Best Practicable Environmental Option

Report for IEA Bioenergy Task 36

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Summary

Emissions inventory or life-cycle (LCA) based analysis is increasingly applied to decision making on waste management planning. The US Environmental Protection Agency and the UK Environment Agency have invested much effort in developing analytical tools for use by waste management planning. For many of the Municipalities in England and Wales, the residual waste has been disposed of by landfilling. However, due to changes in legislation emanating from Europe, in particular, the Landfill Directive and national targets for recycling, this can no longer be seen as the most sustainable solution. Disposal of this increasing amount of waste, which is also more varied than ever, is becoming progressively more difficult, and sustainable waste management alternatives need to be identified.

To inform the waste management decision making process there is increasing application of the BPEO (Best Practicable Environmental Option). This aims to establish the waste management option that provides the most benefits or least damage to the environment as a whole, at an acceptable cost, in the long term as well as the short term. This may mean there is a different BPEO for the same waste stream in a different area or at a different time. The process also ensures that local, environmental, social and economic issues will be important in any decision.

This report produced for IEA Bioenergy Task 36 details the legislative drivers for waste management in the UK and describes the step-wise approach to the BPEO methodology. The report also details the assessment criteria and scoring methodology and gives a case study example for a Municipality in the UK.

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1 Introduction

For many of the Municipalities in England and Wales, the residual waste has been disposed of by landfilling. However, due to changes in legislation emanating from Europe, in particular, the Landfill Directive and national targets for recycling, this can no longer be seen as the most sustainable solution. Disposal of this increasing amount of waste, which is also more varied than ever is becoming progressively more difficult, and sustainable waste management alternatives need to be identified.

The Governments *'Waste Strategy 2000'* document for England and Wales embodies the generic steps required by each Municipality to bring about the move towards more sustainable waste management options. The overall aim is to tackle the growth in waste production and, where waste is produced, maximise the amount recovered through increased re-use, recycling, composting and energy recovery.

The assessment of the Best Practicable Environmental Option (BPEO) forms part of a Municipality's waste management strategy and contains proposals for addressing the key issues surrounding waste management usually until an agreed year, e.g. 2025. A series of waste management scenarios are developed which systematically consider the achievement of various levels of recycling and recovery.

The objectives of the BPEO report are:

- To set out how a Municipality intends to meet their individual statutory performance standards for recycling/composting, as well as the longer term recycling targets stated within the Governments Waste Strategy 2000 (WS2000) document.

- To show how the Municipality intends to meet the EU Landfill Directive targets for diverting biodegradable waste away from landfill in both the long and short term.

- To identify the waste management infrastructure that will deliver the BPEO solution for the Municipality.

- To provide an assessment of the BPEO to
    - support the development of the Waste Local Plan
    - allow planning policies to be developed, and
    - to allow a framework on which individual planning applications can be assessed in terms of their impact on the whole waste management system.

In addition to the physical aspect of increasing the amount of treatment facilities for example, significant effort will be required on promoting waste minimisation activities in order to slow the rise in waste growth and in the area of public education and awareness. The latter is necessary in order to achieve the required high levels of public participation on the various recycling schemes and to gain acceptance of the policies and strategies being proposed for the future management of wastes.

2 Legislative Drivers for Waste Management

The possible drivers for a change in a Municipality's current waste management strategy can be as follows:

- Cost increases due to a shortage of suitable landfill void capacity within the boundary of the municipality
- Cost increases due to a tightening of landfill management operations i.e. site lining, leachate management, gas control and aftercare provisions
- Landfill tax – currently £15/t and increasing at a rate of £3/t per year to £35 by 2010/11
- Imposition of the EU Landfill Directive requiring a phased reduction in the quantity of biodegradable waste going to landfill
- Need to meet the England and Wales Waste Strategy 2000 recycling and recovery targets
- Requirement to meet statutory Best Value Performance Indicators (BVPI) recycling targets set for each Municipality

Further information to legislative drivers for waste management in the UK are provided below.

2.1 THE NATIONAL WASTE STRATEGY

In response to European legislation, and international concern over the environmental impacts of waste disposal, the Government have published the '*Waste Strategy 2000*' for England and Wales.

The strategy sets out a national framework for reducing the amount of waste going to landfill by moving towards more sustainable waste management options. The overall aim is to tackle the growth in waste production and, where waste is produced, maximise the amount recovered through increased re-use, recycling, and composting and energy recovery.

Waste Strategy 2000 for England and Wales An over-arching policy document that is the Government's response to obligations on waste issues contained in European Law. Accordingly, it is both a national waste management plan (as required by European Council Directives 75/442/EEC, amended by 91/156/EEC and 96/350/EC Framework Directive on Waste) and a strategy to divert waste away from landfills (European Council Directive 1999/31/EC).

By managing waste and resources more efficiently, Municipalities and the UK as a whole, can make an important contribution towards sustainable development. This is defined as "*development that meets the needs of the present, without preventing future generations from meeting their own needs*". The Governments sustainable development strategy is based on four key elements:

- Effective protection of the environment
- Prudent use of natural resources
- Social progress which meets the needs of everyone
- High and stable levels of economic growth and employment

Guiding principles for the National Waste Strategy

To ensure that future waste decisions take into account the factors fundamental to sustainable waste management, the Government has advised the following guiding principles be taken into account.

The Best Practicable Environmental Option (BPEO)

The BPEO process should be used when considering the relative merits of various waste management options. This will establish the option that provides the most benefits or least damage to the environment as a whole, at an acceptable cost, in the long term as well as the short term. This may mean there is a different BPEO for the same waste stream in a different area or at a different time. The process also ensures that local, environmental, social and economic issues will be important in any decision.

The Waste Management Hierarchy

This theoretical framework ranks waste management options in order of sustainability. If waste management is to become sustainable there needs to be an increased consideration of the options towards the top of the hierarchy.

REDUCE:	The most effective environmental solution may often be to reduce waste generation in the first place, for example, ensuring products are not over packaged.
RE-USE:	Where further reduction is not possible some materials and products can be used again for either the same or a different purpose.
RECYCLING	Where direct re-use is not possible, materials can be recycled or may be used in production processes as secondary raw materials.
RECOVERY:	If reduction, re-use or recycling is not possible, the next best thing is to regain as much value from the waste as possible through energy recovery.
DISPOSAL:	If none of the previous options offer an appropriate solution only then should the waste be disposed of.

When assessing waste management proposals the waste hierarchy should be used as a guide rather than being applied rigidly. A certain amount of flexibility is needed to arrive at the most balanced environmental, social and economic solution.

Recycling Targets

The National targets to recycle value from municipal solid waste (MSW) are:

To recycle at least 25% of household waste by 2005
To recycle at least 30% of household waste by 2010
To recycle at least 33% of household waste by 2015

Within the overall recycling/recovery targets the Government has specified statutory targets for recycling/composting in each Municipality. These targets are in the form of Best Value Performance Indicators (BVPI).

Recovery Targets
To encourage more efficient use of resources and to obtain value from waste, the Government has set targets for waste recovery via recycling, composting, energy recovery and other methods such as anaerobic digestion.

To recover at least 40% of household waste by 2005
To recover at least 45% of household waste by 2010
To recover at least 67% of household waste by 2015

It is perceived that it will be difficult to achieve the recovery targets through recycling alone and some form of energy recovery via incineration, gasification or pyrolysis will be required. A recent survey by Ernst & Young suggested that by 2015, 27% of municipal waste would be incinerated, or have energy recovered from it.

Regional Self Sufficiency
Regional Self Sufficiency requires that most waste should be treated or disposed of within the region it is produced. Each region is expected to provide sufficient facilities and services to manage the amount of waste it is expected to produce over the next 10 years. It is recognised that the BPEO for some waste may be to transport it to another region where it can be dealt with more effectively. Not all regions have specialist recovery, recycling or treatment facilities, in line with the proximity principal.

The Proximity Principle
Waste should generally be managed as close as possible to where it is produced in order to limit the environmental impact of transportation and create a more responsible approach to waste generation.

The Precautionary Principle
When dealing with issues of environmental protection the Government has stated that regard must be given to the Precautionary Principle. This means "*where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation*".

2.2 THE LANDFILL DIRECTIVE

The European Commission has set challenging targets to ensure that the necessary steps towards sustainable waste management are made. The EU Landfill Directive, which came into force on 16th July 2001, is the main driver behind this. The Commission introduced the following mandatory targets to reduce the amount of biodegradable municipal waste (BMW) going to landfill. When biodegradable (organic) waste decays it gives rise to methane and CO_2, major greenhouse gases, and a liquid leachate that can pollute ground and surface water.

By 2010* reduce biodegradable municipal waste landfilled to 75% of that produced in 1995.
By 2013* reduce biodegradable municipal waste landfilled to 50% of that produced in 1995.
By 2020* reduce biodegradable municipal waste landfilled to 35% of that produced in 1995.
* Includes 4 year derogation

The Landfill Directive requires that landfill sites are classified as hazardous, non-hazardous or inert and effectively ends the co-disposal of hazardous and non-hazardous wastes. It also bans the landfilling of certain wastes such as tyres from 2003, and requires that all waste going to landfill will have to be pre-treated to reduce its environment impact. The UK is implementing these targets for BMW through the tradable allowances scheme.

Tradable Allowances

To ensure that local authorities comply with the requirements of the EU Landfill Directive and '*Waste Strategy 2000',* the Government has introduced a system of tradable allowances for the landfilling of BMW as part of the Waste and Emission Trading Act 2003[1]. These will set a limit on the amount of BMW that can be landfilled, based on the population and number of households in the area.

