);
- The frequency based system delivers a reduction in total waste of 21%; and
- The volume based bin system delivers a reduction in total waste of 6%.

The evidence is clear that charging is most effective at moving material from residual streams to recycling/compostable collection streams, however the degree of this effect will depend on a large range of variables including scheme type, the quality of the recycling and compostable collection services provided, pricing structures, levels of enforcement, charges applied to other material streams, etc[103]. Quantifying the impact of charging separately from these other factors can be difficult, as charging schemes are usually introduced as part of an overall service revision. In respect of recycling, available data from cities that did not change their recycling program with the introduction of user pays typically experienced increases of 32% to 59% in the weight of material recycled[104]. A similar magnitude of effect could be expected for food waste as for dry recyclable material.

10.2.3.3 Key Issues and Risks

Charging for refuse collections does present a number of risks. These include:

Illegal dumping & burning . A study by Eunomia[105] found that there was little evidence to support the hypothesis that the introduction of charging leads to increases in illegal dumping

---

[101] Dijkgraaf, E., and Gradus, R. (2003) Cost Savings of Unit-Based Pricing of Household waste, the case of the Netherlands. Rotterdam: OCFEB

[102] This data suggests that the approach to the charging of garden waste is also important. It should be noted that these effects were achieved at different price levels and that whether or not weight-based schemes out-perform sack- or frequency-based schemes *at the same price level* is certainly not clear from this research. Furthermore, these remarkably significant results are probably indicative of the Netherlands experience where garden waste had previously been collected free of charge.

[103] Refer to the following studies:

Eunomia (2003) *To Charge or Not to Charge?* Final report to IWM (EB).

Eunomia (2005) Evaluation of Local Authority Experience of Operating Household Waste Incentive Schemes, Defra.

Hogg, D. (2006) *Impact of Unit-based Waste Collection Charges*, ENV/EPOC/WGWPR(2005)10/FINAL, Paris: OECD.

Hogg, D., Wilson, D., Gibbs, A., Astley, M., Papineschi, J. (2006b) *Modelling the Impact of Household Charging for Waste in England*, Defra.

[104] Miranda and La Palme (1997) in Hogg, D., Wilson, D., Gibbs, A., Astley, M., Papineschi, J. (2006b) *Modelling the Impact of Household Charging for Waste in England*, Defra.

[105] Hogg, D., Wilson, D., Gibbs, A., Astley, M., Papineschi, J. (2006b) *Modelling the Impact of Household Charging for Waste in England*, Defra.

in the longer term. This certainly does not mean that illegal dumping does not happen. In some systems, there are reports of the incidence of illegal dumping declining as a result of improved enforcement. More usually, the studies suggest increases, though there is very little by way of accurate 'before and after' comparisons. Because of this, data enabling some causal relationship between the type of implementation and the likely outcome is difficult to come by. Generally, it is held that charging schemes are less likely to lead to illegal dumping where recycling schemes are convenient and broad in the scope of materials they cover.

Waste 'tourism' (the migration of wastes to other localities or waste streams such as workplaces). The Eunomia study also found that waste tourism does occur depending on the characteristics of the charging schemes and localities involved, but that this only accounts for a very small fraction of recorded waste reduction (in the order of 1%).

Contamination of recyclable and compostable material. The Eunomia study found that there is not much strong support that charging will lead to contamination, but neither can the notion be rejected. Some studies suggest increased contamination but as with many of the other measures of change, the design of the waste management system and of the charging scheme itself are likely to be key factors shaping the nature of the response.

A.6.1.12 Communications

Communications around food waste collections are a central and often under-rated factor in achieving high capture rates of food waste. Separate food waste collection systems have been pioneered in Europe, particularly in Italy, Spain and Belgium. Experiences in these countries demonstrate participation and capture rates of up to 80% - 90%. This contrasts rather sharply with the relatively limited UK experience to date which tend to exhibit capture rates of typically around 25% - 30%, with current UK best practice around 60%, and similar levels in Australia and New Zealand.

A large proportion of this difference in performance can be explained by the nature of the collection systems and level of service provided in Europe, but this alone does not seem able to account for the difference in performance. (Preston in the UK for example achieved a participation rate of approximately 56% using a system modeled very closely on the system from Monza, Italy, which enjoys participation rates of around 90%[106]). 56% is considered good for the UK but is clearly still some way off what is achieved in Italy.

