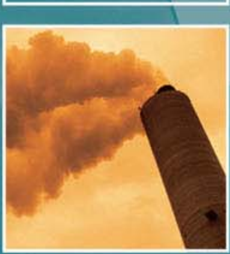
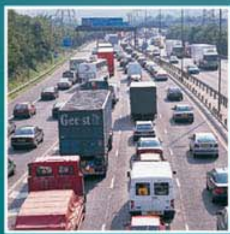
Worcestershire County Council

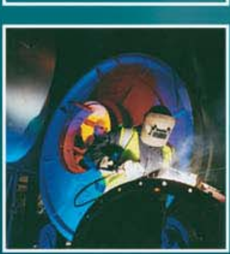
Worcestershire TA Contract Negotiation

OBC Lite – Draft Report

September 2009







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Executive Summary

Purpose of this Report

The purpose of this study is to draw on elements from The Joint Municipal Waste Management Strategy for Herefordshire and Worcestershire and the reference project (Waste Flow Model) to attempt to identify the size of the residual waste treatment facility required to deliver the preferred option identified by the Partnership. An independent assessment of the size of the proposed facility was developed by taking into account previous waste arisings, committed waste collection scheme changes and any require service enhancements. The study provides information on the current and future waste arising in both Counties and their constituent district authorities, and aims to develop the readers understanding of the key issues arising from alternative plant configurations, the requirement to re-procure an operating contract when the plant reverts to council ownership at expiry of the existing contract term, maintenance and lifecycle philosophies and potential costs.

Background

An earlier procurement exercise has resulted in the appointment of a private sector partner, Severn Waste Services, to manage all the waste arising within the two counties over a 25 year period. The identified technology at the time was deemed to be Energy from Waste (EfW), supported by an array of complementary recycling and composting infrastructure.

Since this exercise, a Joint Municipal Waste Management Strategy (JMWMS) for the Partnership (both Herefordshire and Worcestershire) has been produced and is currently under review. In response to this Strategy, several of the constituent authorities have already altered their collection methods and all have plans to increase the range of materials they collect for recycling. They plan to send these to a Commingled Materials Reclamation Facility located in Worcestershire.

To ensure the Strategy remained flexible, the recent review was conducted to take account of changes and advances in waste treatment technologies. A residual options appraisal was undertaken that examined a range of options for the introduction of residual waste treatment capacity for both Herefordshire and Worcestershire. These strategic options were appraised against a number of environmental, social and economic criteria in order to identify the option(s) that perform best overall. This strategy is currently out for consultation.

The Joint Municipal Waste Management Strategy

The JMWMS was developed in 2004. It formed a framework for the management of municipal waste in the counties of Herefordshire and Worcestershire for the next thirty years until 2034. It was prepared jointly by all the Local Authorities (LA) responsible for managing waste across the two counties.

The Waste Strategy is currently under its first review and will be reviewed periodically at least every five years. The Council felt it necessary to review their JMWMS to enable the document to be adaptive to change and remain as relevant as possible as waste management in the United Kingdom continues to evolve.

The document sets out a series of waste minimisation, recycling and recovery targets aligned to the Waste Strategy for England 2007. It also includes a waste treatment options appraisal with WRATE model outputs, and from this it is concluded that a residual waste treatment solution embracing Energy from Waste with combined heat and power (CHP) is the most attractive.

A link to the full Hereford and Worcestershire JMWMS consultation document is available at:
http://worcestershire.whub.org.uk/home/wcc-waste-strategy

Developing a Business Case

It has been recognised that within JMWMS there is need to address the practical aspects of strategy implementation. Entec have been asked to assist in the determination of the scope of any residual waste management and treatment facility that would be required to meet the preferred option in the JMWMS. Entec have independently reviewed the available waste arising data in order to identify the likely capacity of the residual waste treatment facility.

This section reports against the following headings;

- Identification of the quantity of residual waste that will require treatment and/or disposal;
- Assessment of the likely size of any residual waste treatment facility;
- A cost estimate covering capital, operational and lifecycle costs;
- A critical review of plant configuration alternatives (e.g. single vs. twin line);
- An assessment of midlife (expiry of existing contract) to end of life cost considerations;
- Reliability, maintenance downtime and life cycle replacement philosophies;
- An overview of the residual waste treatment supplier market;
- A project programme;
- A project risk register; and
- Model outputs from the waste flow and cost model to feed to financial advisors.

The Entec Waste Flow Model was used to aid the investigation into the appropriateness of the proposed size of the Energy from Waste (EfW) facility for the Counties of Herefordshire and Worcestershire, giving consideration of both planned and committed enhancements to the existing kerbside dry recyclables collection systems, and the introduction of kerbside household green waste and kitchen waste collection schemes in all constituent areas, to enable the Partnership to meet the targets specified in the JMWMS.

This section also includes an appraisal of different suggest waste growth scenarios in order to attempt to size the EfW facility. It concludes from the four realistic waste growth scenarios examined, that the probable required capacity of the proposed residual waste treatment facility is likely to be to the order of 220,000 tpa. The capital cost for a facility of this size is estimated to be of the order of £166M (Capex estimates are accurate to within a tolerance of 30% - 50% excluding contingency margins) inclusion of an allowance of £21 million for site specific costs. The estimated net operational cost per annum is expected to be around £28 per tonne of waste feed excluding capital and life cycle costs.

Cost data are provided on a format that will facilitate the Authority and their Financial Advisors to develop a nominal cost per tonne and public sector comparator model that may be compared to any figure brought forwards by their waste management contractor, Severn Waste Services. It was understood that the Authority was to appoint financial advisors to progress this matter. The appointment remains pending.

A technical review of key issues around the development of projects incorporating EfW technology has been undertaken. This review discusses the key issues arising from alternative plant configurations, the requirement to re-procure an operating contract when the plant reverts to council ownership at expiry of the existing contract term and maintenance and lifecycle philosophies. Consideration of planning, design, reliability, availability, maintenance and cost issues are included. An overview of residual waste treatment suppliers is provided. The report also includes a provisional project programme and an identification of significant project risks.

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Contents

1. Background

This is a combined study of both Herefordshire and Worcestershire. Herefordshire is a statutory Unitary Authority (UA) and Worcestershire is a Waste Disposal Authority (WDA). Worcestershire is comprised of six Waste Collection Authorities (WCAs);

- Bromsgrove District Council,
- Malvern Hills District Council,
- Redditch Borough Council,
- Worcestershire City Council,
- Wychavon District Council,
- Wyre Forest District Council,

An earlier procurement exercise has resulted in the appointment of a private sector partner, Severn Waste Services, to manage all the waste within all authorities over a 25 year period. The preferred technology at the time was deemed to be Energy from Waste (EfW).

Since this exercise, a Joint Municipal Waste Management Strategy (JMWMS) for the Partnership (both Herefordshire and Worcestershire) has been produced and is currently under review. In response to this Strategy, several of the constituent authorities have already altered their collection methods and all have plans to increase the range of materials they collect for recycling. They plan to send these to a committed Commingled Materials Reclamation Facility located in Worcestershire. The Strategy also outlined a change in chosen residual waste treatment technology from EfW to an autoclave facility, but this has been unable to come to fruition.

To ensure the Strategy remained flexible, the recent review was conducted to take account of changes and advances in waste treatment technologies. A residual options appraisal was undertaken and examined a range of options for the introduction of residual waste treatment capacity for both Herefordshire and Worcestershire. These strategic options were appraised against a number of environmental, social and economic criteria in order to identify the option(s) that perform best overall.

The purpose of this study is to draw on elements from the JMWMS and reference project to attempt to size the preferred residual waste treatment option planned by the Partnership.

1.1 Waste Arising

Table 1.1 identifies all waste arising from the two Counties for previous years and displays an estimate of future arisings.

Table 1.1 Summary Waste Arisings in both Herefordshire and Worcestershire

	Year	Household Waste Collected	Collected Trade Waste	HWC Collected Household Waste	Other MSW	Total MSW Arising	Percentage Change
Actual	2006/7	256,313 t	16,293 t	108,218 t	39,788 t	420,613 t	n/a
	2007/8	251,479 t	16,481 t	93,273 t	34,669 t	395,902 t	- 5.87%
	2008/9	244,420 t	16,115 t	92,312 t	34,780 t	387,626 t	- 2.09%
Forecast	2010/11	245,810 t	15,286 t	94,182 t	40,875 t	396,152 t	2.20%
	2015/16	258,307 t	16,063 t	98,970 t	42,953 t	416,293 t	5.08%
	2020/21	270,875 t	16,844 t	103,785 t	45,043 t	436,548 t	4.87%
	2025/26	283,444 t	17,626 t	108,601 t	47,133 t	456,803 t	4.64%
	2030/31	296,012 t	18,407 t	113,416 t	49,223 t	477,058 t	4.43%

1.2 Current Collection and Disposal Arrangements

1.2.1 Worcestershire

Worcestershire County Council is a Waste Disposal Authority (WDA) responsible for arranging the disposal of waste collected through Household Waste Centres and by all of it's constitute authorities. Currently most of the residual waste created in the County is landfilled, with a small amount being exported to EfW facilities in the West Midlands.

A commingled dry recyclable service is currently being rolled out across most of the County. Worcester City was the first and has now been followed by both Redditch and Wychavon. A new Commingled Materials Reclamation Facility (CMRF) (Envirosort) will be on line by November 2009, and each authority will feed into to facility enabling them to extend the range of materials collected.

Worcestershire's six constituent WCAs are listed below along with details of their current collection arrangements.

Bromsgrove District Council

Bromsgrove currently has an alternative weekly collection (AWC). 240litre wheeled bins are used to collect residual waste on the alternate week to the kerbside sort dry recyclables collection. This collection will become commingled from April 2010. A district-wide free green waste collection service has recently ceased and has been replaced with a subscribed green service for up to 15,000 households (hhds) for 9 months of the year. Bromsgrove District Council also collects a small amount of trade waste.

Malvern Hills District Council

Malvern Hills District Council operate a commingled kerbside collection of dry recyclables without glass. Each household (hhd) is provided with 2 bags, one to collect paper and card, and the other, cans and plastic bottles. They recently introduced a subscribed green waste collection for up to 1,000 hhds in June 2009. Glass is collected via network of bring sites. An extended commingled service will begin from April 2010 and materials will be taken to the new CMRF. Glass will remain out of the commingled stream. Similarly to Bromsgrove, Malvern Hills also operate a trade waste collection to a limited number of commercial properties.

Redditch Borough Council

Currently, a commingled AWC operates in Redditch. This will change to the extended service in November 2009 when all materials will go to the new CMRF. Both the residual waste and recycling are collected using 240litre wheeled bins. A restricted green waste collection service to 7,000 hhds is being considered. Redditch Borough Council do not collect trade waste.

Worcestershire City Council

Worcestershire City Council operate a similar recyclable collection system to Redditch and will also change to the extended service in November 2009. A subscribed green waste collection service to 5,000 to 7,000 hhds has been recently introduced in August 2009 and the Council operate a trade waste collection scheme.

Wychavon District Council

Wychavon originally had a similar commingled bag recyclable collection system to Malvern Hills District Council, with an unlimited residual bag collection and a separate glass collection using kerbside boxes. Last year this changed to an AWC (including glass) and 240litre bins are now used for the collection of recyclables. 180litre wheeled bins are used to collect residual waste and have been introduced to attempt to limit the amount of residual waste presented. The Council have accompanied this system with a weekly food waste collection, (although on the residual collection week the food waste is landfilled) and subscribed green waste service to 6,000 to 7,000 hhds covering 12 months of the year.

Wyre Forest District Council

Wyre Forest District Council operate a weekly dry recyclable kerbside sort collection (2 x boxes) with a fortnightly residual collection and collect trade waste. The Council have not yet agreed to move to a commingled collection, or introduce green waste or food waste collections.

1.2.2 County of Herefordshire

Herefordshire Council is a statutory Unitary Authority (UA) and is responsible for both the collection and disposal of municipal waste contained in the County. Currently, most of the residual waste produced here is landfilled, similarly to Worcestershire a small proportion is sent to an EfW facility outside the County.

Herefordshire currently have a similar dry recyclable collection structure as Malvern Hills (without glass). In addition, the Council also sell green waste collection sacks but the green waste currently is landfilled. An AWC system is operated and residual waste is collected in black sacks. The extended commingled service will be introduced in November 2009 when 240litre wheeled bins are introduced to aid collection, glass will also be collected from the kerbside and the dry recyclable collection will become fortnightly. It is understood that there are currently no formalised plans for the introduction of green waste or food waste collections and these waste streams will continue to be taken to landfill for the foreseeable future. Similarly to most authorities in Worcestershire, Herefordshire Council collects trade waste from a limited number of commercial properties.

1.3 Performance of Existing Services

Recycling and Composting Performance

Tables 1.2 and 1.3 are a summary of the recycling and composting performance of both Counties.

Table 1.2 Summary of Worcestershire Recycling and Composting Reported Performance

Year	Tonnage Recycling	Tonnage Composted	% of household waste recycled and composted
2006/7	64,762 t	28,155 t	32.28%
2007/8	75,739 t	28,702 t	38.4%
2008/9	77,494 t	33,503 t	41.6%

Table Note: 2008/9 % of hhd waste recycled and composted includes fractions that are sent for re-use.