It will be possible to trade in allowances between authorities to alleviate any local shortfall of treatment capacity. The scheme details are currently out for consultation and most importantly the penalties for having insufficient allowances for the BMW landfilled will be costly, having been proposed at twice the most expensive disposal option. The implication of this is that most authorities will plan to meet these targets and thus trading is likely to be minimal in the longer term. However, in the short term there may be potential for a market whilst infrastructure for waste treatment is developed.

2.3 LANDFILL TAX

In October 1996 the Government introduced landfill tax to discourage the disposal of waste and encourage more recovery and recycling. The table below shows the increases from 2002/03 until 2011/12 for active waste. The rate of £2/tonne for inert, inactive waste has remained constant.

Table 2-1: Past and predicted changes to the Landfill Tax

Time period	Tax per tonne (active waste)
2002/3	£13
2003/4	£14
2004/5	£15
2005/6	£18
2011/12	£35

Although landfill tax will encourage more sustainable waste management practices it means that local authorities will have real increases in the cost of waste management for the foreseeable future. The Chancellor announced in his 2002 budget that landfill tax levels would increase by £3/t in 2005/6 and at least that amount in subsequent years until the tax rose to £35. The tax collected above £15/t is intended to be returned to local authorities but the mechanism for this return of monies has not been announced.

[1] Waste and Emissions Trading Act 2003, ISBN 0 10 543303 9

2.4 OTHER LEGISLATION INVOLVED IN THE DRIVE TOWARDS SUSTAINABLE WASTE MANAGEMENT

The Environmental Protection Act 1990 and Controlled Waste Regulations 1992

This legislation places a duty on local authorities to manage specified wastes. It regulates waste management and defines how waste should be dealt with.

Animal by-products Regulations 2003 SI1482

Provides requirements on the treatment and processing of wastes that come under the definition of catering waste. This definition includes kitchen wastes from households and thus applies to processing of household waste unless it can be demonstrated to be uncontaminated by kitchen waste. The regulations impose strict handling and processing conditions as well as requirements for the testing and logging of operations. This regulation will principally apply to composting and anaerobic digestion processes including MBT systems.

EU Directive on Waste 75/442/EEC (amended by 91/156/EEC & 91/692/EEC) Articles 3,4,5

Requires the consideration of waste minimisation, recycling and energy recovery as well as the need to protect human health and the environment from potentially polluting developments.

Producer Responsibility Obligations (Packaging Waste) Regulations 1997 and Packaging (Essential Requirements) Regulations 1998

Sets targets for those involved in the packaging chain, from raw material production and retailer selling, to recovery and recycling of packaging waste. Whilst this does not apply to local authorities directly, the industry may be encouraged to form strategic partnerships to facilitate the collection and recycling or recovery of packaging waste from the household waste stream.

Waste Electrical and Electronic Equipment Directive (WEEE)

This Directive is still under consultation, but it should be implemented in the UK by 13 August 2004. It will place requirements on the manufacturers to collect and recycle waste electrical and electronic equipment. One consequence of this is that local authorities may be required to provide facilities at Recycling Centres to collect these items from householders. The actual collection targets and the recycling/recovery targets are to be introduced by the 31 December 2004. The Member States are required to collect 4kg of electrical and electronic equipment per head of population and per year. The recycling and recovery targets vary according to the material category.

End-of-Life Vehicles (ELVs) Directive 2000/53/EC

The End-of-Life Vehicles (ELVs) Directive will require treatment by authorised dismantlers and shredders. This Directive will have impacts on the disposal of ELVs and is likely to increase the level of abandoned vehicles and the costs involved, for the Municipalities concerned. The Directive was partly transposed into national law on 3 November 2003. The implemented part of the new regulation applies new standards to existing sites, requires operators working under a registered exemption to apply for a site licence (if accepting vehicles which have not been depolluted) and sets new minimum technical standards for all sites that store or treat ELVs. Other parts of the Directive are still under consultation according to the Department of Trade and Industry including the recycling/recovery targets and the arrangements for the take back of ELVs.

Batteries and Accumulators Directive.

This will require separate collection and recycling of all batteries across the EU, harmonising very different schemes across the continent. This is likely to result in the Municipalities having to provide separate collection facilities for batteries, most likely sited at Recycling Centres.

[3] WS 2000:England and Wales (Part1), page 40

3 The BPEO Methodology

The assessment methodology incorporates performance against Waste Strategy 2000 (WS 2000) targets, environmental, economic and planning criteria and follows the step-wise approach suggested in the WS 2000. WS 2000 states[3] that:

"Decisions on waste management, including decision on suitable sites and installations for treatment and disposal, should be based on a local assessment of the Best Practicable Environmental Option."

The best practicable environmental option (BPEO) concept was defined in the 12th Report of the Royal Commission on Environmental Pollution as:

"the outcome of a systematic and consultative decision-making procedure which emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefits or the least damage to the environment as a whole, at acceptable cost, in the long term as well as in the short term."

The BPEO concept incorporates two further principles that need to be accounted for in making decisions on waste management, namely:

- The waste hierarchy; and
- The proximity principle.

The above principles are important considerations in guiding the development of the future waste management scenarios. Firstly, scenarios are developed which aim to achieve WS2000 and BVPI recycling targets as a minimum. Secondly, the scenarios have been developed to deal with, in the first instance at least, the waste arising within the Municipality region.

3.1 THE STEP-WISE APPROACH TO BPEO

The step-wise approach to determining the BPEO as set out in WS2000 and in subsequent guidance[4] is noted below:

1. Define and Agree Appraisal Criteria
2. Develop Strategic Waste Planning Options
3. Appraise Strategic Waste Planning Options
4. Rank and Value performance
5. Weighting Indicators
6. Sensitivity Analysis and Option Refinement.

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[4] Land Use Consultants and ERM – "Strategic planning for sustainable waste management", Office of the Deputy Prime Minister, October 2002
http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/pdf/odpm_plan_pdf_606386.pdf

3.2 ASSESSMENT CRITERIA

The "Strategic Planning for Sustainable Waste Management"[3] guidance recommends 12 objectives with 21 indicators as assessment criteria. These objectives are grouped into three principal assessment categories:

1. Environmental Objectives
2. Socio-economic Objectives
3. Operational Objectives

Each of these is further defined by a range of indicators that provide a quantitative or qualitative measure of the performance of the scenario against that objective. The appraisal of scenarios combines a number of methods for deriving indicator values including modelling using specific software tools as well as professional judgement. For the environmental assessment we have made use of the industry standard life cycle assessment tool WISARD as developed and recommended for use by the Environment Agency. Additionally, for determining performance against targets and costs we have used AEA Technology's in-house model (WASTEFLOW). Table 3-1 summarises the various appraisal methods.

Table 3-1: Summary of Appraisal Methods

WISARD	Generic data & WASTEFLOW	Professional judgement
• Resource depletion • Greenhouse gas emissions • Emissions that are injurious to human health • Emissions contributing to air acidification • Emissions contributing to depletion of the ozone layer • Emissions contributing to eutrophication	• Landtake • Transport distances • Number of jobs likely to be created • Percentage of waste recovered • Percentage of waste recycled • Costs	• Noise, litter and vermin problems • Water pollution • Landscape and visual impacts • Likelihood of implementation within required timescale

Environmental Objectives

The environmental objectives and their respective indicators are noted in Table 3-2. Indicator values are either determined from modelling outputs (i.e. WISARD & WASTEFLOW) or are on a 'performance score' based on professional judgement. Details of the WISARD methodology and output are contained in Appendix 1.

Table 3-2: Environmental Objectives

Objectives	Indicators
1. To ensure prudent use of land and other resources	Resource depletion (avoided burden in million years) – *WISARD output*
	Landtake (hectares) *(performance score)*
2. To reduce greenhouse gas emissions	Emissions of greenhouse gases (000 tonnes equivalent of CO_2) – *WISARD output*
3. To minimise air quality impacts	Emissions which are injurious to public health (Human Toxicity Index) – *WISARD output*
	Air acidification (tonnes equivalents of H^+) – *WISARD output*
	Ozone depletion (tonnes equivalents of CFC-11) – *WISARD output*
	Extent of odour problems *(performance score)*
	Extent of dust problems *(performance score)*
4. To conserve landscapes and townscapes	Visual and landscape impacts *(performance score)*
5. To protect local amenity	Extent of noise problems *(performance score)*
	Extent of litter and vermin problems *(performance score)*
6. To minimise adverse effects on water quality	Eutrophication (million grams equivalents of PO_4) – *WISARD output*
	Extent of water pollution *(performance score)*
7. To minimise local transport impacts	Collection transport distance (thousand kilometres) – *WASTEFLOW output*
	Proportion of non motorway traffic *(percentage)*

Socio-Economic Objectives

The principal objectives and indicators are noted in Table 3-3. An estimate of the direct jobs created to operate the required waste management infrastructure has been made based on the tonnage of waste to be handled and/or processed by the treatment and disposal facilities. The cost of the waste management service can be measured in many ways depending on the time and the elements considered. The sum of the annual costs in one defined year, e.g. 2010 when most of the waste management infrastructure is operational, can be used as the measure of the cost of operating the waste management system i.e. equivalent to the annual revenue cost to the Municipality. The cost of the waste management service can also be calculated the aggregate cost of the service from e.g. 2005 until 2020. Costs have been determined using the WASTEFLOW model – further details are contained in Appendix 2.

