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Improvement Plan for Household Waste & Recycling Centres in Stoke-on-Trent City Council

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FINAL REPORT

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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

SUMMARY:	Refer to Section(s):
This report has been commissioned through Defra WIP's consultancy support programme with a view to assisting Stoke-on-Trent City Council in improving its recycling performance, specifically in relation to the authority's Household Waste & Recycling Centres (HW&RCs). Improvements to the sites have been identified and a financial case for carrying out these changes has been produced.	*Scope of report:* 2 *Method:* 3
In the first instance, it is recommended that a full risk assessment of the sites' existing operations is carried out as soon as possible, and that appropriate Health & Safety measures are carried out and procedures put in place. Moreover, any changes to Stoke-on-Trent City Council HW&RCs should also be subject to risk assessments and appropriate actions taken.	Appendix 1,
The combined recycling performance of the sites is currently somewhat below the national average for England CA sites.	4
A significant overhaul of the layout is recommended for both sites, with a view to improving health & safety, operational, traffic management and recycling issues. For Hanford HW&RC it is recommended that the split-level architecture is extended to accommodate the separation of all bulk materials. Other specific improvements common to both sites include: • extending the range of recyclables collected • introducing separation of reuse items • additional staff, measures to increase staff motivation (including financial incentives), and ongoing staff training • upgrade of bin signage • improved traffic management through changes to layout and marking unloading areas & passing lanes • effective trade waste controls, including permit scheme, vehicle licence plate recognition system, disclaimer forms and follow-up procedure to ensure the effective implementation of these systems (refer to report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council)*. • Repair of CCTV systems to improve security • public awareness raising measures, including installation of leaflet dispensers and production of tailor-made leaflets for each site • review of current contract arrangements, in particular with a view to introducting financial incentives to the contractor(s).	5 6.3.5
It is projected that the implementation of the recommended improvements would result in Stoke-on-Trent City Council HW&RCs collectively attaining a BVPI definition recycling rate of 57.2% and an overall diversion rate of 66.9%. It is estimated that in the first year after improvements, CA residual waste across would be reduced by around 9,100 tonnes, with around 7,500 tonnes of biodegradable municipal waste being additionally diverted from CA site residual waste.	5.3

It is estimated that the recommended improvements would result in cumulative incremental savings of around £798,000 up to 2020/21, excluding any additional LATS savings. These savings are primarily due to avoided disposal costs; however, this estimate relies on the assumption that a similar proportion of Stoke-on-Trent City Council's overall MSW arisings will be incinerated annually between 2005/06 and 2020/21.	6.6 6.3.4
Additional cumulative savings from avoided use of Landfill Allowances are estimated to amount to £62,500 *plus or minus* £12,500 per £1 average market value of LATS permits during the period 2005/6 to 2020/21.	6.6
The margin of error in estimating LATS savings is due to problems in accurately projecting the rate of BMW landfill diversion that would result from the diversion of each tonne of BMW from CA residual waste due to implementing improvements. This uncertainty is due to the factors not directly related to the management of the CA sites affecting rates of BMW landfill diversion, such as the overall levels of incineration and recycling carried out by Stoke-on-Trent City Council. We advise that Defra's M-BEAM tool for managing LATS permits should be used to project more accurate assessments of LATS savings arising from CA site improvements.	6.4

2. INTRODUCTION AND AIMS

This report has been commissioned as part of a project funded through Defra WIP's consultancy support programme, with a view to assisting Stoke-on-Trent City Council in improving its recycling performance, specifically in relation to the authority's 2 Household Waste & Recycling Centres (HW&RCs). Improvements to the sites have been identified and a financial case for carrying out these changes is produced in this report. This report forms part of a larger project investigating issues arising from the HW&RCs in Stoke-on-Trent City Council. In particular, the issues of trade abuse and cross-border usage have been investigated and our findings are presented in the report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council*. This report also offers recommendations for dealing with trade abuse and cross-border usage, and it is advised that these improvements should be implemented alongside the general site improvements recommended in this report.

2.1 Summary of Information Presented in this Report

This report has been structured so that the reader can easily access information on a range of issues relating to the proposed improvements to Stoke-on-Trent City Council HW&RCs sites. Information is set out in this report as follows:

- **Section 1: Executive Summary,** which provides a summary of the key findings and recommendations of this report.
- **Section 2: Introduction and Aims** (this section). Section 2 describes the aims and scope of this report and includes a list of abbreviations and definitions used in the report.
- **Section 3: Methodology Overview.** Section 3 briefly describes the methodology used to assess the CA sites, to identify improvements and to produce the financial case for the improvements. These methodologies are described in greater detail in Appendices 2 and 3.
- **Section 4: Current Performance Overview.** Section 4 provides a brief assessment of the current recycling performance of Stoke-on-Trent City Council HW&RCs and benchmarks this performance against national CA site recycling rates.
- **Section 5: Improvement Recommendations for Individual Sites.** Section 5 details our assessment and improvement recommendations for the HW&RCs in Stoke-on-Trent City Council. For each site assessed, all of the improvements considered necessary in order to improve the recycling performance of the site are described. This section also includes estimates of each HW&RC's waste composition and current capture rates for various materials, and projects the improvements in recycling performance that are anticipated to arise from implementing the recommended improvements. Additionally, estimates of the costs of the recommended improvements are included for each site.
- **Section 6: Financial Case for Site Improvements.** Section 6 estimates the financial costs of implementing the proposed improvements and financial benefits arising from carrying out the improvements, notably in terms of avoided disposal costs.
- **Appendix 1: Health & Safety Guidance.** Appendix 1 contains important guidance on Health & Safety issues at CA sites, prepared by the Health & Safety Executive. A summary document on essential Health & Safety issues and a more comprehensive discussion document are included here. **The current Health & Safety record in the**

waste & recycling industry is poor and readers are strongly advised to read and act on this section of the report, regardless of whether this report's other recommendations are acted upon.

- **Appendices 2 & 3:** These appendices contain additional information on the methodology used to identify site improvements and produce the financial case.
- **Appendix 4:** This appendix details the methodology used to calculate BMW tonnage diversion due to CA site improvements, particularly in the context of incinerated MSW.

2.2 Aims and Scope of this Report

The aim of this report is to identify improvements to Civic Amenity (CA) sites in Stoke-on-Trent City Council and to present a financial case for carrying out these improvements. The main objective of the improvements suggested is to increase the recycling rate of the CA sites. It is considered that many of the improvements identified in this report would also result in improvements to operational efficiency and reduced Health & Safety risks. With regard to Health & Safety issues, however, it must be stressed that **the local authority and, as appropriate, the CA site contractor, are responsible for carrying out risk assessments for all changes made to their sites.** Indeed, we recommend that a full risk assessment and review of Health & Safety policies and procedures be carried out by the appropriate parties with regard to Stoke-on-Trent City Council's HW&RCs - see Appendix 1 for Health & Safety guidance prepared by the Health & Safety Executive.

The financial case for the proposed HW&RC improvements estimates the costs of implementing the improvements and assesses cost savings arising from the improvements, notably through avoided disposal costs and, in particular, taking into account financial implications of the LATS regime.

This report describes specific recommendations for site improvements but it does not offer exhaustive details on how each improvement should be implemented. Whilst this report 'signposts' the specific improvements that are considered to be necessary to increase recycling rates at the CA sites, we suggest that the local authority (or contractor, as appropriate) should plan the implementation of each improvement in greater detail in order to ensure that the improvement is carried out in a satisfactory manner, in order to achieve the desired positive effect on the site's performance. We recommend referring to the National Assessment of Civic Amenity Sites (NACAS) report in the first instance, in order to ensure that improvements are implemented in accordance with best practice. Other local authorities and CA site contractors may also be a valuable source of advice on specific details regarding some site improvements.

It is beyond the scope of this report to provide detailed recommendations on improvements that involve significant redevelopment and extensive civil engineering works. Where such improvements are deemed necessary, this report is only able to provide basic improvement recommendations. Furthermore, estimates for the costs of any such improvements are approximate. Therefore it is advised that where the significant redevelopment of sites is recommended, the local authority, and/or contractor as appropriate, should develop more detailed plans for such improvements; and that the costs of such improvements should be further investigated in order to arrive at more accurate cost estimates than this report is able to offer.

Contract management issues are addressed briefly in this report and some basic recommendations on improving the contract management of the HW&RCs are presented. However it is beyond the scope of this report to provide detailed recommendations on these matters and we advise that Stoke-on-Trent City Council should explore these issues in greater detail; and, if deemed necessary, enlist a suitably qualified third party to assist in providing more detailed recommendations in relation to improving the contract management of the sites.

2.3 Abbreviations and Definitions

The following abbreviations and definitions are used in this report:

BMW = Biodegradable Municipal Waste

BVPI = Best Value Performance Indicator. *Unless otherwise stated, recycling rates in this report are according to the current BVPI definition, ie excluding separated inert waste and reuse items from recycling rate calculations. It is understood that the BVPI definitions will shortly be amended to include separated reuse items. The contribution of reuse separation to diversion from disposal is not accounted for in this report, due to the typically relatively low tonnages of these items in relation to recycled tonnages. However properly designed reuse systems are known to have a significantly positive effect on the separation of recyclables, and this effect is noted as appropriate should it be applicable to any of the CA sites assessed in this report*[1]*.*

CA site = Civic Amenity site *[ie facilities provided under EPA 1990 s 51(1)(b) and/or Refuse Disposal (Amenity) Act 1978 c3 s1]*

C&D = Construction & Demolition (waste)

IMD = Index of Multiple Deprivation. *A general measure of deprivation levels derived from analysing a wide range of factors, including income, employment, health, education, housing and access to services. The average IMD for England is 25.80; the higher IMD 'score', the higher the average level of deprivation for a particular area. IMDs in this report are used to infer deprivation levels for CA site catchment populations and are derived from the average IMD for the local authority (or district, as appropriate) where the site is situated. These IMD score do not take into account cross-border usage of individual sites and should therefore be regarded as being indicative, rather than exact. Source: DETR, Indices of Deprivation, 2000.*

FTE = Full Time Equivalent

HW&RC = Household Waste & Recycling Centre. *This term is used interchangeably with "CA site" throughout this report.*

LATS = Landfill Allowance Trading Scheme

MSW = Municipal Solid Waste

na = not applicable

NACAS = National Assessment of Civic Amenity Sites, *Network Recycling and Future West, 2004.*

NACAS Toolkit = National Assessment of Civic Amenity Sites Toolkit, *Network Recycling and Future West, 2004.*

RPI = Retail Price Index

RR = Recycling Rate *(BVPI definition, unless otherwise stated)*

TWICAS = Trade Waste Input to Civic Amenity Sites, *Network Recycling and Future West, 2002.*

VLPR = Vehicle Licence Plate Recognition

WDA = Waste Disposal Authority

WEEE = Waste Electronic and Electrical Equipment

WIP = Waste Implementation Programme

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[1] Refer to *NACAS Report, Chapter 3.3.*

3. METHODOLOGY OVERVIEW

3.1 Assessment of Current Performance and Identification of Proposed Improvements

Improvements to Stoke-on-Trent City Council HW&RCs have been identified by carrying out an onsite assessment of the site. The assessment involved systematically recording details about the site's current operation and performance and details on improvements identified during the site visit. Improvements have been identified primarily on the basis of the findings of the National Assessment of Civic Amenity Sites (NACAS) report, (in particular the NACAS findings on factors influential on CA site recycling rates). However improvements have also been identified on the basis of addressing current shortcomings specific to the site.

Where possible, Health & Safety issues which are considered to require attention have been noted. However, the site assessments presented in this report do not constitute a review of Health & Safety issues at the CA sites, as it should be carried out by suitably qualified Health & Safety professionals. We therefore strongly recommend that the local authority and, as appropriate, the CA site contractor, carry out risk assessments for all changes that they carry out. Indeed, we advise that a full risk assessment and review of Health & Safety policies and procedures be carried out by the appropriate parties with regard to the CA site, regardless of whether any of the proposed changes are to be carried out - see Appendix 1 for Health & Safety guidance prepared by the Health & Safety Executive.

A standard site monitoring form has been used to record current performance and identify proposed improvements. Some additional details on the site's performance and management have been ascertained through liaison with Stoke-on-Trent City Council.

The proposed CA site improvements arising from the site assessment process are described in Section 5. More details on this methodology can be found in Appendix 2 to this report.

3.2 Assessment of Improvement in Recycling Performance

For each assessed site, an increase in recycling performance arising from the implementation of proposed improvements is estimated. This calculation is based on the NACAS multiple regression model of factors affecting recycling rates, whereby for each type of improvement an average increase in the site's recycling rate may be expected. The NACAS model of factors affecting CA site recycling rates has been developed to account for a wider range of site improvements than were included in the NACAS regression model. For more details, see Appendix 2.

3.3 Development of Financial Case for Site Improvements

The methodology for producing the financial case was developed by Network Recycling, with some assistance from Eunomia Research and Consulting.

The cost of implementing the proposed improvements has been estimated, on the basis of the best available information on average costs for each type of improvement. We can expect that these costs will, to a greater or lesser extent, be offset by savings due to avoided disposal and, in particular, by avoided use of LATS permits. However gate fees (or revenue) arising from the diversion of specific materials from disposal also needs to be accounted for.

In order to model which materials are likely to be diverted from disposal, and in what quantities, a mass-balance exercise has been carried out on each individual site. The waste composition of each site has been estimated[2] and through applying current site tonnages to this composition profile, the quantity of uncaptured recyclables has been estimated.

To use a hypothetical example, we can imagine a site with an annual throughput of 10,000 tonnes, with an estimated composition of green waste of 20% of this total, ie 2,000 tonnes pa. This site might currently be separating 800 tonnes of green waste pa, which would represent an estimated 40% of the site's total green waste throughput of 2,000 tonnes pa. Therefore an estimated 60% of the site's green waste throughput, or 1,200 tonnes pa, is potentially available for diversion from disposal.

This type of calculation is repeated for all materials which are intended to be separated at the relevant site under the proposed improvements. In this manner, the quantities of each relevant recyclable available for capture in residual waste are estimated.

The recycling rate increase from each proposed site improvement is accounted for by the assumed diversion from disposal of one or more of the recyclables available for capture in residual waste. Some improvements will be targeted at a particular material, ie the installation of a recycling container, and this type of improvement would be assumed to divert only that material from residual waste; ie the installation of a wood container would be assumed to result in the diversion of only wood from residual waste. Other improvements are more general in nature, (ie improving signage across the site, or increasing staffing levels), and can be assumed to increase the capture of recyclables *in general* at the site. Recycling rate increases from these non-material specific types of improvements are assumed to result in the capture of several of the recyclables separated at the relevant site[3].

Therefore, the projected recycling rate increase for each site is expressed in terms of a mass-balance equation, with the result that an estimate of the quantities of various recyclables diverted from disposal per annum is arrived at. From the assumed diversion of these materials from residual waste, the tonnage of waste diverted from disposal annually has been calculated. This tonnage diversion has then been used to calculate savings in disposal fees, Landfill Tax, and financial benefits arising from the savings in terms of saved LATS permits.

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[2] either on the basis of waste composition typologies (see Appendix 3) or on the basis of waste audit data (should this be available) combined with site tonnage data

[3] A maximum capture rate is set for each recyclable; for many materials this 'capture rate limit' is 95%.

The assumed tonnage diversion for each material allows for gate fees (or revenue) for each material to be calculated. Where possible, gates fees (or income) for each material have been arrived at through consultation with the local authority or, as appropriate, the CA site contractor; in other instances, gate fees (or income) have been estimated.

A sensitivity analysis has been carried out for the financial model in order to ascertain the degree to which changes in certain cost assumptions will affect the financial model.

For more details on the methodology for the financial case for CA site improvements, refer to Appendix 3.

4. CURRENT PERFORMANCE OVERVIEW

This section briefly assesses the current recycling performance of the HW&RCs in Stoke-on-Trent City Council.

Tonnages and BVPI definition recycling rates for both Stoke-on-Trent HW&RCs during the period 2004/05 are summarised in Table 4.1 below.

Table 4.1: Summary of tonnages and BVPI recycling rates for Stoke-on-Trent City Council HW&RCs during the period 2004/05

HW&RC	TOTAL THROUGHPUT (Tonnes)	RECYCLING TONNAGES			BVPI RR
		Green Waste	Inert	Other materials	
Burslem	18,434	1,759	5,673	2,716	35.1%
Hanford	31,360	3,528	10,220	2,270	27.4%
TOTAL	**49,794**	**5,287**	**15,893**	**4,986**	**30.3%**

The overall BVPI RR of 30.3% for Stoke-on-Trent City Council HW&RCs is somewhat lower than what is likely to be the average England CA recycling performance for the period 04/05, of around 40%[4]. The annual tonnage throughput of both sites is higher than the England average of around 9,000 t pa, particularly with regard to Hanford HW&RC. The Hanford site also suffers from the lower recycling performance of the two sites, which may be partially accounted for by the comparative difficulty in managing the higher throughputs of material at the Hanford site, in comparison for the Burslem site. Although the Burslem site is the better performing of the two sites, in terms of BVPI recycling rate, its performance is nevertheless still below the likely average for England CA sites.

[4] Refer to *NACAS Report, p 270.*

5. IMPROVEMENT RECOMMENDATIONS FOR INDIVIDUAL SITES

This section details improvement recommendations for each of the two Household Waste & Recycling Centres (HW&RCs) in Stoke-on-Trent City Council. Each site is addressed in a separate subsection (numbered 5.1 and 5.2 respectively) and each subsection contains the following information for each individual site:

- **Site Improvement Recommendations** - descriptions of proposed improvements specific to each HW&RC.
- **Projected Performance Improvement** - calculations for the estimated recycling rate increase anticipated to result at the HW&RC as a result of the implementation of the proposed improvements; and estimations of required capture of different materials in order to attain this recycling rate increase.
- **Improvement Investment Costs** - estimate of capital and revenue costs for the proposed site improvements.

Improvement recommendations Stoke-on-Trent City Council HW&RCs are described in the following subsections:

5.1 Burslem HW&RC

5.2 Hanford HW&RC

The projected recycling rate increase across both sites combined is presented in Section 5.3, which also includes an estimate of the capture of different materials, across both sites, required to attain this recycling rate increase.

All tonnage figures and recycling rates stated in this section relate to the period 2004/05. Recycling rates are stated according to the BVPI definition, ie excluding separated inert waste and reuse items.

5.1 Burslem HW&RC

Burslem Household Waste and Recycling Centre						
Address	Federation Road, Burslem, ST6 4HU				**Residual**	8,286 t
					Inert	5,673 t
Level	Split				**Throughput**	18,434 t
Number of Staff	**Wk**	2	**W/e**	3	**Recycling Rate**	35.1%

5.1.1 Burslem HW&RC: Site Improvement Recommendations

(i) Introduction

Burslem HW&RC appears to be a clean, tidy and well ordered site. However, it is believed the site suffers from trade waste input that has been estimated as accounting for 19%; refer to the report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council*. Anecdotal evidence from the site staff suggests this is a problem that needs addressing as a matter of urgency. Although the site has a disclaimer system and height barrier to regulate the input of trade waste, these controls do not appear to be working effectively at the present time. The site has a problem with suspected traders and owners of oversize vehicles parking outside the site gates and carrying their waste onsite. This was observed to be occurring extensively during the site assessment.

Burslem HW&RC is believed to experience a significant amount of cross-border usage. This is exacerbated by the proximity of the border with Newcastle-under-Lyme. This issue is addressed in the report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council.*

<u>Photo 5.1.1: Burslem HW&RC</u>

(ii) Recycling Infrastructure

Addition of skips/recycling options:

1. **Textiles**

From the site assessment it was noted there was not enough capacity for the collection of textiles. It was also noted that the contractor servicing the textiles containers ran a less than efficient service. It is not known whether there is not enough capacity provided for the collection of this material or the poor servicing is responsible. Whatever the reason it is recommended that an additional container be provided or the servicing of the skip improved.

2. **Fluorescent tubes**

A container for the collection of fluorescent tubes should be placed next to the relocated paint container and oil collection point. The position for this is illustrated in Figure 5.1.1 below.

3. **Reuse container**

It is recommended a container for the storage of reuse items be installed at the site. This is discussed in greater detail in the reuse section below. The suggested location for this is illustrated in Figure 5.1.1.

4. **WEEE containers**

At the moment there is provision for one open top 40 cubic yard skip for the collection of televisions. It is recommended that two shipping containers be introduced to the site for the collection of all WEEE items. The location of these skips is discussed in the layout section and illustrated in Figure 5.1.1.

Other changes in site infrastructure:

1. **Plastics, Wood and Rubble collection**

From the site assessment it was apparent that one of the bays formerly used for the collection of wood had been designated as a plastics collection point. A compactor had been added to the bay that will be fed by a hopper at the top of the split level. To compensate for the loss of this wood bay, one of the rubble skips has been removed and a wood skip positioned in its place, thereby retaining the two wood skips on site. These changes have been implemented at the same time as a C&D[5] waste limit of two bags per site user per month. At the time of writing, the loss of a rubble skip does not appear to make a significant difference to site operations. However it is recommended that this situation is closely monitored closely. Additionally it is not known how the two bag C&D limit is enforced but it is recommended that an effective checking mechanism should be in place to prevent abuses of the system.

2. **Access to the rubble skip**

It is recommended that access be improved to the first rubble skip. At the moment, the one opening in the railings means there is only one loading point for the skip. This results in the skip being filled by site users at one end only. This then means the skip requires the frequent use of the JCB to evenly distribute the material throughout the skip. Better access to the skip would result in a more evenly filled rubble container and less waiting time for site users wanting to access this skip. It is recommended that the disposal area is extended by lower some of the railings at the disposal point. A risk assessment should be conducted to ensure that the railings are not lowered in such a manner as to pose a hazard to site users.

For additional details on recommendations affecting *Recycling Infrastructure*, refer also to point *(vi) Layout* below.

[5] Construction and demolition

(iii) Reuse

It is recommended a reuse system be implemented at Burslem HW&RC. Due to space restrictions, it is thought that selling intercepted items on the site would not be a viable proposition. The shipping container currently used to collect paint should be repositioned in the central area of the site and used instead for the collection of reuse items; refer to point *(vi) Layout* below; (the position of the reuse container is illustrated in Figure 5.1.1 below). These items should then be collected by pre-registered traders and sold away from the site. Further information on different reuse mechanisms currently in operation at other CA sites; refer to *NACAS Report, Chapter 3.3, page 97*.

(iv) Staffing

Staff numbers:

It is believed this site would benefit from the provision of additional staff. It is recommended the staffing levels be increased from 2 to 3 on a weekday operation and from 3 to 4 on a weekend. With the addition of extra staff and in conjunction with a customer care training programme it is thought the staff would feel empowered to engage site users in a more effective manner.

Staff incentives:

It is understood the site staff are Subject to an incentive scheme that links the performance of the Burslem site to the performance of two other facilities. A bonus payment is made to the staff based on the combined performance of three sites. It is the perception of the staff that they will not receive this bonus due to the underperformance of the two other sites. It is not known whether this is the case, or whether the mechanics of the bonus scheme have not been adequately communicated to the staff. In any event, an effective staff bonus scheme can positively affect the recycling rate of this facility and it is strongly recommended the current bonus scheme be subject to a review. It may be appropriate for staff bonuses to be related solely to the performance of the site that they work on.

Staff training:

It is understood the staff receive anger management, fire fighting and first aid training that is subject to refresher courses annually. It is thought the staff would benefit from additional customer care training. Training around this theme could be designed to inform staff how to deal with irate and uncooperative site users. Additionally, staff should be given adequate information on recycling in general, so that they can educate and motivate site users. This training could include visits to the reprocessing facilities that are currently used as outlets for materials separated at the sites.

If significant changes and improvements are made to the site, like the introduction of improved trade waste controls, it is strongly recommended the site staff receive instruction as to why these changes are being made and how new procedures should be implemented.

(v) Signage

There are some elevated signs on the site that have been used to mark the location of the green and rubble recycling points and the residual compactor. Elevating signs in this way ensures that they are not obstructed by vehicles that park in front of them. It is recommended that elevated signs be additionally used to mark the wood and cardboard bays, and the designated brink bank area. Elevated signage should be installed to mark the central scrap metal recycling area, as it remains unmarked at the present time. To avoid confusion and to provide site users with a quick visual reference as to where materials should be placed, it is recommended that signs are colour coded according to material type. This could be undertaken using the colour scheme recently introduced by WRAP.

(vi) Layout

Consolidation of bring bank facilities:

It is recommended all the bring banks (paper, cans and glass) are moved so they are positioned close up against the kerbstone. Moving the banks back in this manner will create additional space for vehicles to park and unload. It is also recommended the bring banks are moved further round towards where the battery boxes are currently located, as illustrated in Figure 5.1.1.