Table 1.3 Summary of Herefordshire Recycling and Composting Reported Performance

Year	Tonnage Recycling	Tonnage Composted	% of household waste recycled and composted
2006/7	16,877 t	6,657 t	25.92%
2007/8	19,710 t	6,594 t	30.3%
2008/9	20,057 t	7,359 t	33.2%

Table Note: 2008/9 % of hhd waste recycled and composted includes fractions that are sent for re-use.

Residual Waste Treatment

Tables 1.4 and 1.5 are a summary of the residual waste produced by the Partnership. It demonstrates the majority of residual waste is currently landfilled.

Table 1.4 Summary of Worcestershire Reported Residual Waste Treatment

Year	Thermal Treatment	MSW Landfilled	Diversion Rate	BMW Landfilled	Landfill Allowances
2006/7	25,857 t	181,101 t	43.1%	133,044 t	164,466 t
2007/8	25,513 t	155,859 t	48.0%	112,113 t	152,250 t
2008/9	31,317 t	137,200 t	53.5%	96,701 t	136,980 t

Table 1.5 Summary of Herefordshire Reported Residual Waste Treatment

Year	Thermal Treatment	MSW Landfilled	Diversion Rate	BMW Landfilled	Landfill Allowances
2006/7	1,189 t	70,142 t	31.3%	53,549 t	50,681 t
2007/8	85 t	64,340 t	33.0%	48,000 t	46,635 t
2008/9	83 t	59,664 t	35.4%	44,146 t	41,577 t

1.4 Waste Composition

A waste composition of all collected waste, for each WCA and UA, has been taken from 2 studies conducted in 2008 by Resource Futures. The compositional data, issued to Entec by WCC, was spread over 3 seasons, in the case of Worcestershire and 4 in Herefordshire, and is broken down by ACORN group. A full data set for each area

can be found in the reports 'Worcestershire County Council Waste Composition Analysis Comparative Report' and 'Herefordshire Household Waste Analysis Comparative Seasonal Report' possessed by each Council or a summary can be found in the Waste Flow Model Report accompanying this document.

2. Joint Municipal Waste Management Strategy

2.1 Introduction

The first Joint Municipal Waste Management Strategy (JMWMS) for Herefordshire and Worcestershire was developed in 2004. It formed a framework for the management of municipal waste in the counties of Herefordshire and Worcestershire for the next thirty years until 2034. It was prepared jointly by all Local Authorities responsible for managing waste across the two counties.

The Strategy is currently under review and will be periodically reviewed at least every five years. The Council felt it necessary to review their JMWMS to enable the document to be adaptive to change and remain as relevant as possible as waste management in the United Kingdom continues to evolve. During the most recent review the Herefordshire and Worcestershire's partners and stakeholders were invited to give their opinions on the direction that the revised Strategy should take. It is currently awaiting endorsement by the constituent Local Authorities, and the Joint Members Waste Resource Management Forum. It is anticipated that the document will be finalised and published in its final form by late summer 2009.

A link to the full consultation document is available at: http://worcestershire.whub.org.uk/home/wcc-waste-strategy

2.2 Strategy Development

The Strategy review first assessed Herefordshire and Worcestershire's current position and any changes in drivers from the original Strategy. In response to this, a number of principles (Table 2.1) which govern the way municipal waste should be managed in Herefordshire and Worcestershire were identified.

Table 2.1 Summary of Principles

Principle 1	Meeting the challenge of climate change by viewing waste as a resource
Principle 2	Commitment to the waste hierarchy of which waste prevention is the top
Principle 3	Influencing Government, waste producers and the wider community
Principle 4	Continued commitment to re-use, recycling and composting
Principle 5	Minimising the use of landfill
Principle 5	Partnership
Principle 7	Monitoring and review
Principle 8	Customer focus
Principle 9	Value for money
Principle 10	Consideration of social, Environmental and economic impacts

The above principles were used as a framework to guide the creation of 24 policies and 6 targets by which the strategic principles would be delivered. The full range of policies can be found in the web based consultation document and a brief summary of targets are present in Table 2.2 below.

Table 2.2 Target Summary

Target 1	Climate change target (awaiting confirmation but will be measured against NI 185, 186 and 188).
Target 2	To achieve the national reductions in kg/head of household waste (that not re-used, recycled or composted) of 29% by March 2010, 35% by 2015 and 45% by 2020 based on 2000 levels.
Target 3	To achieve national recycling and composting levels of household waste of 40% by 31st March 2010 as a minimum and work towards achieving 45% by 31st March 2015 and 50% by 31st March 2020.
Target 4	To achieve the requirements of the Household Waste Recycling Act 2003 to provide a kerbside collection of at least 2 recyclable materials from all households by 31st December 2010.
Target 5	By 2015 or earlier if practicable, recover value from a minimum of 78% of municipal waste. The aim of this target is to achieve the Best Practicable Environmental Option (BPEO) that was identified in July 2003 through a portfolio of treatment options- i.e. a minimum of 33% of waste to be recycled and/or composted, an additional 45% of waste to be recovered with a maximum of 22% landfilled.
Target 6	To reduce the amount of biodegradable municipal waste landfilled in order to meet the yearly allowances set by Government under the Landfill Allowance Trading Scheme. In particular in target years as below: 154,164 tonnes during April 2009 to March 2010 102,684 tonnes during April 2012 to March 2013 71,851 tonnes during April 2019 to March 2020

The range of options available to enable Herefordshire and Worcestershire to meet their targets has been studied as part of the review. Options appraisals were conducted covering: waste prevention methods; recycling and composting options; and final residual waste collection and disposal.

2.3 Waste Treatment Options

It has long been recognised within the two counties, that reliance on landfill is not a long term, sustainable option and the principle of reducing the use of landfill for disposal of residual waste has been followed. Whatever alternative treatment methods are used, the aim will be to recycle and recover the maximum amounts of waste possible and reduce reliance upon landfill.

An options appraisal was conducted on the following agreed waste treatment options:

- Option A – a single Energy from Waste (EfW) facility
- Option B – a single EfW facility with combined heat and power (CHP)
- Option C – two Mechanical Biological Treatment (MBT) facilities, located on two separate sites, one with on site combustion.

- Option D – two MBT facilities each with off site combustion
- Option E – a single autoclave
- Option F – two autoclaves, located on separate sites
- Option G – EfW located out of county

The options listed above were assessed against a range of environmental, social and economic criteria. Assessment of the different options against the environmental criterion was undertaken using the Environment Agency's life cycle assessment tool – Waste and Resources Assessment Tool for the Environment (WRATE). The assessments against the remaining criteria were undertaken using both quantitative and qualitative appraisal methods.

Option B (EfW with CHP) was identified as the highest ranking technology, scoring the highest mark in global warming, transport, reliability, compliance with policy, flexibility and end product liability. Whilst all the criteria assessed were seen as important, cost, reliability and resource depletion were seen as key criteria. Option B scored well against these key criteria with the exception of cost, where it was ranked fifth, although income from the heat generated had not been taken into consideration.

It may, therefore, be concluded that subject to the outcome of the current consultation exercise it is likely that the county will adopt a strategy including Energy from Waste with CHP.

3. Developing a Business Case

3.1 Background

It has been recognised that within JMWMS there is a need to address the practical aspects of implementation of the waste management strategy. Entec have been instructed to assist in the determination of the likely scope and size of the residual waste management and treatment facility that would be required to meet the preferred option identified in the JMWMS. It is understood that subject to consultation responses and adoption by the concerned authorities, the solution is likely to be mass burn EfW with CHP. Similar solutions are currently being developed across England for the treatment of residual municipal waste. Entec have been appointed to assist with the determination of optimum plant capacity by undertaking and independent review of the likely capacity requirements.

The objectives of this project were to develop an 'OBC Lite' reporting against the following headings;

- Identification of the quantity of residual waste that will require treatment and/or disposal;
- Assessment of the optimum size of any residual waste treatment facility;
- A cost estimate covering capital, operational and lifecycle costs;
- A review of plant configuration alternatives (e.g. single vs. twin line);
- An assessment of midlife (expiry of existing contract) to end of life cost considerations;
- Reliability, maintenance downtime and life cycle replacement philosophies;
- An overview of the residual waste treatment supplier market;
- A project programme;
- A project risk register; and
- Model outputs from the waste flow and cost model to feed to financial advisors.

The following report should inform the Partnership, assisting them to understand what achievements are necessary to meet targets outlined in the JMWMS and the likely capacity of the waste treatment facility required.

3.2 Waste Flow Model

This section of the report has been produced for the purpose of reporting the results of our investigation using the Entec Waste Flow Model into the appropriateness of the proposed size of the EfW facility for the Counties of Herefordshire and Worcestershire. It not only analyses the current practices, but also examines committed and proposed schemes before identifying where scheme enhancement may be required. Enhancements to the existing kerbside dry recyclables collection systems and the introduction of kerbside household green waste and kitchen waste collection schemes in all constituent areas are tested against the targets set out in the relevant strategies.

The Entec Waste Flow Model takes into account waste arising from the kerbside ands other sources (e.g. bring sites, household waste recycling centres (HWRCs), commercial waste, etc) in terms of quantity and composition for a number of differing housing groups within each authority area, of differing performance, in order to estimate the performance of individual collection schemes resulting in an output of residual waste by quantity and quality. The waste flow model has been built from the outturn data from 2008/09 as provided by Worcestershire County Council.

3.2.1 Identification of the Quantity of Residual Waste that will Require Treatment and/or Disposal

It has been assumed that the size of the proposed residual waste treatment facility will be based upon the Partnership meeting the targets set out in the JMWMS. Entec has therefore built a waste flow model to test whether the proposed targets could be met and, if not, give detail of possible enhancements that could aid the authorities in meeting them. The amount of residual MSW produced by both Counties could then forecast on this basis and reflected across a number of different waste growth scenarios.

All data provided by WCC and composition information and other assumptions used in the model are detailed in the Waste Flow Model reference report accompanying this document.

Current Performance

The model was first run to demonstrate the current performance of all WCAs and WDA. This provided outputs from the base year (2008/9) onwards, taking into account of any planned or committed service enhancements and with waste growth assumed to be solely dependant on housing growth[1]. The forecast performance in 2014/15 when any planned or committed roll-outs are likely to be complete was also investigated. The model outputs are presented using the following National Indicators (NI)[2]:

- NI 191 – Kilograms of residual household waste per household per year;
- NI 192 – Percentage of household waste arisings sent for reuse, recycling and composting; and
- NI 193 – Percentage of municipal waste landfilled.

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[1] Scenario 6: Section 2.3 of Waste Flow Model Report, August 2009.

[2] The New Performance Framework for Local Authorities and Local Authority Partnerships: Single Set of National Indicators

The targets outlined in Section 2 (Table 2.2) correspond to these indicators and are in line with the targets presented in the DEFRA Waste Strategy for England 2007. The modelled outputs for each authority are shown in the following sections.

Worcestershire

The performance outputs from the model for each of the WCAs for the year 2008/9 and 2014/15 are set out in Table 3.1.

Table 3.1 NI 192 for each WCA in Worcestershire (excluding HWRC)

Waste Collection Authority	NI 192 (2008/9)	NI 192 (2014/15)
Bromsgrove District Council	41.74%	32.9 %
Malvern Hills District Council	28.15%	28.82%
Redditch Borough Council	31.55%	32.51%
Worcestershire City Council	36.24%	37.09%
Wychavon District Council	34.7%	35.19%
Wyre Forest District Council	30.39%	30.39%

Note a reduction in performance shown by Bromsgrove. This is directly related to the change in the kerbside green waste scheme from a free district-wide service to a subscribed service to only 15,000 households. It has been assumed, for the purpose of modelling, that all green waste currently collected for composting will be subsequently captured within the residual waste stream.

The performance of the HWRCs within Worcestershire is 63.56% for the same year, and for the purposes of this study it has been assumed that the recycling and composting performance of the HWRCs will remain the same for all future years. Table 3.2 shows the overall Worcestershire County Council performance in both years. The small decrease is again due to the reduction of the green waste service in Bromsgrove.

Table 3.2 Worcestershire Overall Performance (including HWRC)

National Indicator	2008/9	2014/15
NI 191	648 kg/hhd/yr	647kg/hhd/yr
NI 192	41.9%	41.0%
NI 193	57.4%	58.2%

Herefordshire

The performance outputs from the model, for the waste collection operations only, for the years 2008/9 and 2014/15, are shown in Table 3.3.

Table 3.3 NI 192 for the Waste Collection in Herefordshire (excluding HWRC)

National Indicator	2008/9	2014/15
NI 192	19.63%	23.0%

The recycling and composting performance for the HWRC contained in the unitary authority is 65.87%. Table 3.4 shows the overall Herefordshire performance in both years. This shows an overall increase due to the committed service enhancements.

Table 3.4 Herefordshire Overall Performance (including HWRC)

National Indicator	2008/9	2014/15
NI 191	680 kg/hhd/yr	673kg/hhd/yr
NI 192	32.17%	34.6%
NI 193	65.5%	63.3%

Herefordshire and Worcestershire

The following table 3.5 details the combined results for Nation Indicator 192 for all WCAs and waste collection operation of Herefordshire only. Here the knock on affect of the green waste service reduction in Bromsgrove is evident. This affect is shown throughout the results.

Table 3.5 Combined Performance of WCAs and Waste Collection of Herefordshire (excluding HWRCs)

National Indicator	2008/9	2014/15
NI 192	31.1%	30.8%

The combined reuse, recycling and composting rate for all HWRCs in both Counties is 64.2% and is assumed to remain constant throughout the period of the model. The overall performance of the Partnership is shown in Table 3.6.