Food waste collection presents a new set of barriers to participation, principally because it is for most people a new concept, and initial reactions[107] are invariably that it will be messy, smelly, and lead to problems with insects and vermin[108] and mould. In addition many people do not understand why it is important to remove organic waste from the residual stream (a common view is that because it is natural it will simply decompose in landfill and that this is not a problem). There are therefore a number of substantial issues of perception and education that need to be overcome before captures of kitchen waste are likely to rival those in Europe. These are likely to require more than a leaflet delivered at the same time as new food waste containers (which seems to be the conventional approach).

---

[106] It should be noted that the Italian systems have the advantage of variable charging for residual waste which will account for a large proportion of the differential in performance. However Preston operates AWC for refuse, and this would be expected to provide a similar, although lesser, level of incentive to participate.

[107] For example in focus groups and surveys that Eunomia has been involved with in a number of London Boroughs, initial reactions to food waste collection were almost exclusively negative.

[108] It is worth noting that anecdotally, Ealing and Hackney in the UK reported improvements with rat problems since introduction of kitchen waste collections

Unfortunately there is no reliable data readily obtainable on the impact of communications in enhancing participation, capture, and contamination rates, therefore it is not possible to quantify the likely impact. Work done by Tucker[109] on dry recycling participation and capture rates suggests that under a 'maximum promotion' scenario participation in kerbside recycling can be raised from 70% ('normal promotion') to 80%, and capture of materials can be increased by 54%, and it could be expected that similar multipliers could apply to food waste collection.

A.6.1.13 Evaluation of Options

For the purposes of this report generic high, medium, and low performing systems are described and an estimated level of performance is ascribed to each.

High Performing System. High performing food waste collection systems will generally have a high frequency of collection (more frequent than the refuse collection), the material will tend to be separately collected (as opposed to being collected with garden waste), and householders will be supplied with ventilated kitchen caddies with biodegradable liners. Operating alongside these systems will be a user pays refuse collection and or a less frequent or a bag based refuse collection system. Finally the collections will be performed by single operatives in small tipper vehicles. This type of system is capable of achieving around 80% capture of food waste. (This is the type of system commonly employed in Italy.) Contamination in these systems is low due to close monitoring by collection crews.

Medium Performing System. Mid level systems will commonly have a similar level of frequency of food waste collection and residual collection (e.g. weekly). Material may be separately collected or co-mingled with garden waste. Householders are supplied with solid sided caddies, with or without liners. A user pays and/or bag based refuse collection service may be in place. Mid level systems tend to be the most common as they attempt to provide a compromise in terms of cost and service provision. These systems will capture 40%-50% of food waste. Levels of contamination are likely to be acceptable.

Low Performing System. At the other end of the scale the most <u>in</u>effective food waste collection systems will provide householders with large frequently collected refuse bins (e.g. 240 litre wheelie bins collected weekly), co-collect the food waste with garden waste, collect the food and garden waste at less frequent intervals than the rubbish, and to provide no form of in-home containment for the food waste. These types of systems are likely to deliver around 10%-15% capture of food waste. There is a risk of unacceptable levels of contamination in these systems.

A.6.1.14 Principles of effective food waste collection.

These hypothetical systems illustrate the key principles behind effective food waste collection systems:

1. There must be a good incentive for householders to use the systems. User pays refuse collections provide the most direct incentive and are generally considered to be most effective in promoting alternatives to disposal (provided the pricing is correctly targeted). Less frequent collection of residual such as fortnightly (or

---

[109] P. Tucker and D. Speirs (2002) *Model Forecasts Of Recycling Participation Rates And Material Capture Rates For Possible Future Recycling Scenarios*, University of Paisley, Report to The Cabinet Office Strategy Unit, www.number-10.gov.uk/su/waste/report/downloads/recycling_participation.pdf, July 2002

restricted capacity for collections), also provides some incentive where food waste collections are more frequent as it provides a motivation to avoid material becoming odorous. Bag based collections can also provide an incentive through householders wishing to avoid dog strike and vermin and so being more reluctant to place food waste in rubbish bags. Large bins, frequent collections, convenient systems and service and free collections for refuse all minimise the incentive to separate out food waste.

2. The food waste collection service must be very user friendly. Food waste can be potentially off-putting for householders to deal with – especially if it involves cleaning of dirty bins caked with rotten food. A service that enables householder to have an experience that is odour free, convenient and easy to use, does not attract vermin, and has no or low direct cost is essential if participation in the service is to be maximised and sustained. The most effective systems therefore tend to be the ones that provide ventilated caddies with liners which reduce odours and mess, and where food waste is collected frequently.

