South West Devon Waste Partnership

SWDWP - Waste PFI - OBC

Options Appraisal and Technical Modelling Assumptions

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April 2008










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South West Devon Waste Partnership

SWDWP - Waste PFI - OBC

Options Appraisal and Technical Modelling Assumptions

April 2008

Entec UK Limited

Executive Summary

Purpose of this Report

This report has been produced for the purpose of supporting the South West Devon Waste Partnership (SWDWP) Outline Business Case (OBC) application to DEFRA for Public Finance Initiative (PFI) credits. The SWDWP is comprised of Plymouth City Council, Torbay Council and Devon County Council.

The report summarises the options appraisal undertaken by the Partnership when determining the Reference Project. The options appraisal process and the results of the assessment are detailed in the report.

The report also details the major assumptions made within the Waste PFI Reference Project Waste Flow Model, and provides a brief over-view of the model itself.

The model provides projections for all sources of municipal solid waste up until 2038/39 (the anticipated final contract year). Waste growth rates and compositions are applied to all municipal waste streams. Recycling and composting schemes conducted by the authorities are modelled to identify the tonnages of material requiring processing in the various treatment facilities. Assumptions around increased materials capture rate of kerbside collections are detailed, as are projected improvements in diversion of material at the Civic Amenity and Recycling Centres (CARCs).

This report provides an assessment of the capital and operational expenditure values for the reference project. The costs summarised in this report are based upon the functional unit costs for each process or facility. Where current operational costs were not available costs are based on generic cost curves/functional unit estimates derived from market information.

The base data used for all future waste projections has been derived from the existing datasets of each of the partnering Authorities. The data used is from the year 2006/07, which is the most recent complete and audited data available.

Contents

1. Introduction

1.1 Background to the SWDWP

The South West Devon Waste Partnership (SWDWP) is comprised of the Unitary Authorities of Plymouth City Council and Torbay Council, and the Waste Disposal Authority of Devon County Council.

The SWDWP aims to procure a waste infrastructure for the treatment of residual municipal waste arising within the Partnership's area. The catchment area is defined as waste arising in Plymouth, Torbay and the three Devon Waste Collection Authorities of West Devon, South Hams and Teignbridge (in part only).

1.2 This Report

In support of the SWDWP Expression of Interest (EoI) and subsequent Outline Business Case (OBC), Entec has assisted the Partnership with a detailed appraisal of waste treatment solutions capable of delivering each Authority's strategic objectives. This report provides details of the full options appraisal process used in determining the PFI Reference Project.

Subsequent to the determination of the appropriate technology to be included in the Reference Project, various assumptions have been tested and refined to ensure that the final Reference Project is robust, deliverable and appropriate. This report also details the key technical assumptions underpinning the Reference Project.

2. Options Appraisal

2.1 Options Appraisal - Long Listing of Technology Options

Each of the respective Authorities within the SWDWP have undertaken numerous detailed appraisals of waste management options, identifying waste treatment technologies capable of meeting each of the Authorities strategic objectives. Given that PCC carried out a technology options appraisal in their updated MWMS (2007), Torbay have also recently conducted a similar exercise for their MWMS (2008), and DCC has carried out various options appraisals in support of their MWMS (2005) and other relevant studies, the SWDWP PFI project team decided that a full 'long list' approach to the joint options appraisal was not required, as each of their respective MWMS have undertaken detailed options appraisals. Therefore, the Partnership has taken forward options that performed well in their individual options appraisals and created a short list of 'joint procurement options' for detailed analysis.

Figure 2.1 below summarises the options appraisal approach adopted by the Partnership.

Figure 2.1 SWDWP Residual Waste Treatment Options Appraisal Process

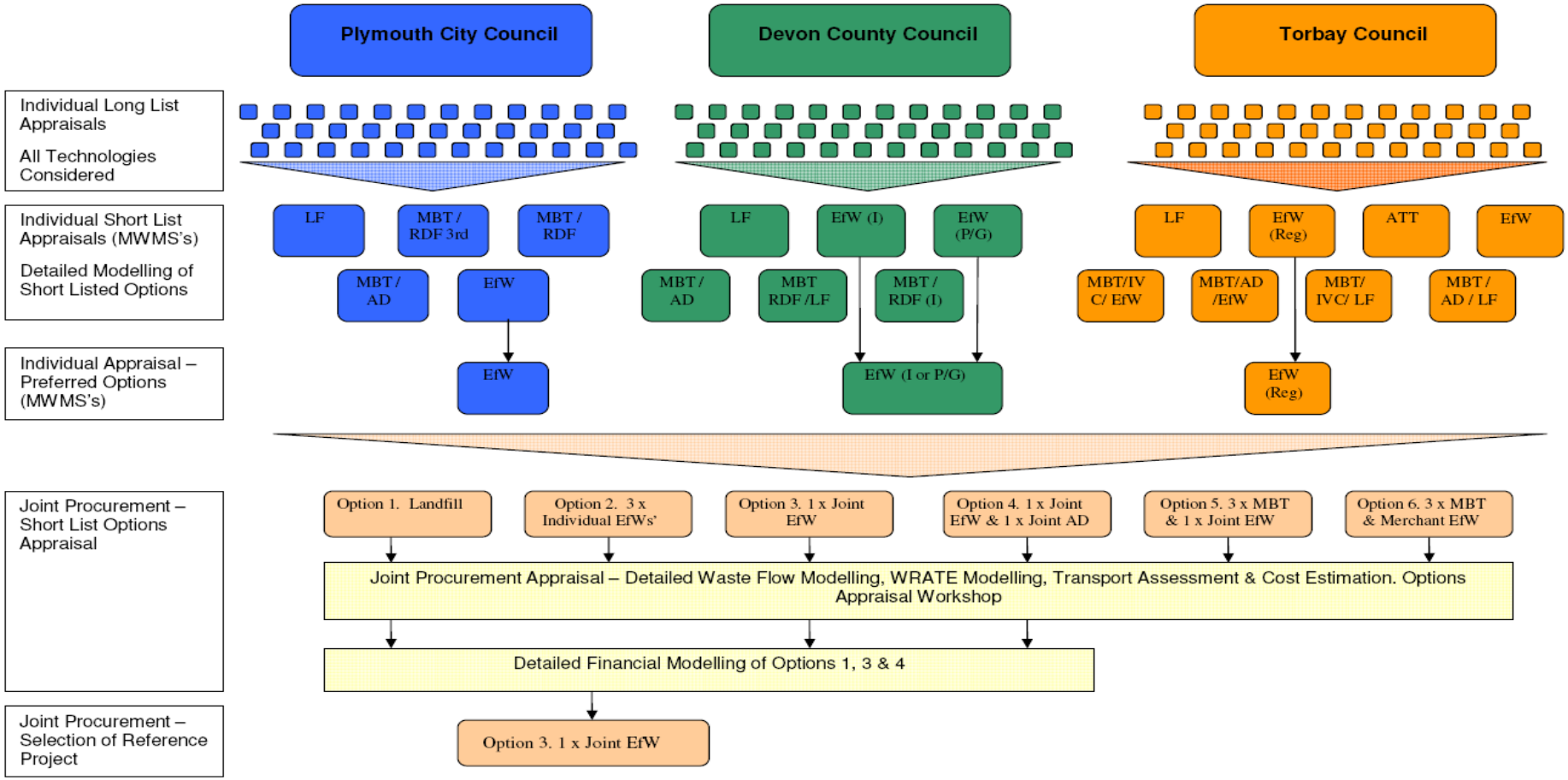


Table 2.1 below presents the technologies that have been appraised by each of the partnering Authorities (note that the solutions presented in Table 2.1 are from each of the individual Authorities 'short list' options appraisals, a wider range of solutions was considered prior to the individual short lists).

Table 2.1 Summary of Options Evaluated by Individual Authorities

Devon		Plymouth	Torbay
MWMS 2005	**Multiple Sites Study 2006**[1]	**MWMS 2007**	**MWMS 2008**
• Landfill all residue	• 2 x 50,000 tpa EfW's (for Devon only)	• Landfill all residue	• Landfill all residue
• EfW (Incineration)	• 2 x EfW's (for Devon, Torbay & Plymouth)	• MBT – RDF (3rd party thermal facility)	• Regional EfW
• EfW (Pyrolysis / Gasification)	• 4 x EfW's (for Devon only)	• MBT – RDF (purpose built thermal facility)	• Advanced Thermal Treatment (ATT)
• MBT – AD	• 2 x EfW's (for Devon & Torbay)	• MBT – AD	• EfW
• MBT – RDF / Landfill	• 3 x EfW's (Devon only)	• EfW	• MBT – IVC – EfW
• MBT – RDF (EfW)	• 100,000 tpa MBT-AD		• MBT – AD – EfW
	• 2 x 50,000 tpa EfW		• MBT – IVC – LF
			• MBT – AD - LF

2.2 Appraisal of Short-listed Options to Identify Reference Project

A project team workshop was held in December 2007 to determine the 'Short List' of options that required detailed modelling. In attendance at the workshop were representatives from each Authority, including personnel from finance, legal, procurement and waste management departments. Also in attendance were the Partnerships legal, financial and technical advisors. A review of the relevant waste strategies and supporting documents was undertaken to established strategic objectives of the respective authorities. Using the individual MWMS's as guidance, the following Short List of options was developed;

- Option 1 – 'Do Minimum' – disposal of residual waste to landfill
- Option 2 – Individually Procured EfW's (a facility for each authority)

[1] Report titled 'Assessment of Costs and Environmental Impacts of Multiple Facilities' report produced by AEAT for Devon County Council, 2006.

- Option 3 – A single joint EfW
- Option 4 – A single joint EfW and a joint AD facility for food waste treatment
- Option 5 – Three strategically located MBT facilities (comprising AD for organic the fraction), producing an RDF which is combusted in a joint RDF burner (located in Plymouth)
- Option 6 – Three strategically located MBT facilities (comprising AD for the organic fraction), producing an RDF which is combusted and a merchant RDF burner (located in Runcorn).

Plymouth identified EfW as the most appropriate technology in their MWMS. Devon identified either EfW or ATT as the most appropriate technology in their MWMS, and Torbay identified a regional EfW as the most suitable technology in their MWMS. As a result, EfW based solutions were the most prominent in the short listed options however, additional options have been looked at for completeness and to reflect recent developments in the UK waste industry.

The Torbay MWMS concluded that a regional EfW would be its preferred option, while both Devon and Plymouth had stated within their MWMS that economies of scale can be achieved through larger facilities, but further work would be required to test the viability of joint procurements. Therefore, one of the key outcomes of this options appraisal was to fully assess and compare of the costs and benefits of individually procured facilities (Option 2) and jointly procured facilities (Options 3 to 6).

The Partnership had decided to adopt a disaggregated procurement strategy, with all other infrastructure requirements procured outside of this PFI project. However, with the recent publication of the Waste Strategy for England 2007 (WSE2007) strongly supporting the use of anaerobic digestion as a means of energy recovery, and with the possibility of receiving revenue support from central government for an AD facility, the Partnership wished to evaluate the costs and benefits of the inclusion of an AD facility within the PFI contract (Option 4). South Hams and Teignbridge currently collect food waste in a co-mingled collection with garden waste, which is then processed in an IVC located at Heathfield. West Devon is currently undertaking food waste collections in Tavistock which is being processed at a merchant AD facility located at Holsworthy. West Devon Borough plan to expand this service to incorporate the remainder of the Authority over the next few years. Torbay have identified the need for food waste collections in their 2008 Waste Strategy, and therefore either require additional infrastructure or capacity at a merchant facility (Holsworthy is the most likely facility as the Heathfield plant is operating at capacity). Option 4 tests the viability of Plymouth, Torbay and West Devon collecting food waste with processing in a new joint AD facility, procured jointly within the PFI contract. All other options assume that Torbay and West Devon collect food waste which is then processed at the Holsworthy AD facility.

Even though each of the partner Authorities have identified EfW as the preferred technology in their respective MWMS's, an options appraisal of this type should still consider other technologies that could deliver additional benefits, incorporating the most recent developments in the industry. In the case of the SWDWP, the use of multiple MBT facilities, which reduce the volume and mass of residual waste prior to transport to a centralised facility, may have additional benefits over a single facility (namely reduced vehicle movements and a reduced

capacity of thermal facility required). Therefore, two MBT options were modelled; one assuming that a purpose built burner is constructed within the Partnership area (Option 5), and the second assuming that the RDF is transported to a merchant facility outside of the Partnership area (Option 6).

Figure 2.2 presents the 6 Short Listed Options with the anticipated size and type of facilities required.

Figure 2.2 Short Listed Options – Required Infrastructure and Estimated Capacity

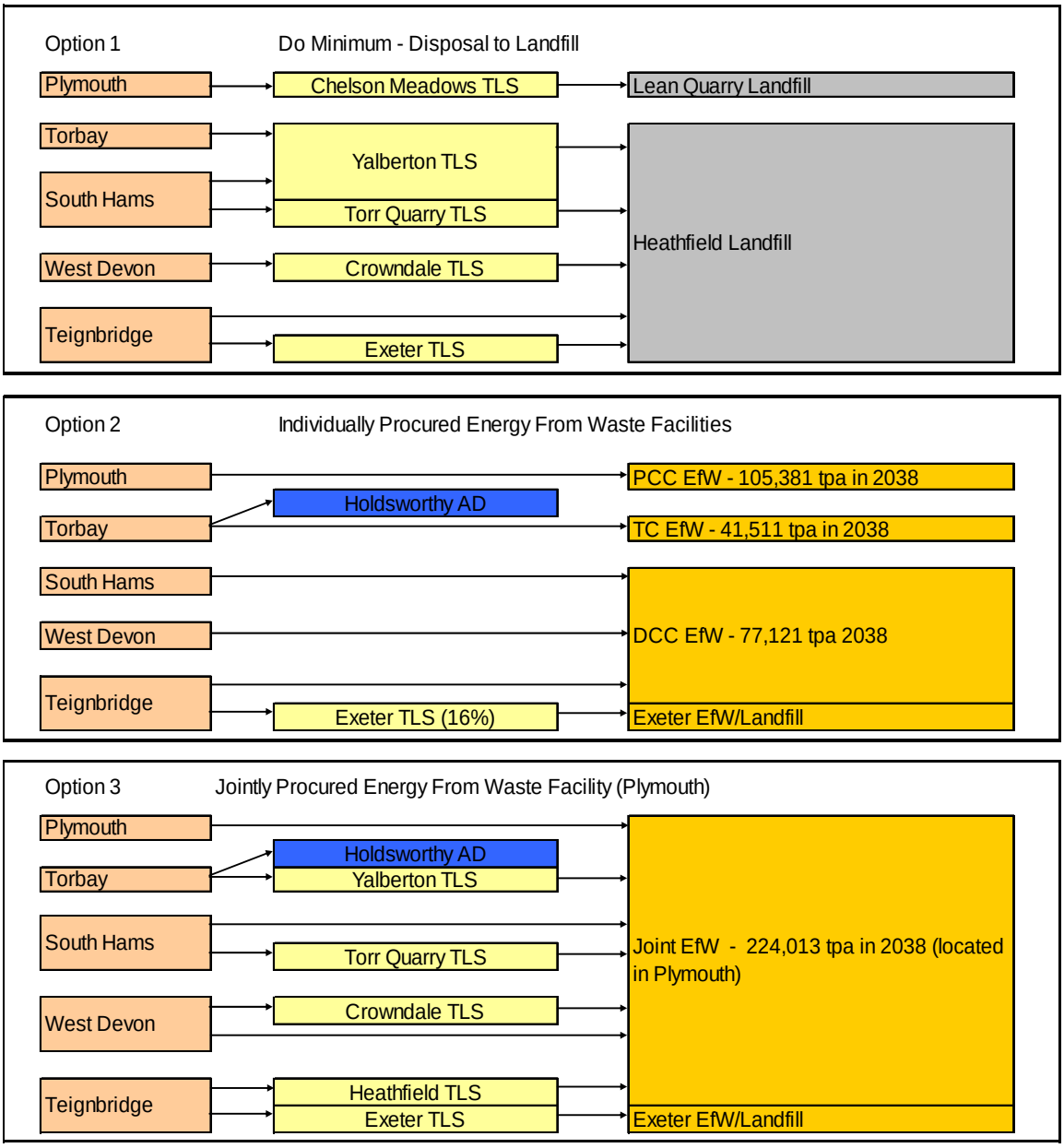
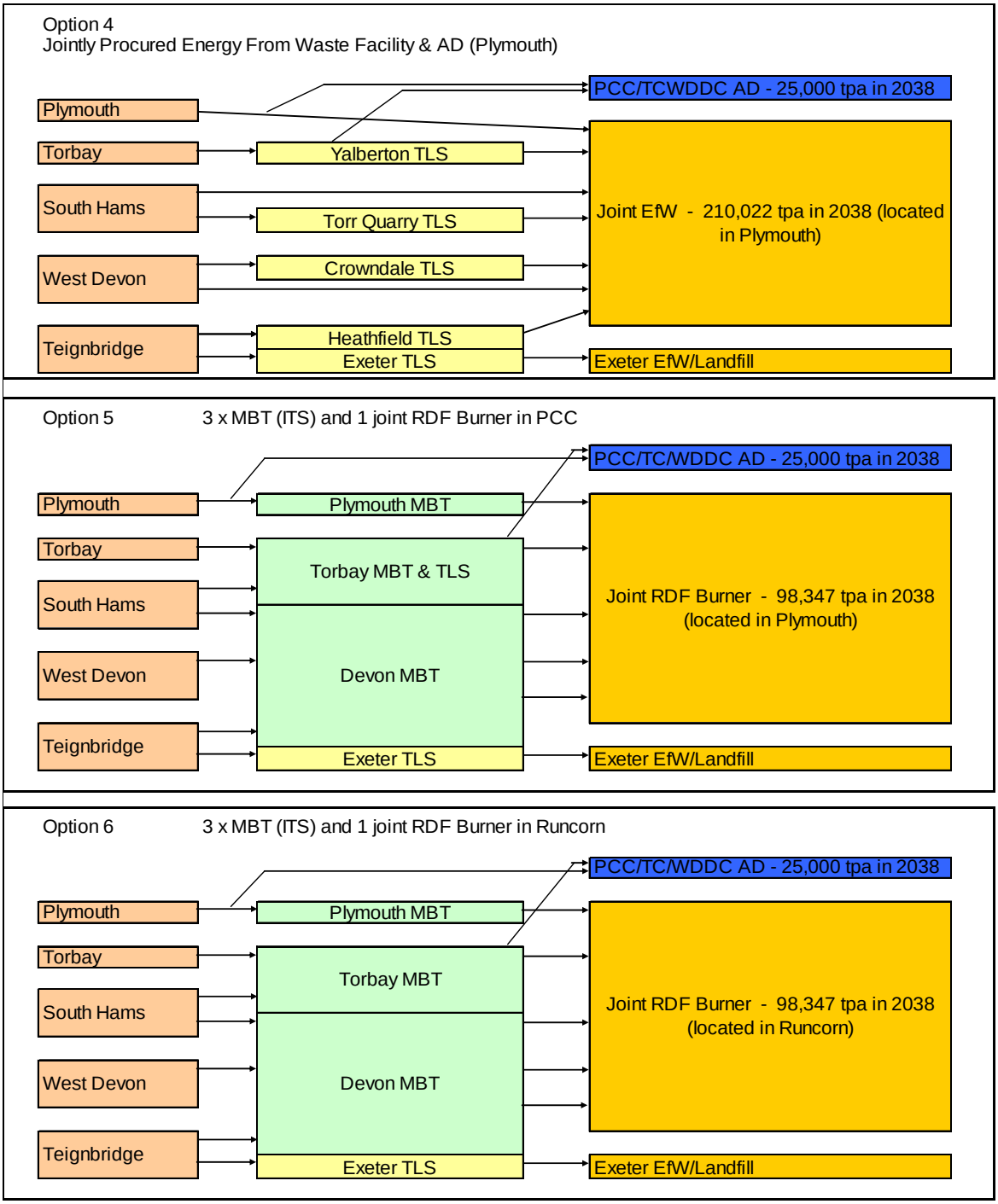


Figure 2.2 (continued) Short Listed Options – Required Infrastructure and Estimated Capacity



All options identified in the Short List underwent detailed modelling, with a full system Mass Flow Model developed for each. The anticipated environmental impacts were modelled for each option using the EA approved WRATE Life Cycle Assessment model (full details of the WRATE assessment are provided in the Entec Technical Note 'SWDWP WRATE Final Technical Note 08227i1').