Movement of skips and recycling modules:

The central area of the site contains five scrap metal skips, two skips for the collection of televisions, one skip for the collection of furniture, asbestos and paint respectively, and a container for the collection of oil. It is thought that better use could be made of this central area through relatively minor changes. This would involve the introduction of two shipping containers (for the collection of WEEE items), the repositioning of skips within this central area and the relocation of some skips to other areas of the site. This is illustrated in Figure 5.1.1, and explained in greater detail below.

Please note: The repositioned containers in the central area should form part of a new skip line approximately one metre further forward of the current loading line. This would mean the back of the skips would be in line with the two lighting towers. The purpose of this would be to create additional space for the servicing of these skips.

1. Introduction of two shipping containers:

Two shipping containers should be introduced to the central area for the collection of WEEE items. These two containers should be placed next to the area currently used for the collection of fridges. The position of these two designated WEEE containers is shown in Figure 5.1.1.

2. Movement of skips within the central area:
   - (i) The paint store should be used for the interception of reuse items rather than paint. This container should be placed next to the WEEE containers mentioned in point 1 above. A new container will be provided for the collection of paint as outlined in point 3. (i) below. The position of the reuse container is shown in Figure 5.1.1.
   - (ii) The furniture skip should be moved from its current location and placed next to the reuse container (as mentioned in point (i) above). The position of the furniture skip is shown in Figure 5.1.1.
   - (iii) The scrap metal skips should be moved further down the loading line to create space for the two WEEE containers, the reuse container and the furniture skip. The new positions of the scrap metal skips are shown in Figure 5.1.1.
   - (iv) The asbestos skip should be moved from its current location and positioned behind the two WEEE containers (as discussed in point (i) above). This is to facilitate the servicing of the repositioned scrap metal skips as discussed in point (iii) above. The new position for the asbestos skip is shown in Figure 5.1.1.

3. Relocation of skips to other areas of the site:

(i) Paint store

The paint is currently collected in a shipping container. It is recommended that a smaller container be used and relocated to the position marked “5” in Figure 5.1.1 below. Adequate provision would have to be made for the servicing of the new, smaller container, but is understood that a smaller container for the collection of this material is not perceived as a problem.

(ii) Oil container

It is recommended the oil container be moved and relocated next to the newly positioned paint store. The new position for the paint store is marked as “5” in Figure 5.1.1 below.

(vii) Traffic Management

Traffic congestion has been identified as a problem that affects the site’s ability to run effectively. Congestion is reportedly worse at weekends, when the site can almost be brought to a standstill by the constant influx of vehicles through the site gates.

Addition of passing lanes:

There are road markings and directional arrows on the hard standing surface that should be repainted to make them stand out to greater effect.

The addition of unloading areas:

1. At the top of the split level:

It is recommended that parking bays are marked at the top of the split level to retain control of vehicles unloading there. From the site assessment it became clear that the unloading position of some vehicles impeded access to the site for other vehicles. The provision of a designated unloading area would aim to exert a degree of control over the movement of vehicles at this point.

2. By the bring banks:

Once the bring banks have been moved back against the kerbstone (see point *(vi) Layout: consolidation of bring bank facilities* above) there would be additional space for the provision of an unloading area. It is recommended that a clearly marked unloading area is provided here for vehicles that only want to use the bring bank facilities.

Preventing site users from parking outside the site:

During the site assessment it was observed that site users were parking outside the gates and carrying their waste onto the site. This included people unhitching trailers from their vehicles and wheeling them in. There is a health and safety risk to site users wandering onto the facility having parked their vehicles outside the gates. Additionally, this practice creates an atmosphere of disorder to site operations and is likely to have a negative impact on the mood of site users generally. The practice of parking vehicles outside the site should therefore be discouraged through the adoption of the trade control recommendations described in the report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council.*

(viii) Trade controls

From the site assessment it became clear that traders were using the site. For a more detailed description of the recommended improvements in trade waste controls, please refer to the report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council.* However, the trade control improvements can be summarised as consisting of implementing a permit scheme for commercial vehicles, introducing a Vehicle Licence Plate Recognition system, and introducing procedures to effectively target suspected traders attempting to use the site; and the raising of the height of the barrier at the site entrance in due course.

(ix) Security

It is reported that the CCTV system at the site is broken. Whilst there were no reported security issues, it is recommended the CCTV system be repaired. If the site experiences security problems in the future, a monitoring and response procedure (using the CCTV system) should be introduced.

(x) Publicity material

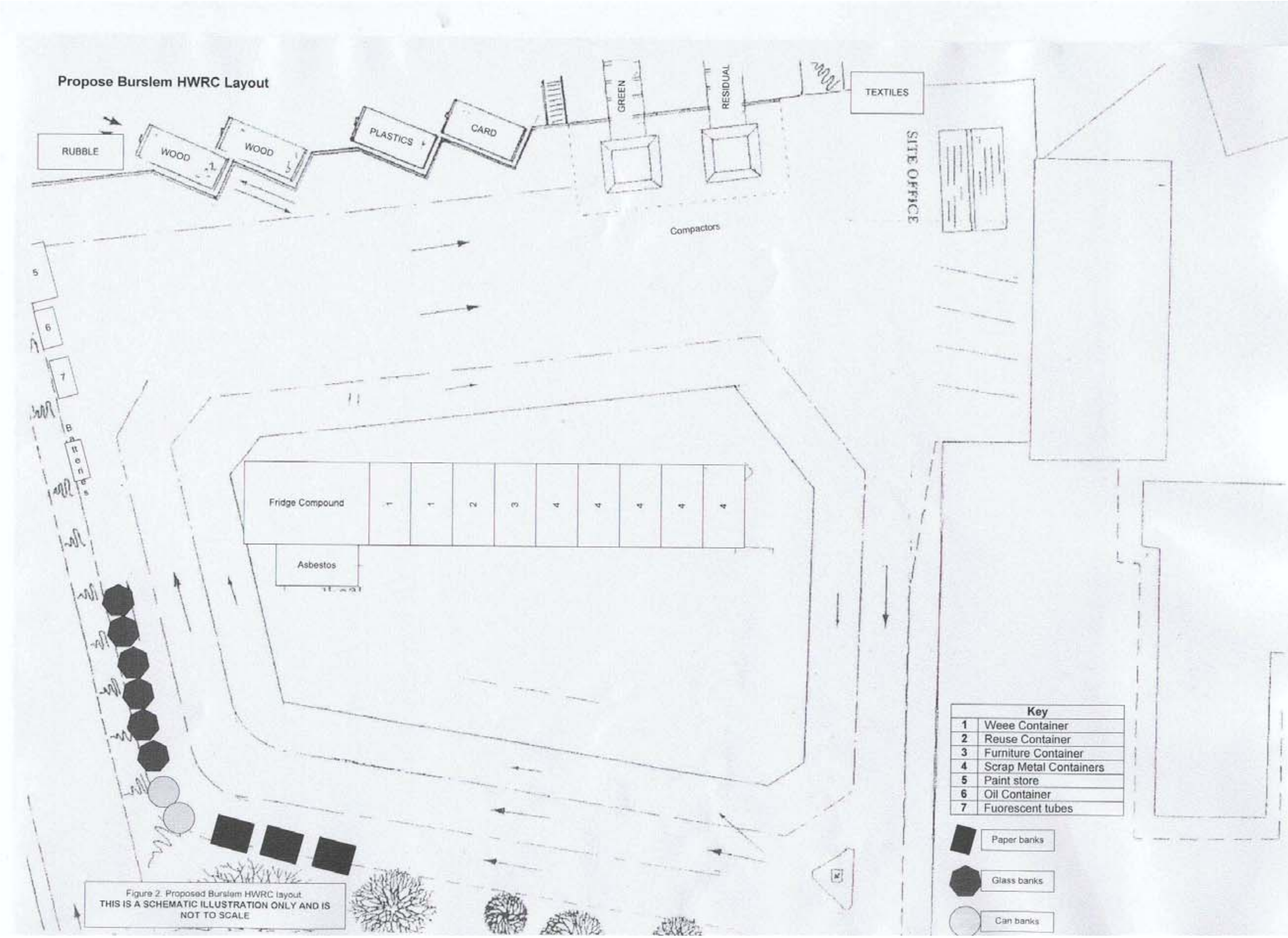
It is recommended that leaflets be distributed from the site informing site users about the recycling facilities and information as to how materials are processed once they have been transported from the site, in order to raise public awareness and improve the use of the site's recycling facilities by the public. Four weather-proof leaflet dispensers should be positioned along the railings at the top of the split level adjacent to each bay. Leaflets should be produced which are specific to this site which inform site users how to use the recycling facilities, and providing general information on recycling in order to raise site user awareness.

The sign displaying the site's recycling rate should be regularly updated in order to inform site users of the results of their recycling efforts.

(xi) Contract Management

Burslem HW&RC is currently managed by WRG under a 10 year contract which expires in May 2008. Stoke-on-Trent City Council reports that they have a good relationship with this contractor. Despite this, and the fact that the contract is due for renewal in the near future, it is recommended that an incentive mechanism is built into the current contract in order to motivate WRG to achieve the best possible recycling rate at the site. This incentive would essentially consist of an additional payment to WRG on condition that a certain recycling rate is achieved at the site. Whilst it is problematic advising how much this payment should be, a recommended level of remuneration is presented in Section 6.3.5, along with some basic advice on appropriate mechanisms for this incentive. Furthermore we advise that such an incentive mechanism should be incorporated in the new CA site management contract (from 2008 onwards).

Figure 5.1.1: Diagram of recommended site improvements for Burslem HW&RC



5.1.2 Burslem HW&RC: Projected Performance Improvement

The implementation of improvements at Burslem HW&RC, as detailed in Section 5.1.1 above, are projected to increase the site's recycling rate to approximately 59% (BVPI definition). These projected performance improvements are estimates based on NACAS findings; (for further details see Sections 3.2 and Appendix 2). Estimated contributions to this recycling rate increase from individual improvements are shown in the table below.

Table 5.1.1: Burslem HW&RC, projected increases in recycling rate due to specific improvements

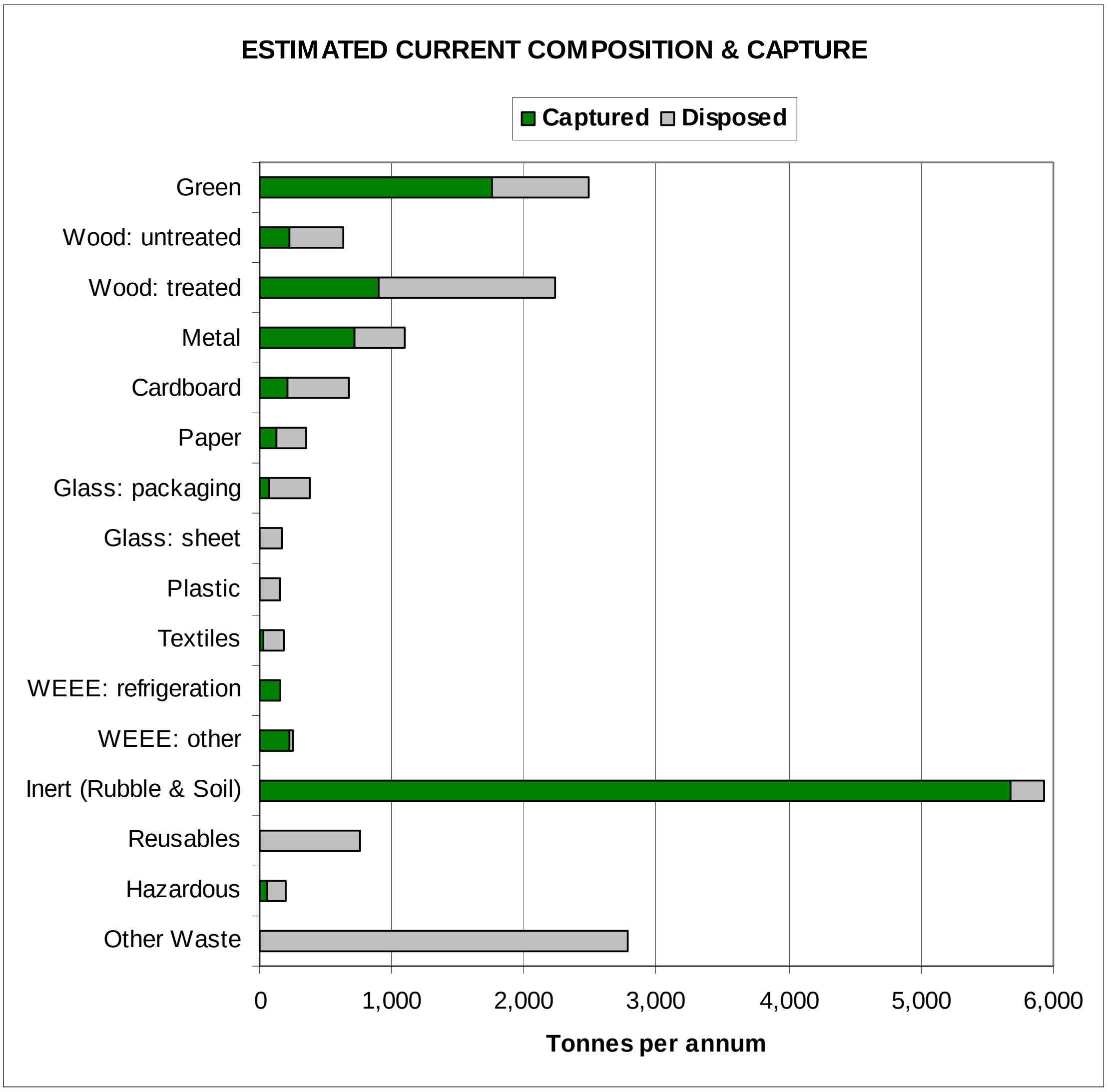
SITE IMPROVEMENTS & PROJECTED RECYCLING RATE INCREASES	
Current recycling rate	**35.1%**
Materials separation	**RR increase**
WEEE, excluding refrigeration: improve	1.0%
Plastic bottles	1.0%
Other improvements	**RR increase**
Reuse system: install	4.7%
Contract incentives: introduce	2.7%
Staffing improvements	2.3%
Signage improvements	6.5%
Good quality publicity leaflets, installation, etc	1.0%
Improve recycling bin order	0.3%
Improve layout & traffic management	0.6%
Remove height barriers, introduce permits	5.9%
Other collection systems	**RR +/-**
K/s green high non-restrictive introduced	-2.4%
Total addition to current RR	**23.6%**
Final target BVPI RR	**58.7%**
Notes: (i) all recycling rates and increases are expressed according to the BVPI definition; (ii) recycling rate increases are in terms of percentage point additions to the current recycling rate; (iii) recycling rate increases are estimates based on the NACAS regression model of factors affecting CA site recycling rates.	

The estimated effects of these increases in terms of additional material separation from residual waste are represented in Figures 5.1.2 and 5.1.3 below, which illustrate site composition and capture of various materials before and after the recommended improvements. For each type of material, the green section of the bar indicates currently separated material (ie recycled, composted or reused) and the grey section indicates material disposed in residual waste containers. It should be borne in mind that these Figures present assumptions about the site's waste composition, which can only be estimated due to lack of data. However every effort has been made to apply a realistic model of waste composition for this site.

The introduction of kerbside green waste collections is projected to have a small negative impact on the site's recycling rate, due to a predicted reduction in green waste inputs.

Whilst the BVPI recycling rate projected to result from site improvements is 59.0%, the mass balance calculations that follow indicate that an overall diversion rate (including inert waste and reuse) of 67.6% would be achieved.

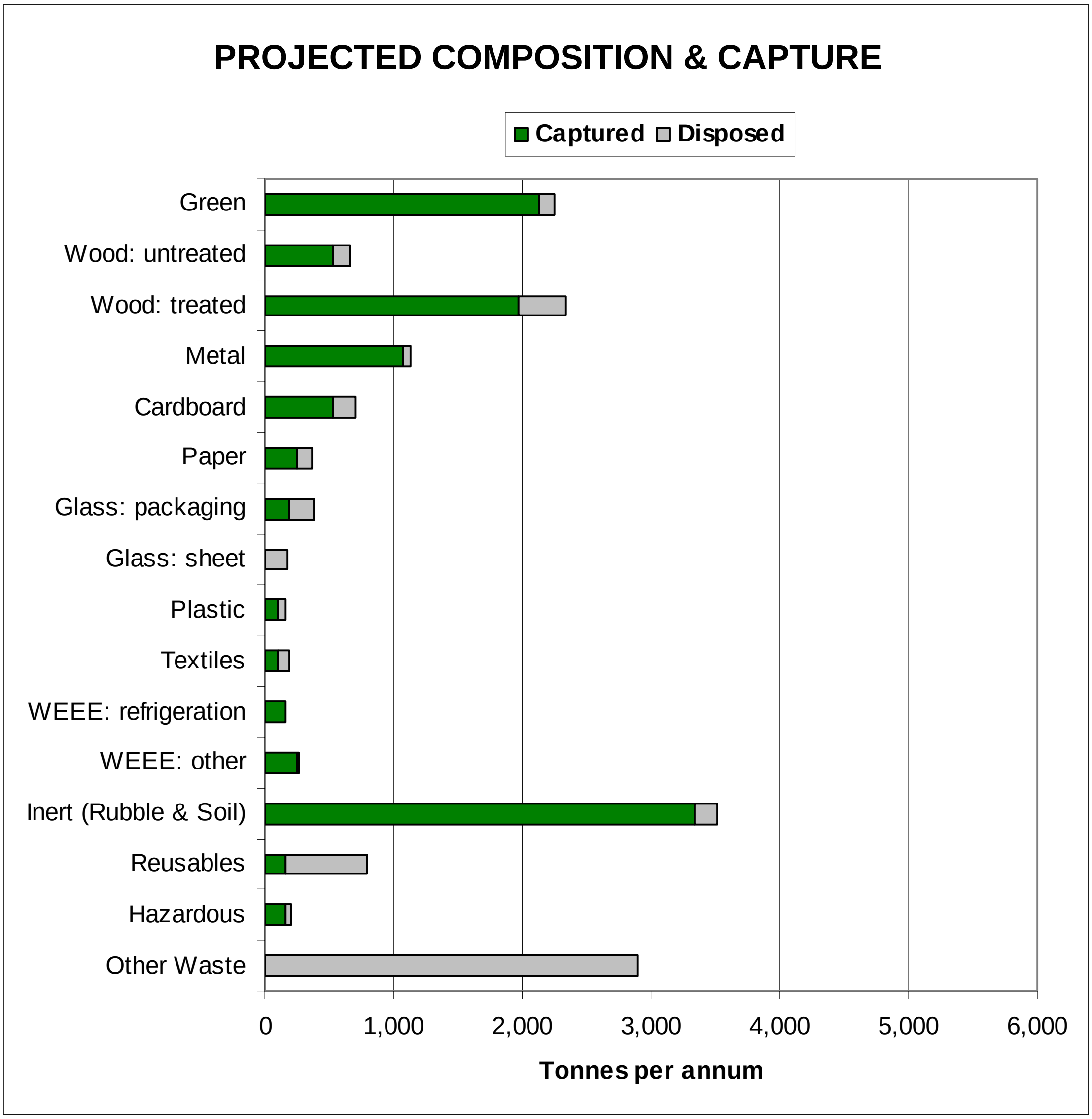
Figure 5.1.2: Burslem HW&RC, Estimated composition and capture BEFORE site improvements



Note on projected capture of materials:

The projected diversion of materials from residual waste presented in this Section (and in Table 5.1.3 in particular) are estimates based on the best currently available data and research. Projected capture tonnages for individual materials should not be regarded as exact targets, though the failure to attain these tonnages in the first year after implementation of improvements may be regarded as a warning signal that the relevant materials may not have been sufficiently well targeted. However, it may be the case that the relevant materials do not arise at the site in the quantities suggested by the composition estimates in this Section. The total projected diversion for all separated materials (in Table 5.1.3) may be regarded as a more reliable target for overall diversion from residual waste. Nevertheless, whilst every effort has been made to provide realistic projections of additional diversion of materials, it should be borne in mind that these are estimated predicted tonnages.

Figure 5.1.3: Burslem HW&RC, Projected composition and capture AFTER site improvements



The proportion of inert waste entering the site is projected to decrease after improvements due to the implementation of effective trade controls and C&D waste limits. This results in a lower overall site throughput, and higher proportions of other materials entering the site. However, the proportion of green waste is predicted to be reduced, due to the introduction of kerbside green waste collections. Additionally, the proportion of "Other Waste" is predicted to increase, which reflects the projected effect of the introduction of fortnightly kerbside collections.

The projected effect of site improvements in terms of capture of materials is also represented in Tables 5.1.2 and 5.1.3 below (which includes data upon which the above two Figures are based). As shown in Table 5.1.3, it is estimated that the recommended site improvements would result in the additional diversion of approximately 805 of MSW from CA residual waste (in the first year after the implementation of improvements). However, since the tonnage of separated rubble is predicted to decrease significantly, it is estimated that the diversion of BMW from CA residual waste would actually increase by around 2,295 tonnes in the first year. Due to reductions in site throughput, total residual waste tonnages are projected to reduce from 8,286 tonnes to 5,250 tonnes, ie a reduction of 3,036 tonnes in the first year.

Table 5.1.2: Burslem HW&RC, Estimated composition and capture BEFORE site improvements

ESTIMATED CURRENT COMPOSITION & CAPTURE					
MATERIAL	COMPOSITION		CAPTURE		BVPI defn. RR
	Tonnes	% total	Tonnes	%	
Green	2,484	*13.5%*	1,759	*71%*	13.8%
Wood: untreated	632	*3.4%*	223	*35%*	1.8%
Wood: treated	2,240	*12.1%*	894	*40%*	7.0%
Metal	1,093	*5.9%*	713	*65%*	5.6%
Cardboard	677	*3.7%*	217	*32%*	1.7%
Paper	350	*1.9%*	125	*36%*	1.0%
Glass: packaging	373	*2.0%*	68	*18%*	0.5%
Glass: sheet	167	*0.9%*	0	*0%*	0.0%
Plastic	157	*0.9%*	0	*0%*	0.0%
Textiles	188	*1.0%*	34	*18%*	0.3%
WEEE: refrigeration	161	*0.9%*	161	*100%*	1.3%
WEEE: other	255	*1.4%*	221	*87%*	1.7%
Inert (Rubble & Soil)	5,926	*32.1%*	5,673	*96%*	*na*
Reusables	761	*4.1%*	0	*0%*	*na*
Hazardous	190	*1.0%*	60	*31%*	0.5%
Other Waste	2,781	*15.1%*	0	*0%*	0.0%
TOTAL	**18,434**	***100%***	**10,148**	***na***	**35.1%**

Table 5.1.3: Burslem HW&RC, Projected composition and capture AFTER site improvements

PROJECTED COMPOSITION & CAPTURE AFTER IMPROVEMENTS						Additional diversion, tonnes
MATERIAL	COMPOSITION		CAPTURE		BVPI defn. RR	
	Tonnes	% total	Tonnes	%		
Green	2,246	*13.9%*	2,130	*95%*	16.8%	371
Wood: untreated	658	*4.1%*	525	*80%*	4.1%	301
Wood: treated	2,334	*14.4%*	1,976	*85%*	15.6%	1,083
Metal	1,139	*7.0%*	1,079	*95%*	8.5%	366
Cardboard	706	*4.4%*	527	*75%*	4.1%	310
Paper	365	*2.3%*	244	*67%*	1.9%	119
Glass: packaging	389	*2.4%*	194	*50%*	1.5%	126
Glass: sheet	174	*1.1%*	0	*0%*	0.0%	0
Plastic	164	*1.0%*	109	*67%*	0.9%	109
Textiles	195	*1.2%*	97	*50%*	0.8%	63
WEEE: refrigeration	168	*1.0%*	168	*100%*	1.3%	7
WEEE: other	266	*1.6%*	253	*95%*	2.0%	32
Inert (Rubble & Soil)	3,510	*21.7%*	3,335	*95%*	*na*	-2,338
Reusables	793	*4.9%*	159	*20%*	*na*	159
Hazardous	199	*1.2%*	158	*80%*	1.2%	98
Other Waste	2,898	*17.9%*	0	*0%*	0.0%	0
TOTAL	**16,204**	***100%***	**10,953**	***na***	**58.7%**	**805**
Projected additional BMW recycled/reused:						**2,295**

5.1.3 Burslem HW&RC: Improvement Investment Costs

Estimated capital and baseline revenue costs for the recommended site improvements are summarised in the following tables. These costs should be viewed in the context of the overall financial case presented in Section 6. For comments on estimated unit costs, also refer to Section 6. Surfacing/concrete costs are rough estimations which are intended to provide a guide figure for approximate costs.