Table 3-3: Socio-economic Objectives

Objectives	Indicators
8. To provide local employment opportunities	Number of direct jobs created (jobs estimated)
9. To provide opportunities for public involvement / education	Potential for participation in recycling and composting (% households with kerbside collection of recyclables)
10. To minimise costs of waste management	Overall costs (e.g. £million - to 2010) - *WASTEFLOW*

[6] For a set of 'n' scores x1 to xn, the normalised score yi of xi is given by: $y_i = \dfrac{x_i - \text{Min}[x_1, x_2, \ldots x_n]}{\text{Max}[x_1, x_2, \ldots x_n] - \text{Min}[x_1, x_2, \ldots x_n]}$

Operational Objectives

The operational objectives (Table 3-4) have two principal criteria; the reliability of delivery and performance against waste policy (i.e. BVPI and WS 2000 targets). The former aims to provide a measure of the degree to which each scenario is proven and deliverable, taking account of various uncertainties and risk e.g. permissions to develop sites. The waste management system must also comply with the various targets for recycling, recovery and landfill diversion – Objective 12 provides a measure of the performance of the various scenarios against these targets. Further details of the assessment methodology are contained in Appendix 2.

Table 3-4: Operational Objectives

Objectives	Indicators
11. To ensure reliability of delivery	Likelihood of implementation within required timescale (planning issues) –*(performance score)*
	Likelihood of implementation within required timescale (technical status and risk) –*(performance score)*
12. To conform with waste policy	Percentage of material recovered (%) - *WASTEFLOW*
	Percentage of material recycled/composted (%) - *WASTEFLOW*

3.3 SCORING METHODOLOGY

The modelling assessments i.e. WISARD (environmental) and WASTEFLOW (costs and performance against targets) produce outputs which are actual numerical values. In order to 'value' the performance of the evaluated criteria the numerical value can be converted to a normalised score by allocating a score between 0 (worst performing) and 1 (best performing). Figure 3-1illustrates the process of converting the numerical value to a normalised score[6] and is based on the highest particular score in this example being 45 and the lowest being -20.

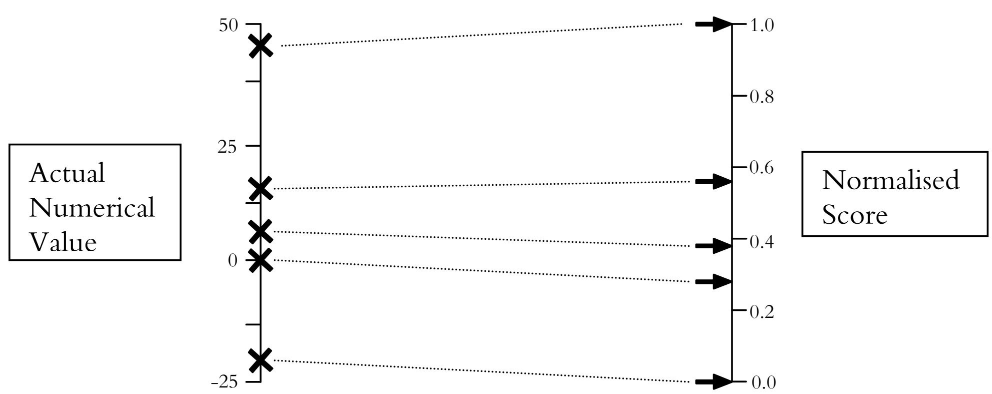


Figure 3-1: Illustration of the conversion of numerical value to normalised score

The conversion of the numerical value to a normalised score allows the various scenarios to be ranked according to performance i.e. the normalised scores are summed to give a total valued score which allows the scenarios to be ranked. A valued performance score, and a ranking of scenarios, has been determined for each of the principal objectives: Environmental, Socio-economic and Operational.

4 A Case Study Example

The Case Study presented below provides information on the UK Waste Management practice in 2001/02 for a Municipality and represents the baseline for the BPEO assessment. The composition of household waste and the amounts of waste delivered to the Recycling Centres are discussed and an approximation of the increase in household waste, produced in the Municipality's area over the next 20 years, is estimated.

A series of waste management scenarios were developed for the BPEO assessment which systematically considered the achievement of various levels of recycling and recovery. The baseline year for the BPEO assessment is 2010 – by which time it is assumed that the full infrastructure of each scenario is in place. Thus the BPEO has been determined based on waste tonnage's forecast to arise in 2010.

The Municipality is responsible for activities such as arranging for the collection, treatment and disposal of municipal waste, providing recycling schemes such as kerbside collection and Recycling Centres but also deciding on waste related planning applications and preparing a Waste Local Plan for the collection of municipal waste.

The region covered by this Municipality is mainly urban although it is located in a predominantly rural region in the UK, and it has estimated the total number of households within its area to be 109,500.

4.1 EXISTING WASTE MANAGEMENT SERVICE

For the year 2001/02, the household waste collected in this Municipality, which was collected on a weekly basis, totalled 77,854 tonnes and included kerbside recycling collections (excluding bulky waste and clinical waste). The total waste arising in 2001/02 at Recycling Centres was 63,717 tonnes. The overall amount of waste generated per household was 1.54 tonnes per household, which is about 30% higher than the national figure of 1.2 tonnes per household per year for England and Wales in 2000/01 (as was determined by the DEFRA survey[8]). Recyclable materials are collected through a combination of drop-off bank schemes, kerbside collection schemes and collection facilities at Recycling Centres. The Municipality achieved a BVPI recycling rate of 14.5% and an MSW recovery rate of 24.5% in 2001/02.

Kerbside collections of refuse and dry recyclables

All household waste collected, which is not either recycled or composted, is currently disposed to landfill within the administrative boundary of the Municipality. Landfill gas is recovered on the site for the generation of electricity via gas engines.

The majority of households (90%) are served by a kerbside collection for dry recyclables. A twin bin scheme (240 litre bins) serves approximately 55% of households; a 55 litre recycling box and black bag scheme covers 35% of the households; and the remaining 10% (comprising of multi-occupancy and high rise blocks) are served only with a general waste collection.

[8] www.defra.gov.uk/environment/statistics/wastats/mwb0001/index.htm

A single materials recovery facility is used to process recyclable materials collected at the kerbside. Some of the recyclables are processed and/or utilised within the region, but the majority are sent to the established re-processor plants outside the region. There is no separate, specific or targeted kerbside collection of kitchen or garden waste.

Bring schemes

There are a total of 52 bring sites within the Municipality's area (~1 per 2000 households) and some are located at supermarkets, where householders can deposit paper, cans, glass and textiles.

Recycling Centres

There are two Recycling Centres serving the East and the West of the Municipality's area. It is widely acknowledged that households located in the northern area and those in the suburbs have poor access to either of these sites. The recycling activities at the Recycling Centres out perform the kerbside and bring operations (even excluding the recycling of soil and rubble which cannot be included in the recycling performance figure according to the BVPI definition).

Table 4-1 collates all of the baseline mass flow data used as the starting point for developing the future recycling system scenarios and Figure 4-1 illustrates schematically the waste mass flows for the current waste management infrastructure.

Table 4-1: Summary data

WASTE ARISINGS[10]	
Household collected waste (includes bulky and clinical)	80,384
Street sweepings	10,166
Recycling Centre collected waste	43,093
Bring	2,406
Total Household Waste Arisings	136,049
Recycling Centre soil and rubble waste	20,624
Co-collected trade waste	10,854
Parks and gardens	975
Total MSW Arisings	168,502
RECYCLING	
Bring recycling	2,406
Kerbside recycling	4,079
Recycling Centre (incl. composting)	13,273
Total Household Waste Recycling	19,758
Recycling Centre soil and rubble recycling	20,624
Parks and gardens composting	975
Total MSW Recycling	41,357
Household Waste Recycling Rate %(BVPI)	14.5%
Total MSW Recovery %	24.5%
Total number of households	109,500
MSW tonnes/household/year	1.54
Number of households on kerbside scheme	98,550

[10] Excludes 10,854 tonnes of co-collected trade waste.

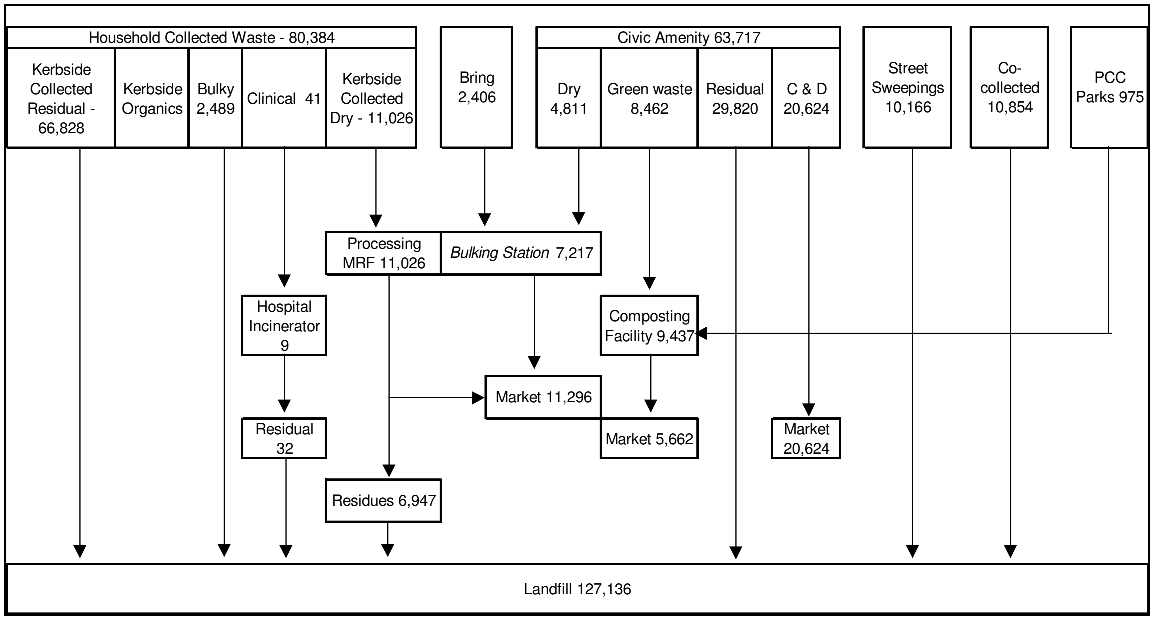


Figure 4-1: Existing Waste flows (tonnes) – 2001/2

Waste growth rate

The facts and figures for the last 3 years which are reported in the Municipality's (Waste Management) Best Value Review show an average growth in waste over the period of about 9% - compared to an average of about 3.4% on a regional level and about 3% on a national level. Two mitigating factors that may account for the high growth rate in this Municipality are:

1. The introduction of wheeled bins over the period in question – the replacement of the sack based collections by wheeled bins can lead to an increase in the weight of waste disposed.
2. Trade waste abuse – in recent years it has been experienced in other areas that there has been an increase in waste deposited at Recycling Centres by traders seeking to avoid paying the higher charges their designated alternate disposal routes.