On the 8th of January 2008 a second Options Appraisal Workshop was held to evaluate the short listed options. Details of the technical modelling, WRATE assessment and cost estimations were presented to the Project Team. The Project Team evaluated the short listed options. The process outlined below was followed:

- Develop evaluation criteria
- Weight each criteria
- Score Options (score of 1-5, preference scoring used)
- Review Results

Table 2.2 below presents the evaluation criteria that the Project Team used to evaluate the Options. The weighting (presented as a % of the overall score) is also presented in the table.

Table 2.2 Short List Evaluation Criteria and Weighting

Primary Criteria	Primary Criteria Weighting	Secondary Criteria	Secondary Criteria Evaluation Indicator	Secondary Criteria Weighting
Planning	15%	Fit with planning framework	Prof Judgement	3%
		Planning and development timescales	Kelly Report	5%
		Availability of Suitable Sites / landtake	Prof Judgement	8%
Technical	20%	Technical track record of technology	Prof Judgement	5%
		Flexibility in capacity	Prof Judgement	1%
		Flexibility in composition	Prof Judgement	1%
		BMW diversion (MSW)	Mass Flow Model	2%
		Absolute diversion from landfill (MSW)	Mass Flow Model	4%
		Operational fit (collection service interface)	Prof Judgement / modelling	1%
		Availability of Markets / outlets	Prof Judgement	1%
		kg of HH waste not recycled / composted	Mass Flow Model	1%
		Material Recycled/Composted (hhw)	Mass Flow Model	4%
Environmental	25%	Abiotic Resource Depletion	WRATE	1%
		Freshwater aquatic ecotoxicity	WRATE	1%
		Acidification	WRATE	1%
		Eutrophication	WRATE	1%
		Global warming potential	WRATE	7%
		Human Toxicity	WRATE	5%
		Local Amenity (odour, visual impact, noise)	ODPM Report	5%
		Localised vehicle movements / congestion	e.g. collection vehicles	4%
Financial & Economic	40%	Total Cost of Solution	NPV of Soln.	24%
		Bankability (number of reference facilities)	Facilities Technical Note	4%
		Exposure to variability in market/output	Prof Judgement	4%
		Exposure to LATS/Landfill Tax cost uncertainty	Prof Judgement	4%
		Local or Economic benefit	Loss of local business through excessive waste disposal costs	2%
		Local Employment opportunity benefit	No. of jobs created	2%

To allow a total score to be calculated for each option, the various scores for each option required 'normalisation' into a common unit. Therefore, the scores for each option were translated into marks using a system of 'preference scoring'. The marks were allocated to each option relative to the scoring range for all the options. Preference scoring has advantages over simply ranking options as it retains the relative performance of options. The distribution of marks for each option was calculated using the following formula:

$$\text{Preference Score} = \frac{(\text{Option Score} - \text{Lowest Option Score})}{(\text{Highest Option Score} - \text{Lowest Option Score})}$$

This allocated the best performing option with the maximum marks (5) and the lowest performing option with the least marks (1). All remaining options are marked according to their relative performance against the highest and lowest scoring options.

The weighted Scores for each option are presented in Table 2.3 (the weighted scores have been calculated by multiplying the 'preference score' of between 1 and 5 with the % weighting for the secondary criteria).

Table 2.3 Weighted Scores

Primary Criteria	Secondary Criteria	Secondary Criteria Weighting	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Planning	Planning framework fit	3%	0.03	0.09	0.12	0.15	0.06	0.06
	Planning and development timescales	5%	0.23	0.05	0.05	0.05	0.05	0.10
	Availability of Suitable Sites / landtake	8%	0.08	0.15	0.38	0.38	0.11	0.11
Technical	Technical track record'	5%	0.23	0.16	0.21	0.18	0.00	0.00
	Flexibility in capacity	1%	0.05	0.04	0.04	0.04	0.04	0.01
	Flexibility in composition	1%	0.07	0.05	0.05	0.04	0.01	0.01
	BMW diversion (MSW)	2%	0.02	0.10	0.10	0.10	0.09	0.09
	Absolute diversion from landfill (MSW)	4%	0.04	0.20	0.20	0.20	0.16	0.16
	Operational fit	1%	0.05	0.03	0.03	0.01	0.01	0.01
	Availability of Markets / outlets	1%	0.01	0.02	0.04	0.05	0.04	0.03
	kg of HH waste not recycled / composted	1%	0.01	0.01	0.01	0.03	0.05	0.05
	Material Recycled/Composted	4%	0.04	0.04	0.04	0.15	0.20	0.20
Environmental	Abiotic Resource Depletion	1%	0.01	0.05	0.05	0.05	0.04	0.04
	Freshwater aquatic ecotoxicity	1%	0.01	0.03	0.03	0.03	0.05	0.05
	Acidification	1%	0.01	0.02	0.01	0.01	0.05	0.04
	Eutrophication	1%	0.01	0.05	0.05	0.04	0.05	0.04
	Global warming potential	7%	0.07	0.34	0.33	0.34	0.36	0.34
	Human Toxicity	5%	0.05	0.17	0.17	0.22	0.23	0.25
	Local Amenity (odour, visual impact, noise)	5%	0.18	0.20	0.25	0.21	0.05	0.05
	Localised vehicle movements / congestion	4%	0.19	0.11	0.11	0.04	0.04	0.04
Financial & Economic	Total Cost of Solution	24%	0.89	0.75	1.20	1.10	0.42	0.24
	Bankability (number of reference facilities)	4%	0.20	0.08	0.04	0.04	0.04	0.04
	Exposure to variability in market	4%	0.04	0.08	0.16	0.20	0.16	0.10
	Exposure to LATS/Landfill Tax cost uncertainty	4%	0.04	0.20	0.20	0.20	0.12	0.10
	Local or Economic benefit	2%	0.02	0.05	0.08	0.09	0.07	0.03
	Local Employment opportunity benefit	2%	0.02	0.06	0.04	0.06	0.08	0.06

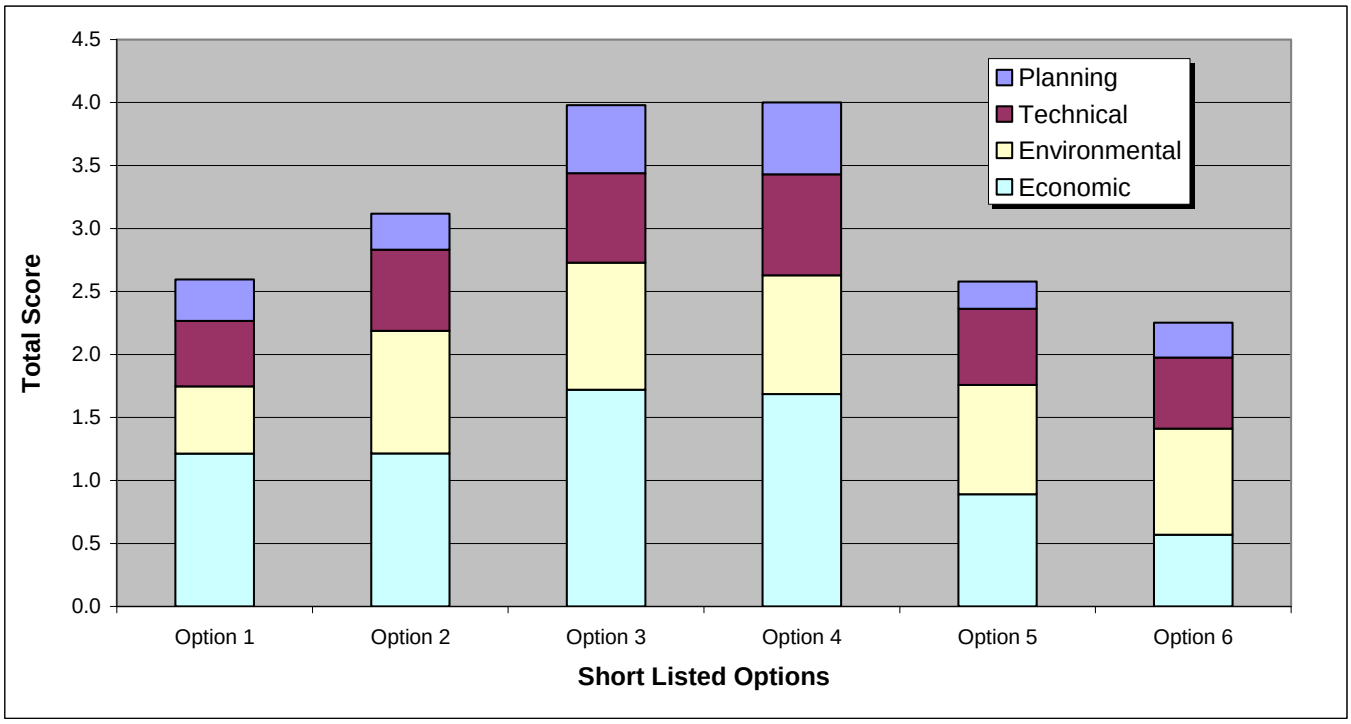
Table 2.4 presents a summary of the results, with the total score for each option and the scores for the four main criteria headings presented.

Table 2.4 Summary Scores for Short Listed Options

Primary Criteria		Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Planning	Weighted Score	0.33	0.29	0.54	0.57	0.22	0.28
	Rank	3	4	2	1	6	5
Technical	Weighted Score	0.52	0.65	0.71	0.80	0.60	0.56
	Rank	6	3	2	1	4	5
Environmental	Weighted Score	0.53	0.97	1.01	0.94	0.87	0.84
	Rank	6	2	1	3	4	5
Financial & Economic	Weighted Score	1.21	1.22	1.72	1.69	0.89	0.57
	Rank	4	3	1	2	5	6
Total Score	Weighted Score	2.60	3.12	3.98	4.00	2.58	2.25
	Rank	4	3	2	1	5	6

Figure 2.3 illustrates the results presented in Table 2.4. The stacked bar chart shows the scores for the four main criteria headings of ‘planning’, ‘technical’, ‘environmental’ and ‘economic’.

Figure 2.3 Summary Scores for Short Listed Options



The initial results of the options appraisal showed that options 3 and 4 were so similar that it was not possible to ascertain which option performed the best. It was therefore decided that due to the similarity of scores for option 3 and 4 that further work is required to assess the most suitable Option for the reference project.

The following pages present a summary of some of the key features of the Options Appraisal and highlight a number of the evaluation criteria that were of particular importance in this evaluation.

2.2.1 Review of Planning Criteria (Total Weighting: 15%)

The issue of the planning process, obtaining planning permission and the availability of suitable sites is key to any procurement process of this type. Plymouth City Council has an adopted Waste Development Plan Document and have two sites identified as being suitable for facilities of the type proposed. However, Torbay has a lack of suitable sites and a joint procurement where strategic facilities are located outside of Torbay is the most suitable option. Options 3 & 4 scored favourably for planning as both Options only require one site. The number of sites required and the total landtake required for Options 2, 5 and 6 meant that these Options scored less well.

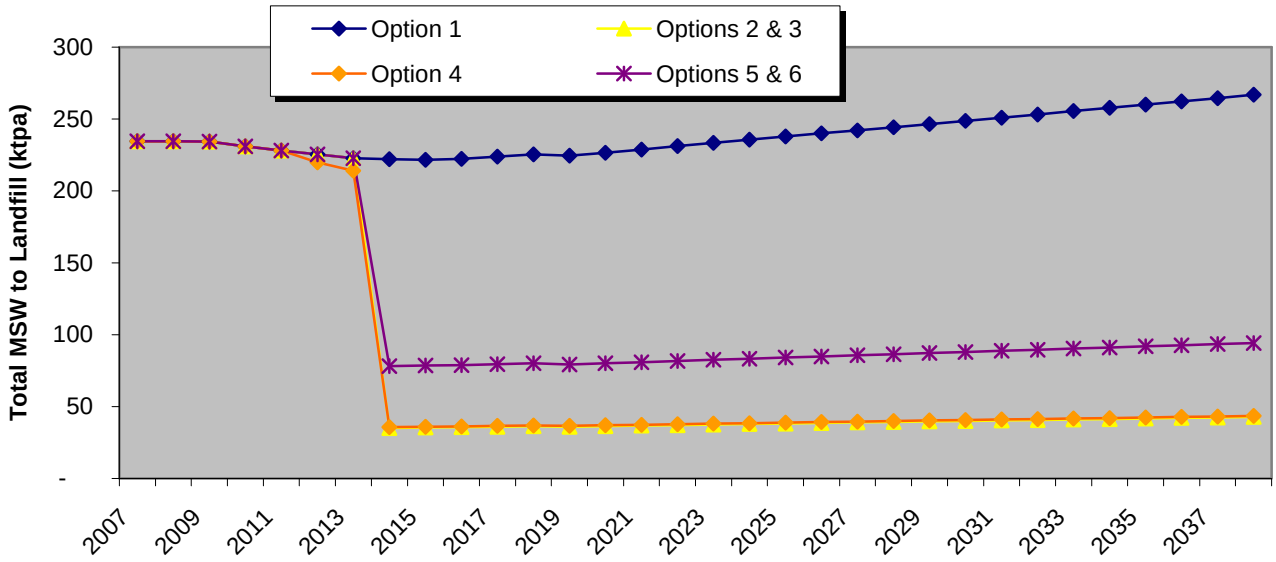
2.2.2 Review of Technical Criteria (Total Weighting: 20%)

The technical criterion was broken down into a number of secondary criteria. Of these secondary criteria, the 'technology track record', 'the absolute diversion of MSW from landfill', and 'material recycled and composted' were the three most highly weighted options with 5%, 4% and 4% of the total score allocated for the criteria respectively. The Partnership has embarked on this procurement process with the aim of delivering a robust solution to divert waste away from landfill. Therefore, any proposed technology must have a good track record both in terms of the number of reference facilities and in terms of historical data on the performance of technologies. An overview of waste treatment technologies is presented in Appendix A of this report. This overview was used as a guide when determining the score for 'technology track record'.

The Partnership has identified that diversion of biodegradable waste from landfill is a key priority of any residual waste technology, as failure to do so may result in the Authorities facing large financial penalties under the LATS scheme. However, while BMW diversion is a key driver, the Partnership has also identified 'absolute diversion of MSW from landfill' as a priority. Landfill capacity in the South West is diminishing, and with Chelson Meadow having closed in April 2008 and Heathfield due to close in 2016, the Partnership believe a solution that is heavily reliant on landfill for the disposal of any process outputs is not a suitable long term solution for the local situation. For this reason, Options 2, 3 and 4 scored well in 'absolute diversion from landfill'.

Figure 2.4 illustrates the projected tonnage of waste requiring landfill for the period 2007/8 to 2038/39 for each of the modelled options. The chart shows that option 1 is expected to require the most landfill capacity, followed by Options 5 and 6, with Options 2, 3 and 4 requiring the least landfill capacity. It should be noted that the modelling has assumed EfW 'bottom ash' is recycled and used as a secondary aggregate, therefore not requiring landfill. This assumption is assumed to be a fair reflection of the current market. It is assumed that APC residue (air pollution control residue / flue gas treatment residue) is disposed of in a hazardous landfill. The MBT options (options 5 & 6) assume that the digestate from the AD facility is sent to landfill. Under current guidance, digestate from plants that are processing mixed municipal waste streams (i.e. non source segregated waste streams) cannot be applied to land and used as a soil improver or fertiliser. The guidance does allow for the digestate to be used in restoration and remediation projects, therefore diverting it from landfill, however it is unlikely that this is a long term sustainable outlet for the digestate.

Figure 2.4 Absolute Diversion from Landfill for Short Listed Options



As mentioned, diversion of BMW is also a key driver for this project. Figures 2.5, 2.6 and 2.7 present Devon's (South Hams, West Devon and Teignbridge only), Plymouth's and Torbay's LATS position for 2007/8 to 20038/39 for each of the modelled Options.

With the exception of Option 1 ('do minimum' with disposal to landfill), all Short Listed Options meet each Authorities respective LATS targets once the facilities come on-line. Options that exclusively use EfW without pre-treatment for residual waste treatment (Options 2, 3 and 4) divert the most BMW from landfill as all waste sent to the facility is deemed to be diverted. The Options comprising MBT facilities (Options 5 and 6) do not divert as much BMW from landfill, with Options 5 and 6 sending up to 60% more BMW to landfill than Options 2, 3 and 4. Table 2.5 presents the tonnages of BMW sent to landfill for each short listed option for key years during the contract.

Table 2.5 Partnership BMW to Landfill and LATS Allocation for Target years (tpa)

	2009/10	2012/13	2019/20
Partnership LATS Allocation*	155,644	103,670	72,541
Partnership BMW to Landfill Option 1	151,860	146,277	145,975
Partnership BMW to Landfill Option 2 & 3	151,860	146,277	22,948
Partnership BMW to Landfill Option 4	151,860	140,323	22,932
Partnership BMW to Landfill Option 5 & 6	151,860	146,277	36,841

Table Note:*The Partnership LATS Allocation has been calculated by summing Plymouth and Torbay's allocations, with South Hams, West Devon and Teinbridge's proportion of Devon County Council's total allocation.