Table 3.6 Combined Overall Performance of Herefordshire and Worcestershire

Indicator	2008/9	2014/15
NI 191	661kg/hhd/yr	695 kg/hhd/yr
NI 192	39.6%	39.6%
NI 193	59.3%	59.4%

Summary

According to the information provided by WCC for the base line year (2008/9), composition and current and committed collection service structures the model predicts that the Partnership will not meet, all but one, of the targets set out in the JMWMS. Table 3.7 below demonstrates the predicted difference between targeted and forecast performance expected in 2014/15.

Table 3.7 JMWMS Targets for Each Indicator and the Forecast Result for Herefordshire and Worcestershire

National Indicator	Authority	2015 Target	2015 Forecast Result
NI 191	Herefordshire	700 kg of residual waste produced per hhd per yr	673kg/hhd/yr
	Worcestershire	524 kg of residual waste produced per hhd per yr	647kg/hhd/yr
NI 192	Herefordshire	45% of hhd waste reused, recycled or composted	34.6%
	Worcestershire	45% of hhd waste reused, recycled or composted	41%
NI 193	Herefordshire	22% of municipal waste landfilled	63.3%
	Worcestershire	22% of municipal waste landfilled	58.2%

Potential Performance with Enhancements

In the light of the aforementioned targets not being met, this section examines a variety of service enhancements, specifically to the kerbside collection schemes, that could be undertaken to aid each authority in an attempt to reach the required performance of 50% reuse, recycling and composting required by the JWMWS for the two Counties by 31st March 2020[3].

[3] The Joint Municipal Waste Management Strategy for Herefordshire and Worcestershire 2004-2034.

The base assumption that the partnership will be able to meet the published targets forms the basis for the waste growth scenarios investigated in the following section and is a key factor in deciding the size of a residual waste treatment facility.

To be able to understand the scope of the service enhancements necessary to meet the published strategy targets, Entec first had to find the potential recycling and composting rate that is necessary to be achieved by each WCA and the collection function of the UA in order to reach an overall joint NI192 of 50% when the HWRC performance was taken into account. It was found that all the collection authorities and Herefordshire combined, had to produce a NI 192 of 45.1% or above, through their collection activity, to reach or exceed an overall performance of 50%, this is assuming the recycling and composting rate of all HWRC sites remains unchanged.

Collection scheme coverage (of dry recyclable, green waste and kitchen waste), participation and recognition were all increased in the model to attempt to reach or exceed 45.1%. The year modelled is 2014/15 so to clearly demonstrate the difference between the current forecast (using the current and committed collection structures), and the impact the enhancements that may be necessary to reach an overall score from NI 192 of 50%. Details of the proposed scheme enhancements tested can be found in the Waste Flow Model report accompanying this document.

Improved Performance

The modelled output from the additional service introductions and enhancements and the modelled performance of each WCA and UA (collected waste only) could be as presented in Table 3.8.

Table 3.8 Committed vs. Enhanced Collection Structure Performance.

Waste Collection Authority	Modelled NI192 for 2008/9	NI192 (2014/15) Committed and Planned Service Enhancements	NI 192 (2014/15) after further Potential Service Enhancements	Shortfall from committed
Bromsgrove District Council	41.7%	32.9%	49.93%	16.93%
Malvern Hills District Council	28.2%	28.82%	52.22%	23.4%
Redditch Borough Council	31.5%	32.51%	42.66%	10.15%
Worcestershire City Council	36.2%	37.09%	45.58%	8.49%
Wychavon District Council	34.7%	35.19%	51.95%	16.76%
Wyre Forest District Council	30.4%	30.39%	43.78%	13.39%
Herefordshire County Council (collection only)	19.6%	23.0%	42.39%	19.39%
Combined	31.1%	31%	46.8%	16.8%

The combined total impact of the modelled service improvements is predicted to be over 16% in order to obtain a combined NI 192 performance of 46.8% from the collection services of the authorities. This exceeds the necessary combined collection performance of 45.1% to enable the Partnership to achieve or exceed an overall performance of NI 192 of 50%, when HWRC activity is included.

The overall NI 192 performance for the Partnership is forecast to reach 51.3% (Table 3.9) if all enhancements are undertaken. It may, therefore, be concluded that there is, given the necessary investment in the collection services, a realistic prospect of the combined authority achieving their strategic target of and exceeding 50% recycling and composting performance.

Table 3.9 NI 192 Enhanced Performance of the Partnership

Authority	WCAs (inc. UA collected) Combined Performance	HWRCs Combined Performance	Overall Enhanced Performance of the Partnership.
Herefordshire and Worcestershire	46.8%	64.2%	51.3%

3.2.2 Assessment of the Optimum Size of the Residual Waste Treatment Facility

Having concluded that the modelled service improvements are capable of delivering a NI 192 performance of 50% by 2030, the next step in the determination of an optimum facility capacity is to take into account varying waste growth scenarios that have been identified from various sources.

Waste Growth

Forecasting the amount of MSW produced by the Partnership is dependant on annual housing and waste growth rates, therefore the required capacity of the waste treatment facility is also dependant on this factor. Figure 3.1 illustrates the MSW growth forecasts produced for each of the five waste growth scenarios detailed in the JMWMS[4] and an additional scenario (6) identified by Entec. Details of each are as follows:

Scenario 1 - the Integrated Waste Management Contractor's growth prediction for MSW.

Scenario 2 - a top end estimate of the average MSW growth rate for the last five years, as quoted in the Waste Strategy for England 2007.

[4] Annex A – Waste Growth, The Joint Municipal Waste Management Strategy 2004-2034

Scenario 3 – a forecast of MSW growth based on the latest (2007-2008) tonnages for Herefordshire and Worcestershire, with rates of production per household remaining constant but with the number of households growing in line with option 2 from the Regional Spatial Strategy.

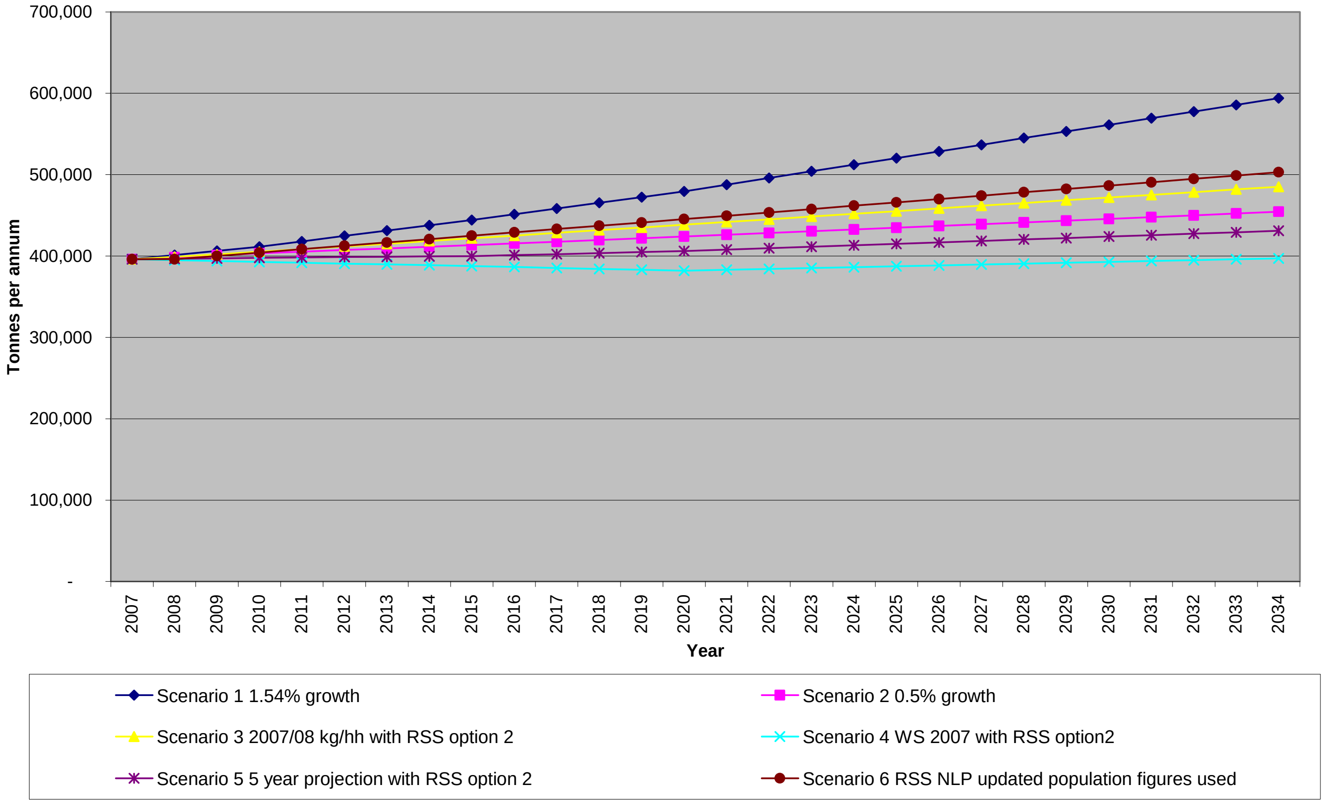
Scenario 4 – a forecast of MSW growth based on the objectives from the Waste Strategy for England 2007 to reduce household waste not reused, recycled or composted to 225kg/head by 2020. So with a 50% reuse, recycling and composting rate total household waste arisings will be 450kg/head. The growth in population associated with option 2 of the Regional Spatial Strategy has been applied to the total household waste arisings of 450kg/head. Non-household waste arisings have been assumed to remain static.

Scenario 5 – a forecast of MSW growth based on a profile of the MSW arisings in Herefordshire and Worcestershire from the last five years but with the number of households growing in line with option 2 of the Regional Spatial Strategy**.**

A further, sixth, scenario has been investigated by Entec and used for the basis of the Entec model (detailed below).

Scenario 6 – a forecast of MSW growth using the most up to date waste arising data provided by WCC, with a reuse, recycling and composting rate of 50% and growing in line with the number of households in option 2 of the Regional Spatial Strategy.

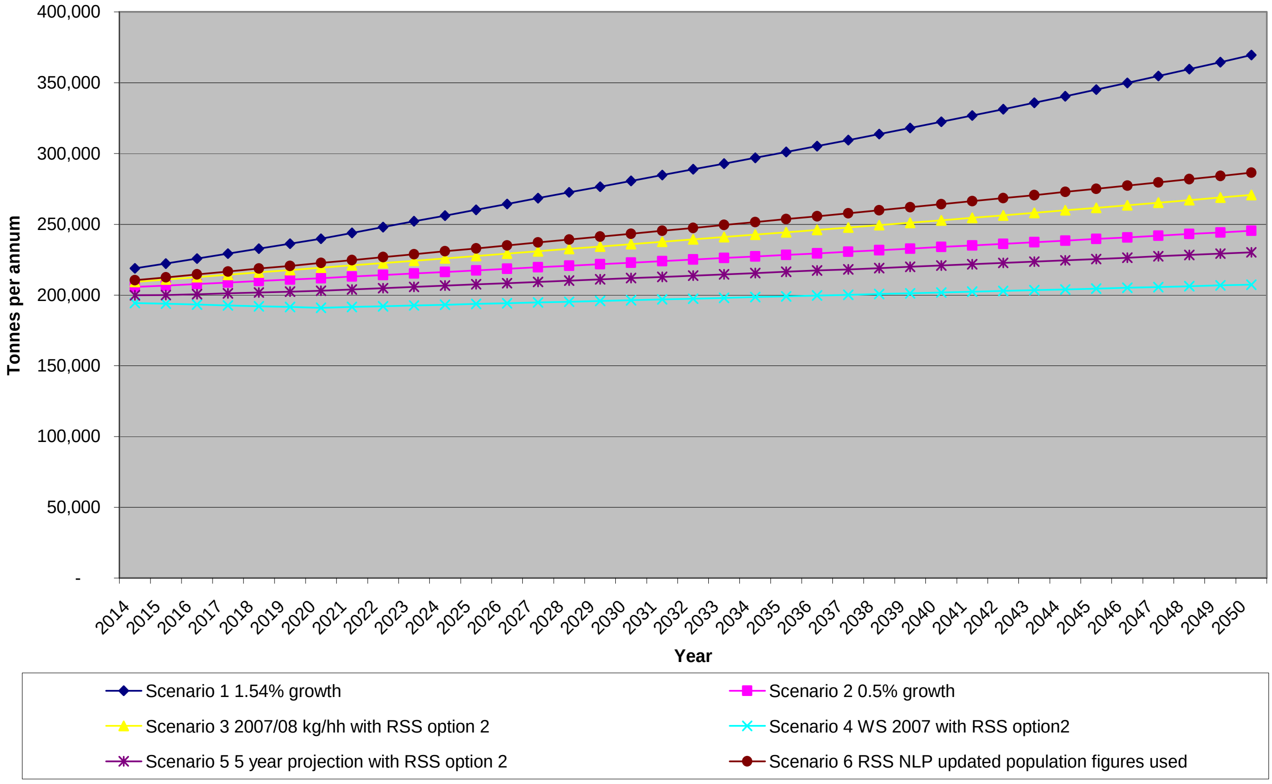
Figure 3.1 Municipal Solid Waste Growth Scenarios for Herefordshire and Worcestershire



The size of the facility is directly dependant on the performance of the authorities in meeting the Waste Strategy 2007 targets for recycling and composting. These targets currently stand at 40% by the 31st March 2010, 45% by 31st March 2015 and 50% by 31st March 2020. Our understanding of current committed schemes and performance is that in the absence of further service enhancements within the waste collection services to those currently planned or committed performance in 2020 will be around 40% (Table 3.8) i.e. a short fall of 10%. Modelling of enhanced collection performance has suggested that it will be possible to achieve a performance of the order of 51.3%, however such achievement will be challenging and will require considerable investment in the collection services. In the determination of residual waste treatment capacity requirements a conservative approach has to be adopted.

