

Options Appraisal Report

To inform the development of the Joint Municipal Waste Strategy

1	INTRODUCTION	1
1.1	Options Assessment Process	1
2	WASTE STRATEGY OBJECTIVES	2
2.1	Historical perspective	2
2.2	Policy Driver Developments	2
3	OPTIONS APPRAISAL METHODOLOGY	6
3.1	Evaluation Criteria	6
3.2	Evaluation Criteria Scoring	7
3.3	Weighting of Evaluation Criteria	10
4	OPTIONS APPRAISAL SCENARIOS	11
4.1	Scenarios Assessment	12
4.2	Key Assumptions	14
5	ASSESSMENT RESULTS	21
6	DISCUSSION	25
6.1	Collection Scenarios	25
6.2	Prevention, reuse and recycling initiatives	25
6.3	Waste treatment options	25
	APPENDIX A: WASTE FORECAST	26
	Methodology	26
	Housing data and forecasts	26
	3 to 5 Year Trends	27
	Economic growth and waste generation	29
	APPENDIX B: WASTE PREVENTION, REUSE AND RECYCLING INITIATIVES ASSUMPTIONS	32
	APPENDIX C: TEES VALLEY WASTE FLOW MODEL	36
	APPENDIX D: SUMMARY OF KAT MODELLING ASSUMPTIONS	37
	High efficiency collection scenario	37
	High recycling collection scenario	37
	APPENDIX E: SUMMARY OF KAT MODEL OUTPUTS	38
	APPENDIX F: SUMMARY OF WASTE FLOW MODEL OUTPUTS	39
	APPENDIX G: SUMMARY OF WRATE OUTPUTS	44
	APPENDIX H: DETAILED ASSESSMENTS OF SCENARIOS	45

1 Introduction

The current Tees Valley Joint Waste Management Strategy (JWMS) was developed to cover the period between 2008 until 2020. Since then there have been developments and changes to waste management policy that means that the existing strategy needs revision. This document refreshes the previous JWMS and extends it until 2035 with particular regard to:

- moving waste up the waste hierarchy of options through prevention, reuse, recycling and composting activities; and
- the identification of a long-term residual waste treatment solution for the region.

This work is supported by a series of supplementary reports that provide technical waste management information and discuss in further detail the considerations used in the preparation of the Strategy. This Options Assessment Report is one of the supporting documents and describes the options appraisal process undertaken by the Tees Valley Councils which resulted in the selection of a draft Preferred Option.

1.1 Options Assessment Process

Key stages in the options appraisal process have included:

- developing the waste strategy objectives, through workshop sessions with officers and members from each of the representative Councils, including the identification of the key issues and drivers for the strategy by reference to existing and proposed policy and legislation.
- identifying options for delivering the waste strategy objectives with input from officers and members.
- agreeing the options appraisal process, i.e. the assessment method, scoring of evaluation criteria, weighting of evaluation criteria;
- development of a waste flow model for the Tees Valley area which enables forecasts of future waste flows and types, and costs (described in Appendix 3)
- undertaking a detailed appraisal of each of the options based on the agreed evaluation criteria to help identify a draft Preferred Option.

2 Waste Strategy Objectives

2.1 Historical perspective

The 2008 JWMS had six key principles:

- to reduce waste generation
- to work towards zero landfill
- to be achievable and affordable
- to have an accountable and deliverable structure
- to minimise the impact on climate change
- to contribute towards economic regeneration

There was also a number of additional policy commitments including; managing waste in line with the waste hierarchy, maximising the amount of material that is recycled, composted or recovered from the residual waste stream and minimising the amount of waste sent to landfill.

2.2 Policy Driver Developments

The first step in reviewing and refreshing the waste strategy objectives was the identification of key policy drivers and related objectives within other relevant strategies and plans. This provided the means to establish an initial set of potential strategic outcomes and allowed the outcomes to be compared to the current position. This information was also used as part of the Strategic Environmental Assessment (SEA¹).

The initial identification of policy drivers involved a desk-based assessment and review of current policy and strategy impacting on the way that waste is managed and is likely to be managed in Tees Valley up to 2035. This was carried out at an EU, national and local level and covered strategic waste management, planning policy, climate change and low carbon initiatives, e.g. Clean Growth Strategy, the Industrial Strategy White Paper, the Tees Valley Strategic Economic Plan 2016-2026.

Other key proposals and consultations relating to future policy and legislative change that may impact on waste management policy and decision making were also reviewed. Such documents included Defra's 25-Year Environment Plan and the European Circular Economy Package.

The policy documents were reviewed and analysed for common issues resulting in the identification of a list of thirty policy and strategy themes related to waste management. The detailed review is provided in Appendix 1 of the Environmental Report prepared for the SEA.

As a number of the themes overlapped or used different terminology to describe the same purpose the themes were rationalised to provide a consolidated list of themes for consideration as part of developing the revised JWMS. The consolidated list of themes together with a commentary is provided in Table 2.1.

¹ All central and local Government plans and strategies that can have a significant effect on the environment are required to be assessed regarding how they contribute to Sustainable Development. An assessment of how a strategy meets the aims of Sustainable Development can be delivered through an approach known as a Strategic Environmental Assessment.

Table 2.1: Consolidated list of themes for the consideration in the revised JWMS

Key Themes	Comments
Waste prevention	Whilst these themes could be combined under the theme of the waste hierarchy, within a JWMS it is important that they are considered as individual themes. The elements of waste hierarchy will also contribute to renewable energy generation and the emerging theme of zero avoidable waste-
Reuse, recycling and composting	
Energy recovery from waste	
Landfill diversion	
Reducing the carbon impact of waste management	Covering climate change and including carbon / greenhouse gas emissions, low carbon economy, reducing transport impacts.
Affordability	Including value for money and the potential for delivering cost savings.
Circular economy	Encompassing resource efficiency / productivity, industrial symbiosis, developing markets for recyclable materials and sustainable procurement as a means of completing the circle.
Limiting environmental impacts and harm to human health	Including environmental protection, sustainable communities.
Reducing fly-tipping and litter	Encompassing the quality of the local amenity and contributing to green infrastructure
Managing the impact of food waste	Two very topical themes, which could be considered under different elements of the waste hierarchy but could be specific themes within the JWMS.
Managing the impact of plastic wastes	
Management of all municipal waste	With the emergence of municipal waste, targets cover commercial wastes similar in nature to household waste.
Raising waste awareness and education	On-going behaviour change.

These themes were subsequently explored at a Members and Officers Workshop which resulted in the addition of three additional themes:

- Economic regeneration and job creation: These are a priority in Tees Valley; and whilst the circular economy theme incorporates an element of resource efficiency and economic benefit, 'economic regeneration and job creation' should be included as a standalone theme.
- Income generation: The potential to generate income from waste management activities is an important consideration for Tees Valley and needs to be considered in the themes. It was agreed that it was not a specific theme in its own right but formed an important element of 'Affordability' as options that can provide an income will contribute to the overall affordability of any solution.
- Service Quality and Customer Satisfaction: Whilst the themes identified covered the key policy areas, it was highlighted that a key priority for the Councils is to provide a high-quality

service that encourages all residents to participate in recycling activities whilst delivering customer satisfaction. Therefore 'Service Quality / Customer Satisfaction' was added as a separate theme.

Future recycling targets and objectives were also discussed at the Workshop in order to determine the level of ambition and commitment to recycling, by the Councils, as part of the development of the revised JWMS. It was accepted that the level of recycling and composting achieved by the Councils would be largely dependent on a combination of the collection systems offered by each Council, education and enforcement over time. This in turn would determine the quantity of residual waste requiring treatment post 2025.

In this context, the ability of the Councils to achieve the recently agreed EU Circular Economy targets of 55% recycling by 2025, 60% recycling by 2030 and 65% recycling by 2035, was also discussed. It was noted in the discussion that rural Councils typically achieve higher recycling rates than urban Councils due to the increased availability of green waste for composting and that those Councils with higher levels of deprivation are frequently associated with lower recycling rates. Therefore, it was concluded that for Tees Valley as a whole, to achieve a recycling rate in excess of 55% by 2025 would be challenging, even though there is an aspiration to reach such a target.

To develop a set of refreshed aims and objectives for the revised JWMS, the themes identified above were prioritised and the following order resulted (highest priority first):

- 1 Affordability / Income Generation
- 2 Reuse, recycling and composting
- 3 Raising waste awareness and education
- 4 Service Quality / Customer Satisfaction
- 5 Waste prevention
- 6 Regeneration / Job Creation
- 7 Reducing fly-tipping and litter
- 8 Limiting environmental impacts and harm to human health
- 9 Circular economy
- 10 Energy recovery from waste
- 11 Landfill diversion
- 12 Reducing the carbon impact of waste management
- 13 Managing the impact of plastic wastes
- 14 Management of all municipal waste
- 15 Managing the impact of food waste

The resulting ranking of the themes was broadly consistent with the principles and policies within the existing JWMS. These were therefore revised to reflect emerging waste management policies and the comments from members and officers. The following draft aims and objectives, were proposed for the revised JWMS:

To deliver a high quality, accessible and affordable waste management service that contributes to:

- economic regeneration, including employment and a more circular economy;
- the protection of the environment and natural resources; and
- reducing the carbon impact of waste management.

and:

- delivers customer satisfaction;
- reduces the amount of waste generated by householders and the Councils;
- increases reuse and recycling;
- then maximises recovery of waste, and;
- works towards zero waste to landfill;

3 Options Appraisal Methodology

3.1 Evaluation Criteria

The evaluation criteria for assessing potential options were developed from the draft aims and objectives of the JWMS. The draft evaluation criteria and potential assessment methods, Table 3.1, were presented to officers, from each of the representative Councils, at an Options Appraisal Workshop. Following discussion of the criteria, officers agreed that Criterion 1 (Delivers engagement and customer satisfaction) and Criterion 9 (Accessible) should be combined into a single criterion because their assessments are very closely linked. The revised list of 10 criteria and their method of assessment are set out in Table 3.2

It was also agreed that the assessment of Criterion 7 (Protection of the environment and natural resources) should include the total waste transport mileage, as a means of considering local air quality.

Table 3.1: Proposed criteria and potential assessment method

No.	Criterion	Potential assessment method
1	Delivers engagement and customer satisfaction	Qualitative assessment of levels of engagement e.g. promotional/educational activity to encourage behavioural change and/or deemed levels of householder acceptability of the option
2	Reduces the amount of waste generated by the householder and the Councils	Qualitative assessment of the reduction in the waste arisings
3	Increases reuse and recycling	Change in reuse and recycling performance from base position
4	Maximises recovery of waste	Change in the percentage of non-recycled waste which is recovered
5	Zero waste to landfill	Change in percentage of waste diverted from landfill compared to base position
6	Economic regeneration, including employment and a more circular economy	Semi-qualitative assessment of employment (jobs created and type of employment) using case studies / waste industry reports for likely employment & training opportunities, combined with the 'Resource use' factor as a European person – Equivalent, which can be extracted from WRATE
7	Protection of the environment and natural resources	Semi-qualitative assessment using the following (quantified) outputs from WRATE: <ul style="list-style-type: none"> • Acidification (kg SO₂) • Human Toxicity (kg 1, 4 – DCB eq.) • Freshwater Aquatic Toxicity (kg 1, 4 – DCB eq.) • Eutrophication (PO₄ kg eq.)
8	Reducing the carbon impact of waste management	Change in tonnes of CO ₂ equivalent emissions from base position
9	Accessible	Qualitative assessment of how easy it was for householders to use/access the service.
10	Long-term affordable	Percentage change in Net Present Value (NPV) from baseline position
11	Deliverability	Qualitative assessment of procurement risk, planning, technology risk, etc.

Table 3.2: Revised criteria and assessment method

No.	Criterion	Potential assessment method
1	Delivers an accessible service with engagement and customer satisfaction	Qualitative assessment of how easy it is for householders to use/access the service taking account of the levels of engagement e.g. promotional/educational activity to encourage behavioural change and/or deemed levels of householder acceptability of the option
2	Reduces the amount of waste generated by the householder and the Councils	Qualitative assessment of the reduction in the waste arisings
3	Increases reuse and recycling	Change in reuse and recycling performance from base position
4	Maximises recovery of waste	Change in the percentage of non-recycled waste which is recovered
5	Working towards zero waste to landfill	Change in percentage of waste diverted from landfill compared to base position
6	Economic regeneration, including employment and a more circular economy	Semi-qualitative assessment of employment (jobs created and type of employment) using case studies / waste industry reports for likely employment & training opportunities, combined with the 'Resource use' factor as a European person – Equivalent, which can be extracted from WRATE
7	Protection of the environment and natural resources	Semi-qualitative assessment informed by the following (quantitative) outputs from WRATE: <ul style="list-style-type: none"> • Resource use (kg Sb eq.) • Acidification (kg SO₂) • Human Toxicity (kg 1, 4 – DCB eq.) • Freshwater Aquatic Toxicity (kg 1, 4 – DCB eq.) • Eutrophication (PO₄ kg eq.) • Total waste transport mileage
8	Reducing the carbon impact of waste management	Change in tonnes of CO ₂ equivalent emissions from base position
9	Long-term affordable	Percentage change in NPV from baseline position
10	Deliverability	Qualitative assessment of procurement risk, planning, technology risk, etc.

3.2 Evaluation Criteria Scoring

A proposed scoring mechanism was presented at the Options Appraisal Workshop and adapted following officers' comments. The resulting scoring mechanism is set out in Table 3.3 with each criterion assigned a scale to score the options from 0 – 5, with 0 representing the lowest score and 5 the highest score. For quantitative criteria which use numerical values, the figures in Table 3.3 have been based on a range of output values derived from the waste flow model or the WRATE ²analysis.

