# ENVIRONMENT DEPARTMENT

## WASTE DISPOSAL

Appendix 3 Enviros Report - Waste Strategy Review - Data, Projections and Markets

**Appendix 3**

# A REPORT BY ENVIROS CONSULTING LIMITED: JANUARY 2006

## STATES OF GUERNSEY – ENVIRONMENT DEPARTMENT

## REPORT 1 - WASTE STRATEGY REVIEW – DATA, PROJECTIONS AND MARKETS

QUALITY CONTROL SHEET

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# 1. INTRODUCTION

The States of Guernsey and its advisors have been actively considering the issues of the management and disposal of wastes, both for the present and for the future over a period of at least ten years. As part of this process, the design and the construction of the supporting infrastructure for a 50,000 tonne per annum (tpa) mass-burn energy from waste (EfW) plant at Longue Hogue had been completed by May 2004.

However, the decision was taken, by means of a Requête or formal request dated 28 May 2004, to defer the contract for the construction and operation of the EfW pending review by an independent panel of experts. The Policy Council was directed to establish this independent panel of inquiry (which became known as the Dadd Panel), "comprising five suitably qualified and experienced members, whose mandate was stated as:

a) to inquire in such a manner as it deems appropriate into the future of solid waste disposal in Guernsey, which inquiry shall include, but not be limited to, the Resolutions of the States on Billet d'Etat XX of 2003;

b) to receive representations from interested parties; and

c) to report its findings to the Policy Council and the Environment Department."

Following publication and review of the Panel's report the Department recommended to the States that further investigations should include:

- Securing a guaranteed medium-term export route;
- Evaluating the alternative and emerging technologies;
- Further evaluating the joint Channel Islands facility option;
- The categorisation of waste for disposal including predicting future arisings.

In addition the following waste diversion and minimisation strategies should be adopted:

- Run a proactive PR campaign to promote waste minimisation and recycling;
- Improve the coverage of recycling sites around the Island;

- Provide recycling banks for cardboard at the most popular recycling sites alongside the well-recognised glass and can banks;
- Provide recycling facilities at schools, etc;
- Pilot waste electronic and electrical equipment recycling banks in partnership with the private sector;
- Explore, as a matter of urgency, the on-island use of glass as inert fill or aggregate substitute;
- Explore, with all Parishes, the early piloting of low technology based kerbside collection systems as a precursor to a permanent kerbside recycling scheme introduced as part of the long-term solution;
- Through the Chamber of Commerce and directly, seek to persuade commercial premises to improve source-segregation of recyclables;
- Through discussion with the private sector, facilitate waste-specific collection rounds for recyclables from commercial premises
- In liaison with the Public Services Department, further increase landfill gate fees;
- In liaison with the Public Services Department and the private sector, pilot the diversion of mixed wastes from Mont Cuet to waste sorting facilities for segregation;
- Investigate the commissioning of an in-vessel composting plant (IVC) for green waste;
- Investigate the commissioning of Civic Amenity (CA) sites.

It is understood that work is underway on many, if not all of these issues and that some have been completed.

Enviros Consulting Ltd was appointed by the States of Guernsey to review the current waste strategies which have been developed for the Island and to provide independent information regarding new technologies and procurement issues. Options for alternative methods for the management, treatment and disposal of parish or household waste and Commercial and Industrial (C&I) wastes which are currently or would otherwise be landfilled were to be identified. The work does not seek to quantify or identify alternatives for the existing Pointes Lane facility.

Enviros was invited to challenge the assumptions made during the process of selecting EfW as the preferred waste treatment and disposal option for Guernsey and to question the outcomes of any related decision-making procedures. A phased approach to addressing the various issues was adopted.

The Enviros team reviewed a range of data on waste arisings and management used to compile the various targets which have been adopted, the associated reports and the decision-making process. Waste arisings data included details and throughputs of current recycling and composting schemes, wastes sent to landfill and waste treatment, covering all waste streams within the category of municipal waste and other waste types included in documents describing or relating to Guernsey's Solid Waste Strategy. Key documents identifying the decision-making process are the Draft Waste Management Plan (document ref: Waste Management Plan Draft v7 2004) and the model used to predict waste arisings and possible options for their treatment and disposal which this contains, produced by Integrated Skills Limited (ISL). Assumptions made as part of the ISL modelling exercise were effectively defined by decisions made previously by the States of Guernsey. These decisions influenced the likely treatment options and thereby the flow of materials and their destinations.

The terminology and management systems for waste are different on Guernsey compared to UK. This may have major implications when comparing either good practice, statistics on waste generation or management systems from elsewhere with Guernsey. In the UK the public sector predominantly collects and manages only municipal and similar wastes. It does not generally collect or manage commercial or industrial wastes. Most of the existing criteria in the UK for Best Value Performance Indicators (BVPI), recycling and diversion targets and arisings data relate to municipal waste. It is not therefore appropriate to compare Guernsey's waste arisings and management performance measures directly with those indicators or targets, although previous analyses have attempted to provide some degree of comparability.

The development and implementation of strategies and policies to plan and manage wastes on Guernsey reflects and addresses the wider range of wastes for which they are responsible.

In order to address, verify or evaluate the points or issues raised, the following series of actions for further work was identified, to include:

1. Data acquisition including wastes composition. This should identify the nature and types of materials arising, allow direct comparison with the results of studies elsewhere and identify

what could be achieved, indicating likely areas of uncertainty regarding current waste arisings;

2. Meeting with the States of Guernsey's Employment and Commerce Department to discuss economic issues and background. This should verify population and gross domestic product (GDP) data, grounds for growth predictions and associated sensitivities;

3. Market development for recyclates. Opportunities for the processing and reuse of recyclates on Guernsey or neighbouring islands, to benefit from greater economies of scale should be evaluated.

4. Modelling including options for maximising recycling. This should allow predictions to be made, confirming the quantity and types of wastes requiring treatment and indicating potential uncertainties or sensitivities associated with the data and the predictions;

5. Technologies, their costings and methods of selection. This should include a comparison of costs and benefits for selected technologies, considering the capacity, timing of implementation and type of treatment processes to be introduced on Guernsey.

6. Procurement options and methods selection, soft market testing. In order to provide treatment facilities, possible procurement options should be explored. The market should be approached to determine the likely viability of selected options.

Tasks 1, 2 and 3 above were agreed and outputs were drawn together in this report, which describes Task 1 (Validation of Waste Data), Task 2 (Validation of Projected Waste Arisings) and Task 3 (Review of Markets for Recycled Materials). The structure of this report is as follows:

Chapter 2 summarises the findings from Task 1 (Validation of Waste Data). The full report is included as Appendix 1;

Chapter 3 summarises the findings from Task 2 (Validation of Projected Waste Arisings). The full report is included as Appendix 2;

Chapter 4 summarises the findings from Task 3 (Review of Markets for Recycled Materials). The full report is included as Appendix 3.

Chapter 5 includes conclusions and recommendations drawn directly from the work.

A key element of the latest work was a series of meetings which were arranged with key personnel on the Island. Contacts and colleagues representing both the States and commercial operations were involved and discussions were held during the week commencing 28th November 2005.

# 2. TASK 1 – VALIDATION OF WASTE DATA

## 2.1 Introduction

The purpose of this task was to review all the existing, available data on the types, sources, composition and quantity of wastes to be managed. This included assessing what data are available, how the data were obtained (e.g. weighed, estimated, by difference, etc.), when they were obtained, the level of confidence in the data, and the significance of the above with respect to selection of waste management options. See Appendix 1 for a full report on this Task.

Table 1 summarises the situation regarding the origins, descriptions and quantities of wastes arising in Guernsey for 2004, the latest date for which information was available.

**Table 1 Origins, Descriptions and Quantities of Wastes on Guernsey**

| Origin | Description | Quantity (2004, tpa) |
|---|---|---|
| (Parish) Household Waste | Waste collected from residential properties on behalf of the Parish by commercial operators and waste/recyclates collected via the bring sites and the Civic Amenity Site (including household green waste). | 25,964 |
| Commercial and Industrial (C&I) Wastes | Wastes collected from commercial (retail, offices, hotels and restaurants, etc) and industrial premises by commercial operators. | Not separately recorded – Estimated to be 35,066 |
| Construction and Demolition (C&D) Wastes | Wastes produced by construction and demolition activities and collected by commercial operators. | Assumed to be "Inerts" into Longue Hogue, diversion via Ronez and builders waste landfilled, 172,900 |
| Wastes also arise from other origins including the horticultural and agricultural sectors | Wastes also arise from other origins including the horticultural, agricultural and healthcare sectors. | Not separately recorded – Estimated to be 14,748 |
| Total Waste Arisings (excluding landfill site preparation) | All waste / recyclates recorded by Guernsey, excludes any landfill site preparation. | 248,678 |

Discussions were held with States staff who were considered most familiar with the data and with the waste model which was used to compile the original Waste Management Plan for Guernsey (Gsy Waste Flows & Costs 25-3-04).

## 2.2 Data on Total Waste Arisings for 2001

Methods of recording the baseline waste data which were used in the ISL model were confirmed, to address the following fundamental issues:

- The different waste categories and how they are identified, differentiated and described in records at the weighbridge;
- Assumptions used for weights when a weighbridge is not available, although all wastes received at Mont Cuet and destined for landfill are weighed;
- Process of calculating or recording data, to calibrate or quantify any assumptions used in the model;
- The most recent data for waste compositions of Guernsey's waste, broken down by agreed waste types.

The report includes details (see Table 2 below) of the available waste data for the ISL model and the level of confidence in those data. In addition, where possible a comparison of these waste data with data from other authorities which have similar socio-economic characteristics as Guernsey has been carried out to establish whether the assumptions and limitations which have been identified for the model are valid or reasonable.

Table 2 **Validation of Base Waste Arisings**

| Main Waste Arisings Categories in Guernsey. | 2001 Base data (tpa) | Base Data Confirmed and Validated | Treatment Route | Implications | Action |
|---|---|---|---|---|---|
| Household | 25,555 | Confirmed and validated | Recycled & possible treatment. | Non-recycled waste will be a main input to the possible treatment facility. ***Large impact on possible treatment solution.*** | No further action required to validate 2001 data. |
| Total Industrial & Commercial (C&I) | 41,260 | Confirmed and validated. Subject to potential double counting and frag* (resulting in error of 1012t). | Recycled & possible treatment. | Non-recycled waste will be a main input to the possible treatment facility. ***Large impact on possible treatment solution.*** | No further action required to validate 2001 data. |
| Healthcare | 400 | Confirmed and validated | Existing separate Incinerator. | Arising managed at healthcare facility - potential of double counting. ***No input to possible treatment facility*** | No further action required to validate 2001 data. |
| Agricultural And Horticultural | 12,400 | Confirmed and validated | Waste managed at source by producers. | Waste managed at source - except a small proportion (e.g. farm plastics) potentially double counted. ***Small input to possible treatment facility*** | No further action required to validate 2001 data. |
| Construction & Demolition (including "Builders Waste") | 167,750 | Unconfirmed - 13,000t$^{+}$ additional of inert. | Inerts - recycled, non-inerts for disposal. | Inerts will be diverted to Longue Hougue. Metals and card shall be recycled. All non recycled, non inert waste will be deposited at Mont Cuet, only wood would be sent to proposed Facility. | Need to check the composition reflects extra 13,000t$^{+}$ additional inert waste. |

| Main Waste Arisings Categories in Guernsey. | 2001 Base data (tpa) | Base Data Confirmed and Validated | Treatment Route | Implications | Action |
|---|---|---|---|---|---|
| | | | | ***Small input to proposed facility – would this be the same input for an alternative treatment facility?*** | |
| ELV & Tyres | 2,300 | Confirmed and validated | Recycled or possible treatment. | This arising is relatively small with ***little impact on possible treatment solution.*** | No further action required to validate 2001 data. |
| Water And Waste Water | 350 | Confirmed and validated | Possible Treatment facility / landfill | Potential double counting.<br>This arising is relatively small with ***little impact on possible treatment solution.*** | No further action required to validate 2001 data. |

*frag Fragmentiser waste from scrap metal processing

+13,000 tonnes based on an assumption later found to be unpredictable

The base data for 2001 were used by ISL to project the waste arisings to 2004 and beyond. As part of this review these projections or predictions were compared with actual, measured tonnages for 2004, as shown in Table 3.

Waste arisings for 2004 were selected for comparison, as this was the most recent whole year for which data were available when conducting this investigation in November 2005.

**Table 3 Comparison Of Actual Data To Predicted Data For 2004**

| Waste Arisings in Guernsey | 2004 Actual Data | 2004 Predicted from the model | Difference |
|---|---|---|---|
| Mixed Domestic Refuse | 16,437 | 15,768 | 669 |
| Recycling Banks: | | | |
| Paper | 2,342 | 2,031 | 311 |
| Glass | 1,510 | 1,117 | 393 |
| Aluminium | 27 | 27 | 0 |
| Steel | 61 | 107 | -46 |
| Textiles | 261 | 241 | 20 |
| Garden | 1,179 | 1,069 | 110 |
| Bulky Refuse | 4,147 | 6,959 | -2,813 |
| **Total Household** | **25,964** | **27,319** | **-1,355** |
| Separated Paper For Recycling | 2,730 | 2,783 | -53 |
| Mixed C&I | 24,358 | 30,354 | -5,997 |
| Separate Metals | 6,000 | 7,063 | -1,063 |
| Electrical And Electronic | 1,600 | 1,681 | -81 |
| Batteries* | 0 | 53 | -53 |
| Oils* | 0 | 788 | -788 |
| Fluorescent Tubes* | 0 | 2 | -2 |
| Asbestos | 304 | 525 | -221 |
| Other Hazardous | 74 | 87 | -13 |
| **Total Commercial & Industrial** | **35,066** | **43,336** | **-8,270** |
| Hospital | 450 | 302 | 148 |
| Other Healthcare | 116 | 101 | 15 |
| **Total Healthcare** | 566 | 402 | 164 |

* Information still missing. Only source either away on vacation or business

| Waste Arisings in Guernsey | 2004 Actual Data | 2004 Predicted from the model | Difference |
|---|---|---|---|
| Abattoir | 300 | 340 | -40 |
| Animal Manure | 6,000 | 5,822 | 178 |
| Plastics | 22 | 49 | -27 |
| Horticultural | 5,000 | 5,822 | -822 |
| **Total Agricultural & Horticultural** | **11,322** | **12,032** | **-710** |
| Inert | 154,000 | 115,909 | 38,091 |
| Mixed | 18,900 | 37,191 | -18,291 |
| **Total Construction & Demolition** | **172,900** | **153,101** | **19,799** |
| End Of Life Vehicles (ELVs) | 2,285 | 2,012 | 273 |
| Tyres | 300 | 302 | -2 |
| **Total ELVs & TYRES** | **2,585** | **2,314** | **272** |
| Water Treatment Sludge | 275 | 352 | -77 |
| **TOTAL** | **248,678** | **238,856** | **9,822** |

Table 3 shows that there is a difference of 9,822t between the 2004 waste arising tonnages as predicted in 2001 and the actual waste arising data for 2004. The difference in total waste arisings is approximately 4% greater amount of waste than predicted.

Table 3 does show that both household and C&I waste arisings are lower than predicted for 2004. These wastes would be the main inputs to the facility proposed in the Waste Management Plan. The largest variation from predicted to actual is with C&D waste, the majority of which would not have been destined for the proposed facility. Household and C&I wastes in particular, previously landfilled, now need alternative treatment.

Current and future waste generation and management activities and initiatives (including reduce[1], reuse and recycling schemes) may well reduce the actual amount of waste which is deposited in Mont Cuet landfill site on an annual basis.

1 For example the web based Free Cycle for Guernsey

## 2.3 Household Waste Composition - Summary and Recommendations

Appendix 1 summarises the information available on Guernsey's waste composition. This exercise confirms that the household waste composition data which were used for the Waste Management Plan and the ISL model provide the most suitable and reliable waste composition for household waste (excluding Civic Amenity or CA waste) available to Guernsey at that time (2001). However, even at the time of creating the Waste Management Plan, ISL stated that the waste compositions *"are, of course, now somewhat out of date and it would seem prudent to carry out a new analysis before confirming the waste arisings for a new plant."*[2]

Appendix 1 also includes a comparison of Guernsey's waste composition with other data from U.K in general and Cambridge in particular, both in terms of composition and variations with time. The data suggest that these waste compositions have altered in recent years. These changes could be due to numerous factors (such as increases in recycling schemes and numbers of CA sites) and these factors may not have occurred on Guernsey. Therefore Enviros recommends that Guernsey should conduct appropriate waste composition analysis or analyses, to provide an updated version of data that is now 10 years old.

## 2.4 Commercial and Industrial Wastes Composition - Summary and Recommendations

Appendix 1 summarises the information available on Commercial and Industrial (C&I) wastes. Guernsey used its own waste audits as a basis for assessing the composition of C&I wastes. These audits are the most comprehensive and applicable data to use in any modelling in Guernsey, especially when compared to other available data elsewhere in Europe. ISL also used their local knowledge and specific knowledge of C&I waste producers to adjust the values for composition. Although it would have been prudent to document the process in reaching these decisions on variations in composition, nonetheless, when developing the model ISL used the best available information based on Guernsey data. However, the ISL adjustments could be challenged by a third party at some future time, potentially exposing a weakness in the waste data.

2 ISLR1V2 page 7 section 3.3. Waste Composition

## 2.5 Validation of Data: Base Waste Arisings Waste Data - Summary and Recommendations

The work undertaken for this review has confirmed that the waste arisings data collected in 2001 (see Table 2 above) for Guernsey are reliable and justifiable with the following exceptions:

- total of 13,000tpa of inerts (part of mixed C&D waste, based on an assumption later found to be unpredictable); and
- a relatively small discrepancy (1012 tonnes) in the amount of C&I waste.

However these waste streams, as modelled by ISL, are likely to have little impact on the inputs to possible treatment plant and therefore require no further investigation.

The additional inert material as part of the C&D waste stream should only have an impact on capacity at Longue Hougue and should have no influence on an alternative possible treatment facility. However, the category known as “Builders waste” currently is disposed into Mont Cuet from approximately 125 companies located on the Island, including skip hire and builders companies. The level of separation of inert from non-inert material and the actual composition of builders waste may require further assessment.

## 2.6 Waste Flow Model

ISL, as part of the development of the Waste Management Plan, compiled a waste mass flow model, which Enviros has found to be comprehensive and easy to understand. Assumptions made as part of the ISL modelling exercise were effectively defined by decisions made previously by the States of Guernsey. These decisions influenced the likely treatment options and thereby the flow of materials and their destinations.

The model has included numerous recycling schemes for different waste streams such as those from household, C&I and C&D. An allowance for the effects of waste minimisation was included in the waste flow model. However, as for all models, the outcome and interpretation of the model are dependent on the input data and the assumptions that are made.

### 2.6.1 Composition Data

The composition data used in this model are based on Guernsey specific data from 1996 or 2000. The two main waste streams which have the

potential to affect the total flows of waste requiring alternative management are:

- Household Waste; and
- C&I Waste.

Other important waste compositions for the total waste flows on Guernsey, but which are less likely to have a significant impact on projected inputs for treatment, are:

- CA waste; and
- C&D waste.

Household, C&I and C&D waste compositions are Guernsey specific. However the data are old and other (UK based) research demonstrates that there have been changes in composition of similar waste types (such as Household and CA) in the U.K. within this timescale. However the impact of changing these compositions when using the Guernsey specific ISL model and assessing the changes on inputs to the facility proposed in the Waste Management Plan is small.

# 3. TASK 2 – VALIDATION OF PROJECTED WASTE ARISINGS

## 3.1 Introduction

The purpose of this Task was to review the socio-economic development expectations for Guernsey, and the changes in waste arisings which may result therefrom. It was considered important, where possible, to describe and evaluate or quantify the uncertainties around these projections, and their implications for the Waste Management Plan. A series of meetings was arranged over two days, with the States' departments responsible for the predictions on population and economic growth over the period to 2026. The following items were discussed:

- population growth factors (both during the modelling period and any amended or current projections);
- predicted GDP (both during the modelling period and any amended or current projections);
- links to waste growth;
- assumptions for these predictions;
- other factors that are linked to population and GDP growth and in addition waste growth; and
- sensitivities of these factors on the predictions.

## 3.2 Forecast Growth

A forecast increase in population equivalent to 0.22% per year cumulative (using forecast net immigration of 200 per annum) was provided in a States of Guernsey actuarial report[3]. The report states (Section 2 page 4) that immigration will be limited to a maximum of 200 per annum, the only option to maintain an approximately stable population, which is one of the identified aims. A central estimate of GDP growth of 1.71% per annum over the modelling period, without any further structural change or decoupling of the link between waste and GDP, was used to estimate the waste input to the facility proposed in the Waste Management Plan, in 2026. The forecast concluded that the input would then reach 77,000tpa in 2026 from a 2001 base of 49,000 tonnes.

3 "Strategic Population & Migration Policy Consultation Document, December 2005", issued by the Strategic Population Review Group of the States of Guernsey government, based on estimates made by the Government's Actuarial Department for the Guernsey Insurance Fund

This estimate is sensitive to the forecast GDP growth, due to the compound nature of the calculation. If GDP growth is forecast in the range 1% to 3%[4], the corresponding range for waste input to the proposed facility would be 65,000 to 106,000 tonnes in 2026.

The probable differential growth in the economy by sub-sectors was estimated, based on discussion with the Commerce department and Policy Research Unit of the States of Guernsey, on the basis that different business sectors would be likely to increase their generation of wastes at different rates over time. On this basis the central forecast falls from 77,000 tonnes to 75,000 tonnes for the input to the proposed facility in 2026.

The possibility that waste generation in some sectors (i.e. Finance & Legal, and Information and the Communications Technology (ICT) & Other Business Services) will not rise proportionately with increased economic output was based on discussion with States of Guernsey's Commerce department and Policy Research Unit. Assuming a 20% reduction in the change in waste growth with respect to economic growth a further reduction in the central forecast is predicted, to 71,000 tonnes of waste input for the proposed facility in 2026. The predicted waste arisings to be delivered to the proposed facility, based on identified assumptions, have been shown to be similar to those used previously.

## 3.3 Energy From Waste

The proposed plant was expected to generate steam to produce electricity, for supply to the Island's main distribution network. It was expected that this would provide about 10% of the Island's annual electrical demand. The plant was specified with a design capacity of 9 tonnes per hour, using waste with a calorific value of 11 MJ/kg and a 25% overall electrical conversion efficiency. This equates to a generating capacity of approximately 6.9 MWe.

The Island's existing generating capacity is sufficient for 100% of requirements. Some of the existing plant are expected to reach the end of their normal working lives in about 2014 (source: Guernsey Electricity). In order to maintain stand-by generating capacity on the Island it is

4 It should be noted that, since completing this report, there have been discussions which suggest that growth in GDP should be higher, at around 2.5%, in order to meet the fiscal demand. This value falls within the 1% and 3 % range which was investigated but is higher than the assumed central estimate of 1.71% per annum growth. In addition the population growth predictions were based on data from the 2001 Census, which is thought to reflect a period of high population growth but little growth in GDP

expected to replace these with equivalent plant. Typical budget costs for replacing this type of equipment are of the order of £600/kW.

The proposed plant, providing 6.9Mwe, would reduce the need for capital spending on replacement generating plant, by an amount of the order of £600 x 6,900 kW, equivalent to £4,140,000 at current prices.

# 4. TASK 3 – REVIEW OF MARKETS FOR RECYCLED MATERIALS

## 4.1 Introduction

A review of existing markets for recycled materials was carried out for a range of secondary resources, both on Guernsey or exported away from Guernsey. The prices and costs of existing markets were established, insofar as it was possible to derive this commercially sensitive information. The potential and feasibility of developing new markets on Island are described in Appendix 3, in terms of requirements for quantities and quality of materials. This includes an evaluation of the opportunities to market recycled materials as part of the development of new waste management infrastructure on the Island.

Meetings were arranged with representatives from the States of Guernsey's Environment Department, the States Agricultural and Environment Advisor, the States Plant Protection Services and the Guernsey Chamber of Commerce. In addition site visits were made to Island Waste and Guernsey Recycling. The following information was established or confirmed:

- What is currently recycled?
- Where are all the outlets for the recyclates?
- How much recyclates are being exported?
- Brief overview of current contract arrangements including gate prices and operational costs;
- Size, number and type of waste / recycling facilities on Guernsey;
- Existing tonnage and material throughput for each facility;
- Any existing spare capacity at the facilities; and
- Any existing plans for expanding recycling schemes.

## 4.2 Current Recycling Activities

Current (2004)[5] amounts of recycled materials which are collected in Guernsey, by type and current market, are shown in Table 4:

5 This was the most recent whole year for which data were available when conducting this investigation in November 2005.

**Table 4** **Quantity of material recycled in 2004 in Guernsey and the existing markets for these materials**

| Material Type | Tonnes (2004) | Current Markets[6] |
|---|---|---|
| Paper & cardboard (household) | 2,342 | Mayside Export - Aylesford |
| Paper & cardboard (commercial) | 2,730 | Mayside Export - Penny Recycling (Exeter) |
| Glass (household) | 1,510 | Export to England – British Glass |
| Plastic (household)[7] | 0 | Currently Contracting in 2004 |
| **Total** | **6,682** | |

Metals and other minor materials are not detailed in Table 4 as there is either no need, or no possibility of developing markets for these streams on Island. Opportunities for developing markets for paper on the Island are minimal. Experience of existing market development initiatives has shown that developing markets for paper outside of the paper industry is problematic. The primary alternative markets have been identified but only animal bedding/vermaculture and composting are realistic opportunities for Guernsey.

Glass is currently exported for processing by British Glass. Guernsey receives Packaging Recycling Notes (PRNs) for this cullet which to some degree off-sets the shipping cost. There is no glass melt industry on the Island so the primary markets that could be developed are the glass aggregate markets and incorporated with the existing inert and aggregate markets with Ronez[8], an aggregate company and Longue Hougue land reclamation.

6 Since 2004 (and completing this report) there has been an increase in the range of materials collected for recycling. Cardboard collection points are now available at a number of bring site, rather than just the CA site and since June 2006 plastic bottles have been collected, which are exported for recycling off Island. In addition successful re-use schemes have been developed on Island, which could be expanded to encourage further diversion of waste from landfill.

7 Plastic bottle recycling was introduced in June 2006, collecting 3.5 tonnes in one month.
8 A glass aggregate trial was undertaken in 2006.

## 4.3 Market Development

Little market development activity is required or is possible for paper and plastic. An animal bedding business could be established for paper and board but the market for this would have to meet a demand of only a few hundred tonnes. The glass aggregates trial which is currently under way is an excellent opportunity for developing these markets on the Island, but further work and support may be required.