CAPITAL INVESTMENT COSTS			
Item	**No. items**	**Unit cost**	**Cost**
CONTAINERS:			
40yd enclosed	2	£2,657	£5,314
8yd closed	1	£631	£631
Textile bank	1	£300	£300
Paint container	1	£1,000	£1,000
SURFACING/CONCRETE:			
Parking bay markings, per m2	300	£9.00	£2,700
Letters/arrows	30	£10.90	£327
Lined road markings, per m	500	£0.55	£273
OTHER ITEMS:			
Adjustment of railings	1	£400	£400
Leaflet dispenser (weatherproof)	4	£300	£1,200
Signs (large)	20	£654	£13,080
Vehicle License Plate Recognition system	1	£25,000	£25,000
CCTV repair and improvement	1	£20,000	£20,000
		TOTAL:	**£70,225**

REVENUE COSTS	
Type of cost	**Cost for site**
Additional staff, FTE (Full Time Equivalent)	£41,000
Financial incentives for staff	£17,325
Training programme for staff	£2,310
Publicity measures	£5,000
Trade controls: permit system & monitoring	£15,000
TOTAL:	**£80,635**
Does not include revenue costs for materials (disposal, haulage & gate fees), LATS or financial incentives to site management contractors.	

5.2 Hanford HW&RC

Hanford Household Waste and Recycling Centre						
Address	Sideway Road, Hanford. ST4 4DX				**Residual**	15,342 t
					Inert	10,220 t
Level	Split				**Throughput**	31,360 t
Number of Staff	**Wk**	4	**W/e**	4	**Recycling Rate**	27.4%

5.2.1 Hanford HW&RC: Site Improvement Recommendations

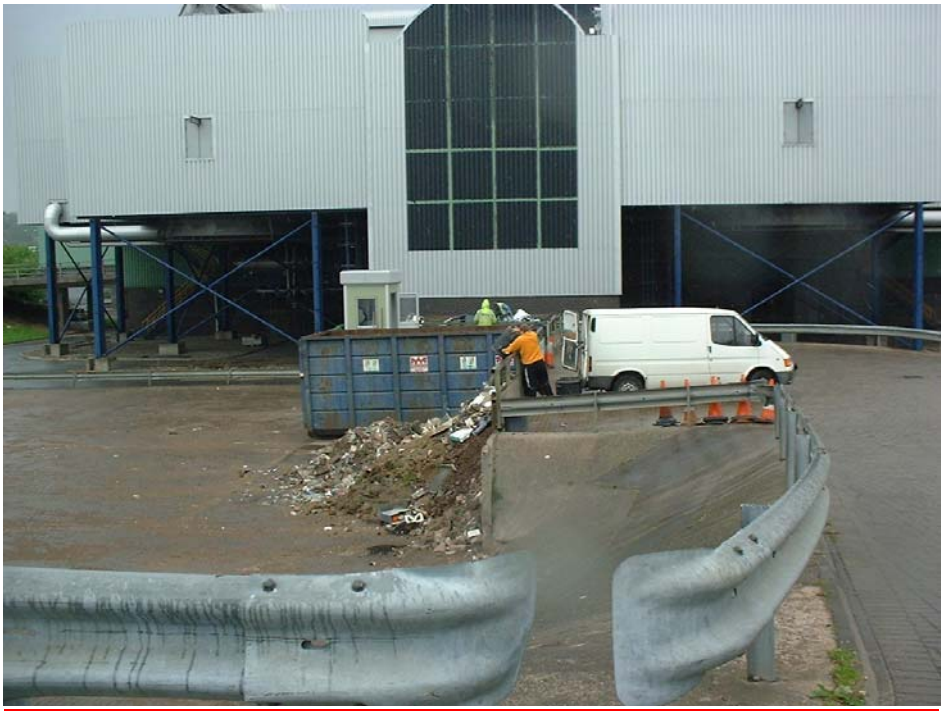
(i) Introduction

Hanford is a split level site whose shape and layout has resulted in a number of operational difficulties. This is compounded by the significant throughput the site processes and the large number of vehicle movements through the site. It is understood that traffic congestion at the entrance of the site and around the facility itself causes significant operational problems.

The Hanford facility is split into two distinct areas; the top of the site contains the residual and green waste compactors in addition to the bring bank facilities. The bottom of the site is connected to the top by an access ramp and contains a rubble bay and skips for wood and scrap metal.

The large throughput of this site is thought to be exacerbated by waste inputs from unauthorised traders and cross-border site users. For details on these issues, refer to the report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council.*

Photo 5.2.1: Hanford HW&RC



A few different scenarios were considered for the development of Hanford. It would be possible to make some relatively minor changes to the facility, such as improving the signs and road markings, but these on their own would only amount to slight improvements and by themselves would not significantly affect the recycling rate. It is therefore advised that the site should be redeveloped in order to extend the split level architecture at the top site further along the current tipping face, (refer to Figure 5.2.1 below). This would mean the removal of the ramp to the bottom site and the relocation of the wood, metal and rubble collection facilities. It is further recommended all the bring banks at the top site are consolidated to form a central island that would encourage a more orderly traffic flow through the site. The new facility would be accessed by the current exit road which, after widening, would also serve as an exit point. The current entry ramp to the site would be used by service vehicles only. It is thought these changes are necessary to improve the site to cope with the current throughput and to plan for the efficient processing of subsequent annual increases in this throughput[6]. At the same time as changing the shape of the site and the way vehicles enter and exit the facility other improvements will need to be implemented. This will include improving the trade waste controls and tackling cross-border usage; for details on these matters refer to the report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council.* Other recommended site improvements are detailed in this section.

It is recommended that readers refer to Figure 5.2.1 below throughout this section, as it represents a schematic diagram of the proposed new facility.

Why does the site need re-designing?

In order to improve the efficiency and performance of Hanford HW&RC it is recommended the site be subject to engineering work designed to provide one tipping face only for bulk recyclables. It is thought these changes have been necessary for the following reasons:

1. Disparate recycling operation

The two separate disposal areas of the site mean the recycling effort is quite disparate and not very user friendly. It is thought that recyclable material is currently being placed in the residual compactor rather than placed in the correct container at the bottom site. For instance, during the site survey it was observed that site users were disposing of their wood waste into the residual compactor at the top of the site, even though there are wood recycling facilities available at the bottom site. Not using the wood skip in this instance maybe due to the perceived difficulty by the site users of accessing a skip not immediately available on the tipping face. It could equally be the case that site users are unaware of the presence of a wood skip.

2. Traffic congestion issues

From both the site assessment and site survey, it was clear that the sheer volume of vehicles using the site made it difficult to effectively control the recycling operation. There were a number of problems observed during the site survey caused by the movement of vehicles around the site. These problems are summarised below:

(i) Congestion at the site entrance

The hopper that leads to the green compactor is located very close to the entrance of the site. Vehicles parking here to use the green compactor can block the entrance for other site users relatively easy. This problem is compounded by the narrow width of the entrance ramp and the

[6] Although the recommended trade waste controls are projected to reduce the site's throughput in the short term (see Section 5.2.2), it is considered likely that annual increases in MSW arisings will be reflected by similar increases in throughputs at this site; (for details of these assumptions, see Section 6.2). In the medium term, this would result in the site processing a larger throughput of waste than it does at present.

tight turning circle at the top. A combination of limited traffic controls and thoughtless parking by site users can effectively prevent other vehicles from entering the site. If this does happen, site users prevented from entering the site become aggravated. Their motivation to use the recycling facilities once they do get onto the site may be reduced by their having to wait to use the facilities. The blocking of the entrance in this manner was something that was observed many times during the site survey work.

(ii) The parking of vehicles on the site itself

The parking bays at the top of the split level are extensively utilised by site users. The lack of a physical barrier to filter vehicles around this top part of the site effectively means that vehicles can, and do, park anywhere. This has two implications:

- Health & Safety concerns

During the site survey it was witnessed that site users were parking their vehicles away from the green and residual hoppers and carrying their waste to them. This meant they were walking in the vicinity of vehicles parking, exiting the site or accessing the rubble, wood and scrap metal area. This clearly represents a serious Health & Safety concern.

- Control of recycling operation

When vehicles are parked in many of the bays, site users are approaching from all directions to use the green and residual bays. This makes it very difficult for site staff to supervise the correct disposal of different materials in the correct containers. For instance, if a site user had carried recyclable material to the compactor hoppers from their car and was directed to a recycling point elsewhere on the site, they may be reluctant to walk further in order to deposit these materials in the correct recycling containers.

(iii) Accessing the lower site

The bottom part of the site contains the wood and metal skips and the rubble bay. The rubble bay attracts many vehicles towing trailers. Due to the small area available here for site user traffic, there is a small turning circle for a vehicle and trailer to park and use the facilities. This means the area can become congested very quickly. This has the effect of preventing other vehicles from accessing this part of the site. These vehicles then wait at the top of the access ramp until it is clear. If too many vehicles are queuing to use the bottom part of the site this can cause congestion at the top part of the site.

(ii) Recycling Infrastructure

Addition of skips/recycling options:

1. WEEE

A shipping container for the collection of WEEE items should be placed in the central area along with the bring banks and other collection points. The recommended position of the WEEE container is marked in Figure 5.2.1 below.

2. Hazardous Chemicals

A hazardous chemical safe should be added to the site and placed next to the relocated oil bank next to the fridge compound.

3. Furniture

A shipping container for the collection of Furniture should be placed in the central area of the site along with the bring banks and other collection points. The position of the furniture container is marked in Figure 5.2.1.

4. **Reuse container**

A shipping container for the collection of reuses items should be placed in the central area of the site along with the bring banks and other material collection points. The position of the reuse container is illustrated in Figure 5.2.1.

5. **Cardboard**

A bay should be provided for the collection of cardboard. The position for this is illustrated in Figure 5.2.1.

6. **Plastics**

It is recommended a container be provided for the collection of plastics. This should be located in the central area along with the other bring banks. The position for this is illustrated in Figure 5.2.1.

7. **Fluorescent tubes**

A container for the collection of fluorescent tubes should be placed next to the hazardous chemicals, fridge and oil collection points. The recommended position of the fluorescent tubes container is illustrated in Figure 5.2.1.

Other changes in site infrastructure:

1. **The addition of a compactor**

There are currently two static compactors installed on the site: one for the collection of residual and one for the collection of green waste. It is recommended that an additional compactor be installed on the site and located in between the current two compactors. This would require the removal of the conveyor belt and staff operation room. It is envisaged that with three compactors, one would be used for the collection of green waste and two for the collection of residual. If this were the case, the residual waste compactors should be placed either side of the green compactor (as illustrated in Figure 5.2.1). This would be carried out in order to intersperse disposal and recycling options and prevent 'lazy tipping' by site users.

2. **Provision of staff shelter**

There is currently not sufficient provision for staff shelter. It is recommended that an additional staff shelter be installed at the entrance area of the new tipping face, as marked in Figure 5.2.1. With the implementation of a designated meet and greet person (see point *(iv) Staffing* below) there should additionally be provision for a smaller shelter at the new entrance to the site.

For additional details on recommendations affecting *Recycling Infrastructure*, refer also to point *(vi) Layout* below.

(iii) Reuse

It is recommended a reuse system be implemented at Hanford HW&RC. Due to space restrictions, it is thought that selling intercepted items on the site would not be a viable proposition. A shipping container should be placed in the central island, along with the other bring banks, for the collection of retrieved items (the position of the container is indicated in Figure 5.2.1). These items should then be collected by pre-registered traders and sold away from the site. Further information on different reuse mechanisms currently in operation at other CA sites, please refer to *NACAS Report, Chapter 3.3, page 97*.

(iv) Staffing

Staff numbers:

Currently there are 4 staff members on site seven days a week[7]. Three members of staff are employed by MES and one is employed through an agency on behalf of Stoke-on-Trent City Council. The three members of staff employed by MES are based on the top site and the agency staff member is based at the bottom site. Once the site is engineered into one tipping face, all staff members should be based at the top site. This will effectively increase the staff numbers from 3 to 4 at the top site. Although this is viewed as a better division of labour, it is recommended that an additional staff member is employed in a meet and greet role and predominantly based at the entrance to the new facility. This would increase the overall staff numbers on site from 4 to 5 seven days per week.

Staff incentives:

It is understood the staff receive no bonus payments. Although they interacted well with site users, the staff appeared demoralised. It is strongly recommended that a bonus system, possibly linked to the recycling rate performance of the site, be introduced.

Staff training:

It is understood the staff receive operator, manual handling and safety and awareness training. It is thought the staff would benefit from customer care training. Training around this theme could be designed to inform staff how to deal with irate and uncooperative site users. Additionally, staff should be given adequate information on recycling in general, so that they can educate and motivate site users. This training could include visits to the reprocessing facilities that are currently used as outlets for materials separated at the sites.

(v) Signage

The site is not clearly marked and would benefit from the provision of elevated and colour coded signs. Elevating signs can ensure they are not completely obstructed by parked vehicles, and provide the opportunity for site users to see in advance what areas of the site they need to utilise. It is recommended that elevated signs be used to mark all the recycling and disposal collection points along the new tipping face of the facility. Additionally the central bring bank area should be clearly marked with elevated signs. To avoid confusion and to provide site users with a quick visual reference as to where materials should be placed, it is recommended that signs are colour coded according to material type. This could be undertaken using the colour scheme recently introduced by WRAP.

[7] Except on Thursday when there are 5 staff onsite. This is due to the shift system the agency staff work. The two agency staff each work on site for 4 days at a time each week and their 'cross-over' day is Thursday on which they both work.

(vi) Layout

Consolidation of bring bank facilities:

With the new layout, it is recommended that all the bring bank facilities are consolidated in the central area of the site. This would clear the periphery of the site for the passage of vehicles, and provide one area with all the bring bank facilities. This central area will also act as a large traffic island, facilitating the passage of vehicles around the outside of the site, and prevent the central area site being used as a large parking area (as it appears to be at present).

Movement of skips and recycling options:

1. **Wood**

The wood collection point would be moved to facilitate the change in the design of the facility. It is recommended that wood be collected in a bay, rather than a skip, and shovel loaded into a 40 cubic yard container. The position of the wood bay is illustrated in Figure 5.2.1.

2. **Rubble**

The rubble collection point would be moved to facilitate the change in the design of the facility. It is recommended that rubble be collected in a bay exactly as it is now. This can then be shovel loaded into a container for removal from site. The position of the rubble bay is illustrated in Figure 5.2.1.

3. **Scrap metal**

The scrap metal collection point would be moved to facilitate the change in the design of the facility. It is recommended that scrap metal be collected in a bay, rather than a skip, and shovel loaded into a 40 cubic yard container. The position of the wood bay is illustrated in Figure 5.2.1.

4. **Oil Bank**

The oil bank should be moved next to the fridge collection compound.

(vii) Traffic Management

Managing vehicles on the site at the present time has proved very difficult. It is one of the reasons that redevelopment of the site should be considered. The top site provides a reasonably large area in which vehicles can move and park. Unfortunately, this has the effect of facilitating chaotic traffic movements in this area. Although the proposed new design of the facility should intuitively provide a natural traffic flow around the site, it is recommended that additional traffic control features are added, as described below.

Addition of passing lanes:

There should be clearly marked vehicle lanes marked onto the hard standing surface. These should be wide enough to accommodate all sizes of vehicle and be marked from the entrance of the site all the way around to the exit. Additionally there should be provision for an adequate number of traffic directional arrows marked within the passing lanes themselves.

Addition of a designated unloading area:

There should be the provision of two unloading areas, one along the length of the tipping face of the main bulk recycling line and one adjacent to the bring bank facilities. These should be clearly marked as unloading areas only. The unloading area at the top of the split level should, (space permitting), be marked up with vehicle parking bays, marked at right angles to the tipping face. It is envisaged that the provision of parking bays will be a very effective means of facilitating controlled traffic movements at unloading areas of the new facility.

Preventing site users from parking outside the site:

During the site assessment it was observed that site users were parking outside the gates and carrying their waste onto the site. There is a Health & Safety risk to site users wandering onto the facility having parked their vehicles outside the gates, especially as the entrance ramp onto the facility is narrow, with no pedestrian access marked on the ramp. Additionally, this practice presents a disorderly impression of site operations, which can have a negative effect of the behaviour of site users generally. The parking of vehicles outside the site should therefore be discouraged through the adoption of the trade control recommendations described in the report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council.*

(viii) Trade contols

From the site assessment it became clear that unauthorised traders were using the site. For a more detailed breakdown of the recommended improvements in trade waste controls, please refer to the report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council.* However, the trade control improvements can be summarised as consisting of implementing a permit scheme for commercial vehicles, introducing a Vehicle Licence Plate Recognition system, and introducing procedures to effectively target suspected traders attempting to used the site; and the raising of the height of the barrier at the site entrance in due course.

(ix) Security

It is understood the CCTV system currently in operation at the site is working but apparently not sufficient to deter intruders. The site has suffered from vandalism and opportunistic theft, usually associated with the scrap metal skip. One of the problems associated with intruders has been the targeting of the scrap metal bin by children looking for bikes. It is thought that with the introduction of a reuse container, and the subsequent interception and secure storage of bicycles, this problem will be alleviated. However, it is recommended that an adequate CCTV system be operational at the site, by upgrading the present one with the addition of more cameras. The site should then be monitored by a security firm and any break-ins should be responded to appropriately in order to deter future break-ins.

(x) Publicity material

It is recommended that leaflets be distributed from the site informing site users about the recycling facilities and information as to how materials are processed once they have been transported from the site. This is to involve site users in the running of the site to a greater degree. Weather-proof leaflet dispensers could be positioned along the railings at the top of the split level adjacent to each bay.

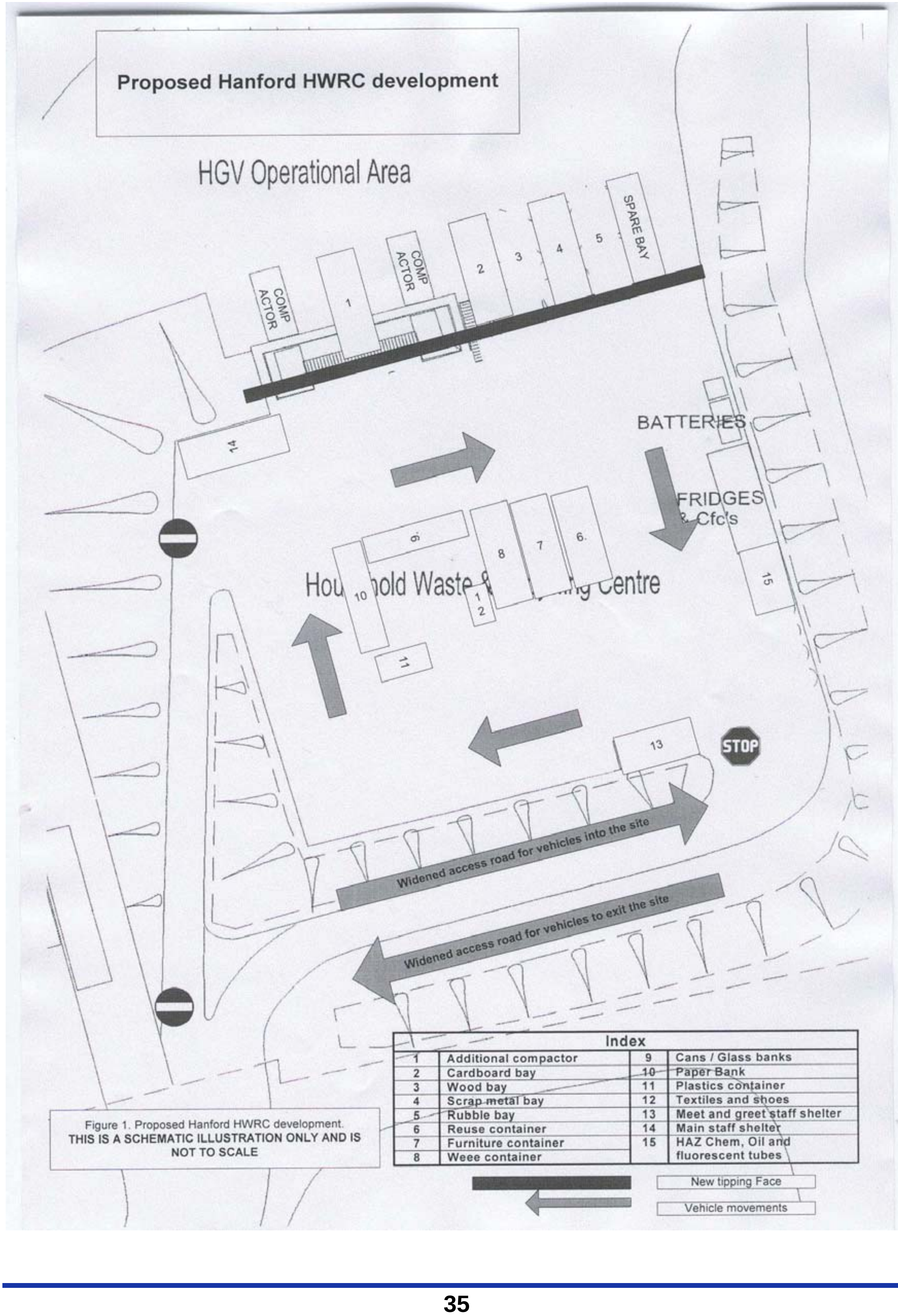
The sign displaying the site's recycling rate at the exit of the site should be regularly updated, in order to provide site users with feedback on their recycling efforts.

(xi) Contract Management

Hanford HW&RC is currently managed by MES under a contract which expires in 2020. This contract forms part of a larger contract for the management of the Energy from Waste plant. MES benefit from an opt-out clause for the CA site management element of the contract, requiring only 9 months notice. It is understood that MES have expressed an interest in allowing another contractor to take over the management of the CA site. If this is indeed the case, we recommend that Stoke-on-Trent City Council should consider tendering the management of the site to another contractor as soon as possible.

In any event, we advise that an incentive mechanism is built into the site management contract, in order to motivate the contractor to achieve the best possible recycling rate at the site. This incentive would essentially consist of an additional payment to the contractor on condition that a certain recycling rate is achieved at the site. Whilst it is problematic advising how much this payment should be, a recommended level of remuneration is presented in Section 6.3.5, along with some basic advice on appropriate mechanisms for this incentive.

Figure 5.2.1: Diagram of recommended site improvements for Hanford HW&RC



5.2.1 Hanford HW&RC: Projected Performance Improvement

The implementation of improvements at Hanford HW&RC, as detailed in Section 5.2.1 above, are projected to increase the site's recycling rate to approximately 56% (BVPI definition). These projected performance improvements are estimates based on NACAS findings; (for further details see Sections 3.2 and Appendix 2). Estimated contributions to this recycling rate increase from individual improvements are shown in the table below.