Waste generation rates are known to depend on a number of factors such as population, geographic location, the local economy and behaviour patterns. The socio-economic profile of an area also affects the amount of waste produced. A number of studies[12,13] have shown a stronger correlation between waste arisings and household numbers than with population. This is significant because there is a general trend nationally towards fewer people per household. The number of households in the Municipality, in the year 2000, from which waste was collected on a regular basis, was estimated to be 109,500. Over the plan period (to 2011) it is projected that this will have increased to over 123,000 households.

[12] B W Gulley. An overview of UK waste analysis experience. IWM, Birmingham, 1983

[13] R L Pocock and N M Rufford. A new approach to household waste analysis and forecasting. IWM, Birmingham, 1993.

For the purposes of the modelling work reported below, which requires a forward projection of the growth in waste, we have assumed a profiled reduction from the current average growth rate of 9% to a level of 1% per annum, by 2015, in a series of steps as follows:

1. A linear reduction between 2001 (9%) and 2005 to align with the average annual rate for the Region i.e. 3.4%. This may be achieved, for example, by implementing policies restricting trade waste abuse at Recycling Centres and/or enforcing tough collection practices at the kerbside e.g. no collection of side waste where wheeled bins are provided.

2. A reduction from 3.4% to 2% per annum taking effect in 2010 and subsequently to 1% per annum in 2015. These further reductions may be achieved by vigorously pursuing various waste minimisation initiatives and more general waste awareness raising issues with the public.

Figure 4-2 shows the year on year projection for waste growth if this profiled reduction in growth rate is achieved and the Recycling/Recovery Tonnages. By 2011, the total MSW requiring management will be about 240,000 tonnes compared to the current total of about 160,000 tonnes. The Best Value Performance Indicators (BVPI) for recycling and composting (or recycling rate) of household waste in this Municipality is 16% in 2003/4, rising to 24% in 2005/6. The tonnages recycled in 2002 were only 20,000 tonnes and for comparison this is indicted in Figure 4-2 by the chequered vertical bar.

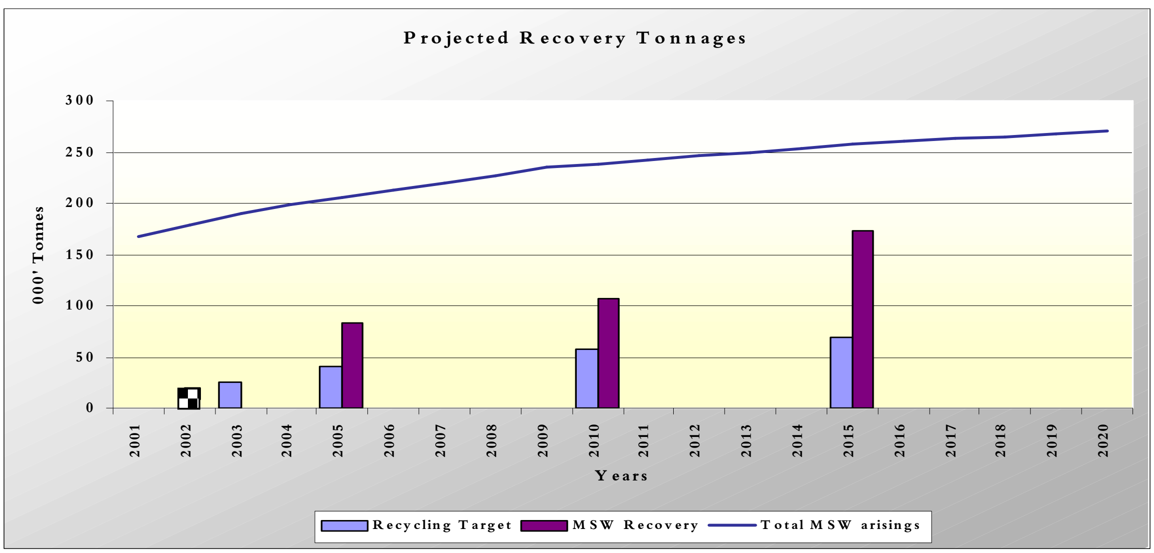


Figure 4-2: Projected growth of MSW arisings and Recycling/Recovery Tonnages

Waste composition

The composition of both household collected (dustbin) waste and the waste taken to Recycling Centres for recycling or disposal are summarised in Table 4-2 and Table 4-3. The waste composition of the dustbin waste is derived from a recent assessment of waste composition in the Municipality (March 2002). The figures comparing the waste taken from Recycling Centres is derived from waste tonnage data compiled by the Municipality.

These waste compositions, and in particular for household collected wastes, have been used in the subsequent modelling work to estimate the tonnage of material that is available and recoverable for recycling.

Table 4-2: Composition of household collected waste

Material	%
Paper	31
Plastic	14
Textiles	3
Nappies	2
Glass	5
Kitchen/garden organics	22
Metal	6
Other material	17
Total	**100**

Table 4-3: Composition of Recycling Centre waste

Material	%
Garden waste	13
Dry Recyclables	8
Soil and Rubble	32
Residual Waste	47
Total	**100**

4.2 POTENTIAL FUTURE SCENARIOS

The principles of proximity and self-sufficiency have been important considerations in developing the scenarios described below. The proximity principle requires that waste be managed as near as possible to its origin. The principal recognises both the desire to avoid passing costs and environmental impacts onto communities not responsible for its generation and the need to reduce transportation impacts. However, it is clear that it is impractical for all wastes to be managed at their absolute point of arising and that due consideration needs to be taken of costs and site (or processing capacity) availability. There is a desire on the part of the Municipality that they have sufficient treatment capacity in place to manage its (municipal solid) waste and that where practicable this is located within its administrative boundary.

In order to adhere to the principles of self-sufficiency and proximity the scenarios have been developed to consider only the MSW arising for which the Municipality is responsible. Any consideration of synergies with plans/policies in neighbouring authorities is undertaken only after determining the BPEO for the Municipality.

A series of waste management scenarios were developed which systematically considered the achievement of various levels of recycling and recovery. The scenarios considered were:

- Scenario A - the current situation (baseline)
- Scenario B – the achievement of targets, in excess of those of Waste Strategy 2000 (WS 2000), through a combination of intensive kerbside collection of household waste, bring site provision, civic amenity site management and energy from waste incineration (EfWI) recovery.
- Scenario C – as Scenario B but with mechanical biological treatment (MBT) of residual waste in place of conventional EfWI – i.e. a non-EfWI or other thermal recovery process.
- Scenario C1 – as Scenario C but including EfW combustion for the residual waste or refuse derived fuel (RDF).
- Scenario D – recycling and recovery sufficient to meet statutory Best Value Performance Indicators (BVPI) and other targets as set out in WS 2000.

4.2.1 Scenario A – Base Case

This scenario represents a continuation of existing practices - it represents a 'do nothing' approach which highlights the consequences in terms of costs and failure to meet targets. Even this approach requires investments and changes to current operations in order to maintain the existing level of service provision and to access new landfill once the local sites are fully utilised.

1. The existing **bring network** (~ 1 site per 2000 households) continues to operate without any significant changes - new sites are introduced only to keep pace with the forecast growth in waste stream.
2. The **kerbside collected** waste system remains unchanged but keeps pace with the forecast waste growth rate.
3. The two **Recycling Centres** continue to provide the current level of service. In 2010 a third site is introduced to cater for the forecast growth in waste.
4. The major **waste processing** systems comprise:
   - MRF to process kerbside collected dry recyclables.
   - Bulking facilities for recyclables from Recycling Centres and bring sites.
   - Composting sites operated by third parties processing the green waste from Recycling Centres.
   - Landfill until existing capacity utilised in 2006. A refuse transfer station is in place by 2006 in order to transfer waste to landfill outside of the Municipality's administrative boundary.

4.2.2 Scenario B – Exceeds Targets (incorporating EfW Recovery)

This scenario represents the case where a system designed to exceed WS 2000 targets is put in place. It envisages a dramatic change to the existing kerbside collection regime – moving from the existing two (240L) bin system to a three (140L) bin system of collection.