It is in the areas of organic composting and wood recycling where there is the potential for significant improvement. A survey is recommended, to fully assess the markets for organic material, as a mix of end uses is always desirable to ensure year round demand for the product and to minimise the need to stockpile.

Landscaping and topsoil improvement opportunities in Guernsey offer the potential to utilise a significant proportion of the compost produced, probably in the region of 10 to 20%. Golf courses and sports pitches may use 2 to 5%. Bagging and selling compost to the public may use 5%. Table 5 below summarises the potential markets on Guernsey for compost.

**Table 5** **Potential Market Mix**

| End use | Tonnes per year | Tonnage as Percentage |
|---|---|---|
| Agriculture and field horticulture | 3105 | 69 (by difference) |
| Protected crops and growing media | 45 | 1 |
| Landscaping and topsoil | 900 | 20 |
| Turf | 225 | 5 |
| Bagged | 225 | 5 |
| **Total** | **4500** | **100** |

Table 5 shows that there is potentially enough market capacity on the Island to take the 4,500t of product that would be produced from composting 7,500t of green waste. More detailed work will be required

to assess the market potential and to develop these markets. This may involve industry workshops, trials and dissemination to stakeholders.

# 5. CONCLUSIONS AND RECOMMENDATIONS

The work reported in this document has confirmed that the base waste data, assumptions and composition used in the compilation of the Waste Management Plan are justified and well documented. Changes which might occur when varying these base assumptions or compositions may have an impact on the waste flows. However they do not appear to produce a significant impact on the tonnage input to the facility proposed in the Waste Management Plan.

Having established the overall validity of the base data for wastes, the assumptions were identified for predicting waste arisings in Guernsey until 2026 as part of the development of the Waste Management Plan. These assumptions and the resulting predictions, made using the ISL model, and the overall interpretation of the results contained in the Plan have been shown to be valid.

However, assumptions made as part of the ISL modelling exercise for the Waste Management Plan were effectively defined by decisions made previously by the States of Guernsey. These decisions influenced the likely treatment options and thereby the flow of materials and their destinations. The existing model does not include all available treatment options. Waste inputs, compositions and specifications for alternative treatment facilities may be different to those used in this earlier modelling.

Nevertheless, as the decision for an energy from waste plant or other alternative waste facilities is currently being reviewed, Enviros notes that available information on the composition of the major waste streams in Guernsey could be considered out of date. However, the compositions of these would be expected to be re-assessed by any waste facility operator prior to the development, as the specifications for alternative waste facilities may require different inputs. In particular the following waste streams should be re-assessed as part of the procurement package:

- Household waste;
- C&I waste;
- Builders waste (as part of mixed C&D); and
- CA waste.

The States of Guernsey currently conducts an audit or analysis of C&I wastes every two years and this is scheduled again in 2006. Enviros

proposes that Guernsey should use the same visual method and form of data presentation as in 2000 to assess C&I and builders waste compositions, to provide up to date data which are comparable to previous information.

It is recommended that any waste flow modelling work should consider a waste composition sensitivity analysis for the major compositions to assess any impacts on modelled waste facilities.

Table 4 in Section 4 of this report details the quantity of wastes recycled for the primary material streams in 2004. Metals and other minor materials are not detailed as there is either no need, or no possibility of developing markets on Island for these streams. All the materials currently collected for recycling are exported to the mainland. Over 5,000 tonnes of paper were exported in 2004, along with 1,500 tonnes of glass. Composting activities are currently limited and there is no recycling of organic material such as wood.

Little in the way of market development activity is required or is possible for paper and plastic on Island. An animal bedding business could be established for paper and board but the market for this would have to meet a demand of only a few hundred tonnes. The aggregate and inert material recovery market is well established on Island. Using glass as an aggregate is currently being trialled, and is an excellent opportunity for developing these markets on the Island, but further work and support may be required.

It is in the areas of organic composting and wood recycling where there is the potential for significant improvement. There is potentially enough market capacity on the Island the take the 4,500t of product that would be produced from composting 7,500t of green waste. However, more detailed work will be required to assess the market potential and to develop these markets. This may involve industry workshops, trials and dissemination to stakeholders.

**APPENDIX 1**

# DATA VALIDATION FOR GUERNSEY

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# 1. DATA VALIDATION INTRODUCTION

In 2002 Integrated Skills (Guernsey) Ltd (ISL) started the preparation of a Waste Management Plan for Guernsey as instructed by the States of Guernsey. Report Number 1 (version 2) published in February 2002, was a key document and outlined the "Present Position and Future Developments". This document identified the recent waste arisings on the island, used the most recently available waste compositions, estimated growths for the different waste categories, recycling and waste minimisation aspirational targets and using a Guernsey specific waste flow model, predicted future waste arisings for a final disposal facility.

Running concurrently to this, consultants Ramboll investigated the future tonnage inputs and composition of waste into a proposed Energy from Waste (EfW) plant. Ramboll adopted a different approach to ISL by ascertaining the current landfilled waste (for 2000) and categorising the waste that would be diverted from landfill (e.g. via recycling or compost schemes), waste that would be suitable for EfW plant (e.g. waste that could be incinerated) and the remaining waste that would continue to go directly to landfill.

Though different approaches were taken by Ramboll and ISL, their research produced similar results for the inputs of waste to the proposed EfW plant commencing in 2006.

The design of the proposed EfW plant was based on this work and the proposed EfW plant was designed to be able to accept from 49,140tpa to 84,240tpa based on accepting waste with a calorific value of 11MJ/kg.[1]

In this exercise, Enviros will review the base data used in the Guernsey Waste Strategy prepared in 2002 by ISL. It will question all assumptions and original information and identify any key issues with this data.

The areas subjected to this process are:

- Base tonnage arising data for the Guernsey waste flow model;
- Overview of the Guernsey waste flow model; and
- Waste compositions used in the Guernsey waste flow model.

1 See supporting documentation 2

## 2. BASE DATA

It was agreed that Enviros would validate the waste arising tonnages in the Guernsey Waste Flow Model (Gsy Waste Flows & Costs 25-3-04) provided to Enviros in September 2005 by the States of Guernsey only as outlined in Table 1.

**Table 1 Base Data of Waste Arising Categories for 2001**

| Main Waste Arisings Categories in Guernsey | Sub sections | 2001 Base data (t) used in the Guernsey Model |
|---|---|---|
| Household waste | Mixed Domestic refuse | 14,750 |
| | Recycling Banks | |
| | Paper | 1,900 |
| | Glass | 1,045 |
| | Aluminium | 25 |
| | Steel | 100 |
| | Textiles | 225 |
| | Garden | 1,000 |
| | Bulk Refuse | 6,510 |
| **Total Household Waste** | | **25,555** |
| Commercial Waste | Commercial Paper | 2,650 |
| Non Hazardous Industrial Waste | Mixed | 28,900 |
| | Separate Metals | 6,725 |
| | Electrical and Electronic | 1,600 |
| Hazardous Industrial | Batteries | 50 |
| | Oils | 750 |
| | Fluorescent Tubes | 2 |
| | Asbestos | 500 |
| | Other Hazardous | 83 |
| **Total Commercial & Industrial** | | **41,260** |
| Healthcare | Hospital | 300 |

| Main Waste Arisings Categories in Guernsey | Sub sections | 2001 Base data (t) used in the Guernsey Model |
|---|---|---|
| | Other Healthcare | 100 |
| **Total Healthcare** | | **400** |
| Agricultural & Horticultural | Abattoir | 350 |
| | Animal Manure | 6,000 |
| | Plastics | 50 |
| | Horticultural | 6,000 |
| **Total Agricultural & Horticultural** | | **12,400** |
| Construction & Demolition | Inert | 127,000 |
| | Mixed | 40,750 |
| **Total Construction & Demolition** | | **167,750** |
| ELV & Tyres | End of Life Vehicles (ELVs) | 2,000 |
| | Tyres | 300 |
| **Total ELV & Tyres** | | **2,300** |
| Water Waste | Water Treatment Sludge | 350 |
| **TOTAL Water Waste** | | **350** |
| **Total Waste Arisings On Guernsey** | | **250,015** |

The entire base data used in the preparation of the Waste Management Plan was described in the ISL Report No. 1 version 2 (from here on this document is referred to as ISL R1V2) and all assumptions with regard to the base data and sources of evidence were identified (see supporting documentation 3).

Various ways have been used to express these data. The total tonnages are similar; however, individual quantities may be different (due to rounding or re-classifications). For example, these base tonnages for 2001 vary to those in the "Preparation of the Waste Management Plan (version 7, September 2004)" and since quoted as appendix 1 in the

Response to the Panel Inquiry, by 0.4% of the total waste arising in 2001.

The main essence of this appendix is to re-visit the sources of this data, confirm the evidence provided and highlight any issues surrounding these data.

## 2.1 Validation of Base Data

ISLR1V2 is a concise document and presents the base data and relevant source in a logical and meticulous method. The same sources of information were contacted and reviewed by Enviros in December 2005 to confirm the base data of 2001. The findings of this exercise are in Table 2. For further details of the calculations see supporting documentation 4.

Table 2 **Validation of Base Waste Arisings**

| Main Waste Arisings Categories (and sub section) in Guernsey. | 2001 Base data (t) | Source of information as per ISLR1V2 | Confirmed/ Calculated/ Weighed/ Estimated | 2001 data (t) from validation process | Explanation if any differences | Outstanding or other issues |
|---|---|---|---|---|---|---|
| Mixed Domestic refuse | 14,750 | Mont Cuet Weighbridge | Weighed | 14,743 | 7t difference due to rounding | None |
| Paper | 1,900 | Recycling sheet - bring site | Weighed | 1,874 | 26t difference due to rounding | None |
| Glass | 1,045 | Recycling sheet - bring site | Weighed | 1,045 | Data sourced in 2005 same as in 2001 | None |
| Aluminium | 25 | Recycling sheet - bring site | Weighed | 25 | Data sourced in 2005 same as in 2001 | None |
| Steel | 100 | Recycling sheet - bring site | Weighed | 69 | 69t was rounded to 100t. 31% error on small tonnage | None |
| Textiles | 225 | Recycling sheet - bring site | Weighed | 222 | 3t difference due to rounding | None |
| Garden | 1,000 | Information from Mont Cuet green waste householders bag input sheet[2] | Calculated estimate | 1,294 | 294t difference due estimated weight of bags of green waste. | None |
| Bulk Refuse | 6,510 | Mont Cuet | Weighed | 6,503 | 7t difference due | None |

2 See Supporting documentation 4 for further information and record sheets

| Main Waste Arisings Categories (and sub section) in Guernsey. | 2001 Base data (t) | Source of information as per ISLR1V2 | Confirmed/ Calculated/ Weighed/ Estimated | 2001 data (t) from validation process | Explanation if any differences | Outstanding or other issues |
|---|---|---|---|---|---|---|
| | | Weighbridge | | | to rounding | |
| **TOTAL HOUSEHOLD WASTE** | **25,555** | | | | | |
| Commercial Paper | 2,650 | Mayside Records | Weighed | 2650 | Data sourced in 2005 same as in 2001 | None |
| Mixed industrial | 28,900 | Mont Cuet weighbridge and adjustments for Frag[3] | Weighed and adjusted | 28,632 | 68t difference due to rounding. Other discrepancies sourced | However, error found in adjustment. See discussion below. |
| Separate Metals | 6,725 | Guernsey Recycling | Confirmed via conversation | 6,500 to 7,000 | Reasonable estimate | None |
| Electrical and Electronic | 1,600 | E.U. Estimates and import audits | Calculated estimates | 1,600 | Reasonable estimate | None |
| Batteries | 50 | Guernsey Recycling | Confirmed by telephone conversation | 50 | Reasonable estimate | None |
| Oils | 750 | St Peter's Port | Unable to confirm | | | |

3 frag Fragmentiser waste from scrap metal processing

| Main Waste Arisings Categories (and sub section) in Guernsey. | 2001 Base data (t) | Source of information as per ISLR1V2 | Confirmed/ Calculated/ Weighed/ Estimated | 2001 data (t) from validation process | Explanation if any differences | Outstanding or other issues |
|---|---|---|---|---|---|---|
| Fluorescent Tubes | 2 | St Peter's Port | Unable to confirm | | | |
| Asbestos | 500 | Mont Cuet Weighbridge | Weighed | 508 | 8t difference due to rounding error | None |
| Other Hazardous | 83 | Mont Cuet Weighbridge and | Weighed & verbally Confirmed | 83 | Reasonable estimate | None |
| **TOTAL COMMERCIAL / INDUSTRIAL[4]** | **41260** | | | | | |
| Hospital | 300 | Princess Elizabeth Hospital | Confirmed via discussion & previous records | 300 | Reasonable Estimates | None |
| Other Healthcare | 100 | Princess Elizabeth Hospital | | 100 | Reasonable Estimates | None |
| **TOTAL HEALTHCARE** | **400** | | | | | **None** |
| Abattoir | 350 | Agricultural advisor | Confirmed via letter / email | 300 | 50t difference – both verbal estimates | None |
| Animal Manure | 6,000 | Agricultural advisor | Confirmed via discussion & email "solid slurry" | 6,000 | Reasonable estimate | None |
| Plastics | 50 | Stan Brouard Ltd | Confirmed via a discussion | 50 | Reasonable estimate | None |

4 N.B. WEEE arisings have been identified as part of the waste that currently is disposed of at Mont Cuet as C&I.

| Main Waste Arisings Categories (and sub section) in Guernsey. | 2001 Base data (t) | Source of information as per ISLR1V2 | Confirmed/ Calculated/ Weighed/ Estimated | 2001 data (t) from validation process | Explanation if any differences | Outstanding or other issues |
|---|---|---|---|---|---|---|
| Horticultural | 6,000 | Horticultural Committee | Confirmed via discussion | 6,000 | Reasonable estimate | None |
| **TOTAL AGRICULTURAL AND HORTICULTURAL** | **12,400** | | | | | |
| Inert | 127,000 | Ronez information and weighed in to Longue Hougue | Weighed and estimated | ? | Discrepancies found | Further explanation below |
| Mixed | 40,750 | This broken into 2 sections. Weighed mixed builders' waste into Mont Cuet & estimate of inert waste separated by using commercial sorting facilities | Builders' waste – weighed.<br><br>Inert - estimated | ? | Unable to confirm inert estimate | Further explanation below |
| **TOTAL CONSTRUCTION AND DEMOLITION** | **167,750** | | | | | |
| End of Life Vehicles (ELVs) | 2,000 | Bulky waste records and estimate | Calculated estimates | 2000 | Reasonable estimate | None |
| Tyres | 300 | Estimation | Calculated estimate | 300 | Reasonable estimate | None |
| **TOTAL ELV & Tyres** | **2,300** | | | | | |
| Water Treatment Sludge | 350 | Water Board | Confirmed via a | 350 | Reasonable | None |

| Main Waste Arisings Categories (and sub section) in Guernsey. | 2001 Base data (t) | Source of information as per ISLR1V2 | Confirmed/ Calculated/ Weighed/ Estimated | 2001 data (t) from validation process | Explanation if any differences | Outstanding or other issues |
|---|---|---|---|---|---|---|
| | | | discussion | | estimate | |
| **TOTAL Water and Waste Water** | **350** | | | | | |
| **TOTAL WASTE ARISINGS ON GUERNSEY** | **250,015** | | | | | |

### 2.1.1 Evidence to Substantiate Data

ISL and the States of Guernsey arranged several meetings with various parties within Guernsey to gather waste arisings data for 2001. Some of this information was gathered directly from meetings and there is no further documentation other than that in ISLR1V2.

Guernsey as a whole has few weighbridges and weighbridge data are only available for materials entering the Mont Cuet landfill site. Therefore often the best available information provided were verbal estimates from informed parties. Generally there is a lack of written clarification with regards to these base data.

### 2.1.2 Mixed Commercial and Industrial Wastes

ISLR1V2 outlines that mixed industrial and commercial (known as Mixed C&I) is derived from the weighbridge data and includes the adjustment of the Frag. Using the following calculation and the weighbridge data[5] the correct arisings tonnage for Mixed C&I could be obtained.

28,900 = "Ind/Com" + "Ind/comm. Comp" + (other non household waste) "Animals" + "Street cleaning" + "wood" + "coastal" + "Frag" (e.g. adjustments for Frag)

= 17540 + 1000 + 42 + 393 + 215 + 500 (for Frag)

= 28,832t

From this calculation it appears that the mixed C&I only has a small rounding error. However from examination of past weighbridge records it is clear that Frag was recorded as "C&I" as it enters the Mont Cuet landfill site. The Frag tonnage is already included in the above calculation.

Therefore this tonnage for Mixed C&I is overestimated by 500t which is an error of 1.7% in the total of Mixed C&I waste.

### 2.1.3 Double Counting

One point to be noted is that ISLR1V2 sets out the wastes as arisings, i.e. the amount of waste produced, either by inference from data on resources coming in to the Island or from weight data obtained at Mont Cuet weighbridge. The waste flow model then proceeds to demonstrate

5 See the supporting documentation for list of the weighbridge categories and totals for 2001 entering Mont Cuet.

what route the different waste categories follow, including recycling, inert landfill and landfill. Several categories of waste have been assessed by using the tonnage of waste weighed as it enters the landfill, whereas other categories have been assessed by collating information from other sources (e.g. by direct conversations with parties responsible for the waste category production).

However these two different methods could potentially lead to double counting. Listed below are the wastes that could have been double counted.

Table 3 **Table Outlining Potential Double Counting Of Waste Categories**

| Main Waste Arisings Categories (and sub section) in Guernsey. | 2001 Base data (t) | Location of double counting | Tonnage potential double counted | Issue |
|---|---|---|---|---|
| Hospital | 300 | Mixed C&I | 112 | It is not clear from the weighbridge records which category the 112t of bottom ash from the Abattoir and healthcare incinerators are recorded as it enters the Mont Cuet Landfill. The weighbridge records show that the majority of this waste enters Mont Cuet recorded under C&I. |
| Other Healthcare | 100 | | | |
| Abattoir | 350 | | | |
| Agricultural Plastics | 50 | Mixed C&I | 50 | Agricultural Plastics arises separately and in 2001 would be disposed to landfill. It is not recorded separately and therefore is likely to be recorded in Mont Cuet as C&I. |
| Water Treatment Sludge | 350 | Mixed C&I | 350 | Cannot see evidence in the weighbridge records of separate section or waste for water as the same amount that the Water Board claim. Therefore it must be recorded at the weighbridge as another element – e.g. C&I. |
| **TOTAL potential for double counting** | | | **512** | |

### 2.1.4 Construction and Demolition Wastes

**Inert**

Construction and Demolition wastes (C&D waste) is the area of most uncertainty. Longue Hougue weighbridge records show that 144,735t were deposited at the site in 2001. It is understood that the construction business was undergoing a "boom" in Guernsey and there would be significantly more inert available in 2001 than should be expected usually, therefore ISL adjusted this figure to 100,000 (closer to the tonnage input in 2000 of 97,462t).

Some commercial sorting and recovery of materials from C&D wastes is carried out on the Island. Ronez is a quarrying company on Guernsey, who also accepts mixed inert C&D wastes from skip companies. Ronez sort these wastes for reuse and dispose of unsuitable C&D inert wastes to Longue Hougue. Therefore information was also obtained from Ronez regarding their estimates of inert waste throughput (as they did not have a weighbridge in place in 2001). Ronez estimated their total throughput (from quarrying and from the skip companies) was 50,000[6]tpa and they sell 30,000tpa as aggregate.

The total inert C&D waste tonnage for 2001 was 127,000t compromising:

- 100,000t of inerts into Longue Hougue;
- 50,000t of inerts dealt with by Ronez; and
- Minus 23,000t of inerts separated from mixed C&D waste by commercial skip companies (see next section for discussion).

**Mixed Construction and Demolition Waste Arisings**

Mixed C&D waste arisings were estimated to be 40,750t in 2001 calculated as follows:

1. The 23,000t of inerts separated by commercial skip companies into Ronez; and
2. Builders' Waste as an input to Mont Cuet.

Builders' waste into Mont Cuet in 2001 was weighed at 17,750t. This waste is brought into the site from approximately 125 companies located on the island including skip and builders' companies.

6 See page 34 section 5.1.13 of ISLR1V2

The 23,000tpa of inerts identified as being separated by commercial skip companies is difficult to confirm. On speaking to Ronez, they do not have any records of clean separated builders' waste into their site for 2001. Speaking to Island Waste Limited (the largest private skip and sorting company on the island and main supplier to Ronez) in December 2005 they estimated around 10,000tpa of inert waste is delivered to Ronez.

There are several estimates available, provided by different sources and all are open to interpretation. There are several implications for this:

- Mixed C&D waste arisings may be overestimated by 13,000t. Their treatment or disposal destination is uncertain;
- Corresponding waste compositions for total C&D waste are incorrect (as this base data with 23,000t of inert waste implies that at **least** 56% of mixed C&D waste is inert. However if there was only 10,000t of separated inert waste then 36% of mixed C&D waste would be inert).

## 2.2 Discussion of Base Data

The tables and sections above show that there are discrepancies within the base waste data arisings for 2001, however these errors have different implications and impacts depending on the current and future disposal routes. Table 4 outlines the potential implications and any actions which would be taken to resolve them.

**Table 4** **Validation of Base Waste Arisings**

| Main Waste Arisings Categories in Guernsey. | 2001 Base data (tpa) | Base Data Confirmed and Validated | Treatment Route | Implications | Action |
|---|---|---|---|---|---|
| Household | 25,555 | Confirmed and validated | Recycled & possible treatment. | Non-recycled waste will be a main input to the possible treatment facility. ***Large impact on possible treatment solution.*** | No further action required to validate 2001 data. |
| Total Industrial & Commercial (C&I) | 41,260 | Confirmed and validated. Subject to potential | Recycled & possible treatment. | Non-recycled waste will be a main input to the possible treatment facility. | No further action required to validate 2001 data. |

| Main Waste Arisings Categories in Guernsey. | 2001 Base data (tpa) | Base Data Confirmed and Validated | Treatment Route | Implications | Action |
|---|---|---|---|---|---|
| | | double counting and frag* (resulting in error of 1012t). | | ***Large impact on possible treatment solution.*** | |
| Healthcare | 400 | Confirmed and validated | Existing separate Incinerator. | Arising managed at healthcare facility - potential of double counting. ***No input to possible treatment facility*** | No further action required to validate 2001 data. |
| Agricultural And Horticultural | 12,400 | Confirmed and validated | Waste managed at source by producers. | Waste managed at source - except a small proportion (e.g. farm plastics) potentially double counted. ***Small input to possible treatment facility*** | No further action required to validate 2001 data. |
| Construction & Demolition (including "Builders Waste") | 167,750 | Unconfirmed - 13,000t$^{+}$ additional of inert. | Inerts - recycled, non-inerts for disposal. | Inerts will be diverted to Longue Hougue. Metals and card shall be recycled. All non recycled, non inert waste will be deposited at Mont Cuet, only wood would be sent to proposed Facility. ***Small input to proposed facility – would this be the same input for an alternative treatment facility?*** | Need to check the composition reflects extra 13,000t$^{+}$ additional inert waste. |
| ELV & Tyres | 2,300 | Confirmed and validated | Recycled or possible treatment. | This arising is relatively small with ***little impact on possible treatment solution.*** | No further action required to validate 2001 data. |
| Water And Waste Water | 350 | Confirmed and validated | Possible Treatment facility / landfill | Potential double counting. This arising is relatively small with | No further action required to validate |

| Main Waste Arisings Categories in Guernsey. | 2001 Base data (tpa) | Base Data Confirmed and Validated | Treatment Route | Implications | Action |
|---|---|---|---|---|---|
| | | | | ***little impact on possible treatment solution.*** | 2001 data. |

*frag Fragmentiser waste from scrap metal processing

+13,000 tonnes based on an assumption later found to be unpredictable

## 2.3 Comparison of Predicted Waste Arisings to Actual Tonnages in 2004

The base data in 2001 were used to project the waste arisings with the agreed growth rates (used by ISL) to 2004. The predictions were compared with actual tonnages for 2004[7].

Waste arisings for 2004 were selected for comparison, as this was the most recent whole year for which data were available when conducting this investigation in November 2005

7 Full details of the source of information and any assumptions used see supporting documentation 5, Figure 7

**Table 5** **Comparison Of Actual Data To Predicted Data For 2004**

| Waste Arisings in Guernsey | 2004 Actual Data | 2004 Predicted from the model | Difference |
|---|---|---|---|
| Mixed Domestic Refuse | 16,437 | 15,768 | 669 |
| Recycling Banks: | | | |
| Paper | 2,342 | 2,031 | 311 |
| Glass | 1,510 | 1,117 | 393 |
| Aluminium | 27 | 27 | 0 |
| Steel | 61 | 107 | -46 |
| Textiles | 261 | 241 | 20 |
| Garden | 1,179 | 1,069 | 110 |
| Bulky Refuse | 4,147 | 6,959 | -2,813 |
| **Total Household** | **25,964** | **27,319** | **-1,355** |
| Separated Paper For Recycling | 2,730 | 2,783 | -53 |
| Mixed C&I | 24,358 | 30,354 | -5,997 |
| Separate Metals | 6,000 | 7,063 | -1,063 |
| Electrical And Electronic | 1,600 | 1,681 | -81 |
| Batteries[8] | 0 | 53 | -53 |
| Oils[8] | 0 | 788 | -788 |
| Fluorescent Tubes[8] | 0 | 2 | -2 |
| Asbestos | 304 | 525 | -221 |
| Other Hazardous | 74 | 87 | -13 |
| **Total Commercial & Industrial** | **35,066** | **43,336** | **-8,270** |
| Hospital | 450 | 302 | 148 |
| Other Healthcare | 116 | 101 | 15 |
| **Total Healthcare** | 566 | 402 | 164 |
| Abattoir | 300 | 340 | -40 |

8 Information still missing. Only source either away on vacation or business

| Waste Arisings in Guernsey | 2004 Actual Data | 2004 Predicted from the model | Difference |
|---|---|---|---|
| Animal Manure | 6,000 | 5,822 | 178 |
| Plastics | 22 | 49 | -27 |
| Horticultural | 5,000 | 5,822 | -822 |
| **Total Agricultural & Horticultural** | **11,322** | **12,032** | **-710** |
| Inert | 154,000 | 115,909 | 38,091 |
| Mixed | 18,900 | 37,191 | -18,291 |
| **Total Construction & Demolition** | **172,900** | **153,101** | **19,799** |
| End Of Life Vehicles (ELVs) | 2,285 | 2,012 | 273 |
| Tyres | 300 | 302 | -2 |
| **Total ELVs & TYRES** | **2,585** | **2,314** | **272** |
| Water Treatment Sludge | 275 | 352 | -77 |
| **TOTAL** | **248,678** | **238,856** | **9,822** |

Table 5 shows that there is a difference of 9,822t between the predicted waste arising tonnages and the actual data provided for 2004. The difference in total waste arisings is in the region of 4% more waste than predicted.