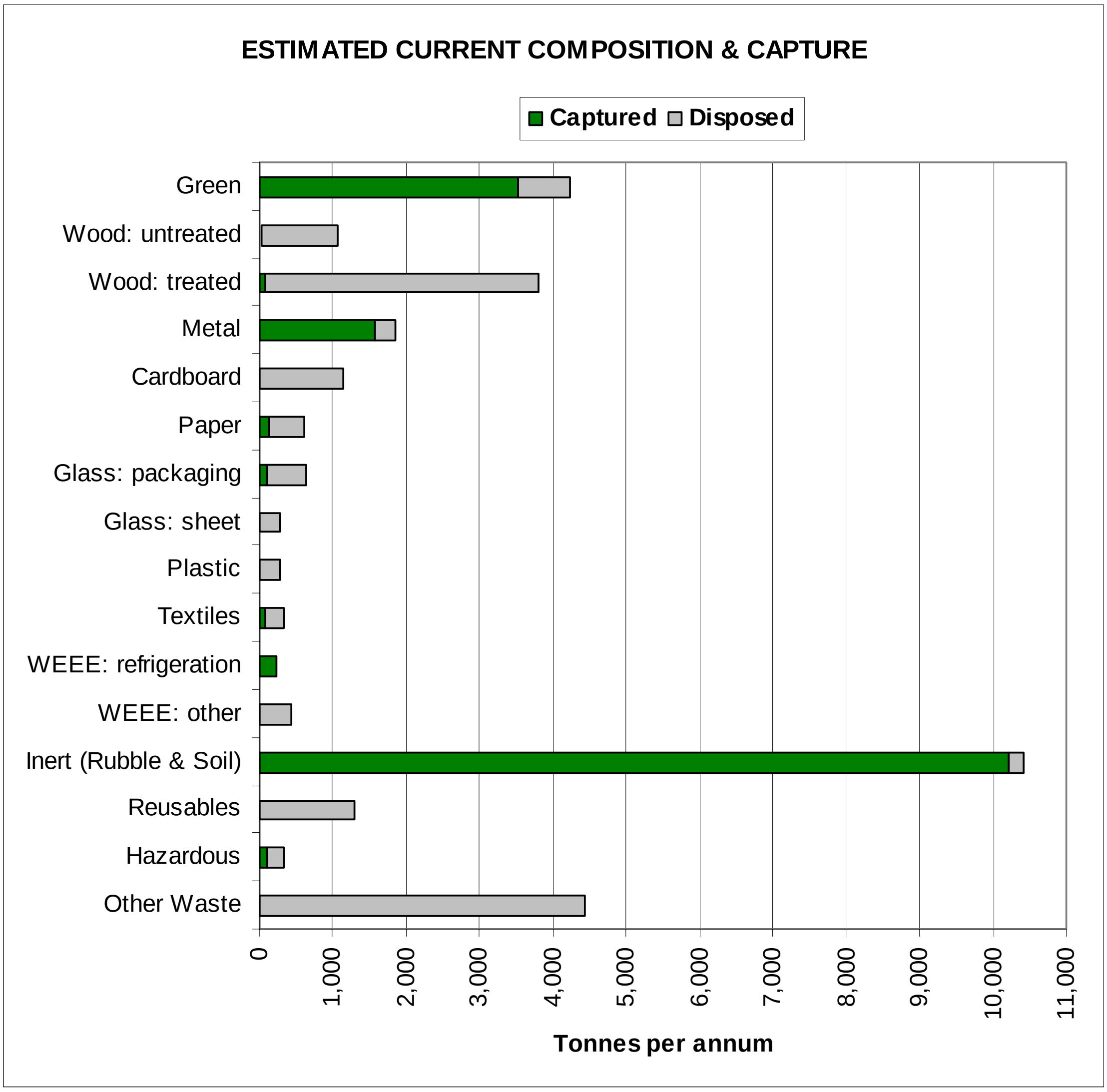
Table 5.2.1: Hanford HW&RC, projected increases in recycling rate due to specific improvements

SITE IMPROVEMENTS & PROJECTED RECYCLING RATE INCREASES	
Current recycling rate	**27.4%**
Materials separation	**RR increase**
Cardboard	2.3%
WEEE, excluding refrigeration	1.2%
Plastic bottles	1.0%
Other improvements	**RR increase**
Reuse system: install	4.3%
Contract incentives: introduce	4.9%
Staffing improvements	1.7%
Signage improvements	7.1%
Good quality publicity leaflets, installation, etc	1.0%
Improve recycling bin order	0.2%
Improve layout & traffic management	0.3%
Remove height barriers, introduce permits	5.4%
Deal with severe security issues	1.7%
Other collection systems	**RR +/-**
K/s green high non-restrictive introduced	-2.2%
Total addition to current RR	**28.8%**
Final target BVPI RR	**56.2%**
Notes: (i) all recycling rates and increases are expressed according to the BVPI definition; (ii) recycling rate increases are in terms of percentage point additions to the current recycling rate; (iii) recycling rate increases are estimates based on the NACAS regression model of factors affecting CA site recycling rates.	

The estimated effects of these increases in terms of additional material separation from residual waste are represented in Figures 5.2.2 and 5.2.3 below, which illustrate site composition and capture of various materials before and after the recommended improvements. For each type of material, the green section of the bar indicates currently separated material (ie recycled, composted or reused) and the grey section indicates material disposed in residual waste containers. It should be borne in mind that these Figures present assumptions about the site's waste composition, which can only be estimated due to lack of data. However every effort has been made to apply a realistic model of waste composition for this site.

Whilst the BVPI recycling rate projected to result from site improvements is 56.2%, the mass balance calculations that follow indicate that an overall diversion rate (including inert waste and reuse) of 66.5% would be achieved.

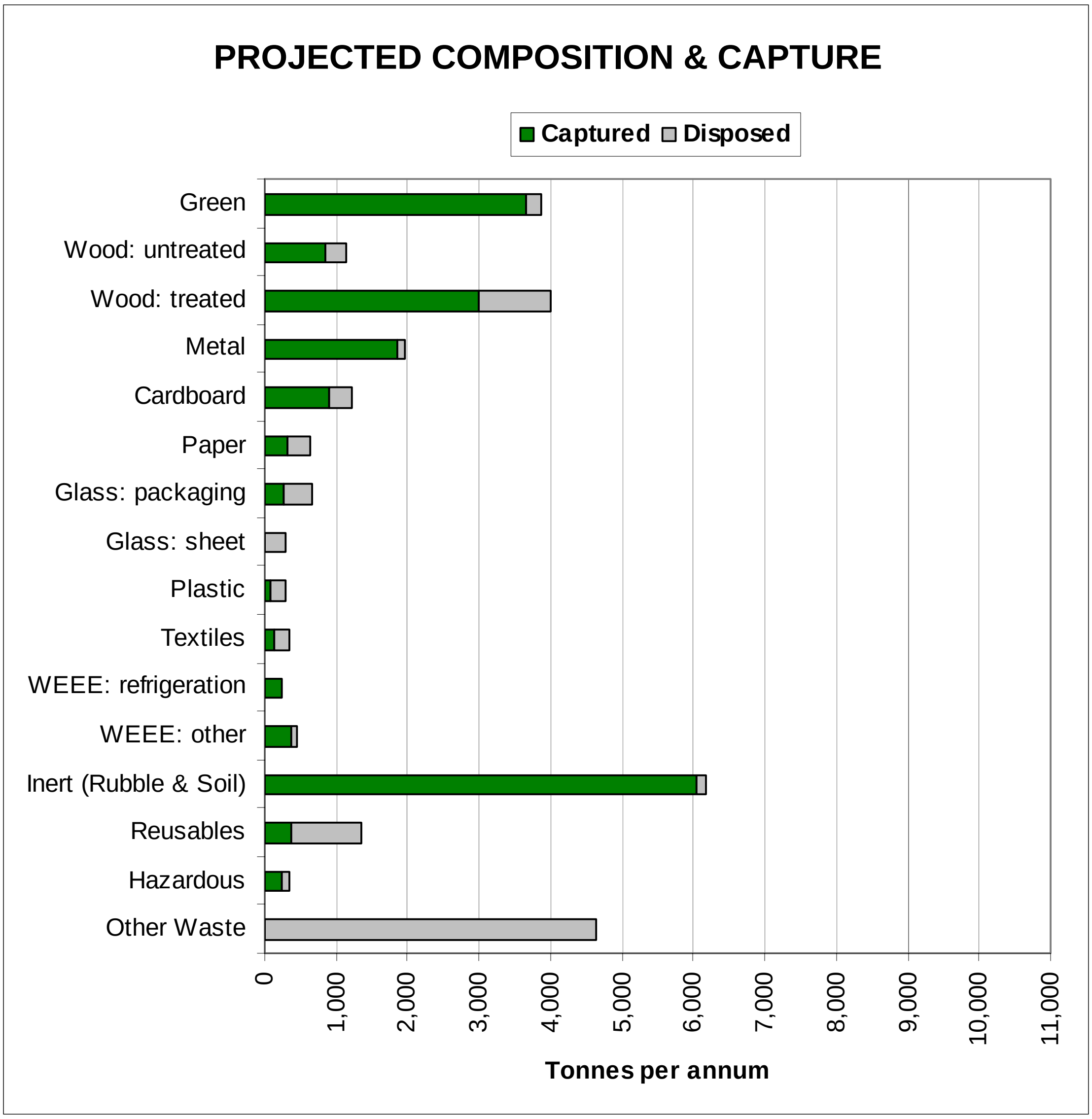
Figure 5.2.2: Hanford HW&RC, Estimated composition and capture BEFORE site improvements



Note on projected capture of materials:

The projected diversion of materials from residual waste presented in this Section (and in Table 5.2.3 in particular) are estimates based on the best currently available data and research. Projected capture tonnages for individual materials should not be regarded as exact targets, though the failure to attain these tonnages in the first year after implementation of improvements may be regarded as a warning signal that the relevant materials may not have been sufficiently well targeted. However, it may be the case that the relevant materials do not arise at the site in the quantities suggested by the composition estimates in this Section. The total projected diversion for all separated materials (in Table 5.2.3) may be regarded as a more reliable target for overall diversion from residual waste. Nevertheless, whilst every effort has been made to provide realistic projections of additional diversion of materials, it should be borne in mind that these are estimated predicted tonnages.

Figure 5.2.3: Handford HW&RC, Projected composition and capture AFTER site improvements



The proportion of inert waste entering the site is projected to decrease after improvements due to the implementation of effective trade controls and C&D waste limits. This results in a lower overall site throughput, and higher proportions of other materials entering the site. However, the proportion of green waste is predicted to be reduced, due to the introduction of kerbside green waste collections. Additionally, the proportion of "Other Waste" is predicted to increase, which reflects the projected effect of the introduction of fortnightly kerbside collections.

The projected effect of site improvements in terms of capture of materials is also represented in Tables 5.2.2 and 5.2.3 below (which includes data upon which the above two Figures are based). As shown in Table 5.2.3, it is estimated that the recommended site improvements would result in the additional diversion of approximately 2,302 of MSW from CA residual waste (in the first year after the implementation of improvements). However, since the tonnage of separated rubble is predicted to decrease significantly, it is estimated that the diversion of BMW from CA residual waste would actually increase by around 5,215 tonnes in the first year. Due to reductions in site throughput, total residual waste tonnages are projected to reduce from 15,342 tonnes to 9,251 tonnes, ie a reduction of 6,091 tonnes in the first year.

Table 5.2.2: Hanford HW&RC, Estimated composition and capture BEFORE site improvements

ESTIMATED CURRENT COMPOSITION & CAPTURE					
MATERIAL	COMPOSITION		CAPTURE		BVPI defn. RR
	Tonnes	% total	Tonnes	%	
Green	4,225	13.5%	3,528	83%	16.7%
Wood: untreated	1,075	3.4%	17	2%	0.1%
Wood: treated	3,810	12.1%	66	2%	0.3%
Metal	1,859	5.9%	1,575	85%	7.5%
Cardboard	1,152	3.7%	0	0%	0.0%
Paper	596	1.9%	128	21%	0.6%
Glass: packaging	635	2.0%	97	15%	0.5%
Glass: sheet	284	0.9%	0	0%	0.0%
Plastic	267	0.9%	0	0%	0.0%
Textiles	319	1.0%	66	21%	0.3%
WEEE: refrigeration	227	0.7%	227	100%	1.1%
WEEE: other	435	1.4%	0	0%	0.0%
Inert (Rubble & Soil)	10,429	33.3%	10,220	98%	na
Reusables	1,294	4.1%	0	0%	na
Hazardous	324	1.0%	94	29%	0.4%
Other Waste	4,430	14.1%	0	0%	0.0%
TOTAL	**31,360**	**100%**	**16,018**	**na**	**27.4%**

Table 5.2.3: Hanford HW&RC, Projected composition and capture AFTER site improvements

PROJECTED COMPOSITION & CAPTURE AFTER IMPROVEMENTS						Additional diversion, tonnes
MATERIAL	COMPOSITION		CAPTURE		BVPI defn. RR	
	Tonnes	% total	Tonnes	%		
Green	3,858	14.0%	3,665	95%	17.3%	137
Wood: untreated	1,128	4.1%	846	75%	4.0%	829
Wood: treated	3,999	14.5%	2,999	75%	14.2%	2,933
Metal	1,951	7.1%	1,853	95%	8.8%	278
Cardboard	1,209	4.4%	907	75%	4.3%	907
Paper	626	2.3%	313	50%	1.5%	185
Glass: packaging	666	2.4%	266	40%	1.3%	169
Glass: sheet	298	1.1%	0	0%	0.0%	0
Plastic	281	1.0%	70	25%	0.3%	70
Textiles	335	1.2%	134	40%	0.6%	68
WEEE: refrigeration	238	0.9%	238	100%	1.1%	11
WEEE: other	456	1.7%	365	80%	1.7%	365
Inert (Rubble & Soil)	6,178	22.4%	6,054	98%	na	-4,166
Reusables	1,358	4.9%	381	28%	na	381
Hazardous	340	1.2%	228	67%	1.1%	134
Other Waste	4,650	16.9%	0	0%	0.0%	0
TOTAL	**27,572**	**100%**	**18,320**	**na**	**56.2%**	**2,302**
Projected additional BMW recycled/reused:						**5,215**

5.2.3 Hanford HW&RC: Improvement Investment Costs

Estimated capital and baseline revenue costs for the recommended site improvements are summarised in the following tables. These costs should be viewed in the context of the overall financial case presented in Section 6. For comments on estimated unit costs, also refer to Section 6. Surfacing/concrete costs are rough estimations which are intended to provide a guide figure for approximate costs. In particular, redevelopment costs are estimates and it is advised that Stoke-on-Trent City Council should further investigate the cost of redeveloping the site; (refer to comments in Section 2.2).

CAPITAL INVESTMENT COSTS			
Item	**No. items**	**Unit cost**	**Cost**
CONTAINERS:			
40yd enclosed	3	£2,657	£7,971
10yd closed	1	£672	£672
Hazardous chemicals safe	1	£1,000	£1,000
SURFACING/CONCRETE:			
Redevelopment: split-level area	1	£75,000	£75,000
Redevelopment: other works	1	£25,000	£25,000
Parking bay markings, per m2	400	£9.00	£3,600
Letters/arrows	30	£10.90	£327
Lined road markings, per m	1000	£0.55	£545
OTHER ITEMS:			
Signs (large)	25	£654	£16,350
Staff office	1	£3,000	£3,000
Staff cabin	1	£1,200	£1,200
Static Compactor	1	£30,000	£30,000
Vehicle License Plate Recognition system	1	£25,000	£25,000
CCTV repair and improvement	1	£20,000	£20,000
		TOTAL:	**£209,665**

REVENUE COSTS	
Type of cost	**Cost for site**
Additional staff, FTE (Full Time Equivalent)	£35,260
Financial incentives for staff	£26,250
Training programme for staff	£3,500
Publicity measures	£5,000
Trade controls: permit system & monitoring	£15,000
Security: monitoring & response	£20,000
TOTAL:	**£105,010**
Does not include revenue costs for materials (disposal, haulage & gate fees), LATS or financial incentives to site management contractors.	

5.3 Projected Performance Improvement for Both Sites Combined

This section presents projections for the increase in recycling rate and capture of materials for both Stoke-on-Trent City Council HW&RCs combined.

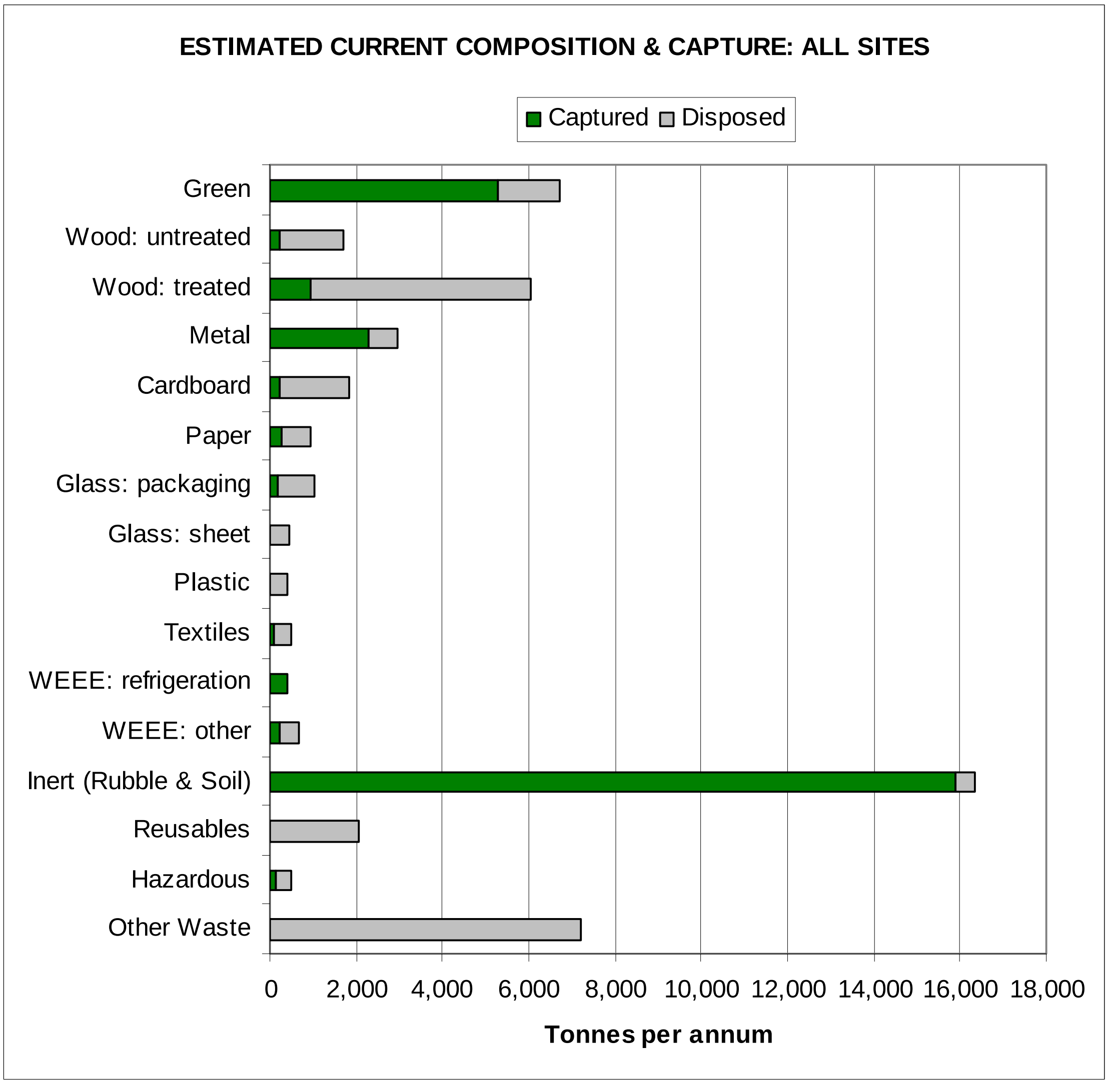
The implementation of improvements at both Stoke-on-Trent City Council HW&RCs, as detailed previously in Section 5, are projected to increase the combined recycling rate performance from 30.3% to 57.2% (BVPI definition). The total diversion rate (including separated inert waste and reuse) is projected to increase to 66.9%. These projected performance improvements are estimates based on NACAS findings; (for further details see Sections 3.2 and Appendix 2).

The estimated effects of these increases in terms of additional material separation from residual waste are represented in Figures 5.3.1 and 5.3.2 below, which illustrate site composition and capture of various materials before and after the recommended improvements. For each type of material, the green section of the bar indicates currently separated material (ie recycled, composted or reused) and the grey section indicates material disposed in residual waste containers. It should be borne in mind that these Figures present assumptions about the site's waste composition, which can only be estimated due to lack of data. However every effort has been made to apply a realistic model of waste combined composition for the sites.

It should be noted that a large increase in the diversion of wood from residual waste is projected (amounting to over 5,000 additional tonnes across both sites in the first year after implementation of improvements). Therefore the capacity of current outlets for wood should be reviewed and, if necessary, other suitable outlets for wood reprocessing should be established. It may also be necessary for site staff to closely supervise the disposal of wood by the public, in order to ensure that the increase in wood separation does not result in unacceptable levels of contamination.

Various changes in site throughput and composition are predicted to take place. Site throughputs are projected to decrease due to the upgrading of trade waste controls. The proportion of inert waste is projected to decrease due to the implementation of trade waste controls, and the enforcement of C&D waste limits for site users. Moreover the proportion of green waste is projected to decrease slightly, due to the introduction of kerbside green waste collections within the catchments of the HW&RCs. Finally, the proportion of "Other Waste" is projected to increase, reflecting the possible effect of the introduction of fortnightly kerbside residual waste collections within the catchments of the sites. It should be noted that it is difficult to predict the effects of these factors with accuracy; however, every effort has been made to provide a realistic projection of changes in site throughput and composition.

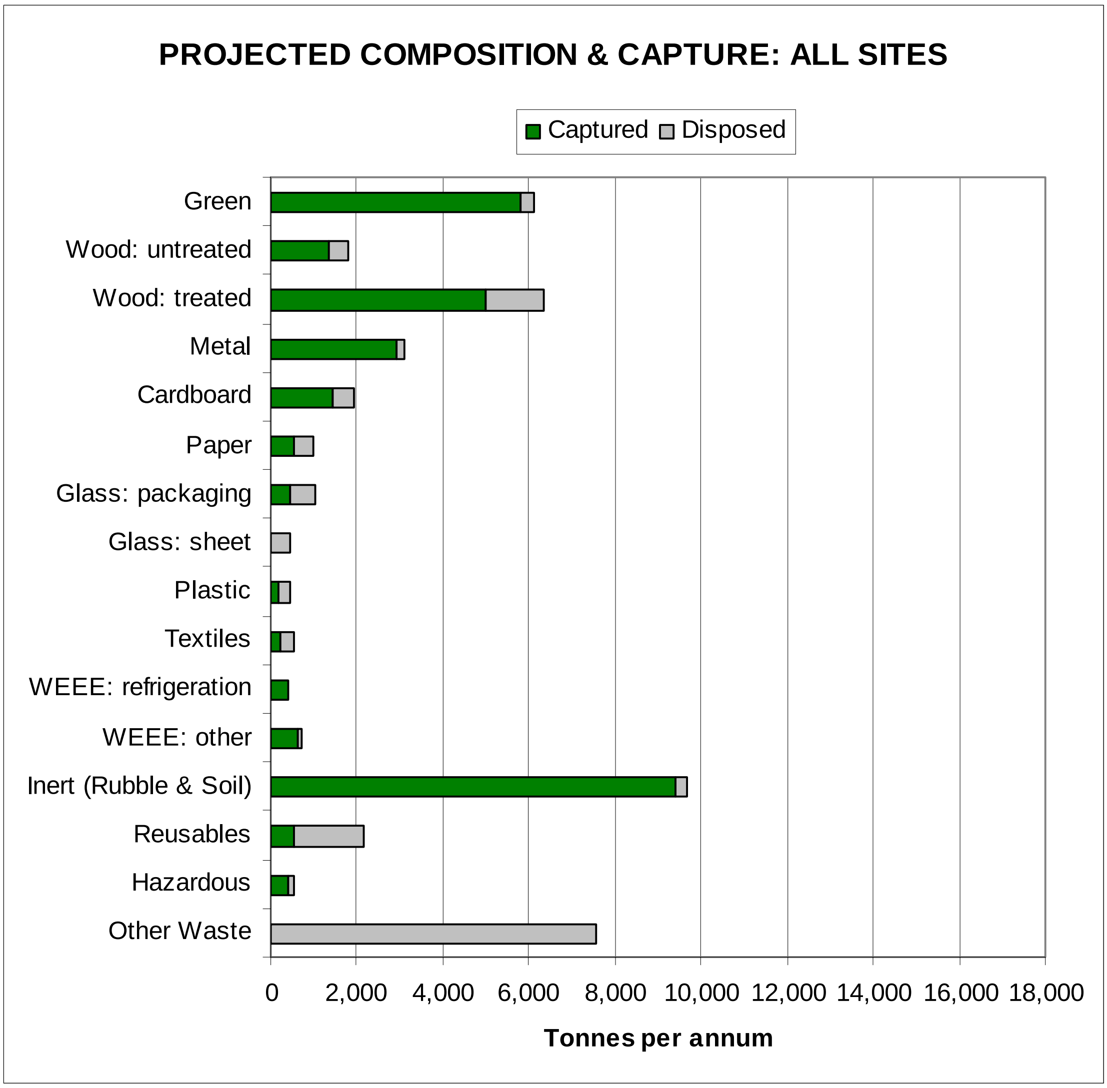
Figure 5.3.1: Both Stoke-on-Trent City Council HW&RCs, Estimated composition & capture BEFORE improvements



Note on projected capture of materials:

The projected diversion of materials from residual waste presented in this Section (and in Table 5.3.2 in particular) are estimates based on the best currently available data and research. Projected capture tonnages for individual materials should not be regarded as exact targets, though the failure to attain these tonnages in the first year after implementation of improvements may be regarded as a warning signal that the relevant materials may not have been sufficiently well targeted. However, it may be the case that the relevant materials do not arise at the site in the quantities suggested by the composition estimates in this Section. The total projected diversion for all separated materials (in Table 5.3.2) may be regarded as a more reliable target for overall diversion from residual waste. Nevertheless, whilst every effort has been made to provide realistic projections of additional diversion of materials, it should be borne in mind that these are estimated predicted tonnages.

Figure 5.3.2: Both Stoke-on-Trent City Council HW&RCs: Projected composition & capture AFTER improvements



The proportion of inert waste entering the site is projected to decrease after improvements due to the implementation of effective trade controls. This results in higher proportions of other materials entering the site. Overall site throughput decreases in the first period after implementation of improvements, again due to trade controls.

The projected effect of site improvements in terms of capture of materials is also represented in Tables 5.3.1 and 5.3.2 below (which includes data upon which the above two Figures are based).