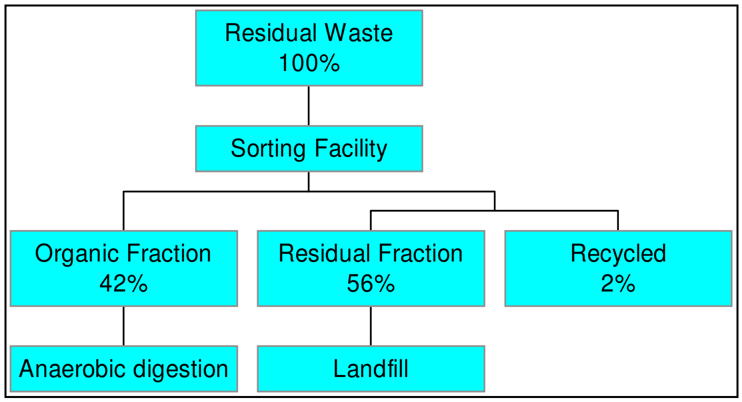
1. The **bring network** is expanded to achieve a coverage of 1 site per 500 households. The materials targeted for collection are glass, cans, paper and textiles from those collection areas not fully covered by the enhanced kerbside collection scheme.
2. The 3 bin **kerbside collected** waste system is operational as follows:
   - 90% of the households are served by 3 (140L) wheeled bins – weekly collection of dry recyclables and alternate weekly for organic and residual waste.
   - The remaining 10% of households, within high density areas or in multi-occupancy properties, continue with the general weekly collection of residual waste but in addition will be issued with sacks for paper recyclables. These households are targeted for the location of the enhanced bring network.
3. The two **Recycling Centres** are upgraded and operational procedures improved to allow improved collection and segregation of dry recyclables and green waste. A third Recycling Centre is introduced in 2010 to cater for the forecast waste growth.
4. The major **waste processing** systems comprise:
   - MRF, to process kerbside collected dry recyclables. The MRF is expected to perform to a high level – reject fractions of no more than 1 %.
   - A biowaste (in-vessel composting) facility is operational in 2007 to process organic waste collected at the kerbside.
   - Bulking facilities for recyclables from Recycling Centres and bring sites.
   - Composting sites operated by third parties processing the green waste from Recycling Centres.
   - Landfill until existing capacity utilised in 2006. A temporary refuse transfer station is in place by 2006 in order to transfer waste to landfill outside of the Municipality's administrative boundary until the recovery process is operational.

- A recovery process (EfW – grate fired, operational 2009) processing residual wastes from kerbside collections rounds and Recycling Centres.

4.2.3 Scenario C – Exceeds Targets (MBT (AD) Recovery)

This scenario is identical to Scenario B except that the residual waste stream is treated without reliance on thermal treatment technology. A mechanical biological treatment (MBT) system is proposed based on the application of anaerobic digestion technology. Figure 4-3 outline the essential components of the MBT system.

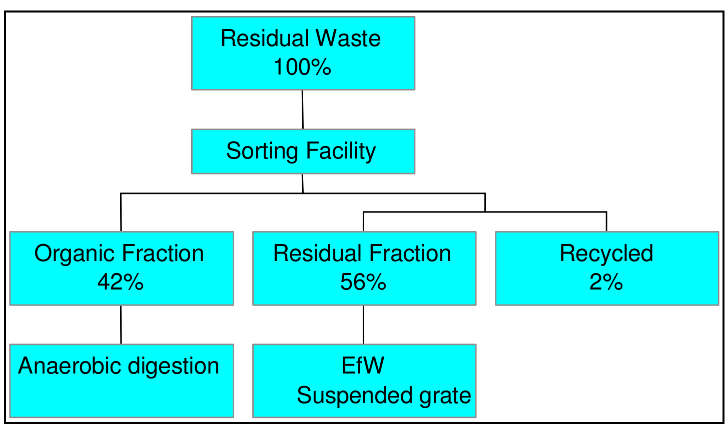
Figure 4-3: Outline of the MBT/AD System



4.2.4 Scenario C1 – Exceeds Targets (MBT (AD/EfW) Recovery)

This scenario is identical to Scenario C except that the MBT system now incorporates EfW (suspension fired grate system) for the treatment of part of the residual waste stream. Figure 4-4 outlines the essential components of the MBT system.

Figure 4-4: Outline of the MBT/(AD/EfW) Recovery System



4.2.5 Scenario D – Meets WS 2000 Targets

This scenario represents the case where a system designed to meet WS 2000 targets is put in place. The scenario envisages building on the existing collection systems i.e. with only minimal disruption to households.

1. The **bring network** is expanded to achieve a coverage of 1 site per 1000 households. The materials targeted for collection are glass, cans, paper and textiles from those collection areas not fully covered by the enhanced kerbside collection scheme.
2. A **kerbside collected** waste system is operational as follows:
   - Approximately 55% of households have a 240L wheeled bin for residual waste collected weekly, a 240L bin for dry recyclables collected fortnightly and a 240L wheeled bin for organic waste collected fortnightly.
   - Approximately 35% of households have a weekly black bag residual waste collection and a fortnightly 55 litre box for dry recyclables.
   - The remaining 10% of households are located within high density areas or in multi-occupancy properties. These properties are serviced weekly with a general waste collection only.
3. The two **Recycling Centres** are upgraded and operational procedures improved to allow improved collection and segregation of dry recyclables and green waste. A third Recycling Centre is introduced in 2010 to cater for the forecast waste growth.
4. The major **waste processing** systems comprise:
   - MRF, to process kerbside collected dry recyclables. The MRF is expected to perform to a high level – reject fractions of no more than 1 %.
   - A biowaste (in-vessel composting) facility is operational in 2007 to process organic waste collected at the kerbside.
   - Bulking facilities for recyclables from Recycling Centres and bring sites.
   - Composting sites operated by third parties processing the green waste from Recycling Centres.
   - Landfill until existing capacity utilised in 2006. A temporary refuse transfer station is in place by 2006 in order to transfer waste to landfill outside of the Municipality's administrative boundary until the recovery process is operational.
   - A recovery process (EfW – grate fired, operational 2009) processing residual wastes from kerbside collection rounds and Recycling Centres.

4.3 SCENARIO MASSFLOWS AND INFRASTRUCTURE REQUIREMENTS

Figure 4-5 to Figure 4-9 show the approximate massflows for each scenario based on the projected tonnages for 2010. The estimates of tonnages of recyclables collected from the bring network, kerbside collections and operations at Recycling Centres have been derived from AEA Technology's WASTEFLOW model – see Annex 2. The tonnages of recyclables collected and residual waste remaining for further treatment allow for the determination of processing or treatment facility capacities and hence the determination of capital and operational costs.

Figure 4-5: Scenario A (2010 Massflows)

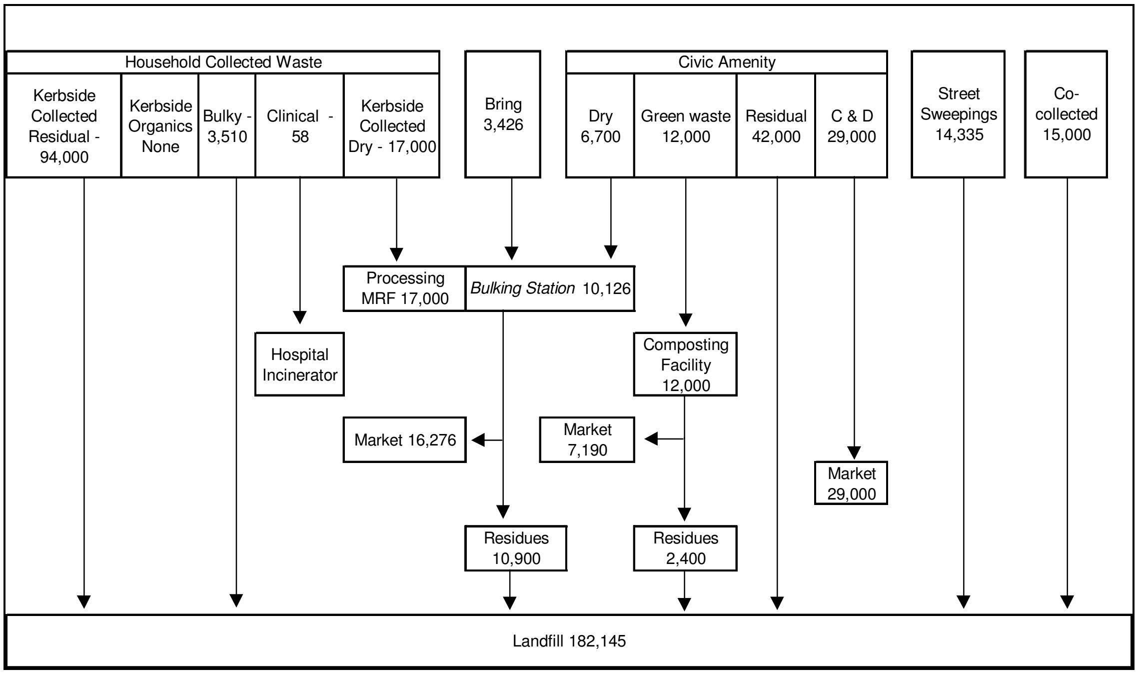


Figure 4-6: Scenario B (2010 Massflows)