Table 5 also shows that both household and C&I waste arisings are lower than predicted for 2004. These wastes would be the main inputs to the facility proposed in the Waste Management Plan. The largest variation from predicted to actual is with the C&D waste, the majority of which would not have been destined for the proposed facility. Household and C&I wastes in particular, previously landfilled, now need alternative treatment.

It is worth noting that Fountaine Vinery (the Guernsey States C&I Materials Recycling Facility (MRF)) started operating in October 2002 and Pointes Lanes MRF (operated by Island Recycling) was operating in both 2001 and 2004. All the corresponding outputs (scrap metal, card, inerts and residual to Mont Cuet) were already included in the tonnage arising information from Guernsey Metals, Mayside, Longue Hougue

and Mont Cuet records respectively. It is assumed that all inputs into the MRF equal the recorded outputs, and these outputs are already included elsewhere within the waste arisings data.

Current and future waste generation and management activities and initiatives (including reduce and reuse and recycling schemes) may reduce the actual amount of waste which is deposited in Mont Cuet landfill site on an annual basis.

# 3. MODEL

This section reviews at the Guernsey specific model. The model is comprehensive and it is easy to follow the flows of data through the model.

## 3.1 Base Data and Flows

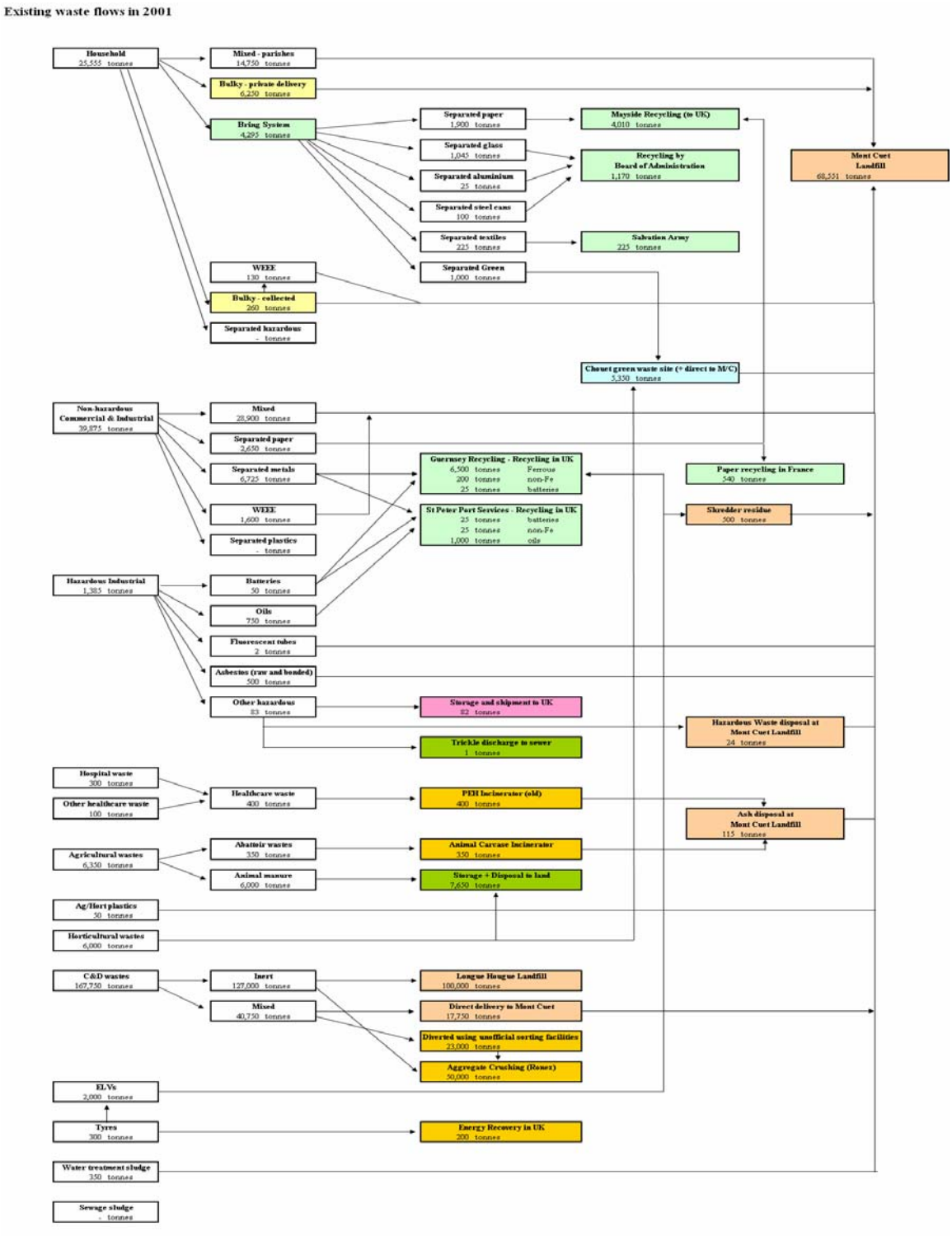
As discussed in the previous section all the available base data were used. The flows for 2001 are shown in Figure 1 [9] using these base data.

The model illustrates the flows for 2001. It shows that 500t of "Shredder Waste" (known as Frag previously), enters Mont Cuet Landfill directly and not as part of C&I waste stream waste. This compounds the Frag discrepancy (discussed in sections 2.1.2 and 2.1.3), so in 2001 there is potentially 1512t extra mixed C&I waste modelled entering Mont Cuet landfill than actually occurred.

However, within this same input of waste into Mont Cuet there is an omission of bulky waste (6,250t). With these adjustments the input into landfill for 2001 should be 73,289t – an addition of 4,738t. Therefore the model shows 6% discrepancy of total waste that should be entering Mont Cuet in 2001.

9 Source: Worksheet called "Flows 2001" of the Guernsey Model "Gsy Waste Flows & Costs 25-3-04"

## Figure 1 Existing Waste Flows As Shown In The Waste Flow Model



## 3.2 Recycling Assumptions

The model indicates the assumption that recycling in Guernsey increases from 2001. The recycling assumptions are all outlined in ISL's Preparation of a Waste Management Plan Report number 2/3, "Review of Waste Management Options and Identification of Preferred Scenario" (known from now on as ISLR3).

The model includes the assumption that kerbside collection has a 70% participation rate (i.e. 70% of the residents who are offered the service will use it). The different materials collected by the kerbside collection have different capture rates (capture is the amount of recyclate material within residual waste that the householder actually recycles.) The assumed capture rates are: Glass – 95%; Cans - 65%, Paper – 45%; and textiles - 65%. These capture and participation rates were based on measured values in Colchester in 2001, (one of the few authorities to monitor these parameters at this time). Using Colchester as an example was a reasonable assumption in 2001 for a successful kerbside scheme.

The model predicts that (using the above assumptions) the overall recycling rate for household waste in Guernsey will increase from 17% to 21% by 2006.

In addition the model predicts that a Civic Amenity (CA) site is developed and opened in 2006. (CA waste has been referred to as "bulky waste" in the base data.) This CA site will divert the following waste streams:

- metals;
- paper and card;
- wood;
- green waste; and
- hardcore.

Green household waste from the CA site will be composted rather than landfilled. It is calculated that 45% of the CA waste will be recyclable and these materials will be recycled with 90% efficiency. This is in line with UK CA recycling rates and it is reasonable to use these assumptions for the CA site in Guernsey. The model shows that overall the recycling at the CA site is expected to increase total Guernsey household recycling to 25%.

The model shows that other waste streams also are assumed to be recycled or diverted from landfill. Green waste from the horticultural waste stream is assumed to be diverted into a composting facility. Other wastes from Agriculture and Horticulture will be dealt with separately. However, it is assumed that both C&I and C&D waste streams will undergo diversion and recycling via waste facilities which have yet to be constructed (see section 3.4).

### 3.3 Waste Minimisation

The following assumptions for waste minimisation were used for the model:

Household Waste 0.5% waste minimisation for the first 10 years.

C&I Waste 1.0% waste minimisation for the first 10 years.

The methods of encouraging waste minimisation activities are outlined in ISLR3 (page 30):

- Information Provision (to encourage public and companies to be aware of waste issues);
- Increase disposal charges;
- Limits on landfill of certain wastes;
- States procurement policy;
- Deposit refund system for batteries;
- Economic instruments (e.g. tax on plastic bags);
- Producer Responsibility Groups; and
- Producer responsibility for packaging.

The ISLR3 report does not detail how these would be implemented in detail, nor does it limit the number of waste minimisation initiatives that could take place in Guernsey.

The model only assumes waste minimisation to have an impact on the total waste growth each year for the first 10 years.

If waste minimisation was not included as a base assumption within the model, the total waste arisings in 2006 would be greater by 1% (2952t) than that which was predicted. However whether certain wastes are

minimised or not has implications not only for the total amount of waste but also for different waste streams and flows and impacts for the nature and content of feedstock for any final waste disposal solution.

### 3.4 Waste Facilities

The ISL model also projects a number of recycling / waste facilities to deal with Guernsey's waste. The first facility is a composting site to be on line in 2006 with an input of approx 6,000t, expanding to 7,100t in 2027. The inputs into this facility will be generated by householders and collected at the CA site, and from the horticultural sector.

The second group of facilities modelled are Material Recycling Facilities "MRF"s, one for C&I waste and the other for C&D waste. Both of these facilities were modelled to be on line in 2006. The C&I MRF was due to start with an input of 33,100t in 2006 and expand to 55,500t by 2027. The C&D MRF inputs start at 34,000tpa and decrease to 30,000tpa. The model assumes both of these facilities will split the waste streams into individual materials and increase recycling, diverting materials from landfill with 75% efficiency.

The final facility modelled by ISL is the EfW plant, due on line in 2006. Therefore after the model has projected the total waste arisings (based on the assumptions discussed throughout this appendix) the input to the EfW plant would be compared to the calculated mechanical capacity[10] and thermal capacity boundaries (for further information see supporting documentation 2). Therefore listed below are the assumptions of the proposed EfW plant.

- Maximum mechanical capacity 10.8 t/hr
- Minimum mechanical capacity 6.3 t/hr
- Maximum thermal capacity 99.0 GJ/hr
- Minimum thermal capacity 69.3 GJ/hr
- Maximum operating hours 7800 hrs per year
- Maximum tonnage input 84,240tpa
- Minimum tonnage input 49,140tpa

10 This is the minimum and maximum tonnage requirement of the EfW.

The ISL Guernsey model shows that when the EfW plant came on line in 2006 the predicted waste input would be 53,575tpa.

### 3.5 Future Waste Flows

The assumptions discussed in the model were used to create and predict future waste flows, inputs and outputs into different waste facilities on Guernsey.

From this modelling and assumptions the main inputs to the proposed EfW plant in 2006 were predicted as:

- Household (non CA) 29%
- CA waste 8%
- C&I waste 59%
- C&D waste 3%

However the model also evaluates waste that would be deposited directly to Mont Cuet from 2006 to be approximately 8,000t; 80% of this waste (6,500t) that goes direct into Mont Cuet is C&D rejects from the C&D MRF.

No discussion is provided on the nature of these rejects, only that “recyclables” (metals, wood) and inerts have been removed. Thus around 6,500t of additional material for combustion might be available for the proposed EfW facility.

### 3.6 Summary of ISL's Waste Model

The waste model was specifically developed for Guernsey and evolved throughout the preparation of a Waste Management Plan for Guernsey. The model combines all the assumptions regarding growth, waste compositions and all the base tonnage data and predicts future waste arisings.

The model has incorporated recycling in different forms from all the large waste streams. For example a householder has the option to recycle via kerbside, bring schemes, or through the CA site. The model assumes C&I waste and C&D waste will be recycled via 2 MRFs. The model has also incorporated waste minimisation schemes and the impact of these on the total waste growth.

Altogether the assumptions used within this model appear to be reasonable and the flow of materials and streams are easy to follow through the model. The only flow that is uncertain is the rejects of the mixed C&D waste after the MRF process. This non recyclable mixed C&D waste is proposed to be deposited directly to Mont Cuet. However in reality some of this 6,500t (in 2006) of rejects of mixed C&D waste may be directed to the proposed EfW plant or an alternative waste disposal facility.

It must be noted that this is only a model and in reality flows may take an alternative route. However for the actual flows to behave in a similar style to the model the entire infrastructure must be in place, including the minimisation initiatives, MRFs, compost facilities, recycling schemes and the proposed EfW plant with the specified range of tonnage boundaries.

# 4. WASTE COMPOSITION

Waste composition analysis provides information on the materials that are present in a given waste stream. Within Guernsey there are several waste streams that have been identified, these include:

- Household (known as Parish [11] waste within the States of Guernsey);
- C&I;
- C&D; and

There are other waste streams within the main categories above that can also be identified, including:

- Agriculture; and
- Horticulture
- Civic Amenity Waste (known as Private Household[12] by States of Guernsey).

Waste composition data on each of these waste streams can be combined together to create the total waste flow and provide useful information for Guernsey as a whole, such as:

- The range of materials within the waste and the different streams;
- The amount of each of these materials and their relative proportions in the total waste;
- The amount of waste that is generated per household or business;
- How much of each material households, businesses (etc) recycle compared to the amount they dispose; and
- The range of materials delivered to a final disposal facility (e.g. landfill or the proposed EfW plant in the ISL model).

11 Guernsey's waste definitions defer to UK. However Parish waste is the residual waste collected at the kerbside and in effect is the same as UK Household Waste once bring and kerbside recycling are added. Within this report all references to household waste refer to parish waste, bring and kerbside, as it is assumed within the waste model.
12 See Mont Cuet weighbridge for this category. It is referred to as CA waste in this report from the references made in the waste model. The ISL reports base data CA waste is referred to as "Bulky waste".

## 4.1 Factors Influencing Waste Composition

Waste compositional analysis can be conducted using several different methods [13] and it is necessary to ensure that the method used is appropriate for the purpose of the waste compositional analysis.

Certain factors may influence the waste composition such as the time when the analysis was conducted. For example:

- There may be seasonal variation (summer will give a different waste composition than winter);
- weather (a dry hot summer will have a different influence to a cold wet summer); and
- The day of the week may create different waste compositions (for example at weekends more people are involved in leisure activities.

Waste compositions will vary from place to place and are influenced by a range of socio-economic characteristics, for example an inner city household waste composition would not be expected to be the same as a rural catchment.

These factors have an influence on the waste composition and may have an impact on the total waste flows. For example a small change in the household waste composition such as reducing the "residual" fraction by 1% and increasing the "paper and card" fraction similarly would result in an additional 180t of paper for recycling. However, the diversion of 180t from the 49,000t to 84,000t of waste destined for the proposed EfW plant would reduce the total input tonnage by (at most) less than 0.4%. Looking at the entire flows this change in composition has little impact on the total tonnage for disposal in a waste facility.

In comparing any waste compositions we need to ensure the definitions of the streams and quantities of the compositions are comparable. In addition the locations of influencing factors of comparative waste compositions should be the same (for example rural compared with rural).

## 4.2 Past Work on Guernsey

In the past 10 years, Guernsey has invested time and money in assessing its waste composition. However different methods and approaches have

13 See Waste Compositional Analysis, 2004, DEFRA, Entec and Eunomia

been applied, often to provide the answer to different questions. Below is a brief summary of work conducted on behalf of or for Guernsey.

### 4.2.1 AEA Technology 1994 - 1995

From 1994 to 1995 AEA Technology conducted 3 phases of investigation to assess the waste composition on Guernsey. In September 1994 they provided non-quantitative subjective comments of the waste composition, observing waste entering the disposal destinations and categorizing the different types of waste including household, commercial, construction & demolition, bulky and green waste sectors. A similar exercise was repeated in January 1995.

In July 1995 AEA Technology selected 2 household refuse collection routes which had a mix of socio-economic household types. It was considered that these 2 rounds were representative of the whole island and detailed waste analysis was conducted on the waste collected. A limitation to the study was that some waste from commercial sources was selected; however the sample was too small to provide statistical characteristics of waste analysis for this stream.

### 4.2.2 WRc 1996

WRc conducted a waste audit of household waste in May and June 1996, carrying out composition analysis on two representative household collection rounds. WRc analysed the waste from household dustbins and therefore excluded any other CA, bring site or bulky waste collection. This analysis gave detailed and quantitative information on household waste composition including size, moisture and calorific value. The study also looked at a limited number of commercial sector loads but this did not provide any significant findings.

### 4.2.3 Guernsey's Department of Engineering, every 2 years

Guernsey conducts an in house subjective volumetric assessment of the loads at Mont Cuet every 2 years. They use relative density information and weighbridge data to extrapolate the weights of the different waste types as the waste enters the landfill site, and calculate the weight of waste that could be diverted. The purpose for this composition is focused to provided an annual tonnage of waste that would be suitable for an EfW plant, additional recyclables, green waste that could be diverted to a composting facility, inert waste and waste that would be sent directly to landfill. This audit provides a range of information, however it does not always look at the different waste streams (e.g. household, commercial and C&D), instead it looks at the whole waste

entering the landfill and does not open black bags to see the composition of the waste from for example households and hotels.

### 4.2.4 Benefits and Disadvantages of Guernsey Composition Estimates

Guernsey has collected their base data over time and seasons (from 1994 – 1996 and repeated every 2 years from 2000 onwards for C&I). Through this research they have sourced a range of Guernsey specific information, including:

- Bulk density;
- Moisture content; and
- Chemical composition.

There are issues to be considered with regard to the past Guernsey research. First and foremost is that some of the data are over 10 years old and could be considered out of date. The research was conducted over a period of time, but to reduce the effect of seasonality, a full waste composition analysis over 4 periods in the same year could have been conducted. As always, the larger the sample size the greater the confidence in the composition results, but practicalities often restrict the size of the sample to that which can be dealt with easily..

## 4.3 Waste Composition Review

Enviros has been asked to review the waste composition used in the Guernsey ISL Waste Model.

### 4.3.1 Household Waste Composition

ISLR1V2 clearly outlines the waste compositions used in the model[14] . The waste composition analysis by WRc in Guernsey provided a quantitative detailed analysis of householder black bag waste, detailed in Table 6.

14 Page 7 onwards

**Table 6** **Estimated Dustbin Waste Arisings From Households In Guernsey For 1996 (Taking Weighted Average Of May And July 1996 Figures) (Source: Table S, Wrc Waste Audit 1996).**

| Waste category | Percentage | tpa |
|---|---|---|
| Putrescibles | 21.1% | 2400 |
| Paper and card | 33.5% | 3770 |
| Plastic film | 9.4% | 1060 |
| Dense plastic | 5.3% | 600 |
| Textiles | 4.6% | 520 |
| Miscellaneous combustibles | 5.1% | 570 |
| Miscellaneous non-combustibles | 2.9% | 330 |
| Glass | 6.2% | 700 |
| Ferrous metal | 2.4% | 275 |
| Non-ferrous metal | 1.1% | 125 |
| >10 mm fines | 8.3% | 940 |
| Total | 100% | c. 11300[15] |

WRc analysed only the black bag element of the household waste and the model needs to ascertain "total household waste composition excluding CA". In Guernsey's case this is all waste collected in parish waste, recyclables from the bring sites and the trial kerbside collection during this period (kerbside paper collection for 8 weeks collecting 6.04t). The quantities of the recyclables for 1996 were added (see supporting documentation 3) to the total tonnage and the composition was adjusted to reflect a total household waste composition excluding CA waste.

15 Based on sample size

**Table 7** **Enviros Adjusted Figures from Waste Composition using 1996 recycling tonnages**

| Waste category | As per WRc Audit | | Total tonnage with Bring Bank recyclates (1996)[16] | |
|---|---|---|---|---|
| | Percentage | tpa | tpa | Percentage |
| Putrescibles | 21% | 2400 | 2400 | 17.7% |
| Paper and card | 34% | 3770 | 5010 | 36.9% |
| Plastic film | 9% | 1060 | 1060 | 7.8% |
| Dense plastic | 5% | 600 | 600 | 4.4% |
| Textiles | 5% | 520 | 549 | 4.0% |
| Miscellaneous combustibles | 5% | 570 | 570 | 4.2% |
| Miscellaneous non-combustibles | 3% | 330 | 330 | 2.4% |
| Glass | 6% | 700 | 1613 | 11.9% |
| Ferrous metal | 2% | 275 | 356 | 2.6% |
| Non-ferrous metal | 1% | 125 | 138 | 1.0% |
| >10 mm fines | 8% | 940 | 940 | 6.9% |
| **TOTAL** | **100%** | **11290** | **13566** | **100%** |

However the adjusted waste composition in Table 7 is not exactly the same as that is used in the model (see Table 8.)

**Table 8** **Table Of Adjusted Waste Composition By ISL And Recent Checks**

| Waste category | Used in the ISL Model | Enviros Adjusted | Difference |
|---|---|---|---|
| Paper & card | 39.1% | 36.9% | 2.2% |
| Plastic | 11.4% | 12.2% | -0.8% |
| Glass | 11.4% | 11.9% | -0.5% |
| Green Waste | 9.0% | 8.8% | 0.2% |
| Kitchen Waste | 9.0% | 8.8% | 0.2% |
| Cans | 1.3% | 1.0% | 0.3% |
| Other Metals | 2.4% | 2.6% | -0.2% |
| Textiles | 3.6% | 4.0% | -0.4% |
| Misc combustibles | 4.0% | 4.2% | -0.2% |
| Misc non - combustibles/fines | 8.8% | 9.4% | -0.6% |
| **TOTAL** | **100.0%** | **100%** | **0%** |

16 See Bring Bank Tonnages in supporting documentation 4

Table 8 suggests that there is a discrepancy between ISL and Enviros using the same method and there is no explanation for this discrepancy. However the impact of this difference is small, with a decrease of paper tonnage in the region of 400t and an increase in miscellaneous combustibles of 36t in 1996.

One area of improvement would be to reference the original WRc information, specifically the ratio of green waste and kitchen waste as part of putrescibles. Ramboll's Memo 5 (page 11) quotes the original WRc data for total putrescible waste, made up of both kitchen (97% of total putrescibles) and green wastes (3%). However the model has assumed the total putrescibles to be a mixture of 50% kitchen and 50% green waste.

The impact of this alteration in composition in the model was assessed. As this household (non CA) green waste was not considered as an input to a green waste composting facility and all household (non CA) putrescible waste was destined for the EfW plant, the change in the ratio of components of putrescible waste from garden waste towards kitchen waste would have little impact on the feedstock to the proposed EfW plant.

### 4.3.2 Comparison of Household Waste Composition in 2001.

As discussed above, the household waste stream for which compositional analysis is available for Guernsey consists of a mixture of:

- black bags from households;
- kerbside segregated collections (though only a pilot scheme at this time); and
- bring bank recycling.

Therefore Guernsey's household waste composition should only be compared with the composition of a similar waste stream, using similar categories or descriptions of components. Table 9 demonstrates ISL's method to compare waste compositions.

**Table 9** **Comparison of Guernsey's Household Waste Composition to others in ISLR1V2 (page 18)**

| | Guernsey | Cambridge[1] | Hampshire Bin Waste[2] | Hampshire CA waste | UK Official statistics[3] | Rhondda Cynon Taff[4] |
|---|---|---|---|---|---|---|
| Paper & cardboard | 39.1% | 36.8% | 32.9% | | 32% | 25% |
| Glass bottles | 11.4% | 9.5% | 4.0% | | 10% | 10% |
| Other glass | | | 0.2% | | | |
| Steel | 1.7% | 6.1% | 2.5% | | 8% | 11% |
| Aluminium cans | 1.0% | | 0.7% | | | |
| Other metals | | | 1.9% | | | |
| Plastic bottles | 11.4% | 7.4% | 1.9% | | 6% | 11% |
| Other plastics | | | 10.9% | | 5% | 8% |
| Textiles & shoes | 3.6% | 40.2% | 5.2% | | 2% | 13% |
| Wood | | | 1.0% | | | |
| Nappies | | | 2.6% | | | |
| Garden waste | 18.0% | | 14.4% | 40% | 21% | 18% |
| Food waste | | | 10.5% | | | |
| Non-compostable organics | 4.0% | | 5.4% | | | |
| Unclassified & fines | 8.8% | | 6.5% | | 16% | 3% |
| Bulky waste | | | | 13% | | |
| Mixed household wastes | | | | 8% | | |
| Wood | | | | 11% | | |
| Rubble | | | | 8% | | |
| Dry recyclables | | | | 11% | | |
| DIY wastes | | | | 4% | | |
| Other | | | | 5% | | |

[1] K. Watanabe, University of Cambridge. Includes recyclables handled by bring schemes *November 2000)*

[2] This waste probably does not include recyclables handled by bring schemes *(1999)*

[3] These figures are believed to include recyclables handled by bring schemes *(NHWA, 1996)*

[4] Waste as delivered to a landfill. Does not include recyclables handled by bring schemes *(September 1999)*

ISL used this table to compare household waste compositions. However not all the waste compositions are compiled using the same categories or descriptions of components as Guernsey and therefore cannot be compared directly, like for like, such as CA waste, Rhondda Cynon Taff or Hampshire bin waste.

However, ISL state "*the most appropriate ones for comparison with the Guernsey figures may well be those from Cambridge, which are similar, with the exception that Cambridge appears to use more cans and fewer bottles and plastics*[17]*.*" From this comparison the data suggest that Guernsey's household waste analysis was in line with other U.K. household waste compositions.

### 4.3.3 Comparison of Household Waste Analysis in 2005

We compared UK 1996 household waste composition (known as the National Household Waste Assessment (NHWA)) with UK 2002 household waste composition (from Waste Not Want Not) in Figure 2 . This shows the changes that have taken place in the National U.K. household waste composition (excluding CA waste) between 1996 to 2002.