As shown in Table 5.3.2, it is estimated that the recommended site improvements would result in the additional diversion of approximately 3,107 of MSW from CA residual waste (in the first year after the implementation of improvements). Due to projected reductions in inert waste inputs, the additional diversion of BMW from residual waste is projected to be greater the figure for additionally diverted MSW, amounting to 7,510 tonnes in the first year. Changes in site composition and throughput (due to trade controls) actually reduce residual waste from 23,628 tonnes to 14,502 tonnes, ie a reduction of 9,126 tonnes, in the first year after implementation of improvements.

Table 5.3.1: Both Stoke-on-Trent City Council HW&RCs, Estimated composition & capture BEFORE improvements

ESTIMATED CURRENT COMPOSITION & CAPTURE: ALL SITES					
MATERIAL	COMPOSITION		CAPTURE		BVPI defn. RR
	Tonnes	*% total*	Tonnes	*%*	
Green	6,709	*13.5%*	5,287	*79%*	15.6%
Wood: untreated	1,706	*3.4%*	240	*14%*	0.7%
Wood: treated	6,050	*12.1%*	960	*16%*	2.8%
Metal	2,951	*5.9%*	2,288	*78%*	6.7%
Cardboard	1,829	*3.7%*	217	*12%*	0.6%
Paper	946	*1.9%*	253	*27%*	0.7%
Glass: bottles	1,008	*2.0%*	165	*16%*	0.5%
Glass: sheet	451	*0.9%*	0	*0%*	0.0%
Plastic	425	*0.9%*	0	*0%*	0.0%
Textiles	507	*1.0%*	100	*20%*	0.3%
WEEE: refrigeration	388	*0.8%*	388	*100%*	1.1%
WEEE: other	690	*1.4%*	221	*32%*	0.7%
Inert (Rubble & Soil)	16,354	*32.8%*	15,893	*97%*	*na*
Reusables	2,055	*4.1%*	0	*0%*	*na*
Hazardous	515	*1.0%*	154	*30%*	0.5%
Other Waste	7,211	*14.5%*	0	*0%*	0.0%
TOTAL	**49,794**	***100%***	**26,166**	***na***	**30.3%**

Table 5.3.2: Both Stoke-on-Trent City Council HW&RCs, projected composition & capture AFTER improvements

PROJECTED COMPOSITION & CAPTURE AFTER IMPROVEMENTS: ALL SITES						Additional diversion, tonnes
MATERIAL	COMPOSITION		CAPTURE		BVPI defn. RR	
	Tonnes	*% total*	Tonnes	*%*		
Green	6,104	*13.9%*	5,795	*95%*	17.1%	508
Wood: untreated	1,786	*4.1%*	1,371	*77%*	4.0%	1,131
Wood: treated	6,333	*14.5%*	4,976	*79%*	14.7%	4,016
Metal	3,090	*7.1%*	2,933	*95%*	8.7%	645
Cardboard	1,915	*4.4%*	1,434	*75%*	4.2%	1,217
Paper	991	*2.3%*	557	*56%*	1.6%	304
Glass: bottles	1,055	*2.4%*	460	*44%*	1.4%	295
Glass: sheet	472	*1.1%*	0	*0%*	0.0%	0
Plastic	445	*1.0%*	179	*40%*	0.5%	179
Textiles	530	*1.2%*	231	*44%*	0.7%	131
WEEE: refrigeration	406	*0.9%*	406	*100%*	1.2%	18
WEEE: other	722	*1.7%*	618	*86%*	1.8%	397
Inert (Rubble & Soil)	9,689	*22.1%*	9,389	*97%*	*na*	-6,504
Reusables	2,151	*4.9%*	539	*25%*	*na*	539
Hazardous	539	*1.2%*	386	*72%*	1.1%	232
Other Waste	7,548	*17.2%*	0	*0%*	0.0%	0
TOTAL	**43,775**	***100%***	**29,273**	***na***	**57.2%**	**3,107**
Projected additional BMW recycled/reused:						**7,510**

6. FINANCIAL CASE

This section presents a financial case for investing in Stoke-on-Trent City Council HW&RCs in order to implement the improvements presented in this report and includes the following information:

- **Section 6.1: Scope of Financial Case** – a concise description of the scope of the economic analysis included in the financial case for implementing site improvements.
- **Section 6.2: Key Assumptions and Limitations** – a discussion of the most significant assumptions applied and the limitations of the financial case.
- **Section 6.3: Financial Case Excluding LATS** – the financial case for all economic factors considered in this report, excluding the impact of the Landfill Allowance Trading Scheme.
- **Section 6.4: Financial Case Including Predicted Effects of LATS** – the overall financial case for implementing recommended site improvements, including the effects of LATS.
- **Section 6.5: Sensitivity Analysis** – an examination of the effects of variations in costs, recycling performance and other factors on the outcome of the financial case.
- **Section 6.6: Financial Case Summary and Conclusions** – a concise summary of the financial case for implementing HW&RC improvements.

For a description of the methodology used to produce the financial case, refer to Section 3.3 and Appendix 3.

6.1 Scope of the Financial Case

This financial case presents *incremental costs/savings* arising from site improvements and does not account for the current operating costs of the site. Therefore all costs/savings presented in this financial case are in addition to all current CA site operating costs/savings. In effect, this financial case represents the net costs/savings that would arise if recommended improvements were implemented, in comparison to if site improvements were not implemented. The financial case takes account of the following types of cost (saving):

1. **Capital investment costs:** capital costs of improvements recommended in this report.
2. **Baseline revenue costs:** revenue costs arising directly from recommended site improvements, such as staffing costs or ongoing trade control costs, (but excluding contractor incentives and costs/savings arising from the diversion of additional material from residual waste).
3. **Materials revenue costs (savings):** haulage and gate fees (or income) from the additional diversion of materials from residual waste.
4. **Avoided disposal costs excluding LATS:** avoided haulage, gate fees and Landfill Tax for residual waste tonnage diverted to recycling, composting or reuse as a result of site improvements.
5. **Contractor incentives:** financial incentives to the site management contractor, linked to target improvements in the site's performance.
6. **Avoided costs through savings in Landfill Allowances:** savings arising from the additional diversion of BMW from landfill, and therefore the avoided use of Landfill Allowances.

The overall period covered by the financial case is from 2005/6 to 2020/21, ie the period during which local authorities will be subject to the Landfill Allowance Trading Scheme.

6.2 Key Assumptions and Limitations

Various assumptions have been applied in order to produce this financial case and some of these assumptions will inevitably include inaccuracies, which in turn will place limits on the predictive power of the financial model used for the financial case. The most significant assumptions and potential inaccuracies arising from them are described briefly in this Section. A sensitivity analysis assessing the effects of inaccuracies in some key assumptions on the financial case is presented in Section 6.5.

Recycling Rate Increases: The recycling rate increases projected in this report are based on NACAS[8] analysis of data over 100 surveyed sites. Although separate effects on CA site recycling rates are projected from certain individual improvements, the implementation of only some of the recommended improvements will not necessarily result in the recycling rate increases associated with these individual improvements being realised, since other barriers to increasing recycling rates may remain and may diminish the effect of these individual improvements. The overall recycling rate increases projected to take place through implementing all recommended improvements may be regarded as being more reliable. However, it should be borne in mind that these are estimated predicted overall recycling rate increases. (See Section 5.3 and Appendix 2 for further comments.)

CA Site Composition: the composition of the relevant CA site(s) has been estimated in order to model the effect of improvements in terms of mass balance, ie estimating which materials are diverted from residual waste in order to achieve target recycling rates. Significant inaccuracies in composition estimates would affect the outcome of the financial case, since some materials being targeted for diversion may actually arise in much lower or higher quantities than the composition estimates suggest. (See Section 5.3 & Appendix 3 for further comments.)

Capture rates for materials: Maximum capture rates have been set for some types of materials since it is assumed that a certain proportion of potentially recyclable materials will still be deposited in residual waste containers, even after improvements. Moreover, it is also assumed that a proportion of certain types of material will be of poor quality or contaminated, to the extent that these materials will be unsuitable for recycling. (Estimated capture rates after improvements are shown in Section 5.3, Table 5.3.2; for estimated capture rates at individual sites, refer to the appropriate subsections in Section 5.)

Capital costs: estimated unit costs for capital items have been applied to arrive at overall capital costs for site improvements. The depreciation of capital items is accounted for by estimating write-off periods for each capital investment item. These unit costs and write-off periods are specified in Section 6.3.1. Write-off periods are used to calculate capital investment in terms of an annual revenue equivalent, in order to assist in financial modelling up to 2020/21.

Baseline revenue costs[9]: estimated unit costs for baseline revenue expenditure on improvements are applied, and these unit costs are specified in Section 6.3.2. Costs for additional site attendants are calculated on the basis of a conversion rate[10] of daily compliment of staff to FTE (full time equivalent) of 1.64.

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[8] National Assessment of Civic Amenity Sites

[9] ie staffing costs and other ongoing costs directly arising from implementing improvements

[10] This conversion rate is required to account for an additional staff member being required 7 days per week, whereas a newly recruited site attendant would generally work only 5 days per week; therefore additional staffing cover during the remaining 2 days (and during holiday periods) would need to be provided and paid for.

Materials revenue costs/income: unit costs (savings) have been applied for haulage and gate fees (income) arising from the additional diversion of materials from CA residual waste for recycling, composting and reuse. These unit costs (savings) are specified in Section 6.3.3 and are based on payment rates per tonne for haulage & gate fees specified under the current contract.

Avoided disposal costs excluding LATS: unit costs for haulage and gate fees for landfill of active residual waste have been applied, in addition to the projected increases in Landfill Tax that the government currently indicates will take place. These unit costs are specified in Section 6.3.4 and are based on payment rates per tonne for haulage & gate fees specified under the current contract.

Avoided costs through savings in Landfill Allowances: accounting for the financial effects of LATS involves a special set of problems, and these issues are dealt with in Section 6.4. Essentially, the main variables that will affect these avoided costs are (i) the tonnage of additional BMW diverted from landfill as a result of CA site improvements, and (ii) the market value of LATS permits in future years. Since Stoke-on-Trent City Council incinerates a proportion of its residual MSW, other variables also affect LATS savings; these issues are also addressed in Section 6.4.

Annual growth in waste arisings: on the advice of Stoke-on-Trent City Council, the following assumptions have been applied, both for CA site waste and the authority's MSW arisings:

- 2005/06 to 2009/10: 2% pa
- 2010/11 to 2015/16: 1% pa
- 2016/17 to 2020/21: 0% pa.

Additional Assumptions: other significant assumptions include (i) annual RPI (Retail Price Index) increases in costs, and (ii) borrowing rate applied to the revenue equivalent of capital investment costs. Details of these assumptions are shown in Table 6.2.1 below.

Table 6.2.1: Additional Key Assumptions applied for the Financial Case

ANNUAL RETAIL PRICE INDEX INCREASES APPLIED TO COSTS	
Annual Retail Price Index (RPI)	3.0%
RPI applied to:	
Residual waste disposal gate fee	YES
Residual waste disposal haulage	YES
Materials revenue costs (savings)	YES
Other revenue costs (ie staffing)	YES
ANNUAL CAPITAL BORROWING RATE	
Assumed annual borrowing rate	7.5%
Borrowing rate applied to annualized capital?	YES

The figure for annual RPI is based on recent data from the Office of National Statistics.

The assumptions listed in Table 6.2.1 are applied to costs/savings presented in Sections 6.3.6 onwards.

6.3 Financial Case excluding LATS

Results of the financial modelling of the effects of implementing the recommended CA site improvements are presented with under different types of cost in the following Sections:

6.3.1 Capital costs

6.3.2 Baseline revenue costs (ie costs arising directly from implementing improvements, ie additional staffing costs)

6.3.3 Materials revenue costs/savings

6.3.4 Avoided disposal costs excluding LATS

6.3.5 Financial incentives to the contractor

A summary of the financial case accounting for all these factors is presented in Section 6.3.6. The financial effects of LATS on the financial case are discussed separately in Section 6.4.

6.3.1 Capital costs

Estimated capital investment costs for implementing the recommended CA site improvements are presented in Table 6.3.1 below, which also includes assumed unit costs, write-off periods and revenue equivalents for capital outlay.

Table 6.3.1: Estimated capital investment costs for implementing site improvements

CAPITAL INVESTMENT COSTS: ALL SITES						
Item	**No. items**	**Unit cost**	**Capital Outlay**	**Write over period (yrs)**	**Annualised cost**	**Revenue Equivalent**
CONTAINERS:						
40yd enclosed	5	£2,657	**£13,285**	7	£380	**£1,898**
8yd closed	1	£631	**£631**	7	£90	**£90**
10yd closed	1	£672	**£672**	7	£96	**£96**
Textile bank	1	£300	**£300**	5	£60	**£60**
Paint container	1	£1,000	**£1,000**	7	£143	**£143**
Hazardous chemicals safe	1	£1,000	**£1,000**	7	£143	**£143**
SURFACING/CONCRETE:						
Redevelopment: split-level area	1	£75,000	**£75,000**	15	£5,000	**£5,000**
Redevelopment: other works	1	£25,000	**£25,000**	15	£1,667	**£1,667**
Parking bay markings, per m2	700	£9.00	**£6,300**	5	£1.80	**£1,260**
Letters/arrows	60	£10.90	**£654**	5	£2.18	**£131**
Lined road markings, per m	1,500	£0.55	**£818**	5	£0.11	**£164**
OTHER ITEMS:						
Adjustment of railings	1	£400	**£400**	10	£40	**£40**
Leaflet dispenser (weatherproof)	4	£300	**£1,200**	5	£60	**£240**
Signs (large)	45	£654	**£29,430**	5	£131	**£5,886**
Staff office	1	£3,000	**£3,000**	10	£300	**£300**
Staff cabin	1	£1,200	**£1,200**	10	£120	**£120**
Static Compactor	1	£30,000	**£30,000**	7	£4,286	**£4,286**
Vehicle License Plate Recognition system	2	£25,000	**£50,000**	7	£3,571	**£7,143**
CCTV repair and improvement	2	£20,000	**£40,000**	5	£4,000	**£8,000**
TOTAL	*na*	*na*	**£279,890**	*na*	*na*	**£36,665**

A total capital investment of an estimated £279,890 is required for the recommended improvements at both HW&RCs. Significant elements of this cost are the introduction of a Vehicle License Plate Recognition system and upgrading of CCTV systems at both sites, and the installation of a static compactor and redevelopment works at Hanford HW&RC. The estimate for capital investment needs to be viewed in the context of the overall business case, as presented in Section 7.3.6. It should be noted that Surfacing/Concrete costs are rough estimates; in particular, redevelopment costs for Hanford HW&RC are estimates and it is advised that Stoke-on-Trent City Council should further investigate the cost of redeveloping the site; (refer to comments in Section 2.2).

Annualised capital (ie capital as a revenue equivalent) is £36,665, plus any borrowing rate that is applied to capital; (see Section 6.2, Table 6.2.1).

The annualised capital cost for the static compactor is assumed to include maintenance costs.

6.3.2 Baseline revenue costs

Estimated baseline revenue costs for implementing recommended improvements for this site are presented in Table 6.3.2 below.

Table 6.3.2: Estimated baseline revenue costs for implementing site improvements

BASELINE REVENUE COSTS	
Type of cost	**Costs for all sites**
Additional staff, FTE (Full Time Equivalent)	£76,260
Financial incentives for staff	£43,575
Training programme for staff	£5,810
Publicity measures	£10,000
Trade controls: permit system & monitoring	£30,000
Security: monitoring & response	£20,000
TOTAL	**£185,645**
Does not include revenue costs for materials (disposal, haulage & gate fees), LATS or financial incentives to site management contractors.	

As shown in the above table, total baseline revenue costs are estimated to be £185,645 per annum, plus any RPI increases on costs that have been applied in the financial case; (see Section 6.2, Table 6.2.1).

The following unit costs have been applied to arrive at the costs in Table 6.3.2 above:

Additional staffing: Annual wage bill of £25,000, multiplied by 1.64 to arrive at an FTE figure; (see Section 6.2 for further comments). This figure is assumed to include National Insurance, pensions and other expenses arising for employers in the context of paying staff wages.

Financial incentives for staff: 15% of annual wage bill, payable to staff upon the achievement of suitable recycling rate targets.

Training programme for staff: £500 per annum per member of staff.

Publicity measures: £10,000 per annum for the production of leaflets, advertising of site facilities, publicising site policies (ie trade controls) and other ongoing publicity costs, for both sites.

Trade controls: £30,000 per annum in management and monitoring of trade control systems across both sites. It is assumed that this cost would also cover management and monitoring of a cross-border permit system, should Stoke-on-Trent City Council decide to implement such a system. For further details of trade waste and cross-border control recommendations, refer to the report *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council.* These costs are based on similar estimated costs for other authorities.

Security measures: £20,000 per annum per site, in management and delivery of security measures; it is assumed that this sum may be spent on employing a security firm to provide an appropriate monitoring and response system for any break-ins occurring at Hanford HW&RC.

6.3.3 Materials revenue costs/savings

Unit costs/savings used in the financial case for economic modelling of the diversion of additional materials from residual waste are shown in Table 6.3.3, which includes estimates for income, gate fees and haulage costs per tonne. It has not been possible to account for market fluctuations in these costs in future years.

Table 6.3.3: Unit costs for materials

UNIT COSTS/SAVINGS FOR SEPARATED MATERIALS PER TONNE				
Type of materials	**Income**	**Gate fee**	**Haulage**	**Net Income**
Green	£0	£23	£5	-£28
Wood: untreated	£0	£26	£0	-£26
Wood: treated	£0	£26	£0	-£26
Metal	£35	£0	£0	£35
Cardboard	£0	£12	£0	-£12
Paper	£0	£25	£10	-£35
Glass: bottles	£0	£5	£10	-£15
Plastic	£0	£35	£10	-£45
Textiles	£29	£0	£0	£29
WEEE: refrigeration	£0	£200	£0	-£200
WEEE: other	£0	£0	£0	£0
Inert (Rubble & Soil)	£0	£6	£5	-£11
Reusables	£0	£0	£0	£0
Hazardous	£0	£150	£20	-£170

Where costs/income are different for each of the sites, a composite average figure has been used which accounts for the proportional tonnages of the relevant materials for the two sites. It has not been possible to separately estimate haulage costs for all materials, and for these materials haulage costs are included in the figure for gate fees.

The income for scrap metal was originally set at £50 per tonne, but this has been lowered to £35 per tonne to account for the likelihood that the increased separation of WEEE items from scrap metal containers will result in lower scrap metal tonnages, and therefore a lower income from scrap metal[11]. Unit costs for WEEE (non-refrigeration) have been set at £0 per tonne, since at the time of writing there are numerous uncertainties as to how the economics of WEEE separation will work from the viewpoint of CA sites. The unit cost for refrigeration of £200 per tonne does not take into account the possibility that the WEEE Directive might be interpreted such that there is no net cost arising to local authorities for refrigeration separation. However in view of the current uncertainties regarding the WEEE Directive's implementation, an approximation of the current cost per tonne is applied in this model.

[11] In reality, we would expect the income per tonne from scrap metal to not be affected by reduced metal tonnages; however due to limitations in the design of the model used for this financial case, altering the mass balance to reflect this is not possible, so the unit income for scrap metal has to be reduced in order to model lower incomes from lower tonnages of scrap metal.

Net receipts from the diversion of additional materials from residual waste are calculated in Table 6.3.4 below.

Table 6.3.4: Net receipts from materials diverted from residual waste after improvements

Type of recovered material	Additional tonnage diverted	Net income (cost) per tonne	Net receipts
Green	520	-£28	-£14,574
Wood: untreated	1,159	-£26	-£30,129
Wood: treated	4,116	-£26	-£107,022
Metal	661	£35	£23,127
Cardboard	1,247	-£12	-£14,968
Paper	311	-£35	-£10,894
Glass: bottles	302	-£15	-£4,535
Plastic	184	-£45	-£8,266
Textiles	134	£29	£3,900
WEEE: refrigeration	19	-£200	-£3,703
WEEE: other	407	£0	£0
Inert (Rubble & Soil)	-6,666	-£11	£73,328
Reusables	553	£0	£0
Hazardous	238	-£170	-£40,436
Totals	**3,185**		**-£134,171**

It is estimated that haulage, and gate fees/income from additionally diverted materials will result in a net cost of around £134,000 in the first year after improvements. Costs from the additional separation of recyclables are offset to a certain extent by incomes resulting from the increased separation of scrap metal and the projected large decrease in rubble tonnages entering the sites (due to trade waste and C&D waste controls). The figures in the above tables do not account for any annual increases in waste arisings or RPI, though these factors are accounted for in Section 6.3.6.

The additional diversion tonnages in the above table differ slightly from those presented in Section 5.3, since the figures in this table take into account assumed increases in waste arisings growth between 2004/05 and 2005/06.

6.3.4 Avoided disposal costs excluding LATS

Stoke-on-Trent City Council currently has two disposal options available for its residual waste: incineration or landfill. Therefore it appears that a reduction in CA site residual waste would have to take into account avoided costs for both of these options. However, the situation is much simplified if it is assumed that Stoke-on-Trent City Council will incinerate similar tonnages of its residual waste annually up to 2020. This assumption is adopted for this financial case on the strength that the joint contract between local authorities in the North Staffordshire conurbation and MES specifies the same minimum delivery tonnages for incineration annually up to 2020; and that Stoke-on-Trent City Council has expressed the view that it would not be unreasonable to suppose that it's share of annual tonnages of incinerated waste would remain fairly static up to 2020.

If we assume that Stoke-on-Trent City Council's annual incineration tonnages remain static, this means that any reduction in CA site residual waste will result in a corresponding reduction in amount of waste that the authority landfills, *regardless of whether CA site residual waste is incinerated or landfilled*[12]. Therefore this financial case excludes avoided incineration costs arising from a reduction in CA residual waste, since overall incineration costs for the authority are assumed to be unaffected by the CA site improvements, due to overall incineration tonnages being assumed to remain the same, regardless of what happens at the authority's CA sites[13].

The only uncertainty would be whether the avoided landfill costs would relate to CA site, kerbside or other types of residual waste. Therefore this financial case uses a unit cost for landfill gate fees and haulage which is an approximate average of the costs arising for the landfill the different types of Stoke-on-Trent City Council's mixed residual waste (ie CA site, kerbside and other types of residual waste). Assumed unit costs for landfill disposal of Stoke-on-Trent's residual waste are calculated in Table 6.3.5 below.

Table 6.3.5: Unit costs for disposal of residual waste: gate fees & haulage only

DISPOSAL UNIT COSTS PER TONNE (excl Landfill Tax & LATS)			
Type of waste	**Gate fee**	**Haulage**	**Net cost**
Mixed waste	£18	£5	£23

These unit costs include landfill gate fees and haulage, but exclude both Landfill Tax and the effects of LATS. It has not been possible to account for market fluctuations in gate fees or haulage costs in future years.

[12] For instance, if all CA residual waste is incinerated, and the amount of CA residual waste is reducted by – say – 9,000 tonnes pa, this would mean that 9,000 tonnes more of the authority's non-CA residual waste would have to be incinerated, in order for the authority's to maintain its annual incineration tonnage delivery 'requirements'. The net effect would be the same if some or all of CA residual waste were landfilled, since a 9,000 tonnes pa reduction in CA residual waste would result in a 9,000 tonnes pa reduction in the authority's overall residual waste; and if the authority's incineration tonnages are to remain the same annually, this reduction can only affect landfill tonnages.

[13] Nevertheless, the fact the Stoke-on-Trent City Council incinerates *any* of its MSW complicates the financial case in another way, in terms of savings in LATS permits, as discussed in Section 6.4.2.

The tonnage of mixed waste additionally diverted from landfill is estimated to be 9,126 tonnes (see Section 5.3), though if we account for annual increases in CA waste arisings, this figure is actually 9,599 tonnes for the first period after improvements. Avoided disposal costs due to the diversion of materials from CA site residual waste are calculated in Table 6.3.6 below. The figures in this table include Landfill Tax at £18 per tonne for the period 2005/06 and any annual increases in RPI applied to haulage and gate fees[14], but exclude any effects arising from LATS.

Table 6.3.6: Avoided disposal costs after improvements, for 2005/06, (excluding LATS)

Type of waste	Net cost per tonne, incl Landfill Tax	Tonnes diverted from residual waste in first year	Avoided costs excl LATS in first year
Mixed residual waste	£41.69	9,599	**£400,173**

From the above table, it is estimated that disposal costs of around £400,000 will be avoided in the first year after implementation of site improvements. The financial effects of LATS are excluded and are addressed separately in Section 6.4.

The unit cost for haulage in Table 6.3.5 assumes that haulage will be paid on the basis of a charge per tonne (or per mile). However, if the disposal contract is set up on a different basis, (ie per vehicle supplied for carrying out disposal, or on the basis of large units of tonnage), the saving of £5 per tonne in haulage costs is likely to be lower, which would result in a lower figure for overall avoided disposal costs (excl LATS) shown in Table 6.3.6 above.