Figure 2.5 Plymouth LATS Position

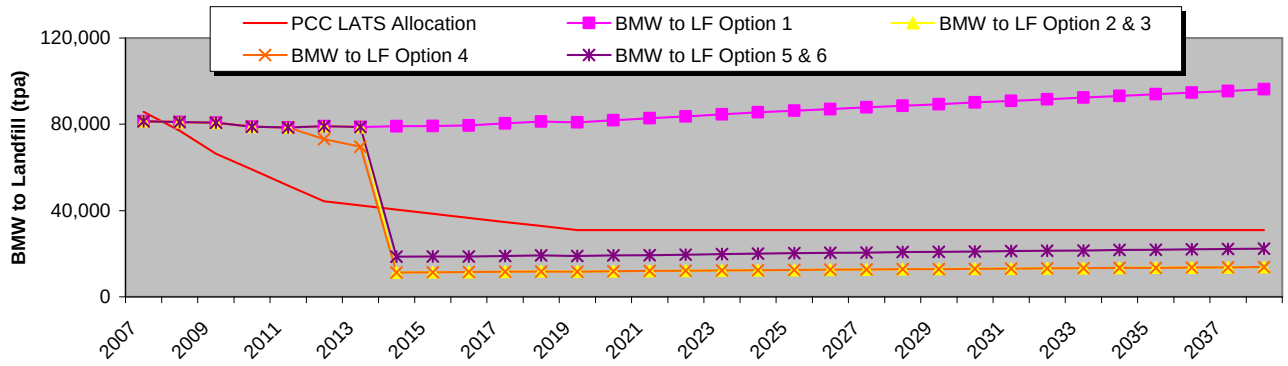


Figure 2.6 Torbay LATS Position

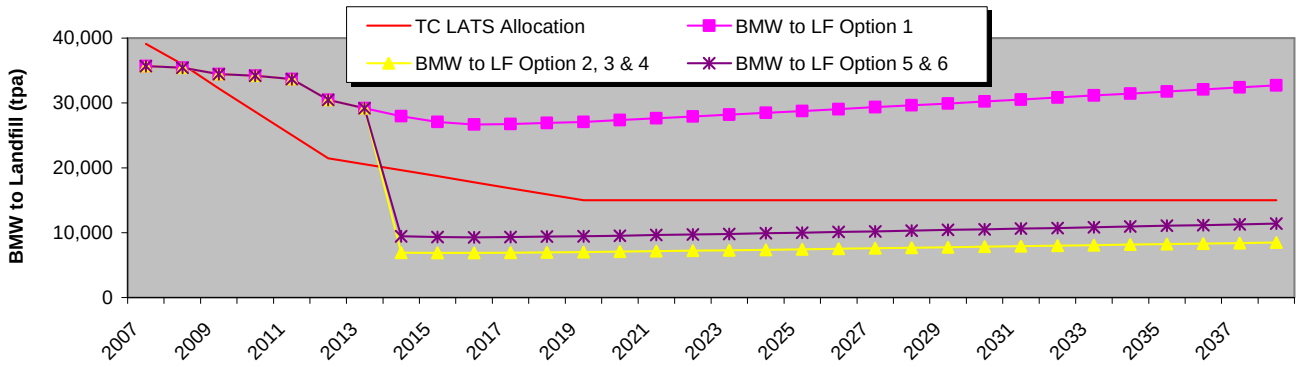
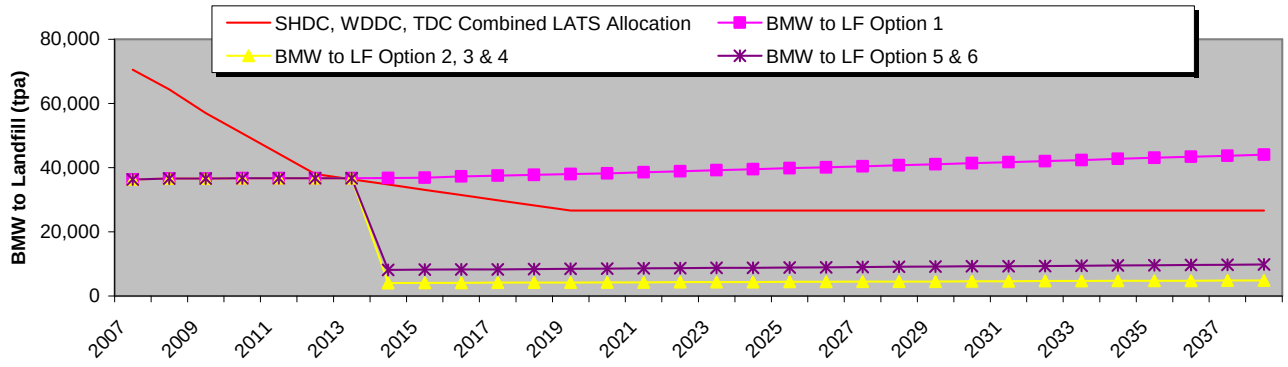


Figure 2.7 Devon (SHDC, WDDC & TDC) LATS Position

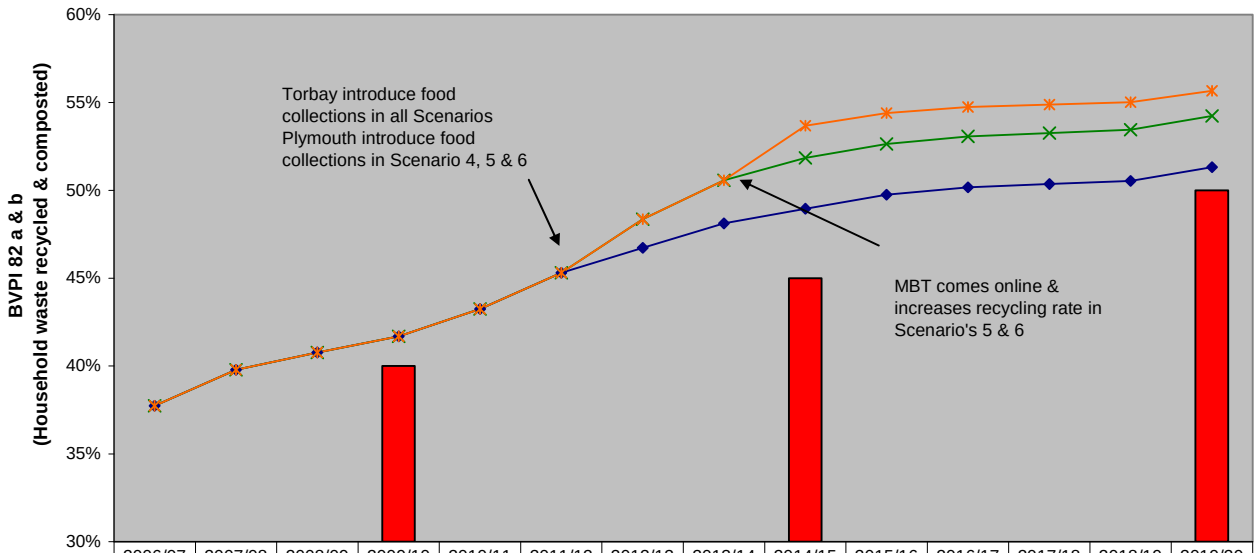


Devon County's strategy for meeting its LATS liability is dependent on treating all waste from some districts to off-set continued landfill of waste in other districts. Although this document considers the waste from Teignbridge, West Devon and South Hams in isolation it is necessary to take account of the County Councils requirement to meet its LATS liability for the County as a whole. For the purpose of assessing affordability the cost of meeting a potential shortfall in the County's LATS permits has been considered in comparing the relative costs of the options.

A key feature of all options progressing to the short list appraisal is the achievement of a Partnership recycling rate that is consistent with the updated national waste strategy (WSE2007), therefore reaching 40% by 2009/10, 45% by 2014/15 and 50% by 2019/20.

Figure 2.8 illustrates the modelled Partnership recycling rate for each of the short listed options.

Figure 2.8 Recycling and Composting Rate for Modelled Options



	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
WSE 2007				40%					45%					50%
Options 1, 2 & 3	37.7%	39.8%	40.8%	41.7%	43.2%	45.3%	46.7%	48.1%	49.0%	49.7%	50.2%	50.4%	50.5%	51.3%
Option 4	37.7%	39.8%	40.8%	41.7%	43.2%	45.3%	48.4%	50.6%	51.8%	52.6%	53.1%	53.3%	53.4%	54.2%
Option 5 & 6	37.7%	39.8%	40.8%	41.7%	43.2%	45.3%	48.4%	50.6%	53.7%	54.4%	54.8%	54.9%	55.0%	55.7%

It can be seen from Figure 2.8 above that all short listed options achieve the WSE2007 recycling and composting targets. Option 4, which incorporates a food waste collection in Plymouth, increases the Partnership recycling rate by approximately 3%. The use of an MBT facility to pre-treat waste prior to thermal processing (Options 5 and 6) could increase the Partnership recycling and composting rate by a further 1.5% over Option 4.

2.2.3 Review of Environmental and Social Criteria (Total Weighting: 25%)

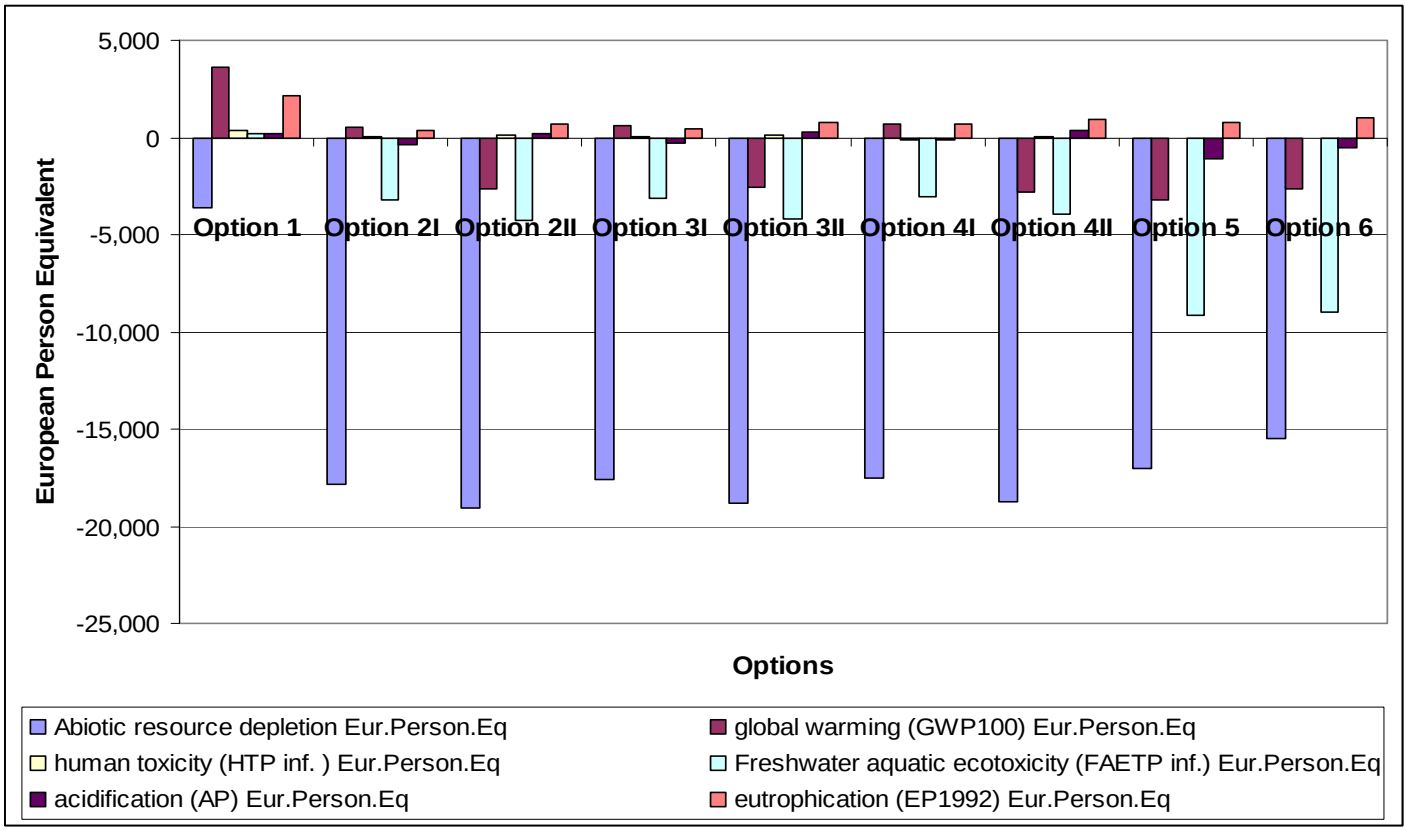
The anticipated environmental impact of each of the Short Listed Options has primarily been evaluated with the Environment Agency's WRATE model (Waste and Resources Assessment Tool for the Environment). Full details of the WRATE assessment, including system boundaries, key assumptions and presentation of results can be found in the Entec Technical Note titled 'SWDWP WRATE Final Technical Note 08227i1'.

The WRATE model uses a variety of databases to generate environmental impacts for a range of potential waste management solutions. One of the databases used is the EA's Waste Technologies Data Centre which uses performance data from existing facilities. Therefore, when developing a waste solution to model, the user must select a reference facility to base the modelling on. Entec's experience of using WRATE has shown that not only does the type of residual waste facility (e.g. EfW versus MBT) have a bearing on the environmental impact of a solution, but so does the specific reference facility selected (e.g. different EfW's have varying degrees of process efficiency and therefore indicators such as Global Warming Potential can vary significantly between reference facilities). For this reason, where a thermal process was used, Entec modelled with multiple reference facilities of varying efficiencies. Options that incorporated EfW were modelled using the Chineham EfW facility (representing a facility producing electricity only) and the Sheffield EfW facility (representing a facility with combined heat and power). Options without CHP are designated Option n I (e.g. Option 2 I) and Options with CHP are designated Option n II (e.g. Option 2 II). Table 2.6 and Figure 2.9 present the summary WRATE results for the short listed options in reference to the EA's Default Impacts.

Table 2.6 Tabulated Summary Results of WRATE Default Impacts

Indicator & Unit of Measurement	Short Listed Options								
	1 Baseline	2 I 3 x EfW	2 II 3 x EfW (CHP)	3 I 1 x EfW	3 II 1 x EfW (CHP)	4 I 1 x EfW & AD	4 II 1 x EfW (CHP) & AD	5 MBT / RDF to EfW (CHP)	6 MBT / RDF to EfW (CHP) Runcorn
Abiotic resource depletion (tonnes antimony eq)	-141	-692	-739	-682	-730	-680	-726	-661	-600
Global warming (tonnes CO2 eq)	45,806	6,430	-32,860	7,539	-31,752	8,652	-35,047	-40,757	-32,988
Human toxicity (tonnes 1,4-dichlorobenzene eq.)	7,892	58	2,101	111	2,154	-2,101	107	-307	-1,461
Freshwater aquatic ecotoxicity (tonnes 1,4-dichlorobenzene eq)	296	-4,274	-5,663	-4,169	-5,558	-3,999	-5,229	-12,074	-11,836
Acidification (tonnes SO2 eq)	17	-27	14	-22	19	-10	28	-76	-39
Eutrophication (tonnes PO4 eq)	71	13	24	14	24	22	31	26	32

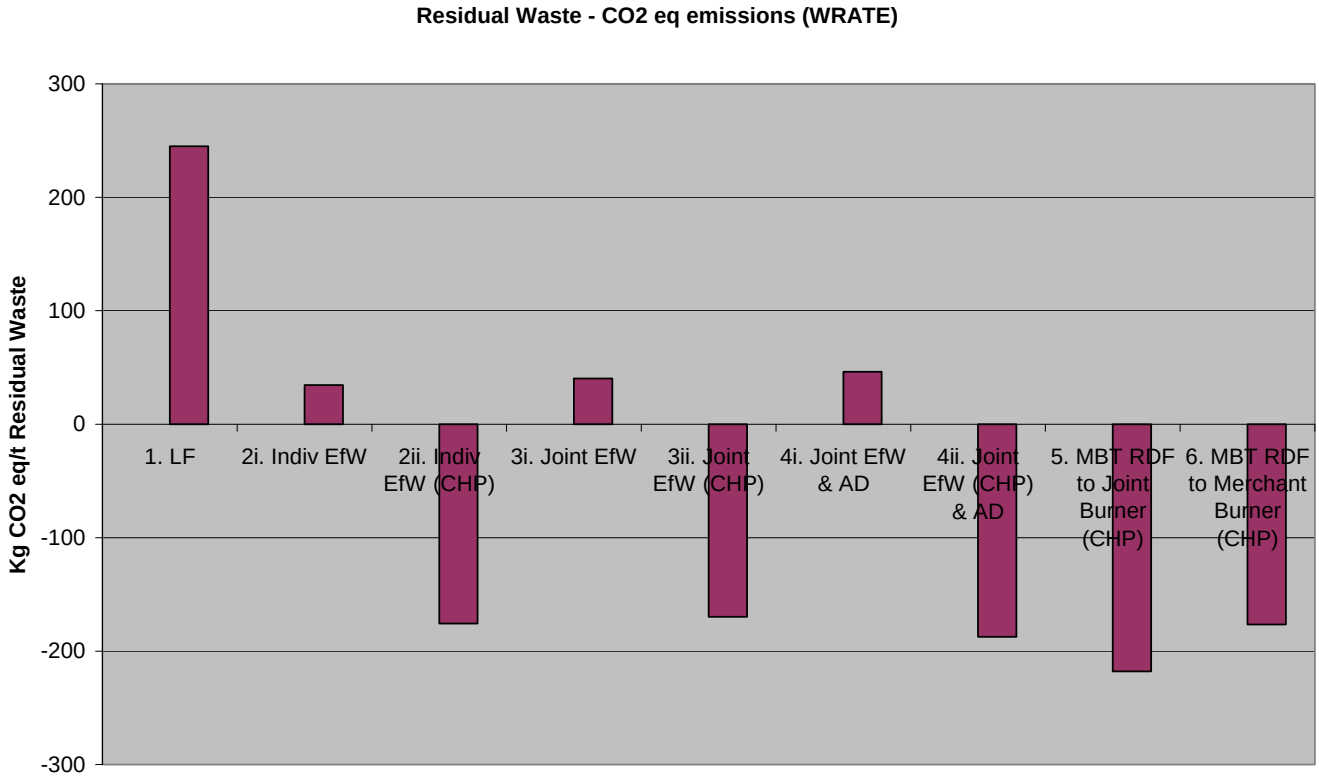
Figure 2.9 Summary Results of WRATE Default Impacts



The results from the WRATE analysis were converted into preference scores and used in the options appraisal. Comparing the results of the modelling process it is clear to see that great savings can be made in terms of the Environmental Impact associated with the management of wastes within the Partnership area by moving away from the reliance on landfill for the disposal of wastes.

Of particular interest to the Partnership is the performance of each of the short listed options with regards to Global Warming Potential (GWP, measured in kg of carbon dioxide equivalent). Figure 2.10 presents the GWP (measured in CO2 equivalent per tonne of residual waste treated) for each of the modelled options.

Figure 2.10 WRATE Output for CO^2 Equivalent Emissions for Modelled Options



The WRATE assessment suggested that EfW facilities with CHP have a significantly better GWP result than EfW facilities without CHP. The GWP indicator was weighted highly in the Options Evaluation with 7% of the total score. This was the third highest individually weighted criteria. This shows the Partnerships commitment to reducing emissions that can contribute to global warming. As a result, the Partnership will ensure that the GWP / Carbon Footprint of the solution to be procured is suitably weighted in the tender evaluation criteria for the PFI procurement process, and bidders that can demonstrate a maximised net GWP benefit will be favoured.

The options appraisal scored the GWP of each option based on the WRATE model outputs. Other impacts vary between the EfW facility and the EfW with CHP which will be related to the specific process emissions of the technologies chosen for this modelling exercise.

Comparing multiple to single sites within WRATE is not easily done, and the results simply show that multiple sites are better as they reduce the transport impact with the impacts associated with the treatment facilities considered to be equal. This is unlikely to be replicated in reality, and of particular concern may be the replication of efficiencies of plants at a smaller scale, however, conversely to this it may be easier to utilise the CHP element at a local level.

The options which incorporate AD facilities show additional savings in terms of GWP and Human Toxicity but this effect is rather limited compared to the total Environmental Impact. The Abiotic Resource Depletion indicator differs depending on the efficiency of the EfW process which may be more effective in terms of this impact. The other indicators in terms of Eutrophication, Aquatic Ecotoxicty and Acidification are slightly elevated compared with the baseline.

The MBT options provide an improvement in terms of all impacts (although this is reduced for the option that requires the RDF to be sent further distances for processing). These improvements are due to the savings associated with the recyclate that is recovered from this process and the high thermal efficiency of the process used to combust the RDF.

2.2.4 Review of Financial and Economic Criteria (Total Weighting: 40%)

Capital Cost of Each Option

Cost estimation of options has been undertaken by Entec UK. Costs have been split into Capital cost estimates and on-going operational cost estimates (Opex and maintenance).

Capital Costs (the 'Capex') are the all inclusive costs associated with the delivery of the required infrastructure. Capex costs include the design, management and construction costs for the delivery of each facility. The design and management costs would include professional fees (e.g. planning, architectural and engineering fees) together with a design or project manager to co-ordinate design requirements and construction. Construction costs include the supply of labour, materials and equipment (sometimes referred to as 'plant' costs) together with contractor's preliminaries such as site supervision, temporary accommodation. Licensing and permitting costs have been included; as are grid connection costs where appropriate (EfW and EfW/RDF options).

The costs presented in this section are based on 'rough order costs' which have been sourced from Entec's internal database of capital cost. These costs have been compiled from various sources, including recent waste procurement projects (PFI and non-PFI projects at various stages in the bidding process) and published literature. These costs do not include allowances for land acquisition or financing costs.