17 ISLR1V2 page 18

**Figure 2 U.K. National Household Waste Compositions for 1996 and 2002.**

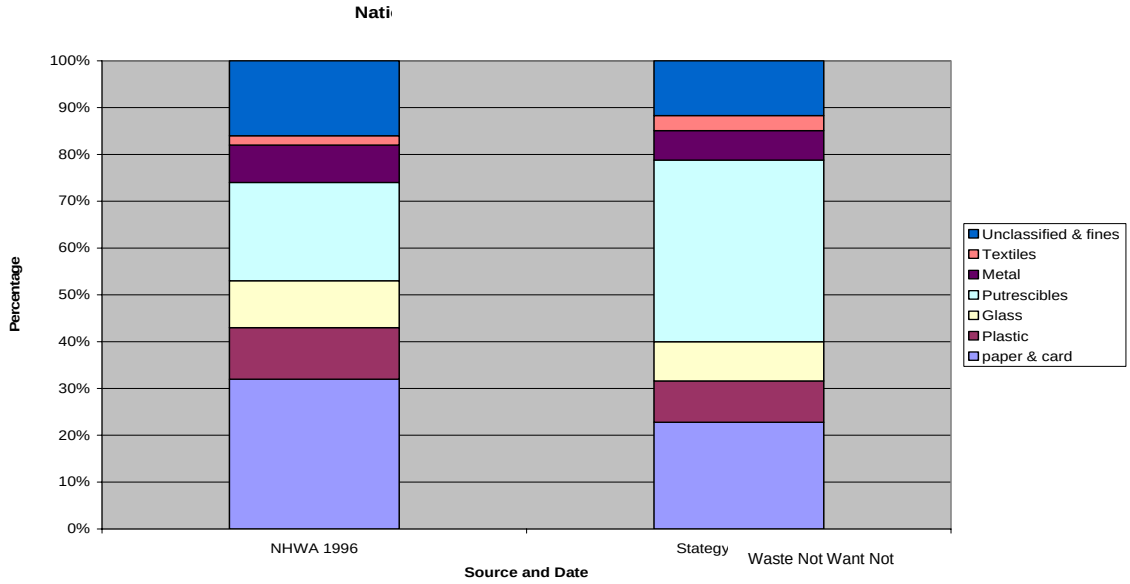
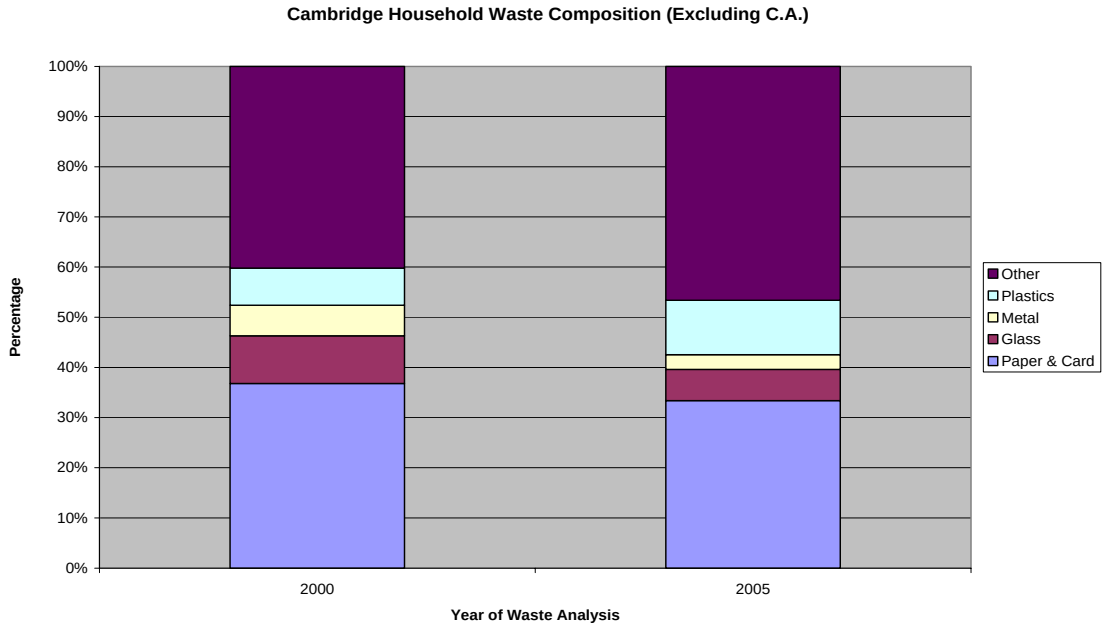



Figure 3 demonstrates that Cambridge's household waste composition (considered to be most similar to Guernsey's by ISL) has also altered since 2000.

**Figure 3 Cambridge Household Waste Composition in 2000 and 2005.**




Guernsey's and the U.K Waste Composition were not the same in 1996 (as shown Table 9 by ISL), however the components or categories of the waste streams are comparable (both waste streams are collected household residual waste, bring banks and kerbside collection.) Therefore we have compared the impact of these different household waste compositions in Table 10

**Table 10 Impact of different Household Waste Compositions on the Proposed EfW plant[18]**

| | Guernsey | NHWA | Cambridge | Waste Not Want Not | Guernsey adjusted (Green Waste 3%) |
|---|---|---|---|---|---|
| Year of analysis | 1996 | 1996 | 2005 | 2002 | 1996 |
| Recyclates available in 2006 from waste composition | 4,524 | 4,262 | 3,489 | 3,242 | 4,524 |
| Difference in Household Waste flows in 2006 | 0 | 262 | 1035 | 1282 | 0 |

18 The proposed EfW in the all the documents "Preparation of a Waste Management Plan".

| | Guernsey | NHWA | Cambridge | Waste Not Want Not | Guernsey adjusted (Green Waste 3%) |
|---|---|---|---|---|---|
| (difference in recyclates and input to EfW plant). | | | | | |
| Household Waste Input to EfW plant in 2006 (excluding CA waste) | 15,644 | 15,906 | 16,679 | 16,926 | 15,644 |
| New Total in EfW plant Input in 2006 | 53,575 | 53,837 | 54,610 | 54,857 | 53,576 |
| Percentage difference to input into the proposed EfW plant in 2006 | 0.0% | 0.5% | 1.9% | 2.4% | 0.0% |

Comparing the results using recent compositions, the data suggest there is potentially up to 1,300t of additional total waste into the proposed EfW plant in 2006. This is an increase of 2.4% over what is currently predicted. If the Waste Not Want Not composition data were used there would be less material available for recycling and therefore the tonnage into the proposed EfW plant would increase.

However, as discussed earlier, Guernsey's waste composition is not identical to the U.K national average, and indeed comparing the U.K waste composition and Guernsey's compositions for 1996 there is a 0.5% difference, although this is not a significant change to the waste input to the EfW plant.

The data also suggests that there is no impact on the model with altering the green and kitchen waste ratios in the putrescibles section of the household waste composition.

Table 11 confirms that Guernsey's data supplies information that is different to the average UK data and they should therefore be used in preference to UK data.

**Table 11 Overview Of Household Waste Composition**

| Waste category | Guernsey Model | NHWA | UK - Waste Not Want Not | Cambridge County | Cambridge County |
|---|---|---|---|---|---|
| **Date** | **1996** | **1996** | **2002** | **2000** | **2005** |
| Paper & card | 39.1% | -7.1% | -16.3% | -2.3% | +1.4% |
| Plastic | 11.4% | -0.4% | -2.6% | -4.0% | -0.6% |
| Glass | 11.4% | -1.4% | -3.0% | -1.9% | -5.2% |
| Cans | 1.3% | +6.7% | +2.0% | -5.3% | -8.4% |
| Other Metals | 2.4% | -2.4% | +0.6% | | |
| Green Waste | 9.0% | +12.0% | +7.5% | +13.5% | +19.9% |
| Kitchen Waste | 9.0% | -9.0% | +13.3% | | |
| Textiles | 3.6% | -1.6% | -0.4% | | |
| Misc combustibles | 4.0% | -4.0% | +2.0% | | |
| Misc non - combustibles/fines | 8.8% | 7.2% | -3.1% | | |

### 4.3.4 Household Waste Composition Summary and Recommendations

Altogether this exercise demonstrates that suitable and reliable waste composition data for household waste (excluding CA) are available to Guernsey. However, even at the time of creating the waste management plan, ISL stated the waste compositions *"are, of course, now some what out of date and it would seem prudent to carry out a new analysis before confirming the waste arisings for a new EfW plant."*[19]

The U.K and Cambridge data suggest that their waste compositions have altered in recent years. These changes could be due to various factors (e.g. increase recycling schemes and CA sites) and these factors may not have occurred on Guernsey. Therefore Enviros would recommend that Guernsey conduct a spot check waste composition.

### 4.3.5 Industrial and Commercial Waste Composition

The audits which the States Department of Environment undertake every 2 years provide useful information with regard to the waste entering the

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landfill site. In 2000 waste compositions for each category over the weighbridge including household, C&I, C&D wastes were assessed. There is also a quantity of black bag waste included within the C&I waste stream and in 2000, approximately 7,000t of 28,000t total industrial and commercial waste was black bags (26%).

However ISL assessed the limited information from the audit in 2000 and focused on the C&I waste stream (compacted and non-compacted) excluding any household or black bag waste. ISL then used their experience of this waste stream and adjusted the waste composition as shown in Table 12. There is no further evidence or documentation for these adjustments, choices or estimates.

**Table 12 Industrial And Commercial Waste Composition (Sourced From ISLR1V2 (Page 12))**

| Industrial and Commercial: Waste categories | Waste Audit | ISL Estimate |
|---|---|---|
| Paper & card | 10% | 15% |
| Plastic | 6% | 10% |
| Wood | 12% | 10% |
| Glass | 2% | 2% |
| Food and Garden Waste | 22% | 22% |
| Metal | 23% | 20% |
| Textiles | 5% | 5% |
| Miscellaneous | 20% | 16% |

The ISL estimates were used in the waste flow model, though there is one evident change that was not documented. That is the adjustment of 5% of the waste composition from putrescibles to metal.

Table 13 **Waste Compositions Used In The Model And Outlined In The ISLR1V2**

| Industrial and Commercial: Waste categories | As per ISLR1V2 | As per the Waste Flow Model | Difference |
|---|---|---|---|
| Paper & card | 15% | 15% | 0% |
| Plastic | 10% | 10% | 0% |
| Glass | 2% | 2% | 0% |
| Green Waste | 22% | 2% | 5% |
| Kitchen Waste | | 15% | |
| Cans | 20% | 0% | -5% |
| Other Metals | | 25% | |
| Textiles | 5% | 5% | 0% |
| Misc combustibles | 10% | 10% | 0% |
| Misc non -combustibles/fines | 16% | 16% | 0% |
| TOTAL | 100% | 100% | |

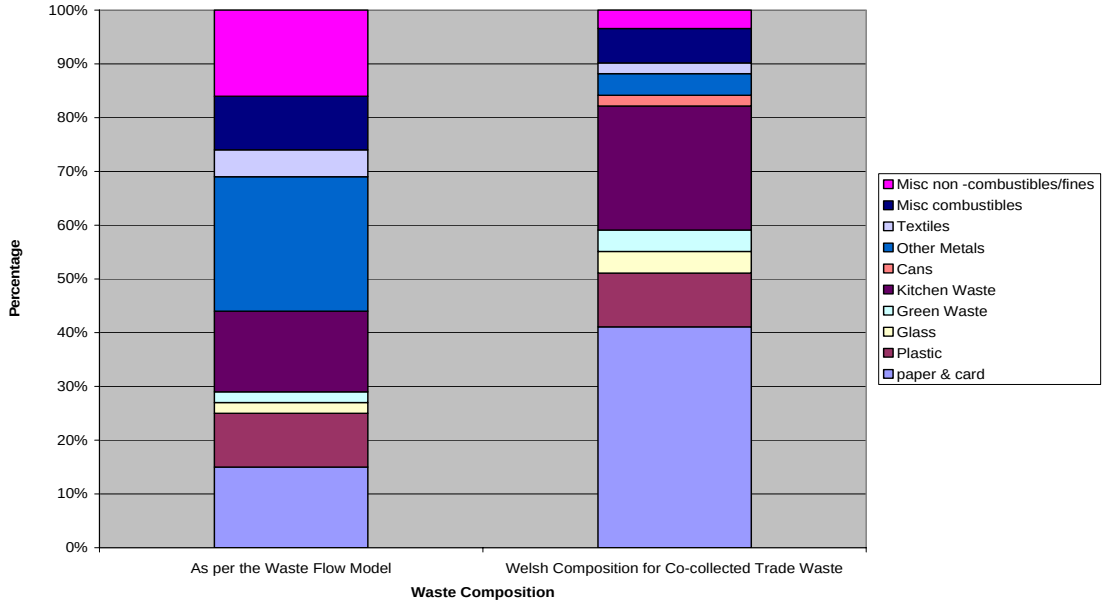
### 4.3.6 Comparison with other C&I Waste Compositions

There has been little research into the composition of C&I waste. UK local authorities have control over municipal waste only (household waste and waste collected by the local authorities from local companies and businesses). Businesses generating C&I waste have control over their own waste and make separate arrangements with private contractors and disposal facilities.

The States of Guernsey does not have control of C&I waste, however all residual C&I waste has only one disposal point – Mont Cuet. Therefore the States of Guernsey has access to the C&I waste composition as taken at this point.

A U.K example of C&I waste composition is from the study of Welsh wastes, looking at the specific waste stream of "Co-collected trade waste".

**Figure 4 Comparison Of Welsh Co-Collected Trade Composition And Guernsey's Industrial And Commercial Waste Composition**




The Welsh composition is very different to Guernsey's C&I waste composition and the reason for this is the sample waste streams are not the same. Guernsey's waste looks at the entire spectrum of C&I waste arising in Guernsey whereas the Welsh composition looks at only waste collected by local authorities. Therefore these 2 data sources are not comparable.

Other waste composition information for C&I waste comes from the Environment Agency in England and Wales , who in 1999 and in 2003 completed a survey of all the industrial waste types and commercial waste types within the 9 planning regions in the UK and in Wales. This survey provides comprehensive information of tonnages, recycling and disposal routes for C&I waste in those years.

However these C&I waste compositions in the UK and Guernsey ***cannot*** be compared as the waste categories are different. For instance, paper and card can be assumed to be the same waste type, however textiles, glass and plastics are not separated into different waste types. In fact most of the waste types discussed by the Environment Agency would fall into either miscellaneous combustibles or non combustibles types in comparison to Guernsey waste composition categories.

The comparison of data suggests that Guernsey has the most comprehensive and up to date information for C&I waste composition in comparison to the U.K.

### 4.3.7 Changes In Guernsey's C&I Waste Composition Since 2000

The States of Guernsey conduct a waste audit every two years and since 2000 there have been audits in 2002 and 2004. Therefore observing alterations in C&I waste composition from 2000 should be relatively easy. However, the subsequent audits do not observe the separate waste streams into Mont Cuet. Therefore the waste audit is categorized into waste materials (e.g. paper, inerts, glass, metals etc) as it enters the landfill and not related to the waste stream, such as household or C&I.

Therefore the subsequent waste audits cannot identify any specific changes to C&I waste composition.

### 4.3.8 Impact of C&I composition

C&I waste is a large percentage of Guernsey's total waste arisings (including C&D wastes) (approximately 20%) and residual C&I waste was proposed to be a large proportion of the waste input to the proposed EfW plant (approximately 60%). As discussed above, Guernsey has specific data on C&I waste composition and ISL adjustments to these compositions (in the model and the ISL1V2 report).

**Table 14 Impact Of C&I Composition**

| Composition tested | As per the Model | Original from audits (before intuitive estimates) | As per report ISR1V2 |
|---|---|---|---|
| EfW plant input (total) as modelled | 53,575 | | |
| New Total in EfW plant Input in 2006 | 53,575 | 55,491 | 55,198 |
| Percentage increase to EfW plant | | 3.6% | 3.0% |

Table 14 shows the predicted tonnage input to the proposed EfW plant using the different C&I waste composition. It indicates that the tonnage input to the proposed EfW plant can altered by less than 5% depending on the composition used. The table also shows that the composition

used assumes the least material that will be disposed of by the proposed EfW plant.

### 4.3.9 Industrial and Commercial Wastes Composition Summary and Recommendations

Guernsey used its own waste audits as a basis for assessing the composition of C&I wastes. These audits are the most comprehensive and applicable data to use in any modelling in Guernsey, especially when compared to other available data elsewhere in Europe. ISL also used their local knowledge and specific knowledge of C&I waste producers to adjust the values for composition. Although it would have been prudent to document the process in reaching these decisions on variations in composition, nonetheless, when developing the model ISL used the best available information based on Guernsey data. However, the ISL adjustments could be challenged by a third party at some future time, potentially exposing a weakness in the waste data.

## 4.4 CA Waste Composition

There was no reference to the CA waste composition used in ISLR1V2 or noted on the model itself other than that it is based on typical UK figures. None of the previous waste audits conducted on Guernsey have focussed on C.A waste (both recyclables and residual), as it is a relatively small part of the total waste arisings (4%). Therefore, with no other information available, using typical UK figures is an understandable assumption. However, evidence from household and C&I compositions shows that Guernsey's waste compositions are different to the average U.K compositions.

Since the development of the model in 2001 / 2002 there has been more research into Civic Amenity site (known as CA site) waste compositions and it has been brought together in one UK national report called the "National Assessment of CA sites" or "NACAS" report.

The NACAS report identifies that the waste composition of a CA site can vary widely and is influenced by factors such as rural or urban location or the nature and number of facilities provided. The NACAS report provides the most succinct data of the UK national CA waste composition. It states that the CA waste composition will vary and uses the CRN, WRAP and Waste Not Want Not CA waste compositions as a comparison.

When the Guernsey Waste Flow Model CA waste composition is compared to the NACAS information, the first noticeable difference is

the values for the category "residual" or "other" wastes. Guernsey's residual waste is 10 – 20% greater than the NACAS and the Waste Not Want CA waste compositions respectively.

**Table 15 CA Waste Composition Comparisons**

| Waste Categories | Guernsey Waste Flow Model | CRN, WRAP & Waste Not Want Not[20] | NACAS[20] |
|---|---|---|---|
| **Year of information** | **2001** | **2004** | **2004** |
| Metal | 8% | 10% | 8.9% |
| Paper | 4% | 4.2% | 5.4% |
| Wood | 2% | 8.8% | 9.3% |
| Green | 25% | 37.6% | 24.6% |
| Hardcore | 16% | 15% | 16.7% |
| "Residual" or "Other" | 45% | 24.4% | 35.1% |
| **TOTAL** | **100%** | **100%** | **100%** |

Table 15 shows that percentages of metal, paper, green and hardcore are in line with more recent information from the UK. It also shows Guernsey CA waste composition has a smaller proportion of wood compared to both sources of UK CA waste compositions.

However if wood was adjusted (to be in line with the other CA waste compositions), there would be a reduction in "residual" but there would be no change on the input tonnage to the EfW plant. The model assumes that wood from the CA site would be an input to the EfW plant. However if wood was to be recycled by some other means, this change in composition would have an impact of up to 430t[21] being diverted from the final destination.

## 4.5 Construction and Demolition Mixed Waste Composition

C&D waste is a large waste stream, however a large proportion of this waste is inert. Therefore it will affect inputs to Longue Hougue, however it is assumed that it will not affect the inputs into any final disposal system.

20 Source: NACAS Report 2004, Network Recycling
21 If approximately 6000t of CA waste per year and change the composition from 2% wood to 9.3%.

The waste flow model indicates the following assumptions for mixed C&D waste:-

- Proportion of inerts in mixed C&D waste 70%
- Proportion of wood in mixed C&D waste 5%
- Proportion of recyclables in mixed C&D waste 10%
- Other non recyclable / inert waste 15%

No justification is provided for these assumptions or linked to previous case studies outlining these findings. However the model assumes that this mixed C&D waste stream is separated by a MRF, which has a 75% efficiency to sort the recyclables.

There is little research of mixed C&D waste compositions within the UK to compare with Guernsey. However, this composition is comparable to the 2000 waste audit for "Builders' waste" adjusted with an additional 23,000t of inert waste diverted through Ronez to Longue Hougue.

- Proportion of inerts in mixed C&D waste 65%
  (stone and ceramics and 23,000t)
- Proportion of mixed C&D waste wood 7%
- Proportion of mixed C&D waste recyclable 11%
  (including card, plastics, green waste and metal)
- Other non recyclable / inert waste 18%

This demonstrates that the assumed waste composition for this waste type is reasonable, when compared to Guernsey specific information. There is a difference of 3% - the model diverts this waste from landfill (as it is "recyclable or inert") whereas the information from the 2000 audit would send it to Mont Cuet as it is either "non-recyclable or non inert" waste.

### 4.5.1 Mixed C&D Waste Base data

As discussed (in section 2.1.4) there is uncertainty regarding the base data of this waste stream. If the main assumption of 23,000t of inert waste separated by commercial skip companies was adjusted to 10,000t, it would alter the mixed C&D waste composition to:-

- Proportion of inerts in mixed C&D waste 47%
  (stone and ceramics and 10,000t)

- Proportion of mixed C&D waste wood 11%
- Proportion of mixed C&D waste recyclable (including card, plastics, green waste and metal) 16%
- Other non recyclable / inert waste 26%

This shows that the C&D composition has altered significantly, however with the adjustment of 10,000t in the base data there is no change in the waste flows modelled.

### 4.5.2 Impact of different Construction and Demolition Waste Composition

The C&D waste composition used in the model appears to be based on the Guernsey specific waste audit and therefore is reasonable to use. However, the impact of altering the waste composition was also assessed, by using the model and observing the impacts on the flows in 2006. The data suggests that little impact is observed, as only segregated wood from C&D waste is included in the waste flows for the proposed EfW plant, as all the other waste is either recycled or it is inert or non-suitable for the EfW plant and would be disposed of to Mont Cuet.

## 5. DISCUSSION OF IMPACTS

This appendix has highlighted discrepancies or errors in the available data and where appropriate indicated the impact these discrepancies have on the total waste arisings. However to bring it into a wider context these discrepancies need to be assessed in line with predictions of the EfW plant minimum and maximum tonnage capacity. As discussed previously in section 1, Ramboll has assessed the EfW plant to have a minimum tonnage of 49,140tpa at 11MJ/kg and a maximum tonnage of 84,240tpa at 10.8MJ/kg. Therefore Enviros has used the Guernsey model and conducted several scenarios, by changing the base data as discussed throughout this appendix and observing the impact on the throughput tonnage of the proposed EfW plant from 2006 to 2010.

The impacts are shown in Figure 5 .

**Figure 5 Tonnage Input To The Proposed EfW plant**

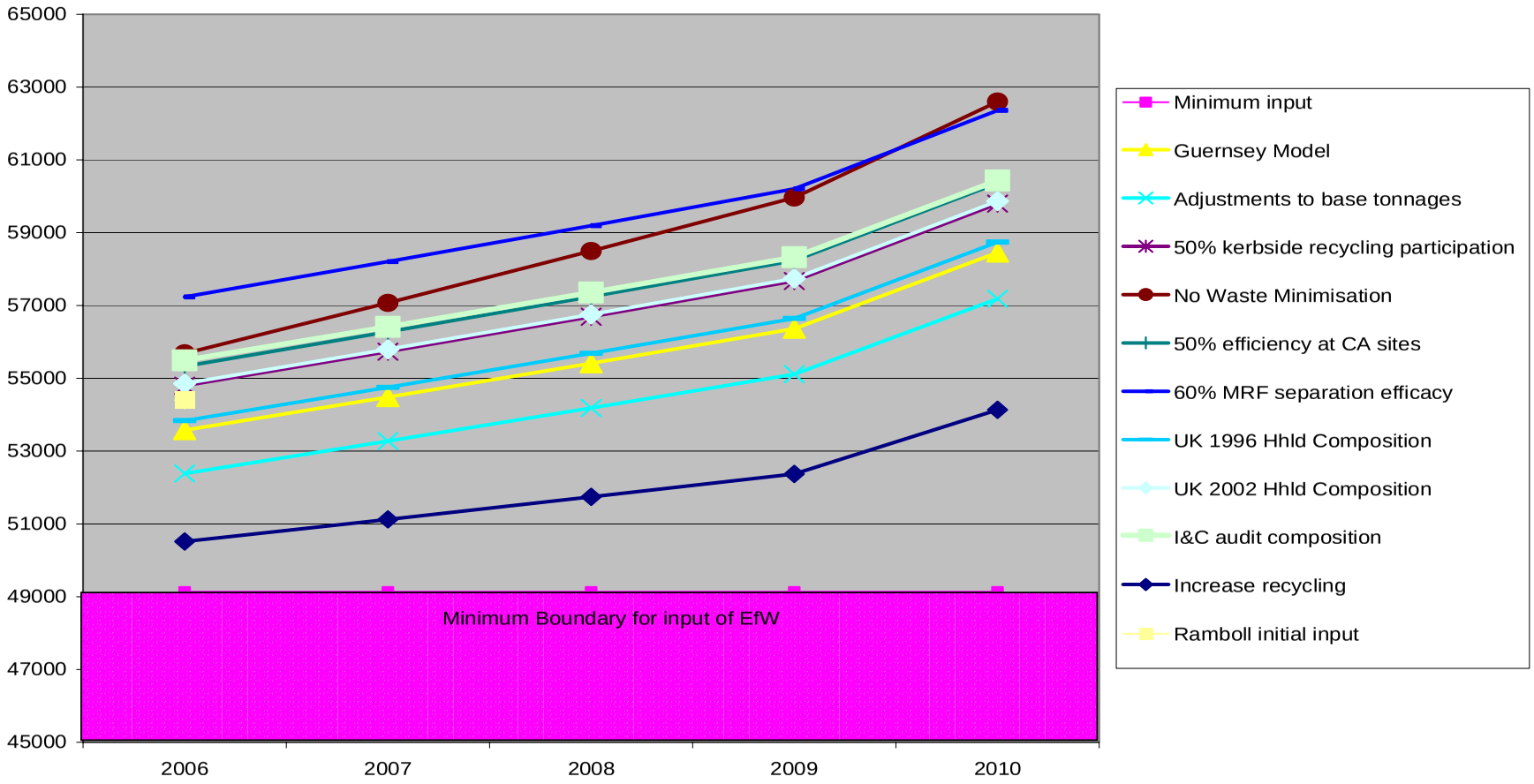


Figure 5 shows changes to the base data do affect the annual tonnage through the proposed EfW plant. The majority of the changes (including reducing any recycling schemes, MRF facilities or **not** implementing any waste minimisation) increase the tonnage into the EfW plant. In addition using comparable waste compositions (i.e. Waste Not Want Not Composition (U.K. 1996 Hhld Composition) and the NHWA (U.K. 1996 Hhld Waste Composition) also increases the tonnage input to the proposed EfW plant.

Adjusting the base tonnages of C&I due to double counting and Frag adjustments, decreases the input of the tonnage into the EfW plant. The other decrease in tonnage input (shown in Figure 5 ) is observed from a hypothetical "increased" recycling scenario, which included household waste minimisation at 1%, kerbside participation increasing to 80%, and the MRF efficiency increasing to 80%. With this hypothetical situation the tonnage input still does not cross the minimum threshold.

Altogether Figure 5 shows that the changes in waste arisings, waste composition or recycling rates have been postulated would **NOT** reduce the inputs to the proposed EfW plant below the acceptable threshold.

# 6. CONCLUSIONS

## 6.1 Base Data

The waste arisings data collected in 2001 for Guernsey suggests that it was the reliable and justifiable with exception of the total of 23,000t of inerts as part of mixed C&D waste stream, and a relatively small discrepancy in the C&I waste arisings. However these waste streams, as currently modelled, have little impact on the inputs to the proposed EfW plant and therefore require no further investigation.