It should be noted that considerable variance in annual incineration tonnages, or the introduction of additional residual waste treatment capacity (ie MBT) for Stoke-on-Trent City Council, would significantly alter the avoided disposal cost projections presented in this financial case.

[14] See Section 6.2, Table 6.2.1 for details of these assumptions.

6.3.5 Contractor incentives

The site improvement recommendations include the introduction of financial incentives to the site management contractor, with these incentives linked to targets for the improvement of CA site recycling performance. The contractor is uniquely placed to ensure that the recommended site improvements are carried out in such a way as to maximise their positive effect on the recycling rate of the CA site, and contractor incentives are designed to encourage the contractor to do precisely this.

For the purposes of estimating the overall value of contractor incentives for this financial case, it is assumed that these costs would equate to a payment of £5 per tonne recycled, excluding inert waste and reuse. On this basis, the total cost of contractor incentives in the first year after improvements would be around £97,000. This figure is based on payments per tonne for all recycled/reused materials, (rather than for additionally recycled materials only).

Though available data on the costs of financial incentives for other authorities is limited, it is thought that the above mentioned payments per tonne are roughly in line with the overall costs of financial incentives for some other authorities. However, we are not suggesting that this payment mechanism would necessarily be the most appropriate one for Stoke-on-Trent City Council to use[15]. Rather, we are suggesting that a financial incentive which works out at an overall cost of around £97,000 would be roughly in line with incentives used by some other authorities. For future periods, we could expect this cost to increase in line with annual increases in CA waste arisings; (refer to Section 6.2).

To put financial incentives to the contractor - as presented in this financial case - in their proper context, it is worthwhile noting here that we can reasonably expect that the successful implementation of the recommended CA site improvements will be dependent upon the contractor being:

(i) remunerated for the costs of implementing improvements (estimated in Section 6.3.1 and 6.3.2);

(ii) able to achieve a reasonable profit from the management of the CA sites, once these sites achieve improved recycling performance;

(iii) provided with financial incentives, (which are in addition to the reasonable level of profit described in point (ii) above), payable upon the achievement of recycling targets, with the amount of these incentives being roughly commensurate with those proposed in this section, ie £97,000 during the first period after improvements.

The exact mechanism for contractor incentives should be carefully designed to ensure that the contractor makes efforts not only to achieve the recycling rate projected in this report, but also strives for continual improvement in the site's performance. This point is borne out by the sensitivity analysis of the financial case for site improvements (in Section 6.5), which shows that overall revenue savings are significantly affected by the recycling rate achieved at the site. Therefore if the contractor is motivated to achieve, or surpass the projected recycling rate, further significant disposal costs will be avoided (from avoided disposal).

[15] In fact, there are potential drawbacks to offering a flat rate per tonne recycling as an incentive, as discussed below.

In this light, we note that the payment of a unit amount per tonne recycled is not necessarily the best mechanism to encourage continual improvements in recycling performance. Beyond a certain level of recycling performance, we can expect that the cost of improving the recycling is likely to progressively increase, due to progressively larger resources required to capture additional materials to achieve these higher recycling rates (ie staff time, contractor management, possibly higher gate fees for separation of other materials not mentioned in this report, ie plastic bottles or carpets). An incentive based on a unit payment per tonne does not reflect this progressively increasing cost. Therefore under such an incentive scheme it may make greater financial sense to the contractor to achieve a certain minimum level of recycling performance, and to make little or no effort to achieve higher recycling rates.

A more suitable incentive mechanism may be for the achievement of certain recycling rates to trigger different levels of financial incentive payment to the contractor. This mechanism should be designed so that the contractor experiences a significant financial disincentive to underachieve the project recycling rate (by, say, more than 5%), and a significant financial incentive to achieve the recycling rate target. The contractor should also be able to benefit from further significant financial incentives for achieving recycling rates above the rates projected in this report, with the magnitude of these financial incentives calculated in the context of the progressively greater costs that are likely to be associated with achieving higher than projected recycling performance.

It would be advisable for Stoke-on-Trent City Council to assess the degree to which the recycling rates projected in this report are realistically attainable. This is in order to avoid the situation whereby the contractor is being unfairly penalised for failing to attain targets which are unrealistic. In making this assessment, we advise that the combined recycling rate increases due to improvements (presented in Section 5.3) are likely to be fairly realistic, since they are based on the survey data from a large number of sites[16]. There is greater uncertainty, however, about the composition of CA site waste. In the simple mass balance model presented in Section 5.3, different materials are assumed to arise in various quantities and captured at various rates. Although every effort has been made to provide realistic figures for the mass balance, if the model contains significant inaccuracies then the projected achievable recycling rate may also be inaccurate. For instance, if bulk recyclables such as green waste and wood actually arise in lesser quantities than is suggested in the mass balance model, then we would expect the achievable recycling rate to be lower than is suggested. On the other hand, these bulk recyclables may arise in greater quantities, or the capture rates for some material may be pessimistic in relation to what is achievable, which would make a higher recycling rate attainable.

Therefore we recommend that Stoke-on-Trent City Council assesses the degree to which the mass balance presented in Section 4.3 is realistic and, if deemed necessary, conducts an analysis of the site's waste composition using a suitably reliable method[17]. This data can then be used to produce an amended mass balance model, which in turn can be used to amend projections for achievable recycling rates. However, if such amendments are made, it should be noted that this would affect the financial case for CA site improvements presented here.

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[16] Regression analysis of survey data from over 100 sites throughout the UK, conducted for the NACAS project.

[17] Refer to *NACAS Report, pp 52-3,* for a review of methods of investigating CA waste composition.

6.3.6 Summary of Financial Case excluding LATS

The overall incremental costs/savings due to implementing site improvements, excluding any effects of LATS, are illustrated in Figure 6.3.1 below. These incremental costs/savings include all the financial factors addressed earlier in Section 6.3. The blue bars include annualised capital costs, baseline revenue costs and contractor incentives. The red bars indicate net incremental costs/savings for each period, excluding LATS.

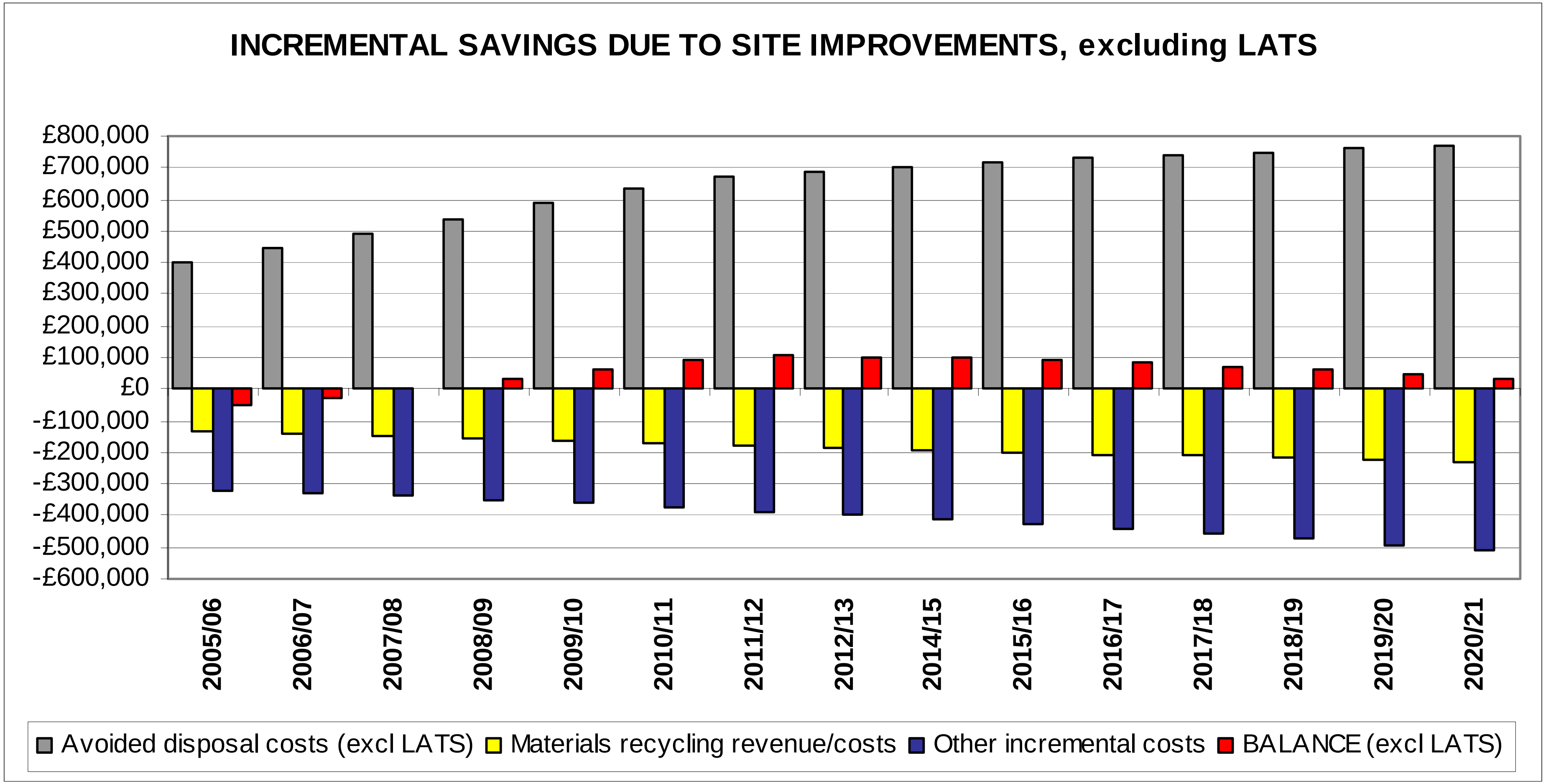
Incremental costs/savings arising from site improvements are also shown in Table 6.3.7 on the following page. As shown in Table 6.3.7, the balance of incremental costs (excl LATS) in 2005/06 would amount to around £53,000. However net costs (excl LATS) reduce annually due to avoided disposal costs increasing, principally in line with Landfill Tax increases. There a net saving of £3,000 results in 2007/08, increasing annually up to 2011/12, when a net saving of around £107,000 results. Thereafter, net annual incremental savings (excl LATS) decrease gradually, as the rate of increase in avoided disposal costs reduces, due to the assumption that Landfill Tax will not escalate above £35 per tonne from 2011/12 onwards.

Cumulative savings, excluding LATS, from 2005/06 to 2020/21 amount to an estimated £798,000. These savings will be augmented - to a greater or lesser extent - through the avoided use of Landfill Allowances, as discussed in Section 6.4 below.

For the sake of clarity, annual changes in different types of costs/savings presented in Table 6.3.3 are specified here:

- "Savings in avoided disposal costs, excl LATS": Landfill Tax escalator, annual increase in CA waste arisings (see Section 6.2), 3% RPI on non-Landfill Tax element
- "Material revenue costs, overall": annual increase in CA waste arisings (see Section 6.2), 3% RPI
- "Other revenue costs (ie staffing)": 3% RPI
- "Annualised capital costs": 7.5% borrowing rate per annum.
- "Contractor incentives": annual increase in CA waste arisings (see Section 6.2).

Figure 6.3.1: Incremental costs/savings arising from site improvements, excluding LATS



Notes: ***(i) "Materials recycling revenue/costs" includes gates fees or income and haulage costs for additional materials diverted from residual waste. (ii) "Other incremental costs" includes annualised capital costs, baseline revenue costs (ie staffing etc) and financial incentives to the site management contractor.***

Table 6.3.7: Incremental costs/savings arising from implementing site improvements, 2005/6 to 2020/21, excluding LATS

Period	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Savings in avoided disposal costs, excl LATS	£400	£445	£491	£539	£589	£634	£671	£687	£703	£720	£730	£740	£751	£762	£774
Material revenue costs, overall	-£134	-£141	-£148	-£156	-£163	-£170	-£177	-£184	-£191	-£199	-£205	-£211	-£218	-£224	-£231
Other revenue costs (ie staffing)	-£186	-£191	-£197	-£203	-£209	-£215	-£222	-£228	-£235	-£242	-£249	-£257	-£265	-£273	-£281
Capital investment	-£280	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*
Annualised capital costs	-£37	-£39	-£42	-£46	-£49	-£53	-£57	-£61	-£65	-£70	-£76	-£81	-£87	-£94	-£101
Contractor incentives	-£97	-£99	-£101	-£103	-£105	-£107	-£109	-£111	-£113	-£116	-£118	-£120	-£123	-£125	-£128
Total incremental savings (costs) due to improvements, excl LATS	**-£53**	**-£26**	**£3**	**£32**	**£63**	**£90**	**£107**	**£102**	**£98**	**£92**	**£82**	**£71**	**£59**	**£46**	**£33**
Cumulative incremental savings (costs), excl LATS	-£53	-£79	-£76	-£44	£19	£108	£215	£317	£415	£507	£589	£660	£718	£765	£798

Note:

(i) ***All costs are in units of £1,000***

(ii) ***RPI cost increases, a borrowing rate on annualised capital and annual increases in waste arisings are accounted for in the figures in this table – see Section 6.2 for details of the relevant assumptions applied for this financial case.***

6.4 Financial Case including Predicted Effects of LATS

6.4.1 Introduction

Under the Landfill Allowance Trading Scheme, local authorities that divert BMW (biodegradable municipal waste) from landfill will experience a revenue saving arising from each tonne of BMW thus diverted. This saving will result either through avoiding having to purchase Landfill Allowances, or through having additional Landfill Allowances available to sell to other authorities. In either case, the value of the revenue saving will depend on two factors:

- tonnage of BMW diverted from landfill
- market value of Landfill Allowances.

The mass balance model applied for this financial case suggests that 7,510 tonnes of BMW will be diverted from CA residual waste during 2005/06 due to CA site improvements; (see Section 5.3, Table 5.3.2). It is of course possible that the quantities and types of materials additionally diverted at the CA site(s) due to improvements may result in a different figure for BMW diversion from landfill. However, the figure produced by the mass balanced model represents the best currently available estimate. This tonnage diversion is projected to increase in future periods, in line with annual growth of overall CA waste arisings, (see Section 6.2).

The market value of Landfill Allowances is difficult to predict, particularly since at the time of writing the trading scheme had only just started. However, it is possible to calculate overall revenue savings on the basis of different LATS market values. For instance, if LATS permits were to have a trading value of, for the sake of argument, £10 per tonne during 2005/06, revenue savings due to LATS can be estimated as £10 x {estimated BMW diversion from landfill} during this period, ie £10 x 7,510 tonnes = £75,100. These revenue savings can then be added to other incremental costs/savings (as detailed in Section 6.3) to arrive at a financial case outcome that represents the overall costs/savings that are estimated to arise due to implementing CA site improvements.

Whilst the report authors cannot predict likely LATS market values, we can provide Stoke-on-Trent City Council with a method for calculating the outcome of the financial case (in terms of cumulative revenue savings) for LATS permits at different values, as detailed in Section 6.4.3.

However, we must first account for the fact that Stoke-on-Trent City Council incinerates some of its waste, since this means that we cannot assume that each one tonne of BMW diverted from CA site residual waste will equate to one tonne of BMW diverted from landfill. This matter is discussed in Section 6.4.2 below.

6.4.2 Accounting for effect of incineration on BMW landfill diversion

Due to the proposed manner in which the LATS regime will be monitored, authorities that incinerate some of their waste will find that the calculations for diverted BMW from landfill are not as straightforward as for authorities that only landfill their residual waste. This also applies to BMW diversion from CA residual waste, *regardless of whether the CA waste is actually landfilled or incinerated*, since the authority's total waste arisings are essentially treated as a single entity, for the purposes of calculating BMW diversion from landfill. (This is on the assumption that BMW landfill diversion under LATS will be calculated in a manner that is accurately represented by the calculation methods set out in Appendix 4.)

The net result of this is that the amount of BMW diversion from landfill (resulting from the diversion of each tonne of BMW from CA residual waste) is dependent upon a number of variables that are not directly related to the management of the CA sites in question. These variables are:

- total MSW arisings for the authority
- total amount of MSW recycled by the authority (ie through CA sites *and* kerbside collections, bring banks, etc)
- total BMW arisings for the authority
- total BMW recycled by the authority (ie through CA sites *and* kerbside collections, bring banks, etc)
- total residual waste incinerated.

The reasons why these variables affect calculations of additional BMW diverted from landfill by CA improvements are described in Appendix 4. Briefly, however, the effect of these variables can summarised as affecting the proportion of BMW in the authority's residual waste which is incinerated; and this in turn affects calculations of tonnage reductions of BMW landfilled due to diversion of BMW from CA site residual waste.

Since the financial case covers the period 2005/06 to 2020/21, it is – in principle – necessary to know what the variables listed above will be for this period. For many local authorities this will be problematic. In particular, it will be difficult for many authorities to accurately predict the levels of overall MSW and BMW recycling that will be achieved as far into the future as 2020/21.

In fact, two of the variables listed above need not concern us unduly:

- total MSW arisings – since we can reasonably assume that these will change fairly gradually (ie between 0% and 2% growth pa, as detailed in our assumptions in Section 6.2);
- total BMW arisings – because this is calculated as being a proportion of MSW arisings (68% according to Defra's methodology), BMW arisings therefore are likely to change only gradually, in line with MSW arisings.

The remaining variables are more problematic, since they could potentially vary to a considerable degree between 2005/06 and 2020/21:

- total MSW recycled
- total BMW recycled
- total residual waste incinerated.

Fortunately, however, these variables have a limited effect on calculations of additional BMW diverted from landfill due to CA improvements, so long as they stay within a certain range. In order to determine the effect of these variables on BMW landfill diversion, it is useful to set a likely baseline figure for the next few years. Through analysing projection data from Stoke-on-Trent City Council's most recent return for BVPIs 82a-d, and other information provided by the authority, the following performance is thought to be likely for the authority for the periods 2005/06 and 2006/07:

- MSW recycled (including inert) will constitute approximately 30% of total MSW arisings (corresponding to roughly 35% of household waste arisings)
- BMW recycled (including estimated BMW content of dry recycling collections) will constitute approximately 19% of total MSW arisings
- incinerated waste will constitute approximately 46% of total MSW arisings (taking into account annual waste increases reducing the proportion of MSW incinerated).

Applying these figures to the equations presented in Appendix 4 shows that for each 1 tonne of BMW diverted from CA residual waste (due to implementing the recommended improvements), approximately 500 kg BMW would be assumed to be diverted from landfill, for the purposes of monitoring of LATS permits. In other words, for *each additional tonne* of BMW recycled/reused at the CA sites, the authority would save *0.50 of a tonne* in LATS permits.

Changing any of the above assumptions will change this BMW landfill diversion figure. Nevertheless we can specify a range in this diversion figure. The range chosen for this financial case is:

400kg to 600kg BMW landfill diversion per 1 tonne of BMW additionally diverted from CA residual waste.

The degrees to which recycling and incineration tonnages (as a proportion of MSW arisings) may vary, whilst allowing BMW landfill diversion calculations to stay in this range, are shown in Table 6.4.1 below:

Table 6.4.1: Permissible range of variables affecting BMW landfill diversion tonnages

Permissible range of variables, in order to arrive at 400 to 600 kg BMW landfill diversion per 1 tonne BMW recycled/reused at CA sites	
Variable	**Approximate permissible range of variable, as proportion of MSW arisings**
Total BMW recycling by authority	**14% to 26%**
Total MSW recycling by authority	**20% to 40%**
Total waste incinerated by authority	**43% to 49%**

As can be seen, the range of 400kg to 600kg BMW landfill diversion allows for a relatively narrow degree of variation for these different factors. Rates of BMW landfill diversion are (for intuitively obvious reasons) particularly sensitive to the proportion of the authority's waste that is incinerated. The figure of 43% to 49% of MSW incinerated allows for a variation in incineration tonnages approximating to an average (across the period 2005/06 to 2020/21) of 78,000 tonnes *plus or minus* 5,000 tonnes annually, taking into account annual increases in MSW arisings up to 2020/21. However, for 2005/06 the valid range for this financial case for incineration tonnages is estimated to be 71,000 tonnes *plus or minus* 5,000 tonnes.

The range in MSW recycling requires that the authority recycles between 20% and 40% of MSW arisings, which roughly corresponds to 25% to 50% of estimated household waste arisings for Stoke-on-Trent City Council (if we assume that household waste consists of approximately 80-85% of the authority's MSW arisings).

The range in BMW recycling requires that the authority recycles 14% to 26% of its MSW arisings, which corresponds to around 21% to 38% of the authority's BMW arisings (applying Defra's assumption that BMW consists of 68% of MSW arisings).

Whilst these ranges of proportions of MSW incinerated or recycled allow for some variance from the baseline figures used to arrive at this financial case, it is easy to imagine scenarios where one or more of these variables may stray outside this range. Therefore the part of the financial case that deals with savings from avoided use of LATS permits should be treated with caution. It should be borne in mind that LATS savings in this financial case are dependent on the authority's rates of incineration and recycling remaining within the ranges specified in Table 6.4.1 above. The effects of rates of incineration and recycling straying outside this range on the financial case are discussed in the sensitivity analysis in Section 6.5.

In summary, this financial case calculates that for each tonne of BMW *additionally* diverted from CA site residual waste, between 400 and 600 kg of BMW will be *additionally* diverted from landfill, for the purposes of LATS. This rate of BMW landfill diversion (per 1 tonne BMW diverted at CA) can also be expressed as:

- 500 kg *plus or minus* 100 kg;

or

- 500 kg *plus or minus* 20%.

A procedure for calculating more accurate figures for LATS savings – ie without the 20% variance in BMW landfill diversion rates – is briefly described at the end of Section 6.4.3, which discusses the use of Defra's M-Beam tool for the management of LATS permits.

6.4.3 Method for calculating projected savings due to avoided use of LATS permits

As noted previously, savings from avoided use of LATS permits depend upon avoided BMW landfilled and the market value of LATS permits. This basic method used to calculate LATS savings in this financial case can be illustrated in the following example:

If we recall that the mass balance model for this financial case (in Section 5.3) predicts that an additional 7,510 tonnes will be diverted from CA residual waste during 2005/06, the findings in Section 6.4.2 suggest that this is likely to equate to 3,755 tonnes *plus or minus* 751 tonnes diversion of BMW from landfill[18]. Therefore if, for the sake of argument, the average value of LATS permits is £10 per tonne during 2005/06, revenue savings from avoided use of LATS permits can be estimated as {3,755 *plus or minus* 751} x £10 = £37,550 *plus or minus* £7,510.

Figure 6.4.1 on the following page shows the financial case outcomes for LATS permits at different market values. This figure shows cumulative savings for the whole financial case for the entire period 2005/06 to 2020/21, at different average LATS permit values during this period. Three sets of outcomes are shown, corresponding to the range of BMW landfill diversion that is considered likely to occur due to the CA site improvements:

- *Worst case scenario:* 1 tonne of BMW diversion at CA equates to 400kg BMW landfill diversion
- *Middle case scenario:* 1 tonne of BMW diversion at CA equates to 500kg BMW landfill diversion
- *Best case scenario:* 1 tonne of BMW diversion at CA equates to 600kg BMW landfill diversion

The data represented in Figure 6.4.1 is essentially:

{Incremental savings due to improvements; as presented in Section 6.3.6} *plus*
{Revenue savings due to avoided use of Landfill Allowances, at different LATS market values}.

As can be seen in Figure 6.4.1, the relationship between different LATS values and overall costs/savings is linear for each scenario. It is therefore possible to represent cumulative incremental savings at different LATS values with a simple linear equation[19], as follows:

Cumulative incremental savings, including LATS, 2005/6 to 2020/21 = {[average LATS market value] x [62,500 *plus or minus* 12,500]} + 798,000

For example, if average LATS market value is estimated to be equal to £30 per tonne[20] over the relevant periods, overall savings up to 2020/21 would be calculated as

{30 x [62,500 *plus or minus* 12,500]} + 798,000 = savings of approximately £2,673,000 *plus or minus* £375,000.