In estimating facility size for the residual waste treatment plant it has been assumed that an overall recycling and composting rate for household waste of 50% is achievable, in accordance with national strategic goals. Figure 3.2 illustrates the projections for residual waste requiring treatment and/or disposal going forwards against each of the six growth scenarios on the assumption that 50% of household waste is recycled or composted. On the basis of these projections and looking to a medium to long term requirement, it is suggested that in the year 2030 (i.e. at or about termination of existing contract arrangements) a residual waste volume of the order of 196,325 to 280,610 tonnes of residual waste will require disposal per annum (tpa).

Figure 3.2 Herefordshire and Worcestershire Residual Waste Projections



In recent months there has been much discussion on waste growth forecasts and in response to this a critical appraisal of each of the growth scenario was conducted. This is summarised in Table 3.10 below.

Table 3.10 MSW Growth Rate Scenario Appraisal

Scenario	Possible Waste to EfW (tpa)			Comment
	2015	2020	2030	
Scenario 1 - the Integrated Waste Management Contractor's growth prediction for MSW	222,117	239,775	280,610	Substantiation for the projected growth rate is not present and given the government's recent position statement regarding future waste arising growth we can see no current justification for using it.
Scenario 2 - a top end estimate of the average MSW growth rate for the last five years, as quoted in the Waste Strategy for England 2007	206,673	211,892	222,837	As DEFRA are rethinking their forecast of national growth rate to be 0.5% (lower than the originally published 1.5%) this scenario would appear to be appropriate for consideration.
Scenario 3 - a forecast of MSW growth based on the latest (2007-2008) tonnages for Herefordshire and Worcestershire, with rates of production per household remaining constant but with the number of households growing in line with option 2 from the Regional Spatial Strategy	210,889	219,228	235,905	This is a realistic scenario given its links to the RSS but to its detriment does not take into account the most recent waste arising data and may be over optimistic given recent national waste arising trends reported.
Scenario 4 - a forecast of MSW growth based on the objectives from the Waste Strategy for England 2007 to reduce household waste not reused, recycled or composted to 225kg/head by 2020. So with a 50% reuse, recycling and composting rate total household waste arisings will be 450kg/head. The growth in population associated with option 2 of the RSS has been applied to the total household waste arisings of 450kg/head. Non-household waste arisings have been assumed to remain static.	193,769	190,926	196,325	When compared to recent results of kg/head the assumption of reducing it to 225kg/head appears a potentially unobtainable target. It would need assertive, possibly unrealistic and expensive waste minimisation initiatives to ensure this scenario was realised, therefore it is questionable as to whether it should be taken forward for serious consideration unless commitment to waste minimisation can be evidenced..
Scenario 5 - a forecast of MSW growth based on a profile of the MSW arisings in Herefordshire and Worcestershire from the last five years but with the number of households growing in line with option 2 of the Regional Spatial Strategy	199,946	203,036	211,916	Basing waste growth on the last five years of MSW arisings is a reasonable approach, although it does not account for the most recent waste arising figures.
Scenario 6 - a forecast of MSW growth using the most up to date waste arising data provided by WCC, with a reuse, recycling and composting rate of 50% and growing in line with the number of households in option 2 of the Regional Spatial Strategy	212,450	222,607	243,264	This assumes growth in housing and population in accordance with the update RSS and no growth in waste arising per head. This is a potentially aggressive stance in terms of waste minimisation. It has grounds for detailed consideration given its links to a regional adopted strategy as this is consulted widely when making strategic decisions. It also uses the most up to date population figures so it could be argued that this scenario is the most relevant on current evidence.

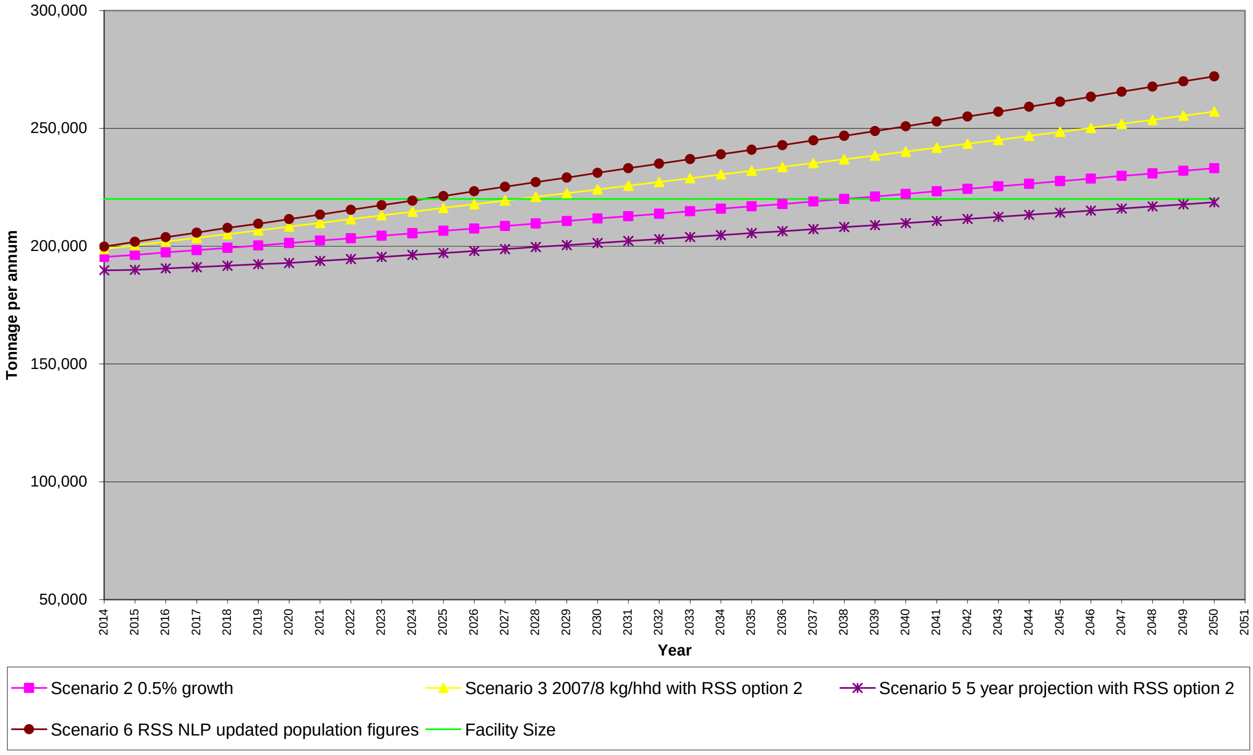
Of the aforementioned waste growth scenarios, four have been deemed as most appropriate and chosen for further consideration. These are:

- Scenario 2 – 0.5% growth;
- Scenario 3 – 2007/8 kkg/hhd with RSS option 2;

- Scenario 5 – 5 year projection with RSS option 2; and
- Scenario 6 – RSS NLP updated population figures.

Of those growth Scenarios selected as reasonable, the range of need is between 211,916 and 243,264 tpa (this creates an average of 228,481 tpa). Looking at it realistically, there are waste streams that we believe are not combustible, e.g. large bulky waste or fly tipped waste. To account for these Entec has made a 5% reduction in waste destined for the facility. Figure 6.3 sets out the projections for residual waste requiring treatment going forwards against each of the four chosen growth scenarios growth scenarios.

Figure 3.3 Four Reasonable Growth Scenarios with a 5% Reduction for Unsuitable Wastes



The 5% reduction in waste destined for the facility thus reduces the forecast range of facility size to between 201,320 and 231,101 tpa (Table 3.11).

Table 3.11 Possible MSW (with 50% NI192) to EfW with a 5% Reduction for Unsuitable Wastes

Scenario	Possible Residual Waste to EfW (tpa)		
	2015	2020	2030
Scenario 2	196,339	201,297	211,696
Scenario 3	200,345	208,267	224,110
Scenario 5	189,949	192,884	201,320
Scenario 6	201,828	211,476	231,101

The year 2030 has been chosen to size the facility as the current waste collection and treatment contract comes to a close at or about this time, and the accuracy of the longer term waste forecasts and projections cannot be verified. Also, it takes account of the current financial climate as banks are reducing the number of years they will accept within any forecast of waste arising growth projections.

Taking into account the above reductions and that each of the four waste growth scenarios could be plausible, a simple average of projected residual waste arising that could be sent to the proposed EfW facility is calculated to be 217,057 tpa in 2030. A reasonable approach would be to size the plant on the 2030 projection and approximately to the termination point of the existing contract, this suggests the capacity of the facility would need to be 220,000 tpa.

Current industry practise suggests that a modern EfW facility burning untreated MSW is capable of providing approximately 8,000 operational hours per year this would suggest that if all available residual waste is to be treated by incineration a plant of approx 28 tonnes per hour is required. This could be provided by either a single of twin stream facility.

It should be noted that there are a number of periods throughput the year when the EfW facility will be unavailable to receive and process waste due to planned and unplanned maintenance. Current best practise suggests that one of these outages will be for a period of the order of two weeks. It has been assumed that during this period waste will be stored in the reception pit or at an alternative location pending recommencement of the plant. On the assumption of operations, stored waste could be fed into the plant. Such provision is subject to suitable storage being available.

In the event the Partnership does not meet the targets set out in the JMWMS and is unable to increase from the 39.6% performance figure suggested in the model, to the required 50% to ensure the size of the facility suggested is viable, the amount of residual waste needing disposal will be approximately 10% higher (Table 3.11) than that quoted in Table 3.12.

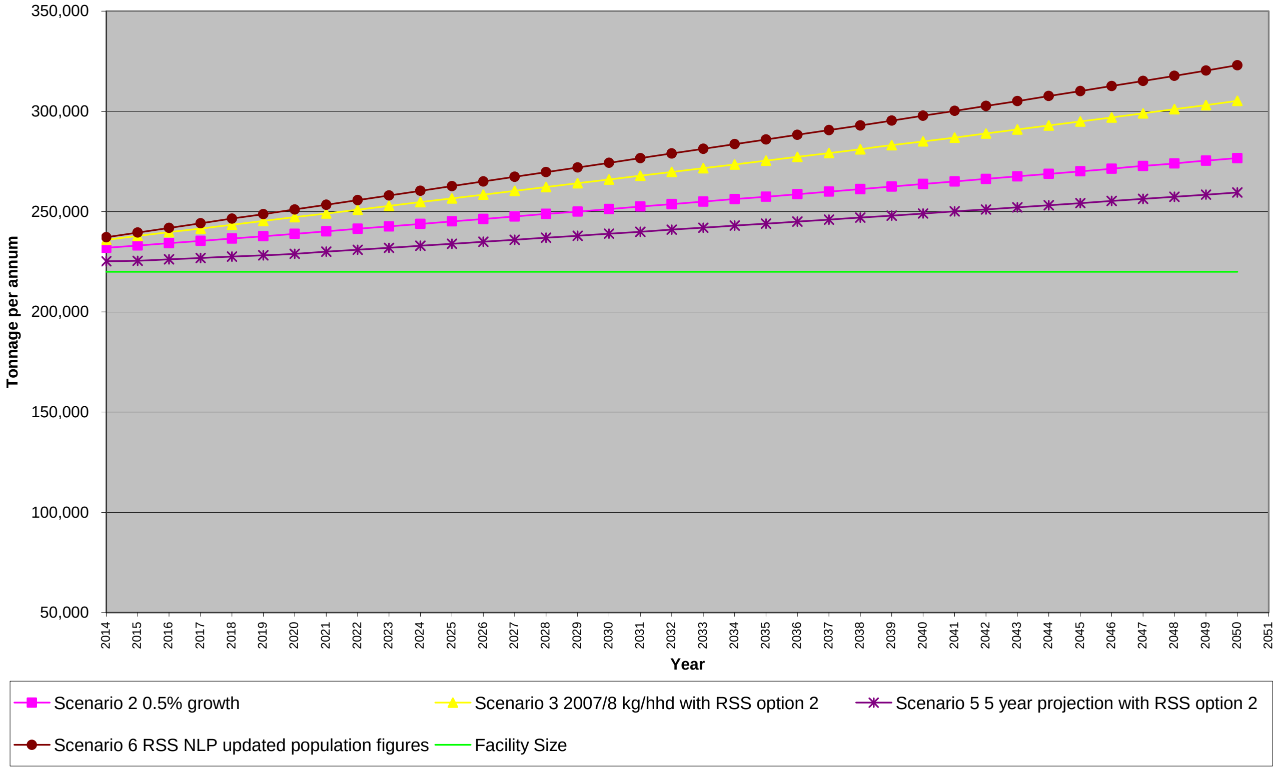
Table 3.12 MSW to EfW if NI 192 is 39.6% (with a 5% Reduction for Unsuitable Wastes)

Scenario	Possible Residual Waste to EfW (tpa)		
	2015	2020	2030
Scenario 2	232,973	238,857	251,195
Scenario 3	237,727	247,126	265,926
Scenario 5	225,391	228,874	238,884
Scenario 6	239,486	250,935	274,221

Figure 3.4 overleaf clearly demonstrates the degree to which the amount of residual waste would exceed the facility capacity in each scenario. A 5% reduction for unsuitable waste is also included and brings the average amount of residual waste produced in 2030 to 257,557 tonnes per annum, therefore a proportion of the residual waste produced by both Counties will need an alternate disposal solution or a plant of the order of 260,000 tonnes per annum is required.