The small apparent discrepancy in the amount of C&I waste generated, a result of possible double-counting (see Table 3,) could easily be resolved. The additional inert material as part of the C&D waste stream should only impact Longue Hougue and should have no influence on an alternative final disposal facility.

## 6.2 Waste Flow Model

The waste flow model is comprehensive and easy to understand. The model has included numerous recycling schemes for different waste streams such as household, C&I and C&D. The waste flow model has made an allowance for the effects of waste minimisation.

As with all predictive models, the accuracy of the projections made by the Guernsey ISL waste model is dependent on the accuracy and reliability of the input data, on the assumptions made, and on the structure of the model. The projections are not a firm guide to what will actually happen in the future.

## 6.3 Composition Data

The composition data used in this model in the main is based on Guernsey specific data from 1996 or 2000. The main 2 streams which will the potential to have an affect on the total flows into the proposed EfW plant are:

- Household Waste; and
- C&I Waste.

Other important waste compositions for the total waste flows on Guernsey are:

- CA waste; and

- C&D waste.

Household, C&I and C&D waste compositions are Guernsey specific. However the data are old and other (UK based) research demonstrates that there have been changes in composition of similar waste types (such as Household and CA) in the U.K. within this timescale. However the impact of changing these compositions when using the Guernsey specific ISL model and assessing the changes on inputs to the facility proposed in the Waste Management Plan is small.

## 7. RECOMMENDATIONS

The base data, the majority of the assumptions and waste composition data can be validated and the majority of the sources are well documented. This appendix shows that a change in these base assumptions or compositions does have an impact on the waste flows. However they do not appear to produce a significant impact on the tonnage input to the proposed EfW plant.

Nevertheless, as the decision for an EfW plant or alternatively other waste facilities is currently being reviewed, Enviros would recommend that all the large waste stream compositions should be re-assessed. The compositions are still an area that could be challenged with reference to market development schemes (for example, wood recycling) or for the specifications for alternative waste facilities, as they may require different inputs.

It is proposed that the composition of the following major waste streams is re-assessed:

- Household waste;
- C&I waste;
- Builders waste (as part of mixed C&D); and
- CA waste.

The States of Guernsey currently conducts an audit or analysis of C&I wastes every two years and this is scheduled again in 2006. Enviros proposes that Guernsey should use the same visual method and form of data presentation as in 2000 to assess C&I and builders' waste compositions, to provide up to date data which are comparable to previous information.

It is recommended that any future predictions using waste composition data should include a sensitivity analysis on the composition of key componenets of household (Parish) waste and, potentially, an analysis of components of bulky wastes arriving at the CA site.

# SUPPORTING DOCUMENTATION

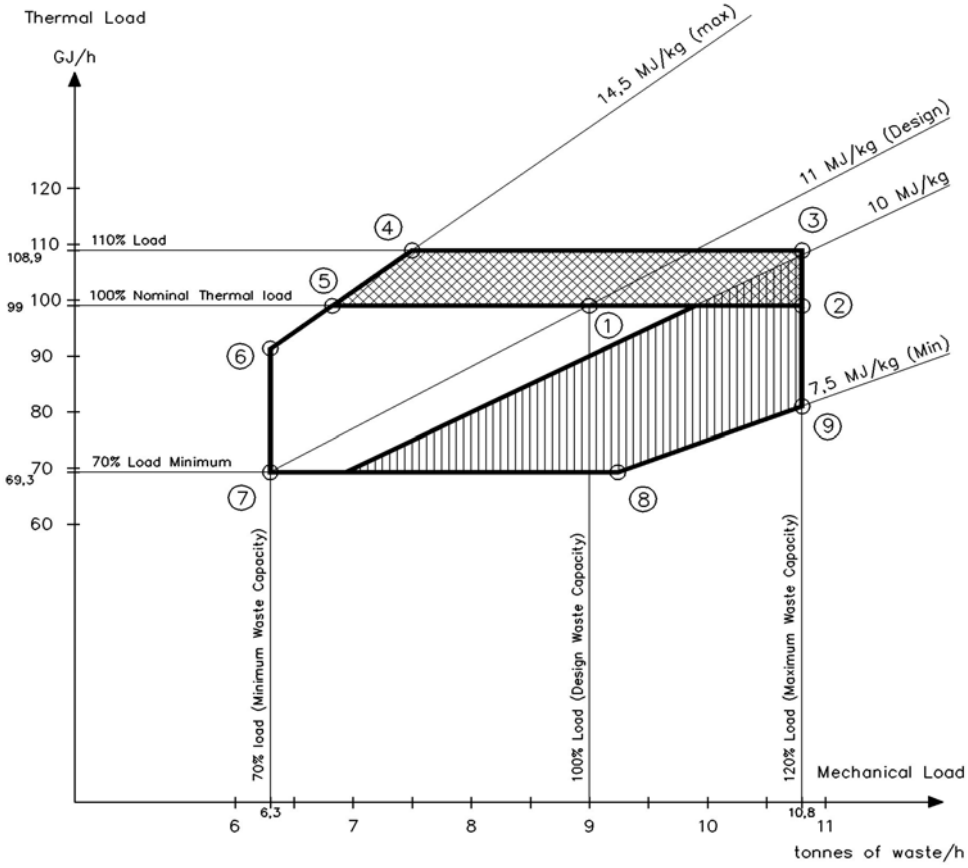
# 1. ACRONYMS

Below are common used acronyms through out this appendix:

- ISL Integrated Skills (Guernsey) Ltd
- ISLR3 Preparation of a Waste Management Plan Report number 2/3, “Review of Waste Management Options and Identification of Preferred Scenario”
- CA Civic Amenity
- C&I Industrial and Commercial
- C&D Construction and Demolition
- EfW Energy from Waste
- NACAS National Assessment of CA sites
- MRF Materials Recycling Facility
- Frag Fragmentiser residue from Scrap Metal Yard

## 2. THERMAL AND MECHANICAL CAPACITIES

**Figure 6 The Thermal and Mechanical Capacities of the Proposed EfW plant**




This is sourced from The States of Guernsey Final Project Definition Brief (section 2.2.2). Ramboll Memo 5, states that the Calorific Value of the input material would be 11 MJ/kg and therefore the following boundaries are observed.

| | |
|---|---|
| Minimum mechanical capacity | 6.3 t/hr |
| Maximum mechanical capacity | 10.8 t/hr (with CV dropping to 10 MJ/kg) |

Assuming 7200 operating hours a year the capacities as tonnages per annum are:

| | |
|---|---|
| Minimum mechanical capacity | 49,140 |
| Maximum mechanical capacity | 84,240 |

## 3. TABLE SOURCING BASE DATA FROM ISLR1V2

**Table 16 Waste Arisings by category, showing source of information (Sourced: ISLR1V2)**

| *Waste Arisings by category, showing source of information* | | |
|---|---|---|
| **Category** | **Quantity (tpa)** | **Source** |
| **Household** | | |
| Mixed | 14,750 | Mont Cuet weighbridge (parish waste) |
| Bring System: | | |
| Paper | 1,900 | BoA recycling data |
| Glass | 1045 | BoA recycling data |
| aluminium | 25 | BoA recycling data |
| Steel | 100 | BoA recycling data |
| Textiles | 225 | BoA recycling data |
| VFG | 1,000 | Input to Chouet from households is ~ 130,000 bags, which probably amounts to about 1,000 tonnes |
| TOTAL | 4,300 | |
| Bulk Refuse (total) | 6,510 | BoA finance section/Mont Cuet weighbridge + "private household" and "bags" |
| Bulk Refuse (WEEE) | 130 | Examination of bulk refuse records show that around 50% of collections are for WEEE items. |
| **Non-hazardous Industrial** | | |
| Mixed | 28,900 | Mont Cuet weighbridge after appropriate adjustments, e.g. for fragmentiser residue |
| Separated metals | | |
| Ferrous | 6,500 | Guernsey Recycling |
| non-ferrous | 250 | Guernsey Recycling and St Peter Port Services |
| TOTAL | 6,750 | |
| Separated paper | 2,650 | Mayside Reclamation Ltd/Guernsey Press |
| WEEE | 1,000 | The Department of Engineering 1995 Imports Audit suggests this category amounts to 1,600 t.p.a. but the methodology introduced a number of inaccuracies. The EU estimate WEEE arisings of 16kg per |

*Waste Arisings by category, showing source of information*

| Category | Quantity (tpa) | Source |
|---|---|---|
| | | inhabitant, equivalent to 960 t.p.a. in Guernsey. Given that 130 t.p.a. of this waste is already accounted for by Bulk Refuse Collections, ISL have revised the Imports Audit downwards and estimate this category to contain 1,000 t.p.a. |
| **Hazardous Industrial** | | |
| Batteries | 50 | Guernsey Recycling and St Peter Port Services |
| Oils | 1,000 | St Peter Port Services |
| Fluorescent tubes | 2 | ISL estimate that no more than 20,000 tubes are replaced every year. |
| Asbestos | 500 | Mont Cuet weighbridge (asbestos and bonded asbestos) |
| Other hazardous | 83 | HSE (12t) + Prosper Waste Management (54 t from SIMCO/print companies) + 17 t contaminated soil |
| **Healthcare** | | |
| Hospital Waste | 300 | Princess Elizabeth Hospital Engineering |
| Other Healthcare Waste | 100 | Princess Elizabeth Hospital Engineering |
| **Agricultural/Horticultural** | | |
| Abattoir | 350 | Agriculture & Countryside Board |
| Animal manure | 6,000 | ADAS estimated manure quantities based upon livestock numbers in 1996, recent changes in financing milk production have led to a 25% reduction in dairy herd sizes. |
| Plastics | 50 | Stan Brouard Ltd |
| Horticultural wastes | 6,000 | Horticulture Committee |
| **Construction & Demolition** | | |
| Inert | 127,000 | Longue Hougue weighbridge and Ronez |
| Mixed | 40,000 | Mont Cuet weighbridge and waste hauliers |
| **ELVs** | 2,000 | 1,860 cars were disposed of under |

*Waste Arisings by category, showing source of information*

| Category | Quantity (tpa) | Source |
|---|---|---|
| | | the bulk refuse scheme in 2001 (BoA) – excluding commercial etc. |
| **Tyres** | 300 | BoA estimates 40,000 tyres a year, assume average 7.5 kg/tyre |
| **Water Treatment Sludge** | 350 | States Water Board |
| **Sewage Sludge** | Nil | No WWTP at present |

# 4. BASE DATA EVIDENCE

| 2001 Waste Arisings in Guernsey From Model | 2001 Actual Quantity (tonnes pa) used in Model | Validation of Data | | Calculations and Base Data recorded | | | | | | Difference | Explanation | Calculation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Source of information | Weighed / Calculated / Estimated/Confirmed | Mont Cuet Landfill sheet for 2001 | Lounge Hougue Input sheet 2001 | Recycling sheet for 2001 | TOTAL | Adjustments or confirmation | Grand Total | | | |
| Mixed Domestic refuse | 14,750 | Mont Cuet Weighbridge | Weighed | 15003 | | | 15003 | -260 | 14743 | -7 | Rounding | =Parish + Bags - 260 (for bulk collection spreadsheet) |
| Recycling Banks: Paper | 1,900 | Recycling sheet - bring site | Weighed | | | 1874 | 1874 | | 1874 | -26 | Rounding ? 1% difference | |
| Glass | 1,045 | Recycling sheet - bring site | Weighed | | | 1045 | 1045 | | 1045 | 0 | | |
| Aluminium | 25 | Recycling sheet - bring site | Weighed | | | 25 | 25 | | 25 | 0 | | |
| Steel | 100 | Recycling sheet - bring site | Weighed | | | 69 | 69 | | 69 | -31 | Rounding? 31% error | |
| Textiles | 225 | Recycling sheet - bring site | Weighed | | | 222 | 222 | | 222 | -3 | Rounding? 1% error | |
| Garden | 1,000 | Number of bags entering the site multiplied by the average weight. | Calculated Estimate | | | | | 1294 | 1294 | 294 | Different assumption on weights of the bags | Bob Fisher, Recycling and Waste Manager has weighed the bags in the past and an average of 100 bags equals a tonne. Recorded 1293 bags in 2001 |
| Bulk Refuse | 6,510 | Mont Cuet Weighbridge and include bulk Collections | Weighed | 6243 | | | 6243 | 260 | 6503 | -7 | Unknown? | = Priv. HSHLD + 260 bulk collection (as pre spreadsheet) |
| **TOTAL HOUSEHOLD** | **25,555** | | | 21247 | 0 | 3235 | 24482 | 1294 | 25775 | 220 | | |
| Separated paper for recycling | 2,650 | Mayside Confirmed this figure | Weighed by Mayside | | | | 0 | 2650 | 2650 | 0 | Exact figure | |
| Mixed | 29,900 | Mont Cuet Weighbridge | Weighed - followed by adjustments | 28332 | | | 28332 | 500 | 28832 | -68 | Rounding Error? | =Ind/Com and Ind/comm. Comp plus "Frag" adjustment that enters M.C. as part of "Site Prep" also includes all other waste types that does not fit into other categories eg Wood, animals & Street Cleaning |
| Separate Metals | 6,725 | Verbal confirmation of approximation from Carl Katwyk December 2005 Managing Director of Guernsey Recycling. | Verbal Confirmation | | | | 0 | 6725 | 6725 | 0 | Verbal confirmation | |
| Electrical and Electronic | 1,600 | Estimated approximately from E.U. study in 1995 | | | | | 0 | 1600 | 1600 | 0 | From Report | |
| Batteries | 50 | Verbal confirmation of approximation from Carl Katwyk December 2005 Managing Director of Guernsey Recycling. | Verbal Confirmation | | | | 0 | 50 | 50 | 0 | Verbal confirmation | |
| Oils | 750 | St Peter's Port Services | Unable to confirm - requested information on 4 occasions | | | | 0 | | 0 | -750 | Unable to confirm | |
| Fluorescent Tubes | 2 | St Peter's Port Services | | | | | 0 | | 0 | -2 | Unable to confirm | |
| Asbestos | 500 | Mont Cuet Weighbridge | Weighed - followed by adjustments | 508 | | | 508 | | 508 | 8 | Rounding Error | |
| Other Hazardous | 83 | Mont Cuet Weighbridge & export tonnages | Weighed & verbal confirmation | 17 | | | 17 | 66 | 83 | 0 | Weighbridge & confirm | |
| **TOTAL COMMERCIAL / INDUSTRIAL** | **41,260** | | | 28857 | 0 | 0 | 28857 | 11591 | 40448 | -812 | | |
| Hospital | 300 | Princess Elizabeth Hospital Engineering | Verbal Confirmation from Chris Tomlins, Estate Manager | | | | 0 | 300 | 300 | 300 | Not yet | |
| Other Healthcare | 100 | Princess Elizabeth Hospital Engineering | | | | | 0 | 100 | 100 | 0 | Not yet | |
| **TOTAL HEALTHCARE** | **400** | | | 0 | 0 | 0 | 0 | 400 | 400 | 0 | | |
| Abattoir | 350 | Agriculture and Countryside Board | Email confirmation by Andrew Casebow | | | | 0 | 300 | 300 | -50 | Confirmed estimate from 2001 - no weigh bridge record | |
| Animal Manure | 6,000 | Agricultural Waste Strategy by ADAS | Calculation And confirmed estimate by email as "solid waste" by Andrew Casebow | | | | 0 | 6000 | 6000 | 0 | Confirmed | |
| Plastics | 50 | Stan Brouard Ltd - main supplier | Confirmed via telephone conversation. | | | | 0 | | 50 | 0 | Confirmed | |
| Horticultural | 6,000 | Horticulture Committee | Verbally confirmed during meeting with Horticulture and Agriculture 1/12/05 | | | | 0 | 6000 | 6000 | 0 | Confirmed | |
| **TOTAL AGRICULTURAL AND HORTICULTURAL** | **12,400** | | | 0 | 0 | 0 | 0 | 12300 | 12300 | -100 | | |
| Inert | 127,000 | Inert to Longue Hougue estimates & Ronez Estimation | Estimated | | 144735 | | 144735 | | 144735 | 17735 | Due to difference in estimated Ronez tonnages and the Longue Hougue Inputs estimates | From Report 1 v 5, assumed the input to Longue Hogue to be 100,000 per annum plus activity at Ronez. |
| Mixed | 40,750 | Mont Cuet Weighbridge & Estimates | Weighed - followed by adjustments | 17773 | | | 17773 | | 17773 | -22977 | Need 23,000 Estimate to other sites | |
| **TOTAL CONSTRICTION & DEMOLITION** | **167,750** | | | 17773 | 144735 | 0 | 162508 | 0 | 162508 | -5242 | | |
| **End of Life Vehicles (ELVs)** | 2,000 | ELV number of cars 1860 - average weight of car 1075 kg | Calculated Estimate | | | | 0 | 2000 | 2000 | -1 | Rounding error | Information from Environment department 1860 ELV |
| **Tyres** | 300 | BoA estimated 40,000 tyres a year, assume average 7.5 kg / tyres | Calculated Estimate | | | | 0 | 300 | 300 | 0 | | Information from Report |
| **TOTAL ELVs & TYRES** | **2,300** | | | 0 | 0 | 0 | 0 | 2300 | 2300 | -1 | | |
| **Water Treatment Sludge** | 350 | States Water Board | Verbal confirmation via Alan Redhead (Director) of Guernsey Water | | | | 0 | | 350 | 0 | Average | Spoke to Andrew Redhead - estimated 300 to 350 tonnes |
| **TOTAL WATER & WASTE WATER** | **350** | | | 0 | 0 | 0 | 0 | 0 | 0 | 350 | | |

MC spreadsheet
Confirmation of estimates or verbally confirmed
Recycling Sheets
Unable to confirm - relevant people unavailable

Above is detailed spreadsheet outlining the calculations and adjustments made to calculate the base data for 2001. Other base information follows includes:

- Copy of Mont Cuet Weighbridge records
- Copy of Recycling since 1996 from the Environment Department

| Weighbridge Description | 2001 Jan | Feb | Mar | Apr | May | Jun | 2001 Jul | Aug | Sep | Oct | Nov | Dec | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Animals | 2.64 | 3.76 | 8.52 | 2.70 | 8.76 | 1.82 | | 4.72 | | 1.76 | 2.28 | 5.24 | 42.20 |
| Asbestos (Bonded ASB) | 19.78 | 20.92 | 28.96 | 20.56 | 26.08 | 51.1 | 22.22 | 53.62 | 17.30 | 22.68 | 27.38 | 32.48 | 343.08 |
| Asbestos | 55.60 | 90.44 | 4.82 | 0.28 | 1.18 | 1.42 | 0.10 | 1.60 | 1.18 | 3.54 | 1.56 | 2.94 | 164.66 |
| Builders | 1158.34 | 1846.42 | 1623.36 | 1401.32 | 2230.14 | 1591.47 | 1623.64 | 1411.98 | 1040.46 | 1292.48 | 1125.96 | 1427.32 | 17772.89 |
| Bags | 49.16 | 50.02 | 54.74 | 61.36 | 66.24 | 67.64 | 76.02 | 72.36 | 58.44 | 66.70 | 65.82 | 68.44 | 756.94 |
| Bund Material | | | | | | 7.16 | | | | | | 55.82 | 62.98 |
| Cardboard | 11.06 | 26.58 | 13.14 | 3.22 | 13.26 | 7.94 | 3.74 | 3.62 | 3.44 | 10.98 | 2.70 | 2.72 | 102.40 |
| Chouet Green Waste | | | | | | | | | | | | | 0.00 |
| Chemicals | 0.68 | 0.30 | 0.82 | 1.18 | 0.56 | 0.56 | 0.28 | 0.42 | 0.58 | 0.82 | 0.96 | 0.54 | 7.70 |
| Coastal | 16.86 | 15.74 | 13.94 | 17.82 | 19.22 | 19.3 | 25.40 | 24.20 | 18.12 | 14.10 | 17.32 | 13.30 | 215.32 |
| Cardboard / Paper | | | | | | | | | | | | | 0.00 |
| Hard core | 23.16 | 16.52 | 49.48 | 59.32 | 29.36 | 28.46 | 280.12 | 296.56 | 334.58 | 85.36 | 77.20 | 9.56 | 1289.68 |
| Hort | 311.24 | 240.71 | 290.08 | 431.69 | 229.00 | 349.38 | 458.36 | 921.84 | 372.76 | 1239.40 | 347.92 | 173.50 | 5365.88 |
| Fridges | | | | | | | | | | | | | 0.00 |
| Ind/Com | 1425.62 | 1486.77 | 1452.10 | 1618.10 | 1551.16 | 1375.54 | 1353.99 | 1337.22 | 1170.51 | 1417.80 | 1578.64 | 1773.36 | 17540.81 |
| HSHLD/ Trade | | | | | | | | | | | 0.60 | | 0.60 |
| Ind/comm. comp | 792.44 | 696.56 | 807.84 | 759.70 | 881.24 | 795.48 | 891.54 | 951.52 | 807.12 | 868.26 | 920.04 | 828.66 | 10000.40 |
| Liquid/non special | | | | | | | | | | | | | 0.00 |
| Others | 3.58 | | 29.52 | | | | 4.92 | | 1.98 | 2.42 | | | 42.42 |
| St. Clean | 46.02 | 28.42 | 26.04 | 36.40 | 22.30 | 32.98 | 28.52 | 30.12 | 27.38 | 43.44 | 39.04 | 32.64 | 393.30 |
| Priv. HSHLD | 449.66 | 458.78 | 494.82 | 684.18 | 746.86 | 624.94 | 546.28 | 604.88 | 449.82 | 473.60 | 356.56 | 352.90 | 6243.28 |
| Scrap (Public) | 9.58 | 7.62 | 7.44 | 6.22 | 11.42 | 8.16 | 7.42 | 10.16 | 4.32 | 6.46 | 6.94 | 5.44 | 91.18 |
| Parish | 1382.58 | 1112.52 | 1236.12 | 1121.70 | 1233.18 | 1095.72 | 1163.48 | 1223.03 | 1073.56 | 1257.28 | 1163.96 | 1183.30 | 14246.43 |
| Scrap | 49.38 | 71.58 | 82.98 | 65.15 | 59.4 | 77.41 | 64.82 | 61.12 | 51.06 | 68.30 | 56.58 | 45.28 | 753.06 |
| Slaughter house | | | | | | | | | | | | | 0.00 |
| Sewage sludge | | | | | | | | | 0.48 | 0.30 | | | 0.78 |
| Site Prep | 1334.24 | 2003.82 | 662.78 | 708.84 | 415.66 | 761.7 | 816.82 | 532.14 | 258.50 | 1296.78 | 3344.46 | 650.70 | 12786.44 |
| Contaminated Soil | | 17.32 | | | | | | | | | | | 17.32 |
| Belgreve Vinery Compost | | | | | | | | | | | | | 0.00 |
| Glass | | | | | | | | | | | | | 0 |
| Fontaine Vinery XSS & Creve Coeur XCC | | 50.70 | | | | | | | | | | | 50.70 |
| Wood | 12.32 | 5.90 | 11.00 | 8.88 | 17.04 | 8.1 | 16.32 | 20.46 | 10.10 | 14.36 | 6.78 | 9.02 | 140.28 |
| Waste for recycling | 0.00 | 0.00 | 0.00 | 1.80 | 0.00 | 5.42 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.22 |
| | | | | | | | | | | | | | 0.00 |
| Total across the weighbridge | 7153.94 | 8251.40 | 6898.50 | 7010.42 | 7562.06 | 6911.70 | 7383.99 | 7561.57 | 5701.69 | 8186.82 | 9142.70 | 6673.16 | 88437.95 |
| Total Waste in | 5792.96 | 6231.06 | 6156.72 | 6240.46 | 7117.04 | 6108.96 | 6282.13 | 6732.87 | 5106.63 | 6802.26 | 5721.04 | 5957.08 | 74249.21 |
| Site Prep Materials | 1357.40 | 2020.34 | 712.26 | 768.16 | 445.02 | 797.32 | 1096.94 | 828.70 | 593.08 | 1382.14 | 3421.66 | 716.08 | 14139.10 |
| Recycled* | 70.02 | 105.78 | 103.56 | 76.39 | 84.08 | 98.93 | 75.98 | 74.90 | 58.82 | 85.74 | 66.22 | 53.44 | 953.86 |
| Others (stone, etc. leaving site) | 3.58 | 0.00 | 29.52 | 0.00 | 0.00 | 0.00 | 4.92 | 0.00 | 1.98 | 2.42 | 0.00 | 0.00 | 42.42 |
| **Net Waste In** | **5722.94** | **6125.28** | **6053.16** | **6164.07** | **7032.96** | **6010.03** | **6206.15** | **6657.97** | **5047.81** | **6716.52** | **5654.82** | **5903.64** | **73295.35** |
| | | | | | | | | | | | | | 0 |
| Percentage Site Prep | 19.17 | 24.80 | 10.53 | 11.08 | 5.95 | 11.71 | 15.02 | 11.07 | 10.51 | 17.07 | 37.70 | 10.82 | 185.43 |
| | | | | | | | | | | | | | 0.00 |
| Total Site Inputs (Waste & Site Prep) | 7080.34 | 8145.62 | 6765.42 | 6932.23 | 7477.98 | 6807.35 | 7303.09 | 7486.67 | 5640.89 | 8098.66 | 9076.48 | 6619.72 | 87434.45 |

## Materials Recycled Under Environment Department Operated Schemes (Tonnes)

| Material | 1995 | 1996 | 1997 | 1998* | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminium Cans | 26 | 13 | 13 | n/a | 24 | 21 | 25 | 24 | 12 | 27 |
| Steel Cans | 65 | 81 | 100 | n/a | 102 | 108 | 69 | 100*** | 72 | 61 |
| Metal Diverted from Landfill** | - | - | - | 92 | 454 | 672 | 848 | 734 | 1,277 | 1,161 |
| Bottle Glass | 888 | 913 | 941 | n/a | 955 | 1,039 | 1,045 | 1,165 | 1,223 | 1,241 |
| Plate Glass | 142 | 214 | 144 | n/a | 160 | 159 | 23**** | 292 | 272 | 269 |
| Paper | 1,182 | 1,240 | 1,453 | 1,798 | 1,637 | 1,741 | 1,874 | 1,960 | 2,138 | 2,305 |
| Cardboard** | - | - | - | - | - | - | 85 | 138 | 108 | 133 |
| **Total** | **2,304** | **2,460** | **2,650** | **1,890** | **3,331** | **3,739** | **3,969** | **4,414** | **5,103** | **5,197** |

**Explanatory Notes:**

** Data for all materials is not available for 1998*

*** The collection of scrap metal and cardboard at Mont Cuet for recycling is undertaken by the Public Services Department*