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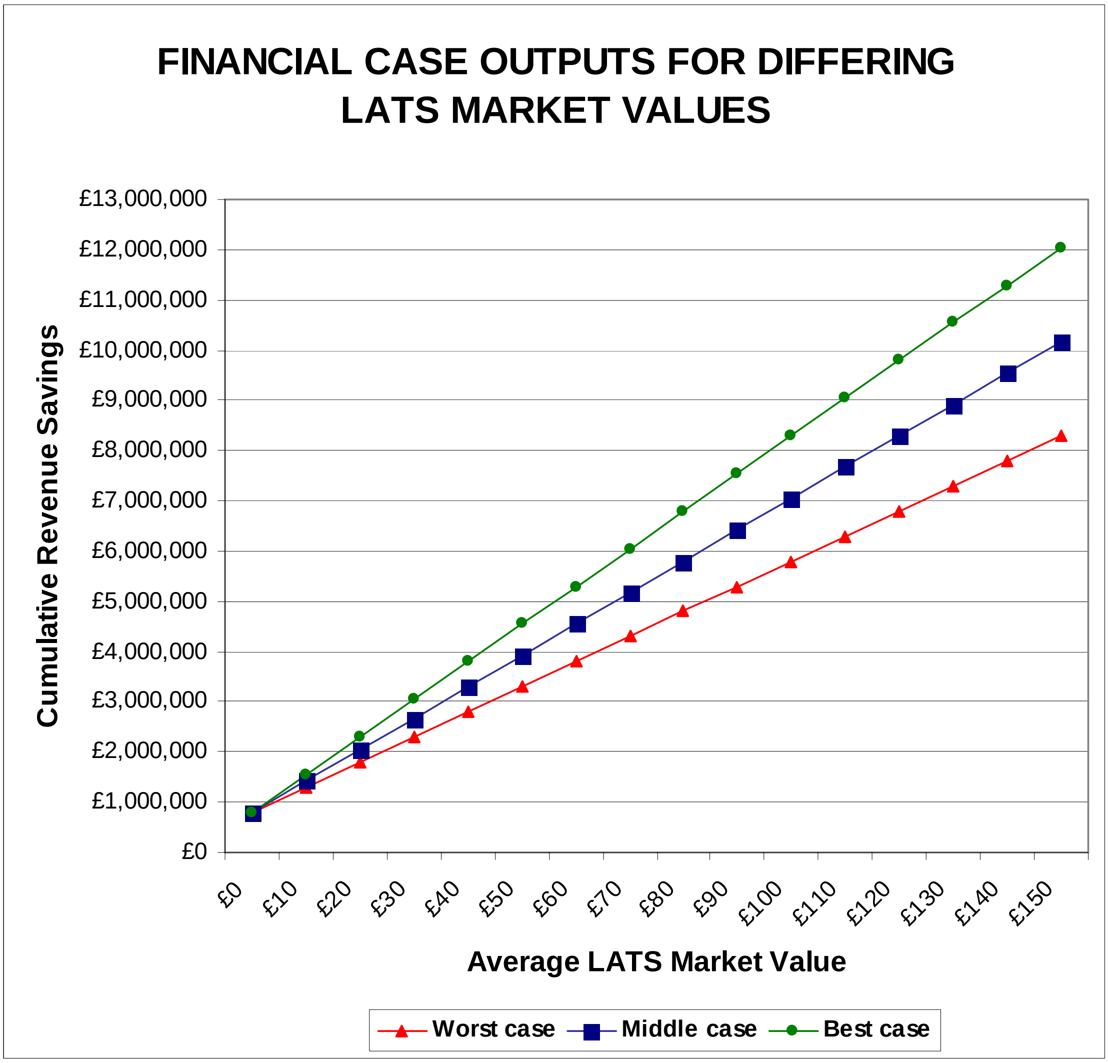
[18] In Section 6.4.2 it was determined found that 1 tonne of BMW diversion at CA would approximately equate to 500 kg *plus or minus* 100kg diversion of BMW from landfill, due to the authority's incineration capacity; in this example, BMW diversion would be estimated as 7,510 x (0.500 *plus or minus* 0.100) = 3,755 tonnes *plus or minus* 751 tonnes.

[19] These equations can be interpreted as:
Overall savings = {[average LATS market value] x [cumulative additional BMW diverted from landfill]} + [cumulative incremental savings excluding LATS]

[20] The figure of £30 per tonne is included merely in order to illustrate an example calculation.

Figure 6.4.1: Financial Case Outcome at Various LATS Market Values



It should be noted that these figures represent cumulative savings across the relevant periods, and not savings per annum. Furthermore, we reiterate that these represent overall *incremental* savings, ie savings arising from improvements which are *in addition to* costs/savings currently arising from running the sites.

In effect, the example figures given above show that in the period up to 2020/21, with LATS permits at an average value of £30 across this period, an overall saving of around £2,673,000 *plus or minus* £375,000 would result due to site improvements. Conversely this outcome of the financial case shows that not implementing site improvements would result in a cumulative revenue loss of around £2,673,000 *plus or minus* £375,000 during the same period (in comparison to the situation in which the improvements had been carried out).

In applying the above equation to estimate cumulative savings, it should be noted that *average* values for LATS permits should be applied. In reality, we would not expect LATS permits to have the same value in each period. Therefore when Stoke-on-Trent City Council are attempting to project future permit values, we advise that the *average* projected market value across all relevant periods must be applied when using the equation supplied in this section.

The equation presented in this section cannot account for variations in LATS permit values in individual periods. It will be possible for Stoke-on-Trent City Council to model the effects of such variations in permit values by using a tool called M-BEAM that Defra has made available to local authorities to assist them in managing their LATS permits[21]. One of the capabilities of this tool is that it enables local authorities to enter their own projections for LATS permit values for individual periods. M-BEAM will also allow Stoke-on-Trent City Council to enter the mass balance data relating to CA site improvements presented in this report, in Section 5.3, in order to model the incremental effects of CA site improvements on the basis of different LATS permit values for each period. Such an exercise would involve Stoke-on-Trent City Council making its own judgements as to what value LATS permits are likely to be in future periods. This would enable Stoke-on-Trent City Council to project incremental revenue costs/savings due to CA site improvements for individual periods, which would provide more detailed financial projections for revenue costs/savings (*including* LATS) than are presented in this section.

Moreover, the M-BEAM tool will allow Stoke-on-Trent City Council to enter waste arisings, incineration and recycling tonnage data that affects the rate of BMW landfill diversion per one tonne of BMW diverted from residual waste, (as discussed in Section 6.4.2 above). Calculating the *incremental* savings due to CA site improvements would require using M-BEAM to calculate the difference in the authority's BMW landfilled under two different scenarios:

- CA site improvements *not carried out* (ie with sites diverting MSW and BMW at their current rates)
- CA site improvements *implemented* (ie with sites diverting MSW and BMW at projected improved rates)

The mass balance data presented in Section 5.3, relating to materials diversion at CA sites before and after improvements, may be used for these calculations; annual increases in waste arisings should be applied to any figures used in M-BEAM for this purpose.

Stoke-on-Trent City Council should note that M-BEAM is likely to be of more general assistance in calculating their use of LATS permits, particularly in light of the fact that its incineration capacity means that calculating BMW diversion from landfill is less straightforward than for authorities with no incineration or residual waste treatment capacity.

A general theoretical discussion on the effect on incineration (and residual waste treatment) capacity on the management of LATS permits, and diversion of BMW landfilled in particular, is presented in Appendix 4.

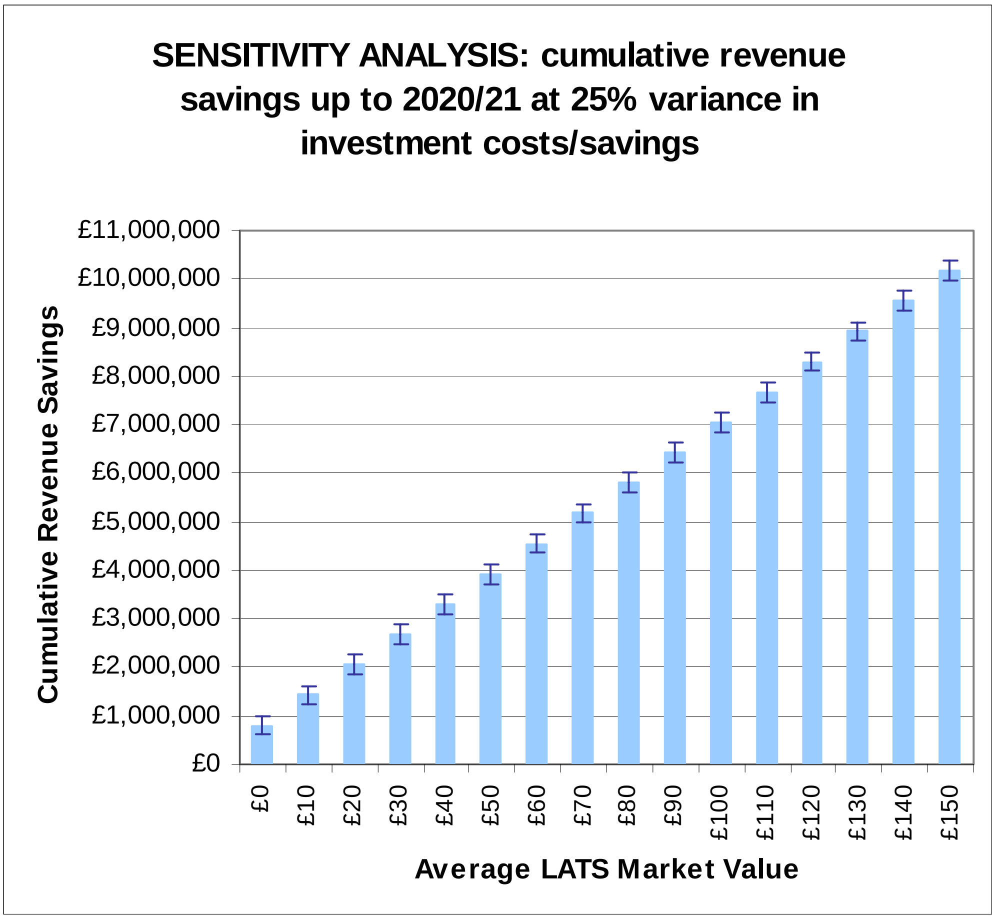
[21] M-BEAM can be downloaded by visiting http://lasupport.defra.gov.uk/ and clicking on the "M-BEAM" link.

6.5 Sensitivity Analysis

In this section we examine the effects of variations in investment costs and projected recycling performance on the outcome of the financial case for CA site improvements. An overriding sensitivity in the financial case is the market value of LATS permits. Therefore variations in investment cost and projected recycling rates are examined at varying average market values for LATS permits.

In terms of variations in investment costs, we can assume, for the sake of argument, these costs might differ from those presented in this report by 25%. This 25% variance has been applied to the *overall incremental costs/savings* up to the period 2020/21, excluding LATS. This includes annualised capital costs, baseline revenue costs, materials revenue costs/savings, avoided disposal costs (excluding LATS) and contractor incentives. For the business case presented here, this figure amounts to a cumulative saving of £798,000 up to 2020/21, and a 25% variance would mean this figure could be £798,000 *plus or minus* £199,500. Revenue savings through avoided use of Landfill Allowances need to be added to this figure, and cumulative savings at different average LATS market values are shown in Figure 6.5.1 below. The ‘middle case scenario’ for BMW landfill diversion rates is applied here, (see Section 6.4.3). The 25% variances in investment costs/savings (excluding LATS) are indicated by error bars.

Figure 6.5.1: Sensitivity analysis of 25% variance in investment costs/savings



As the above figure illustrates, the 25% variance has a proportionally lower effect on the outcome of the business case as the average market value of LATS permits increases. The percentage variance in overall revenue savings at different average LATS market values is shown in Table 6.5.1 below.

Table 6.5.1: Percentage variance in cumulative revenue savings up to 2020/21 due to 25% variance in investment costs, at different average LATS market values

LATS average market value	Percentage variance in relation to overall revenue savings
£0	25.0%
£10	14.0%
£20	9.7%
£30	7.5%
£40	6.1%
£50	5.1%
£60	4.4%
£70	3.9%
£80	3.4%
£90	3.1%
£100	2.8%
£110	2.6%
£120	2.4%
£130	2.2%
£140	2.1%
£150	2.0%

Therefore any errors in estimations of investment costs become progressively less significant as the average market value of LATS permits increases. This underlines the fact that LATS permit values are the overriding sensitivity in the financial case for CA site improvements.

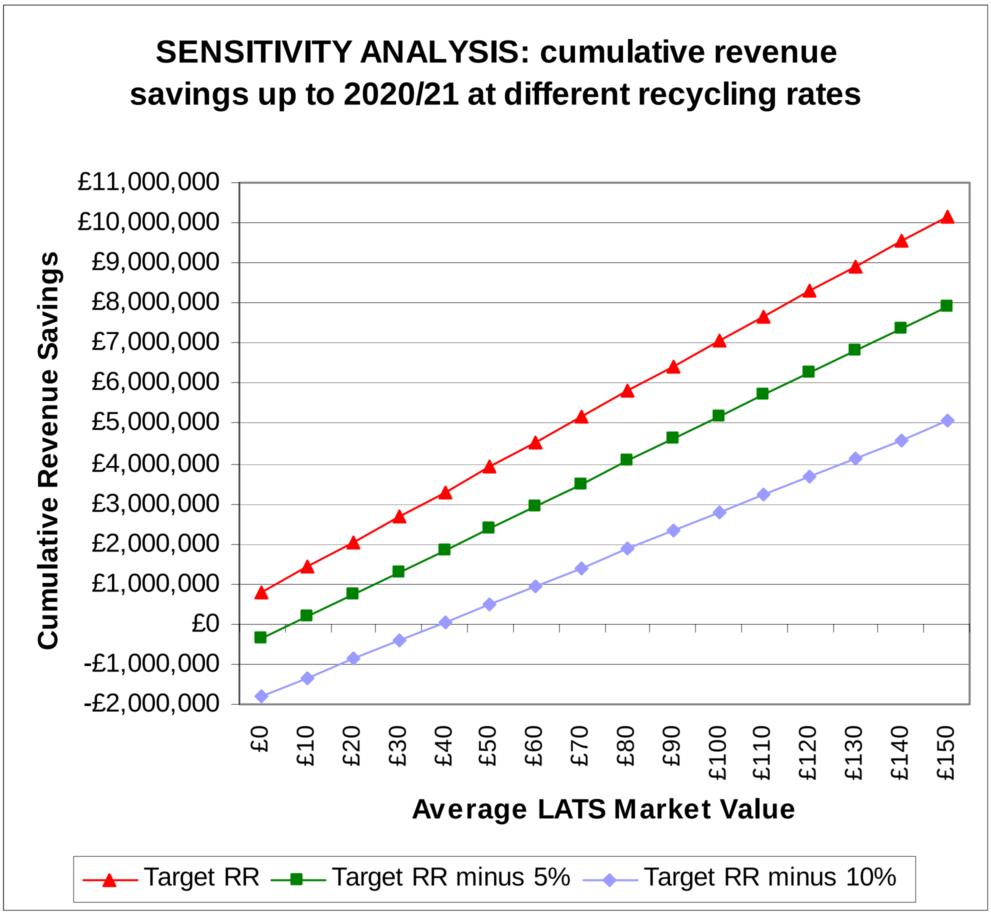
However, the situation is not as clear cut for variations in target recycling performance. If the CA sites eventually achieve a combined recycling rate that is below the target recycling rate projected in these recommendations, (see Section 5.3), then various factors affect the outcome of the financial case:

- less material is diverted from CA residual waste, resulting in lower savings in avoided disposal costs (excluding LATS)
- the amount of BMW diverted from CA residual waste is lower, resulting in lower savings in avoided use of Landfill Allowances
- various materials are diverted from CA residual waste in lesser quantities, effecting materials revenue costs/savings, (ie gate fee/income & haulage).

The effects of failing to achieve the projected recycling rates are illustrated in Figure 6.5.2 below, which shows cumulative revenue savings up to 2020/21 at different LATS market values in various scenarios:

- target recycling rate of 57.2% (BVPI definition) is achieved, across all sites combined
- target recycling rate is “missed” by 5%, ie a recycling rate of 52.2% is achieved
- target recycling rate is “missed” by 10%, ie a recycling rate of 47.2% is achieved.

Figure 6.5.2: Sensitivity analysis of effect of failure to achieve target recycling rate on cumulative revenue savings up to 2020/21



Note: the middle case scenario for BMW landfill diversion rates is applied for the above Figure; see Section 6.4.3.

The above figure demonstrates that cumulative revenue savings would be significantly less if the target recycling rates are not achieved. Even excluding the effects of LATS, cumulative revenue savings are reduced by approx £1.1 million if the recycling rate is "missed" by 5%, (resulting in an incremental loss of £0.3 million, excl LATS); and by approx £2.6 million if the recycling rate is "missed" by 10%, (resulting in an incremental loss of £1.8 million, excl LATS).

Although revenue savings increase in absolute terms for all scenarios as the average market value of LATS increases, in comparative terms savings progressively decrease for the lower recycling rate scenarios, due to lower tonnages of BMW diverted from residual waste. Therefore there is a powerful financial incentive to achieve the recommended projected recycling rate.

The financial case may be similarly affected if the assumptions about CA site waste composition presented in Section 5.3 are incorrect. For instance, if wood waste does not arise in the quantities estimated, this would impact both on the site's recycling rate and on savings through avoided use of Landfill Allowances. Therefore we recommend that Stoke-on-Trent City Council investigates the composition of CA waste in order to ascertain whether the mass balance estimates used for the financial case (summarised in Section 5.3) are realistic.

The overriding sensitivity of the financial case to LATS permit market values provides some reassurance that overall revenue savings can be achieved in the financial case, so long as the projected recycling rate is not 'missed' by too great a margin. For instance, even if improvement investment costs prove to be 25% higher than estimated, the worst case scenario for BMW landfill diversion is applied[22] *and* the projected recycling rate is 'missed' by 5%, the average market value for LATS permits (during 2005/06 to 2020/21) would have to be lower than £10 per tonne before a cumulative incremental loss would arise.

However LATS savings are sensitive to other factors, due to the fact that Stoke-on-Trent City Council incinerates some of its residual waste[23]. This financial case has calculated that for each 1 tonne of BMW additionally diverted from CA site residual waste, 500 kg *plus or minus* 100 kg of BMW will be diverted from landfill (regardless of whether CA residual waste is incinerated or landfill). This range of BMW landfill diversion rates is dependent on the following incineration and recycling assumptions being correct for the authority:

- between 43% and 49% of MSW arisings are incinerated
- between 25% and 50% of household waste is recycled/composted (including inert waste)
- between 21% and 38% of BMW arisings are recycled/composted; (see Section 6.4.2 for further details regarding these estimates).

If all of these variables happen to go outside these values, then the BMW landfill diversion rates used in this financial case will no longer apply. For instance, we can examine what will happen if these variables all stray 5 percentage points below their specified valid ranges:

- the incineration of 38% MSW, recycling/composting of 20% of household waste and recycling/composting of 16% of BMW arisings will result in a BMW landfill diversion rate of *670 kg per 1 tonne of BMW diverted from CA residual*.

On the other hand, if these variables all stray 5 percentage points *above* their valid ranges:

- the incineration of 54% MSW, recycling/composting of 55% of household waste and recycling/composting of 43% of BMW arisings will result in a BMW landfill diversion rate of *270 kg per 1 tonne of BMW diverted from CA residual*.

The valid ranges for these variables are wider than those specified in Table 6.4.1 (in Section 6.4.2) if only one variable goes outside the valid range, so long as the remaining two variables are near the middle of their respective ranges.

For example, if the authority's recycling/composting average performance from 2005/06 to 2020/21 were to be close to the baseline figures used in the financial case, namely total recycling/composting comprising 30% of MSW arisings and BMW recycling/compositing comprising 19% MSW arisings[24], the valid range for the proportion of MSW incinerated would widen from 43-47% to approximately 38-57%; ie resulting in a BMW landfill diversion rate of between 400kg and 600kg per 1 tonne BMW diverted from CA residual waste.

Nevertheless the relationship between these variables, and their combined effect on the financial case presented here, is not simple. Therefore it is advised that Stoke-on-Trent City Council should use Defra's M-BEAM tool for managing LATS permits to more accurately estimate LATS savings arising from CA site improvements, as discussed in Section 6.4.3.

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[22] ie 400 kg BMW landfill diversion per 1 tonne of BMW diverted from CA residual waste
[23] This effect is discussed in Section 6.4.2.
[24] refer to Section 6.4.2

A summary of the sensitivity of the financial case to various factors that could potentially affect its outcome is presented in Table 6.5.2 below.

Table 6.5.2: Summary of sensitivities of various factors on outcome of financial case

FACTOR potentially affecting outcome of financial case	SENSITIVITY of financial case to the factor
LATS market value	VERY HIGH
Effect of incineration and non-CA recycling levels on BMW landfill diversion rates	HIGH
"Missing" target recycling rate	HIGH
Costs/income arising from implementing CA site improvements, *excluding LATS*	MODERATE to LOW
Avoided disposal costs excluding LATS (ie gate fees, haulage and Landfill Tax)	MODERATE
Materials recycling gate fees/income & haulage	LOW
Baseline revenue costs (ie staffing etc)	LOW
Contractor incentives	VERY LOW
Capital costs	VERY LOW

The key points highlighted by the sensitivity analysis are:

- In terms of demonstrating an overall incremental saving, the financial case is fairly robust, with potential variations in many types of cost having a small effect on the overall cumulative revenue savings, once savings from avoided use of Landfill Allowances are accounted for; (refer to Figure 6.5.1 above).
- Failure to achieve the recycling rates projected in this report will have a significant effect on the outcome of the business case. We therefore advise that every effort is made to achieve these recycling rates. Furthermore, obtaining a better understanding of waste composition at the relevant CA site(s) would provide additional valuable information regarding the achievability of these projected recycling rates.
- The financial case is extremely sensitive to the market value of LATS permits. We therefore advise that care will be required in projecting future LATS market values when assessing the overall outcome of the financial case; (see Section 6.4.3).
- Aside from the issue of LATS permit values, the accurate projection of LATS savings is problematic, due to the effect of incineration and non-CA recycling levels on the rates of BMW landfill diversion that would be achieved through implementing the recommended CA site improvements; (see Sections 6.4).

6.6 Financial Case Summary and Conclusions

Implementing the CA site improvements recommended in this report is estimated to result in a cumulative revenue saving up to 2020/21 of approximately £798,000, plus a potentially considerable sum due to the avoided use of Landfill Allowances. Cumulative revenue savings up to 2020/21, including LATS can be estimated using the following equation:

Overall savings = {[average LATS market value] x [62,500 *plus or minus* 12,500]} + 798,000.

For instance, if Stoke-on-Trent City Council were to project that the average market value of LATS permits between 2005/06 and 2020/21 would, for the sake of argument, be £30 per tonne[25], cumulative savings during this period can be estimated as:

{30 x [62,500 *plus or minus* 12,500]} + 798,000 = savings of approximately £1,875,000 *plus or minus* £375,000.

It is suggested that Stoke-on-Trent City Council uses the equation provided to estimate overall revenue savings on the basis of their judgement of what the average market value of LATS might be across the periods 2005/06 to 2020/21.

Cumulative savings arising from the avoided use of LATS permits may also be expressed as amounted to £62,500 *plus or minus* £12,500 per £1 average market value of LATS permit during the period 2005/06 to 2020/21.

The margin of error in the estimation of LATS savings is due to problems in accurately projecting the rate of BMW landfill diversion that would result from the diversion of each tonne of BMW from CA residual waste due to implementing improvements. This uncertainty is due to the factors not directly related to the management of the CA sites affecting rates of BMW landfill diversion, such as the overall levels of incineration and recycling carried out by Stoke-on-Trent City Council. We advise that Defra's M-BEAM tool for managing LATS permits should be used to project more accurate assessments of LATS savings arising from CA site improvements. Please refer to Section 6.4 for further comments on these matters.

The financial case presented here demonstrates *incremental* savings due to site improvements and does not account for the current costs/savings involved in running the site. Therefore the financial case is effectively demonstrating that a cumulative saving of at least £798,000 is likely to be realised by the period 2020/21 through implementing the site improvements; and conversely, failure to implement site improvements would result in a revenue loss of at least £798,000, in comparison to the situation if improvements had been carried out. The market value of LATS, and BMW landfill diversion rates, will have a potentially highly significant impact on the overall revenue savings that would be realised through implementing improvements.

The potentially large effect of LATS savings makes the financial case generally robust in respect of variations in estimated investment costs. However estimating BMW landfill diversion rates is problematic and introduces a considerable element of uncertainty in this financial case's projected LATS savings; (see Section 6.5 for further comments).

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[25] Neither Defra nor the report authors are suggesting that LATS permits might be around this value, nor can any advice be offered by Defra or the report authors on what the average value of LATS permits might be. The figure of £30 per tonne is included merely in order to illustrate an example calculation.

Even excluding the effects of LATS, there is clearly a strong financial case for improving Stoke-on-Trent City Council HW&RCs. The minimum saving of around £798,000 million (ie excluding additional savings due to LATS) arises primarily due to the various investment costs being offset by significant avoided disposal costs (excl LATS). These avoided disposal costs have been calculated on the assumption that similar amounts of the authority's waste will be incinerated annually from 2005/06 to 2020/21; (see Section 6.3.4).