² Forecasts of future waste flows in the Tees Valley were determined using a waste flow model. WRATE is a tool developed by the Environment Agency for quantifying the environmental impact of various waste management systems (see section 4.2.5).

Table 3.3: Scoring for evaluation criteria

Criterion	Evaluation Criteria	Score
1. Delivers an accessible service with engagement and customer satisfaction	High levels of accessibility (>90%) with levels of engagement that should lead to increased understanding and high customer satisfaction	5
	Moderate levels of accessibility (70%-90%) with levels of engagement that should lead to increased understanding and high customer satisfaction	4
	Lower levels of accessibility (<70%) with levels of engagement that should lead to increased understanding and customer satisfaction	3
	Moderate levels of accessibility (70%-90%) with levels of engagement that may lead to increased understanding but neutral/reduced customer satisfaction	2
	High / moderate levels of accessibility with limited levels of engagement & / or potential customer dissatisfaction	1
	Lower levels of accessibility with no engagement and /or potentially high levels of customer dissatisfaction	0
2. Reduces the amount of waste generated by householder and managed by the Councils from baseline forecast	Evaluation Criteria	Score
	Very high reduction in waste arisings (>2%)	5
	High reduction (1 - 2%)	4
	Medium reduction (0.51- 0.99%)	3
	Minor reduction (<0.50%)	2
	No change in waste arising	1
	Increase in waste arising	0
3. Increases reuse and recycling	Evaluation Criteria	Score
	High increase in reuse/recycling/composting rate (>10%)	5
	Medium increase in reuse/recycling/composting rate (5 - 9.99%)	4
	Reasonable increase in reuse/recycling/composting rate (2 - 4.99%)	3
	Minor increase in reuse/recycling/composting rate (0.1 - 1.99%)	2
	No change in reuse/recycling/composting rate	1
Decrease in reuse/recycling/composting rate	0	
4. Maximises recovery of waste	Evaluation Criteria	Score
	Reasonable increase in proportion of non-recycled household waste recovered (5 – 14.99%)	5
	Minor increase in proportion of non-recycled household waste recovered (1 – 4.99%)	4
	No change in proportion of non-recycled household waste recovered (+/- 0.99%)	3
	Minor decrease in proportion of non-recycled household waste recovered (1 – 4.99%)	2
	Reasonable decrease in proportion of non-recycled household waste recovered (5 – 14.99%)	1
High decrease in proportion of non-recycled household waste recovered (>15%)	0	
5. Working towards zero waste to landfill	Evaluation Criteria	Score
	High decrease in waste to landfill (2.5 - 5%)	5
	Medium decrease in waste to landfill (1 - 2.49%)	4
	Reasonable decrease in waste to landfill (0.5 – 0.99%)	3
	Minor decrease in waste to landfill (<0.5%)	2
	No change in landfill diversion	1
Increase in waste to landfill	0	

6. Economic regeneration, including employment and a more circular economy	Evaluation Criteria	Score
	Medium positive contribution to jobs created / potentially secured and a reduction in the Resource use Eur.Person.Eq from the baseline which could benefit Tees Valley	5
	Minor positive contribution to jobs created / potentially secured and a reduction in the Resource use Eur.Person.Eq from the baseline which could benefit Tees Valley	4
	No net additional jobs created and/or no wider employment security and reasonable reduction in the Resource use Eur.Person.Eq (10 - 50% from baseline) which could benefit Tees Valley	3
	No net additional jobs created and/or no wider employment security and no significant change in the Resource use Eur.Person.Eq (+/-9.99% from baseline) which could benefit Tees Valley	2
	Job losses and/or no wider employment security but a reasonable reduction in the Resource use Eur.Person.Eq (10 - 50% from baseline) which could benefit Tees Valley	1
	Job losses and/or no wider employment security and no significant change in the Resource use Eur.Person.Eq (+/-9.99% from baseline) which could benefit Tees Valley	0
7. Protection of the environment and natural resources	Evaluation Criteria	Score
	High level of improvement in environmental protection based on resource use, acidification, human toxicity, freshwater aquatic toxicity, eutrophication and mileage	5
	Medium level of improvement in environmental protection based on resource use, acidification, human toxicity, freshwater aquatic toxicity, eutrophication and mileage	4
	Minor improvement in the level of environmental protection based on resource use, acidification, human toxicity, freshwater aquatic toxicity, eutrophication and mileage	3
	No change in the level of environmental protection based on resource use, acidification, human toxicity, freshwater aquatic toxicity, eutrophication and mileage	2
	Decrease in the level of environmental protection based on resource use, acidification, human toxicity, freshwater aquatic toxicity, eutrophication and mileage	1
	Significant decrease in the level of environmental protection based on resource use, acidification, human toxicity, freshwater aquatic toxicity, eutrophication and mileage	0
8.Reducing the carbon impact of waste management	Evaluation Criteria	Score
	Significant reduction in tonnes of CO ₂ equivalents (>30,000 tonnes CO ₂ -Eq)	5
	High reduction in tonnes of CO ₂ equivalents (20,000-30,000 tonnes CO ₂ -Eq)	4
	Medium reduction in tonnes of CO ₂ equivalents (10,000-19,999 tonnes CO ₂ -Eq)	3
	Minor reduction in tonnes of CO ₂ equivalents (1,000-9,999 tonnes CO ₂ -Eq)	2
	No change in tonnes of CO ₂ equivalents from baseline (+/- 999 tonnes CO ₂ -Eq)	1
	Increase in tonnes of CO ₂ equivalents (>1,000 tonnes CO ₂ -Eq)	0
9. Affordable (long term measure)	Evaluation Criteria	Score
	Significant percentage savings in NPV achieved (>10%)	5
	High percentage savings achieved in NPV (-7.5 to -10%)	4
	Medium percentage savings in NPV (-5% to -7.49%)	3
	Minor percentage savings in NPV (-2.5% to -4.99%)	2
	No significant percentage change in NPV (+/- 2.49%)	1
	Some percentage increase in NPV (>+2.5%)	0
10. Deliverability	Evaluation Criteria	Score
	No major deliverability challenges envisaged	5
	Some minor deliverability issues	4
	Some moderate deliverability issues	3
	Some substantial deliverability issues	2
	Major deliverability risks	1
	High chance of being undeliverable	0

3.3 Weighting of Evaluation Criteria

It is common practice to weight evaluation criteria to reflect local conditions. It was agreed at the Options Appraisal Workshop that the weightings should be based on the prioritisation at the Members and Officers Workshop but also revised to more broadly reflect the Tees Valley Combined Authority aims of driving economic growth and for Tees Valley to become a high-value, low-carbon, diverse and inclusive economy. The weightings are shown in Table 3.4.

Table 3.4: Weighting for Evaluation Criteria

Evaluation Criteria	Weighting
Delivers an accessible service with engagement and customer satisfaction	3
Deliverability	3
Affordable (long term measure)	3
Increases reuse and recycling	3
Reduces the amount of waste generated by householders and the Councils	3
Economic regeneration, including employment and a more circular economy	3
Protection of the environment and natural resources	2
Reducing the carbon impact of waste management	2
Maximises recovery of waste	2
Working towards zero waste to landfill	1

4 Options Appraisal Scenarios

Whilst a key output of the revised JWMS is to help determine the nature of any future residual waste treatment facility for the Tees Valley, it is also intended that the revised JWMS helps each Council make decisions about waste prevention, reuse and recycling options they may wish to adopt in the future. Therefore, a range of options were agreed across the waste hierarchy having regard to the policy and legislation review, potential collection systems for the Tees Valley Authorities and the ranking of themes at the first workshop.

The agreed options for consideration in the options appraisal process are:

Waste Prevention, Reuse and Recycling Initiatives

Raising waste awareness and education campaigns	Various campaigns designed to raise awareness and increase participation in waste prevention and reuse activities, including: <ul style="list-style-type: none">• general education and waste prevention initiatives;• general reuse initiatives• Love Food Hate Waste• Junk Mail• promoting smart shopping practices
Home Composting / Digestion	Promote home composting (or anaerobic digestion) to reduce the demand on collection services and treatment capacity
Reuse at HWRCs	Install facilities at HWRCs that allow members of the public to leave and collect items such as furniture. This can include awareness and promotional campaigns of the service.
Bulky Collection Reuse	Sort bulky waste collections to extract reusable goods with a view to refurbishment, reuse and resale. This can include awareness and promotional campaigns.

Recycling and Composting Options

High efficiency scenario	Which would look at increasing dry recycling performance, through a reduction in residual waste capacity and introducing a charge for garden waste services
High recycling performance scenario	Which would look at increasing dry recycling performance through introducing separate food waste collections, reducing residual waste capacity and introducing a charge for garden waste services

Alongside these primary options, the following Initiatives would be assessed:

Bulky Waste Recycling	Sort bulky waste collections to extract recyclable goods in order to improve recycling performance across the councils in Tees Valley. This can include awareness and promotional campaigns of the services provided.
Reducing contamination in recycling/composting	Stronger engagement with residents to increase public understanding of the issues associated with contamination of recycling/composting collections to deliver behaviour change. Combined with tighter management of contamination across all Tees Valley councils.

Residual Waste Treatment Options

The primary waste treatment scenarios that would be assessed on the Tees Valley level are:

- Contract extension (beyond 2025) for existing EfW contract
- New build energy recovery facility
- New build refuse derived fuel facility (RDF)
- Utilise third party energy recovery facility capacity

4.1 Scenarios Assessment

It was agreed that the options would be grouped together into scenarios to highlight what could be achieved by:

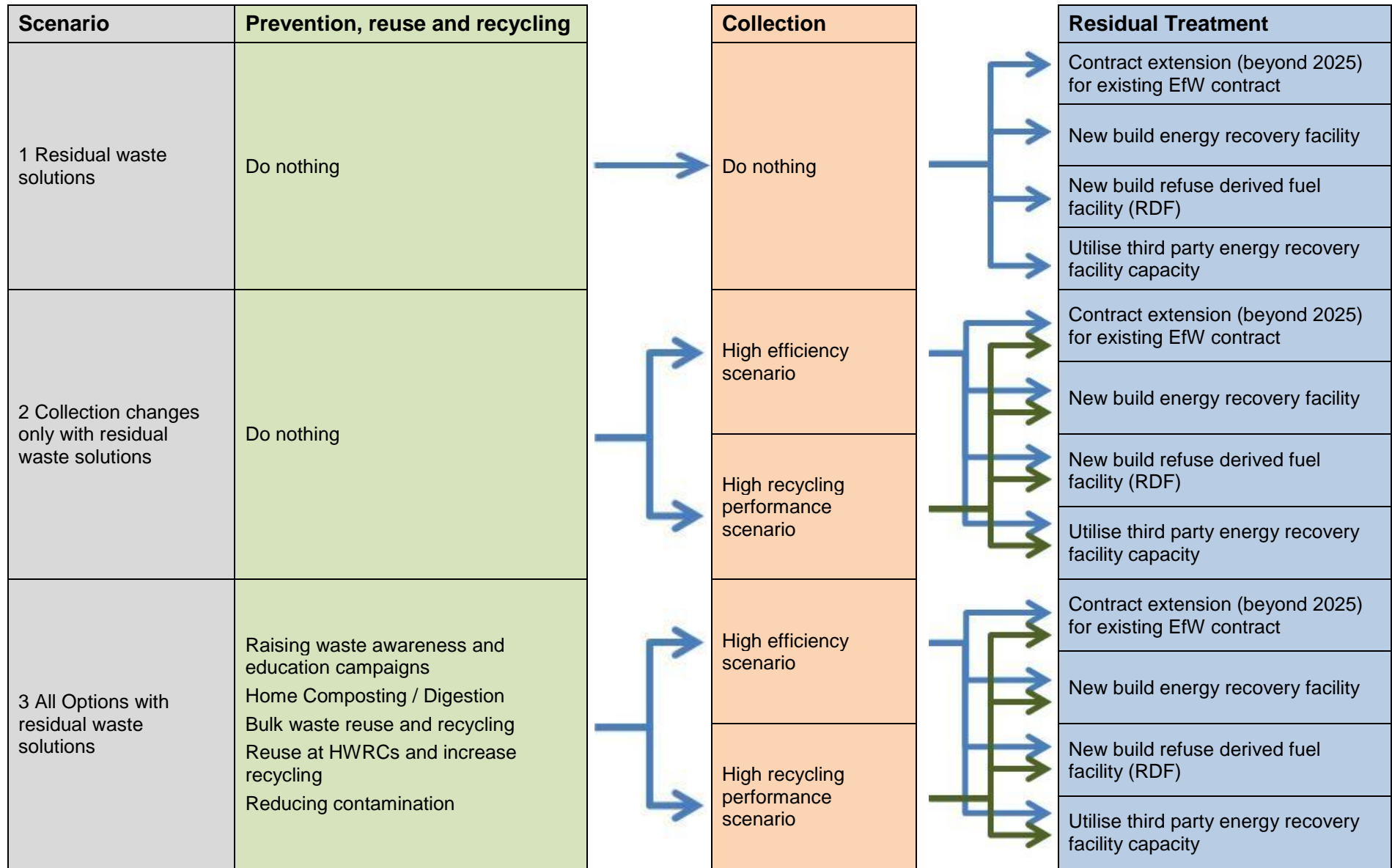
- residual waste treatment options alone;
- implementing the residual waste treatment option alongside collection changes; or
- by implementing a full range of prevention, reuse and recycling options alongside collection changes and residual waste treatment options.

This approach provided an insight into how the different waste management ‘building blocks’ could be arranged, what might be achieved and how the combination of variables effect the residual waste treatment options. The scenarios are summarised in Figure 4.1 and Table 4.1; this approach is broadly consistent with the approach taken in the 2008 options appraisal.