3. Thirdly, for a system to be cost effective it must minimise collection costs and provide the opportunity for overall organic waste collection and processing as well as total waste management costs to be optimised. Although collection costs will be dependent on a wide range of factors and the 'best' system will likely be different in each situation, in general systems that collect food waste separately and use small low cost collection vehicles tend to outperform other systems on a cost basis. There are a number of reasons for this:

    - Separate collection provides the opportunity to either not collect garden waste or to charge for its collection. There is substantial evidence to show that collecting garden waste for free results in additional garden waste being attracted into the municipal waste collection system. This is material that then must be paid for by the council to collect and process where was not being paid for previously. A user pays system for garden waste can also recover any additional cost.
    - Small collection vehicles are low cost and efficient in terms of pick up
    - Separate collection of material maximises processing options and enables processors to control inputs to their composting processes
    - Manual collections of food waste enables easier and better quality control resulting in superior diversion rates and more saleable final product
    - If food waste systems are sufficiently effective in capturing material then the frequency of residual collections can be reduced and the savings used to offset the costs of separate collection.

A.6.1.15 Issues for Further Consideration

What has been presented here is an overview of some of the key factors that are likely to affect the performance of kerbside collection of food waste (either separately or combined with garden waste). Considerable further work will need to be done to determine the best systems for collecting food waste in the Bay of Plenty context. Critical to this further work will be determination of the following:

- The quantities of food waste that is desired to be collected through the system. If relatively large quantities of food waste are required to achieve the necessary economies of scale for processing this will require a relatively high performing collection system.
- The quantities of garden waste that is desired to be collected through the system. As noted providing 'free' collections of garden waste to households can lead to substantial additional quantities of garden waste entering the municipal waste stream. If this material is required for facility sizing or bulking agent, then 'free' collections of garden waste may serve a positive purpose.
- Quality issues around acceptable levels and types of contamination.
- Whole system costs. Some collection system configurations may appear less costly when considered on their own, however the impact of collection systems on total system costs needs to be considered.

A.7.0 New Zealand Agricultural Census data 2002 and 2007

Table a – Agricultural Land Area, by Usage and Territorial Authority (hectares)[110] – 2007 and 2002

Territorial authority	Tussock and danthonia used for grazing (whether oversown or not)	Grassland	Grain, seed and fodder crop land, and land prepared for these crops	Horticultural land and land prepared for horticulture	Plantations of exotic trees intended for harvest	Mature native bush	Native scrub and regenerating native bush	Other land	*Total Land*
WBOP District	C	65,114	C	12,440	22,605	3,637	5,762	4,492	*115,366*
Tauranga District	15	C	C	630	C	C	C	C	*C*
Rotorua District	C	100,572	1,211	C	58,798	4,650	4,006	5,342	*175,414*
Whakatane District	115	57,602	2,403	1,609	115,748	3,422	2,835	3,010	*186,744*
Kawerau District	-	C	-	C	C	C	C	C	*C*
National average	***64,750***	***113,862***	***6,867***	***2,390***	***26,497***	***6,936***	***9,505***	***6,231***	

C – Confidential (not provided by Statistics NZ)

*Averages are calculated from Statistics NZ figures for land use area in each NZ TA and are provided for comparative purposes only.

[110] Source: 2007 Agricultural Production Census. Statistics NZ. http://www.stats.govt.nz/methods_and_services/access-data/tables/2007-agricultural-census-tables.aspx

Table b – Number of farms, by farm type and territorial authority[110] – 2007 and 2002