Table 2.7 presents the required capital infrastructure necessary to deliver each of the short listed options. The Table presents the number, capacity (in tonnes per annum, tpa) and initial capital cost estimate of each facility required. The costs presented here are 'real' costs at Q1 2008 prices.

Table 2.7 Details of Proposed Waste Management Facilities for Short Listed Options

Facility Type	Option 1	Option 2		Option 3		Option 4		Option 5		Option 6	
		Capacity (tpa)	Capex	Capacity (tpa)	Capex	Capacity (tpa)	Capex	Capacity (tpa)	Capex	Capacity (tpa)	Capex
EfW	-	45,000 75,000 100,000	£52.6m £67.0m £91.9m*	225,000	£140.4m*	210,000	£137.6m*	-	-	-	-
EfW (RDF)	-	-	-	-	-	-	-	100,000	£102.1m*	Merchant Facility	
MBT	-	-	-	-	-	-	-	100,000	£29.1m	45,000 75,000 100,000	£20.30 £24.50 £39.9*
AD	-	-	-	-	-	25,000	£9.8m*	25,000	£9.8m*	25,000	£9.8m*
Total Capex	**-**	**-**	**£211.5m**	**-**	**£140.4m**	**-**	**£147.40**	**-**	**£185.80**	**-**	**£94.5m****

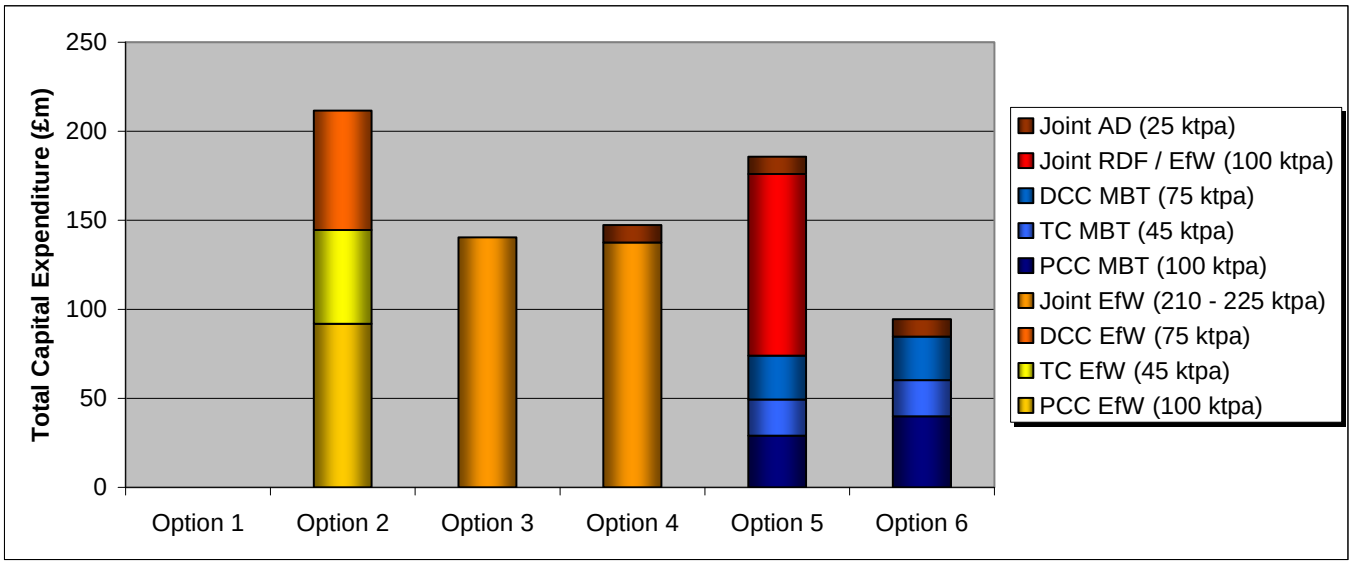
Table Notes

*A Reference Site has been identified in Plymouth. The assumed Reference Site has known constraints, including abnormal topography, proximity to an MOD explosive licensed area, and planning considerations relating to visual appearance of the site. Therefore, the Capex estimates for facilities to be located at the Plymouth Reference Site have been uplifted accordingly and are likely to cover other unique costs if an alternative site were to be taken forward. However until detailed site investigations have been undertaken, the full extent of the works required to deliver the project are unknown but will be identified during the procurement and included as part of the Final Business Case.

*Option 6 has a low Capex as it is assumed that the RDF produced by the MBT facilities is processed in a third party merchant facility.

Figure 2.11 presents the total Capex required for each of the short listed options.

Figure 2.11 Total New Capital Expenditure by Facility Type and Size



Whole Life Cost of Each Option

In addition to capital cost estimates, Entec have built detailed waste flow models for each of the short listed options. Unit operating costs and revenues are then applied to the mass flow model to estimate the annual cost of each option based on the tonnage of waste modelled for each year. The modelling of all waste flows for each authority allows a direct comparison of the anticipated cost of each option. Table 2.8 presents the full cost over the anticipated duration of the contract of the capital expenditure, operating costs, lifecycle maintenance and any other direct cost impacts which can vary between the option (including landfill costs and LATS). The costs are presented in Net Present Value (NPV) terms for the period 2007/8 to 2038/39.

Table 2.8 Comparative Cost of Short Listed Options

	Option 1 £m	Option 2 £m	Option 3 £m	Option 4 £m	Option 5 £m	Option 6 £m
Capital Costs	6.7	179.3	117.9	123.7	150.5	80.2
Land Acquisition	-	-	-	-	-	-
Life Cycle Costs	0.6	23.4	15.2	19.2	39.2	29.9
Operating Costs	198.1	302.1	287.5	296.4	296.9	382.8
Revenue	-	-56.8	-56.8	-55.5	-27.9	-
Landfill Costs	132.9	53.1	53.1	53.3	74.2	74.2
Landfill Tax	204.7	80.7	80.7	80.3	109.2	109.2
Tradable Allowances	18.9	6.3	6.3	5.4	6.3	6.3
Total	561.9	588.1	503.9	522.8	648.4	682.6

Table note: The NPV calculations are for the period 2007/8 to 2038/39, and a discount rate of 3.5% has been used to restate these costs at April 2008 prices. Costs presented in this table are for relative option comparison purposes as a subsequent more detailed financial analysis has been carried out on the Reference Project. The cost pf LATS purchases has been included in the above table, however it is assumed no income is generated from the sale of surplus LATS permits.

Shadow Price of Carbon

In addition to the evaluation of environmental impacts presented in Section 2.2.3, the Partnership has calculated the Shadow Price of Carbon, using the WRATE output for GWP, for each option. The Shadow Price of Carbon assigns a ‘cost’ to each tonne of CO2 equivalent. Therefore, for scenarios that have a net reduction in CO2 emissions (e.g. an EfW with CHP facility offsets more CO2 than it produces, therefore resulting in a net CO2 ‘benefit’) the total cost of the solution is reduced. For Options with a net CO2 impact (e.g. a solution that produces more CO2 than it offsets), the cost of the solution is increased. Table 2.9 below presents the calculated NPV of the modelled options, along with the ‘Shadow Price of Carbon’ and the ‘SPC Adjusted NPV of each Option’.

Table 2.9 SPC Adjusted NPV of Modelled Options

Modelled Options		Option NPV (£m)	Shadow Price of Carbon (£m)	SPC Adjusted NPV (£m)
Option 1	Landfill	£561.90	£23.02	£584.92
Option 2i	Indiv EfW	£588.10	£3.23	£591.33
Option 2ii	Indiv EfW (CHP)	£588.10	-£16.51	£571.59
Option 3i	Joint EfW	£503.90	£3.79	£507.69
Option 3ii	Joint EfW (CHP)	£503.90	-£15.96	£487.94
Option 4i	Joint EfW & AD	£522.80	£4.35	£527.15
Option 4ii	Joint EfW (CHP) & AD	£522.80	-£17.61	£505.19
Option 5	MBT RDF to Joint Burner (CHP)	£648.40	-£20.48	£627.92
Option 6	MBT RDF to Merchant Burner (CHP)	£682.60	-£16.58	£666.02

Note: The SPC has been calculated using the Defra SPC template spreadsheet. The 'cost' of Carbon is assumed to be £25.40 per tonne of CO2 in 2007. A discount rate of 3.5% has been used.

Table 2.9 shows that when the SPC is combined with the NPV of each Option, the Options with CHP (Options 2ii, 3ii, 4ii, 5 and 6) have reduced NPV's. Option 5 (MBT with AD, sending RDF to purpose built burner with CHP) has the best result in terms of GWP, and therefore has the largest net benefit with regards to SPC. However, the result of the SPC and the adjusted NPV's does not change the ranking of Options. The SPC exercise further highlights the Partnerships desire for an EfW facility with CHP.

2.2.5 Landfill Tax and LATS Sensitivities

The costs presented in this OBC are based on a range of assumptions. Two of the key assumptions that could alter the cost of solutions significantly are;

- Trade price of LATS allowances, and
- Landfill tax (post 2010).

To assess the impact of these variables on each of the modelled Options, two profiles have been developed for LATS and landfill tax costs.

Table 2.10 and Figure 2.12 below illustrate the four potential LATS cost profiles. Table 2.11 presents the total LATS liabilities for each of the modelled options for the four LATS profiles. It should be noted that the actual cost of LATS credits and whether the LATS regime will continue beyond 2020 is unknown. However it is likely that

landfill disposal will continue to be discouraged through financial disincentives hence these profiles are considered representative of high medium and low risk scenarios.

Table 2.10 Modelled LATS Profiles

LATS Profile	Profile Description
LATS 1 - Options Appraisal LATS Profile	Trade price of £0/t 2006/7 – 2008/9, £30/t 2009/10 – 2011/12, £75/t 2012/13 – 2013/14, £50/t 2014/15 – 2019/20, £0/t 2020/21 thereafter
LATS 2 - OBC LATS Baseline Profile	Trade price of £0/t 2006/7 – 2008/9, £30/t 2009/10 – 2011/12, £75/t 2012/13 – 2013/14, £50/t 2014/15 thereafter
LATS 3 - OBC LATS Scenario 1	Trade price of £0/t 2006/7 – 2008/9, £30/t 2009/10 – 2011/12, £75/t thereafter
LATS 4 - OBC LATS Scenario 2	Trade price of £0/t 2006/7 – 2008/9, £30/t 2009/10 thereafter

Figure 2.12 Modelled LATS Profiles

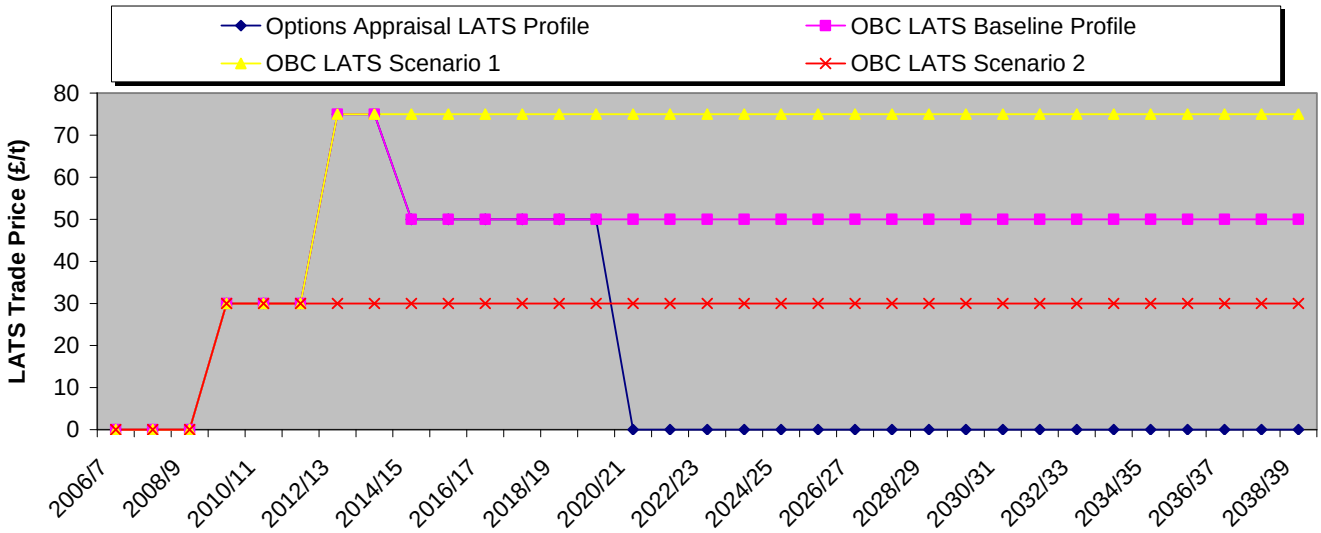


Table 2.11 NPV of LATS Liabilities for Modelled Options (2007/8 – 20038/39)

	Option 1 NPV £m	Option 2 NPV £m	Option 3 NPV £m	Option 4 NPV £m	Option 5 NPV £m	Option 6 NPV £m
LATS 1 - Options Appraisal LATS Profile	18.9	6.3	6.3	5.4	6.3	6.3
LATS 2 - OBC LATS Baseline Profile	56.7	6.3	6.3	5.4	6.3	6.3
LATS 3 - OBC LATS Scenario 1	82.0	6.3	6.3	5.4	6.3	6.3
LATS 4 - OBC LATS Scenario 2	33.4	3.1	3.1	2.8	3.1	3.1

Table Note: The NPV presented in Table 2.8 has used the LATS profile titled 'Options Appraisal LATS Profile'. The SWDWP OBC has used the other three LATS profiles for a sensitivity analysis.

Table 2.12 and Figure 2.13 below illustrate the two potential landfill tax cost profiles. Table 2.12 presents the total landfill tax liabilities for each of the modelled options for the two landfill tax profiles. Landfill tax is known to be escalating to £48 per tonne by 2010/11 and it is highly possible that this will continue to rise in future years to continue to discourage disposal in landfill and also to bring the UK more in line with landfill tax levies existing in many EU countries.

Table 2.12 Modelled Landfill Tax Profiles

	Profile Description
Landfill Tax Profile 1 - Options Appraisal Profile	LF Tax increasing by £8/t until £48/t in 2010, remaining at £48/t thereafter
Landfill Tax Profile 2 - OBC Baseline Profile	LF Tax increasing by £8/t until £72/t in 2013, remaining at £72/t thereafter

Figure 2.13 Modelled Landfill Tax Profiles

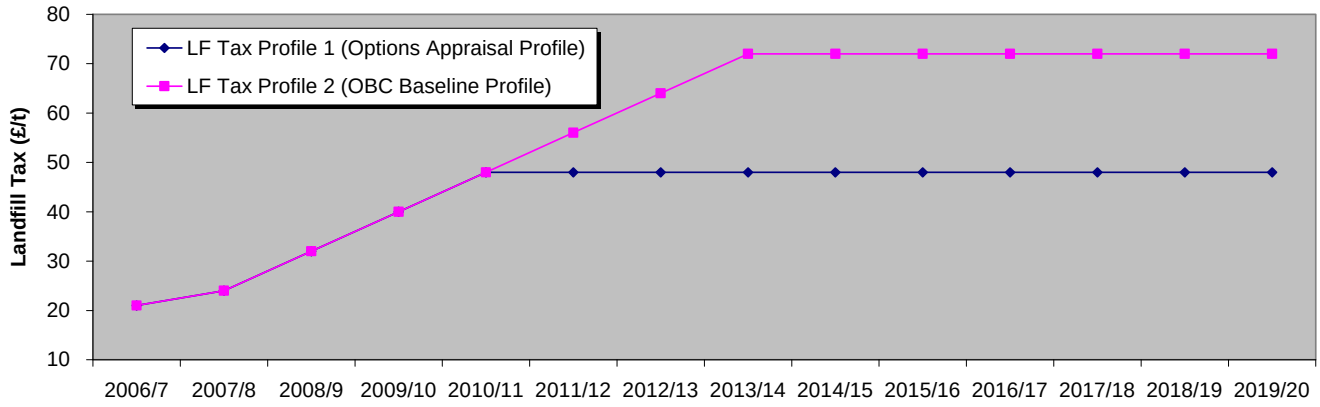


Table 2.13 NPV of Landfill Tax Costs for Modelled Short Listed Options (2007/8 – 20038/39)

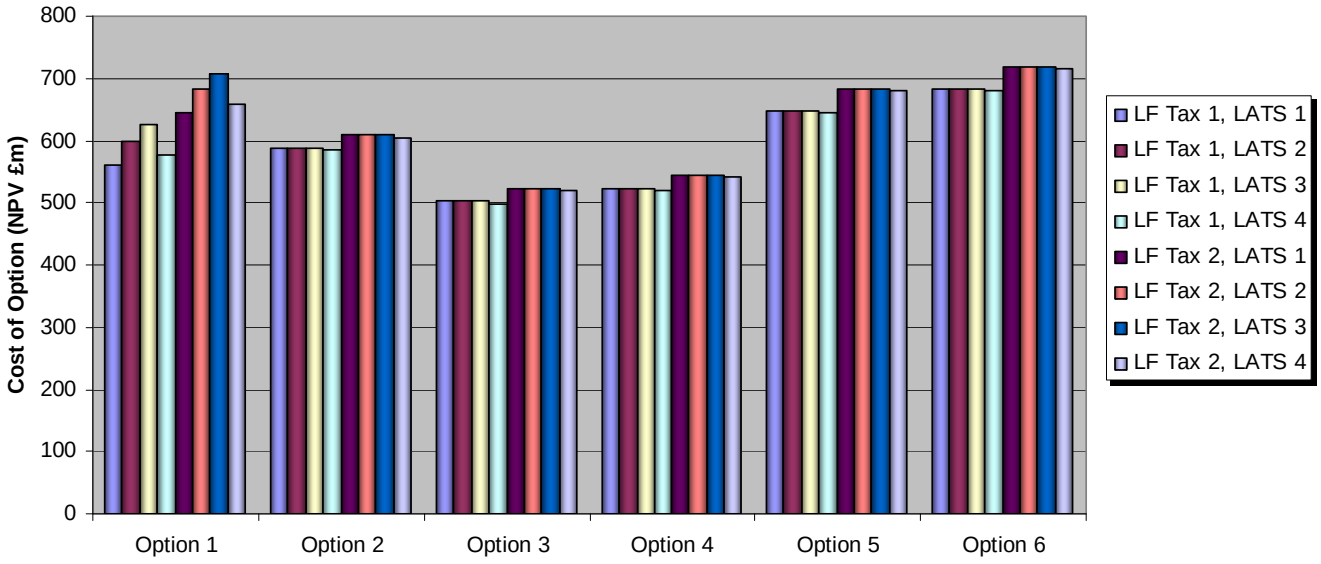
	Option 1 NPV £m	Option 2 NPV £m	Option 3 NPV £m	Option 4 NPV £m	Option 5 NPV £m	Option 6 NPV £m
LF Tax Profile 1 (Options Appraisal Profile)	204.7	80.7	80.7	80.3	109.2	109.2
LF Tax Profile 2 (OBC Baseline Profile)	287.2	101.2	101.2	100.6	144.0	144.0

Table Note: The NPV presented in Table 2.8 has used the landfill tax profile titled 'Landfill Tax Profile 1'.

Figure 2.14 below illustrates eight modelled NPV's for each of the short listed options. The various NPV's present each option's potential financial susceptibility to landfill tax and LATS costs, based on the profiles defined in Figures 2.12 and 2.13. The key to the chart shows which combination of landfill tax profile and LATS profile have been used to calculate the NPV's.

As would be expected, the options that have a greater reliance on landfill (e.g. the 'do minimum' option 1, and the MBT options 5 and 6) report the greatest range of costs when the sensitivities of landfill tax and LATS costs are tested. The EfW options (Options 2, 3 and 4) report the narrowest range for landfill tax and LATS costs sensitivities, illustrating that these options present the least risk options to the council with regards to the unknown costs associated with the increasing cost of landfilling waste. In all cases, option 3 is the least cost solution.