Table 4.1: Assessment Scenarios

Scenario	Prevention, reuse and recycling	Collection	Residual Treatment
1a	No change	No change	Contract extension (beyond 2025) for existing EfW contract (No change)
1b	No change	No change	New build energy recovery facility
1c	No change	No change	New build refuse derived fuel facility (RDF)
1d	No change	No change	Utilise 3 rd party energy recovery facility capacity
2a	No change	High efficiency	Contract extension (beyond 2025) for existing EfW contract
2b	No change	High efficiency	New build energy recovery facility
2c	No change	High efficiency	New build refuse derived fuel facility (RDF)
2d	No change	High efficiency	Utilise 3 rd party energy recovery facility capacity
2e	No change	High recycling performance	Contract extension (beyond 2025) for existing EfW contract
2f	No change	High recycling performance	New build energy recovery facility
2g	No change	High recycling performance	New build refuse derived fuel facility (RDF)
2h	No change	High recycling performance	Utilise 3 rd party energy recovery facility capacity
3a	All measures	High efficiency	Contract extension (beyond 2025) for existing EfW contract
3b	All measures	High efficiency	New build energy recovery facility
3c	All measures	High efficiency	New build refuse derived fuel facility (RDF)
3d	All measures	High efficiency	Utilise 3 rd party energy recovery facility capacity
3e	All measures	High recycling performance	Contract extension (beyond 2025) for existing EfW contract
3f	All measures	High recycling performance	New build energy recovery facility
3g	All measures	High recycling performance	New build refuse derived fuel facility (RDF)
3h	All measures	High recycling performance	Utilise 3 rd party energy recovery facility capacity

Figure 4.1: Assessment Scenarios



4.2 Key Assumptions

As part of the options appraisal process assumptions were made around potential performance and costs. The key assumptions relate to:

- Waste forecasts in future years.
- The performance of prevention, reuse and recycling initiatives (based on the impact on current systems and publicly available information)
- Alternative collection scheme performance and costs – based on a set of agreed assumptions applied in WRAP’s KAT model for the high efficiency and high recycling performance scenario as described in Section 4.0 above
- Waste treatment options performance and costs – based on existing publicly available information.

Details are provided below.

4.2.1 Waste forecasts

National Planning Practice Guidance on waste (NPPG: Waste) provides information in support of the implementation of waste planning policy. It includes guidance on how waste planning authorities should forecast municipal waste arisings and preparing waste growth profiles. The NPPG: Waste methodology was used to prepare a range of growth profiles to estimates future arisings, the detailed analysis is provided in Appendix A.

The analysis resulted in five waste growth scenarios, which are summarised in Table 4.2, with the resulting tonnage forecasts based on MHCLG³ housing forecast provided in Table 4.3 and Figure 4.2.

Table 4.2: Waste Growth Scenarios

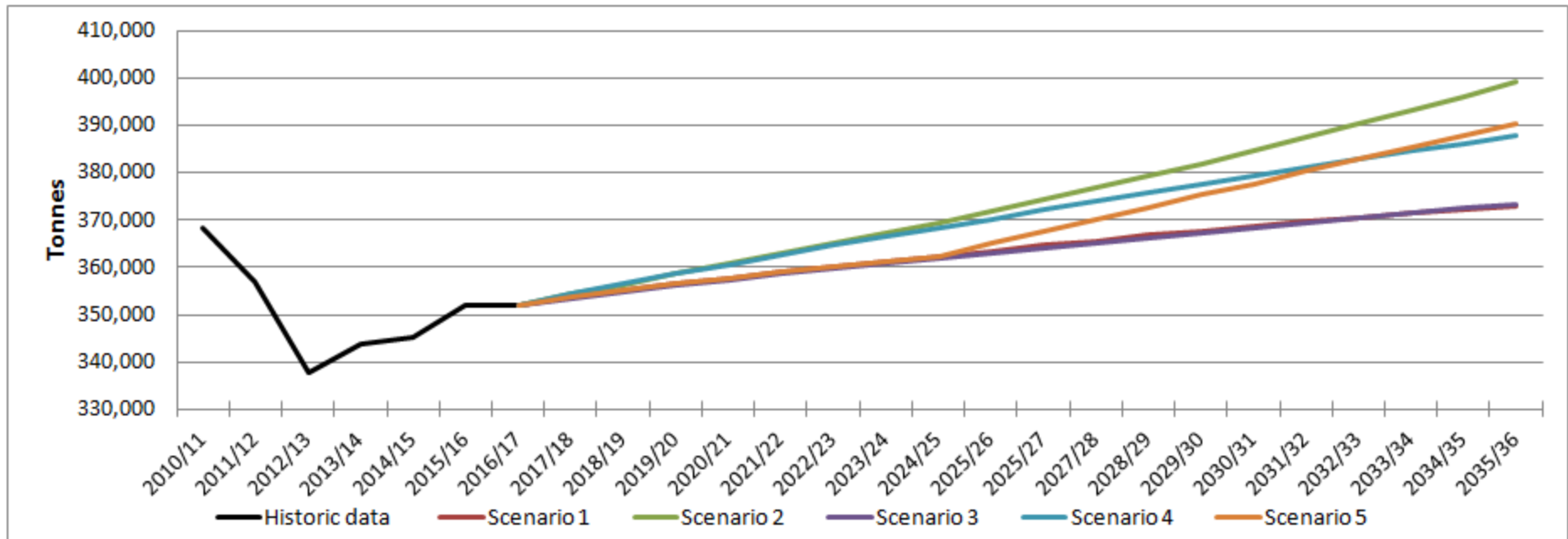
Scenario	Household waste per household assumptions	Non-household waste assumptions
1	Static household waste per household based the 2016/17 figure	Non-households waste remains static at 2016/17 level.
2	The household waste per household changes from the 2016/17 figure based on the annual average change since 2014/15	Non-households waste remains static at 2016/17 level.
3	The household waste per household changes from the 2016/17 figure based on the annual average change since 2012/13	Non-households waste remains static at 2016/17 level.
4	The household waste per household increases at 0.25% per annum from the 2016/17.	Non-households waste remains static at 2016/17 level.
5	As per Scenario 1 up to 2024/25, then a 0.5% per annum increase in household waste per household	Non-households waste remains static at 2016/17 level.

³ Ministry of Housing, Communities and Local Government (formerly DCLG)

Table 4.3: Forecast Tonnage based on MHCLG housing forecast

	2020/21	2025/26	2030/31	2035/36
Scenario 1	357,700	363,500	368,600	373,100
Scenario 2	360,800	371,800	384,600	399,200
Scenario 3	357,400	362,900	368,300	373,300
Scenario 4	360,600	370,200	379,400	388,000
Scenario 5	357,700	365,000	377,700	390,300
Range	357,400 to 360,800	362,900 to 371,800	368,300 to 384,600	373,100 to 399,200

Figure 4.2: Forecast Tonnage based on MHCLG housing forecast



The proposed waste forecasts were agreed at the Options Appraisal Workshop, with Waste Forecast Scenario 4 being used as the forecast in the waste flow model. However, it was also agreed to run a sensitivity analysis on the waste forecasts using the percentage changes in household numbers which are proposed in upcoming Local Plans for some of the constituent Councils. The tonnage forecasts based on the housing growth proposed by each Council is provided in Table 4.4, and highlight that if the housing growth proposed within Local Plans is achieved there is the potential for an additional 18,000 to 20,000 tonnes of waste to be managed per annum.

Table 4.4: Forecast Tonnage based on constituent Council housing forecast

	2020/21	2025/26	2030/31	2035/36
Scenario 1	360,600	372,000	383,400	392,400
Scenario 2	363,600	380,500	399,600	419,600
Scenario 3	360,200	371,200	382,300	391,700
Scenario 4	363,500	378,900	394,500	408,200
Scenario 5	360,600	373,600	393,000	410,900
Range	360,200 to 363,600	371,200 to 380,500	382,300 to 399,600	391,700 to 419,600

4.2.2 Prevention, reuse and recycling initiatives assumptions

For the prevention, reuse and recycling initiatives (including bulky waste recycling and minimisation of contamination in dry recycling and composting), a series of performance and cost assumptions were developed based on information produced by WRAP and industry knowledge. The assumptions are provided in Appendix B. The assumptions were fed into the waste flow model. Appendix C provides an overview of the waste flow model.

4.2.3 Collection modelling assumptions

The collection system modelling was undertaken using WRAP's Kerbside Analysis Tool (KAT). This provided a means to calculate the amount of residual waste requiring treatment depending on the alternative collection system modelled and the level of recycling achieved.

Each Council was provided with KAT data pro-formas to obtain data on their current collection service performance and operation. The pro-formas captured data under the following general headings:

- Vehicle requirements;
- Vehicle specifications / costs / operational parameters and performance;
- Operational and capital costs, financing arrangements and infrastructure procurement details;
- Collection tonnages;
- Round data; and
- Staffing levels.

This data was then used to develop a baseline model. The baseline model reflects the current service operation and therefore provides an accurate representation of the existing service to compare against the alternative collection scenarios. All cost elements are annualised, including existing bins, vehicles etc. This approach allows a 'like for like' comparison against alternative collection systems.

A number of assumptions were made to supplement the information provided. These were based on industry practice, either in the form of WRAP guidance or prior experience from comparable

authorities. All assumptions were agreed with officers prior to modelling. A summary of the KAT modelling assumptions is provided in Appendix D

The outputs from KAT modelling were fed into the waste flow model. In addition, the outputs from KAT have been used to inform the assessment of:

- Criterion 6: Economic regeneration, including employment and a more circular economy, in term of the employment implications of different collection scenarios;
- Criterion 7: Protection of the environment and natural resources, with the different mileage from the different collection scenarios being fed to the WRATE analysis.

4.2.4 Waste treatment options assumptions

The waste flow model allows the performance of each of the scenarios to be tested and provides outputs for the assessment of:

- Criterion 2: Reduces the amount of waste generated by householder and managed by the Councils from baseline forecast;
- Criterion 3: Increases reuse and recycling;
- Criterion 4: Maximises recovery of waste;
- Criterion 5: Working towards zero waste to landfill; and
- Criterion 9. Affordable (long term measure).

To inform the inputs to the waste flow model a series of assumptions were needed about the waste treatment options.

Contract extension (beyond 2025) for existing EfW contract

Under this option, it has been assumed that the existing Haverton Hill EfW continues to be used under an extension to the existing agreements. The performance of the facility remains the same with waste being received from Hartlepool, Middlesbrough, Redcar and Cleveland and Stockton-on-Tees with Darlington continuing to use the Stonegrave treatment facility to prepare an RFD.

The agreed cost profile for the Haverton Hill EfW continues up 2025 after which the gates fee is aligned with market prices.

New build energy recovery facility

The term energy recovery facility can cover a range of technologies and facility designs, such as Incineration (which usually involves the combustion of unprepared residual waste) or Advanced Thermal Treatment (ATT) - the principal processes being gasification and pyrolysis. Both Incineration and ATT technologies offer the option of treating residual waste and recovering energy. However, these technologies are different in how the waste is processed and the energy liberated for recovery, i.e. combustion directly releases the energy in the waste, whereas pyrolysis and gasification thermally treat the waste to generate secondary products (gas, liquid and/or solid) from which energy can be generated.

In the UK, there is a proven commercial and operational track record for incineration, whereas there has been limited success with ATT technologies. Therefore, for the purposes of the options appraisal process it has been assumed that the energy recovery facility would be a new EfW and both electricity only and CHP facilities have been considered. In the result for these scenarios, the assessment only uses the scores for the CHP facility to show the potential benefits from developing a CHP facility. In this scenario it is assumed that waste for all the Councils is sent for the new energy recovery facility from 2025.

In addition, the use of an EfW in the options appraisal process would not prevent an ATT facility being brought forward by a potential contractor in any subsequent procurement process.

New build refuse derived fuel facility (RDF)

Under this option, it has been assumed that waste for all the Councils is sent to a new RDF facility from 2025 with the RDF being exported to Europe, as is the case with the RDF currently produced from Darlington's waste at Stonegrave treatment facility.

Utilise third party energy recovery facility capacity

Under this option, it has been assumed that, from 2025, capacity at an existing EfW facility outside Tees Valley in the UK is secured for the waste for all the Councils. So, alongside the gate fee for the 3rd party EfW facility there is a transport cost of transferring the waste to the energy recovery facility.

4.2.5 WRATE assumptions

The WRATE (Waste and Resources Assessment Tool for the Environment) software developed by the Environment Agency was used to perform a life cycle analysis for the baseline and alternative scenarios (primarily the collection and residual treatment options). WRATE is applied to assess environmental impacts of waste management activities during their whole life cycle. The model incorporates the EcoInvent life cycle database, allowing the environmental impacts of the material inputs and outputs to be calculated. The model includes peer reviewed waste management data and processes to facilitate the benefits and disbenefits of waste treatment, recycling and disposal.

The WRATE results include the following parameters which have been utilised for the Strategy development process, either in terms of this options appraisal or the Strategic environmental assessment:

- Climate Change impacts
- Human Toxicity
- Acidification
- Eutrophication
- Resource Use
- Freshwater Aquatic Toxicity
- Land Take
- Vehicle Mileage data

It should be noted that WRATE is not a good tool for measuring waste prevention or re-use activity, and for these options alternative approaches have been used within the options appraisal.

A comparison of alternative collection and treatment options and the effect of implementing alternative collection systems was modelled using the 2027 waste arisings (from the waste flow model) and associated estimated energy mix (within WRATE). This is the mid-point of the strategy and a point by which alternative residual waste treatment systems are assumed to have been implemented.