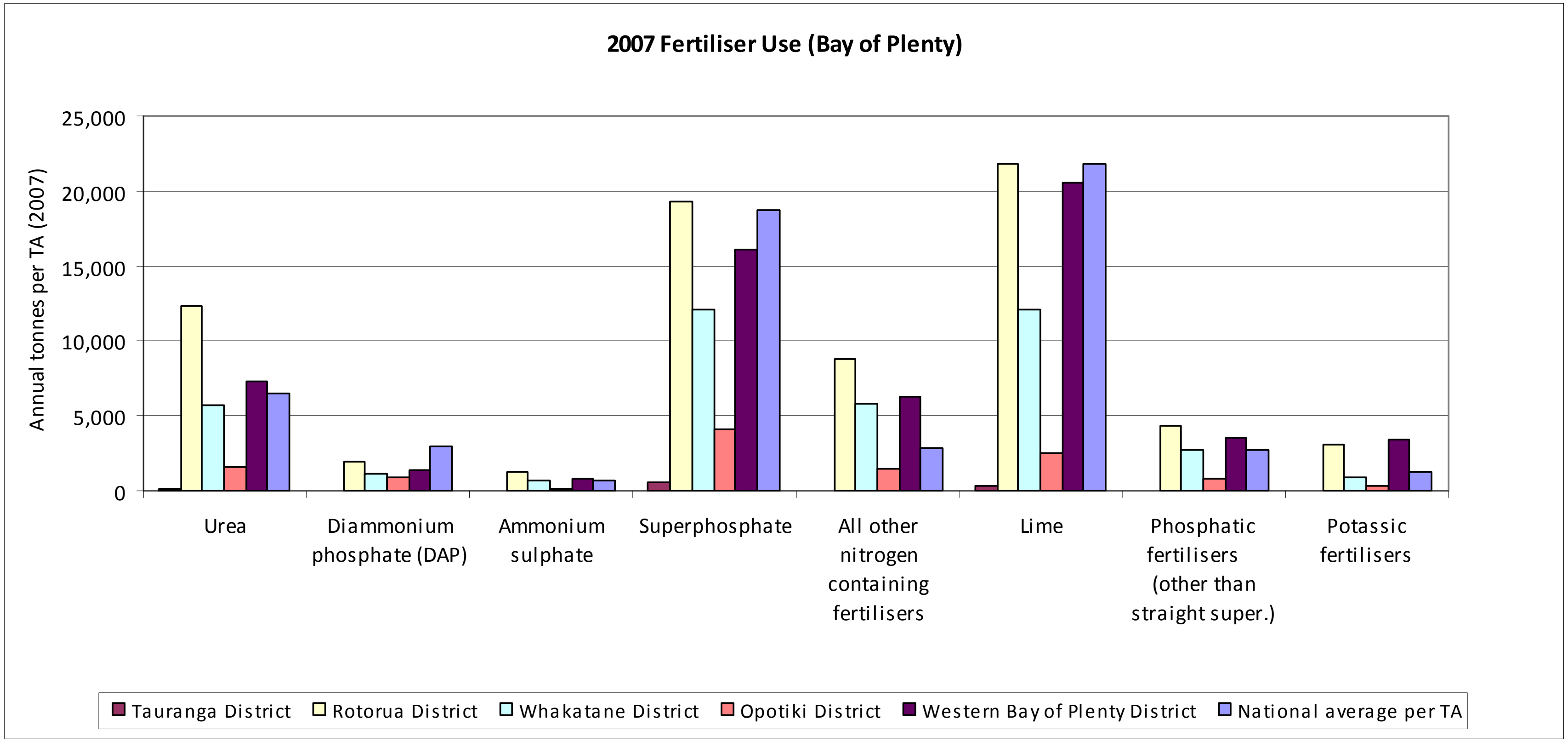
Territorial Authority	Plant nurseries	Cut flower/ seed	Veget-able	Grape, apple, pear, stone fruit	Kiwifruit	Citrus	Berry fruit	Other fruit	Grain	Sheep, cattle, dairy farming	Other animal farming	Forestry	Other farm types	Total
WBOP District - 2007	84	63	27	9	1,497	48	6	555	6	750	144	102	66	*3,366*
WBOP District - 2002	85	100	55	29	1,400	65	15	410	9	800	223	100	66	3,300
Tauranga District - 2007	3	6	6	0	81	6	-	45	-	36	12	9	3	*207*
Tauranga District - 2002	20	30	9	9	130	12	-	70	3	93	33	15	9	420
Rotorua District - 2007	12	3	3	0	6	-	-	6	-	576	81	96	57	*849*
Rotorua District - 2002	12	6	9	0	12	S	3	12	-	648	132	90	44	970
Whakatane District - 2007	3	6	12	12	108	3	6	42	18	507	69	66	63	*912*
Whakatane District - 2002	3	6	30	9	85	3	9	25	15	608	103	55	53	1,000
Kawerau District - 2007	-	-	-	0	-	-	-	-	-	0	0	3	0	*6*
Kawerau District - 2002	-	-	-	0	-	-	-	-	-	0	0	3	-	9
Opotiki District - 2007	6	-	3	3	123	3	-	39	3	162	18	33	12	*396*
Opotiki District - 2002	3	3	6	0	95	3	-	25	3	203	30	25	-	410
2007 average # per TA*	***16***	***12***	***25***	***72***	***77***	***17***	***7***	***37***	***15***	***555***	***89***	***67***	***74***	***856***
2002 average # per TA*	***21***	***18***	***36***	***67***	***52***	***16***	***7***	***35***	***13***	***624***	***116***	***62***	***43***	***950***

*Averages are calculated using Statistics NZ figures for farm numbers in each NZ territorial authority and are provided in this table for comparative purposes only.