Given the pressures brought to bear by national targets it is recommended that this additional EfW capacity is not provided for in the planned facility. Surplus waste arisings can be diverted to landfill or any other disposal solution and the absence of disposal capacity at the Partnerships facility should ensure that pressure continues to be brought on recycling and waste minimisation initiatives.

Figure 3.4 Waste Growth in each of the Studied Scenarios if NI 192 remains at 39.6%



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4. Estimate of Capital, Operational and Lifecycle Costs

4.1 Single Stream Facility

It is understood that Severn Waste Services are currently developing costed proposals for their energy from waste solution. However it currently remains unclear as to how they are developing their costs and how any requirements for competitive procurement are being discharged. In order for an assessment to be made as to the reasonableness of their proposals, Entec have independently prepared an estimate of the anticipated capital, operational and life cycle costs that such a development could attract. When examining the cost estimates it is necessary to have an understanding of how the estimates have been derived.

All estimates of capital costs developed at early stages of a project are subject to uncertainty. Entec use the IChemE estimating guidance with regard to uncertainty and early stage estimates are generally considered to be in a confidence range of +/- 50% rising to +/- 20% as more information is made available and detailed studies are completed and site specific items assessed. It is therefore considered that on the basis of information made available to and assessed by the client team the current estimate of £145 million plus £21 million for unidentified budget lines for site specific items the estimate is probably of the order of +/- 30 - 50% accuracy overall. The table below sets out the IChemE estimating class guidance.

We have a reasonable level of confidence that the estimate for the core plant of £145 million reflects current market conditions (having reviewed recent bid submissions from a number of EfW proposals). However this must be viewed against the turbulence of the recent market and the high proportion of the process plant and turbine that will be sourced in Euros or other foreign currency. It is difficult to assess whether bidders have included additional risk premiums within their bids or whether they will seek to pass such risk onto developers as negotiations proceed. There is therefore a case for considering whether exchange rate sensitivity should be run within the model in order to get a feel for the impact of exchange rate movements, and such matters will have to explored further when a price is received from the Contractor.

The sum of £21 million should be added to the core plant estimate. This is to account for items of additional "site specific" expenditure that have not been specifically identified and covers items such as ground conditions and foundations, flood defence, ground contamination, enhanced architecture and finishes etc. These are difficult to quantify at this time. Such items are very site specific but could add considerable sums to the overall cost of the development. We are aware that in some recent projects the Authority has taken on the development platform preparation work outside the general procurement as a means of getting better value for money through the closer management of such risks. With regard to architectural form and sustainability, WIDP and others within government, with CABE, have been encouraging developers to improve the architectural form of waste management facilities and embrace aspects of sustainability and guidance has been issued. It is considered prudent to provide for such matters. The Environment Agency and the planning authorities are examining all development proposals for their potential flood risks, and allowance for flood specific capital works may be required.

Table 4.1 Estimate Types

Class	Terminology	Alternative terms	Purpose of Estimate	Design Information available (Refer to Appendix F)	Estimating methods	Typical accuracy	Estimators Time (INDICATIVE ONLY)	Normally Prepared by
E	Order of Magnitude Estimate	Inception, Feasibility,	To indicate approx. level of expenditure for a given design solution. Assists in very broad business investment decisions	Works capacity, population size, building area	Unit cost (e.g. £/unit basis) Cost curves, (e.g. TR61 database for water industry and BCIS) Gross (overall) proportion based on historic data for similar schemes adjusted for differences in location, execution, escalation and size (.6 factor rule)	+/- 30% to 50%	hours	Client/ Consultant
D	Study Estimate	Option Study	Assist in evaluation of options and decisions to proceed with investments. Primarily interested in delta costs between options.	Basic Process Design (PFD, mass balance, process control philosophy)	Factored or Semi-detailed based on pro-rata methods or approx. quantities and in-house rates (Historic, Spons, CESMM3) to estimate main individual elements and historic Approx. quantities, equipment schedule, factoring to cover the balance	+/- 20% to 30%	day / days	Consultant
C	Preliminary Estimate	Conceptual	Confirm design and costs are still within budget. Investigate / incorporate residual issues from previous stages	PFD Approved, P&ID's, Equipment Spec, Geotechnical surveys, Approximate quantities	Similar to study estimate but estimate for main individual items to be backed up by Budget quotes	+/- 10% to 25%	days / week	Consultant

Class	Terminology	Alternative terms	Purpose of Estimate	Design Information available (Refer to Appendix F)	Estimating methods	Typical accuracy	Estimators Time (INDICATIVE ONLY)	Normally Prepared by
B	Definite Estimate	Pretender	Client Sanction and provides the cost plan against which individual orders and all project expenditure will be monitored Assists in Tender evaluation, change control and is a basis for forecasting project outcome	P&ID's, building layouts, particular spec's, geotechnical surveys, contract drgs, equipment list etc and all other drgs used to define the project	Fully detailed estimate requiring a full parts and materials take off from complete "Approved for Estimating" design package. (Refer appendix F). Quotes and current contract rates to be used wherever possible. Use of historic In-house rates to be minimised	+/- 5% to 15%	weeks	Consultant
A	Final Cost Estimate	Tender	Contract Award	As above	Priced Bills of quantity. Firm orders, Contracts and sub-contract prices	+/-2% to 5%	4 weeks typically	Contractor

Throughout the working life of the facility maintenance costs will occur. These fall into two principal categories. The first covers day to day routine maintenance and the second lifecycle replacement maintenance. The former is primarily aimed at keeping the plant and machinery in working order and may include such tasks as oiling and greasing bearings, replacing valve and pipe seals etc. as well as minor repairs and replacements. The second covers the routine and planned replacement of parts that have a limited life, such items include refractory linings, boiler tubes, filters etc.

The operating cost estimate comprises variable and fixed items. The fixed items such as staffing, compliance and office support remain constant regardless of plant throughput. Variable items are directly related to plant operational throughput and include consumables used in the flue gas treatment train and the disposal of residues. As disposal costs have assumed that the bottom ash will be recycled, and only a small residual portion will be disposed of to landfill.

An estimate of potential revenues from electricity sales has also been included. The figure quoted, £35 per MWhr is a prudent position is currently being accepted on a number of deals. However in reality it may be possible to secure a revenue of up to £50 per MWhr.

In summary we believe that the costs estimates presented reflect current market conditions, but would recommend that when developing the public sector comparator a number of sensitivities are evaluated around the above items. Further refinement may be possible by looking at the weighted probability of occurrence and running a three point estimate Monte Carlo exercise, if considered worthwhile, but only as further information becomes available around specific site development issues. It should also be noted that procurement of the plant and equipment within the current market is challenging and until the markets stabilise uncertainty remains. It is therefore recommended that all consideration of gate fee and overall project costs be considered against these uncertainties, and quoted within a range, that is then subject to challenge and refinement, as additional information is brought to bear.

4.2 Twin Stream Plant – Brief Comparison

This section gives a very brief overview as to the likely impacts on price a twin stream plant would have versus a single stream plant of the same overall capacity. This sizing being considered in this paper relates to a capacity requirement of 220,000 te per annum, at a calorific value of 9.3MJ/kg.

On this basis, the following key points should be noted: -

- Although there are similar components, a twin stream plant will generally cost more than a single line plant of the same overall capacity
- Typically, where proven plant is concerned, there will be no gain in overall availability of processing capacity
- There may be some minor savings in spares holdings (parts smaller, therefore cheaper, some commonality of spares holdings).

- Lifecycle costs (i.e. major replacement cycles) may be slightly higher owing to there being smaller components but duplicated.

Where a twin stream plant might be installed there is still a presumption that a single steam turbine on a "ranged" system will be employed. This is quite an old philosophy which essentially means that more than one boiler can feed a steam turbine.

The advantages of a single turbine are in economies of scale in cost as well as improved generation efficiencies.

However, cost increases occur in other areas. Because of the additional ancillary plant and the need for effective maintenance around each unit, the building size will be larger than that employed for a larger single stream plant. Whilst the costs for the bunker arrangements and reception hall (assumed common) will be similar, larger foundations will be required to cover the greater footprint of the two smaller streams.

In general, Entec typically provide pricing on the basis of single stream facilities as these reflect the general demands of the market. In reviewing the potential for a twin line plant, we have considered the above points and provided an estimate of what a twin stream plant might cost. This includes for: -

- A single steam turbine and condenser arrangement
- An increase in the civils costs representing the additional works for buildings and foundations.
- Although there will be a slight reduction in efficiency (owing to radiative losses and stack losses being slightly greater, we have excluded this from our assessment at this time as it is difficult to estimate and contact with manufacturers on these points would be advised as more information becomes available).

The following estimate has been based on taking out the Steam Turbine price element and ensuring an equivalent cost for a single unit has been included.

Regarding Civils, a cost somewhere between that of the two prices shall be achieved, i.e. more than a single line, but less than the two plants. We have assumed that a mid point would be representative.

Table 4.2 Cost for a Single Line Plant

	Single Line Estimate (220ktpa)	**2 x 110ktpa Estimate (total 220ktpa)**	**Twin Stream Plant Estimate**
Overall Cost (model)	£145	2 * £95m	£190
Steam Turbine Cost	15% (21.75m)	15% (14.25)	(-28.5 + 21.75) = -6.75m
Civil Costs	35% (50.75m)	35% (33.25m)	(midpoint) = -7.875m
		Diff 20%	£175.4m

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Figure 4.1 220ktpa EfW (single stream)

EFW COSTS ESTIMATION (UPDATED JUNE 2009)
Energy Services
Valid for EfW projects > 120ktpa

Project	Herefordshire and Worcestershire
Reference	220ktpa EfW with CHP
For	Jonathan Bebbb
By	Steven Wood
Date	09 September 2009

CAPEX ESTIMATE

Waste Stream	MSW			
Plant Type	Single Stream			
Waste CV	9.3	MJ/kg		
Capacity	220,000	tonnes/year		
Location	Central England			
Location Costing Factor	95%	Costing Factor (relative to Base Case data)		
Tonnage Rating	27.5	tonnes per hour	8000	Operating hours per year
Thermal Capacity	71	MW(th) @	91%	Load Factor
Electrical Output	16	MW(e) @	22%	Net Electrical Efficiency
Electrical Output	125,176	MWh per year =	569	kWh(e) per tonne of waste
Estimated EFW EPC Capex				
Base EFW Capex £	**145**	**M**	**£ 659**	**per tonne/year capacity**

Capex estimates are accurate to +/- 50%
Capex estimates do not include contingency margins

MAINTENANCE ESTIMATE

Lifecycle Replacement Costs £	0.6	M per year		
Other Routine Maintenance Costs £	0.8	M per year (Annual Average over Lifetime)		
Total Annual Average Maintenance Costs £	**1.5**	M per year =	£ 7	per tonne of waste feed

OPEX ESTIMATE

VARIABLE OPERATING COSTS (Purchase of consumables and disposal of residues)

Consumables					
Lime	15.0	kg/tonne	£ 156	per tonne	£ 514,800
Activated Carbon	1.0	kg/tonne	£ 560	per tonne	£ 123,200
Ammonia (30% Solution)	4.0	kg/tonne	£ 153	per tonne	£ 134,640
Process Water	0.6	m3/tonne	£ 0.80	per m3	£ 105,600
Sodium Bicarbonate		kg/tonne	£ 200	per tonne	£ -
Urea		kg/tonne	£ 330	per tonne	£ -
By-Products Disposal					
Bottom Ash	25%	of Waste Feed @	£ 20	per tonne	£ 1,100,000
FGT Residues	4%	of Waste Feed @	£ 150	per tonne	£ 1,320,000
Total Variable Costs £	**3,298,240**	=	**£ 15**	per tonne	

FIXED OPERATING COSTS (Staffing, environmental compliance, office admin costs, excludes insurance)

Staffing	£ 1,180,000	per year		
Environmental Compliance	£ 100,000	per year		
Office Expenses	£ 40,000	per year		
Other Unspecified	£ 50,000	per year		
	£ 1,370,000	per year	**£ 6**	per tonne of waste
	Excludes insurances			

SUMMARY OF O&M COSTS

Variable Opex Estimate	£ 15	per tonne of waste feed
Fixed Opex Estimate	£ 6	per tonne of waste feed
	£ 21	per tonne of waste feed
Esimated Maintenance Cost Estimate	£ 7	per tonne of waste feed
Total O&M Cost Estimate	**£ 28**	per tonne of waste feed

REVENUES ESTIMATE

Electricity Production	125,176	MWh per year		
Electricty Sale Price	£ 35	per MWh		
Electricity Sales Revenue	**£ 4,381,168**	per year =	**£ 20**	per tonne of waste

Figure 4.2 220ktpa EfW (twin stream)