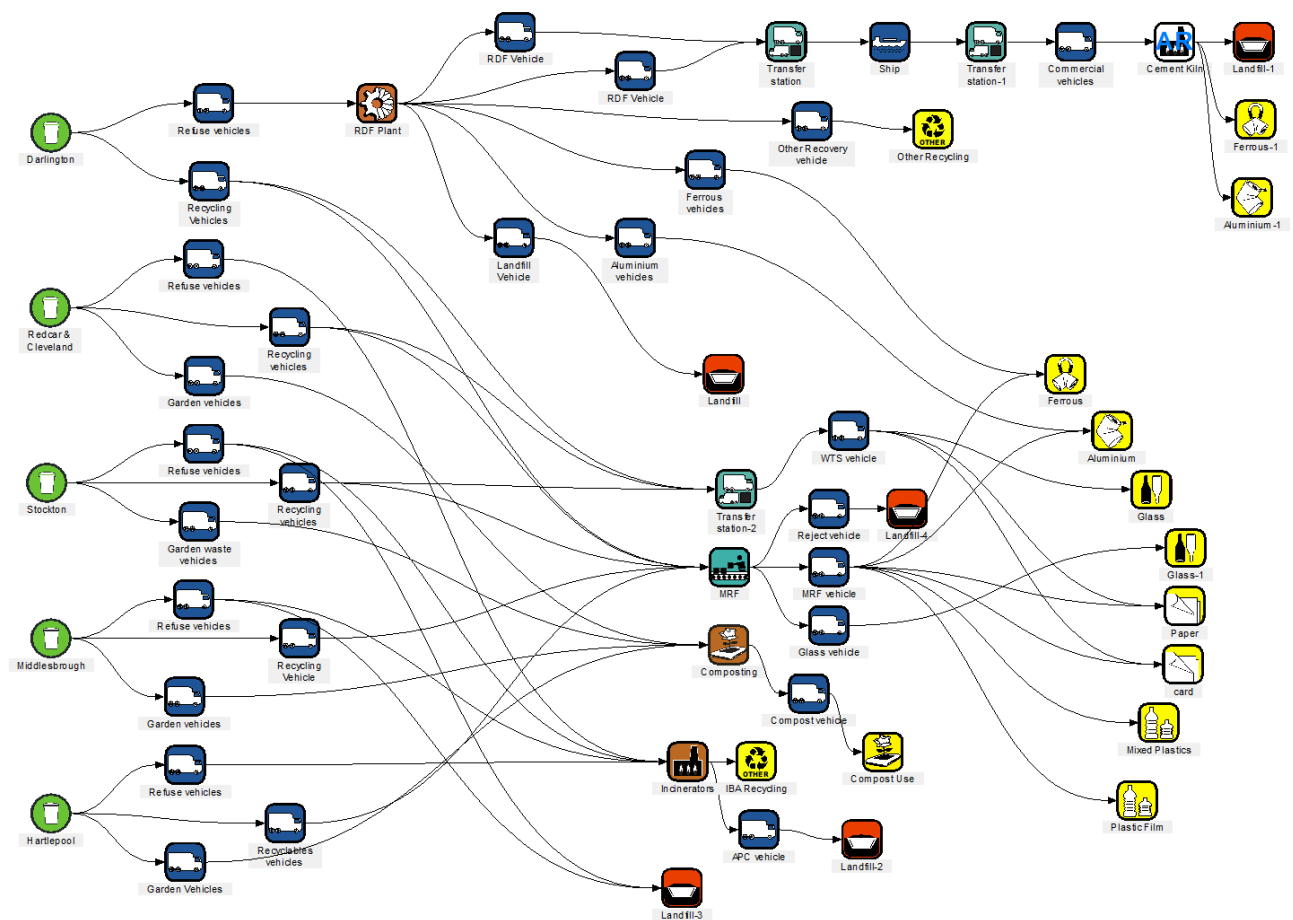
The assumptions applied within the models incorporated the data from the collection modelling (KAT), waste growth assumptions and the waste flow model assumptions. Other key assumptions applied to the modelling are:

- Default technologies and closest vehicles applied from WRATE database

- Existing mass balances and energy recovery efficiency applied for the RDF and EfW plants respectively
- New EfW plant scenario has 29% electrical efficiency
- Third party EfW plant assumed at 50-mile A-B distance from waste arisings
- Anaerobic Digestion assumed for food waste processing
- Where waste is displaced (e.g. via the charged garden collection), this is sent to home composting in the model as a proxy of impact
- Collection mileages from KAT are inflated by the same factor as waste growth (in 2027) as a proxy of vehicle impacts
- RDF is exported as per actual situation, to Latvia
- All reprocessors / non-specific outputs are set as 20km (A-B) distance, with the exception of Air Pollution Control residues which are 50km. Incinerator Bottom Ash (IBA) assumed to be processed at the EfW site, as per current arrangement
- Separated recycle fractions are sent straight to a transfer station, comingled recycle streams to an MRF

Figure 4.3 illustrates the structure of a scenario being modelled using WRATE.

Figure 4.3: Schematic of the Tees Valley WRATE Model



Date 17/05/2018
Software V version 4.0.1.0
Database Version 4.0.1.0

4.2.6 Other Assumptions

2016/17 figure were used for the base year for the waste arisings from WasteDataFlow⁴.

The inflation rate for all costs is assumed to be 2.5% pa other than where future price profiles have been provided.

The changes in the collection arrangements has been modelled to start from 1st April 2020 for all authorities.

In the scenarios where additional recycling communications are employed, and additional activities are used to enhance the recycling at HWRCS, this has been modelled as a 2.5% increase in the amount of recyclates in the first year and a 0.5% increase for the subsequent 9 years ending in 2030. This has been assumed to cost £1 per household in addition to the normal collection costs. The impact of the HWRC interventions will lead to an increase in recycling and reuse of 11% for Middlesbrough, Stockton and Hartlepool or 12% for Redcar and Cleveland and Darlington. The costs to set this up are £50k per site plus an annual cost of £25k for additional staffing.

Anaerobic Digestion

Where scenarios utilise separate food waste collection this is sent to anaerobic digestion, which is modelled as a facility within the Tees Valley area, but no specific facility is represented. A gate fee of £20/t is assumed

New RDF production facility

Based on a typical performance of 33% mass loss, 2% recycling, 35% RDF, 30% landfill.

Costs are £25/t operational cost, RDF gate fee of £100/t and landfill at the prevailing costs (gate fee plus landfill tax)

New EfW

For the scenario analysis, data from a range of facilities has been collated and two options have been assessed. A local facility of 250ktpa capacity and a larger (450ktpa) remote “merchant” facility. The costs for the local facility is estimated at £83.56 /t on a 2016/17 basis and inflated at 2.5% pa. The larger non-local facility was assumed to cost £68.14/t but require £15/t in additional transport costs, but again on a 2016/17 basis plus 2.5% inflation.

The mass balance assumed was, 3.6% APCR and unrecovered IBA to landfill, 2% recycled, 73% process loss and 21.4% recovered IBA.

Landfill

The model assumes a single gate fee of £24.95 plus the landfill tax at the current rate and in subsequent years inflated in line with the other cost in the model at 2.5%. Landfill of asbestos is costed at £181.75/t plus tax.

⁴ the web-based system for LACW data reporting by UK local authorities to government

5 Assessment Results

The options appraisal process involved evaluating the twenty scenarios against the evaluation criteria set out in Table 3.3. A summary of the outputs from the various models used to support the assessment are provided in the following appendices:

- Appendix E: Summary of KAT model outputs
- Appendix F: Summary of waste flow model outputs
- Appendix G: Summary of WRATE outputs

The assessment results are provided in Table 5.1 and graphically in Figure 5.1 which shows the unweighted scores and Figure 5.2 which presents the weighted scores.

For both the unweighted and weighted scores the options which included building of a new energy recovery facility scored best within each scenario. With Scenario 3f, which includes all prevention, reuse and recycling initiatives, high recycling collections and new energy recovery facility, scoring highest overall.

The detailed assessment of each scenario is provided in Appendix H.

Table 5.1: Assessment results

Scenario	1. Delivers an accessible service with engagement and customer satisfaction	2. Reduces the amount of waste generated by household and managed by the Councils	3. Increases reuse and recycling	4. Maximises recovery of waste	5. Working towards zero waste to landfill	6. Economic regeneration, including employment and a more circular economy	7. Protection of the environment and natural resources	8. Reducing the carbon impact of waste management	9. Affordable (long term measure)	10. Deliverability	Unweighted Score	Weighted Score
1a: Contract extension only	1	1	1	3	1	2	2	1	1	0	13	31
1b: New energy recovery only	1	1	1	4	4	5	4	5	1	1	27	60
1c: New RDF only	1	1	1	0	0	4	3	0	1	2	13	36
1d: 3rd Party EfW	1	1	1	3	4	0	3	3	1	2	19	40
2a: High efficiency collection with contract extension	2	4	2	3	2	0	1	2	3	0	19	47
2b: High efficiency collection with new energy recovery	2	4	2	4	4	4	1	5	3	1	30	72
2c: High efficiency collection with new RDF facility	2	4	2	0	0	2	2	1	4	2	19	54
2d: High efficiency collection with 3rd Party EfW	2	4	2	4	4	0	0	4	3	2	25	59
2e: High recycling collection with contract extension	3	4	4	3	3	4	0	2	2	0	25	64
2f: High recycling collection with new energy recovery	3	4	4	4	5	5	0	5	1	2	33	80
2g: High recycling collection with new RDF facility	3	4	4	0	0	4	0	2	2	3	22	64
2h: High recycling collection with 3rd Party EfW	3	4	4	4	5	2	0	4	1	3	30	72
3a: Waste prevention with high efficiency collection and contract extension	3	5	3	3	2	0	2	2	4	0	24	61
3b: Waste prevention with high efficiency collection and new energy recovery	3	5	3	4	4	4	2	5	3	1	34	83
3c: Waste prevention with high efficiency collection and new RDF facility	3	5	3	0	0	2	3	2	4	2	24	67
3d: Waste prevention with high efficiency collection and 3rd Party EfW	3	5	3	4	4	1	1	4	3	2	30	73
3e: Waste prevention with high recycling collection and contract extension	3	4	5	3	4	4	1	2	2	0	28	70
3f: Waste prevention with high recycling collection and new energy recovery	3	4	5	4	5	5	1	5	1	3	36	88
3g: Waste prevention with high recycling collection and new RDF facility	3	4	5	0	0	4	1	3	2	4	26	74
3h: Waste prevention with high recycling collection and 3rd Party EfW	3	4	5	4	5	3	1	4	1	4	34	83