Figure 2.14 Cost of Short Listed Options – Landfill Tax and LATS Sensitivities (£m NPV 2007/8 to 2038/39)



2.2.6 Bankability

For a particular waste management solution to be successful, it depends on the successful development and commercial delivery of individual capital projects. For a project to be delivered, there are a number of requirements, not least of which are:

- Planning permission for the facility,
- Operating licences or permits,
- Contractors and equipment providers who are able to deliver the hardware and put it to work, and
- The capital finance required to pay for it.

There is a wide range of waste processing technologies, both 'established' and 'new' that can contribute to the diversion of BMW away from landfill disposal. Indeed, the word 'new' encompasses a wide range of technical maturity, ranging from technologies that have yet to pass beyond the pilot or bench-scale, to those that have seen widespread commercial application, but on feedstocks other than 'typical' UK MSW.

The more established technologies include mechanical processing technologies, such as magnetic separators, eddy current separators, pulverisers and screens. Such technologies separate and sort mixed waste streams into different component parts. In addition, there are numerous waste combustion technologies that have long track records of successful commercial operation, including grate-based combustion plant, rotating or oscillating kilns, and

fluidised beds. In each of these technologies, however, any one specific application may have some degree of novelty – for instance a fluidised bed combustion technology may have seen application on one particular type of waste stream, but may be commercially untested on another. Any project development process must, therefore, carefully consider not only the level of 'novelty' in a particular technology, but also how the technology is to be applied, in order to identify project-specific technical risks.

With respect to technology supply, the most notable features of a bankable process are:

- robustness and security of financial projections (capital costs, operating and maintenance costs, and revenues);
- the technology supplier/contractor's ability to warrant performance and provide necessary guaranties and financial cover for performance failure; and
- technology track record.

The size, financial position and experience of the contractor and technology supplier are important in determining whether a particular project will be delivered on time, to budget and to specification. More importantly, however, these factors are absolutely critical in determining whether unanticipated technology problems that might arise during the project will be resolved.

In all cases involving the mitigation of risk through a contractual relationship with a third party, banks will be very careful to ensure the counter-party is sufficiently robust to meet its obligations under the contract. This tends to count against those smaller providers of relatively novel technologies that cannot draw on their own balance sheet to provide bankable corporate completion and performance undertakings.

Technology track record is critical to providing confidence to the investors that the performance projections on which the financial model is based are achievable. Lenders usually require to see at least 24 months of successful operating history (throughput and plant reliability) for any technology in order to demonstrate that key financial model assumptions such as waste processing rate and availability can be achieved.

With respect to Thermal Treatment in particular, it can be noted that, to date, there are no examples of any projects using advanced thermal technologies in the UK that have successfully secured significant debt finance, although there is much work being done to encourage their uptake.

In summary, the 'bankability' of the various waste technology solutions has been a key consideration of The Partnership's options appraisal, and a detailed review of existing facilities has been undertaken to establish the track record of each technology. The current evidence base suggests that conventional EfW technologies are the most bankable, with the longest track record and therefore a greater degree of confidence on the performance and costs associated with these technologies. This review of technologies is provided in Appendix A of this report.

2.3 Determination of the Reference Project and Reference Case

2.3.1 Analysis of Options 3 and 4

The result of the options appraisal suggested that options 3 (a single EfW) and option 4 (a single EfW and a joint AD facility) were the two options that best met the Partnership's criteria. The similarity in the scores for the two options meant further evaluation of both options was required. This further evaluation included detailed financial modelling of both options 3 and 4, and a review of the key considerations and risks of both.

Financial Modelling of Options 3 and 4

Option 3 is the procurement of an EfW plant only in Plymouth, operational from April 2014. Option 4 is the procurement of an EfW plant in Plymouth, operational from April 2014, but also the procurement of an AD plant operational from April 2013.

The estimated real capital cost of the AD facility in Q1 2008 is £9.8m. The Partnerships financial advisors then modelled both options to see the effect of including the AD facility in the PFI contract and Reference Case. The additional 'nominal' capex required for this AD facility is calculated to be £12.6m (assuming construction inflation of 5.5%). Once inflation, financing costs and commercial activities are factored into the calculation, the effect of including an AD facility in the reference case model is as follows;

Reference Case Cost for Contract Duration - Option 3 - £796m

- Option 4 - £836m

It can be seen that once financing costs are calculated for the additional capital of the AD facility, the Reference Case costs increase by a total of £40m.

However, due to the Partnership incurring this higher capital expenditure, a larger PFI credit support should be available. The Revenue Support Grant (RSG) for Option 4 is calculated at £10m greater than that available for Option 3. Therefore, taking into account the effect of the RSG, the additional procurement of the AD facility would result in an increase of £30m for Option 4.

In addition to the additional costs resulting from the increased capital expenditure modelled in the Reference Case, there is also the effect of increased costs associated with recycling collections and bulking and transport costs. The net effect of these costs is that Option 4 incurs approximately £20m additional costs.

The effect of the other additional costs of £20m and the additional costs of the Reference Case of £30m results in Option 4 being £50m more expensive than Option 3 over the operational life of the contract.

Key Considerations and Risks of Options 3 and 4

Table 2.14 summarises some of the key considerations and risks associated with Options 3 and 4.

Table 2.14 Summary of Options 3 & 4

	Option 3	Option 4
Cost	Option 3 was the least cost option.	Including an AD to treat food waste within the PFI contract may not deliver value for money. The capital cost of the AD facility would be repaid over the 25 year concession, therefore accruing significant interest. Current guidance from HM Treasury, Defra and PRG suggests that PFI is preferred as a procurement route for residual waste treatment only, with additional recycling and composting infrastructure procured through alternative routes.
Commercial and Operational Risk	A merchant AD facility already exists at Holsworthy in Devon. This facility is already operational and currently accepts small quantities of food waste from West Devon. The facility has capacity to accept food waste from Torbay, West Devon and potentially, if the need arose, Plymouth. Negotiating a gate fee based contract with an existing operational facility is regarded as significantly less risky than the construction and operation of a new facility.	If the Partnership were to include an AD facility within the PFI contract the Partnering Authorities would have guaranteed long term treatment capacity. This security could prove to be beneficial over the use of an existing merchant capacity where it is less likely that treatment capacity could be secured for such a long period.
Competitive Procurement Process	Recent changes in waste PFI guidance has seen a shift away from integrated contract and a movement towards residual treatment only contracts. The SWDWP Reference Project Technology is EfW. By having a non-integrated contract the number of potential bidders capable of bidding for the project is increased, therefore increasing competition and ensuring Value for Money.	
Recycling & Composting Rates	Option 3 achieves a Partnership household waste recycling and composting rate of 51.3% in 2019/20, therefore exceeding the WSE2007 target of 50% in the same year.	Option 4 achieves a recycling and composting rate 2.9% higher than option 3.
Operational Difficulties – Collection Vehicles	Both West Devon and Torbay are committed to the implementation of food waste collections. However, there are many logistical issues in Plymouth that would make the collection of food waste problematic. The topography and layout of streets in the city of Plymouth do not favour multiple collection vehicles and the narrow streets and back lanes which can become congested. Therefore additional dedicated food waste collection vehicles could exacerbate any congestion.	
Operational Difficulties – Waste Receptacle Storage	Of the 110,000 households within Plymouth, only 55,000 of them have adequate space to store two wheeled bins, the current preferred collection scheme. Hence many properties are highly unsuitable for multiple container storage and access for collection and return including those multiple occupancy premises, high-rise accommodation, and terraced properties that have no front or accessible rear storage areas. .	

The Partnership has carefully and fully considered the advantages and disadvantages of including an AD facility in the PFI Reference Project. In light of current guidance on waste PFI's with regards to the Government's preference for residual waste treatment only contracts, and in an attempt to maximise value for money through a competitive procurement process, the Partnership have decided that the PFI contract will not include a new AD facility. However, West Devon and Torbay will pursue food waste collection, and envisage utilising spare capacity at the merchant facility at Holsworthy. It should be highlighted that omitting an AD facility and a Plymouth food waste collection from this PFI solution is not seen as a constraint to future enhanced recycling and composting performance. To ensure that this is the case, the Partnership will seek flexibility as part of the procurement and contract agreement to be able explore and draw in alternative waste streams to replace any MSW that is diverted through enhanced recycling in the future.

2.3.2 The 'Reference Project' and the 'Reference Case' Technology

Therefore, the Partnership has concluded that a single joint EfW facility with CHP is the selected residual waste treatment technology for the Reference Case.

An initial assessment has been carried out to review the potential for CHP assuming the new facility is located within Plymouth. This assessment has highlighted several possible small-scale users local to the available strategic sites and also larger potential users located further a field. The Partnership will be analysing and investigating these opportunities in more detail during 2008, in order to maximise the potential for CHP as part of the project. In addition, the project team will work with Plymouth City Council's planning department to encourage, as far as practical, future developments near to the strategic sites in Plymouth to consider and make use of any heat potential from the treatment facility.

Each of the partnering authorities will continue with their individual activities, including enhanced recycling and composting operations, to ensure a combined recycling and composting rate of at least 50% is achieved by 2020. Energy will be recovered from waste that is not re-used, recycled or composted by processing in an EfW facility, to be located in the Plymouth region. Table 2.13 presents details of the infrastructure required in the PFI Reference Project.

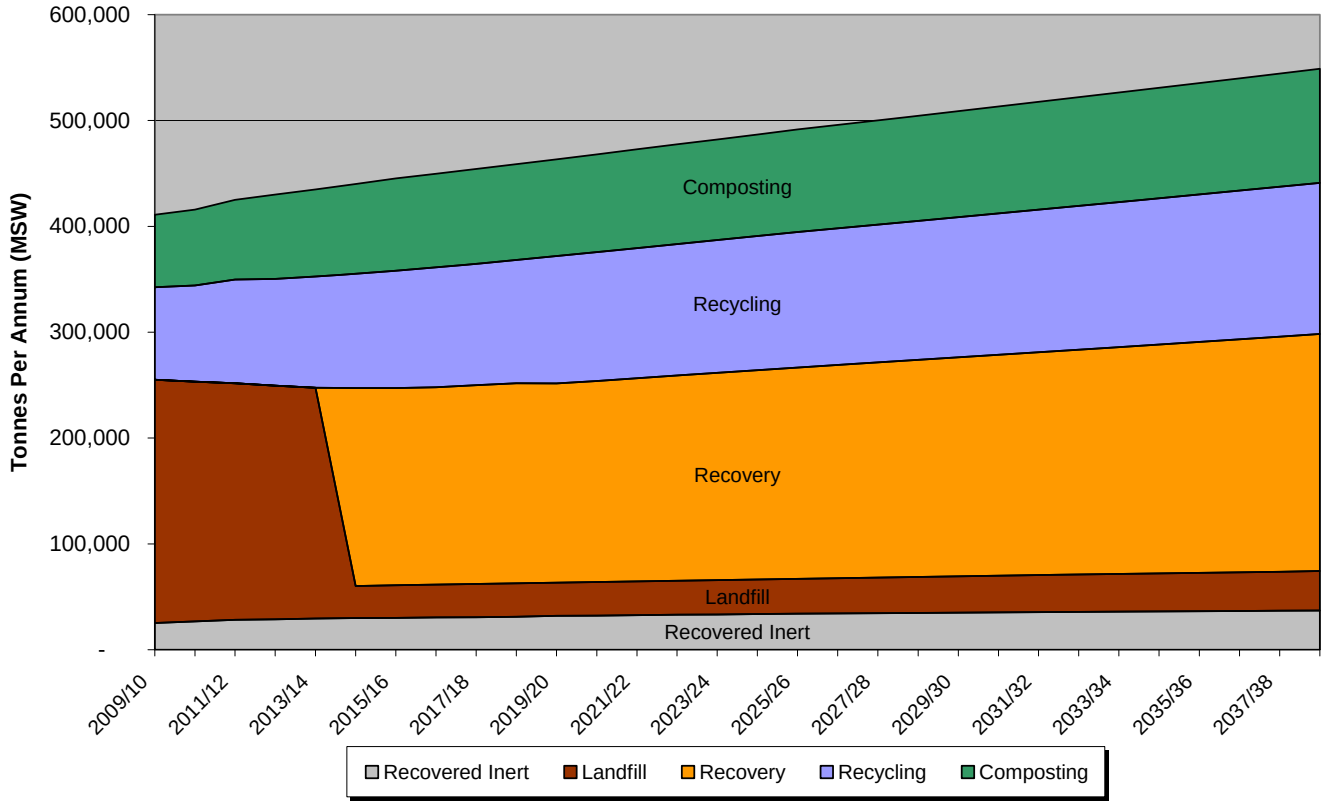
Table 2.15 Required Infrastructure for Reference Case

Proposed Facility	Waste Stream	Number of Proposed Facilities	'Nominal' Capital Expenditure	Capacity of Facility
EfW (with CHP)	Municipal Residual Waste	1	£196m	225,000

Table Note: The nominal capital cost of the facility has been calculated by inflating the 'real' capital cost taken at Q1 2008 by 5.5% per annum until the costs occur, e.g. the construction of the facility.

Figure 2.15 below illustrates the anticipated waste arisings and flows for the Partnership over the life of the contract.

Figure 2.15 SWDWP PFI 'Reference Project' Waste Flow Graph



The reference project assumes that, once on-line, approximately 86% of the residual waste that cannot be recycled or composted will be processed through the facility, with the remaining 14% being disposed of in landfill. The facility is anticipated to process approximately 40% of the total MSW waste stream. Table 2.14 presents summary data for the Reference Project.

Table 2.16 Reference Project Summary Table

Year	National Recycling Targets	Reference Project Recycling Performance	Partnership LATS Allowance	Reference Project – BMW Landfilled	LATS Surplus / (Deficit)
	%	%	Tonnes	Tonnes	Tonnes
2009/10	40	41.7	155,644	151,860	3,784
2012/13	-	46.7	103,670	146,277	(-42,607)
2014/15	45	49.0	94,776	22,288	72,488
2019/20	50	51.3	72,541	22,948	49,593
2038/39		51.3	72,541	27,130	45,411

The figures are based on assumptions about the suitability of waste streams for processing in any given facility, and the proportion of residual waste that may have to be disposed of into landfill during planned and un-planned facility downtime. Details of these assumptions are in Section 3 of this report. While the Reference Project facility capacity has been size based on these technical assumptions, the Partnership will look to bidders to maximise the percentage of residual waste that is processed through the facility, and thereby minimise the waste to landfill.

3. Waste Arisings Data and Waste Growth

3.1 Waste Arisings

The base data used for all future waste projections has been derived from the existing datasets from Plymouth City Council, Torbay Council, Devon County Council and each of the relevant WCAs of Devon. The base data used is from the financial year 2006/07, which is the most recent complete and audited data available. Table 3.1 presents the breakdown of arisings for each WCA.

Table 3.1 Municipal Solid Waste Arisings 2006/07 (tonnes)

	Plymouth	Torbay	South Hams	Teignbridge	West Devon	SWDWP Total
Kerbside Refuse Collection	63,112	35,950	11,948	21,020	17,608	149,638
Kerbside Dry Recyclables (inc. rejects)	13,597	6,221	3,462	8,161	6,331	37,771
Kerbside Organic Collection (incl. Rejects)	5,209		3,888	14,666	7,066	30,829
Clinical / Nursing / Residential Homes	5			73	23	101
Third Party Recycled	745	331	259	729	402	2,466
Other Dry Recyclables (Bring)	4,615	2,914	616	912	3,128	12,183
Street Sweepings (landfill)	5,397	2,670	154	2,208		10,429
Street Sweepings (composted)				2,341	935	3,276
Rural Skips (composted)				12		12
Other Collected Household	1,174					1,174
Parks & Gardens / Christmas Trees	997			6		1003
Trade Residual	11,391	1,500	-	86	5,374	18,351
Commercial Refuse (mainly C&D)		5,916	-			5,916
Bulky Recycling				203		203
Trade Recycling	81	1,167	-			1,248
Trade composting		412	-			412
Fly Tipped Council Land			12			12
Fridge / Freezer Collections					19	19
Seaweed composting		1,400	-			1,400
Rubble	1,717		-			1,717
Household Bulky Collection	685		145	85	2	917
Hazardous Waste		24	14			38

Table 3.1 (continued) Municipal Solid Waste Arisings 2006/07 (tonnes)

	Plymouth	Torbay	South Hams	Teignbridge	West Devon	SWDWP Total
CARC Residual	19,855	8,851	2,990	5,823	4,054	41,573
CARC Composted	5,575	4,850	2,739	5,863	2,387	21,414
CARC Recycled	9,979	2,442	2,008	8,125	4,226	26,780
CARC Rubble	11,753	5,964	1,927	2,241	2,241	24,127
TOTAL MSW	155,887	80,610	30,162	72,554	53,795	393,007

3.2 Current Dwelling Stock and Growth Projections

Table 3.2 presents the current dwelling stock for each Authority and the Draft Regional Spatial Strategy for the South West (2006) anticipated net increases in the number of dwellings for each of the Authorities within the SWDWP.

Table 3.2 Partnership Dwelling Stock and Future Growth Projections

Local Authority	Number of Dwellings (2007)	Annual Net Increase in Dwelling Stock	
		2006-2016	2016-2026
Plymouth City Council	112,592	1,000	1,450
Torbay Council	62,174	500	500
South Hams District Council	41,289	650	450
Teignbridge District Council	55,658	480	380
West Devon District Council	22,566	190	190

3.3 Population Growth

Table 3.3 shows the revised 2004-based Sub-National Population Projection (SNPP) for each of the authorities in the SWDWP. Long term sub-national population projections are an indication of the future trends in population 25 years. They are trend based projections, which means assumptions for future levels of births, deaths and migration are based on observed levels over the previous five years. They show what the population will be if recent trends in these continue. The data presented in Table 3.3 below uses the SNPP for the years 2007 to 2029, the final year of published data. Entec have then calculated the percentage growth rate for population over the last 5 years (2025-

2029) and have continued to increase the population at this rate until 2039, the final year of the Waste Flow Modelling.

The SNPP projections do not take into account any future policy changes that have not yet occurred. They are constrained at a national level by the national projections produced by GAD on 20 October 2005. The projections presented here were published on 27 September 2007 are based on the revised 2004 mid year population estimates (published 22 August 2007). Further information on can be obtained from the following website www.statistics.gov.uk/snpp.