**** Estimated figure as no steel cans were exported in 2002 but they continued to be collected*

***** The majority of plate glass collected in 2001 was stockpiled at Belgrave Vinery and exported to the UK in 2002 & 2003*

## Textiles Recycling undertaken by Salvation Army

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Textiles | 0 | 29 | 163 | 161 | 166 | 203 | 222 | 253 | 249 | 262 |
| **Total (inc Textiles)** | **2,304** | **2,490** | **2,813** | **2,051** | **3,497** | **3,943** | **4,191** | **4,667** | **5,352** | **5,459** |

# 5. 2004 ACTUAL DATA

## Figure 7 2004 Waste Data

| 2004 Actual Quantity (tonnes pa) | | Source of information | Weighed / Calculated / Estimated? | Issues with data |
|---|---|---|---|---|
| **Household** | | | | |
| Mixed Domestic refuse | 16,437 | Mont Cuet Weghbridge | Weighed | |
| Recycling Banks: | | | | |
| Paper | 2,342 | Mayside Records | Written Confirmation | |
| Glass | 1,510 | Recycling sheet - bring site | Weighed | |
| Aluminium | 27 | Recycling sheet - bring site | Weighed | |
| Steel | 61 | Recycling sheet - bring site | Weighed | |
| Textiles | 261 | Recycling sheet - bring site | Weighed | |
| Garden | 1,179 | 117,886 bags from Recycling figures at 1 tonne per 100 bags | Calculated estimate | |
| Bulk Refuse | 4,147 | Mont Cuet Weghbridge | Weighed | |
| **TOTAL HOUSEHOLD** | **25,964** | | | |
| **Commercial** | | | | |
| Separated paper for recycling | 2,730 | Letter from Brian Perry, from Mayside Recycling dated 29th July 2005. Also letter from Guernsey Press 28th Oct - 5 ton/month to Mayside | Written Confirmation | |
| **Non-Hazardous industrial** | | | | |
| Mixed | 24,358 | Mont Cuet Weghbridge (Not adjusted for FRAG) | Weighed | Not Adjusted for FRAG - as already included under "Industrial and commercial" waste |
| Separate Metals | 6,000 | Verbal confirmation of approximation from Carl Katwyk December 2005 Managing Director of Guernsey Recycling. | Verbal Confiramtion | |
| Electrical and Electronic | 1,600 | Estimated approximately 1,600 currently landfilled from discussions with Guernsey Recycling | Verbal Confirmation | |
| **Hazardous Industrial** | | | | |
| Batteries<br>Oils<br>Fluorescent Tubes | | Unable to confirm - requested information on 3 occassions in December 2005 and once more in January 2006 | | |
| Asbestos | 304 | Mont Cuet Weghbridge | Weighed | |
| Other Hazardous | 74 | Letter from R Brown, Chief H&S officer, Commerce and Employment (H&S dept) 12th August ) - 11.4t collected. Letter from Prosper Waste Man. 12th Oct - Simco (58 t), H&S (7.6 exported), Fuel - one load, and 4.9 t of contaminated soil. | Written Confirmation | |
| **TOTAL COMMERCIAL / INDUSTRIAL** | **35,066** | | | |
| **Healthcare** | | | | |
| Hospital | 450 | Letter from Chris Tomlins, Estate ManagerHealth and Social Services 18th August 2005 | Written Confirmation | Clinical waste from hospitals 450 tonnes |
| Other Healthcare | 116 | | | Clinical waste from commercial practices (70t), Collections from community nurses (16.5) and black bags from hospital (29t) |
| **TOTAL HEALTHCARE** | **566** | | | |
| **Agricultural/ Horticultural** | | | | |
| Abattoir | 300 | From Letter dated 30th September 2005 from Andrew Casebow | Written Confirmation | |
| Animal Manure | 6,000 | Estimate provided by due to solid manure element via writen confiramtion. Total wet slurry could be up to 12,000 tonnes | Verbal & writen confiramtion. confirmation | |
| Plastics | 22 | Letter from Rodney Brouard (Managing Director) of Stan Brouard Ltd (supplier) dated 3rd August 2004 | Written Confirmation | |
| Horticultural | 5,000 | From meeting 1/12/05 | Verbal confirmation | |
| **TOTAL AGRICULTURAL AND HORTICULTURAL** | **11,322** | | | |
| **Construction and Demolition** | | | | |
| Inert | 154,000 | Letter from Ronez dated the 12th August 2005 from Peter W de Garis (Director/General Manager) Longue Hougue weighbridge 159,000 | Written Approximation and estimated weights. | Various sources within construction industry for processing - **including rounding estiamtions** |
| Mixed | 18,900 | Builders Waste Input to MC is 8,900 tonnes. Discussion with Island Recycling and Points Lane - estimate 10,000 tonnes of inerts per annum. | Weighed and Estimated | **Mixed C&D waste - any other separated inert waste?** |
| **TOTAL CONSTRICTION & DEMOLITION** | **172,900** | | | |
| **End of Life Vehicles (ELVs)** Number of vehicle | 2,285 | Record from Bulk Waste Number of vehicles - used average of 1.075t/car | Calculated estimate | |
| **Tyres** | 300 | Used previous inforamtion - as no further updates. | Calculated estimate | |
| **TOTAL ELVs & TYRES** | **2,585** | | | |
| **Water Treatment Sludge** | 275 | Letter from Alan Redhead (Director) of Guernsey Water dated 15th August 2005 | Written Confirmation (250 to 300t) | |
| **Waste water treatment Sludge** | | | | |
| **TOTAL WATER & WASTE WATER SLUDGE** | **275** | | | |
| **TOTAL TONNAGE** | **248,678** | | | |

Info missing
info received via letter
Weighed from Mont Cuet
Recycling Sheets
Spreadsheets and further calcuations

**APPENDIX 2**

# VALIDATION OF PROJECTED WASTE ARISINGS

**January 2006**

## 1. INTRODUCTION

Section 1 of this Appendix focuses on forecasting waste arisings to 2026 from the base year data of 2001 and, in particular, that component-stream which would be presented to landfill or alternative treatment facilities. Forecasts used for the previously proposed Energy from Waste (EfW) plant have been challenged on the basis on several factors, including a lower population forecast, differing growth rates of sub-sectors in the economy and a weakening of the link between economic growth and the growth in waste arisings. We assess these factors and evaluate their effects on projected waste arisings.

Section 2 of the Appendix, with regards to the previously proposed EfW plant, considers the contribution that such a plant would have on the electricity generating capacity of the island and the effect on future plans for capital investment in generating equipment.

The study was carried out after meetings with the following representatives of the States of Guernsey government:

- Alan Richards and Nick Whalley, Department of Environment
- John Ogier, Economic Adviser to the Commerce & Employment Department
- Andrew Birnie, Strategic Adviser (Economics & Research), Policy Council

## 2. PROJECTED WASTE ARISINGS

The issue of predicting future waste arisings has been addressed in the Rambol report "Waste Arisings and Calorific Value" and in the Commerce & Employment Department report "Waste Disposal through an Energy from Waste Plant – An Economic Impact Assessment". These papers proposed differing forecasts for the volume of waste likely to be presented to the previously proposed Energy from Waste (EfW) plant. The key elements of these papers are summarised in Table 1 below.

This Appendix focuses on identifying the significant factors affecting the waste projections and the uncertainties in the forecasts. Where uncertainties exist, we attempt to identify acceptable ranges for the key parameters and measure their affect on the total projections.

**Table 1 Summary of Key Points and Differences between Rambol report and Commerce & Employment Department response**

| Waste Categories | Rambol | C&E Dept |
|---|---|---|
| Household | • Population forecast to increase by 0.27% p.a. to 64,396 in 2025.<br>• includes net immigration of 200 p.a.<br>• Waste forecast to increase by similar amount | • 200 net immigration forecast challenged. Zero net immigration proposed.<br>• Proportion of "absent residents" has grown over last 20 years[1] from 3.5% in 1981 to 5.8% in 2001. If this trend continues, this may affect the total HH waste arisings. |
| Construction & Demolition | • GDP forecast to grow by 1 – 3% p.a.<br>• Waste arisings assumed to grow in line with GDP<br>• Recycling forecast to increase, | • C&D activity and waste is forecast to fall after 2005, following a boom in the construction industry. |
| Agricutlure & Horticulture | | • Activity and waste forecast to decline |

1 Guernsey Census 2001

| Waste Categories | Rambol | C&E Dept |
|---|---|---|
| Commerce & Industry | compensating partially for this increase<br>• Acknowledgement that "changes and variations in industrial activity" will influence the waste projections, but without detailed analysis. | • GDP growth expected to be lower than the recent past<br>• Forecast GDP growth of 1 to 3% considered acceptable<br>• Waste not expected to grow with GDP growth, due to higher value added activities (without proportionate increase in waste generation, especially in the Finance sector)<br>• Large price rises for waste disposal (using £100 per tonne forecast) is expected to influence waste management practices, hence diverting waste from landfill or EfW to other disposal options (including recycling)<br>• Large differences between growth forecasts for different industry sub-sectors considered significant for waste projections |
| Total | • Waste for a proposed EfW plant forecast to grow at 1.3% from 48,000 t/y in 2001 to 65,000 t/y in 2025. | • Waste for a proposed EfW plant of 50,000 t/y by 2025, due to some/all of:<br>• lower population growth<br>• reduction in tonnesWaste/$£_{GDP}$<br>• increase in waste diversion / recycling |

We consider the following main sources of waste arisings:

a) Household Waste – this includes parish waste, domestic waste deposited at Mont Cuet civic amenity site, and litter. In 2004, a proportion (19%) was recycled and the rest deposited in the Mont Cuet landfill site.

b) Construction & Demolition (C&D) Waste – this is waste from construction and demolition activities and other builders' waste. Since 1999, this has been the largest component of total waste arisings (by weight). However, most of this is inert waste, which is sent to the Longue Hougue land reclamation site. Only a small proportion would be sent to landfill or an alternative facility.

c) Agricultural and Horticultural Waste – this comprises largely of abattoir waste (directed to a special incinerator), manure and plant waste. This is directed to either disposal on land or (currently) landfill. We assume that recycling facilities for this waste stream (i.e. composting) are developed in the future, such that only a small amount of general waste would go to landfill or any future alternative facility.

d) Commercial & Industrial (C&I) Waste – this includes all commercial and industrial waste other than b & c above.

## 2.1 Current Waste Arisings

**Table 2 2001 (Base Year) Waste Arisings**

| | Total Arisings | | Landfill | | Proposed EfW | |
|---|---|---|---|---|---|---|
| | (t/y) | % | (t/y) | % | (t/y) | % |
| Household | 25,555 | 10% | 22,260 | 30% | 17,790 | 36% |
| C&D | 167,750 | 67% | 17,750 | 24% | 2,038 | 4% |
| Ag & Hort | 12,400 | 5% | 4,454 | 6% | 0 | 0% |
| C&I | 43,960 | 18% | 29,987 | 40% | 29,479 | 60% |
| Water Treatment | 350 | 0% | 350 | 0% | 0 | 0% |
| Total | 250,015 | 100% | 74,801 | 100% | 49,307 | 100% |

Table 2 shows the base year Waste Arisings data for 2001, with the proportion sent to the Mont Cuet landfill site. Columns 5 & 6 show an estimate[2] of this 2001 waste which would be sent to the previously proposed EfW plant.

Regarding C&D waste, it can be seen from Table 2 that despite contributing 67% in tonnage of total waste in 2001, this sector contributed only 24% of landfill input and would contribute only 4% of input to a proposed EfW plant. This is due to the high level of diversion of inert waste to the Longue Hougue land reclamation site. The significant sources of waste for a future treatment plant are Households and Commerce & Industry.

## 2.2 Future Waste Projections

### 2.2.1 Household Waste

The factors affecting the Household Waste projections are considered to be:

1) Per capita income growth – we estimate this to change in line with GDP and population. See the analysis below for discussion of sub-sector growth prospects. The total economy is expected to grow in the future at a long-run rate of 2% p.a.. Due however to below average growth between 2001 and 2004 and an expected cyclical turndown in the Construction industry, the average over the 2001 to 2025 period is expected to be 1.7% (equivalent to per capita GDP growth of 1.52% p.a.)[3].

2 Estimated using the DoE Waste Model, assuming composting of A&H organic waste.
3 It should be noted that, since completing this report, there have been discussions which suggest that growth in GDP should be higher, at around 2.5%, in order to meet the fiscal demand. This value falls within the 1% and 3 % range which was investigated but is higher than the assumed central estimate of 1.71% per annum growth.

| Net immigration Per annum | 2003 | 2004[5] | 2008 | 2013 | 2023 | 2026[6] | Average p.a. Growth |
|---|---|---|---|---|---|---|---|
| zero | 62,028 | 61,977 | | 61,520 | 60,488 | 59,800 | -0.16% |
| plus 100 | 62,231 | 62,297 | 62,557 | 62,813 | 63,001 | 62,710 | 0.03% |
| plus 200 | 62,434 | 62,601 | | 64,107 | 65,514 | 65,621 | 0.22% |
| plus 300 | 62,637 | 62,913 | 64,021 | 65,401 | 68,026 | 68,530 | 0.39% |

2) Population growth [4] – using the latest figures from the island's Government Actuarial Department, the island's population is expected to grow to 65,585 in 2025. This central forecast assumes a net immigration of 200 persons p.a.

3) Net immigration – this is likely to be affected by a number of factors, including island GDP relative to other countries. Considerable uncertainty exists and we consider a range of 100 to 300 net immigration per year, as well as the central estimate of 200 per year. Historically, census results have shown considerable variation in net immigration, ranging between an average 580 p.a. between 1986 to '91 and -127 from 1991 to '96. The average from 1951 to 2001 was 240 per year.

**Table 3** **Effect of Net Immigration on Population Forecast**

4) Proportion of absent residents – recent census results show an increasing proportion of residents were absent on census night. Assuming that this is representative of the year as a whole and that a resident generates less waste per year if absent for some of the year, this could have an effect on future household waste arisings. Assuming that the increase in the proportion of absenteeism continues by 0.076% per year over the period to 2026, the number absent will grow as shown below.

**Table 4** **Absent Residents**

| | 1976 | 1981 | 1986 | 1991 | 1996 | 2001 | 2004 | 2026 |
|---|---|---|---|---|---|---|---|---|
| Population | 53,637 | 53,313 | 55,482 | 58,867 | 58,681 | 59,807 | 62,936 | 65,621 |
| No. absent | 2,190 | 1,906 | 2,312 | 2,718 | 3,004 | 3,584 | 3,916 | 5,186 |
| No. present | 51,447 | 51,407 | 53,170 | 56,149 | 55,677 | 56,223 | 59,020 | 60,435 |
| Proportion absent | 4.1% | 3.6% | 4.2% | 4.6% | 5.1% | 6.0% | 6.2% | 7.9% |

4 The population growth predictions were based on data from the 2001 Census, which is thought to reflect a period of high population growth but little growth in GDP.
5 Interpolated Data
6 Interpolated Data

The forecast increase in absenteeism from 6.0% in 2001 to 7.9% in 2026 represents a drop in the non-absent resident population from 61,689 to 60,435 in 2026, or an apparent fall in the population by 2.0% over the period (equivalent to 0.08% p.a.). If we assume a resident generates zero waste while away (this ignores one-off waste generated from travel), then we predict a growth in household waste due to absenteeism of -0.08% p.a. Due to uncertainty in this figure, we test the sensitivity of the total prediction to this factor using forecasts of 0% and -0.16% p.a. growth due to absenteeism.

5) Recycling – increased rates of recycling by households would lead to a reduction in the growth of household waste disposed of. The ISL model assumes the introduction of recycling of separated household waste for paper/cardboard, glass, metal, plastics, textiles and wood. We follow this model to estimate recycling rates until 2026.

*Summary for Household Waste*

Using the factors discussed above, we predict the household waste to increase using the model below:

$$(1+q_{HH}) = (1+n)\times(1+y)\times(1+\alpha)\times(1-\rho)$$

where :

$q_{HH}$ = ave. annual growth in Household Waste tonnage

$n$ = ave. annual growth in population

$y$ = ave. annual growth in per capita income

$\alpha$ = equivalent ave. annual growth in population due to absentee residents

$\rho$ = ave. annual increase in recycling percentage

Using the central estimates of our forecasts, we obtain the following result:

| Parameter | n | y | a | r | qHH | 25 year period growth in HH waste |
|---|---|---|---|---|---|---|
| Value | 0.22% | 1.71% | -0.08% | 0.00% | 1.85% | 58.2% |
| Growth factor | 1.0022 | 1.0171 | 0.9992 | 1.0000 | 1.0185 | 1.582 |

Over a 25 year period from 2001 to 2026, this would result in an increase in household waste of 1.0185 ^ 25 = 1.58, or 58%.

### 2.2.2 Construction & Demolition

The factors affecting this component are:

1) Sector growth – this sector of the economy has experienced considerable growth over the last five years. Using the analysis of this sector carried out by the States of Guernsey Board of Industry[7]

7 "The Guernsey Capital Spending Programme and the Construction Industry", May 2003, States of Guernsey Board of Industry

and discussions with John Olgier (Employment & Commerce Dept), we forecast a large fall in sector output from 2006 to 2009, followed by a small above-average rebound between 2010 to 2013 before a long-run growth equal of 2% (i.e. approximately industry average).

2) Waste type and disposal method - most C&D waste is inert materials and is sent to land reclamation, i.e. not landfill or any proposed alternative facility. Based on the 2006 forecasts, C&D waste would account for only 4% of waste suitable for a proposed EfW plant, despite accounting for 67% of total island waste by tonnage. Its influence on the capacity issue of the previously proposed EfW plant is therefore small.

### 2.2.3 Agriculture and Horticulture

The factors affecting this component are:

1) Sector growth/decline - output in these sectors of the economy has fallen on average by 3% p.a. over the last 10 years and this decline is expected to continue. We use a forecast of -3% p.a. growth over the prediction period.

2) Waste type and disposal method – most (>99%) of the waste from this sector is organic and we assume the introduction of on-island facilities to compost this waste (excluding carcases sent for specialist incineration). Only small amounts of plastic waste will be routed to landfill or an alternative facility.

### 2.2.4 Commercial and Industrial

This main economic sector is comprised of a number of sub-sectors and we consider each of these below, with particular regards to the following factors:

1) Sub-sector growth

2) Forecast changes in relationship between waste arisings and GDP output (i.e. specific waste arisings)

3) Waste types by sub-sector

4) Alternative methods of waste management (i.e. opportunities for recycling)

***Review of C&I Sub-Sectors***

*Finance & Legal*

Finance and Legal is the largest sub-sector of the island's economy, representing around 40% of GDP (measured as a percentage of factor

incomes[8] by sub-sector). This has varied slightly over the last 10 years, growing from 37.5% in 1995 to a maximum of 42.4% in 2000, but falling back to 37.0% in 2004.

In absolute terms, the sector grew very strongly from 1995 to 2000 (with annual growth of 10% in 3 of those 5 years). This very strong growth has not been sustained since then, with small rises or falls resulting in -1% p.a. average growth between 2001 and 2004.

Growth in this sector is particularly difficult to predict, especially due to the planned changes in corporation tax in 2006 (the so-called zero-ten proposals). We propose a central forecast of 2% p.a. real growth over the prediction period.

The key relationship between waste arisings and this sub-sector's output is unclear. It can be argued that an increase in sector output may not result in the same increase in waste arisings. Activities in this sector are expected to move up the "value-chain", with faster growth in high value activities and lower growth in "back-room" activities. This can be expected to result in a lower tonnage of waste arisings per £ of output. Quantifying this shift in the "specific waste arisings" involves considerable uncertainty, and we evaluate a reduction of 0%, -20% and -40% in the growth of waste tonnes per £ of GDP.

*Health, Education, Public Admin and Non-profit*

This is the 2nd largest sub-sector, accounting for 15.6% of factor income in 2004, and has grown rapidly in recent years, on average by 5% p.a. between 2000 and 2004.

Over the next 5 years, Public Sector expenditure is expected to fall as a percentage of the economy partly due to tighter fiscal policies and the proposed changes to the corporation tax system (known as the zero-ten proposals). For this sector, we consider zero growth in real terms from 2005 to 2010, followed by 2% growth from 2011 onwards.

*Wholesale, Retail and Utilities*

This sub-sector accounted for 13% of the economy in 2004 and is expected to rise by 2% p.a. (i.e. approximately in line with the economy as a whole).

Opportunities for recycling of paper and cardboard packaging depend upon the problems of on-site storage and collection of separated waste, which need to be resolved before this becomes a viable option. We do not model an increase in recycling in this sector.

8 Factor incomes are a combination of remuneration and profits. GDP is derived by adding Other Income (i.e. unearned income, rent and public sector trading boards) to Factor Income. (Ref. "2005 Guernsey Facts and Figures").

*ICT & Other Business Services*

This sub-sector has seen considerable growth over the last 10 years, growing in relative importance from 8% to 12% of the economy and in absolute terms by an average of 10% p.a. from 1995 to 2000 and maintaining strong growth of around 7.5% p.a. from 2000 to 2004.

Over the long term, growth in this sub-sector is likely to be affected in particular by the Finance sub-sector and by the rest of the economy in general. We predict this sub-sector growth to continue at levels above the rest of the economy, but for this differential to fall (from 6% over recent years) to 3% from 2005 to 2009 and then to 1% from 2010 to 2025. With a central forecast for the whole economy of 2%, this equates to a sub-sector growth of 5% p.a. from 2005 to 2009 and 3% p.a. from 2010 to 2025.

*Hostelry & Recreation*

Despite a small growth in absolute output (averaging 1% p.a. between 1995 and 2004), the importance of this sub-sector is falling gradually as a proportion of the whole economy. In 2004 it represented just under 5% of the economy by factor income. In the near future, it is expected that this sub-sector will do well to maintain its level in absolute terms. We use a central forecast of 0% p.a. throughout the prediction period.

*Manufacturing*

Output in manufacturing has been in steady decline for the past 10 years (average growth of -2.9% p.a. from 1995 to 2004) and it now accounts for only 3% of the island's economy. It is expected that this decline will continue and so we use a central forecast of -3% p.a. growth over the prediction period for this sub-sector.

*Transport*

This sub-sector's output has shown significant year-on-year variation since 1995, but the trend shows an average of just 0.1% p.a. growth between 1995 and 2004, below the figure for the total economy. In relative terms, this reflects a decline from 3.0% to 2.2% of the total economy. We use 0% p.a. growth rate as our central forecast for this sub-sector.

*Personal Services*

This small sub-sector represents just 1.4% of the economy in 2004, but has shown strong average growth of 4.7% p.a. from 1995 to 2004. We use a 3% p.a. growth forecast to 2010 and then falling to 2% p.a. (i.e. in line with the total economy) from 2011.

### *Summary of C&I Sub-sector Growth Forecasts*

The graphs below show the relative sub-sector sizes in 2004, a summary of the growth forecasts (shown as indices normalised to 100 in 2004), the forecast sub-sector sizes in 2025 and the cumulative growth of the economy (by factor income) over the period.