Figure 5.1: Assessment results – unweighted scores

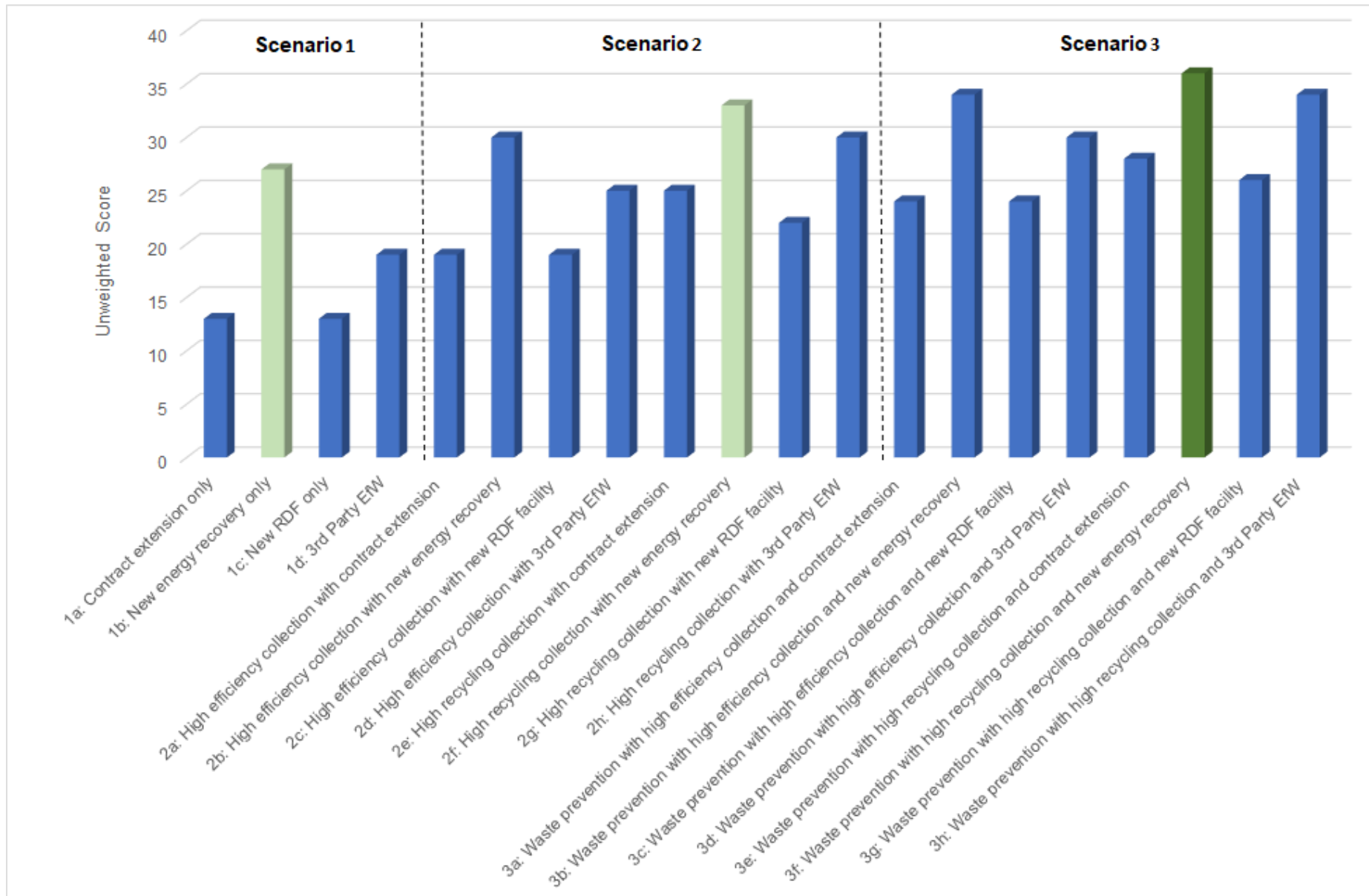
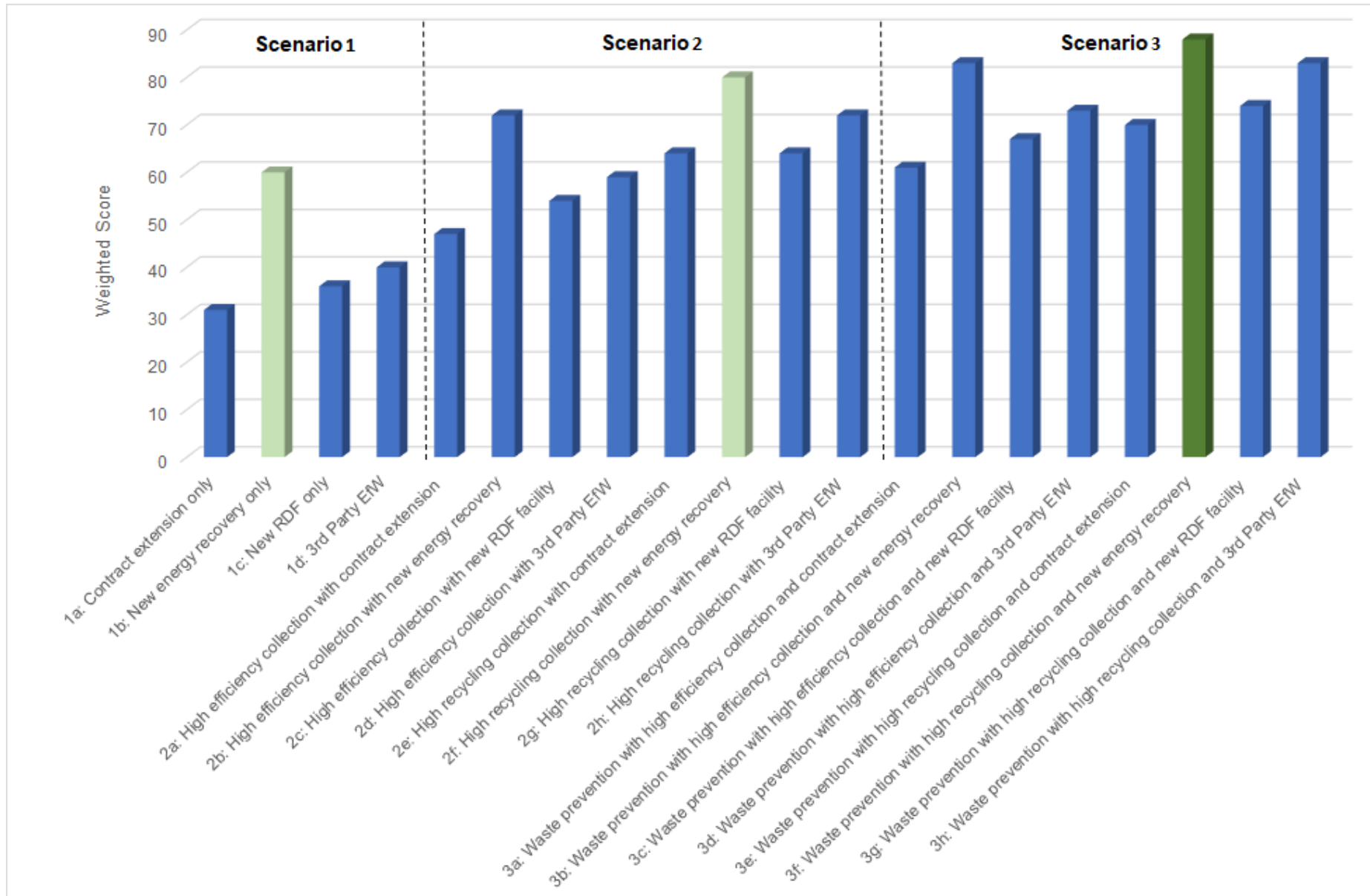


Figure 5.2: Assessment results –weighted scores



6 Discussion

The key factors that influenced the performance of different scenarios were;

6.1 Collection Scenarios

Both the baseline position and the high efficiency collection scenarios in isolation have no or limited impact on the level of reuse or recycling and as a result score less well than the high recycling collection scenarios. In addition, the high efficiency collection scenarios reduce the coverage and frequency of certain collections services which results in a loss of collection jobs; whereas the high recycling collection scenarios increases the number of collection jobs.

6.2 Prevention, reuse and recycling initiatives

The various waste prevention, reuse and recycling initiatives contribute to improved engagement, reuse and recycling, resource recovery and increased deliverability (due to consistency with current and emerging national policy). Therefore, Scenario 3s score better than the comparable Scenario 2s.

6.3 Waste treatment options

The different waste treatment options have a range of influencing factors:

- Scenarios based on a contract extension (beyond 2025) of the existing EfW contract perform poorly in terms of: economic regeneration/employment because no new jobs are created and is unlikely to help to secure other jobs in Tees Valley; the carbon impact of waste management because of the efficiency of the facility and no CHP capability; and deliverability mainly due to the fact that further extension to the current contract without competition is highly likely to be in breach of procurement rules.
- Scenarios which include a new build energy recovery facility score well because: they have the potential to secure jobs in the construction engineering sectors during construction of a new facility and if a CHP facility is developed it could help to secure employment in the energy use and manufacturing sector; also, a CHP facility would significantly reduce the carbon impacts of waste management. However, there are some deliverability issues related to securing funding and locating a suitable site.
- Scenarios which include a new build refuse derived fuel facility (RDF) perform poorly in terms of maximising recovery, diversion of waste from landfill and reducing the carbon impacts of waste management. This is because there is a significant increase in the amount of waste sent to landfill when compared to the current situation and the other technology options considered.
- Scenarios which utilise 3rd party energy recovery facility capacity score poorly on economic regeneration/employment because it is assumed that the 3rd party facility is located outside Tees Valley, resulting in a loss of jobs in the waste management sector. It also scores less well than the new build energy recovery facility on reducing carbon impacts, as it was assumed that the 3rd party facility is not CHP enabled and there is additional transport.

Therefore, based on the agreed evaluation criteria, and regardless of weighting, the preferred option would be; all prevention, reuse and recycling initiatives, high recycling collections and new energy recovery facility. The outcome is consistent with the approach adopted in the existing Waste Strategy.

Appendix A: Waste Forecast

Methodology

National Planning Practice Guidance on waste (NPPG: Waste) provides information in support of the implementation of waste planning policy. It includes guidance on how waste planning authorities should forecast municipal waste arisings preparing growth profiles. Box A1 reproduces the guidance for the 2014 revision (<https://www.gov.uk/guidance/waste> accessed 3rd February 2018)

Box A1: National Planning Practice Guidance: Waste

How should waste planning authorities forecast waste arisings?

Waste planning authorities should anticipate and forecast the amount of waste that should be managed at the end of the plan period. They should also forecast waste arising at specific points within the plan period, so as to enable proper consideration of when certain facilities might be needed. However, the right balance needs to be made between obtaining the best evidence to inform what will be necessary to meet waste needs, while avoiding unnecessary and spurious precision.

Paragraph: 028 Reference ID: 28-028-20141016

How should waste planning authorities forecast future municipal waste arisings?

Forecasts of future municipal waste arisings are normally central to the development of Municipal Waste Management Strategies.

It will be helpful to examine municipal waste arisings according to source (ie household collections, civic amenity site wastes, trade waste etc.). This may allow growth to be attributed to particular factors and to inform future forecasts.

A 'growth profile', setting out the assumed rate of change in waste arisings may be a useful starting point for forecasting municipal waste arisings. The growth profile should be based on 2 factors:

- household or population growth; and
- waste arisings per household or per capita.

Paragraph: 029 Reference ID: 28-029-20141016

How is a growth profile prepared?

A growth profile is prepared through a staged process:

- calculate arisings per head by dividing annual arisings by population or household data to establish short- and long-term average annual growth rates per household and
- factor in a range of different scenarios, e.g. constant rate of growth, progressively lowering growth rates due to waste minimisation initiatives.

The final forecast can then be modelled with scenarios based on the long- and short-term rate of growth per household, together with household forecasts.

Paragraph: 030 Reference ID: 28-030-20141016

Housing data and forecasts

To analyse the trends in waste generation per household, historic household numbers 2016/17 are required, along with household forecasts up to 2031 to consider future trends.

Ministry of Housing, Communities and Local Government (MHCLG formerly DCLG) housing data⁵ cover the period from 2010 to 2039. This data allows current trends in waste per household to be analysed using the same dataset that will be used for estimating future arisings, ensuring the dataset is internally consistent.

⁵ Table 406 of the Household_Projections_Published_Tables spreadsheet published in July 2016. <https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections>

3 to 5 Year Trends

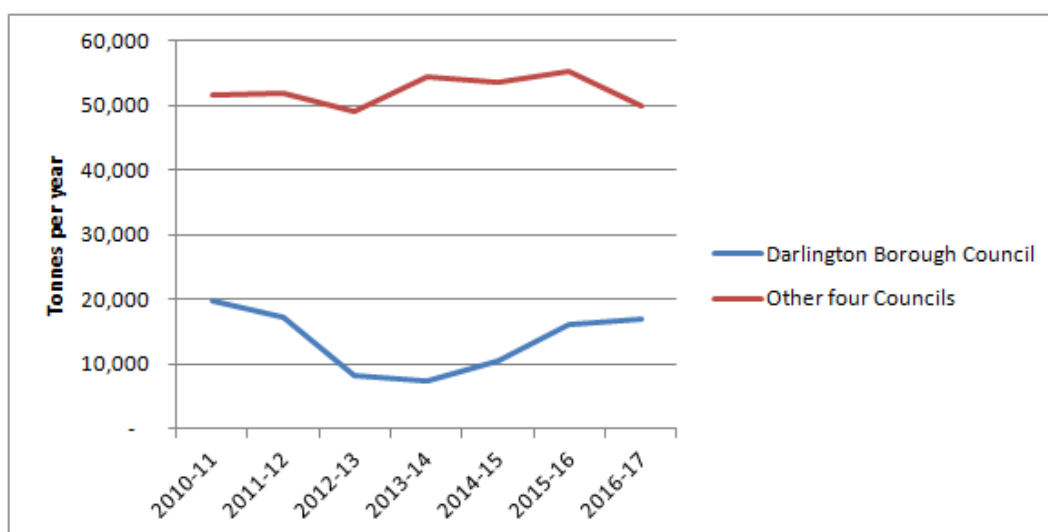
The trends are considered over the last three to five years as this coincides with the low point in LACW arisings both in Tees Valley and nationally following the impact of the recession on waste generation levels, see Table A1.

Household waste growth is broadly consistent with growth in the number of households, with the growth in LACW being driven more by the growth in non-household waste. The change in the non-household waste over the last five years is effectively as a result of the increase of 9,000 in Darlington over the last five years, with total for the other four authorities sitting between 50,000 and 55,000 tpa over the last five years, see Figure A1. Figure A1 also highlights that the non-household waste in Darlington has recover to the pre 2012-13 levels.

Table A1: Tees Valley LACW tonnage Trends

	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Number of Households ('0000) Source: MHCLG ¹	281.40	283.05	284.31	285.50	286.79	288.14	289.70
Annual average change since 2014/15						0.51%	
Annual average change since 2012/13					0.47%		
Total LACW	368,444	356,897	337,664	343,809	345,150	352,107	352,116
Annual average change since 2014/15						1.00%	
Annual average change since 2012/13					1.05%		
Total household waste	296,970	287,654	280,321	281,885	281,138	280,538	285,160
Annual average change since 2014/15						0.71%	
Annual average change since 2012/13					0.43%		
Total non-household waste	71,474	69,243	57,343	61,924	64,014	71,570	66,956
Annual average change since 2014/15						2.27%	
Annual average change since 2012/13					3.95%		
1. Ministry of Housing, Communities and Local Government (formerly DCLG)							

Figure A1 Total non-household waste, 2010-11 to 2016-17



The overall household waste per household for Tees Valley has been effectively static over the last three to five years, as shown in Table A2 below. Although, there are differences in the trends between the authorities but there is no consistent trend.

Table A2: Trends in household waste per household

Household waste per household	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Darlington	1.06	1.02	0.98	0.98	0.93	0.94	0.93
Annual average change since 2014/15						-0.15%	
Annual average change since 2012/13					-1.17%		
Hartlepool	1.06	1.03	1.01	1.05	1.01	1.00	0.99
Annual average change since 2014/15						-0.70%	
Annual average change since 2012/13					-0.52%		
Middlesbrough	1.09	1.04	1.00	0.97	0.97	0.98	1.02
Annual average change since 2014/15						2.96%	
Annual average change since 2012/13					0.55%		
Redcar and Cleveland	1.01	0.97	0.92	0.93	0.96	0.96	0.95
Annual average change since 2014/15						-0.32%	
Annual average change since 2012/13					0.97%		
Stockton-on-Tees	1.06	1.03	1.02	1.02	1.02	0.99	1.00
Annual average change since 2014/15						-0.70%	
Annual average change since 2012/13				-0.31%			
Tees Valley	1.06	1.02	0.99	0.99	0.98	0.97	0.98
Annual average change since 2014/15						0.21%	
Annual average change since 2012/13					-0.04%		

Economic growth and waste generation

Historical trends in most industrial economies show that resource use and the resulting waste generation is linked to economic activity. Decoupling economic growth from waste generation is the main objective of recent waste policies (e.g. waste prevention, resource efficiency, circular economy) across Europe. Consequently, there have been a number of studies over the last few years that look at the relationship between waste growth and economic growth.