Table c – Fertilizer use, by type and territorial authority (tonnes)[110] – 2007 and 2002

Territorial authority	Urea	Diammonium phosphate (DAP)	Ammonium sulphate	Super-phosphate	All other nitrogen containing fertilisers	Lime	Phosphatic fertilisers (other than straight super.)	Potassic fertilisers	Total (tonnes)	% increase between 2002 and 2007
WBOP District - 2007	7,346	1,386	784	16,080	6,290	20,578	3,548	3,398	59,410	32%
WBOP District - 2002	6,351	1,184	312	13,136*	7,111	19,961	Not recorded	10,142	45,061	
Tauranga District - 2007	148	25	4	619	C	361	C	C	1,157	31%
Tauranga District - 2002	161	75	34	757*	277	1,50	Not recorded	337	884	
Rotorua District - 2007	12,288	1,923	1,264	19,336	8,814	21,810	4,311	3,094	72,840	23%
Rotorua District - 2002	9,529	2,851	1,549	18,176*	7,828	26,376	Not recorded	10,946	59,079	
Whakatane District - 2007	5,652	1,153	707	12,141	5,853	12,074	2,719	863	41,162	17%
Whakatane District - 2002	5,661	1,458	453	11,924*	7,051	14,285	Not recorded	6,344	35,252	
Kawerau District - 2007	-	-	-	-	C	-	C	C	0	0%
Kawerau District - 2002	C	C	-	C	C	-	Not recorded	-	0	
Opotiki District - 2007	1,645	894	152	4,059	1,521	2,457	748	391	11,867	24%
Opotiki District – 2002	1,581	413	..S	4,381*	1,945	3,956	Not recorded	1,675	9,570	
National average per TA	***6,467***	***2,991***	***689***	***18,666***	***2,905***	***21,852***	***2,790***	***1,273***	***57,633***	
National average per TA	***4,619***	***2,688***	***700***	***17,109****	***3,321***	***24,974***	Not recorded	***5,356***	***58,767***	

C – Confidential (data not provided by Statistics NZ)
S – cell estimate suppressed by Statistics NZ, as contains 70 per cent or more imputation.
* - In the 2002 Census quantities of superphosphate were not recorded separately, as was the case in 2007. Therefore 2002 figures for 'phosphatic fertilisers' is assumed to include superphosphate.
** - National averages are calculated using Statistics NZ figures for fertilizer use in each NZ territorial authority and are provided in this table for comparative purposes only.



2007 Fertiliser Use (Bay of Plenty)
Annual tonnes per TA (2007)
25,000
20,000
15,000
10,000
5,000
0
Urea
Diammonium phosphate (DAP)
Ammonium sulphate
Superphosphate
All other nitrogen containing fertilisers
Lime
Phosphatic fertilisers (other than straight super.)
Potassic fertilisers
Tauranga District
Rotorua District
Whakatane District
Opotiki District
Western Bay of Plenty District
National average per TA

A.8.0 Bibliography

Bioform Ltd (2010) "Eco-efficiency of the Zespri System: Distributed Biogas Production and Nutrient Recycling" provided in draft by Zespri Ltd

Cox, B, East Harbour Management Services (2009) *"Bay of Connections – Regional Energy Strategy"*

Dijkgraaf, E, and Gradus, R (2003) *Cost Savings of Unit-Based Pricing of Household waste, the case of the Netherlands.* Rotterdam: OCFEB

Environment Bay of Plenty factsheet, 2004 *"Efficient Fertiliser Use"*

Environment Bay of Plenty, 2008 *"Regional Policy Statement – Monitoring and Evaluation"* available on www.ebop.govt.nz/policies

Environment Bay of Plenty, 2009 *"Bay of Plenty Regional Water and Land Plan"*, available on www.ebop.govt.nz/knowledge-centre

Environment Bay of Plenty media release, 18th December 2009, available on www.ebop.govt.nz

EPA, 1999 *National Source Reduction Characterisation Report For Municipal Solid Waste in the United States*

Eunomia (2003) *To Charge or Not to Charge?* Final report to IWM (EB).