**Figure 1 C&I Sub-sectors by Factor Income, 2004**

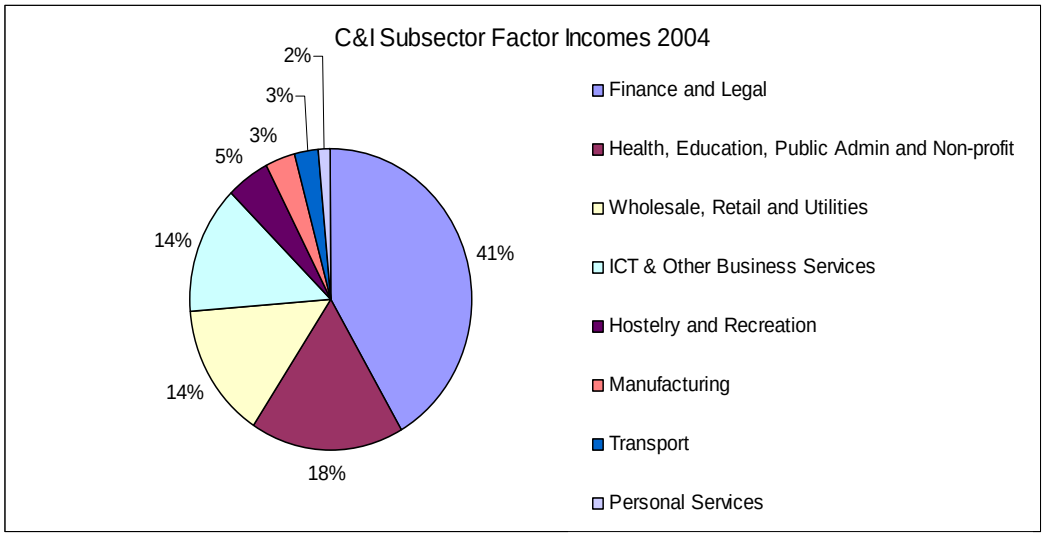
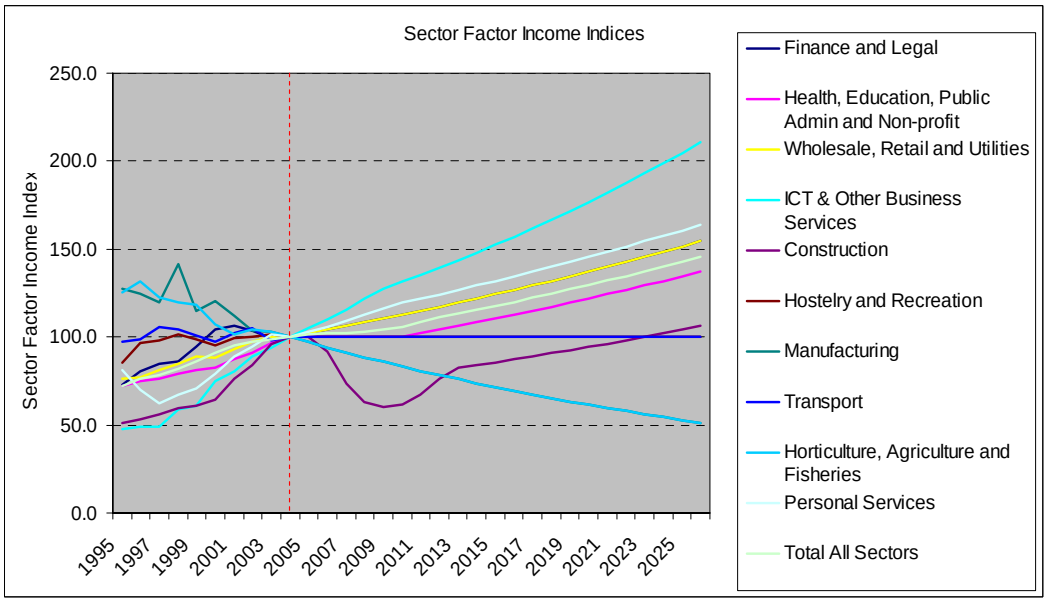
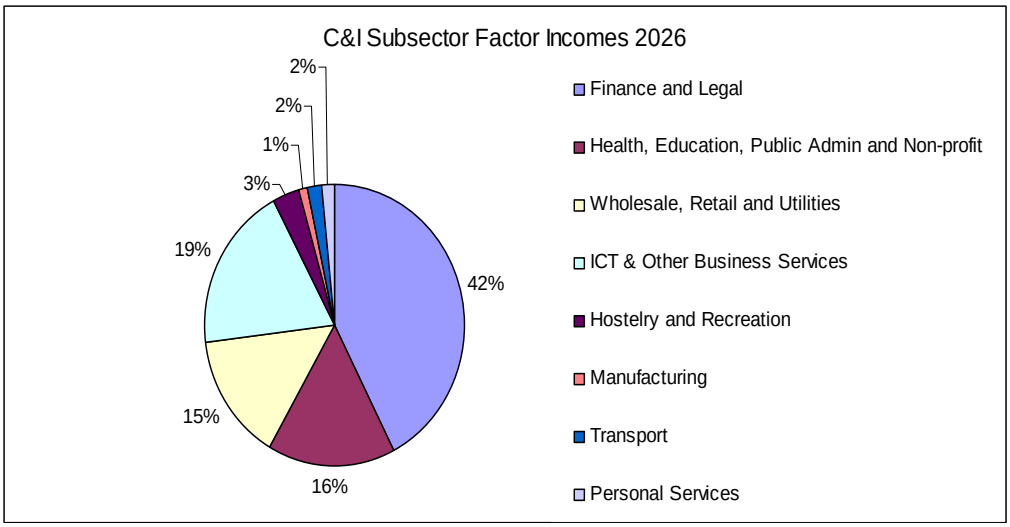



**Figure 2 Sub-sector Economic Growth Forecasts**



## Figure 3 Sub-sector Economic Growth Forecasts




## Figure 4 Cumulative Economic Growth over Period

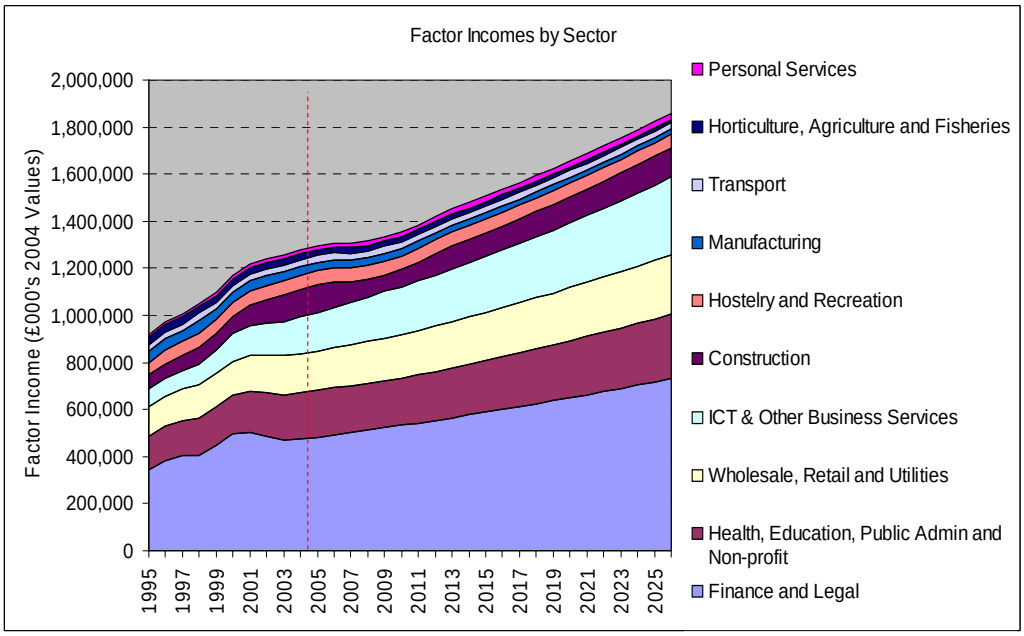


**Table 5** **Forecast Sub-sector Growth, by Factor Income**

| Factor Income | 2001 | 2004 | 2026 | Total Growth | Ave. Annual Growth |
|---|---|---|---|---|---|
| Finance and Legal | 503,131 | 473,204 | 731,564 | 45% | 1.51% |
| Health, Education, Public Admin and Non-profit | 174,542 | 199,049 | 273,252 | 57% | 1.81% |
| Wholesale, Retail and Utilities | 153,126 | 164,093 | 253,684 | 66% | 2.04% |
| ICT & Other Business Services | 125,987 | 155,965 | 329,008 | 161% | 3.91% |
| Hostelry and Recreation | 59,436 | 59,777 | 59,777 | 1% | 0.02% |
| Manufacturing | 42,353 | 37,834 | 19,358 | -54% | -3.08% |
| Transport | 29,230 | 28,590 | 28,590 | -2% | -0.09% |
| Personal Services | 15,330 | 17,263 | 28,297 | 85% | 2.48% |
| Sub-total C&I | 1,103,135 | 1,135,775 | 1,723,530 | 56% | 1.80% |
| Construction | 89,334 | 116,994 | 124,307 | 39% | 1.33% |
| Horticulture, Agriculture & Fisheries | 25,152 | 24,836 | 12,707 | -49% | -2.69% |
| Total All Sectors | 1,217,621 | 1,277,605 | 1,860,545 | 53% | 1.71% |

## 2.3 Analysis of Waste Projections

To translate forecast growth rates of economic activity into forecasts of waste arisings in a comprehensive quantitative model, we would need to know the following:

a) forecast growth rates of output by sub-sector;

b) changes in specific waste arisings (waste tonnes per £ output) of each sub-sector;

c) the breakdown of C&I waste by sub-sector source and waste composition (e.g. waste fraction from the Finance sub-sector sent to different recycling or disposal facilities);

d) forecast changes in recycling rates of each sub-sector, with particular attention to price-elasticity of demand for waste disposal.

Forecasts of sub-sector growth rates (i.e. item a above) can be made based on future expectations, as described in the paragraphs above.

Although items b, c & d are not readily available, it is important to understand that it is the *change in these factors over time* that is important and not their absolute value. For example, if the sub-sectors grow at the same rate and the waste composition, specific waste arisings and recycling rates are constant over the forecast period, then we can consider the C&I sector to be a homogenous unit and use a weighted average GDP growth factor to predict the growth in C&I waste suitable for a waste facility. Furthermore, if changes are only small, then we can use estimates of these factors without introducing significant errors.

Sensitivity analysis can then be used to test the robustness of these estimates.

In addition, the dominance of the Finance sub-sector reduces the effect of any differences between other sub-sectors. "Finance & Legal" and the closely related sub-sector "ICT & Other Business Services" together account for over 50% of economic activity.

Case One

Before considering how factors b, c & d will affect the forecast waste arisings, we first consider the simple case of waste linked only to economic growth (at 1.71% p.a.), without any structural change or change in specific waste arisings or recycling rates. Using these assumptions, waste for for the previously proposed EfW plant would grow to 76,000 tonnes in 2025, as shown below:

**Table 6** **Waste Project – Case One**

| | 2001 | | | | Factor Income Growth | 2026 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total Arisings | | Input to EfW | | | Total Arisings | | Input to EfW | |
| | Tonnes | %age | Tonnes | %age | % p.a. | Tonnes | %age | Tonnes | %age |
| Household | 25,555 | 10% | 17,790 | 36% | 1.85% | 40,411 | 12% | 28,132 | 37% |
| C&D | 167,750 | 67% | 2,038 | 4% | 1.33% | 233,407 | 67% | 2,836 | 4% |
| Ag & Hort | 12,400 | 5% | 0 | 0% | -2.69% | 6,271 | 2% | 0 | 0% |
| C&I | 43,960 | 18% | 29,479 | 60% | 1.80% | 68,668 | 20% | 46,048 | 60% |
| Water Treatment | 350 | 0% | 0 | 0% | 1.71% | 535 | 0% | 0 | 0% |
| | | | | | | | | | |
| **TOTAL** | **250,015** | **100%** | **49,307** | **100%** | | **349,292** | **100%** | **77,015** | **100%** |

*Sensitivity Analysis – GDP Growth*

The above central forecast uses factor income growth of 1.71% p.a.[9] If this were to vary between 1% and 3%, the corresponding range in forecast waste to the previously proposed EfW plant is 66,000 to 96,000 tonnes per annum respectively, as below:

9 As discussed earlier, since completing this report discussion that the requirement for GDP is 2.5% to meet the fiscal demand. This level falls within the 1% and 3 % range investigated above however must be noted that it is higher than the average 1.71% assumed.

**Table 7** **Sensitivity Analysis – GDP Growth**

| | 2001 | | | | Factor Income | 2026 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total Arisings | | Input to EfW | | Growth | Total Arisings | | Input to EfW | |
| | Tonnes | %age | Tonnes | %age | % p.a. | Tonnes | %age | Tonnes | %age |
| Total | 250,015 | 100% | 49,307 | 100% | 1.00% | 306,330 | 100% | **64,622** | 100% |
| Total | 250,015 | 100% | 49,307 | 100% | 1.71% | 349,292 | 100% | **77,015** | 100% |
| Total | 250,015 | 100% | 49,307 | 100% | 3.00% | 443,614 | 100% | **105,749** | 100% |

*Sensitivity Analysis – Population Growth*

The forecast above uses a 1.85% p.a. forecast growth of Household waste (as explained in Section 1.3.1). This in turn uses forecast population growth of 0.22% (from natural changes in the domestic population and immigration) and a continued increase in absentee residents to 7.9% by 2026 (equivalent to a decline of 0.08% p.a. in resident population). Sensitivity to these factors is tested in the table below.

**Table 8** **Sensitivity Analysis – Population Growth and Absenteeism**

Increasing Absenteeism

Population growth (% p.a. - equivalent to increase in absenteeism)

Increasing population

Population growth (% p.a.) from natural changes and immigration

| | 0% | **-0.08%** | -0.16% |
|---|---|---|---|
| 0% | 76,064 | 75,535 | 75,015 |
| **0.22%** | 77,573 | **77,015** | 76,468 |
| 0.39% | 78,867 | 78,213 | 77,643 |

If population growth is zero and the proportion of absenteeism grows at twice its historical rate, then the quantity of waste to landfill or an alternative facility will reach 75,000 tonnes by 2026, or a 2.6% reduction compared to our central estimate.

Conversely, if population grows by 0.39% per annum (that resulting from net immigration of 300 per year) and absenteeism stays at the same proportion as 2004, then the quantity of waste will reach 79,000 tonnes by 2026, or a 2.4% increase compared to our central estimate.

Case Two

In order to consider the effect of factors such as differences between industrial seb-sector growth rates and specific waste arisings, it has been necessary to make a number of assumptions about the breakdown between sub-sector and waste composition. This has been done in order to test the sensitivity of the forecast waste projections to these factors. We use the estimated waste composition by sub-sector shown in Table 9 below, and sub-sector growth estimates (for the 1.71% total factor income growth) shown in Table 5 above.

**Table 9 Estimated Composition of C&I Waste, by component and sub-sector**

| C&I Waste Arisings (Total) | Finance and Legal | Health, Education, Public Admin and Non-profit | Wholesale, Retail and Utilities | ICT & Other Business Services | Hostelry and Recreation | Manufacturing | Transport | Personal Services | Sub-Total C&I | %age to EfW |
|---|---|---|---|---|---|---|---|---|---|---|
| Paper and board | 8.9% | 2.2% | 1.2% | 1.8% | 0.4% | 0.2% | 0.2% | 0.1% | 15.0% | 25% |
| Plastic | 3.2% | 2.0% | 1.7% | 1.1% | 0.6% | 0.8% | 0.4% | 0.2% | 10.0% | 25% |
| Glass | 0.5% | 0.4% | 0.4% | 0.2% | 0.2% | 0.1% | 0.1% | 0.1% | 2.0% | 10% |
| Green waste | 0.5% | 0.4% | 0.4% | 0.2% | 0.2% | 0.1% | 0.1% | 0.1% | 2.0% | 100% |
| Kitchen waste | 2.4% | 3.9% | 3.7% | 0.7% | 3.0% | 0.6% | 0.4% | 0.3% | 15.0% | 100% |
| Cans | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0% |
| Other metals | 7.8% | 3.3% | 5.4% | 2.6% | 1.0% | 3.1% | 1.4% | 0.3% | 25.0% | 0% |
| Textiles | 1.3% | 1.0% | 1.0% | 0.4% | 0.5% | 0.3% | 0.2% | 0.2% | 5.0% | 50% |
| Misc combustible | 3.2% | 1.4% | 2.2% | 1.1% | 0.8% | 0.8% | 0.4% | 0.1% | 10.0% | 100% |
| Misc non-combustible | 5.2% | 2.2% | 3.6% | 1.7% | 1.3% | 1.2% | 0.6% | 0.2% | 16.0% | 0% |
| TOTAL | 33.1% | 16.9% | 19.7% | 9.6% | 8.2% | 7.3% | 3.8% | 1.5% | 100.0% | |

| C&I Waste Arisings (to previously proposed EfW plant) | Finance and Legal | Health, Education, Public Admin and Non-profit | Wholesale, Retail and Utilities | ICT & Other Business Services | Hostelry and Recreation | Manufacturing | Transport | Personal Services | Sub-Total C&I |
|---|---|---|---|---|---|---|---|---|---|
| Paper and board | 6.2% | 1.6% | 0.9% | 1.2% | 0.3% | 0.1% | 0.1% | 0.1% | 10.4% |
| Plastic | 2.3% | 1.4% | 1.2% | 0.7% | 0.4% | 0.5% | 0.3% | 0.1% | 7.0% |
| Glass | 0.1% | 0.1% | 0.1% | 0.0% | 0.1% | 0.0% | 0.0% | 0.0% | 0.6% |
| Green waste | 1.5% | 1.2% | 1.1% | 0.4% | 0.6% | 0.4% | 0.2% | 0.2% | 5.6% |
| Kitchen waste | 6.7% | 10.7% | 10.2% | 2.0% | 8.4% | 1.7% | 1.1% | 0.9% | 41.7% |
| Cans | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Other metals | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Textiles | 1.8% | 1.5% | 1.4% | 0.5% | 0.8% | 0.5% | 0.3% | 0.2% | 7.0% |
| Misc combustible | 9.0% | 3.8% | 6.2% | 3.0% | 2.3% | 2.2% | 1.1% | 0.3% | 27.8% |
| Misc non-combustible | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| TOTAL | 27.5% | 20.2% | 21.1% | 7.9% | 12.8% | 5.4% | 3.2% | 1.8% | 100.0% |

Using these estimates, we obtain waste projections for the previously proposed EfW plant as below:

**Table 10 Waste Projection to the previously proposed EfW plant using Sub-sector Waste Composition and Growth Estimates**

| | 2001 | | | | Ave. Growth | 2026 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total Arisings | | Input to EfW | | | Total Arisings | | Input to EfW | |
| | Tonnes | %age | Tonnes | %age | % p.a. | Tonnes | %age | Tonnes | %age |
| HH | | | 17,790 | 36% | 1.85% | | | 28,132 | 38% |
| C&D | | | 2,038 | 4% | 1.33% | | | 2,836 | 4% |
| A&H | | | 0 | 0% | -2.69% | | | 0 | 0% |
| C&I | | | 29,479 | 60% | 1.80% | | | 43,988 | 59% |
| Water Treatment | | | 0 | 0% | 1.71% | | | 0 | 0% |
| | | | | | | | | | |
| **TOTAL** | | | **49,307** | **100%** | | | | **74,956** | **100%** |

This shows the effect of the forecast decline of the higher specific waste generating sectors (e.g. manufacturing), which tends to reduce the total amount of waste generated per £ GDP of the whole economy. The forecast result is a total waste projection for the previously proposed EfW plant of 75,000 tonnes per annum compared to 77,000 tonnes for the simple Case One result.

Case Three

Now we consider the effect of a reduction in the link between an increase in economic activity and waste generation. For simplicity, we only consider the effect on the Finance & Legal and ICT & Other Business Services sub-sectors. We calculate the effect of a 10%, 20% and 30% reduction in the growth of waste from these two sectors, with the result as below:

**Table 11 Effect of break in link between GDP growth and Waste growth**

| Change in link between GDP and Waste | 2025 EfW Waste Input (tonnes) |
|---|---|
| 0% | 74,956 |
| -20% | 71,374 |
| -40% | 67,791 |

Case Four

In our forecasts, we follow the assumption in the ISL model of the separation of household waste for recycling of paper/cardboard, glass, metal, plastics, textiles and wood. In the Agriculture and Horticultural sector, we assume the introduction of composting to divert all non-

carcase waste away from landfill or an alternative facility. We do not however forecast a significant increase in recycling of waste from the Commercial and Industrial sectors.

## 2.4 Conclusion

Using a forecast increase in population equivalent to **0.22%** per year (using forecast net immigration of 200 persons) and our central forecast for GDP growth of **1.71%,** without any further structural change or decoupling of the link between waste arisings and GDP, we estimate the waste input to the previously proposed EfW plant in 2026 to reach **77,000 tonnes** p.a. from a 2001 base of **49,000 tonnes**.

This estimate is sensitive to the forecast GDP growth, due to the compound nature of the calculation, and if GDP growth is forecast in the range **1% to 3%,** the corresponding range for waste input to the previously proposed EfW plant would be **65,000 to 106,000 tonnes**.

Changes in population will affect the growth in household waste. If instead of growing at 0,22% p.a. the population stays at the current level and if the rate of absenteeism increases twice as fast as in the past, then the amount of waste for the previously proposed EfW plant would be 75,000 tonnes. Alternatively, an increase in population to 68,530 persons by 2026, without any increase in the proportion of absentee residents, the amount of waste would be 79,000 tonnes.

When we introduce the probable differential growth in the economy by sub-sectors, then our central forecast falls from **77,000 tonnes** to **75,000 tonnes**.

If we introduce the possibility that waste generation in some sectors (i.e. Finance & Legal and ICT & Other Business Services) will not rise proportionately with economic output, then a **20% reduction** in the rate of waste growth with respect to economic growth would reduce the central forecast further from 75,000 to **71,000 tonnes** of waste input for the previously proposed EfW plant.

## 3. CONSIDERATION OF THE POTENTIAL ELECTRICAL GENERATING CAPACITY OF AN EFW PLANT

Since 2000, Guernsey has imported most of its electricity from France via an undersea cable via Jersey. This provides power at a lower cost and with greater reliability than was possible with on-island generating equipment alone. The cable, rated at 60 MW capacity, is supplemented with on-island generation during high-demand periods. During the 2004/5 financial year, Guernsey Electricity reported that 84% of the annual demand was met using the cable and 16% from on-island generation.

The previously proposed Energy from Waste Plant would generate steam to produce electricity, for supply to the island's main distribution network. It could be expected that this would provide about 10% of the island's annual electrical demand. An EfW plant had been specified with a design capacity of 9 tonnes per hour, a calorific value of 11 MJ/kg and a 25% overall electrical conversion efficiency. This equates to a generating capacity of approximately 6.9 MWe.

The island's existing generating capacity comprises of the following plant:

**Table 12** **Generation Plant 2004/2005 (source: Guernsey Electricity)**

| | Mfr | Model | Rating | Speed | Cylinders | Bore | Stroke | Commissioned |
|---|---|---|---|---|---|---|---|---|
| "C" Station | | | | | | | | |
| Set 1 | Sulzer | 9RNF68 | 12.2 | 150 | 9 | 680 | 1,250 | 1979 |
| Set 2 | Sulzer | 9RNF68 | 12.2 | 150 | 9 | 680 | 1,250 | 1980 |
| Set 3 | Sulzer | 9RNF68 | 12.2 | 150 | 9 | 680 | 1,250 | 1982 |
| Set 4 | Sulzer | 9RTA58 | 14.2 | 125 | 9 | 580 | 1,700 | 1987 |
| "D" Station | | | | | | | | |
| Set1 | Sulzer | 9RTA58 | 14.5 | 136 | 9 | 580 | 1,700 | 1993 |
| Gas Turbines | | | | | | | | |
| GT2 | Thomassen | PG-5271 | 19.5 | 5,100 | | | | 1996 |
| GT | Thomassen | PG-5271 | 19.5 | 5,100 | | | | 1997 |
| GT | Alstom | Cyclone | 11.0 | 9,500 | | | | 2003 |
| EMBEDDED | | | | | | | | |
| CHP | MAN | D2842LE | 0.28 | 1,500 | 12 | 128 | 142 | 2001 |

Sets C2 and C3 are expected to reach the end of their normal working lives in about 2014. In order to maintain stand-by generating capacity on the island it is expected to replace these with equivalent plant. Typical budget costs for replacing this type of equipment is of the order of £600/kW.

If an EfW plant with the above design characteristics were constructed on Guernsey it would reduce the need for capital spending on replacement generating plant, by an amount of the order of £600 x 6,900 kW, that is about £4,100,000.

**APPENDIX 3**

# REVIEW OF MARKETS FOR RECYCLED MATERIALS

# 1. OPPORTUNITES FOR DEVELOPING MARKETS FOR RECYCLATES ON GUERNSEY

## 1.1 Introduction and Summary

Understanding the existing and potential markets for recyclates, both on and off the island, is essential in developing a long term recycling strategy. Guernsey's island status makes this particularly important as the shipping of materials with a low commodity value to markets on the mainland will significantly impact on the economics of recycling.

The purpose of this market development assessment is to:

- Identify potential markets for recyclates on Guernsey;
- Estimate the capacity of each market; and
- Assess the potential for developing each market.

In order to assess the potential for market development on Guernsey meetings were held with:

- Representatives of the States of Guernsey – Environment Department
- Andrew Casebow – Agriculture and Environment Advisor
- Terry Brokenshire – Head of Plant Protection Services
- Mike Collins/Bob Barlet – Chamber of Commerce
- Dan Hubert – Island Waste

Developing markets for recyclates has gained increased importance in the UK over recent years. The Waste and Resources Action Programme (WRAP) has received significant funding to develop markets for the following material streams:

- Glass
- Plastic
- Paper/Board
- Wood
- Organics

- Aggregates
- Tyres
- Plasterboard

Market development has also been implemented at a regional level through WRAP's regional initiatives and through independent regionally funded initiatives. These programmes have collaborated to form the ReMaDe Network UK and meet regularly to exchange ideas on best practice etc. WRAP fund the post of ReMaDe Network Coordinator whose role is to provide a link between the regional programmes and WRAP. The following regions of the UK currently have active market development programmes:

- ReMaDe London
- Recycling Action Yorkshire
- ReMaDe Scotland
- ReMaDe Kent and Medway
- ReMaDe Essex
- ReMaDe Kernow (Cornwall)
- SouthWest ReMaDe
- Clean Merseyside Centre
- CWMre (Wales)

In addition to these programmes ReMaDe feasibility studies are currently being undertaken or considered for the East Midlands, NorthWest and NorthEast England.

Through the national and regional initiatives a great deal of research has been undertaken over recent years in identifying new markets for recyclates and overcoming the barriers to developing these markets. Guernsey has an opportunity to develop markets for materials on the island by utilising this research and by implementing good practice.

Table 1 details the quantity recycled for the primary material streams in 2004[1]. Metals and other minor materials are not detailed as there is either no need, or no possibility, of developing markets for these streams on Island.

**Table 1 Quantity of material recycled in 2004 in Guernsey and the existing markets for these materials**

| Material Type | Tonnes (2004) | Current Markets[2] |
|---|---|---|
| Paper & cardboard (household) | 2,342 | Mayside Export - Aylesford |
| Paper & cardboard (commercial) | 2,730 | Mayside Export - Penny Recycling (Exeter) |
| Glass (household) | 1,510 | Export to England – British Glass |
| Plastic (household)[3] | 0 | Currently Contracting |
| **Total** | **6,682** | |

All the materials currently collected for recycling are exported to the mainland. Over 5,000 tonnes of paper was exported in 2004 and 1,500 tonnes of glass. Composting is limited and there is no recycling of organic material such as wood.

**Glass**

Glass is currently exported for processing by British Glass. Guernsey receives Packaging Recycling Notes (PRNs) for this cullet which to some degree off-sets the shipping cost. There is no glass melt industry on the island so the primary markets that could be developed are the glass aggregate markets.

There is already a strong existing aggregate and inert market on Island with Longue Hougue land reclamation and Ronez, who are a leading supplier of aggregate, pre-mixed concrete, concrete products and road surfacing on Guernsey. Exiting inert and aggregate material and already

1 This was the most recent full year's data that was available when this report was being compiled in November 2005.

2 Since 2004 (and since completing this report) there has been an increase in the range of materials collected for recycling. Cardboard collection points are now available at a number of bring sites, rather than just the CA site. Since June 2006 plastic bottles have been collected and exported for recycling off Island. In addition successful re-use schemes have been developed on Island, which could be expanded to encourage further diversion of waste from landfill.

3 Plastic bottle recycling was introduced in June 2006, collecting 3.5 tonnes in one month

diverted from landfill by these markets. Therefore glass aggregate could utilise these markets.

A trial is currently planned to produce glass aggregate on the island. A glass crusher is being imported for use by Ronez[4]. Glass can be used as an aggregate for:

- Highway construction;
- Concrete aggregate;
- Water filtration; and
- Decorative products.

Information on these markets and case studies can be found in WRAPs Recycled Glass Market Study & Standards Review – 2004 Update, written by Enviros.

**Plastics**

A plastic collection scheme is currently being tendered by Guernsey Environment Services for the collection and management of 200 tonnes per annum of post consumer plastic bottles. This quantity is too small to consider processing on the island and export of this material appears to be the only viable option.[5]

**Paper**

Opportunities for developing markets for paper on the island are minimal. Experience of existing market development initiatives has shown that developing markets for paper outside of the paper industry is problematic. The primary alternative markets include:

- Animal bedding/vermaculture;
- Building insulation;
- Moulded pulp products; and
- Composting.

4 Since completion of the report, the States of Guernsey has conducted a glass aggregate trial, further work needs to be undertaken to ensure reliable outlets within the aggregate market.

5 June 2006 saw the start of the collection of plastic bottles via the bring sites, which are then exported off Island for recycling

Of these alternatives only animal bedding/vermaculture and composting are realistic opportunities for Guernsey. There are no existing manufacturing facilities for moulded pulp products and there is almost certainly insufficient market capacity to support a plant producing building insulation (which primarily uses post industrial rather than post consumer waste). Examples of organisations that have established these businesses can be found on WRAP's Recycled Products Guide (www.recycledproducts.org.uk).