At the end of 2012, WRAP published a report⁶ highlighting that household waste arisings peaked between 2003 and 2007 and started to fall before the start of the recession, showing strong evidence of decoupling. For England, there was strong evidence of decoupling of household waste arisings from Gross Disposable Household Income⁷ and a short period of decoupling with Gross Value Added⁸. However, from 2005/06 waste rose and fell in line with Household Expenditure⁹, suggesting a strong link, or coupling, between Household Expenditure and household waste arisings, as would be expected.

It also highlighted that the perception of the 2007 credit crunch precipitated a loss of consumer confidence, with Household Expenditure falling while income was yet unaffected, and that household waste arisings are not coupled to Gross Disposable Household Income at a time of low consumer confidence (although they may well be at other more positive times).

More recent modelling¹⁰ undertaken by the National Infrastructure Commission (NIC) to inform the National Infrastructure Assessment highlighted that historical data shows that waste generation is correlated with economic activity. However, recent trends indicate that economic growth and LACW arisings may be decoupling (i.e. using less resources and generating less waste per unit of economic activity). Due to the uncertainty around the rate at which waste arisings may decouple from economic growth in the future, a sensitivity analysis of the degree of decoupling was factored into this modelling of future LACW arisings.

The NIC modelling of future LACW arisings suggested LACW arisings of between 31 million tonnes and 59 million tonnes by 2050; with the exception of the model which assumed a high decoupling rate, which indicated a reduction to 23 million tonnes compared with a 2015 arising of 26 million tonnes.

Therefore, when forecasting future LACW arisings, there is a need to recognise a degree of decoupling of waste growth from economic growth but a correlation of house expenditure with LACW growth is still evident.

Therefore, three growth scenarios based on the trends over the last five years have been considered along with two scenarios that assume a level of economic growth which increase the waste generation per household:

- One scenario considers a small increase of 0.25% per annum in household waste per household from 2016/17; and

⁶ WRAP, Decoupling of Waste and Economic Indicators, October 2012

⁷ Gross Disposable Household Income (GDHI) – an alternative measure of income; it measures what is available for households to spend or save once taxes, social contributions, pension contributions and property ownership have been taken into account.

⁸ Gross Value Added (GVA) measures the contribution to the economy of each individual producer, industry or sector in the United Kingdom and is a headline measure used to monitor economic performance.

⁹ Household Expenditure (HE) encompasses all domestic outlays (by residents and non-residents) for individual needs, including expenditure on goods and services.

¹⁰ Infrastructure Commission (NIC) Modelling Results Roundtable, London, June 2017

- Another scenario seeks to reflect an increase in the UK economy from growth in manufacturing within the UK, as a result of the UK's decision to leave the European Union. However, there is clearly a degree of uncertainty over how the UK economy will change as a result of Brexit.

The scenarios are summarised in Table A3

Table A3: Waste Growth Scenarios

Scenario	Household waste per household assumptions	Non-household waste assumptions
1	Static household waste per household based the 2016/17 figure	Non-households waste remains static at 2016/17 level.
2	The household waste per household changes from the 2016/17 figure based on the annual average change since 2014/15	Non-households waste remains static at 2016/17 level.
3	The household waste per household changes from the 2016/17 figure based on the annual average change since 2012/13	Non-households waste remains static at 2016/17 level.
4	The household waste per household increases at 0.25% per annum from the 2016/17.	Non-households waste remains static at 2016/17 level.
5	As per Scenario 1 up to 2024/25, then a 0.5% per annum increase in household waste per household	Non-households waste remains static at 2016/17 level.

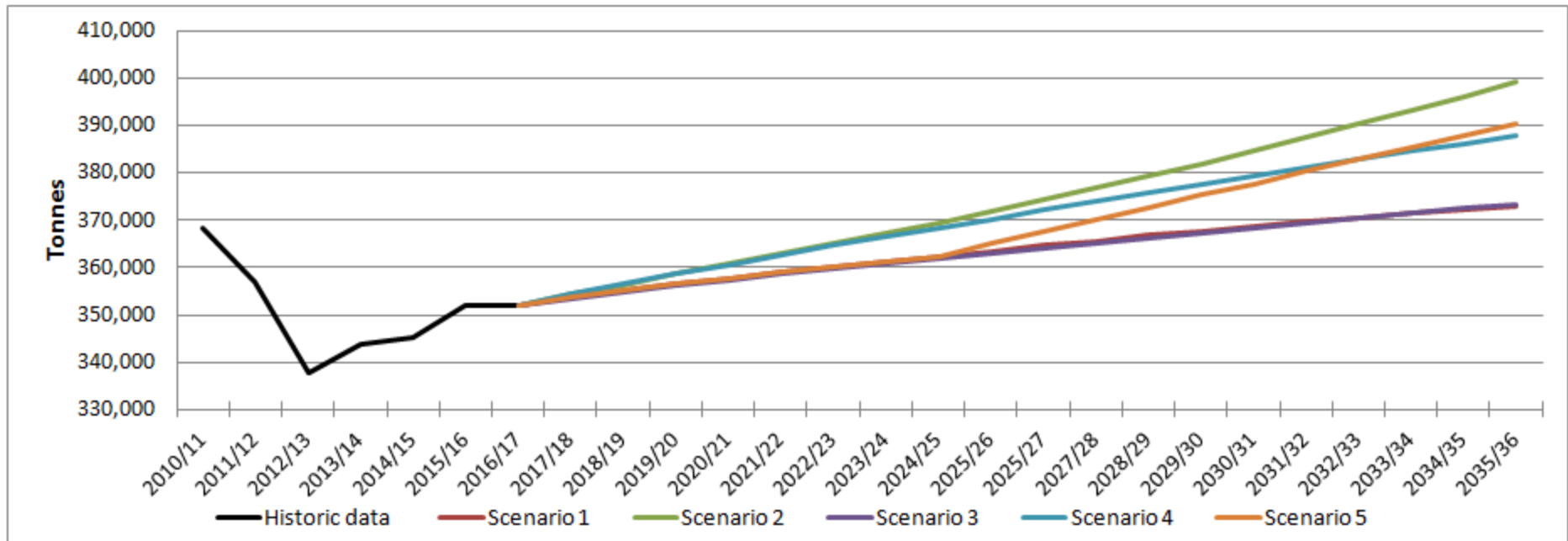
Table A4 and Figure A2 at a 'Tees Valley' level shows Scenarios 1 and 3 are almost identical with an average annual growth equivalent to 0.3%. Scenario 2 shows a higher growth, equivalent to 0.7% average annual growth, mainly due to the 3% increase in the household waste per household in Middlesbrough over the last three years. Scenarios 4 and 5 show average annual growth equivalent to 0.5% and 0.55% respectively and therefore sit between Scenarios 1 & 3 and Scenario 2.

Table A4: Forecast Tonnage based on MHCLG housing forecast

Waste Forecast	2020/21	2025/26	2030/31	2035/36
Scenario 1	357,700	363,500	368,600	373,100
Scenario 2	360,800	371,800	384,600	399,200
Scenario 3	357,400	362,900	368,300	373,300
Scenario 4	360,600	370,200	379,400	388,000
Scenario 5	357,700	365,000	377,700	390,300
Range	357,400 to 360,800	362,900 to 371,800	368,300 to 384,600	373,100 to 399,200

The proposed waste forecasts were agreed at the Options Appraisal Workshop, with Waste Forecast Scenario 4 being used as the central forecast in the waste flow model. However, it was also agreed to run a sensitivity analysis on the waste forecasts using the percentage changes in household numbers which are proposed in upcoming Local Plans for some of the constituent Authorities.

Figure A2: Forecast Tonnage based on MHCLG housing forecast



Appendix B: Waste Prevention, Reuse and Recycling Initiatives Assumptions

Option	Raising waste awareness and education campaigns
Current Activity	<p>Overall communications are focussed on operational information (including social media, calendars, leaflets, bin stickers, vehicle side advertisements, press releases, council magazine) with limited budget allocated to campaigns on raising waste awareness and education.</p> <p>Annual budgets for waste related communications are</p> <ul style="list-style-type: none"> • Darlington: £3k • Hartlepool: £12k • Middlesbrough: None Allocated • Redcar & Cleveland: None Allocated • Stockton-on-Tees: None Allocated
Description	<p>A rolling programme of campaigns designed to raise awareness and increase participation in waste prevention and reuse activities, including:</p> <ul style="list-style-type: none"> • General education and waste prevention initiatives; • General reuse initiatives • Love Food Hate Waste • Junk Mail • Promoting smart shopping practices
Performance Assumptions	<p>There is no definitive evidence base on the impact of communications campaigns due to the range of variables related to the impacts.</p> <p>Modelling assumption: 2.5% uplift in recycling in year 1 followed by 0.5% per annum</p> <p>Modelling assumption: .0.1% waste prevention per annum</p>
Cost Assumptions	<p>WRAP - Improving recycling through effective communications:</p> <p><i>'There is, unfortunately, no simple formula to determine how much needs to be spent on communications to achieve any given desired result. There are too many variables and too many ways of achieving results for such a formula to exist. As a rule of thumb, however, experience suggests that an effective campaign costs a minimum of £1.00 per household (NB. This will vary and for small LAs the figure could be greater as core costs for activities like monitoring etc will absorb a greater proportion of your funding). Your budget may also need to be proportionally greater if, for example, you are launching a new authority-wide service. If your plan requires a budget of much less or more than this figure (e.g. £0.50 - £1.50 per household) it is not necessarily wrong but you should reconsider it and satisfy yourself that your proposed budget is neither too high nor too low. These figures will give you an approximate target budget to aim at.'</i></p> <p>Modelling assumption: £1/household per year</p>

Option	Home Composting / Digestion
Current Activity	The Council currently do not heavily promote composting. A couple of council's direct residents to the RecycleNow composting website and another directs to the getcomposting.com website for subsidised home composting bins.
Description	Actively promote home composting (or anaerobic / aerobic digestion) to reduce the demand on collection services and treatment capacity by providing a £5 subsidy per composting bin.
Performance Assumptions	Modelling assumption: 1000 composting bins requested per annum for 5 years 150kg diversion per composting bin per year Lapse rate 5% per annum Tonnage diversion Year 1: 150 tonnes Year 2: 293 tonnes Year 3: 428 tonnes Year 4: 557 tonnes Year 5: 679 tonnes etc Based on WRAP Waste Prevention Calculator from 2010
Cost Assumptions	Modelling assumption: £5 subsidy per composting bin. Communications costs covered as part of overall waste awareness and education campaigns options.

Option	Recycling & Reuse at Household Waste Recycling Centres (HWRC)
Current Activity	There is a high level of landfill diversion (96%) from the HWRCs due to the majority of residual waste being diverted to the Haverton Hill EfW facility. However, the recycling rates (excluding rubble) at the HWRCs are low (30%-43%) compared to the UK average of 62% in 2015/16 ¹
Description	Install facilities at HWRCs that allow members of the public to leave and collect items such as furniture. This can include awareness and promotional campaigns of the service. The WRAP HWRC Toolkit has been used to estimate the impact of: <ul style="list-style-type: none"> • Introducing reuse system; • Introducing/expanding 'meet and greet' policy with an additional staff member; • Rebranding the site as strongly focused on recycling and reuse; and • Introducing activities that strongly promote on recycling and reuse or displaying current recycling rate on site.
Performance Assumptions	The WRAP HWRC Toolkit indicates that the above activities could increase the recycling rates (excluding rubble) at the HWRCs as follows: <ul style="list-style-type: none"> • Haverton Hill: +11% • Burn Rd: +11% • Dunsdale Rd: +12% • Mewburn Rd: +12%
Cost Assumptions	WRAP: HWRC shops overview 2016:

	<p><i>'Smaller shops cost an average of £12,000 to set up (approximately £200 per sq. metre). Larger shops cost an average of £135,000, or £380 per sq. metre, to set up'.</i></p> <p><i>'Most shops cover their running costs and larger shops can generate substantial tonnage and profit returns.'</i></p> <p>Modelling assumption: One off set up cost of £50,000 per site and cost neutral running costs.</p> <p>Modelling assumption: £25,000 per annum per additional staff member, assume one per site (4 in total)</p> <p>Communications costs covered as part of overall waste awareness and education campaigns options.</p>
1. WRAP HWRC Toolkit (May 2017)	