EFW COSTS ESTIMATION (UPDATED JUNE 2009)
Energy Services
Valid for EfW projects > 120ktpa

Project	Herefordshire and Worcestershire
Reference	220ktpa EfW with CHP
For	Jonathan Bebbb
By	Steven Wood
Date	09 September 2009

CAPEX ESTIMATE

Waste Stream	MSW	
Plant Type	Twin Stream	
Waste CV	9.3	MJ/kg
Capacity	220,000	tonnes/year
Location	Central England	
Location Costing Factor	95%	Costing Factor (relative to Base Case data)

Tonnage Rating	27.5	tonnes per hour	8000	Operating hours per year
Thermal Capacity	71	MW(th) @	91%	Load Factor
Electrical Output	16	MW(e) @	22%	Net Electrical Efficiency
Electrical Output	125,176	MWh per year =	569	kWh(e) per tonne of waste

Estimated EFW EPC Capex				
Base EFW Capex	**£ 175**	**M**	**£ 795**	**per tonne/year capacity**

Capex extimates are accurate to +/- 50%
Capex estimates do not include contingency margins

MAINTENANCE ESTIMATE

Lifecycle Replacement Costs	£ 0.6	M per year		
Other Routine Maintenance Costs	£ 0.8	M per year (Annual Average over Lifetime)		
Total Annual Average Maintenance Costs	£ **1.5**	M per year =	£ 7	per tonne of waste feed

OPEX ESTIMATE

VARIABLE OPERATING COSTS (Purchase of consumables and disposal of residues)

Consumables					
Lime	15.0	kg/tonne	£ 156	per tonne	£ 514,800
Activated Carbon	1.0	kg/tonne	£ 560	per tonne	£ 123,200
Ammonia (30% Solution)	4.0	kg/tonne	£ 153	per tonne	£ 134,640
Process Water	0.6	m3/tonne	£ 0.80	per m3	£ 105,600
Sodium Bicarbonate		kg/tonne	£ 200	per tonne	£ -
Urea		kg/tonne	£ 330	per tonne	£ -

By-Products Disposal					
Bottom Ash	25%	of Waste Feed @	£ 20	per tonne	£ 1,100,000
FGT Residues	4%	of Waste Feed @	£ 150	per tonne	£ 1,320,000

Total Variable Costs	£ **3,298,240**	=	£ **15**	per tonne

FIXED OPERATING COSTS (Staffing, environmental compliance, office admin costs, excludes insurance)

Staffing	£ 1,180,000	per year		
Environmental Compliance	£ 100,000	per year		
Office Expenses	£ 40,000	per year		
Other Unspecified	£ 50,000	per year		
	£ **1,370,000**	per year	£ **6**	per tonne of waste

Excludes insurances

SUMMARY OF O&M COSTS

Variable Opex Estimate	£ 15	per tonne of waste feed
Fixed Opex Estimate	£ 6	per tonne of waste feed
	£ **21**	per tonne of waste feed
Esimated Maintenance Cost Estimate	£ 7	per tonne of waste feed
Total O&M Cost Estimate	£ **28**	per tonne of waste feed

REVENUES ESTIMATE

Electricity Production	125,176	MWh per year		
Electricty Sale Price	£ 35	per MWh		
Electricity Sales Revenue	£ **4,381,168**	per year =	£ **20**	per tonne of waste

5. Technical Review

This section considers the key issues arising from alternative plant configurations, the requirement to re-procure an operating contract when the plant reverts to council ownership at expiry of the existing contract term and maintenance and lifecycle philosophies.

5.1 A SWOT Review of Plant Configuration Alternatives: Single Line vs. Multiple Line Configurations

5.1.1 Introduction to EfW

Energy from waste (EfW) is the term generally used to describe a range of technologies that seek to recover value from the waste stream through energy. In recent years the term has been associated with technologies such as anaerobic digestion, incineration gasification and pyrolysis. It is understood that Severn Waste Services are proposing to develop a mass burn energy from waste incineration facility at a site as yet to be identified. There are many examples of similar technology in the UK and a number of the plants have been in operation for more than twenty years. In England EfW Plants are regulated by the Environment Agency and are required to be compliant with the Waste Incineration Directive (Directive 2000/76/EC). This directive requires that waste incineration plant comply with certain standards regardless of plant configuration.

The waste flow modelling undertaken to date has suggested that a plant capacity of the order of 220,000 tonnes per annum is required if all of the available residual waste is to be incinerated. Recent proposals from the waste management industry suggest that such capacity could be provided either in a single or twin stream configuration. If it is assumed that the plant will be available to receive and process waste for the industry standard of 8,000 hours per year a single stream 27.5 tonne per hour unit could be provided or a twin stream plant, comprising two steams of 13.75 tonnes per hour each as an alternative. There would appear to be no industry consensus as to whether the single or twin stream configuration is technically better or more reliable, and each operator would appear to select the solution with regard to their corporate preference. However, in general, economies of scale have meant that the single stream approach has become the norm.

5.1.2 Available Technology

EfW facilities can be supplied in a range of different technologies and configurations dependent on the waste stream being treated, the operational philosophy and the availability of technology at the particular scale considered.

In the same way as conventional power plant, typical unit (or "line") sizes have increased in recent years, as the technologies have incorporated better materials and gained reference experience of operation to demonstrate their reliability at those scales.

It is now common to see conventional grate technologies employed in a single stream from typically 80,000te/annum to 250,000te/annum. Other technologies, such as gasification projects, might incorporate units individually of a size around 40,000te/annum but using multiple streams to accommodate larger tonnages.

The following sections seek to review some of the key areas that should be considered when identifying whether a single or multiple stream plant offers benefits over a single stream plant of the same capacity (assuming always that a single stream is within the acceptable size ranges for that technology).

Planning and Consenting

Emissions - In many respects plant and consenting of a plant is related more to the emissions and to the visual aspects of a proposal. Broadly speaking, if a fuel is combusted in a plant of single line configuration the emissions from combusting the same quantity of fuel in a twin line configuration would be similar.

Building Height - If considering the same technology for both configurations then visual impacts are unlikely to be changed as the scale of the building would still be significant in impact terms. The principle constraint on the building size is the combustion chamber and boiler height of the plant. In order to attain the required conditions under the Waste Incineration Directive the plant has to be designed with a certain residence volume immediately above the combustion zone. It is this element that, together with the boiler dimensions, defines the height of the structure. Whilst there may be a slight reduction in height by going to a smaller unit size, it would not be significant. However the footprint of the building will be greater with a twin stream configuration.

Permitting – Whilst the permit process will be made more complex by monitoring points and further process detail, the principles of the process will remain similar. There may therefore be twice the number if monitoring points within a twin stream plant and the monitoring and reporting requirements of the regulator will reflect this position.

Availability / Reliability

In general, having two plants at 50% scale versus a single 100% plant will not improve the overall availability to burn waste. The guaranteed availability of a plant will generally be stated as 8,000 hours per year, for example. The only way in which additional / standby capacity and a gain in the availability of waste throughput is to increase the scale of the smaller lines, i.e. 2 x 60%.

The overall design of a plant includes a review of the reliability of all components and therefore provides an informed view as to the level of availability guarantee that can be offered by the contractor. Evidence from reference plants suggest that the 8,000 hours per year of operational combustion performance is achievable.

Maintainability and Spares Holdings

A twin or multiple plant configuration will have two or more fully operational combustion lines, each comprising of a grate, boiler and gas cleanup stage. It is possible that there may be some capital savings made in spares holdings owing to the smaller scale of some of the required items in the multiple line configurations. However, this will be offset by the fact that they will be used in duplicate and a large stock of holdings on site may be required.

Maintenance costs in general are likely to be higher for a twin stream plant as the labour costs will generally be increased (carrying out two, smaller operations versus one larger) as well as the combined cost of the duplicated parts required (i.e. few economies of scale in components).

Conclusion

In general, there are few significant benefits in progressing a multiple stream plant unless a modular design is required owing to a technological constraint. A multiple stream plant will lose the benefits of economies of scale that apply in both capital and through-life costs with little counter benefit seen in planning terms. However, it should be recognised that a number of supplies of EfW technology only produce plant within a certain size range. In such cases it may be that the case for single or multiple lines is based on supplier capability and the purchaser's requirements, with regards to operational track record, relationships etc or other specific commercial issues, rather than direct economic cost.

In Summary – a SWOT appraisal of a single line plant could be considered thus (Figure 5.1): -

Figure 5.1 SWOT Appraisal

STRENGTHS	WEAKNESSES
Economies of Scale • Capital Cost • Efficiency • Operational costs – staffing • Maintenance Costs	Major incident could disrupt entire plant, not just a proportion of available capacity. High visual impact could accentuate planning risks (see Note 1)
OPPORTUNITIES	THREATS
Potentially higher returns (based on strengths)	Smaller module sizes gain cost advantage through mass offsite fabrication (See Note 2)

Figure note 1: Remains for twin line grates etc

Figure note 2: Smaller plants are very modular and may become cost effective for sub 200ktpa plants.

5.2 Midlife (expiry of existing contract) to End of Life Cost Considerations

5.2.1 Background

As part of the review of the technical aspects of the options available to the Partnership, Entec have been asked to examine the issues that could arise around the transfer of plant ownership part way through the design life of a facility. This could potentially occur should the existing contract only have a period of, say, 15 years left to run and therefore terminate prior to the plant having reached the end of its operational design life. It is generally accepted that modern EfW plants have a useful operational life of at least 20 to 25 years, with further lifetime potential on conclusion of an economic life extension appraisal and could have an operational life of up to 40 years with appropriate lifecycle and operational maintenance. There will therefore be considerable life remaining in the plant at the contract termination date. A number of options are available for managing this residual value that remains in the plant; this section considers and develops the readers understanding of the potential factors that could influence plant life and the value of the asset at termination.

5.2.2 Plant Design, Operation and Maintenance

Overview

The residual life of a complex piece of process plant can be influenced by a number of factors. These include the technical issues relating to the original design of the plant, including, for example, its quality of manufacture, track record and pedigree and any guarantees still available from the procurement process. The manner in which it has been maintained will also influence plant value as will the need for significant life cycle cost replacement at a given point in time. Other points of influence on value could be related to any secured contracts associated with the plant both in terms of waste feed and outputs such as ash or energy. The potential to secure additional third party contracts will also have the potential to influence value. Such contracts could include those for third party waste treatment within the plant or off-takers for ash residues, electrical power or heat and their associated revenue streams.

Basis of Plant Design

The design of a plant will have considered at an early stage projections on waste arisings that will be the source of waste for the plant. It is important to note that a plant will have a "design point" for operation as well as an operating envelope that defines the plants capabilities to accept waste in volume and energy content terms. Other aspects that would need to be considered at design stage include:

- Waste volume;
- Waste sources;
- Waste composition;
- Rate of waste delivery;
- Electricity off take requirements;
- Heat off take requirements;
- Reagent and chemical use.

Plant Operation

The operational regime employed on the plant will impact on the operational costs that are realised. Operational performance will have been predicted at the design stage. However, it is often the case that actual operational experience will vary and result in a differing cost regime to that predicted.

These costs could include:

- Reagent and chemical costs;
- Plant efficiency not as per design predictions;
- Additional waste feed mixing;
- Unexpectedly high plant downtime;
- Corrosion and erosion of key plant items;
- Unreliability of control system;
- Procedures arising from unsuitable waste deliveries and additional reject waste;
- Recovered materials market values e.g. scrap metal, bottom ash etc.
- Additional post processing reject disposal costs e.g. bottom ask, FGT residues etc.
- Fluctuations in quantity of energy available for sale;
- Fluctuations in the market value of energy available for sale;
- Management of stream systems;
- Waste boiler and turbine control philosophy;

- Ramp up and down and load variations and the ability to maintain steady state operation; and
- The reliability of fail safe alarms and systems and emergency shut down procedures.

Plant Maintenance

The plant design will have addressed the maintenance requirements of the plant. However experience elsewhere has suggested that there is a balance to be drawn between higher capital cost and ongoing maintenance requirements. This could include issues arising from:

- Overall maintenance philosophy around the use of their own in house staff against contracted out maintenance to a specialist sub contractor;
- Design life of materials against long term expectations;
- Costs saved by extended or stretched maintenance schedules;
- Ongoing routine and periodic maintenance and overhaul periods that are not practicable;
- Quality of operational staff and adequacy of manning levels;
- Scope and characteristics of maintenance sub contracts;
- Changes to costs of wear items and components e.g. boiler tubes, grates, furnace refractory, crane ropes, turbine blades etc.
- Ease of access to key parts of plant for routine replacement to avoid down time; and
- Spares philosophy on site store vs. “just in time” supply.

Life Cycle Costs

Life cycle costs are those costs associated with the replacement of major parts of the plant and equipment at pre determined intervals. The ability to delay life cycle costs could have a significant impact on the economics of plant operation at the potential risk of catastrophic failure. Many of these items will have a performance guarantee associated with their supply and suggest a life cycle replacement interval. Items that could fall within this category include:

- Grate bars;
- Refractory replacement;
- Boiler tube replacement;
- Turbine nozzles, blades and bearings;

- Building envelope;
- Roads and hard standings; and
- Reagent storage silos.