Eunomia (2005) *Evaluation of Local Authority Experience of Operating Household Waste Incentive Schemes*, Defra.

Eunomia (2006) *Kitchen Waste Collections: Optimising Container Selection*. (UK)

Eunomia (2007), *Household Waste Prevention Policy Side Research Programme*, Final Report for Defra, London, England

Hogg, D (2006) *Impact of Unit-based Waste Collection Charges*, ENV/EPOC/WGWPR(2005)10/FINAL, Paris: OECD.

Hogg, D (2008) *Organics – Upping the Ante,* Presentation to WasteMINZ Conference 2008, Marlborough Convention Centre, Blenheim

Hogg, D, Wilson, D, Gibbs, A, Astley, M, Papineschi, J (2006) *Modelling the Impact of Household Charging for Waste in England*, Defra.

Giro, F (2003), Situation of source separated biowaste in Catalunya.

Gallagher, B (2007) *321 Zero, Results And Experiences Of The Timaru District Council 3 Bin Kerbside Collection*, Timaru District Council

Landcare Research, Soil Horizon Newsletter, Issue 7, March 2002

Ministry of Agriculture and Forestry, 2003 *"Abatement of Non-Carbon Dioxide Greenhouse Gas Emissions – Chapter Six Nitrous Oxide"*

Ministry of Agriculture and Forestry, unknown date, *"Organic Technical Paper #4"*,

Ministry for the Environment *"The Framework for a New Zealand Emissions Trading Scheme, Section 6"*

Ministry for the Environment (2002) *Solid Waste Analysis Protocol*

Ministry for the Environment (2005) *Options for Kerbside Collection of Household Organic Wastes*. Wellington

Ministry for the Environment (2006) Targets in the New Zealand Waste Strategy: 2006 Review of Progress. Wellington

Ministry for the Environment (2007) *"Guidance Principles: Best Practice for Recycling and Waste Management Contracts"* working draft available at www.mfe.govt.nz

Ministry for the Environment (2009) Waste Minimisation in New Zealand. A discussion document from the Ministry for the Environment. Wellington

Ministry for the Environment (2009b) Waste Minimisation in Waste Management and Minimisation Planning - Guidance for Territorial Authorities, Wellington

Ministry for Social Development, 2009 *"Regional Indicators – Bay of Plenty region"* available at www.socialreport.msd.govt.nz

Moore, T (2005) *Trial Kerbside Collection of Household Organic Waste in Christchurch.* Presentation to Waste MINZ Conference

National Party (2008) *A Bluegreen Vision for New Zealand*. Discussion Paper by Hon Dr Nick Smith MP, National Party Environment Spokesperson. Wellington

Resourcefutures (2008) *Evaluation of the WRAP Separate Food Waste Collection Trials*. Report for WRAP, UK

Scion (2008) "Waste 2 Gold – Feasibility Study for Zespri : Final Report" provided confidentially by Zespri Ltd

Sinclair Knight Mertz (2007), *"Waste Infrastructure Stocktake and Strategic Assessment"* report for EBoP

Tucker, P and Speirs, D (2002) *Model Forecasts Of Recycling Participation Rates And Material Capture Rates For Possible Future Recycling Scenarios*, University of Paisley, Report to The Cabinet Office Strategy Unit, www.number-10.gov.uk/su/waste/report/downloads/recycling_participation.pdf, July 2002

URS (2004) *Regional Options for Food Waste Composting – Market Issues*. Report prepared for the OWWG by URS Consulting

Waste Not Consulting (2003) *Trial of MGB-based Waste Collection Services*. Report for North Shore City Council

Waste Not Consulting (2009) *Food & Beverage Sector Organic Waste Survey*. Report for Enterprising Manukau

Western Bay of Plenty District Council, unknown date *"Western Bay Smart Future – Indicator Data Sheet C04-01 Soil"* available on www.westernbay.govt.nz

Western Bay of Plenty District Council, 2008 *"Water and Sanitary Services Assessment"* available on www.westernbay.govt.nz

Zero Waste South Australia (2007) *Business Case for Councils to Undertake Co-Collection of Food Waste with Garden Organics*