Option	Bulky waste collection reuse and recycling
Current Activity	<p>There is limited information on the extent of bulky waste collection reuse and recycling.</p> <ul style="list-style-type: none"> • Darlington: Charged (£16.83 for 6 items) 472 tonnes collected, from 4,577 collections Recycled, reuse and resale – Not known Cost of service £74.6k, Income ~£77k (based on collections) • Hartlepool: Charged (£20 for 3 items) 243 tonnes collected 12% recycled (scrap metal, wood, WEEE), no reuse and resale Cost of service £25k, Income £31.6k • Middlesbrough: Charged (£10 for up to 5 Items) 500 tonnes collected (estimated) 20% recycled, no reuse and resale No separate cost information • Redcar & Cleveland: Charged (£18/6 items; £29/7-12 items; £39/13-18 items) 291 tonnes collected (budgeted) Recycled, reuse and resale – Not known No separate cost information, Income £80k • Stockton: Charged (£15 for 6 items) 749 tonnes collected 36% recycled, no reuse and resale No separate cost information
Description	Sort bulky waste collections to extract reusable goods with a view to refurbishment, reuse and resale either by 3 rd sector organisations or via re-use shops at HWRCs. Awareness and promotional campaigns to support this option would be included as part of the overall waste awareness and education campaigns options.
Performance Assumptions	<p>WRAP - Composition and reuse potential of household bulky waste in the UK (2012): <i>"For items collected via bulky waste collections, surveyors estimated that across all types of items 24% of bulky items were re-usable, with a further 16% assessed as re-usable with slight repair"</i>.</p> <p>Modelling assumption 25% of collected bulky is diverted to reuse.</p>

Cost Assumptions	<p>Awareness and education costs covered as part of overall waste awareness and education campaigns options.</p> <p>No net changes in service delivery costs as assumed that any additional costs would be reflected in charges.</p> <p>Cost saving from avoided treatment disposal costs of material reused.</p>
------------------	---

Option	Reducing contamination
Current Activity	<p>There is limited information on the extent of bulky waste collection reuse and recycling.</p> <ul style="list-style-type: none"> • Hartlepool 22% • Darlington 15% • Middlesbrough 12.2% - 14% (KAT modelling used the 12.2%) • Redcar & Cleveland 25.1% • Stockton on Tees 2.8%
Description	<p>A combination of communication and enforcement reduce the contamination levels in the dry recycling collection. Awareness and promotional campaigns to support this option would be included as part of the overall waste awareness and education campaigns options.</p>
Performance Assumptions	<p>There is no definitive evidence base on the impact of communications campaigns and enforcement on reducing the level of contamination due to the range of variables related to the impacts.</p> <p>Modelling assumption: A reduction of one third in the level of contamination of the single and two stream collection of recycling, which is correctly place in the residual waste stream</p>
Cost Assumptions	<p>Awareness and education costs covered as part of overall waste awareness and education campaigns options.</p> <p>Modelling assumption: £30,000 per annum per add additional staff member, assume one per Council collecting dry recycling co-mingled</p> <p>Cost saving on tonnage entering the MRF</p>

Appendix C: Tees Valley Waste Flow Model

Overview

The waste flow model for this project has been developed to allow the quick evaluation of changes to the ways waste is managed over time. The model allows the impacts of alternative collection scenarios and treatment processes through to the end disposal points or markets to be determined. In addition, it is possible to model alternative disposal arrangements so that the scale of facilities that might be considered can be determined and the resultant costs evaluated.

The model also captures the costs associated with the various treatment operations and the different collection schemes. This is carried out in a simple method of applying gate fee type calculations to the tonnages processed or a cost per household to the collection costs. This provides a consistent methodology for comparing the cost impacts resulting from the alternative waste management systems considered.

Appendix D: Summary of KAT Modelling Assumptions

High efficiency collection scenario

This represents a 'high efficiency' option incorporating a charged garden waste service and a fortnightly residual waste collection using 140 litre wheeled bins. Dry recycling remains as per the current systems, albeit with higher performance due to the restricted residual capacity¹¹. The assumptions used for the garden waste service can be found within Table D1. Due to the restricted residual service it was assumed that only 20% of the garden waste no longer collected via the charged system would be put into the residual stream and 30% would be sent to HWRC's. The remaining 50% of 'non-collected' garden waste is assumed to be prevented / home composted. It was also assumed that as the service is a charged service, garden waste contamination would be 0%.

Table D1: Assumptions used for the modelling of High Efficiency scenario

Assumptions	
Subscription fee	£35/hh
Take up (of those that received the free garden waste collection)	30%
Set out amongst subscribers	95%
Participation amongst subscribers	100%
Proportion of GW Tonnage collected ¹²	45%

High recycling collection scenario

This scenario models a 'high recycling performance option'. It applies a charged garden waste service (as outlined in the High Efficiency Scenario), a separate weekly food waste collection, a fortnightly 2 stream dry recycling collection and a three-weekly residual collection in 240l wheeled bins. A restricted residual waste service combined with regular recycling collections was modelled to maximise the amount of material segregated for recycling. The assumptions used for the increase in recycling performance are outlined in Table D2.

Table D2: Assumptions used for the modelling of the enhanced dry recycling

Assumptions- dry recycling stream	
Participation	+ 7.5%
Set out	+ 5%
Capture	+ 2.5%
Contamination	+ 2%

In addition, the food waste collection was modelled to deliver a high yield of food waste via the weekly service. The data was sourced from the WRAP 'Ready Reckoner' formula and assuming a 60% participation rate.

¹¹ The enhanced dry recycling is the same as the increase shown in Table D2 (High recycling scenario)

¹² Versus the free service, as currently offered in all Tees Valley Authorities except Darlington

Appendix E: Summary of KAT model outputs

Table E3: Indicative annualised collection costs and kerbside recycling performance for all Councils

Gross annualised collection costs/kerbside recycling performance (%)						
Council	Baseline		High efficiency option		High recycling option	
Darlington	£3,068,664	21%	£3,248,679	29%	£3,615,253	45%
Hartlepool	£3,478,372	32%	£2,533,937	27%	£3,370,668	41%
Middlesbrough	£4,455,631	31%	£3,163,232	28%	£3,869,119	36%
Redcar & Cleveland	£5,281,723	43%	£4,461,639	39%	£5,169,295	52%
Stockton-on-Tees	£6,236,458	21%	£6,015,219	21%	£6,806,005	31%
Tees Valley	£22,520,848	29%	£19,422,706 [£17,383,088*]	28%	£22,830,340 [£20,790,722*]	40%
* includes Garden waste service subscription net revenue						

Table E4: Number of front line roles required to operate collection service for all Councils

Council	Baseline	High efficiency option	High recycling option
Darlington	39	42	53
Hartlepool	36	30	46
Middlesbrough	57	39	54
Redcar & Cleveland	76	64	78
Stockton-on-Tees	91	78	98
Tees Valley	299	253	329

Table E5 Collection mileage, derived from KAT and inflated to 2027 projection (km)

Council	Baseline	High efficiency option	High recycling option
Darlington	342,029	359,292	492,353
Hartlepool	623,680	309,909	474,569
Middlesbrough	250,001	199,404	259,744
Redcar & Cleveland	1,041,667	884,785	1,386,169
Stockton-on-Tees	591,697	587,813	794,664
Tees Valley	2,849,074	2,341,204	3,407,500

Appendix F: Summary of waste flow model outputs

Scenario 1a (Baseline)		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	358,024	360,016	361,934	363,711	365,511	367,313	369,224	371,049	372,838	374,567	376,317	378,145	379,860	381,553	383,138	384,737
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	34.1%	34.1%	34.0%	34.0%	34.0%	34.0%	33.9%	33.9%	33.9%	33.9%	33.8%	33.8%	33.8%	33.8%	33.7%	33.7%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.3%	89.3%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.4%	89.4%	89.4%	89.4%	89.5%	89.5%	89.5%	89.5%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	6.2%	6.2%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%
	NPV	£505,244,769																			
Scenario 1b		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	358,024	360,016	361,934	363,711	365,511	367,313	369,224	371,049	372,838	374,567	376,317	378,145	379,860	381,553	383,138	384,737
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	34.1%	34.1%	34.0%	34.0%	34.0%	34.2%	34.2%	34.1%	34.1%	34.1%	34.0%	34.0%	34.0%	34.0%	34.0%	33.9%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.3%	89.3%	89.3%	89.3%	89.4%	93.3%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	6.2%	6.2%	6.1%	6.1%	6.1%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%
	NPV	£514,479,309																			
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0%	4.0%	4.0%	4.0%	4.0%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%
	9: % change in NPV	1.8%																			
Scenario 1c		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	358,024	360,016	361,934	363,711	365,511	367,313	369,224	371,049	372,838	374,567	376,317	378,145	379,860	381,553	383,138	384,737
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	34.1%	34.1%	34.0%	34.0%	34.0%	34.2%	34.2%	34.1%	34.1%	34.1%	34.0%	34.0%	34.0%	34.0%	34.0%	33.9%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.3%	89.3%	89.3%	89.3%	89.4%	64.9%	64.9%	64.9%	65.0%	65.0%	65.0%	65.0%	65.1%	65.1%	65.1%	65.1%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	6.2%	6.2%	6.1%	6.1%	6.1%	20.2%	20.2%	20.2%	20.2%	20.2%	20.2%	20.3%	20.3%	20.3%	20.3%	20.3%
	NPV	£494,885,562																			
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-24.5%	-24.5%	-24.5%	-24.4%	-24.4%	-24.4%	-24.4%	-24.4%	-24.4%	-24.4%	
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	
	9: % change in NPV	-2.1%																			
Scenario 1d		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	358,024	360,016	361,934	363,711	365,511	367,313	369,224	371,049	372,838	374,567	376,317	378,145	379,860	381,553	383,138	384,737
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	34.1%	34.1%	34.0%	34.0%	34.0%	34.2%	34.2%	34.1%	34.1%	34.1%	34.0%	34.0%	34.0%	34.0%	34.0%	33.9%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.3%	89.3%	89.3%	89.3%	89.4%	93.3%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	6.2%	6.2%	6.1%	6.1%	6.1%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	
	NPV	£513,847,597																			
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0%	4.0%	4.0%	4.0%	4.0%	3.9%	3.9%	3.9%	3.9%	3.9%	
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	
	9: % change in NPV	1.7%																			

Scenario 2a		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	351,723	353,674	355,551	357,293	359,055	360,821	362,693	364,481	366,235	367,930	369,645	371,437	373,117	374,777	376,331	377,899
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	34.4%	34.4%	34.4%	34.4%	34.3%	34.3%	34.3%	34.3%	34.2%	34.2%	34.2%	34.2%	34.1%	34.1%	34.1%	34.1%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
	NPV	£468,574,929																			
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.34%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.13%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
	9: % change in NPV	-7.3%																			
Scenario 2b		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	351,723	353,674	355,551	357,293	359,055	360,821	362,693	364,481	366,235	367,930	369,645	371,437	373,117	374,777	376,331	377,899
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	34.4%	34.4%	34.4%	34.4%	34.3%	34.5%	34.5%	34.5%	34.4%	34.4%	34.4%	34.4%	34.3%	34.3%	34.3%	34.3%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.5%	89.5%	89.5%	89.5%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	6.0%	6.0%	6.0%	6.0%	6.0%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%
	NPV	£477,748,444																			
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%	0.3%	0.3%	0.3%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%
	9: % change in NPV	-5.4%																			
Scenario 2c		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	351,723	353,674	355,551	357,293	359,055	360,821	362,693	364,481	366,235	367,930	369,645	371,437	373,117	374,777	376,331	377,899
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	34.4%	34.4%	34.4%	34.4%	34.3%	34.5%	34.5%	34.5%	34.4%	34.4%	34.4%	34.4%	34.3%	34.3%	34.3%	34.3%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.5%	89.5%	89.5%	89.5%	64.8%	64.9%	64.9%	64.9%	64.9%	65.0%	65.0%	65.0%	65.1%	65.1%	65.1%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	6.0%	6.0%	6.0%	6.0%	6.0%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%
	NPV	£458,598,575																			
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%	0.3%	0.3%	0.3%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	-24.5%	-24.5%	-24.5%	-24.5%	-24.5%	-24.5%	-24.4%	-24.4%	-24.4%	-24.4%	-24.4%
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	13.9%	14.0%	14.0%	14.0%	14.0%	14.0%	14.0%	14.0%	14.0%	14.0%	14.0%
	9: % change in NPV	-9.2%																			
Scenario 2d		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	351,723	353,674	355,551	357,293	359,055	360,821	362,693	364,481	366,235	367,930	369,645	371,437	373,117	374,777	376,331	377,899
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	34.4%	34.4%	34.4%	34.4%	34.3%	34.5%	34.5%	34.5%	34.4%	34.4%	34.4%	34.4%	34.3%	34.3%	34.3%	34.3%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.5%	89.5%	89.5%	89.5%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%	93.4%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	6.0%	6.0%	6.0%	6.0%	6.0%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%
	NPV	£477,131,043																			
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%	0.3%	0.3%	0.3%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%
	9: % change in NPV	-5.6%																			