Failure to carry out lifecycle replacement could offer considerable short term savings. It is therefore necessary to understand how and when such replacement is proposed in the context of the project lifecycle, which could either necessitate considerable expenditure, either just prior to, or immediately after the termination of any contract between the Contractor and the Authority. This will clearly have an influence on the value of the asset going forwards and could necessitate the injection of capital to bring the plant up to a specification acceptable to an incoming contractor.

Opportunity Costs

The ongoing contractual position with regard to other activities covered by the plant will influence ongoing value. These may be either the relationship between the Contractor and the Partnership or between the Contractor and other third parties. Such positive contract positions could include:

- Long term waste supply agreements with the public or private sectors;
- Long term scrap metal recyclate agreements;
- Electrical power purchase agreements;
- Heat purchase agreements;
- The ability of the plant to secure fiscal support through ROCs or similar;
- Secure cost positive bottom ash recovery opportunities;
- Ability of plant to operate within the constraints of any necessary consents e.g. planning, environmental permitting etc; and
- Ability to keep operational by having Planning and Environmental Permit approvals in place.

Items that could be a negative impact on long term value could include:

- Change in regulatory regime for energy sales which depresses prices;
- Change to the requirements of the Waste Incineration Directive and other regulatory requirements;
- No ongoing waste contracts;
- Commercial waste opportunities not available;

- Energy markets for heat fail;
- Planning approval restricts commercial opportunities;
- Inability to import waste from outside the Authority area; and
- Mass burn EfW technology is outdated and deemed redundant as a means of ensuring sustainable waste management for public authorities.

Financial Accounting

In all likelihood there will always be some residual value remaining in the plant, albeit that this may be limited to the scrap value of the plant and equipment, or the value associated with an established land use on the site. If it is assumed that there will be considerable, (10 years or more) operational life remaining at contract termination questions must be posed around the financial accounting procedures employed by the Contractor. Issues to be resolved include whether the plant has been "written off" or whether it is free of all debt servicing obligations. Such matters would have a material impact on the cost per tonne being charged by the Contractor to the Authority and to the potential value that they may see in the plant at termination. There is also question around whether the development costs associated with the plant are capitalised or written down elsewhere under the existing contract.

A related issue is the transfer of any environmental liabilities relating to the plant – contamination, flood risk etc. that may have an associated cost. Although there will have been a full survey of the site and an assessment of all site base liabilities identified at the time, any incoming contractors will have to carefully assess the risks and liabilities they are expected to take over. There are also the associated costs applicable at the end of the plants useful operating life to be considered i.e. the costs for decommissioning and removing the facility in an acceptable fashion.

Key Issues and Discussion

As can be seen from the above elements, it is difficult to ascertain an accurate estimate as to the end value of a plant after a period of time, though it is clear that there could be considerable life, and hence value, in the facility.

There is therefore a need to fully consider and understand the underlying assumptions that underpin any contractual undertaking that assumes a residual life within the plant on termination, balanced against any assumptions for refurbishment and/or decommissioning costs. Scenarios could then be modelled in order to establish the likely value of the plant within a broad range.

5.3 Reliability, Maintenance Downtime and Life Cycle Replacement Philosophies

Maintenance of facilities is normally considered as either breakdown or preventative. The former usually causes some consternation and perhaps embarrassment on behalf of the operator. The latter, managed properly, demonstrates a good understanding of the plant and when to schedule maintenance to ensure that unplanned downtime is minimised.

A general redundancy philosophy for the design of an EfW plant might be: -

"That no failure of any single auxiliary item of plant or equipment shall result in either the direct loss of, or affect the overall functionality of, critical systems or main plant items."

Main plant items in this regard would relate to, for example, the combustion unit and the steam turbine / condenser (where installed).

This captures the fact that to ensure reliability of a plant does not mean that the plant has to have every component duplicated into duty/standby pairs. It may be that a plant can operate for a short period of time without a system in service or by operating in a slightly less efficient mode. However, such operation should not be expected on a regular basis or to the detriment of other plant components.

The overall reliability, maintenance downtime and lifecycle replacement philosophies should have been developed with due preferences to the principle reason for the plants existence is to burn waste (hence the inclusion of the grate in the "main items") and to recover the energy from the system (hence the inclusion of the Steam Turbine).

Routine Maintenance

This is generally planned as a result of the equipment manufacturer's maintenance instructions, and can vary from the replacement of filters, application of grease or other lubricant, through to replacement of more major parts after their anticipated lifetime. A simple analogy here would be servicing a car. The manufacturer recommends that the driver should replace filters, change the oil, brake pads/discs etc at regular intervals. At some point a more major piece of work is required such as replacing a cam-belt.

All of these are, in some respects preventative maintenance as they ensure the wellbeing of the equipment to minimise the risk of it failing whilst in service. Careful selection of equipment and materials at the design and development stage of the plant will set later requirements.

Lifecycle Maintenance

At some point in time, all pieces of equipment come to a point at which it is no longer economical to repair them and they need replacing (returning to the car analogy – the engine has now done 200,000 miles and parts are no longer easy to get).

For some pieces of plant and equipment this is easier to check and manage. For example, pumps and drives can be monitored on an ongoing basis by looking at how they are operating. However other factors are hidden from view and need more regular, structured inspection programmes to see how they are faring.

These Condition Surveys might include pipework, cladding or internals of the boiler, and the intention is to assess the point at which they would need to be replaced. In this way, the work can be planned accordingly when the plant is already down for other maintenance, therefore not reducing the plants overall availability. The initial design of the plant can have a significant impact on the ease of the replacement and the downtime required to complete such tasks.

Financial Accounting – The Maintenance Bank Account

Routine Maintenance is reasonably well defined, and once a plant has been constructed, the Operation and Maintenance Manuals can be used to structure an appropriate programme of maintenance. On major power plant, the requirements are built into automatic scheduling systems to ensure that the work is carried out and best practice suggests that similar systems are adopted at energy from waste facilities.

Once these works are understood and defined, an appropriate cost can be provided for in that particular year.

Lifecycle maintenance is slightly more difficult to predict, as it is generally dependent on how long the equipment lasts and the subsequent Condition Monitoring Surveys that are carried out (plant designers inherently include a safety margin, and the plant may not be operating in as aggressive circumstances as originally envisaged).

Some items, such as superheater tubes (which can corrode/erode rapidly on EfW plants), can be provided for on a regular basis as a relatively known event. Others may, or may not, occur when expected.

When purchasing a plant, the only option is to make a reasoned estimate for the provision of lifecycle maintenance on an annual basis. This data is normally requested as part of the procurement, in terms of schedules that detail when it would be expected for items to need replacing. The determined annual sum of money is debited from the project (e.g. paid into a bank account set aside for the lifecycle maintenance) to ensure that the money is available as and when it is required. Exactly how this is done in accounting terms needs careful consideration to ensure that the appropriate rules and regulations are followed, and appropriate advice from a Financial Advisor.

6. Overview of the Residual Waste Treatment Supplier Market

The waste treatment plant supplier market is currently experiencing a period of high interest, and increased demand for its products. As more and more overall waste treatment solutions are being provided under the Waste Infrastructure Development Programme (WIDP) umbrella, as well as other schemes elsewhere in Europe, now incorporate an element of thermal treatment of residual waste, the existing, established, players in the marketplace are looking to take advantage of an imbalance in the supply/demand situation following a long period of low activity.

This situation is resulting in an overall increase in the tender prices being seen within the sector, which far outstrip other influencing factors such as inflation and raw material availability/costs or exchange rate fluctuations.

This should be a transient effect as it is believed a tipping point will be reached, at which projects no longer become viable due to the increased capital costs being quoted by established players, and other, newer, entrants fight to gain an increasing share of the market. These factors should help to bring a more realistic view of pricing for this type of product. It should be recognised that most of the significant plant and equipment that is required to develop and EfW plant is sourced from the European mainland with only the civil engineering and building elements sourced locally. Suppliers have therefore established a number of relationships in order to deliver plants in the UK some of which are exclusive and some of which are not.

The timescale for the recovery of the marketplace to a more sustainable level is not yet known.

Table 6.1 is a summary of the main EfW technology providers.

Table 6.1 Main EfW Technology Providers

Technology Company	Comments
Austrian Energy and Environment	AEE acquired Von Roll and Lentjes to become a major player in the EFW market. Well proven moving grate technology from both VRI and Lentjes
Babcock and Wilcox Volund	Good track record
CNIM	CNIM hold license for the Martin grate, as well as the Stein and Widmer and Ernst technologies. Martin grate is one of the most commonly used in the UK market to date and is well proven
Fisia Babcock	Roller grate and Rotary Kilns. Other technologies held include Steinmuller and Noell. Proven technology but not currently actively marketed.

Technology Company	Comments
EBARA	The technology offered is moving grate and fluidised bed. They have significant experience and have developed the TIF technology – a rotating fluidised bed plant as per that at Allington in Kent. (Lentjes built under license from Ebara – license since terminated). Reasonably proven but not much direct UK experience
Energos	Developing a number of biomass facilities in the UK and also active in the MSW market for smaller projects. Well-proven technology in Scandinavia. Isle of Wight plant now in operation.
Enerkem (Novera)	Fluidised Bed Gasification – demonstration plants only, with UK plant (Demonstrator Programme) on hold.
EPI	RDF plants with well proven references
Ethos Recycling	Former Compact Power technology. Since its acquisition by Ethos, the company has developed a strategy of technology supply into various markets rather than as a project developer. Demonstration projects are well proven with further plant under design at scale. The technology has been well developed, though cannot be considered commercially proven on MSW at the current time. Historically has been suitable for high value fuels owing to the technology and development cost.
Foster Wheeler	FW have been active primarily in the biomass market in the UK with their FBC technology. They have a number of plants in Scandinavia and Europe with a strong emphasis on the pulp and paper industries where they combust a variety of fuels
GEM	Pyrolysis technology, small scale plant in the UK operated for a period but since closed. Involved in Demonstrator programme project in Scarborough and believed to be seeking involvement in other UK projects
Keppel Seghers	Moving grate technology. Becoming more active in the UK market (e.g. Ineos Chlor, Runcorn). Reasonably well proven. Not well known in the UK Market
Martins	License technology to CNIM, MHI and Covanta. Well proven, leading supplier of grate technology
Planet Advantage	Gasification technology that operates in small units that are batch loaded. First commercial plant being in Dumfries in Scotland by project owners Ascot Environmental
Takuma	Becoming active in the UK and have proven technology. Problems recently at the Lakeside facility, Colybrook near Slough. Well proven technology active in Europe and UK.
TIRU (Cyclerval)	Have plant in the UK (Grimsby) processing MSW and supplying heat to industrial neighbour. Unknown as to any further projects in UK but are actively bidding (Use an oscillating kiln and provide plant of up to 60,000 tpa per line).
Vinci Environmental UK	Offer proven combustion technologies: • Stepped Grate for units under 6.5 T/h • Roller Grate for units over 6.5 T/h • Water Cooled Grate for high calorific solid waste • Rotary Kiln for solid, liquid or sludge industrial waste Work with Norwest Holst (part of Vinci group) who provide engineering services.

7. Project Programme

The following programme has been drafted in order to identify the realistic timeframe for the development of a fully operational EfW plant. It has been drafted with reference to programmes identified by a number of bidders for similar projects of similar sizes elsewhere in the UK. It should however be recognised that any site that is to be developed with a major piece of infrastructure is liable to attract different constraints, some of which may impact on programme in either a negative or positive way.

The draft programme identifies that there is a need for the Partnership to engage with the Contractor in order to reach a negotiated position and allow a “Letter of Intent” or similar contract variation to be authorised. In the absence of a detailed knowledge of the state of readiness of the Contractor with regard to the contracted position with their EPC (Engineer, Procurement Construct) contractor, preliminary design, specification status and the development of an understanding of site constraints, it is difficult to set a realistic time frame for these discussions. It is also unclear as to whether the Contractor has secured funding for the development and the state of readiness of any potential bank or corporate funder. Recent experience on other projects has suggested that this matter, in the current financial market conditions, could become protracted. It is therefore considered that a minimum period of the order of six months will be required to get to a position where the Authority would be able to sign a contract with the Contractor.

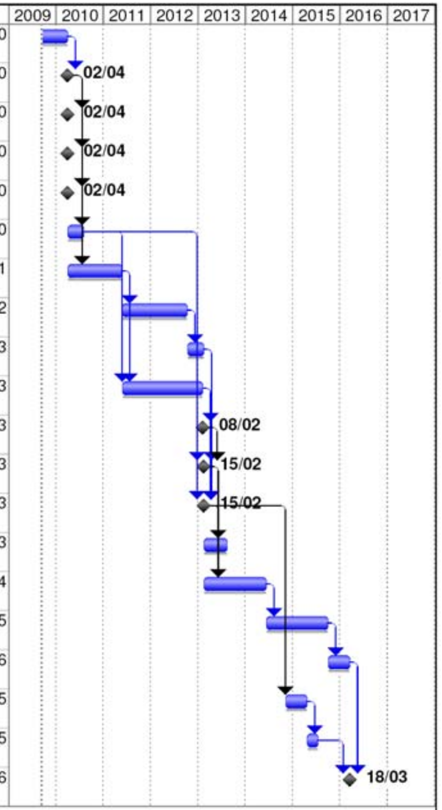
It is understood that a potential site for the proposed Energy from Waste site has been identified. In order to develop the facility there will be a requirement to have planning and other necessary consents in place. Current experience suggests that this process can take a considerable time and there are very few examples that have been resolved at local level by the planning authorities. It is therefore prudent to allow a period of just over one year for site investigations and environmental studies, if necessary baseline information is not available, and a period of the order of eighteen months for the planning and permitting process.