Table 3.3 Sub-National Population Projections

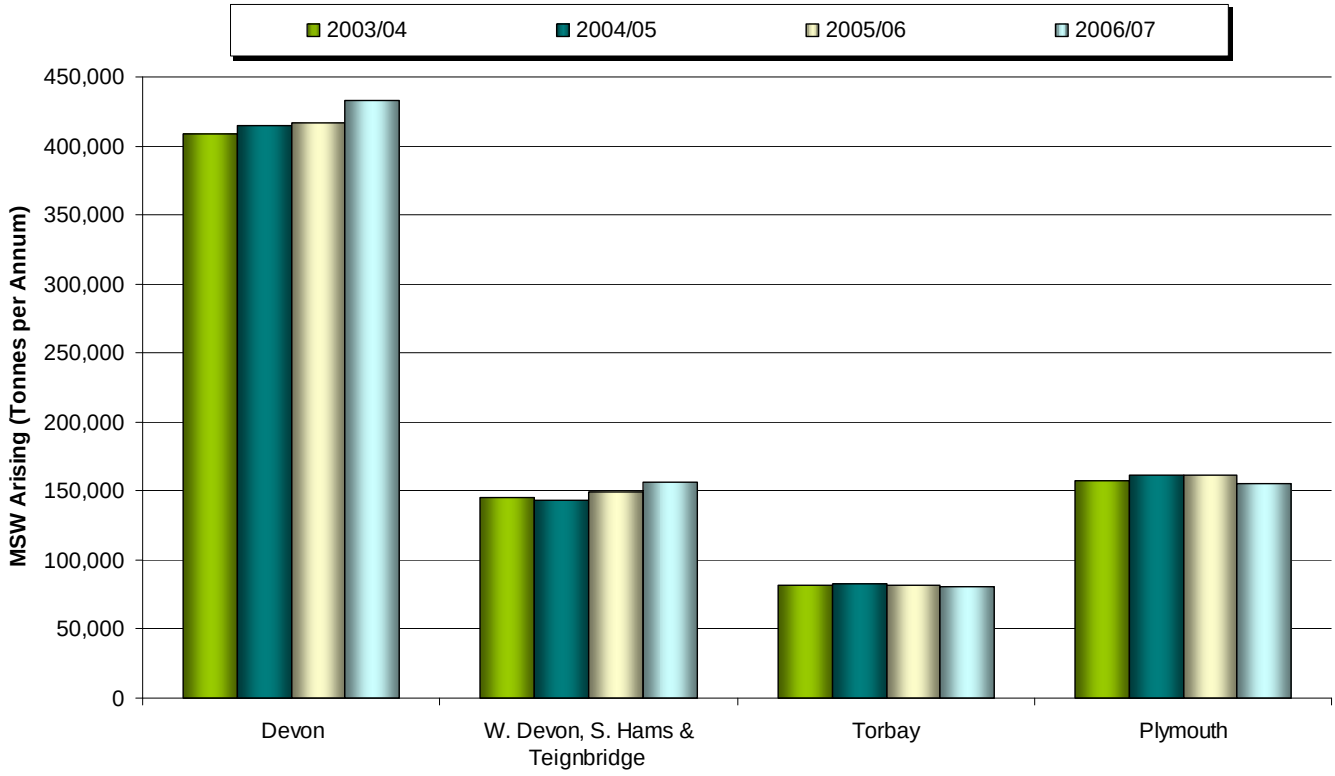
	Plymouth	Torbay	South Hams	Teignbridge	West Devon
2007	245,700	136,800	83,200	127,300	51,700
2008	246,300	138,200	83,400	128,300	52,100
2009	246,900	139,600	83,700	129,400	52,500
2010	247,600	141,000	84,000	130,400	52,900
2011	248,200	142,400	84,300	131,400	53,300
2012	248,800	143,700	84,600	132,500	53,700
2013	249,500	145,100	85,000	133,500	54,100
2014	250,100	146,500	85,300	134,600	54,500
2015	250,800	147,900	85,700	135,700	55,000
2016	251,500	149,300	86,100	136,800	55,400
2017	252,200	150,700	86,500	138,000	55,800
2018	253,000	152,100	87,000	139,100	56,300
2019	253,700	153,500	87,400	140,200	56,700
2020	254,500	154,900	87,900	141,400	57,200
2021	255,200	156,200	88,400	142,600	57,600
2022	255,900	157,500	88,800	143,700	58,000
2023	256,800	158,800	89,300	144,800	58,500
2024	257,600	160,100	89,700	146,000	58,900
2025	258,400	161,300	90,200	147,000	59,300
2026	259,200	162,500	90,600	148,100	59,700
2027	259,900	163,700	91,100	149,100	60,000
2028	260,600	164,800	91,500	150,100	60,400
2029	261,300	165,900	91,800	151,100	60,800
2030	262,002	167,007	92,101	152,107	61,203
2031	262,706	168,122	92,403	153,120	61,608
2032	263,411	169,244	92,706	154,140	62,016
2033	264,119	170,374	93,010	155,167	62,427
2034	264,828	171,511	93,315	156,201	62,840
2035	265,540	172,656	93,621	157,241	63,256
2036	266,253	173,808	93,928	158,289	63,675
2037	266,968	174,968	94,236	159,344	64,097
2038	267,685	176,136	94,545	160,405	64,521
2039	268,404	177,312	94,855	161,474	64,949

3.4 Waste Growth Profiles

3.4.1 Historic Waste Growth

Figure 3.1 presents the MSW arisings for each of the partnering authorities for the period 2003/04 to 2006/07. It can be seen that MSW arisings in Plymouth and Torbay have remained relatively constant over the four year period. However, Devon has seen MSW arisings grow over the same period. Analysis of waste arisings data suggests that the increase in MSW arisings in Devon could be due to the expansion of kerbside garden waste collections which has brought additional material into the municipal waste stream that was previously disposed of via alternative means (e.g. home composting). However, the tonnage of residual waste over this period has decreased.

Figure 3.1 Historical MSW Arisings



3.4.2 Relationship between Waste Growth and Household Growth

The growth profile forms a fundamental assumption of any mass flow model. Whilst authorities often wish to reflect the impact of waste minimisation initiatives within growth profiles there also needs to be a recognition of the growth in household numbers. The Entec model multiplies arisings at the household level by the number of households. Therefore if the number of households increases, so in turn do waste arisings. The model also includes a separate waste growth profile applied at the household level to account for waste minimisation activities and actual growth in waste arisings per household. Therefore, all waste streams have an underlying growth rate of at least the anticipated growth in housing stock. Comparison of the final two columns shows that the modelled growth in waste MSW arisings is higher than the anticipated growth in household numbers.

Table 3.4 Reference Project Waste Growth Assumptions

Year	Plymouth		Torbay		South Hams, Teignbridge & West Devon		Partnership		
	MSW Arisings	% Change	MSW Arisings	% Change	MSW Arisings	% Change	MSW Arisings	% Change in MSW Arisings	% Change in Household Numbers
2006/7	156,388	-	80,610	-	157,282	-	394,280	-	-
2007/8	158,745	1.5%	81,416	1.0%	160,229	1.9%	400,390	1.5%	1.0%
2008/9	161,041	1.4%	82,231	1.0%	162,848	1.6%	406,120	1.4%	0.9%
2009/10	163,274	1.4%	83,053	1.0%	164,683	1.1%	411,010	1.2%	0.9%
2010/11	165,440	1.3%	83,883	1.0%	166,523	1.1%	415,846	1.2%	0.9%
2011/12	167,627	1.3%	89,093	6.2%	168,368	1.1%	425,088	2.2%	0.9%
2012/13	169,840	1.3%	89,984	1.0%	170,220	1.1%	430,044	1.2%	0.9%
2013/14	172,080	1.3%	90,884	1.0%	172,077	1.1%	435,040	1.2%	0.9%
2014/15	174,347	1.3%	91,793	1.0%	173,939	1.1%	440,079	1.2%	0.9%
2015/16	176,642	1.3%	92,711	1.0%	175,807	1.1%	445,160	1.2%	0.9%
2016/17	178,313	1.2%	93,638	1.0%	177,682	1.1%	449,633	1.0%	0.8%
2017/18	180,438	1.2%	94,574	1.0%	179,211	0.9%	454,224	1.0%	0.9%
2018/19	182,566	1.2%	95,520	1.0%	180,747	0.9%	458,832	1.0%	0.9%
2019/20	184,693	1.2%	96,475	1.0%	182,288	0.9%	463,456	1.0%	0.9%
2020/21	186,820	1.2%	97,440	1.0%	183,835	0.8%	468,096	1.0%	0.9%
2021/22	188,947	1.1%	98,414	1.0%	185,390	0.8%	472,751	1.0%	0.9%
2022/23	191,075	1.1%	99,398	1.0%	186,950	0.8%	477,423	1.0%	0.9%
2023/24	193,202	1.1%	100,392	1.0%	188,516	0.8%	482,110	1.0%	0.9%
2024/25	195,330	1.1%	101,396	1.0%	190,088	0.8%	486,814	1.0%	0.9%

Table 3.4 (continued) Reference Project Waste Growth Assumptions

Year	Plymouth		Torbay		South Hams, Teignbridge & West Devon		Partnership		
	MSW Arisings	% Change	MSW Arisings	% Change	MSW Arisings	% Change	MSW Arisings	% Change in MSW Arisings	% Change in Household Numbers
2025/26	197,457	1.1%	102,410	1.0%	191,667	0.8%	491,535	1.0%	0.9%
2026/27	199,154	0.9%	103,434	1.0%	193,253	0.8%	495,841	0.9%	0.8%
2027/28	200,850	0.9%	104,469	1.0%	194,845	0.8%	500,163	0.9%	0.8%
2028/29	202,545	0.8%	105,513	1.0%	196,442	0.8%	504,502	0.9%	0.8%
2029/30	204,241	0.8%	106,568	1.0%	198,047	0.8%	508,857	0.9%	0.8%
2030/31	205,937	0.8%	107,634	1.0%	199,659	0.8%	513,230	0.9%	0.8%
2031/32	207,632	0.8%	108,710	1.0%	201,278	0.8%	517,621	0.9%	0.8%
2032/33	209,328	0.8%	109,797	1.0%	202,904	0.8%	522,029	0.9%	0.8%
2033/34	211,023	0.8%	110,895	1.0%	204,536	0.8%	526,455	0.8%	0.8%
2034/35	212,719	0.8%	112,004	1.0%	206,175	0.8%	530,899	0.8%	0.8%
2035/36	214,415	0.8%	113,124	1.0%	207,822	0.8%	535,361	0.8%	0.8%
2036/37	216,111	0.8%	114,256	1.0%	209,476	0.8%	539,842	0.8%	0.8%
2037/38	217,808	0.8%	115,398	1.0%	211,136	0.8%	544,342	0.8%	0.8%
2038/39	219,506	0.8%	116,552	1.0%	212,803	0.8%	548,861	0.8%	0.8%

3.4.3 Potential Reasons for Higher than Average Waste Growth

There are two key reasons as to why waste arisings in the Partnership area may increase above the rate of housing growth. These are:

- Effect of tourism on waste arisings; and
- lack of alternative disposal routes for non-household waste.

Various studies have suggested a link between municipal waste arisings and areas of high tourist activity. Devon is one of the country's premier holiday destinations, and the resident population swells considerably during the holiday season. While much of the waste generated by tourists will be captured in 'trade waste' waste stream, a proportion will undoubtedly end up in the household waste stream, whether this is via street sweeping and litter bin collections, through regular household waste collections from bed and breakfast accommodation or second homes and holiday homes (this would count as household waste even though the waste would be produced by people residing outside of the County), or from the many thousands of seasonal workers employed in the tourist industry (again, waste produced by these people will contribute to household waste but the full number of seasonal workers

will not always be captured). The numbers of tourists has steadily increased in the South West Region in recent years. Some analysts are projecting large increases in tourist numbers in Devon, and some even suggest that as the climate warms, the number of people holidaying in the UK, and particularly on the south coast will rise sharply. The recently published Teignbridge State of the District Address 2007[2] suggest that tourism projections from 2001 to 2011 forecast an increase of 58% in short breaks, a 4% increase in long breaks, a 41% increase in business trips and a 71% increase in visiting friends and relatives. All of these tourists will produce waste which must be managed. A study conducted by Consultancy and Research for Environmental Management in 2000, identified that an average tourist produces approximately 1.2 kg of waste per bednight.

The second factor that may cause the SWDWP to have higher waste growth than other authorities is the scarcity of alternative disposal routes for non-household waste. The lack of landfill voidspace or treatment capacity in the region means there are limited options for commercial and trade waste. The South West Region is physically constrained and, as such is in a unique position with very few waste disposal options. With the recent closure of Chelson Meadow, and the imminent closure of Heathfield (2016) coupled with escalating landfill tax, it is likely that commercial operators that do not currently use the Council services will look to their respective local authority to assist with waste disposal. The modelling has assumed that non-household waste growth will grow at the same rate as household waste, however there is a risk that demand for disposal capacity will be greater than anticipated. The Partnership will look to work with the private sector to ensure an economic solution is procured, but one that can meet the needs of the local population.

3.5 Recycling and Composting Performance

The Partnership have committed to achieving the recently released Waste Strategy for England 2007 recycling and composting targets of:

- 40% by 2010;
- 45% by 2015; and
- 50% by 2020.

Table 3.5 presents the current and projected recycling and composting rates for each of the partnering authorities for the WSE2007 target years.

[2] Source: http://www.teignbridge.gov.uk/index.cfm?articleid=5714

Table 3.5 Reference Project Projected Recycling and Composting Rates

	Reference Project Recycling and Composting Projections			
	2006/7	2009/10	2014/15	2019/20
WSE2007 Target	-	40%	45%	50%
Partnership Total	38%	42%	49%	51%
Plymouth	27%	29%	39%	43%
Torbay	26%	31%	46%	51%
Devon (SHDC, TDC & WDDC only)	52%	58%	59%	59%

3.6 Scheme Capture Rates

The quantity of a specific material captured for recycling on a particular scheme is a result of a number of variables, namely:

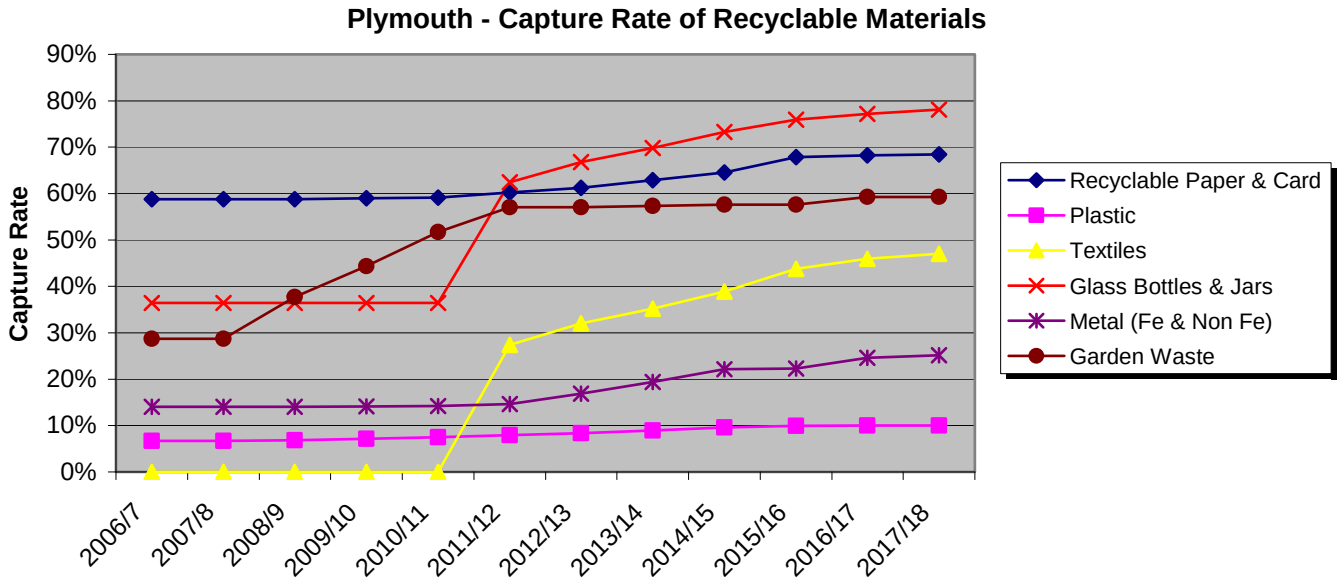
- Scheme coverage (i.e. the number of households offered the scheme);
- waste composition (how much of the materials present in the waste);
- scheme participation rate (the number of households that use the recycling scheme as a percentage of the scheme coverage); and
- material recognition rate (how well each participating household 'recognises' and captures each targeted material).

The four variables are interrelated and any assumptions made about one variable will have an impact on the other variables. The Entec mass flow model is 'calibrated' for the base year (in this case 2006/7), meaning that the four variables referenced above are tuned so that the models base year reflects the reality of actual data. The variables are benchmarked against best practise data gathered from schemes across the country to validate any assumptions made. The model enables future scenarios to be modelled by adjusting any of the variables over time, whether this is increasing the coverage of a particular scheme as more households have access to it, or increasing participation or recognition rates due to an increase in publicity or education.

Figures 3.2 to 3.6 present the material capture rates for each targeted material in each Authority. The data presented relates to kerbside collection schemes and bring banks located throughout each authority. The first modelled year (2006/7) is based on actual data, and the capture rate has been calculated for each material by dividing the tonnage of captured material by the tonnage of total material available (calculated based on the assumed composition).

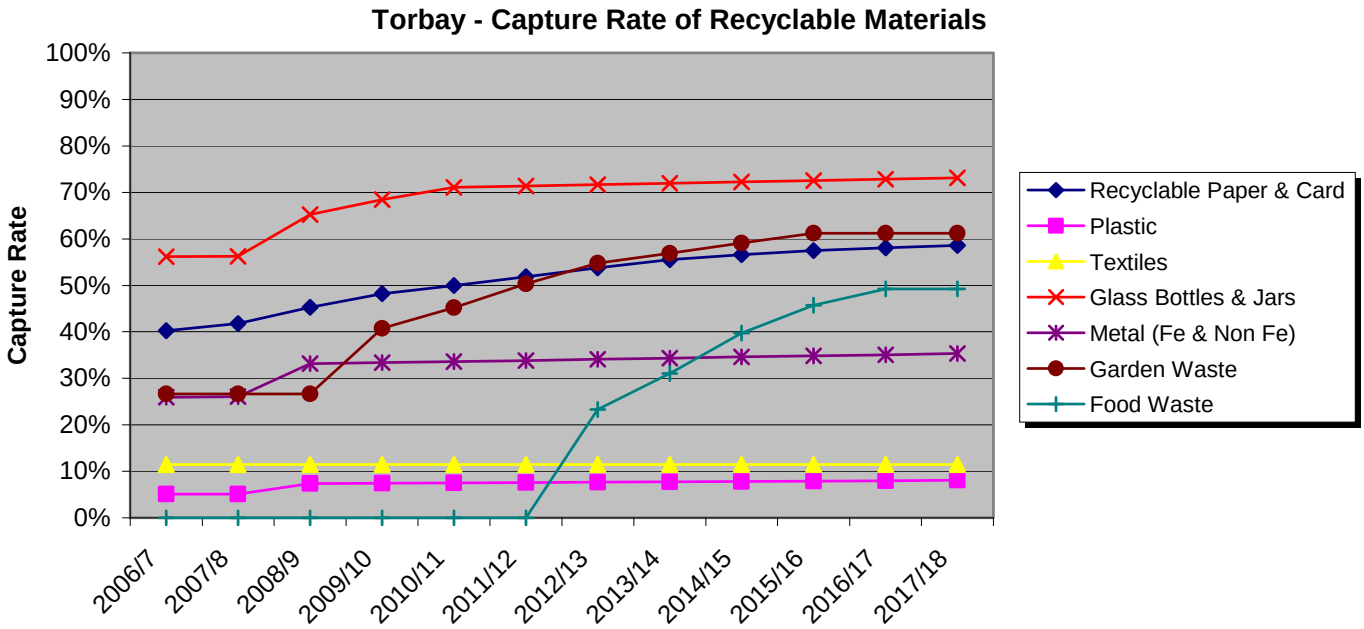
It can be clearly seen in the charts where an authority intends to roll-out a new scheme or target specific material for increased participation. An assessment of current capture rates has been undertaken and those materials where improvements can be made have had capture rates increased over time.

Figure 3.2 Plymouth Kerbside Collection and Bring Bank Capture Rates



From Figure 3.2 it can be seen that for Plymouth to achieve the desired level of recycling and composting, new materials need to be targeted and increased materials capture is required for all materials. The modelling has assumed that garden waste collections will be expanded throughout the city in a phased approach. A textiles and glass collection will be introduced in 2011/12 (the tonnage of glass being collected at present relates to bring bank collections).

Figure 3.3 Torbay Kerbside Collection and Bring Bank Capture Rates



Torbay Council intends to expand the range of materials collected at the kerbside post 2008/9. This will include an expanded glass bottles and jars collection and ferrous and non-ferrous can collections. The Council do not operate a regular garden waste collection, but rather operate garden waste drop off reception points where residents can leave garden waste for collection on certain days. It is intended that the frequency of these mobile garden waste collections will be increased, therefore increasing capture of material. It is anticipated that a food waste collection will be implemented, and the model assumes this will take place in 2012/13.