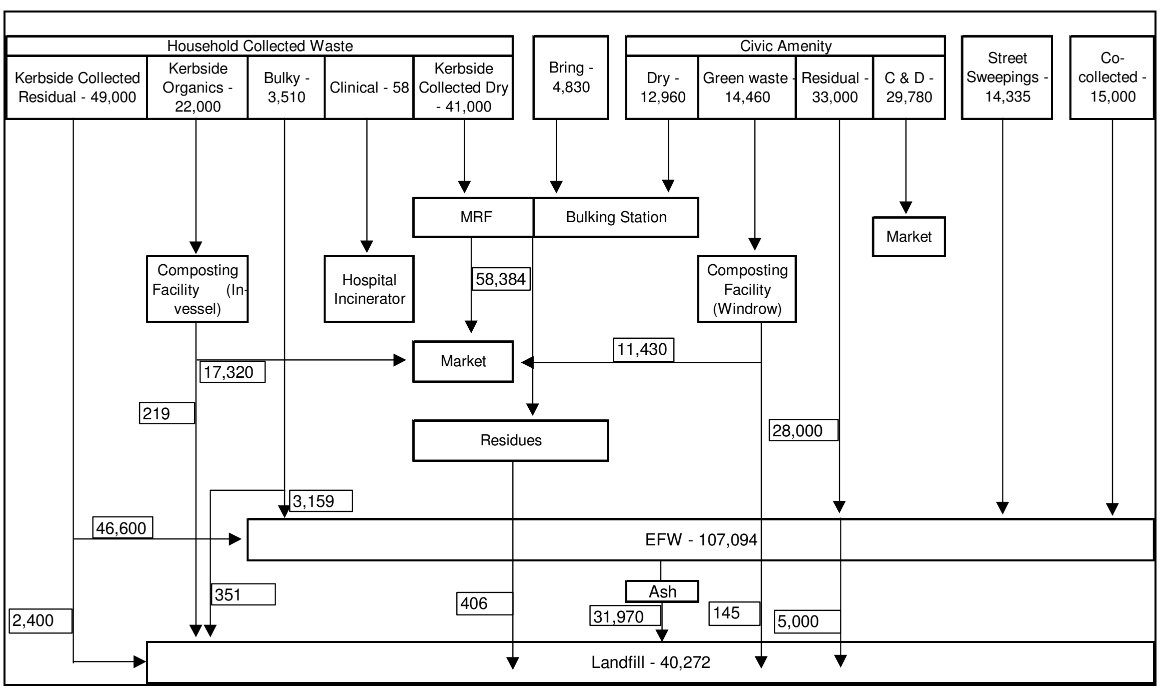


Figure 4-7: Scenario C (2010 Massflows)

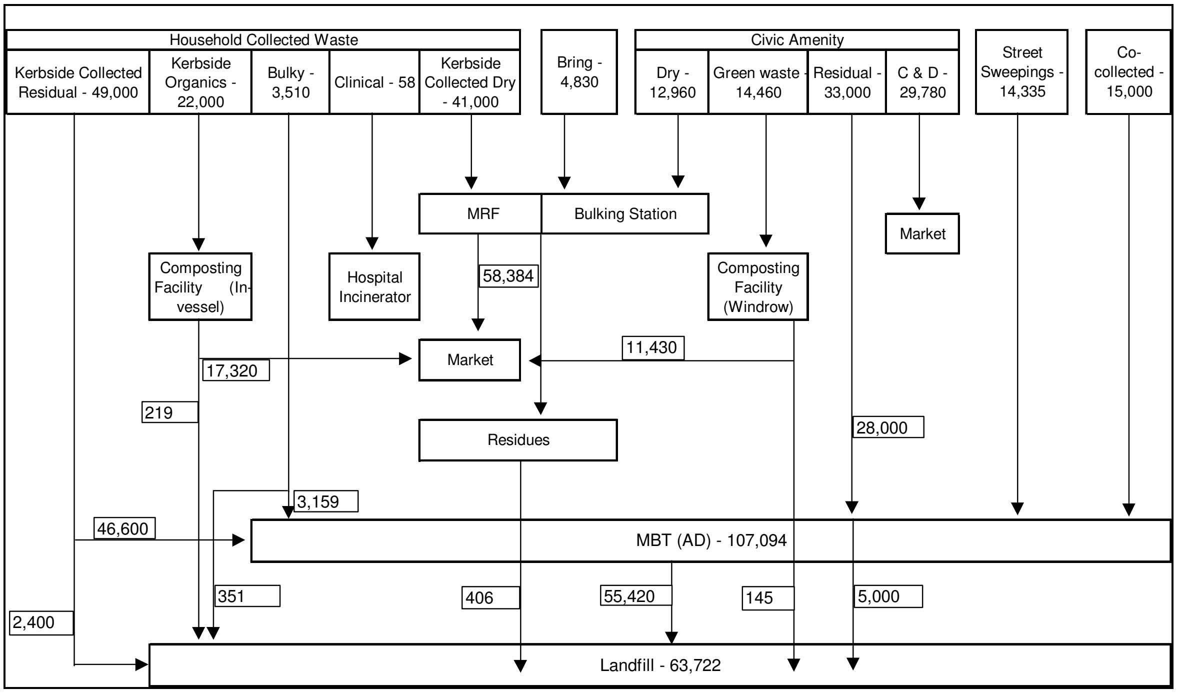


Figure 4-8: Scenario C1 (2010 Massflows)

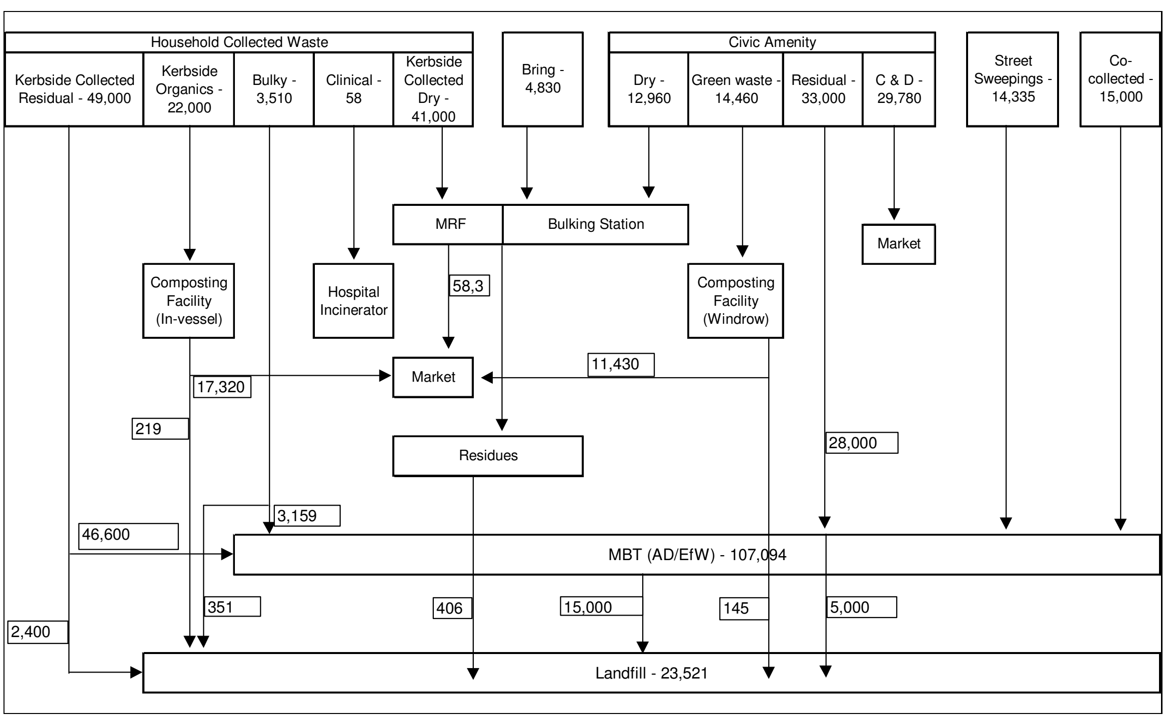


Figure 4-9: Scenario D (2010 Massflows)

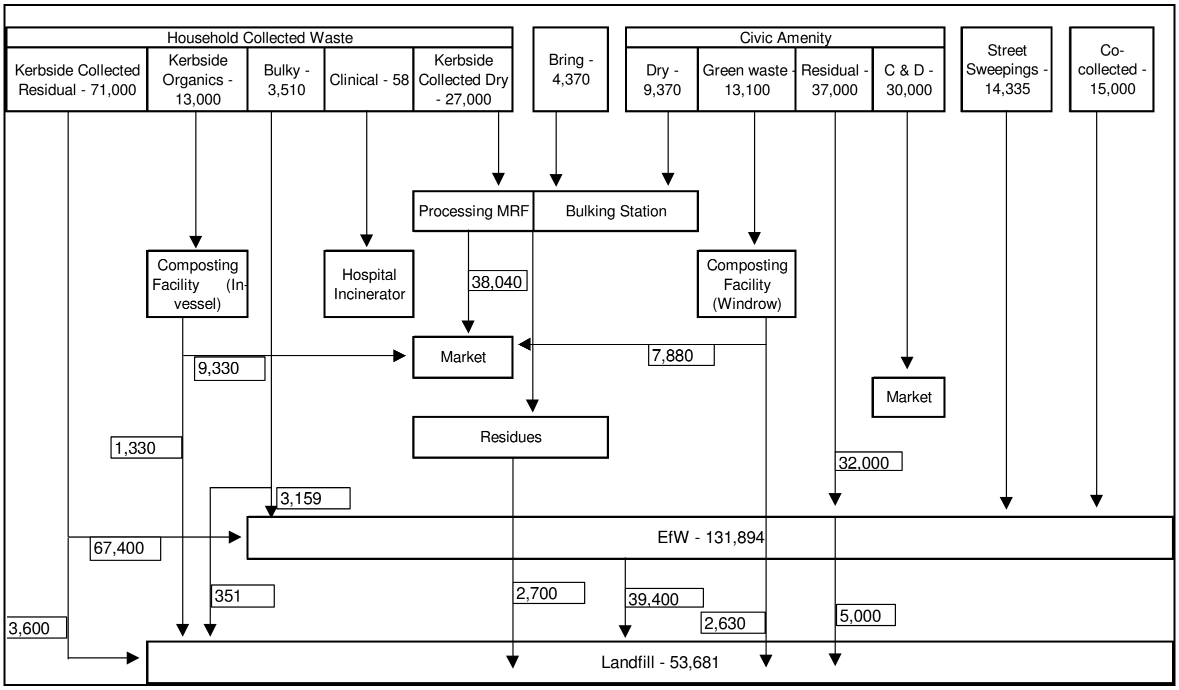


Table 4-4 shows for each scenario the capacity required for each type of processing facility.