Experience suggests that detailed design of the facility is unlikely to commence until planning and other necessary consents have been secured, unless the EPC contractor’s design costs have been underwritten by the Partnership or the Contractor. The design and construction of the plant should take approximately thirty months from being receipt of the necessary approvals with a further period of six months for commissioning and testing. With the successful completion of the commissioning and testing period the plant is available for full service to commence.

There are several areas where it may be possible to bring the planned service commencement date forward. These include early starts on the site and environmental investigations and early commencement of the detailed design. However, recent experience in the UK market, has made many contractors wary of spending on such activity “at risk”, and have sought guarantees or indemnities from the client Authorities to cover their costs, in the event that the project does not proceed. With such commitments from the Partnership it may be possible to save three to nine months on the programme.

Figure 7.1 Project Programme

ID		Task Name	Duration	Start	Finish
1		WCC Procurement and Negotiation	150 days	Mon 07/09/09	Fri 02/04/10
2		Confirm WCC Decision to Proceed & Sign Letter of Intent	0 days	Fri 02/04/10	Fri 02/04/10
3		Appoint Architects	0 days	Fri 02/04/10	Fri 02/04/10
4		Appoint EPC Contractor	0 days	Fri 02/04/10	Fri 02/04/10
5		Appoint IBA Contractor	0 days	Fri 02/04/10	Fri 02/04/10
6		Concept Design & Site Investigations	90 days	Mon 05/04/10	Fri 06/08/10
7		Environmental Impact Assessment	300 days	Mon 05/04/10	Fri 27/05/11
8		Planning Application & Determination (incl. appeal/judicial review etc.)	360 days	Mon 30/05/11	Fri 12/10/12
9		Planning Contingencies	90 days	Mon 15/10/12	Fri 15/02/13
10		Other Necessary Consents (Discharge permits, way leaves etc.)	445 days	Mon 30/05/11	Fri 08/02/13
11		Planning & Necessary Consents Secured	0 days	Fri 08/02/13	Fri 08/02/13
12		Notice to Proceed EPC Contractor	0 days	Fri 15/02/13	Fri 15/02/13
13		Notice to Proceed Bottom Ash Facility Contractor	0 days	Fri 15/02/13	Fri 15/02/13
14		Detailed design, procure and manufacture bottom ash equipment	130 days	Mon 18/02/13	Fri 16/08/13
15		Detailed Design, Site Preparation, Civil Engineering & Building	345 days	Mon 18/02/13	Fri 13/06/14
16		Erection of EFW Process Equipment and Facility Completion	340 days	Mon 16/06/14	Fri 02/10/15
17		EFW Commissioning	120 days	Mon 05/10/15	Fri 18/03/16
18		Erect Bottom Ash Facility Equipment	120 days	Mon 10/11/14	Fri 24/04/15
19		Bottom Ash Facility Commissioning	60 days	Mon 27/04/15	Fri 17/07/15
20		Planned Service Commencement	0 days	Fri 18/03/16	Fri 18/03/16



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Date: Wed 09/09/09

Task		Milestone	◆	External Tasks	
Split		Summary		External Milestone	◆
Progress		Project Summary		Deadline	⇩

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8. Project Risk Register

When developing a project it is necessary to look at the risks that may arise that could lead to failure of the project to meet its objectives. The register set out below identifies some of the technical risks that could arise in seeking to source a residual waste treatment facility within the existing contract framework. There are likely to be other risks that are not, as yet, identified that are specific to the legal context of the existing contract arrangements. These will have to be examined by the Authority's legal and financial teams.

CATEGORY	ID	CAUSE	EFFECT	CONSEQUENCE FOR PROJECT	Commentary
		There is a risk that …..	**resulting in …..**	**with the consequence that …..**	
Planning & Permitting	1	planning permission will not be achieved within a reasonable time frame.	(i) possible delay in procurement process and award of EPC contract. Additional development costs. (ii) Failure to deliver facility	Increased costs, project failure, delay.	The inability to get planning approval in a reasonable time, could lead to overall project failure given the limited project term remaining
Planning & Permitting	2	The EP is not secured.	delay in procurement process and award of contract.	Increased costs, project failure. Additional development costs.	FoE and others have been challenging the EA when granting permits. Permit applications have had to be resubmitted
Project Delivery	3	Speed of commercial negotiations is slow due to market under capacity	Do not meet required timeframes	Project delay and increased costs	Key equipment suppliers and the banks are busy on a number of projects. Capacity is constrained.
Project Delivery	4	Procurement is challenged	Cancellation of project variation	Project Stopped/Halted until resolved	This has become a real risk with opponents of EfW challenging the procurement process.
Finance & Affordability	5	The bid prices are outside of the affordability envelope	(i) a delay due to protracted negotiation (ii) a need to abort the project (unaffordable)	Delay to project programme, increased LATS compliance costs, increased costs associated with securing and implementing an alternative solution	EfW EPC contract prices have increased markedly in the recent past. A considerable portion of the equipment is sourced from the Euro zone. Banking margins remain high.
Finance & Affordability	6	The preferred solution is not bankable	Delay to the procurement programme.	Delay to project programme, increased LATS compliance costs, increased costs associated with securing bank support and possibly implementing an alternative business model solution	This is unlikely if the selected EPC contractor uses an established technology supplier. However banks have hardened their position with regard to risk and will wish to see their position protected.

CATEGORY	ID	CAUSE **There is a risk that …..**	EFFECT **resulting in …..**	CONSEQUENCE FOR PROJECT **with the consequence that …..**	Commentary
Finance & Affordability	7	Finance is not available	No money available for funding	Bankability issues and project delay	Current market conditions for financing large projects remain challenging.
Finance & Affordability	8	Commodity and construction prices increase significantly during procurement and construction phases	Excessive unanticipated costs	Increased project costs, and possibly exceeding the agreed affordability envelope	Prices have been and continue to remain volatile, especially if exchange risk is a factor.
Finance & Affordability	9	Long term interest rates rise beyond current anticipated levels	Increased funding costs and exceedance of affordability envelope	Increased project costs or abandonment of project.	Banking conditions remain volatile
Project Delivery	11	Severn Waste Services withdraw from the process or fail to reach a satisfactory commercial/financial close	Need to recommence full procurement process.	Delay, increased costs, abandonment of project. Need to reprocure.	There is a need to understand the Contractor's position and that of the parent companies.
Planning & Permitting	12	Public opposition to EfW-based solution remains, leading to protester action	Delay to contract commencement	Delays to project delivery programme, additional LATS penalties, affordability envelope threatened.	The Partnership (and Contractor) need to proactively manage this risk.
Wastes	13	The Councils fail to reach recycling targets.	Plant design capacity insufficient.	Increased landfill costs.	Adequate funding for the required enhanced collection services needs to be identified and secured. Alternative provision for excess waste is required, if such an eventuality arises.
Wastes	14	The Councils significantly exceed their recycling targets.	Councils do not have sufficient waste to meet minimum tonnage requirements, and plant oversized.	Additional cost to Councils	There may be a market for surplus capacity either with other public sector bodies or from the private sector. Does the Partnership or Contractor manage this risk?
Sites	15	The site is susceptible to flooding or other environmental risk	considerable pre-development work to make site acceptable for development	Delay to the project, additional cost impact on affordability or if site issues cannot be resolved abandonment of the project.	
Political	16	The project will lack political support	Delays in decision-making, damage to credibility, bidder interest diminished. , need to change solution late	Delays to project, increase in costs, loss of competitive pressure, threat to VFM (value for money), possible procurement challenge and need to change the project scope.	Adoption of the recently reviewed H&W JMWMS is pending.

CATEGORY	ID	CAUSE **There is a risk that …..**	EFFECT **resulting in …..**	CONSEQUENCE FOR PROJECT **with the consequence that …..**	Commentary
Project Delivery	17	Utility connections may not be readily available.	Delays in construction programme or additional costs	Possible threat to affordability, delay to programme	Early investigation of the site is required so that such risks may be quantified.
Sites	18	Site conditions are not as anticipated	Increase in bid prices, uncompetitive negotiation at PB stage, delay to contract close	Delay in project programme, excessive LATS costs, excessive capex prices, possible threat to affordability	The Partnership needs to determine at what point this risk is best transferred to the Contractor.
Project Delivery	19	Construction contractor (or other sub-contractor) becomes insolvent during construction phase	Project delay and legal implications during insolvency of contractor	Delay to project whilst insolvent contractor is re procured.	Current market conditions are challenging for the construction sector. This risk should be shared or passed over the Contractor at an appropriate point.
Wastes	20	Calorific value of delivered residual waste exceeds upper bound	Throughput tonnage reduced	Additional cost to Councils	The Contractor's bank may wish to pass this risk to the Partnership, due to the impact on their ability to receive third party waste. There may therefore be a risk share if the cv does not fall within an agreed range.
Wastes	21	Calorific value of delivered residual waste is below lower bound	Combustion conditions compromised and power generation reduced.	Reduced energy income	The Contractor's bank may wish to pass this risk to the Partnership, due to the possible requirements for ancillary fuel.
Performance	22	Landfill capacity not available for residues	Disposal costs exceed anticipated level	increased project operational costs, increase in environmental impacts (due to increased transport)	There is much discussion within government around the definition of bottom ash that may impact on landfill acceptance criteria. Residues from the gas cleanup require appropriately licensed facilities.
Performance	23	The selected EfW technology fails to perform to required standard (unreliable or poor performance)	Increased unavailability of the facility.	More waste than anticipated is landfilled with associated cost, tax and LATS implications.	The Partnership needs to determine how such risk will be managed given the limited life remaining in the existing contract and the need to secure a new operating contract
Performance	24	No heat outlet for EfW (CHP)	No revenue gained	Costs increase.	Does the Partnership require heat to be used? This may require additional resources from other agencies to facilitate such development.

CATEGORY	ID	CAUSE	EFFECT	CONSEQUENCE FOR PROJECT	Commentary
		There is a risk that …..	**resulting in …..**	**with the consequence that …..**	
Project Delivery	25	Insufficient project resource for the duration of the contract (numbers and knowledge/experience of staff/project team)	(i) Delays to project, (loss of project knowledge), (ii) incorrect decisions that require re-visiting (iii) inadequate management and supervision of contracts	Contract conditions and provisions not complied with and costs to 'repair' project at end of initial term. Reduced market interest in second term operational contract and consequent loss of competitive pressure (VFM).	The Partnership needs to determine the level of engagement that they wish to maintain. Given the length of the existing contract and the anticipated asset life an additional operational contract will be required at the end of the current contract term. This may necessitate a greater level of knowledge.
Wastes	26	Bottom Ash/Fly Ash legislative changes lead to reclassification as active waste.	New classifications result in landfill bottom ash attracts landfill tax rate of approx £70/tonne rather than £2.50/tonne presently predicted.	Increased restrictions and increased landfill disposal costs .	This is an area that remains under discussion within government.
Regulatory	27	Change in legislation or guidance either at European, national or regional/local level	Unforeseen impacts on project performance	Could require revisit of preferred solution, possible termination of project, excessive LATS compliance costs	The Waste framework Directive has recently been reviewed. This may lead to policy change over time.
Project Delivery	28	Facilities not commissioned on time	Additional costs incurred to complete commissioning, delay to programme	Possible delay to project programme, LATS compliance costs incurred.	
Project Delivery	31	The Councils fail to agree suitable contract terms with Severn Waste Services.	Full re-procurement required and delay to programme, loss of PFI credits.	Possible delay to project programme, LATS compliance costs incurred.	The existing contract was drafted some time ago. Government as recently standardised their preferred terms for Waste Sector PFI contracts. There may be a requirement to adopt some of these new terms within any variation if PFI credits are to be retained. This needs to be assessed by the Partnership's lawyers.

9. Conclusions

Entec have independently examined the proposed project from a technical perspective, and drawn conclusions around the capacity requirements for a proposed residual waste treatment plant, required to handle the residual waste arising from within the two Counties.

It is clear that the currently planned and committed waste collection schemes will need to be enhanced if the proposed target of 50% recycling and composting is to be reached. The Authorities will need to ensure that adequate resources are allocated to this task if the strategy targets are to be achieved.

On the understanding that the strategy targets can be achieved, differing waste growth projections have been examined. In the event that all residual waste suitable for treatment is directed to the proposed waste treatment facility it has been concluded that a plant capacity of the order of 220,000 tonnes per annum capacity is required.

Estimates of capital, life cycle and operational costs have been provided. These need to be processed by the Authority's financial team in order to develop a shadow tariff model and public sector comparator. It is understood that, to date, the Authority has yet to appoint their financial advisor and it has therefore not been possible to progress this matter.

A number of issues around the development of a single or twin stream plant have been identified and discussed. It has been noted that plant configuration preferences differ between contractors and both configurations would, in all likelihood meet the Authority's needs. Estimated costs, and configuration cost difference have been provided.

A preliminary project risk register has been developed, from a technical perspective. This register needs to be tested by the Authority's legal and financial teams and additional risks specific to legal and financial matters identified. Entec have not had sight of the Authority's current waste contract.

A high level project programme has been developed which has drawn on recent project development experience. This identifies hat the planning and permitting process will require completion before works can commence on site. The plant is likely to be ready for commissioning in the summer of 2015 with "Full Services" likely to commence in the spring of 2016.

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