Figure 3.4 South Hams Kerbside Collection and Bring Bank Capture Rates

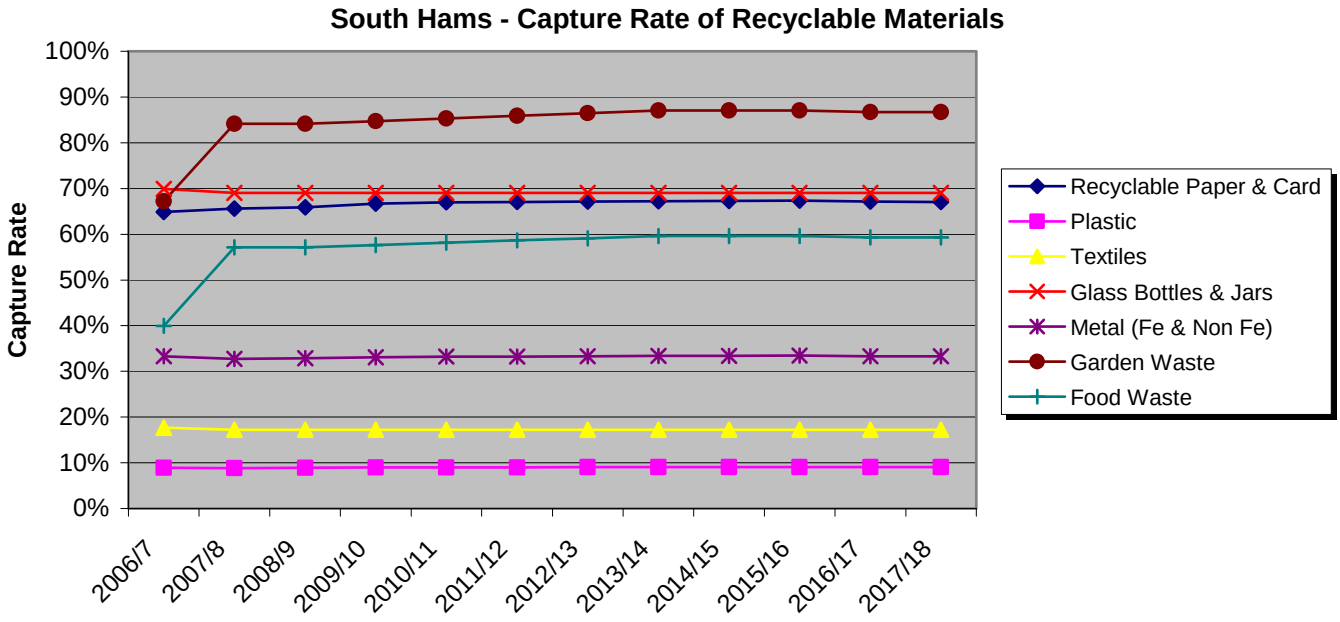


Figure 3.5 Teignbridge Kerbside Collection and Bring Bank Capture Rates

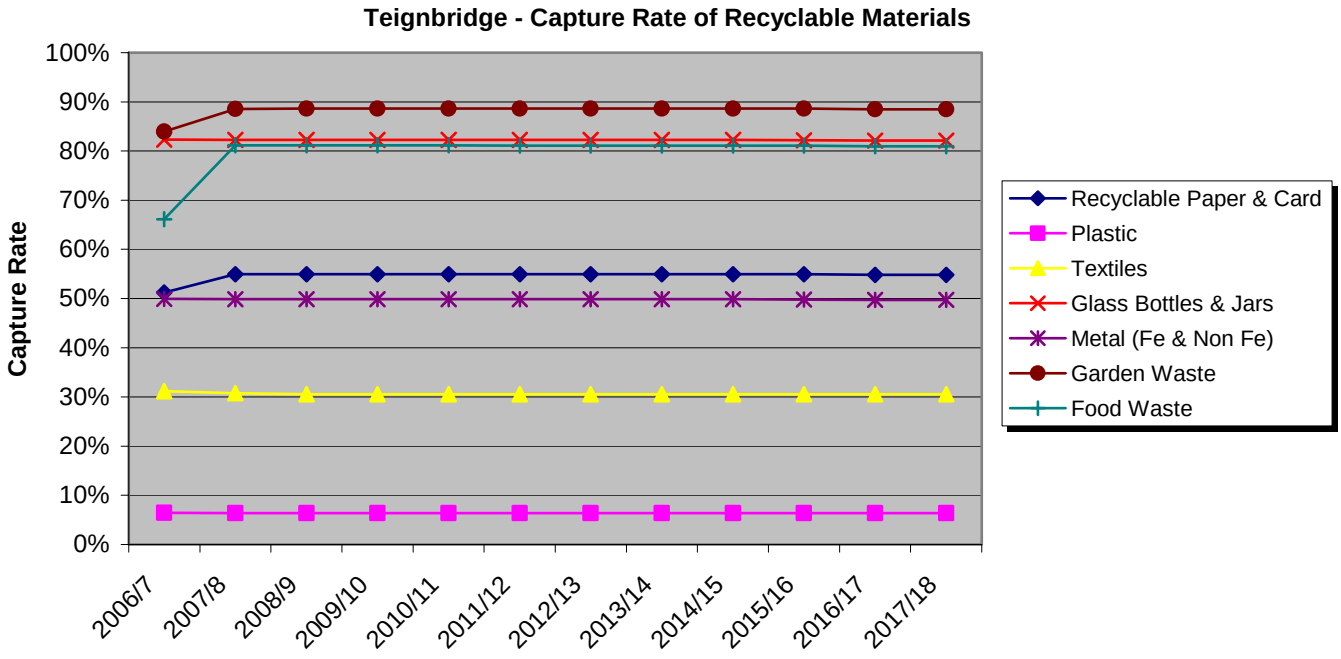


Figure 3.6 West Devon Kerbside Collection and Bring Bank Capture Rates

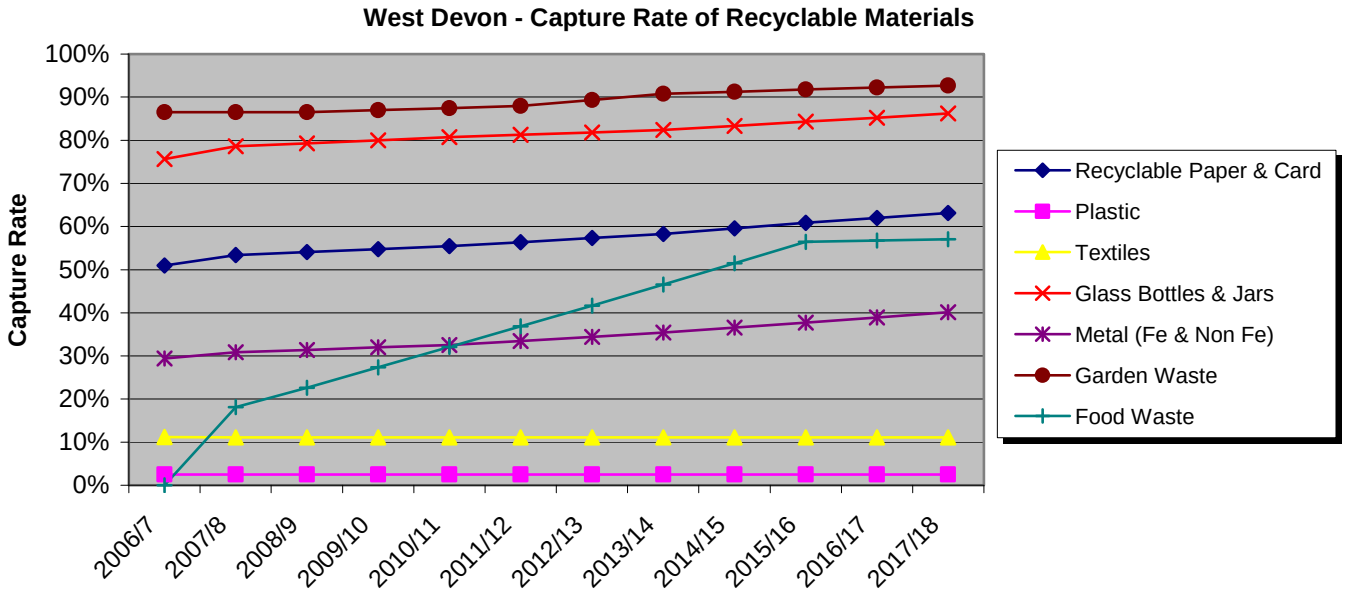


Figure 3.4 to 3.6 present the projected material capture rates for South Hams, Teignbridge and West Devon. Each of the Devon authorities have mature collection schemes will most materials currently collected. The only exception is West Devon who do not currently collect food waste district wide. Recent food waste collection trails have proved successful and it is anticipated that the food collection scheme will be expanded. The modelling has assumed that food waste capture in South Hams and Teignbridge increases in 2007/8 (this is based on half yearly actual projections), with other materials remaining relatively constant. Less investment is required for the Devon authorities than Plymouth and Torbay, and the modelling suggests that the Devon authorities will reach 59.3% recycling and composting by 2019/20.

Section 7 of this assumptions report provides details of the financial assumptions associated with the increased recycling and composting activity detailed in this section. Full costing for all service improvements have been included in the financial assessment of the Reference Project and costs have been included in all affordability calculations.

4. Residual Waste Treatment (PFI)

4.1 Facility Sizing

Due to the increasing scarcity of landfill voidspace in the south west region, one of the key objectives of the SWDWP is to minimise the amount of waste disposed of in landfill. The SWDWP aim to manage waste in accordance with the waste hierarchy, by first reducing waste and then increasing recycling and composting. However, even after waste reduction, recycling and composting, there will remain a residual element of the waste that, if diversion from landfill is to be achieved, requires treatment. Therefore, to minimise landfilling, the Reference Project facility (EfW) has been sized to accommodate the throughput of waste that is left after recycling and composting. Table 4.1 presents the waste streams that have been assumed will be treated in each facility.

Table 4.1 Waste Stream Process Modelling Assumptions

	Direct to Landfill	Residual Treatment Facility	Windrow / IVC / AD	Bulking / MRF / Reprocessing	SWDWP 2006/7 Tonnage
Kerbside Refuse Collection		100%			149,638
Kerbside Dry Recyclables				100%	37,771
Kerbside Organic Collection			100%		30,829
Clinical / Nursing / Residential Homes	100%				101
Third Party Recycled				100%	2,466
Other Dry Recyclables (Bring)				100%	12,183
Street Sweepings (landfill)	100%				10,429
Street Sweepings (composted)			100%		3,276
Rural Skips (composted)			100%		12
Other Collected Household		100%			1,174
Parks & Gardens / Christmas Trees			100%		1003
Trade Residual		100%			18,351
Commercial Refuse (mainly C&D)	100%				5,916
Bulky Recycling				100%	203
Trade Recycling				100%	1,248
Trade Composting			100%		412
Fly Tipped Council Land	100%				12
Fridge / Freezer Collections				100%	19
Seaweed Composting			100%		1,400
Rubble				100%	1,717
Household Bulky Collection	100%				917
Hazardous Waste	100%				38
CARC Residual	25%	75%			41,573
CARC Composted			100%		21,414
CARC Recycled				100%	26,780
CARC Rubble				100%	24,127

The Reference Project facility has been sized to ensure adequate capacity to process residual waste based on the final contract year of 2038/39, assuming the assumptions detailed in Table 4.1 above. Therefore, the facility has been sized to have a total operating capacity of 224,013 tonnes per annum. Table 4.2 below details the anticipated facility throughput, by Authority, for the SWDWP Reference Project. The anticipated spare capacity is also presented in Table 4.2. Table 4.3 presents the facility throughput, by Authority, as a percentage of the facility total capacity.

Table 4.2 SWDWP Reference Project Facility Throughput (Tonnes Per Annum by Authority)

Contract Year	Calendar Year	Facility Throughput (Tonnes Per Annum)						
		Plymouth	Torbay	Devon			SWDWP Total	Plant Spare Capacity
				South Hams	Teignbridge	West Devon		
Year 1	2014/15	87,563	35,527	25,566	25,887	12,477	187,020	36,993
Year 2	2015/16	87,445	34,544	25,920	26,107	12,273	186,289	37,724
Year 3	2016/17	87,487	34,090	26,357	26,376	12,266	186,576	37,437
Year 4	2017/18	88,304	34,097	26,607	26,561	12,258	187,827	36,186
Year 5	2018/19	88,937	34,229	26,857	26,747	12,286	189,056	34,957
Year 6	2019/20	87,631	34,360	27,107	26,934	12,312	188,344	35,669
Year 7	2020/21	88,640	34,704	27,356	27,121	12,278	190,100	33,913
Year 8	2021/22	89,650	35,051	27,606	27,308	12,401	192,016	31,997
Year 9	2022/23	90,635	35,402	27,856	27,497	12,525	193,913	30,100
Year 10	2023/24	91,643	35,756	28,106	27,685	12,650	195,840	28,173
Year 11	2024/25	92,652	36,113	28,356	27,874	12,776	197,772	26,241
Year 12	2025/26	93,390	36,474	28,606	28,064	12,904	199,438	24,575
Year 13	2026/27	94,313	36,839	28,855	28,254	13,033	201,295	22,718
Year 14	2027/28	95,235	37,207	29,105	28,445	13,164	203,156	20,857
Year 15	2028/29	96,157	37,580	29,355	28,636	13,295	205,024	18,989
Year 16	2029/30	97,080	37,955	29,605	28,828	13,428	206,896	17,117
Year 17	2030/31	98,002	38,335	29,855	29,021	13,562	208,775	15,238
Year 18	2031/32	98,924	38,718	30,104	29,214	13,698	210,659	13,354
Year 19	2032/33	99,846	39,105	30,354	29,407	13,835	212,549	11,464
Year 20	2033/34	100,769	39,496	30,604	29,602	13,973	214,444	9,569
Year 21	2034/35	101,691	39,891	30,854	29,796	14,113	216,346	7,667
Year 22	2035/36	102,613	40,290	31,104	29,992	14,254	218,253	5,760
Year 23	2036/37	103,536	40,693	31,354	30,188	14,397	220,167	3,846
Year 24	2037/38	104,458	41,100	31,603	30,384	14,541	222,087	1,926
Year 25	2038/39	105,381	41,511	31,853	30,582	14,686	224,013	-

Table 4.3 SWDWP Reference Project Facility Throughput (Percentage Split by Authority)

Contract Year	Calendar Year	Facility Throughput (Percentage Split by Authority)					
		Plymouth	Torbay	Devon			Plant Spare Capacity
				South Hams	Teignbridge	West Devon	
Year 1	2014/15	39%	16%	11%	12%	6%	17%
Year 2	2015/16	39%	15%	12%	12%	5%	17%
Year 3	2016/17	39%	15%	12%	12%	5%	17%
Year 4	2017/18	39%	15%	12%	12%	5%	16%
Year 5	2018/19	40%	15%	12%	12%	5%	16%
Year 6	2019/20	39%	15%	12%	12%	5%	16%
Year 7	2020/21	40%	15%	12%	12%	5%	15%
Year 8	2021/22	40%	16%	12%	12%	6%	14%
Year 9	2022/23	40%	16%	12%	12%	6%	13%
Year 10	2023/24	41%	16%	13%	12%	6%	13%
Year 11	2024/25	41%	16%	13%	12%	6%	12%
Year 12	2025/26	42%	16%	13%	13%	6%	11%
Year 13	2026/27	42%	16%	13%	13%	6%	10%
Year 14	2027/28	43%	17%	13%	13%	6%	9%
Year 15	2028/29	43%	17%	13%	13%	6%	8%
Year 16	2029/30	43%	17%	13%	13%	6%	8%
Year 17	2030/31	44%	17%	13%	13%	6%	7%
Year 18	2031/32	44%	17%	13%	13%	6%	6%
Year 19	2032/33	45%	17%	14%	13%	6%	5%
Year 20	2033/34	45%	18%	14%	13%	6%	4%
Year 21	2034/35	45%	18%	14%	13%	6%	3%
Year 22	2035/36	46%	18%	14%	13%	6%	3%
Year 23	2036/37	46%	18%	14%	13%	6%	2%
Year 24	2037/38	47%	18%	14%	14%	6%	1%
Year 25	2038/39	47%	19%	14%	14%	7%	0%

Figures 4.1 and 4.2 graphically illustrate the data presented in Tables 4.2 and 4.3.

Figure 4.1 SWDWP Reference Project Facility Throughput (Tonnes Per Annum by Authority)

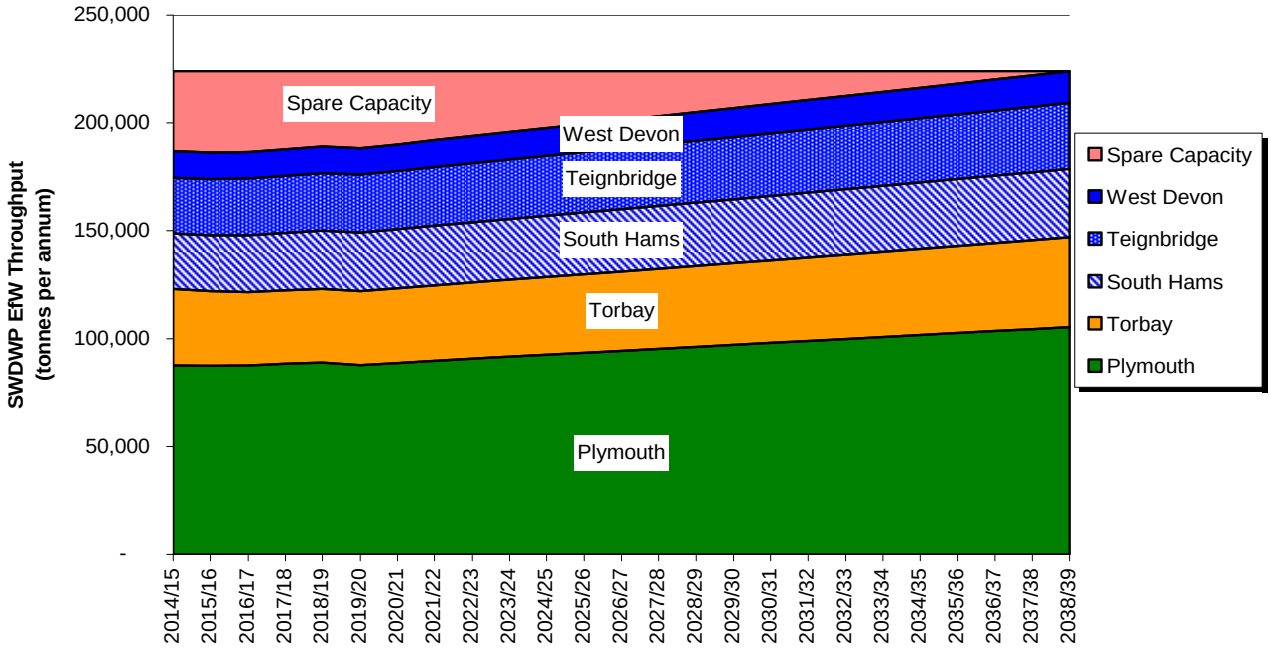
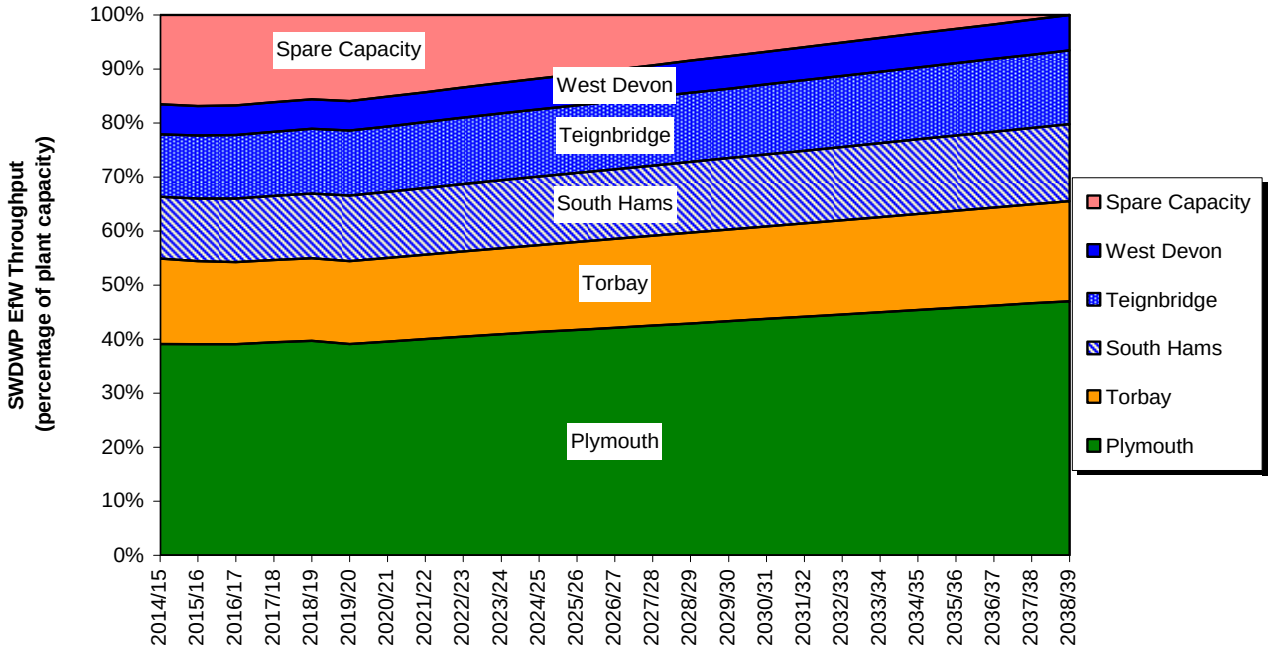


Figure 4.2 SWDWP Reference Project Facility Throughput (Percentage Split by Authority)



4.2 Facility Sizing Sensitivity Analysis

In order to test the modelling assumptions, a variety of waste growth profiles and recycling rates were modelled to assess the impact on the size of residual waste treatment facility required. The assumption and results are presented in Table 4.4 below.