Scenario 2e		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	351,908	353,859	355,738	357,480	359,243	361,009	362,882	364,671	366,425	368,121	369,836	371,628	373,309	374,969	376,523	378,091	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	43.3%	43.3%	43.3%	43.3%	43.2%	43.2%	43.2%	43.1%	43.1%	43.1%	43.1%	43.0%	43.0%	43.0%	43.0%	43.0%	42.9%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.4%	89.4%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.6%	89.6%	89.6%	89.6%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%
	NPV	£492,540,215																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.09%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.85%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	
	9: % change in NPV	-2.5%																				
Scenario 2f		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	351,908	353,859	355,738	357,480	359,243	361,009	362,882	364,671	366,425	368,121	369,836	371,628	373,309	374,969	376,523	378,091	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	43.3%	43.3%	43.3%	43.3%	43.2%	43.4%	43.3%	43.3%	43.3%	43.3%	43.2%	43.2%	43.2%	43.2%	43.2%	43.1%	43.1%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.4%	89.4%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.3%	5.3%	5.3%	5.3%	5.3%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%
	NPV	£500,738,857																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	9.2%	9.2%	9.2%	9.2%	9.2%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	
	9: % change in NPV	-0.9%																				
Scenario 2g		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	351,908	353,859	355,738	357,480	359,243	361,009	362,882	364,671	366,425	368,121	369,836	371,628	373,309	374,969	376,523	378,091	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	43.3%	43.3%	43.3%	43.3%	43.2%	43.4%	43.3%	43.3%	43.3%	43.3%	43.2%	43.2%	43.2%	43.2%	43.2%	43.1%	43.1%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.4%	89.4%	64.3%	64.4%	64.4%	64.4%	64.5%	64.5%	64.5%	64.6%	64.6%	64.6%	64.6%	
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.3%	5.3%	5.3%	5.3%	5.3%	17.8%	17.8%	17.8%	17.8%	17.8%	17.8%	17.9%	17.9%	17.9%	17.9%		
	NPV	£483,813,313																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%		
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	9.2%	9.2%	9.2%	9.2%	9.2%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%		
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	-25.0%	-25.0%	-25.0%	-25.0%	-25.0%	-24.9%	-24.9%	-24.9%	-24.9%	-24.9%		
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	11.7%	11.7%	11.7%	11.7%	11.7%	11.7%	11.7%	11.7%	11.7%	11.7%		
	9: % change in NPV	-4.2%																				
Scenario 2h		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	351,908	353,859	355,738	357,480	359,243	361,009	362,882	364,671	366,425	368,121	369,836	371,628	373,309	374,969	376,523	378,091	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	43.3%	43.3%	43.3%	43.3%	43.2%	43.4%	43.3%	43.3%	43.3%	43.3%	43.2%	43.2%	43.2%	43.2%	43.2%	43.1%	43.1%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.4%	89.4%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	93.2%	
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.3%	5.3%	5.3%	5.3%	5.3%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%		
	NPV	£500,193,169c																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%		
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	9.2%	9.2%	9.2%	9.2%	9.2%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%		
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%		
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%	-2.7%		
	9: % change in NPV	-1.0%																				

Scenario 3a		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	350,427	352,369	354,238	355,970	357,725	359,482	361,345	363,125	364,871	366,559	368,266	370,050	371,722	373,375	374,922	376,483	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	37.0%	37.1%	37.1%	37.1%	37.2%	37.2%	37.3%	37.3%	37.3%	37.4%	37.3%	37.3%	37.3%	37.3%	37.2%	37.2%	
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%	89.6%	89.6%	89.6%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%
	NPV	£467,033,114																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	2.9%	3.0%	3.1%	3.1%	3.2%	3.3%	3.3%	3.4%	3.4%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.4%	-0.4%	-0.36%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	
	9: % change in NPV	-7.6%																				
Scenario 3b		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	350,427	352,369	354,238	355,970	357,725	359,482	361,345	363,125	364,871	366,559	368,266	370,050	371,722	373,375	374,922	376,483	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	37.0%	37.1%	37.1%	37.1%	37.2%	37.4%	37.5%	37.5%	37.5%	37.6%	37.5%	37.5%	37.5%	37.5%	37.4%	37.4%	
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.5%	89.5%	93.3%	93.3%	93.3%	93.3%	93.3%	93.3%	93.3%	93.3%	93.3%	93.3%	93.4%	
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.8%	5.8%	5.8%	5.8%	5.8%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	
	NPV	£475,864,465																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	2.9%	3.0%	3.1%	3.1%	3.2%	3.5%	3.5%	3.6%	3.6%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-2.4%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	
	9: % change in NPV	-5.8%																				
Scenario 3c		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	350,427	352,369	354,238	355,970	357,725	359,482	361,345	363,125	364,871	366,559	368,266	370,050	371,722	373,375	374,922	376,483	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	37.0%	37.1%	37.1%	37.1%	37.2%	37.4%	37.5%	37.5%	37.5%	37.6%	37.5%	37.5%	37.5%	37.5%	37.4%	37.4%	
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.5%	89.5%	64.7%	64.7%	64.7%	64.7%	64.8%	64.8%	64.8%	64.8%	64.9%	64.9%	64.9%	
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.8%	5.8%	5.8%	5.8%	5.8%	19.4%	19.4%	19.3%	19.3%	19.3%	19.3%	19.3%	19.3%	19.3%	19.3%	19.3%	
	NPV	£457,570,071																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	2.9%	3.0%	3.1%	3.1%	3.2%	3.5%	3.5%	3.6%	3.6%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	-24.7%	-24.7%	-24.7%	-24.7%	-24.7%	-24.6%	-24.6%	-24.6%	-24.6%	-24.6%	-24.6%	
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	13.2%	13.2%	13.2%	13.2%	13.2%	13.2%	13.2%	13.2%	13.2%	13.2%	13.2%	
	9: % change in NPV	-9.4%																				
Scenario 3d		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	350,427	352,369	354,238	355,970	357,725	359,482	361,345	363,125	364,871	366,559	368,266	370,050	371,722	373,375	374,922	376,483	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	37.0%	37.1%	37.1%	37.1%	37.2%	37.4%	37.5%	37.5%	37.5%	37.6%	37.5%	37.5%	37.5%	37.5%	37.4%	37.4%	
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.5%	89.5%	93.3%	93.3%	93.3%	93.3%	93.3%	93.3%	93.3%	93.3%	93.3%	93.3%	93.4%	
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.8%	5.8%	5.8%	5.8%	5.8%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	
	NPV	£475,274,645																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	2.9%	3.0%	3.1%	3.1%	3.2%	3.5%	3.5%	3.6%	3.6%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-2.4%	-2.5%	-2.45%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	
	9: % change in NPV	-5.9%																				

Scenario 3e		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	350,790	352,764	354,667	356,433	358,221	360,011	361,909	363,723	365,503	367,225	368,935	370,722	372,398	374,053	375,603	377,166	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	46.2%	46.3%	46.3%	46.4%	46.5%	46.5%	46.6%	46.7%	46.7%	46.8%	46.8%	46.7%	46.7%	46.7%	46.7%	46.7%	46.6%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.4%	89.4%	89.4%	89.4%	89.4%	89.4%	89.4%	89.4%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.1%	5.1%	5.1%	5.1%	5.1%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
	NPV	£490,596,307																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-1.97%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	12.1%	12.2%	12.3%	12.4%	12.5%	12.6%	12.7%	12.8%	12.8%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.02%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%
	9: % change in NPV	-2.9%																				
Scenario 3f		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	350,790	352,764	354,667	356,433	358,221	360,011	361,909	363,723	365,503	367,225	368,935	370,722	372,398	374,053	375,603	377,166	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	46.2%	46.3%	46.3%	46.4%	46.5%	46.7%	46.8%	46.8%	46.9%	47.0%	46.9%	46.9%	46.9%	46.9%	46.9%	46.8%	46.8%
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.4%	89.4%	93.0%	93.0%	93.0%	93.0%	93.1%	93.1%	93.1%	93.1%	93.1%	93.1%	93.1%	93.1%
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.1%	5.1%	5.1%	5.1%	5.0%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%
	NPV	£498,429,872																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-1.97%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	12.1%	12.2%	12.3%	12.4%	12.5%	12.7%	12.8%	12.9%	13.0%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-2.8%	-2.8%	-2.8%	-2.8%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%
	9: % change in NPV	-1.3%																				
Scenario 3g		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	350,790	352,764	354,667	356,433	358,221	360,011	361,909	363,723	365,503	367,225	368,935	370,722	372,398	374,053	375,603	377,166	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	46.2%	46.3%	46.3%	46.4%	46.5%	46.7%	46.8%	46.8%	46.9%	47.0%	46.9%	46.9%	46.9%	46.9%	46.8%	46.8%	
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.4%	89.4%	64.1%	64.1%	64.1%	64.2%	64.2%	64.2%	64.3%	64.3%	64.3%	64.3%	64.4%	
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.1%	5.1%	5.1%	5.1%	5.0%	17.0%	17.0%	17.0%	16.9%	16.9%	16.9%	16.9%	16.9%	16.9%	16.9%	16.9%	
	NPV	£482,459,135																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	12.1%	12.2%	12.3%	12.4%	12.5%	12.7%	12.8%	12.9%	13.0%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	-25.3%	-25.3%	-25.3%	-25.2%	-25.2%	-25.2%	-25.2%	-25.2%	-25.2%	-25.1%	-25.1%	
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	10.8%	10.8%	10.8%	10.8%	10.8%	10.8%	10.8%	10.8%	10.8%	10.8%	10.8%	
	9: % change in NPV	-4.5%																				
Scenario 3h		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	
WfM outputs	Total LACW arisings	351,644	351,860	353,917	356,011	350,790	352,764	354,667	356,433	358,221	360,011	361,909	363,723	365,503	367,225	368,935	370,722	372,398	374,053	375,603	377,166	
	Reuse and recycling	34.2%	34.2%	34.2%	34.1%	46.2%	46.3%	46.3%	46.4%	46.5%	46.7%	46.8%	46.8%	46.9%	47.0%	46.9%	46.9%	46.9%	46.9%	46.8%	46.8%	
	Recovery of waste	88.1%	89.3%	89.3%	89.3%	89.4%	89.4%	89.4%	89.4%	89.4%	93.0%	93.0%	93.0%	93.0%	93.1%	93.1%	93.1%	93.1%	93.1%	93.1%	93.1%	
	Waste to landfill	6.8%	6.2%	6.2%	6.2%	5.1%	5.1%	5.1%	5.1%	5.0%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	
	NPV	£497,914,968																				
Options appraisal criterion	2: % change in arisings	0.0%	0.0%	0.0%	0.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	
	3: Change in % recycling	0.0%	0.0%	0.0%	0.0%	12.1%	12.2%	12.3%	12.4%	12.5%	12.7%	12.8%	12.9%	13.0%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	
	4: Change in % recovery	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	
	5: Change in % landfill	0.0%	0.0%	0.0%	0.0%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-2.8%	-2.8%	-2.8%	-2.8%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	
	9: % change in NPV	-1.5%																				

Appendix G: Summary of WRATE outputs

Raw Data	Unit	Sc1a (Baseline)	Sc1b EfW (electricity only)	Sc1b EfW (CHP)	Sc1c	Sc1d	Sc2a	Sc2b EfW (electricity only)	Sc2c	Sc2d	Sc2e	Sc2f EfW (electricity only)	Sc2g	Sc2h
Climate change: GWP 100a	kg CO2-Eq	-10,090,974	-29,507,099	-52,175,384	-7,479,756	-27,927,226	-14,563,558	-33,067,854	-10,936,213	-31,427,214	-15,182,048	-31,777,034	-15,756,06	-30,649,906
Climate change: GWP 100a Change from baseline	t CO2-Eq		-19,400	-42,100	2,600	-17,800	-4,500	-23,000	-800	-21,300	-5,100	-21,700	-5,700	-20,600
Acidification potential: average European	kg SO2-Eq	-113,435	-111,320	-133,577	-217,651	-102,795	183,710	184,925	81,331	193,779	207,962	206,909	116,398	212,991
Eutrophication potential: generic	kg PO4-Eq	21,249	12,971	12,862	53,109	14,605	87,601	79,919	119,739	81,616	89,458	83,331	115,427	84,496
Freshwater aquatic ecotoxicity: FAETP infinite	kg 1,4-DCB-Eq	-7,922,771	-8,538,891	-8,536,584	-7,713,597	-8,392,579	-8,617,423	-9,216,150	-8,373,291	-9,064,210	-8,565,552	-9,145,763	-8,300,587	-9,041,380
Human toxicity: HTP infinite	kg 1,4-DCB-Eq	-96,566,232	-99,971,347	-102,687,607	-97,228,199	-99,267,663	-100,769,624	-104,112,354	-100,942,537	-103,381,605	-100,589,203	-103,807,886	-100,713,163	-103,305,857
Resources: depletion of abiotic resources	kg antimony-Eq	-750,360	-816,308	-999,816	-1,425,738	-802,791	-772,400	-839,637	-1,417,230	-825,600	-766,045	-825,077	-1,413,915	-815,433
Normalised data (Eur.Person.Eq)	Unit													
Acidification potential: average European	Eur.Person.Eq	-1,586	-1,556	-1,867	-3,042	-1,437	2,568	2,585	1,137	2,709	2,907	2,892	1,627	2,977
% change from baseline			-2%	18%	92%	-9%	-262%	-263%	-172%	-271%	-283%	-282%	-203%	-288%
Eutrophication potential: generic	Eur.Person.Eq	636	388	385	1,589	437	2,621	2,391	3,583	2,442	2,677	2,493	3,454	2,528
% change from baseline			39%	39%	-150%	31%	-312%	-276%	-463%	-284%	-321%	-292%	-443%	-297%
Freshwater aquatic ecotoxicity: FAETP infinite	Eur.Person.Eq	-6,009	-6,476	-6,474	-5,850	-6,365	-6,536	-6,990	-6,350	-6,874	-6,496	-6,936	-6,295	-6,857
% change from baseline			8%	8%	-3%	6%	9%	16%	6%	14%	8%	15%	5%	14%
Human toxicity: HTP infinite	Eur.Person.Eq	-4,886	-5,058	-5,195	-4,919	-5,022	-5,098	-5,268	-5,107	-5,231	-5,089	-5,252	-5,096	-5,227
% change from baseline			4%	6%	1%	3%	4%	8%	5%	7%	4%	7%	4%	7%
Resources: depletion of abiotic resources	Eur.Person.Eq	-9,418	-21,125	-25,874	-36,896	-20,775	-19,988	-21,728	-36,676	-21,365	-19,824	-21,352	-36,590	-21,102
% change from baseline			9%	33%	90%	7%	3%	12%	89%	10%	2%	10%	88%	9%

Note: For the % change from baseline, a positive value is an improvement in performance and a negative value is a deterioration in performance

Appendix H: Detailed assessments of scenarios

Refer to options appraisal scoring spreadsheet.

NOTE!

Tables will be inserted once they are agreed.