The other alternative is to compost the paper. This is a low value alternative that can prove problematic as the paper, with its high carbon content, would need to be blended with a nitrogenous waste such as slurry. The feasibility of composting paper could be looked at further as part of a more detailed study into composting a range of organic materials on the Island.

**Opportunities**

Therefore little market development activity is required or is possible for paper and plastic. An animal bedding business could be established for paper and board but this would have a capacity of a few hundred tonnes at most. The glass aggregates trial is an excellent way to commence developing these markets on the island. Work may be required with procurers to allay fears and to stimulate demand by encouraging specifiers to specify the product. Ronez may need support to properly examine the true product range available for them to produce and to ensure the trials are exhaustive.

It is in the areas of organic composting and wood recycling where there is the potential for significant improvement. These materials are discussed in more detail in the sections below.

## 1.2 Wood Waste Collection and Recycling

The National Assessment of Civic Amenity Sites (NACAS) work undertaken in 2004 by Network Recycling & Future West gathered data on Civic Amenity (CA) sites across England; their work calculated that introducing wood recycling facilities at CA sites would be expected to increase the CA site recycling rate by 7%.

Wood waste collected at CA sites has a variety of end use markets depending on the quality of material collected. The quality of wood waste at CA sites is often not of a high enough quality to go into

markets where high quality wood chip is required, this is due to the presence of contaminants such as chipboard and treated wood. Wood collected from commercial sources is often of a cleaner quality and fit for higher quality end use markets than wood from householders. Table 2 illustrates the likely breakdown of wood material entering a CA site:

**Table 2** **Composition of wood waste at CA sites**

| Wood Type | Percentage |
|---|---|
| Chipboard | 32% |
| Fibre board | 15% |
| Treated solid wood | 12% |
| Painted solid wood | 11% |
| Untreated solid wood | 11% |
| Solid wooden furniture | 10% |
| Block boards | 6% |
| Virgin untreated timber | 2% |
| Miscellaneous items | 1% |
| **Total** | **100%** |

Source: WRAP, Municipal wood waste arisings, 2002. Data from Waste & Energy Research Group University of Brighton – CA Site waste study September 2001.

A main end use market for wood is the panel board industry. The quality specification required by this market is high; A typical list of acceptable wood waste for an end use market in the panel board industry would include white softwood, solid doors, floorboards, wooden packaging waste, offcuts and untreated fencing. Wood waste such as Medium Density Fibreboard (MDF), treated wood waste (e.g. fence panels) and painted wood (e.g. windows, doors, etc.) commonly seen at CA sites would be unacceptable for such a market.

Alternative end use markets for wood waste include animal bedding, surfaces and mulches or as a solid fuel. All of these require wood to be free from contaminants and demand a high quality wood waste.

Alternative end-use markets for lower quality grades of wood are not as developed, however the use of lower grade wood in the compost market is expanding.

Wood waste collected at CA sites is generally delivered to a waste management company or wood recycler for classification before on site reprocessing or transportation on to the panel board industry. The actual end use market of wood waste is normally determined by the infrastructure in the local region as factors such as transportation costs are an important consideration when determining the end use market for wood.

### 1.2.1 Case Study – Oxfordshire County Council

Oxfordshire County Council has found a use for the lower grade of wood enabling them to collect a further 65 tonnes of wood waste on average a month. Previously Oxfordshire had only collected higher grade wood waste for recycling for use in higher grade end-use application or the fuel market.

The new scheme enables the authority to collect lower grade wood such as plywood, MDF and chipboard. The lower grade wood is then transported to a company in Northampton who treat the product before using it is a soil improver on land. The gate fee is £23/tonne excluding transportation costs. *(Source: Letsrecycle.com).*

### 1.2.2 Case Study – Wakefield Metropolitan District Council

Wakefield Metropolitan District Council collects wood waste at all of its CA sites. In 2002-03 over 400 tonnes per month of wood waste were collected, representing around 10% of waste collected at the CA sites. This tonnage has doubled from when collections started due to a number of factors including raising public awareness and improvements in collection systems.

Wood collected at the CA sites is taken to a wood recycler for end use predominately in the panel board industry so quality control and segregation by CA site personnel is an important factor in minimising rejected loads. *(Source: WRAP, Civic Amenity Sites – Wood Waste Recycling Good Practice Guide, 2005).*

## 1.3 Organic Material - Composting and Developing the Markets

Currently green waste is ‘matured’ at the Chouet site prior to being landfilled at Mont Cuet. Green waste with a diameter greater than ¼” is landfilled directly.

It is estimated that 7,500 tonnes of green wastes, excluding catering waste, are available for composting per year in Guernsey.

### 1.3.1 Windrow Composting - Collection of Organic Material

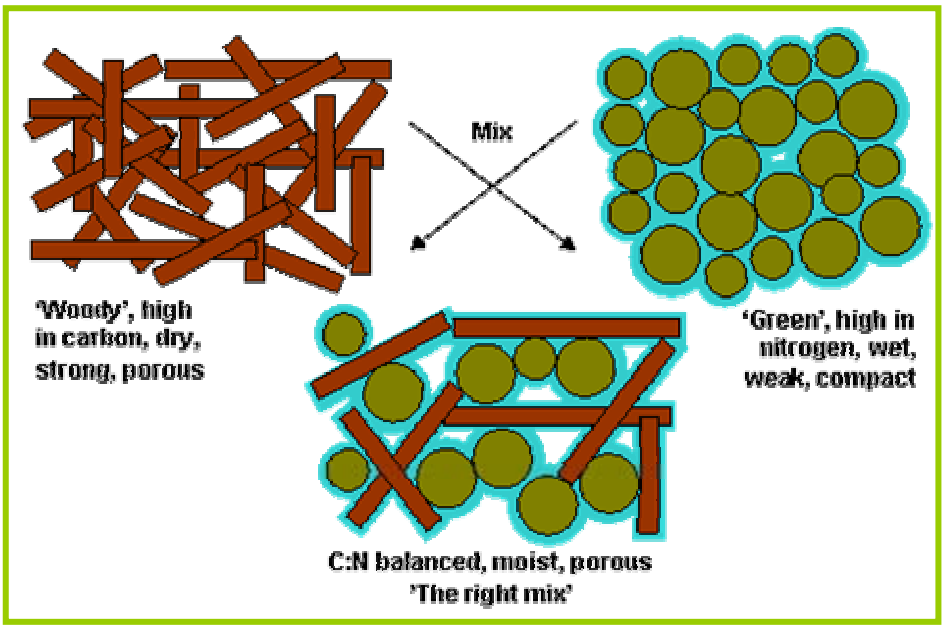
It is essential that the materials are as clean as possible before being shredded otherwise the levels of contamination are usually unacceptable to end-users. It is normal for contracts for the supply of green wastes to stipulate the levels of contamination (number of plastic bags per load, for example). A model contract is available from WRAP.

Green wastes from Household Waste Recycling Centres (HWRC) or CA sites in the UK tend to be cleaner than those collected at the kerbside. Educational programmes are essential to raise participation rates and to improve waste separation. Inspection and hand picking of deliveries can result in good quality products.

**Material Composition**

It is important to get the right mix of organic materials. A blend of woody and leafy materials with a carbon to nitrogen (C:N) ratio of between 20:1 and 40 to 1 is ideal (Figure 1). If the C:N ratio is lower, there is the tendency for odours to be produced. At higher C:N ratios the process tends to be slower. Moisture content should also be between 50 and 60% by weight at the start of the process. Shredding opens up the surfaces of the materials for microbial activity and also creates a better structure for aeration. If shredding is too fine there is the possibility for areas in the heap to become anaerobic and produce odours. A buyers guide to shredders and grinders is available in The Composting News Volume 9 Issue 1 (Spring/Summer 2005).

**Figure 1 The right mix of organic material**




As composting proceeds, the moisture falls to around 35% which is ideal for efficient screening. The C:N ratio also falls to between 15:1 and 20:1 and the materials stabilise. Correct shredding also minimises the fraction of oversize remaining after screening although these materials can be mixed back into the feedstock if they are clean enough. The use of fan extraction at the screening stage is often essential to minimise the presence of plastics in oversize materials.

### 1.3.2 Mixing green waste with slurry

Animal and industrial organic slurry can be added into the composting process. Sludges can be pressed to reduce the moisture content before addition to the mix. The impact of the introduction of sludge on the composting process is that it lowers the C:N ratio and increases moisture content, both of which may contribute to the generation of odours. Enviros has designed a system in Scotland for Scottish Water to do this, which is currently being constructed. Enviros has also designed farm-based systems for manures in Scotland (in-building using a tractor-drawn windrow turner), which are very effective (Figure 2). Alternatively, the first phase (10 to 14 days) of composting can be carried out 'in-vessel'.

**Figure 2 Windrow turner in Scotland**

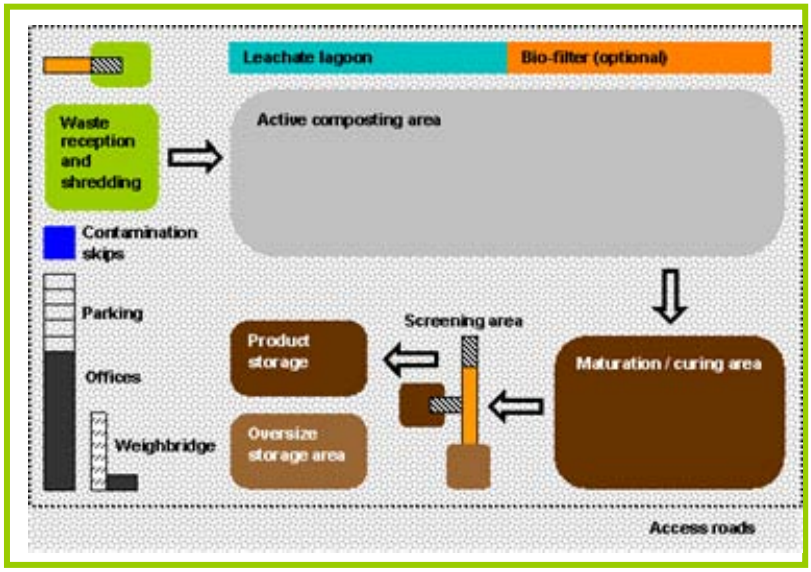

### 1.3.3 Emerging Composting Techniques

There are many research-based systems available in the UK and from around the world but many are unproven. The Composting Association has a directory of in-vessel systems. Some systems are based on 'clamps' with low air flow rates but these may not cope with potentially odorous materials. Other systems move the materials through drums, containers or bays but this introduces associated problems and often higher maintenance costs. Batch systems with adequate air flow rates, coupled with an ammonia scrubber and biofilter, are most suited to mixes of green wastes and slurries or sludges. These systems are well proven in the mushroom industry and may be large concrete structures or based on smaller 'container' systems. Covered aerated piles work on the same principles (Figure 3).

**Figure 3 Figure 3 In-vessel batch systems**

Green wastes are most economically composted in open windrows. A schematic of a site is shown in Figure 4. The layout of a site may be governed by existing infrastructure if farm concrete standing or buildings are used.

**Figure 4 Typical layout for a farm-based open windrow composting site**




An example of a farm composting operation is shown in the site pictures from Colchester in Essex (Figure 5). This started as an exempt site composting less than 5,000 tonnes of green waste a year. In 2005 a full waste management licence for 25,000 tonnes was obtained and the site is currently expanding the processing infrastructure. Although some concrete hardstanding was originally available from the former airfield site, the remaining surfaces are based over clay with a membrane covered by hard core and crushed stone. A sacrificial layer of compost helps to avoid the stone contaminating the products. Asphalt may also be used as a cheaper surface than concrete but its longevity is less than for concrete. The Composting Association's Guide No. 3 to composting pads and drainage systems (written by Enviros) in Composting News Volume 9 Issue 3 (Winter 2005) provides useful background information.

**Figure 5 Colchester composting site showing weighbridge, green waste, shredding, windrows, screening and product stockpile awaiting harvest for application.**

Turning equipment that is fairly basic can be used, such as front-end/tele loaders or 360$^{o}$ excavators. The advantages and disadvantages of these turners are shown in Figure 6 .

**Figure 6 Turning equipment**

| Advantages | Disadvantages |
|---|---|
| **Low capital cost and readily available** | **Relatively slow rate (~200 $m^3$ per hr)** |
| **Equipment can be applied to other uses** | **Material is not always aerated thoroughly** |
| **Equipment can operate on any surface** | **Material is not always mixed thoroughly** |
| **Material can be relocated in any direction** | **Buckets may damage surfaces** |
| **Pile size is more flexible** | **Difficult to add water during turning** |
| | **Windrows must be turned in a systematic order to allow room for the next** |

If dedicated machinery is used, such as self propelled windrow turners, the costs of capital equipment can rise. They are more suited to large-scale operations over 10,000 tonnes per year. It is important to purchase the correct shredder according to the wastes being composted. If other farm wastes are incorporated, mixing equipment might also be considered. Screens can be changed on many trommels to ensure particle sizes to suit a range of end uses.

### 1.3.4 Areas required for composting

7,500 tonnes per annum of green wastes do not arrive uniformly at a site during the year. Up to a maximum of 15% or double that of a "typical"

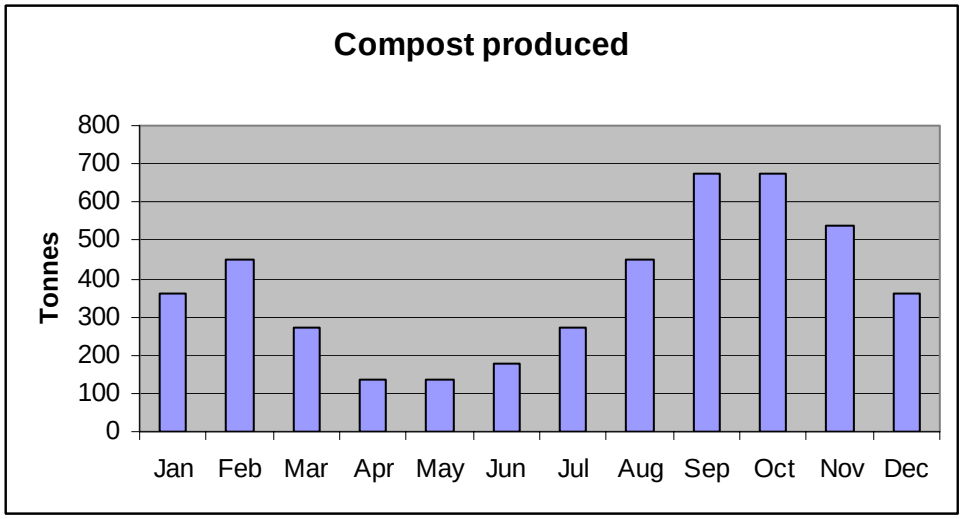
month, may come in at the busiest times and so the site needs to be sized accordingly. The maximum monthly arising may be 1,125 tonnes and a shredder of the correct size will be required as well as suitable and adequate concrete pad space.

Approximately 6,000 to 7,000m$^2$ of land may be required for this tonnage including waste reception area, shredding, composting, screening and product storage space. Allowance must be made for roadways, an office, weighbridge and a storm water pond. One front-end loader may be able to cope with this amount of material although access to be able to reverse such equipment is essential.

The amount of product that is generated will be approximately 60% by weight of that coming in, due to losses from moisture and carbon dioxide. 4,500 tonnes of screen products may therefore be available for markets. A typical screen size is 25mm for many agricultural operations but topsoil, landscaping and horticulture usually require a 10mm screened material. Golf courses may need an even finer product, less than 5mm in order to remove stones etc., if the compost is to be spread on fairways and tees.

The timing of compost production is important when marketing is considered. Assuming that the process takes four months from reception to end use, the 4,500 tonnes is likely to be split in a pattern as shown in Figure 7.

**Figure 7 Compost production pattern.**



A far greater amount is typically available from August to November and this coincides with arable farmland becoming free after harvest. The landscaping markets peak in the spring and autumn when most planting is carried out. Gardeners use most soil improver products in the spring around Easter and so the compost produced in the early part of the year can be bagged ready for their use although it may need to be matured for longer than four months to be stable in the bag.

### 1.3.5 Markets for compost

Compost contains both organic matter and plant nutrients. The organic matter content is often approximately 30% or more of the dry matter and so, at 30 tonnes per hectare, over 6 tonnes of organic matter may be applied. Topsoil contains 30 tonnes of organic matter per hectare per 1 % measured and so the amount applied in compost is significant. However, this fresh organic matter is used by soil microorganisms and so up to two thirds may be 'lost' through their activity and released as carbon dioxide within a year or so. To build up soil organic matter therefore takes repeated applications.

The typical values for nitrogen (N), phosphorus (P) and potassium (K)in compost are shown in Table 2.

**Table 3** **Beneficial properties of compost**[6]

| | Moisture % | Total N % | Total P % | Total K % |
|---|---|---|---|---|
| Compost | 36 | 1.25 | 0.21 | 0.80 |

Fertilisers are sold in terms of nitrogen, phosphate and potassium or potash content. Table 4 shows the values for converting the analysis of concentrations in the dry matter into the amount applied per tonne and as a loading of 30 tonnes per hectare.

6 Wallace P and Brown S (2004) 'To support the development of standards for compost by investigating the benefits and efficacy of compost use in different applications' WRAP project STA0015.

**Table 4** **Compost nutrient content**[7]

| | Rate | Total N | Total $P_2O_5$ | Total $K_2O$ |
|---|---|---|---|---|
| Compost | per tonne | 0.81 kg | 3.3 kg | 6.6 kg |
| | @30 t/ha | 250 kg/ha | 100 kg/ha | 200 kg/ha |

Not all of the nutrients are immediately available for crops. Only approximately 10% of the total nitrogen becomes available over three years, and only 10 to 15% of the total phosphate is readily available. Potash is more water soluble and exchangeable and so 80% may be immediately available. Compost also has a small liming effect and can help offset the acidifying effects of inorganic fertilisers.

The rates of addition should be according to the Nitrate Vulnerable Zone (NVZ) regulations as measures similar to those in Britain have been adopted in Guernsey in order to reduce water pollution[8]. It has been agreed that the whole island is an NVZ when considering the application of farmyard manure or slurry to the land and this includes compost. There is a closed period for high nitrogen poultry manures, slurries or sludge between 1st October and 31st December inclusive. As compost has a low nitrogen content and low availability of nitrogen as N, it can be spread in this autumn period if soil conditions allow. Farms must follow an approved management plan and apply organic materials to provide sufficient nutrients to satisfy an actual crop requirement.

Research into the benefits of compost in agriculture has been carried out by Enviros in long-term experiments in England since 1999. The results from these landfill tax funded trials [9] are available from www.compost.me.uk. They confirm that organic matter in soils can be raised and that potash is the most available nutrient. Yields of crops including potatoes can be raised where soil conditions have been improved by using compost. An alternative strategy is to use compost in order to lower inorganic fertilizer requirements whilst maintaining yields. A brief summary of this work appeared in The Composting News Volume 9 Issue 1 (Spring/Summer 2005).

Where repeated use of manures has raised the soil phosphate levels then the amounts of further addition of organic matter through either manure and compost, which also contains some available phosphate, may be restricted.

7 WRAP 'Using Compost in Agriculture and Field Horticulture' Compost Information Package 1.
8 Water Board and the Agriculture and Countryside Board note.
9 Wallace P A (2005) 'Compost Use in Agriculture: Consolidated Report', Enviros Consulting Ltd.

### Methods of application

Compost is most easily applied when the soil conditions are suitable (to avoid soil compaction,) with a rear discharge, moving floor muck spreader (Figure 8).

**Figure 8 Field application – moving floor muck spreader**

### 1.3.6 Compost markets

### Agriculture

The Island of Guernsey is 63 square kilometres in area or 6,300 hectares. The area in agricultural land is shown in Table 5 and totals just over 9,000 hectares

Table 5 **Areas of agricultural land.**

| | Grazing | Silage | Hay | Maize and fodder | Potatoes | Cereals | Vegetables |
|---|---|---|---|---|---|---|---|
| Dairy farms | 3018 | 2928 | 641 | 629 | 355 | 157 | 0 |
| Non-dairy | 540 | 71 | 210 | 6 | 41 | 19 | 48 |
| Growers | 0 | 0 | 95 | 22 | 128 | 0 | 106 |
| | | | | | | | |
| Total | 3558 | 2999 | 946 | 657 | 524 | 176 | 154 |

The bulk of the agricultural land is under grass for grazing, silage and hay, followed by fodder crops, principally in support of the diary industry. Potatoes and vegetables are high value crops and the way they grow may be governed by supermarket protocols relating to managing risk in the food supply chain. Risks include the transmission of human pathogens from organic materials (mainly animal manures and biosolids but compost may be included as a source). Cereals would be grown in a rotation with the other crops and so the risks associated with manures may be overcome by allowing an interval between application of compost and harvesting the crop. For manures, this interval is often 10 months and so applying compost over a year before a sensitive crop is grown provides a very wide safety margin.

If all 4,500 tonnes of compost which could be produced were to be applied to farmland at a rate of 30 tonnes per hectare only 150 hectares of land per year would be required. However, this would require almost all of the cereal-sown land available in Guernsey to be used every year. The soil indices for nutrients such as phosphate and potash must be taken into account so as not to exceed crop requirements and this may further restrict the area of land available or the rates of application.

Compost can be applied to grassland, particularly after a first cut of silage or hay when a second cut is to be taken. If compost is applied to grazing land, then an interval of at least three weeks should be allowed, to reduce the chance of ingestion.

## Horticulture – protected crops

Compost can be used for glasshouse or polytunnel-grown crops but this may be restricted by supermarket protocols. Salts can also build up in glasshouse soils and care should be taken when using composts, which may have a high electrical conductivity (an indication of salt content). However, compost can be successfully used in glasshouses as shown by the Cantello nursery experience[10].

## Horticulture - growing media

Some nurseries own-mix their growing media to raise plants[11]. Extensive work has been carried out through WRAP-funded projects and by the Clean Merseyside Centre in Liverpool. It has been shown that up to 33% of a mix can be compost graded to less than 10mm. If vegetable modules are being filled, then a 5 mm grade may need to be utilised. Stockbridge Technology Centre in Yorkshire has successfully trialled the growing of vegetable transplants using composted materials.

Some growers may be understandably cautious, as there is a small chance of the transmission of plant diseases from the compost if it was made from feedstocks that contained plant diseases and the process was not adequately controlled. Publicly Available Specification 100 (PAS 100) recommends a temperature of 65$^{o}$C for at least seven days in the windrows with adequate moisture to ensure plant pathogens are eradicated. This is based on work funded by WRAP at Warwick-HRI.

## Landscaping

Compost less than 10mm in particle size of often used by landscapers[12]. It can be delivered in bulk or in one cubic metre bags, which are very popular. The compost can be used as a soil improver for lawns and beds or as a surface mulch. The coarser grades of compost, 10 to 20mm or larger, can also be used as a mulch if it is clean. As this is not visually as good as bark for mulching, compost mulch can be 'cut' with more expensive barks.

Landscaping use of compost is often governed by the amount of house building and renovation works. Highways projects, including tree and hedge planting, can also utilise compost for soil improvement or mulching, as shown in Figure 9.

10 WRAP case study: 'Cantello'
11 WRAP case study: 'Jack Moody nursery'
12 WRAP case study: 'Gardenscape'

**Figure 9 Tree and hedge mulching on A131 in Essex.**

### Top-soil manufacture

Where topsoil is in short supply or is being conserved, compost can be used to improve low grade materials such as skip soils and sands. A typical application rate is one part compost to between 2 and 4 parts of soil/sand by volume. ReMaDe Essex has developed a 'Topsoil Toolkit' with WRAP funding to optimise the mixing of poor quality soils and sand with compost. Brownfield sites can also be redeveloped and improved using compost[13].

**Figure 10 Topsoil manufacture**

13 WRAP case study: 'Kent brownfields'

## Golf courses and sports grounds

Golf courses can use compost on fairways and tees as long as the quality is good. There must be no stones or other inert materials and the grade of compost should preferably be less than 5mm to ensure the compost falls into the fine sward, although less than 10mm can be used successfully if it is stone-free. Sports pitches also require a good quality material for safety reasons.

During the construction of a new fairway, 250m$^3$ of compost may be used. An 18 hole course may have up to 18 hectares of fairways and 450m$^3$ of compost per golf course could be used annually as a topdressing. As an example, this approach was carried out on the Epping Golf course near London[14]. Compost can also be used in golf green construction and approximately 3m$^3$ may be used per green of 300m$^2$ area.
WRAP has published a guide to using compost in turf, highlighting compost use on a golf course in Northern Ireland, Newbury Racecourse and a cricket pitch in Essex[15].

**Figure 11 Compost application to tees and fairways**

## Bagging compost

Compost, graded to less than 10mm, can be bagged and sold to the public or given away to encourage recycling. A guide to screening and bagging equipment is provided in Composting News Volume 9 Issue 2 (Autumn 2005). As an indication of the potential usage, if 1,000 householders used two 50 litre bags of such compost per year, 100m$^3$ would be utilised.

14 WRAP Case study: 'Epping Golf Course'.
15 WRAP guide: 'Top turf with Compost'.

**Figure 12 Examples of bagged compost**


### 1.3.7 Potential Market Mix

A baseline survey is required to fully assess the markets. A mix of end uses is always desirable to ensure year round demand for the product and to minimise the need to stockpile.

The soil types, their organic matter and nutrient status for the agricultural sector should be quantified, coupled with the amounts of manures being produced and used. This will establish the degree of competition for nutrient application in agriculture. As there is increasing concern with regards the possible environmental effects from diffuse pollution, the use of manures and composts may become restricted by their nutrient contents and that of the soils under arable and grassland production. All of the potential annual compost production (around 4,500 tonnes) could possibly be used on 150 hectares of arable land if the conditions were suitable, but this is unlikely.

The amounts of compost used in glasshouse crops or in growing media are likely to be small and there are technical barriers to the penetration of these markets but they can be overcome through demonstration trials.

Landscaping and topsoil improvement does offer the potential to utilise a significant proportion of the compost produced, probably in the region of 10 to 20%. Golf courses and sports pitches may use 2 to 5%. Bagging and selling compost to the public may use 5%.

Table 6 **Potential market mix**

| End use | Tonnes | % |
|---|---|---|
| Agriculture and field horticulture | 3105 | 69 |
| Protected crops and growing media | 45 | 1 |
| Landscaping and topsoil | 900 | 20 |
| Turf | 225 | 5 |
| Bagged | 225 | 5 |
| **Total** | **4500** | **100** |

There is therefore potentially enough market capacity on the island the take the 4,500t of product that would be produced from composting 7,500t of green waste. However, more detailed work will be required to assess the market potential and to develop these markets. This may involve industry workshops, trials and dissemination to stakeholders.