Table 4.4 Residual Waste Facility Sizing Sensitivity Analysis

Sensitivity Scenario	Level of Waste Growth	Level of Recycling and Composting	Size of Facility Required (based on 2038/39 Tonnage)	Difference over Reference Project (+/- Tonnes)
Reference Project Base case	As presented in Table 3.4	As presented in Table 3.5	224,013	0
Sensitivity 1	Reduced Waste Growth (growth in line with Housing growth)	Recycling rate same as Reference Project	211,826	-12,187
Sensitivity 2	Waste growth 0.3% pa higher than Reference Project	Recycling rate same as Reference Project	246,306	22,293
Sensitivity 3	Waste Growth the same as Reference Project	Recycling rate 5% higher than Reference Project by 2020	200,975	-23,038
Sensitivity 4	Waste Growth the same as Reference Project	Recycling rate 5% lower than Reference Project by 2020	246,214	22,201
Sensitivity 5	Waste growth 0.3% pa higher than Reference Project	Recycling rate 5% lower than Reference Project by 2020	270,716	46,704
Sensitivity 6	Reduced Waste Growth (growth in line with Housing growth)	Recycling rate 5% higher than Reference Project by 2020	190,041	-33,972

Table 4.4 presents the results of the facility sizing sensitivity analysis. The modelling suggests that if a reduced waste growth was used (a waste growth in line with housing growth only) and the recycling projections remained as they are in the reference project, a facility approximately 12,187 tonnes smaller would be required (this tonnage is based on the final year, 2038/39, estimated throughput). If the waste growth was 0.3% per annum higher than anticipated and recycling and composting was 5% lower than anticipated, a facility with a capacity of 270,716 tonnes per annum would be required, 46,704 tonnes per annum larger than the reference facility. However, if waste growth was lower than anticipated (in line with housing growth) and recycling and composting was 5% higher than anticipated, a facility with a capacity of 190,041 tonnes per annum would be required.

4.3 EfW Plant Assumption

The Reference Project requires EfW capacity to treat a maximum of 224,013 tonnes of waste per year up to 2038/39. The EfW is assumed to be operational in April 2014.

The material treated thermally is fully diverted for the purposes of BMW diversion calculations and from operation start the solution will contribute significantly to each of the partnering Authorities LATS requirements. The output bottom ash is assumed to be approximately 23% by weight of the input tonnage. The modelling assumes that the bottom ash is sent for reprocessing for aggregate. It is anticipated that metal will be recovered from the bottom ash. The quantity of metal recovered is dependant on the quantity of metal in the input waste stream which is largely determined by the kerbside collection schemes in operation and the level of participation by residents. The Entec mass flow model has assumed that approximately 2% of the input tonnage will be recovered as metal from the EfW bottom ash (this is in addition to the 23% bottom ash). Air pollution control residues (APC) are 3% of the input mass and are assumed to be sent to specialist hazardous landfill sites.

Facility assumptions are presented in Table 4.5.

Table 4.5 EFW Facility Assumptions

Item	Assumption			
Bottom Ash	23% of input mass (excluding recovered metals)			
Recovered metals from bottom ash	2% of input mass			
Air Pollution Control (APC) residue	3% of input mass			
CV of Waste	10 MJ/kg			
Operating Time	8,760	Hours in a year		
Thermal Capacity	85	MW(th) @	85%	Load Factor
Electrical Output	19	MW(e) @	22%	Net Electrical Efficiency
Electrical Output	139,494	MW.h per year =	612	kWh(e) per tonne of waste

5. EfW Capital Cost Information

This Section has been removed as it contains commercially sensitive information.

6. Indicative EfW Operating Costs

This Section has been removed as it contains commercially sensitive information.

7. Other Reference Project Costs

This Section has been removed as it contains commercially sensitive information.

Appendix A
Review of Waste Treatment Technologies

A summary of the status of waste management facilities in the UK is provided in Table A1. Table A2 provides a more detailed summary of existing waste management treatment facilities, facilities that are in construction, are planning to be constructed or that have been refused planning permission. The results presented in this table have been researched by Entec and are, as far as we know, accurate at the time of writing. The list may not be fully inclusive and there may be additional facilities either in existence or in the planning phase. Every effort has been made to thoroughly research the range and extent of facilities throughout the UK.

A summary of the findings is presented in Table A1.

Table A1 Summary of the Status of Waste Management Facilities in the UK

Status of Facilities	EfW/ATT (untreated MSW)	EfW/ATT (pre-treated waste)	MBT
Operational	21	2	11
In construction	3	3	6
Planning permission granted	7		6
Subject to Planning	3		10
Under proposal	2	5	11
Planning refused	7		

Table A2 Detailed Status of UK Waste Management Facilities

Facility Type	Region	Location	Design Capacity	Technology	Status	On Line	Operator	Feedstock
EfW	East Midlands	Eastcroft CHP, Nottingham	150,000	Grate	Operational	2006	WRG	Non-Hazardous (MSW/Commercial)
EfW	London	Edmonton, London	600,000	Grate	Operational	2006	Sita/London Waste	MSW / commercial / clinical
EfW	London	SELCHP, London	420,000	Grate	Operational	2006	Veolia/SELCHP	MSW
EfW	Yorkshire and Humberside	Sheffield CHP	135,000	Grate	Operational	2006	Veolia	MSW
EfW	North East	Cleveland, Tees Valley	250,000	Grate	Operational	2006	Sita	MSW
EfW	Yorkshire and Humberside	Sheffield B	225,000	Grate	Operational	2006	Veolia	MSW
EfW	North West	Douglas, Isle of Man	65,000	Grate	Operational	2006	Sita	MSW / clinical / Animal
EfW	North West	Bolton, Manchester	130,000	Grate	Operational	2006	GMWDA	MSW
EfW	Scotland	Baldovie, Dundee	120,000	Fluidised Bed	Operational	2006	DERL	MSW
EfW	Scotland	Lerwick, Shetland Isles	26,000	Grate	Operational	2006	Amec Birelco	MSW
EfW	South East	Chineham, Basingstoke, Hampshire	90,000	Grate	Operational	2006	Hampshire Waste Services/Veolia	MSW
EfW	South East	Slough, Berkshire	75,000	Fluidised Bed	Operational	2006	Slough Heat & Power	Fibre Fuel & Wood Chip
EfW	South East	Marchwood, Hampshire	165,000	Grate	Operational	2006	Veolia	MSW
EfW	South East	Portsmouth, Hampshire	165,000	Grate	Operational	2006	Veolia	MSW
EfW	South East	Allington, Kent	500,000	Fluidised Bed	Operational	2006	WRG	MSW
EfW	Wales	Crymlyn Burrows, Swansea	170,000	Grate	Operational	2006	Unknown	RDF

Table A2 (continued Detailed Status of UK Waste Management Facilities

Facility Type	Region	Location	Design Capacity	Technology	Status	On Line	Operator	Feedstock
EfW	West Midlands	Coventry CHP	240,000	Grate	Operational	2006	Coventry & Solihull	MSW
EfW	West Midlands	Tyseley, Birmingham	370,000	Grate	Operational	2006	Veolia	MSW
EfW	West Midlands	Dudley	90,000	Grate	Operational	2006	Martin Engineering Systems	MSW
EfW	West Midlands	Wolverhampton	110,000	Grate	Operational	2006	Martin Engineering Systems	MSW
EfW	West Midlands	Stoke on Trent	200,000	Grate	Operational	2006	Martin Engineering Systems	MSW
EfW	Yorkshire and Humberside	Huddersfield, Kirklees	136,000	Grate	Operational	2006	Sita	MSW
EfW	Yorkshire and Humberside	Grimsby CHP, North East Lincolnshire	56,000	oscillating kiln	Operational	2006	Tiru	MSW
EfW	South East	Lakeside, Colnbrook, Berkshire	400,000	Grate	Construction	2008	Grundon/Viridor	MSW
EfW	North East	Cleveland Line 3, Tees Valley	130,000	Grate	Construction	2013	Sita	MSW
EfW	London	Fairview Industrial Estate, Dagenham, London	90,000	Gasification	Construction	2009	Novera Energy Ltd	SRF
EfW	South East	Isle of Wight	30,000	Gasification	Construction	2008	Energos	RDF
EfW	Yorkshire and Humberside	Seamer Carr, Scarborough	35,000	Gasification	Construction	2008	Yorwaste Ltd	RDF
EfW	South West	Avonmouth	34,000	Pyrolysis	Construction	2007	Compact Power	MSW (RDF??)
EfW	South West	Avonmouth	30,000	Pyrolysis	Planning Granted	Unknown	Compact Power	MSW

Table A2 (continued) **Detailed Status of UK Waste Management Facilities**

Facility Type	Region	Location	Design Capacity	Technology	Status	On Line	Operator	Feedstock
EfW	Scotland	Locharmoss, Dumfries	60,000	Gasification	Planning Granted	2008	Scotgen (Dumfries) Ltd	MSW, industrial/commercial
EfW	Yorkshire and Humberside	Salt End, Hull, East Riding of Yorkshire	250,000	Grate	Planning Granted	2010	WRG	MSW
EfW	London	Belvedere, London	585,000	Grate	Planning Granted	2010	Cory/RRR	MSW
EfW	East Midlands	Derby	180,000	Gasification	Planning Granted	0	Brightstar	MSW
EfW	South East	North Quay, Newhaven	210,000	Not specified	Planning Granted	2009	Veolia	MSW
EfW	Scotland	Bin Farm, Perth and Kinross	60,000	Grate	Planning Granted	2013	Sita	MSW
EfW	South West	St Dennis, Cornwall	240,000	Grate	Subject to Planning	2012	Sita	MSW
EfW	South East	Trumps Farm, Surrey	160,000	Grate	Subject to Planning	2013	Sita	MSW
EfW	South East	Capel, Surrey	110,000	Grate	Subject to Planning	2012	Sita	MSW
EfW	South West	Cornwall	64,000	Pyrolysis	Proposal	Not Known	Compact Power	RDF
EfW	South West	Exeter, Devon	60,000	CHP	Proposal	2010	Viridor	MSW
EfW	North West	Greater Manchester	300,000	Not specified	Proposal	2012	TBC	SRF
EfW	South West	Dorset	40,000	RDF	Proposal	2009	Being procured	SRF
EfW	South West	Dorset	40,000	RDF	Proposal	2012	Being procured	SRF
EfW	South West	Dorset	40,000	RDF	Proposal	2020	Being procured	SRF
EfW	South East	Buckinghamshire	200,000	Not specified	Proposal	2014	Being procured	MSW
EfW	Yorkshire and Humberside	Goole, East Riding of Yorkshire	400,000	Grate	Planning Refused	0	EPR	MSW

Table A2 (continued) Detailed Status of UK Waste Management Facilities

Facility Type	Region	Location	Design Capacity	Technology	Status	On Line	Operator	Feedstock
EfW	South East	Ridham Dock, Kent	260,000	Grate	Planning Refused	0	Sita	MSW
EfW	West Midlands	British Sugar Site, Kidderminster	150,000	Grate	Planning Refused	0	Severn Waste	MSW
EfW	Scotland	Altens, Aberdeen	160,000	Grate	Planning Refused	0	Sita	MSW/commercial and industrial
EfW	Yorkshire and Humberside	Hull, East Riding of Yorkshire	165,000	Grate	Planning Refused	0	WRG	MSW
EfW	South East	Slyfield Industrial Estate, Guildford, Surrey	225,000	Grate	Planning Refused	0	Thames Waste Management	MSW
EfW	South East	Copyhold, Redhill, Surrey	225,000	Grate	Planning Refused	0	Sita	MSW
MBT	East Midlands	Bursom, Leicester	100,000	Hese (Ball Mill)	Operational	2006	Biffa	MSW
AD	East Midlands	Wanlip Sewage Treatment Works, Leicester	40,000	AD	Operational	2006	Biffa	MBT Organics
MBT	London	Frog Island, Rainham, LB Havering	180,000	Ecodeco	Operational	2006	Shanks	MSW
MBT	London	Beddington Farmlands, LB Sutton	110,000	Dano	Operational	2006	Viridor	MSW
MBT	North East	County Durham	5,000	Civic	Operational	2006	Premier Waste	
AD	North East	Tursdale, Durham	135,000	AD	Operational	2007	Premier Waste Management	MSW
MBT	North East	Byker, Newcastle, Northumberland	120,000	Horstman	Operational	2006	Sita	MSW
MBT	South East	Forest Road, Isle of Wight	65,000	Wright	Operational	2006	Biffa	MSW & Commercial
MBT	Wales	Neath Port Talbot	54,000	Horstmann	Operational	2006	HLC	MSW
AD	West Midlands	Ludlow, South Shropshire	5,000	AD	Operational	2006	Greenfinch	Food

Table A2 (continued) Detailed Status of UK Waste Management Facilities

Facility Type	Region	Location	Design Capacity	Technology	Status	On Line	Operator	Feedstock
MBT	Yorkshire and Humberside	Seamer Carr, Scarborough	85,000	Wastec &HotRot	Operational	2006	Yorwaste Ltd	MSW
MBT/IVC	Wales	Wrexham	120,000	Unknown	Construction	2007	WRG	MSW
MBT	Scotland	Locharmoss, Dumfries & Galloway	60,000	Ecodeco	Construction	2007	Shanks	MSW
MBT	London	Jenkins Lane, Barking, LB Newham	180,000	Ecodeco	Construction	2007	Shanks	MSW
AD/IVC	Scotland	Stornoway, Isle of Lewis, Western Isles	21,000	Linde/Hot Rot	Construction	2007	Unknown	Biowaste
MBT	North West	Huyton Industrial Estate, Merseyside	50,000	Fairport Engineering	Construction	2008	Merseyside WDA (Fairpoint Engineering)	MSW
Autoclave	Yorkshire and Humberside	Yorkshire	80,000	Sterecycle	Construction	2007	Sterecycle	MSW & Commercial
MBT	South East	Milton Keynes	240,000	Ecodeco	Planning Granted	0	Shanks	MSW
MBT	North West	Lyme and Woods, Merseyside	120,000	Bedminster	Planning Granted	2008	Cory	MSW
MBT	Wales	Duffryn Industrial Estate, St Ives, Caerphilly	55,000	Horstmann	Planning Granted	2009	Biffa	MSW
Autoclave	East of England	Stoney Street Industrial Estate, Madley, Herefordshire	100,000	Estech	Planning Granted	0	ReEnergy Ltd	MSW
Autoclave	West Midlands	Hartlebury, Worcestershire	100,000	Estech	Planning Granted	0	ReEnergy Ltd	MSW
Autoclave	London	Coldharbour Lane, Rainham, LB Havering	160,000	Tempico Rotoclave	Planning Granted	Unknown	Veolia / Purac Ltd	MSW
MBT	East of England	Waterbeach, Cambridgeshire	188,000	VKW	Subject to planning	2009	Donarbon	MSW
MBT	East of England	Stanway Hall Quarry, Essex	250,000	Not Specified	Subject to planning	2010	Cory	MSW

Table A2 (continued) Detailed Status of UK Waste Management Facilities

Facility Type	Region	Location	Design Capacity	Technology	Status	On Line	Operator	Feedstock
AD	East of England	Stanway Hall Quarry, Essex	50,000	Not Specified	Subject to planning	2010	Cory	Green/Food
AD	London	Beddington Farmlands, LB Sutton	75,000	AD	Subject to planning	2009	Viridor	Biowaste
MBT	North West	Vista Road, New Boston, St Helens	120,000	Bedminster	Subject to planning	2010	Cory	MSW
MBT	North West	Leyland, Lancashire	170,000	UR-3R	Subject to planning	2011	Global Renewables	MSW
MBT	North West	Thornton, Lancashire	170,000	UR-3R	Subject to planning	2011	Global Renewables	MSW
MBT/AD	South East	Brookhurst Wood, Horsham, West Sussex	320,000	Not Specified	Subject to planning	2009	Biffa	MSW
MBT/AD	South West	Walpole Landfill, Bridgewater	55,000	Not Specified	Subject to Planning	2008	Viridor	MSW
MBT	Wales	Rechem, Pontypool	120,000	Ecodeco	Subject to Planning	2010	Shanks	MSW
MBT/AD	East of England	Longwater Industrial Estate, Costessey, Norfolk	150,000	Not Specified	Proposal	2009	SRM	MSW
MBT	London	Old Kent Road, Southwark	100,000	TBC	Proposal	2011	Veolia	MSW
MBT	North West	Cumbria	180,000	Ecodeco	Proposal	2011	Shanks	MSW
MBT/AD	North West	Greater Manchester	600,000	Clarke/Haase and Enpure	Proposal	2010	Viridor	MSW
MBT	North West	Derby	180,000	Not Specified	Proposal	Not specified		MSW
MBT	South West	Hurn, Dorset	120,000	TBC	Proposal	2012	TBC	MSW
MBT	South West	Winfrith, Dorset	120,000	TBC	Proposal	2009	TBC	MSW
MBT	South West	Ferndown, Dorset	120,000	TBC	Proposal	2020	TBC	MSW

Table A2 (continued) Detailed Status of UK Waste Management Facilities

Facility Type	Region	Location	Design Capacity	Technology	Status	On Line	Operator	Feedstock
MBT	South West	Northacre Resource Recovery Centre, Westbury, Wiltshire	60,000	Entsorga	Proposal	2009	Hills	MSW
Autoclave	Yorkshire and Humberside	Bradford	100,000	Sterecycle	Proposal	2008	Sterecycle	MSW
Autoclave	Wales	Neath Port Talbot	160,000	Sterecycle	Proposal		Sterecycle	MSW

Appendix B
Crystal Ball Risk Modelling

This Section has been removed as it contains commercially sensitive information.