Table 4-4: Approximate Processing and Treatment Capacities (2010 tonnages)

Facility	Scenario (Capacity kt/y)				
	A	B	C	C1	D
Bulking (dry waste)	10	16	16	16	12
MRF	17	41	41	41	27
Green waste composting (windrow)	12	14	14	14	13
Biowaste composting (in-vessel)		22	22	22	13
MBT			107	107	
AD (post MBT)			45	45	
EfW (RDF feed post MBT)				60	
EfW (Grate fired – mixed waste)		107			132
Landfill (active)	182	8	64	9	14
Landfill (inert)		32		15	39

A key aspect of all of the scenarios (except A) is the encouragement of high participation rates in the recycling schemes – more so for Scenarios B, C and C1 in comparison to D. This is in part provided by the reduction of residual waste capacity (Scenarios B, C, C1), in conjunction with waste minimisation and awareness campaigns aimed at informing householders on the steps necessary to reduce their waste and maximise their recycling. This is a challenge that the Council, Officers and Members as well as the householders of the Municipality will have to work towards to make the high recycling rates possible.

The processing plants considered within these scenarios are of a generic type – chosen for the quality of the data set (of the plant) that describes their performance.

4.4 BPEO APPRAISAL

4.4.1 Environmental objectives

Table 4-5 collates the outputs from the modelling assessment for environmental objectives. Direct use of these results to determine overall performance is difficult because of the complexity of the matrix and use of different units. By normalising the numerical values to a score the matrix is simplified and the performance against criteria is placed on a common scale - whilst still retaining the cardinal nature of the original data. In Table 4-6 the original outputs have been normalised to give the valued performance scores for each scenario and hence a rank.

Table 4-5: Environmental Objectives – Performance of Scenarios

Objectives	Indicators	Scenario				
		A	B	C	C1	D
1. To ensure prudent use of land and other resources	Resource depletion (avoided burden in million years)	-0.51	-1.45	-1.39	-1.50	-1.05
	Landtake (hectares)	9.93	9.18	13.18	11.43	9.98
2. To reduce greenhouse gas emissions	Emissions of greenhouse gases (ktonnes equivalents of CO_2)	27.81	-0.83	-15.80	-22.40	1.37
3. To minimise air quality impacts	Emissions which are injurious to human health (Human Toxicity Index)	-121.10	-608.20	-284.80	-618.40	-603.00
	Air acidification (tonnes equivalents of H^+)	-3.26	-14.80	-7.46	-15.20	-14.40
	Ozone depletion (tonnes equivalents of CFC-11)	-2.72	-53.40	-40.50	-54.70	-43.30
	Extent of odour problems *(performance score)*	16.00	15.00	17.00	15.00	15.00
	Extent of dust problems *(performance score)*	11.00	11.00	11.00	10.00	11.00
4. To conserve landscapes and townscapes	Visual and landscape impacts *(performance score)*	14.00	18.00	16.00	17.00	18.00
5. To protect local amenity	Extent of noise problems *(performance score)*	11.00	11.00	11.00	11.00	12.00
	Extent of litter and vermin problems *(performance score)*	15.00	14.00	15.00	14.00	14.00
6. To minimise adverse effects on water quality	Eutrophication (million grams equivalents of PO4)	460.22	56.57	324.40	141.40	55.24
7. To minimise local transport impacts	Collection transport distance (thousand kilometres)	1755	2097	2097	2097	1664

The penultimate row of Table 4-6 sums the valued performance scores for each option. This provides a simple overall measure of the performance of the scenarios and allows the scenarios to be ranked to identify the best performing scenario[14]. From a consideration of environmental objectives alone it is seen that the ranking of performance is C1, B, D, C and A. On balance

[14] The scenario which scores the highest is best performing. The results should not be regarded as a precise overall measure of performance; the two decimal places are retained only for consistency.

the difference in score between Scenarios C1, B and D is probably not significant but these scenarios clearly out perform Scenario C and A.

Table 4-6: Environmental Objectives – Valued Performance

Objectives	Indicators	Scenario				
		A	B	C	C1	D
1. To ensure prudent use of land and other resources	Resource depletion (avoided burden in million years)	0.00	0.94	0.88	1.00	0.54
	Landtake (hectares)	0.81	1.00	0.00	0.44	0.80
2. To reduce greenhouse gas emissions	Emissions of greenhouse gases (ktonnes equivalents of CO2)	0.00	0.57	0.87	1.00	0.53
3. To minimise air quality impacts	Emissions which are injurious to human health (Human Toxicity Index)	0.00	0.98	0.33	1.00	0.97
	Air acidification (tonnes equivalents of H+)	0.00	0.97	0.35	1.00	0.94
	Ozone depletion (tonnes equivalents of CFC-11)	0.00	0.97	0.73	1.00	0.78
	Extent of odour problems *(performance score)*	0.50	1.00	0.00	1.00	1.00
	Extent of dust problems *(performance score)*	0.00	0.00	0.00	1.00	0.00
4. To conserve landscapes and townscapes	Visual and landscape impacts *(performance score)*	1.00	0.00	0.50	0.25	0.00
5. To protect local amenity	Extent of noise problems *(performance score)*	1.00	1.00	1.00	1.00	0.00
	Extent of litter and vermin problems *(performance score)*	0.00	1.00	0.00	1.00	1.00
6. To minimise adverse effects on water quality	Eutrophication (million grams equivalents of PO4)	0.00	1.00	0.34	0.79	1.00
7. To minimise local transport impacts	Collection transport distance (thousand kilometres)	0.79	0.00	0.00	0.00	1.00
Total		**4.10**	**9.43**	**4.99**	**10.47**	**8.56**
Rank		**5**	**2**	**4**	**1**	**3**

4.4.2 Socio-economic objectives

The outputs of the assessment of socio-economic objectives are listed in Table 4-7 and the normalised performance scores in Table 4-8. It was decided by this Municipality that the objective labelled number 10 in Table 3-3 was not appropriate so it has been removed from this assessment. Scenarios B, C and C1 score relatively high for objective 8 due to the more intense collection and waste processing systems, but they have relatively higher costs (objective 9). On balance, as the total valued performance score shows, there is no significant difference in the overall ranking of these scenarios.

Table 4-7: Socio-economic Objectives – Performance of Scenarios

Objectives	Indicators	Scenario				
		A	B	C	C1	D
8. To provide local employment opportunities	Number of direct jobs (jobs)	162	234	244	254	184
9. To minimise costs of waste management	Overall costs (£million - to 2010)	148.8	153.7	152.7	154.4	148.2

Table 4-8: Socio-economic Objectives – Valued Performance

Objectives	Indicators	Scenario				
		A	B	C	C1	D
8. To provide local employment opportunities	Number of direct jobs created (jobs)	0.00	0.78	0.89	1.00	0.24
9. To minimise costs of waste management	Overall costs (£million - to 2010)	0.91	0.12	0.28	0.00	1.00
Total		**0.91**	**0.90**	**1.17**	**1.00**	**1.24**
Rank		**4**	**5**	**2**	**3**	**1**

4.4.3 Operational objectives

The outputs of the assessment of operational objectives are listed in Table 4-9 and the normalised performance scores in Table 4-10. The total normalised scores show little variation as the scoring between criteria e.g. likelihood of implementation and high recycling/recovery rates scores, cancel each other out.

Table 4-9: Operational Objectives – Performance of Scenarios

Objectives	Indicators	Scenario				
		A	B	C	C1	D
10. To ensure reliability of delivery	Likelihood of implementation within required timescale (planning issues) -*(performance score)*	16.00	20.00	18.00	18.00	20.00
	Likelihood of implementation within required timescale (technical status and risk) - *(performance score)*	7.00	9.00	11.00	11.00	9.00
11. To conform with waste policy	Percentage of material recovered (%)	23	96	73	96	93
	Percentage of material recycled/composted (%)	13	48	58	58	31

Table 4-10: Operational Objectives – Valued Performance

Objectives	Indicators	Scenario				
		A	B	C	C1	D
10. To ensure reliability of delivery	Likelihood of implementation within required timescale (planning issues) -*(performance score)*	1.00	0.00	0.50	0.50	0.00
	Likelihood of implementation within required timescale (technical status and risk) - *(performance score)*	1.00	0.50	0.00	0.00	0.50
11. To conform with waste policy	Percentage of material recovered (%)	0.00	1.00	0.68	1.00	0.96
	Percentage of material recycled/composted (%)	0.00	0.78	1.00	1.00	0.40
Total		**2.00**	**2.28**	**2.18**	**2.50**	**1.86**
Rank		**4**	**2**	**3**	**1**	**5**

4.4.4 Total valued performance of scenarios

The total valued performance scores of the scenarios for each of the main objectives are summed up in Table 4-11 to give an overall measure of performance. There is little variance between Scenarios C1, B and D but their performance is significantly better than for Scenarios C or A.

Table 4-11: Total Valued Performance

Objectives	Scenario				
	A	**B**	**C**	**C1**	**D**
Environmental	4.10	9.43	4.99	10.47	8.56
Socio-economic	0.91	0.90	1.17	1.00	1.24
Operational	2.00	2.28	2.18	2.50	1.86
Total Score	**7.01**	**12.62**	**8.35**	**13.97**	**11.65**
Rank	**5**	**2**	**4**	**1**	**3**

The assessment so far has been undertaken on the basis that the appraisal indicators are of equal importance. Because there are 19 indicators, each contributes only about 5% to the outcome of the appraisal. Decision-makers and/or stakeholders are likely to attach more importance to some indicators or criteria than to others. Some indicators may be of critical importance and could 'swing' the outcome of the appraisal whilst others may be of interest but be of much less consequence. Applying 'weights' to the valued performance information can assist in assessing the relative importance of indicators. Ideally, the relative weights should be determined through a consultative process involving the relevant decision-makers and stakeholders. Table 4-12 lists the appraisal indicators and weightings used. Particularly high weightings are placed on cost and implementation as well as harmful emissions.

Table 4-12: Weighting factors

Indicator	Weight (%)
Resource depletion	4.0%
Landtake	1.0%
Greenhouse gases emitted	9.0%
Emissions injurious to public health	10.0%
Air Acidification	3.0%
Ozone depletion	3.3%
Extent of odour problems	4.0%
Extent of dust problems	1.5%
Visual and landscape impacts	2.0%
Extent of noise problems	1.5%
Litter and vermin problems	1.5%
Eutrophication	2.5%
Total transport distance	5.0%
Number of jobs created	5.0%
Overall costs	15.5%
Implementation within timescale (technical)	4.5%
Implementation within timescale (planning)	16.0%
% Recovery of waste	6.5%
% Material recycled/composted	4.5%

The results of applying the weighting factors to the valued performance scores are set out in Table 4-13 and the totals summarised in Table 4-14.

Table 4-13: Weighted Scores

Objectives	Indicators	Scenario				
		A	**B**	**C**	**C1**	**D**
1. To ensure prudent use of land and other resources	Resource depletion (avoided burden in million years)	0.00	0.04	0.04	0.04	0.02
	Landtake (hectares)	0.01	0.01	0.00	0.00	0.01
2. To reduce greenhouse gas emissions	Emissions of greenhouse gases (ktonnes equivalents of CO2)	0.00	0.05	0.08	0.09	0.05
3. To minimise air quality impacts	Emissions which are injurious to human health (Human Toxicity Index)	0.00	0.10	0.03	0.10	0.10
	Air acidification (tonnes equivalents of H+)	0.00	0.03	0.01	0.03	0.03
	Ozone depletion (tonnes equivalents of CFC-11)	0.00	0.03	0.02	0.03	0.03
	Extent of odour problems *(performance score)*	0.02	0.04	0.00	0.04	0.04
	Extent of dust problems *(performance score)*	0.00	0.00	0.00	0.02	0.00
4. To conserve landscapes and townscapes	Visual and landscape impacts *(performance score)*	0.02	0.00	0.01	0.01	0.00
5. To protect local amenity	Extent of noise problems *(performance score)*	0.02	0.02	0.02	0.02	0.00
	Extent of litter and vermin problems *(performance score)*	0.00	0.02	0.00	0.02	0.02
6. To minimise adverse effects on water quality	Eutrophication (million grams equivalents of PO4)	0.00	0.02	0.01	0.02	0.03
7. To minimise local transport impacts	Collection transport distance (thousand kilometres)	0.04	0.00	0.00	0.00	0.05
8. To provide local employment opportunities	Number of direct jobs created (jobs)	0.00	0.04	0.04	0.05	0.01
9. To minimise costs of waste management	Overall costs (£million - to 2010)	0.14	0.02	0.04	0.00	0.16
10. To ensure reliability of delivery	Likelihood of implementation within required timescale (planning issues) -*(performance score)*	0.16	0.00	0.08	0.08	0.00
	Likelihood of implementation within required timescale (technical status and risk) - *(performance score)*	0.05	0.02	0.00	0.00	0.02
11. To conform with waste policy	Percentage of material recovered (%)	0.00	0.07	0.04	0.07	0.06
	Percentage of material recycled/composted (%)	0.00	0.04	0.05	0.05	0.02

Table 4-14: Total Weighted Scores

Objectives	Scenarios				
	A	**B**	**C**	**C1**	**D**
Environmental	0.10	0.35	0.21	0.41	0.36
Socio-economic	0.14	0.06	0.09	0.05	0.17
Operational	0.21	0.12	0.17	0.19	0.10
Total Score	**0.45**	**0.53**	**0.47**	**0.65**	**0.63**
Rank	**5**	**3**	**4**	**1**	**2**

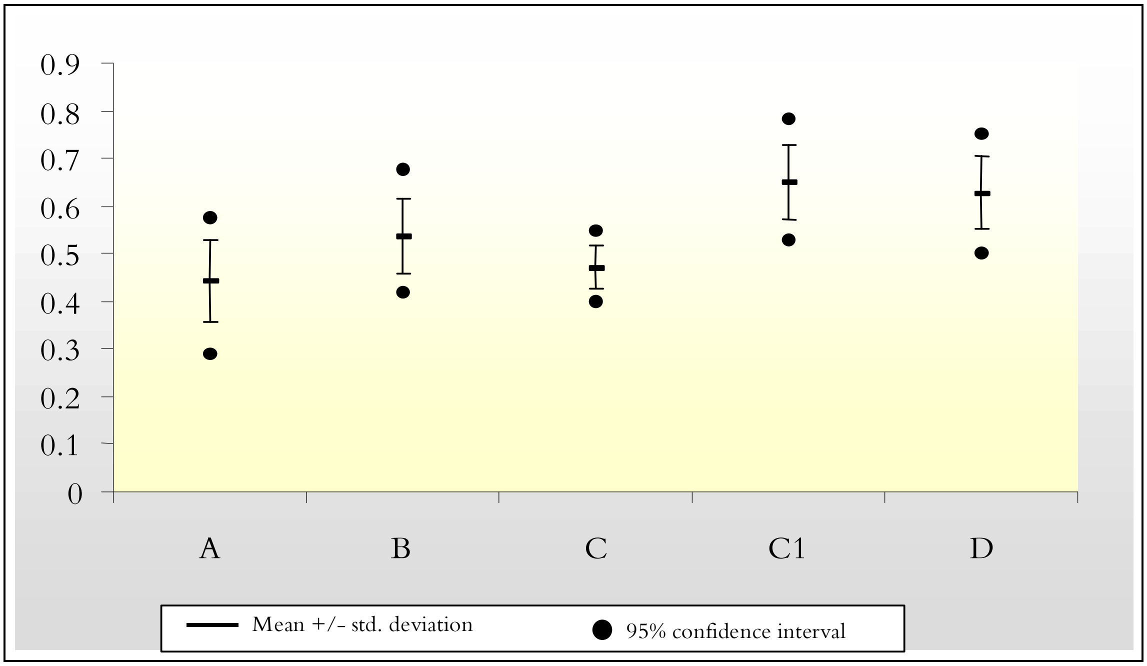
The weighted performance numbers are uncertain stemming as they do from the imprecise nature of the weighting process – the figures are shown to several decimal places for consistency only. The ranking of scenarios is now C1, D, B, C and A. The performance of Scenarios C1 and D is essentially the same but the application of the weightings has differentiated these scenarios as performing significantly better than the other scenarios.

4.4.5 Sensitivity analysis

The above analysis has shown that applying weights can alter the relative rankings of the scenarios when compared with the application of equal weights. A sensitivity analysis around the weightings given can aid the assessment of the relative robustness of the rankings. We have carried out such a sensitivity test by varying the weights recorded in Table 4.9 for each indicator by 100% i.e. between zero and twice the value shows the variance in range of weighted scores for each scenario.

The sensitivity analysis shows the better (and equivalent) performance of Scenarios C1 and D but also a significant overlap with Scenario B. The common theme for these scenarios is the high diversion from landfill.

Figure 4-10: Sensitivity of Weighted Scores



4.5 CONCLUSIONS

A number of major conclusions can be drawn from this study.

1. The principal drivers for change in waste management in the Municipality will be the rising cost of landfill disposal and statutory targets for material recycling, recovery and the diversion of organic wastes from landfill.
2. The response to these drivers will necessitate significant capital expenditure and change to the way in which waste is managed in the Municipality in the future, leading to the development of recycling, recovery and disposal infrastructure over the period to 2011 to manage some 240,000 tonnes per year of MSW.
3. A range of scenarios may be considered and the sustainability appraisal has shown that these are likely to involve enhanced systems for waste collection (bring, kerbside and Recycling Centres) and capital plant for material recycling, composting and recovery operations. There will also be an on-going need for waste transfer and landfill disposal.

Short-term (2006/7) measures

4. The short-term recycling target (24% of household waste by 2005/6) is unlikely to be attained though progress towards it can be made if there is an immediate overhaul of the existing MRF operations – requiring capital investment.
5. Comprehensive coverage of a 2 and/or 3 container collection system will be required with consequent changes to the type and frequency of collections in order to achieve the required material recovery rates.

6. A comprehensive education and publicity programme will need to be introduced in order to achieve and maintain a required householder participation rate (of 75 – 100%) if the recycling targets are to be achieved.
7. Urgent and immediate action needs to be taken to plan for the anticipated closure (in 2006) of the local landfill. New landfill sites and/or waste transfer facilities will need to be developed.
8. Whilst the short timescale (to 2005/6) precludes any significant contribution from recovery operations the development of these should not be delayed given the known (long) lead times for implementing these processes.

Medium term (2010) measures

9. For the mid to long term (2005/6 onwards) a recovery process is required to manage the residual waste stream – to achieve future recovery targets and to reduce exposure to rising landfill costs
10. Provision needs to be made for at least a single recovery process or waste treatment centre capable of accommodating any given combination of recovery technology – MBT/AD/RDF, EfWI etc.

Our recommendations to the Municipality are:

1. To undertake further consultation to disseminate the findings of this sustainability appraisal to Members and other stakeholders, including the public.
2. To develop/update the existing waste strategy following the consultation on the sustainability appraisal.
3. To undertake a contractual review of the principal waste collection and treatment options and agree the procurement process to deliver the preferred scenario.
4. That, given the time scale for developments to occur, these recommendations are actioned as a matter of urgency.