The financial case is sensitive to the recycling performance that Stoke-on-Trent City Council HW&RCs would achieve after improvements. For instance, if the combined recycling rate target (for both sites collectively) of 57.2% is "missed" by 5%, this would result in incremental cumulative revenue savings up to 2020/21 being reduced by at least £1.1 million, with this relative loss increasing as the average market value of LATS increases. Therefore it is vitally important that all efforts are made to achieve the recycling targets projected in this report.

Whilst every effort has been made to project realistic recycling targets, we note that these targets are partly based on an estimate of the site's waste composition; (see Section 5.3). We recommend that Stoke-on-Trent City Council conducts further investigations of the waste composition of the Stoke-on-Trent City Council HW&RCs, using a suitably reliable method[26].

Finally, if Stoke-on-Trent City Council deems it prudent to allocate resources additional to those recommended in this report, in order to ensure that the recycling rates projected in this report are achieved, we note that the financial case suggests that any such additional costs are likely to be lower than the reduction in revenue savings that would result from "missing" the recycling rate target.

[26] Refer to *NACAS Report, pp 52-3,* for a review of methods of investigating CA waste composition.

REFERENCES

Network Recycling and Defra, *Projected Recycling Rates for CA Sites in England, 2003 to 2006, PART ONE: National Results and Overview,* 2003

Network Recycling and Future West, *National Assessment of Civic Amenity Sites, Report & Toolkit,* 2004

Network Recycling and Future West, *Trade Waste Input to Civic Amenity Sites,* 2002

Network Recycling, *Civic Amenity Site Survey and Trade Waste Controls for Stoke-on-Trent City Council,* 2005

These reports can be downloaded at: http://www.networkrecycling.co.uk/casites

APPENDIX 1: HEALTH & SAFETY GUIDANCE

(1) ESSENTIALS OF HEALTH & SAFETY AT CIVIC AMENITY SITES

Health & Safety Executive

Civic Amenity Sites:
Essentials of Health & Safety, Summary Document

August 2004

Questions to consider.

Does the site risk assessments for each activity undertaken that presents a risk? (A legal requirement under the Management of Health and Safety Regulations.)

The risk assessment should:

- Identify the hazards
- Assess the risks
- Eliminate the hazard wherever possible, or where this cannot be done
- Stipulate the measures (equipment or work systems) to control the risks

Do the control measures adequately deal, so far as is reasonably practicable, with the risks? The following is a brief list of some prime control measures. It is ***not*** an exhaustive list.

1 **Transport**
- Segregation of pedestrians from moving vehicles
- Provision of clear directions and site rules on entry to the site
- Elimination/Minimisation of the need for vehicles to reverse
- Elimination/Minimisation of plant and HGV movements when pedestrians are close by (or is adequate segregation achieved)

2 **Falls from height**
- Provision of adequate barriers at skip loading platforms
- Elimination of the need to walk on skip tops to
  - (a) remove contaminants
  - (b) sheet the skip/container

3 **Slips and Trips**
- Good maintenance of ground and floors (well drained with minimal inclines – free from contaminants)
- Good containment of refuse to prevent spillage
- Regular housekeeping to clear spillages
- Removal of any need to walk on waste

4 Manual Handling

- Mechanical handling aids (lifting plant, barrows etc.) provided and used where practicable
- Methods adopted to enable vehicles to get close to skip and minimise the distance items are moved
- Training in manual handling techniques received and good techniques used by staff

5 Machinery guarding

- It should not be possible to touch dangerous parts of machinery when they are in motion or use
    - Guarding to dangerous parts (e.g. rams of compactors, in-running nips of conveyors) kept in good condition and always replaced (especially after cleaning or maintenance)
    - Operator only in working area during use of compactor – all other people excluded from working area

6 Personal Protective Equipment

- High-visibility clothing (e.g. coats/vests) to be worn at all times in the yard unless the risk of collision from vehicles has been eliminated
- Footwear should have steel toe-caps and sole plates
- Long trousers should be worn (cut-resistant trousers made from 'ballistic' material if the risk from glass, sharps etc is high). Shorts are unacceptable.
- Miscellaneous protective equipment may be needed depending on the risks from the tasks undertaken (e.g. eye protection, ear defenders, respiratory protection)

7 Welfare and hygiene

- Adequate washing facilities should be provided, maintained and used
- Hand-to-mouth contact (smoking/eating/drinking) only if hands are clean

(2) HEALTH & SAFETY AT CIVIC AMENITY SITES: DISCUSSION DOCUMENT

Health & Safety Executive: Discussion document

August 2004

Health & Safety at

Civic Amenity Sites

Introduction

This guidance is produced by the HSE Manufacturing Sector: Waste and Recycling Unit. It is intended as a limited list of some *key* health and safety considerations to be taken into account when designing and operating a Civic Amenity site***.***
It does not aim to be comprehensive in its guidance. The risks associated with your specific site, and the methods of reducing those risks, should be revealed during your Risk Assessment.

Risk Assessment

The Management of Health and Safety at Work Regulations 1999 make it a legal requirement for employers to carry out a risk assessment of their undertaking to identify the measures they need to have in place to comply with their duties under health and safety law. (See final paragraph for a list of further sources of information.)

The aim of a risk assessment is to:

1. **Identify** the hazards and **avoid** them wherever reasonably practicable
2. **Assess** the risks from these hazards if they cannot be avoided
3. **Reduce** the risks that remain by implementing risk reduction techniques

It is important that this work is **monitored** at appropriate intervals. This will help you identify potential flaws in your systems, such as:

- Do employees follow your agreed systems of work? If not, why not?
- Are your systems adequate to control the risk? Do they need revising?
- Is the procedure you have instituted sufficiently frequent? Do you need to do certain tasks more (or even sometimes less) frequently?

Transport

The most hazardous activity in Civic Amenity sites is typically the movement of vehicles in the proximity of pedestrians; of all vehicle movements, reversing is the most hazardous.
The aims should be to ease vehicle movements by:

a) **slowing** vehicle speed – e.g. suitable provision of high visibility speed retarders (humps) and prominent speed limit sign on entry

b) **directing** people, e.g. by:
   - I. a clear route (one way systems are best)
   - II. skip contents signage easily visible from all parts of the site
   - III. vehicle control can be enhanced by the provision of an adequately trained employee who can reduce congestion by controlling vehicle access and giving clear directions

c) **segregating** vehicles and pedestrians from their respective activities, e.g. by:
   - I. ensuring HGV and heavy plant movements are separated from other activities. The most effective methods of achieving this are by:
     - a. **Organising** such movements when no other activities are being carried on (e.g. during 'silent hours' - pre-work or end of working day)
     - b. **Segregating** the heavy vehicle movements by clear demarcation and the *effective* prevention of entry of others to the movement zone.
   - II. providing clear parking/drop-off zones, (consider installing bollards, kerbs, painted lines and clearly designated areas)
   - III. providing pedestrian road crossing points that are in open areas, away from blind corners, and clearly marked (e.g. zebras)

d) **minimising reversing**, e.g. by providing:
   - I. a one-way system which eliminates the need to reverse
   - II. positioning skips so that reversing is unnecessary, or minimised
   - III. consider the possible advantages of providing an adequately trained 'banksman' to guide vehicles (but remember that this work is a high potential risk to the banksman)

e) **improving vision**
   - I. provide illumination if twilight/dark reception is carried out
   - II. avoid blind corners by appropriate location of receptacles (where blind corners cannot be avoided, provide risk minimisation hardware, e.g. mirrors, traffic control lights etc.)
   - III. make obstructions, bollards, etc. prominent (e.g. by high visibility paint/tape)

Falls from height

The *major* (but not only) risks of falls from height in CA sites are:

Falls from commercial vehicles/skips during sheeting

The unsafe sheeting of high sided commercial vehicles by climbing onto the vehicle without adequate edge protection or without gantries/harnesses to prevent falls is likely to invoke enforcement action from the Health and Safety Executive. (Detailed advice is given on their website *http://www.hse.gov.uk/workplacetransport/information/sheeting.htm*.)
Prevention of such falls from vehicles can be achieved by:

a) **Automatic sheeting systems** (autosheeters) remove the need to access the vehicle at height to sheet. They are becoming increasingly popular since they protect workers both on site, and out on collection where other safety facilities may not be provided.
b) **Sheeting platforms** (looking similar to scaffolding arrangements) can often be provided.
c) **Gantries and harness systems** are often used on site to prevent falls during sheet/unsheeting. The requirements of adequate training, supervision and maintenance should be addressed.

Falls into/from skips

Wherever raised platforms are provided above skip lip height to permit easy manual skip loading, there is the potential from falls either into the skip, or in the case of steelwork platforms, from the platform itself. This risk can be controlled by providing:

a) Barriers around the platform (at waist height)
b) A system of work which does not require access at height (e.g. by leaving heavier items at ground level to be mechanically loaded later)
c) Persons should not be permitted to climb over these barriers into skips to retrieve contaminants or for “totting” (removing items of value) purposes. Items of value or contaminants should be intercepted before they enter the skip.
Entry into skips could lead to falls over the side of the skip to the ground, or even falls into load voids. ‘Retrieval tools/poles’ should be provided for staff if interception of items prior to disposal cannot be assured.

Slips and trips

The potential for injury to site operators, and particularly to visiting members of the public, from slips and trips is high. The prime hazards giving rise to the risks include:

- Failure to control spillages
- Failure to clear away floor contaminants
- The condition of floors, steps etc
- The effects of weather
- Diminished visibility (poor lighting/carrying large loads which affect vision etc.)

1. **Floors** of CA sites should be constructed and maintained in a good, sound condition and, so far as is reasonably practicable, without sudden changes in level (e.g. steps, potholes or excessive inclines). The effects of weather should

be considered and good drainage for rainwater and methods to combat ice should be available if necessary. In areas where liquids are moved (e.g. oil stores), then spillage controls should be in place. Examples could include bunding and the use of absorbent granules.

2. **Containment** of contaminants is important to prevent their contents encroaching onto walkways.
    I. ***Skips*** should be subject to routines of regular decommissioning/emptying to prevent overfilling. This also helps prevent people from being struck by objects falling from overloaded skips where the contents are inadequately contained.
    II. ***Loose piles*** of materials should be kept in a stable condition: serious major injuries have occurred where persons have walked on loose piles of materials and the stack face has collapsed. The prevailing systems of work should make walking on stacks unnecessary. Loose material piles should be, so far as is reasonably practicable, confined to designated areas, and on-foot access to these areas be minimised by appropriate working procedures.
3. **Housekeeping** is equally important. Rigorous procedures should be in place to remove spillages of both solids and liquids as soon as is reasonably practicable. Particular attention should be directed to the prompt clearing of spilt fluids (e.g. oils etc.) and solid materials which may become slippery under foot (e.g. green waste).
4. **Walking on loaded skips and loose piles of materials is an activity which gives a high risk of slips and trips.** With thought, and the application of appropriate working procedures, this activity can nearly always be eliminated. The main reasons for walking on material piles is to trim loads, sheet vehicles or remove contaminants: these issues are addressed elsewhere in this guidance. *Good CA site management can invariably remove the need to do this!*
5. **Impaired vision** can increase the risks. Work should only be carried out in adequately lit areas (daylight or adequately lit in twilight conditions). Site procedures, and appropriate working methods (e.g. 2-man handling, stockpiling to permit movement by mechanical handling aids etc.) should be in place to minimise the following:

Situation	Risk
Bulky item	• Can't see where feet are going, can't assess condition of flooring, presence of contaminants, or changes in flooring level • Possibly using both hands to carry item, therefore cannot grasp handrails, etc. • Can't minimise the effects of a fall by using hands to break fall
Heavy item	• Off balance due to exertions • Possibly using both hands, therefore cannot grasp handrails, etc. • Can't minimise the effects of a fall by using hands to break fall

6. **Platforms to skips** offer increased risk of slips and trips. Therefore from a Health & Safety viewpoint sites should ideally by designed using split-level architecture.
Where it is not reasonably practicable to operate a split-level site, then ramps or steps to access a loading platform may be necessary.
Ramps are preferable to steps since they permit an easy, consistent incline, and may permit the use of mechanical handling aids (barrows etc.) They minimise the risks associated with sudden (and often unseen) changes in level.

I. ***Design***

Ramps

- Should not be excessively steep.
- Designs with a 'dog-leg' may minimise yard space usage, and may help arrest 'runaway' barrows etc. where used

Steps

- Should have broad treads.
- Should have low risers between treads
- The gap between treads should be fitted with risers to prevent feet being caught between treads
- Tread nosings should be hi-visibility (e.g. yellow contrast painted) and rounded to prevent feet catching.
- Signs should warn of step hazard, and/or indicating public should ask for staff assistance where necessary.

II. ***Materials*** selected for ramps/steps should exhibit slip resistant properties: gratings, chequer plate and proprietary applications incorporating grit have been used. The criteria for selection and use include their abilities to:

a. Resist contaminant accumulation (fine gratings can permit the shedding of fluids, and allow finer solids to fall through)
b. Provide good grip to the sole without increasing the risk of feet catching in any excessively large apertures in the flooring material.

III. ***Maintenance*** of ramps and steps is essential. They should be maintained in a sound condition and kept free of contaminants. Working procedures should include regular checks and maintenance. Check bolts for tightness & welding for integrity.

IV. ***Handrails*** and guardrails should be provided at platforms, steps and ramps. They prevent falls from the sides of these means of access and can help people safely negotiate the changes in level.

Manual handling

To reduce the risks of injury caused by manual handling, the following checklist may help you to devise improved ways of working.

Avoid manual handling

1. **Does the item need to be moved at all?**
   There are instances where by just leaving the item where it is for a while, the need to move it, or move it twice, can be eliminated.
2. **Can it be moved using aids?**
   Although manually handling items is no doubt fast and convenient, the accumulated strains on a person can add up over the years. Consider:
   - Can the item be left in a 'holding area' to be moved by machinery (e.g. a skip loader bucket) later in the day?
   - Can the item be moved by a barrow or similar?

Assess the task

3. Can the **workplace layout** be improved?
   A well laid out CA site will allow
   - Vehicles to get as close as possible to the disposal point and therefore minimise distances that items need to be carried.
   - A reduction in the amount of twisting and stooping required both picking up and disposing of items. For example, lifting direct from vehicles is preferable to 'double handling' by placing the item on the floor to be manually lifted a second time later.
4. Can the **load** be:
   - Made lighter, or less bulky? Sometimes, the risks of manual handling can be reduced by breaking down the load into smaller, more easily managed 'parcels'. This is often a practicable solution in CA sites.
   - Made easier to grasp? Similarly, this can often be a practicable option. Loose loads of green waste, as just one example, may be capable of being placed into suitable receptacles for handling. It may be possible to stipulate the acceptable containers that the public may only use for handling their waste on site (e.g. bags not exceeding a certain capacity or weight)
5. Can the **workplace** be improved by:
   - Removing obstructions to free movement?
   - Provide better conditions underfoot?
   - Avoiding steps and steep ramps?
   - Better lighting?

6. **Your staff:** have they:
   - Been *assessed* to take into account pre-existing physical weaknesses (bad backs etc.)?
   - Been *trained* in when, and how to use which preferred methods of safer lifting?
   - Do they adhere to the agreed safer manual handling procedures? If not, why not? Do your agreed working methods need revising, or does your staff need refresher training or greater supervision?
   - Do you promote *less restrictive clothing* and personal protective equipment?

Machinery guarding

Are your machines safe to use? To minimise the risks from machinery used on your site, you should:

Assess the risks

Choose the appropriate safeguard, and consider:
- Normal work at the machine, as well as setting-up, maintenance, repair, cleaning, breakdowns and removing blockages.
- Who uses the machine, including experienced staff, new starters, people who have changed jobs or are relief workers
- Convenience of the guard. If it is inconvenient to use or easily defeated.(i.e. circumvented by guard removal or interfering with correct interlock switch operation).
- Workers who may act foolishly or carelessly, or make mistakes

Suppliers should provide the right safeguards by law, but in reality, this is not always the case. It should not be automatically assumed that a new machine is equipped with appropriate safeguards, , so it should be thoroughly checked before first being used.

Choose the right guards

- Fixed guards which enclose the dangerous parts are often the best; it is obvious when they are in place. They should be secured by nuts and bolts, Allen bolts etc. so they can’t easily removed.
- Think about the best materials to use for the guard. Where wire mash or similar materials are used, the holes should be small enough to prevent reaching the dangerous parts. Plastic is easily damaged and therefore inadequate.
- For regular approach to the dangerous parts (to clear blockages, lubricate, or clean), fixed guards may not be practicable. Interlocked guards, which prevent the machine operating unless the guard is shut, and cannot be opened whilst the machine is moving, are a common and effective solution.
- Photoelectric devices, pressure sensitive mats or automatic guards are used where fixed or interlocked guards are impractical. These devices need regular checking and maintenance.

Routinely check and maintain the guards
- Regularly check that fixed guards are in position and give adequate protection before the machine is used. They must be replaced after removal for machinery repair or to clear blockages.
- Regularly check that interlocked guards are working properly - they can be prone to failure, or to being defeated.

- Institute a system of daily, weekly or 'before use' guarding checklists.
- Ensure that staff knows that they are required to report faulty guards - *their safety may depend on this!*

Work Safely

- Machine users should have received sufficient information, instruction and training to use it safely
- You should not be able to start the machine when dangerous parts can be touched, e.g. during maintenance, repair, clearing blockages etc.
- Controls should be clearly marked to show what they do
- Controls should be designed and constructed to prevent accidental operation. Start buttons and pedals should be shrouded
- Emergency stop controls, should be kept in good working condition and should be within in easy reach.

Operators Checklist

Before working	Yes	No
Are you authorised and trained to use the machine?		
Do you know how to stop the machine before you start it?		
Do the 'emergency stop' controls work?		
Are all guards in position and safety devices working properly?		
Is your working area clean, tidy and free from obstructions?		
Can you tell your supervisor immediately if the machine and safeguards are not working properly?		
Are you wearing appropriate protective clothing and equipment, eg safety glasses, footwear etc.?		
Have you made sure that dangling chains, loose hair, loose clothing etc can't get caught up in the moving machinery?		
NEVER • Try to clean a machine whilst it is in motion • Distract people who are using machines		

Two common waste industry machines deserve special mention because they regularly cause serious injuries:

Balers, compactors and similar machines

Balers/compactors can minimise some hazards and can be beneficial within CA sites by reducing the number of skip movements: however, severe injuries can be caused by baler/compactor rams.
Ram shear traps should be suitably guarded, and access should not be possible to these dangerous parts whilst the machine is in motion or use.

In extremely unusual circumstances, and only when traps *cannot* be guarded, then:

- Manual loading and machine working should be a one-man operation and all others *effectively* excluded from the working area
- Controls should be of a 'hold-to-run design'; release should stop ram movement and ideally return it to the safe 'home' position
- It should not be possible to reach the ram traps from the controls
- Operators should have a good, unobstructed view of the whole operation and immediate vicinity.
- Under no circumstances should these machines be operated when members of the public cannot be *effectively* excluded from the vicinity of the machine during use, if it is possible to reach any dangerous moving part of the machine.

Depending upon the machine's usage, adequate precautions should be taken to control the risks of ejected materials during use. This may include:

- Rigorous exclusion of materials likely to become ejected from the feedstock
- Enclosure (e.g. by doors, guards, well-maintained chain screens etc.) of the compactor chamber
- Ensuring safety by distance (e.g. feeding by conveyor etc. to a remote compactor chamber)

Conveyors

Serious injuries occur when guarding has been removed to:

- Clear spillages and blockages, and then not replaced
- Replace belts or adjust the tracking

.
Fixed guarding should be designed so that items routinely spilled can pass through the guarding where it can be safely cleared away, BUT such guarding should prevent anyone touching the dangerous in-running nip between belt and drum.
Interlocked guards must stop conveyor movement when opened and prevent restarting until the guard is back in position. Interlocking switches should be robust to withstand foreseeable damage and regularly checked to ensure that they are still working properly.
Conveyors should never be set in motion without the guards being in place.

Good Skip/Container Practice		
Activity	**Reason**	**Risk**
Locating a skip		
Check the integrity of the: • skip • lifting equipment • lifting points	Look for • Wear • Corrosion	• Skip, or load bearing points could fail
Look for snagged: • Chains • Fluid power pipes • Mechanical/ structural parts	The skip should be able to move freely as intended	• Destruction or catastrophic failure of lifting equipment • Unexpected movement of skip when it becomes free
Check the condition of the ground. Is it (and likely to remain): • Firm • Reasonably level • Well drained	• Soft ground can bog down a vehicle or affect the ability to carry out an efficient lift • Inclines can affect safe lifting • Standing pools of water can promote skip corrosion and affect its integrity	• Stranded vehicles requiring subsequent towing • Poor lifting conditions and possibility of overturning • Catastrophic skip failure
Check the location and surrounding area. Does the skips location: • Conform to your instructions of where it should be placed • Impede or interfere with traffic movement • Make a blind corner (Special precautions are required under any overhead lines and pipework! Ask site management)	• A skips location is important for safe and efficient operation of the site • Interfering with smooth and planned traffic flow can increase the risks of collisions • Creating blind corners, or obstructing pedestrian walkways can increase vehicle risks to pedestrians	• Collisions between vehicles/plant/ped estrians • Contact with electricity or dangerous fluids

Are all pedestrians *well clear* of the drop-zone? Are you absolutely sure there is no possibility of them coming dangerously close? Do you need to: • Where practicable, Drop during 'quiet hours', close site temporarily • Have the zone demarcated (cones, bunting, signs etc.) • Have an assistant as a 'second pair of eyes' to check for or stop pedestrians	• Effective exclusion of other people during the movement of skips is critical • Effective skip location is important. Some premises have made this job easier by providing raised floor-guides (e.g. railway sleepers, kerbs and similar) to ease skip location. Others use painted lines. • Prevention of skip 'over-run' can be achieved by using similar materials as raised stops for the skip wheels	• Risks of skip 'over-run' outside of the designated zone
Walking on skip contents		
• Good site management can often eliminate any need to walk on skip contents • Contaminants should be excluded before contents are put in the skip • Methods should be in place to ensure that skips are loaded evenly, so far as is reasonably practicable • Where 'trimming' of the load is necessary, this can be done by raking with plant buckets, or plant fitted with compaction devices. • Manual trimming (as a last resort) should be done using tools from outside the skip • Systems of work should prevent the overfilling of skips and thereby eliminate the need to trim the load	The aim should be to adopt the hierarchy of: • Eliminating the need to trim loads by adopting good loading practices • Use plant to trim loads if this cannot be achieved • Manual load trimming is the last resort, and should be done from outside the skip using tools wherever practicable	• Trips and subsequent falls from the skip to the ground • Trips on the same level • Falls into hidden voids in the load • Cuts from load contents

Staff

Personal protective equipment should extend to:

- **High – visibility jackets** should be worn at all times outdoors.
- **Gloves,** appropriate to the task, should be worn whenever handling waste.
- **Cut-resistant** ('ballistic') **trousers** should be worn wherever there is a risk of cuts to the legs – shorts are inappropriate for work with waste.
- **Boots** with steel toe-cap and steel soleplate should be worn. Many waste sites insist upon boots with good ankle support to reduce the risk of twisted ankles when dismounting from cabs or accidentally walking on spillages.
- **Other equipment** (e.g. helmets, eye protection, ear defenders, respiratory protection) may be needed depending upon the work done.

Welfare and Hygiene

Welfare facilities should be well maintained in a good state with clothes-drying room/facilities when outside work in rain is carried out. They should have usable means of washing the hands with cleaning materials and warm water. Employees should avoid hand-to-mouth contact (e.g. eating/drinking/smoking) unless hands are clean.

Information

Further information is available from the HSE **Infoline** (tel. 08701 545500) or the HSE website (http://www.hse.gov.uk/index.htm).
The following information sources are of particular note and are available from the HSE website or printed copies from HSE Books (01787 881165)

- Waste Industry Safety and Health – reducing the risks INDG359
- A guide to risk assessment requirements INDG218
- Five steps to risk assessment INDG163
- Managing Vehicle Safety at the Workplace INDG199
- Sheeting tipper lorries (http://www.hse.gov.uk/workplacetransport/information/sheeting.htm)
- Safe use of Skip Loaders INDG378.
- Slips and Trips: Guidance for employers on identifying hazards and controlling risks HSG155
- Preventing slips and trips at work Leaflet INDG 225(rev1)
- Avoiding falls from vehicles INDG395

***The Health and Safety Executive acknowledges the invaluable help of Network Recycling (http://www.networkrecycling.co.uk) in the production of this discussion document*.**

APPENDIX 2: METHODOLOGY FOR IDENTIFYING CA SITE IMPROVEMENTS

Identification of CA site improvements

Improvement recommendations for CA sites described in this report have been arrived at primarily with a view to improving the recycling performance of the relevant sites. Account has also been taken of issues relating to the site's operational efficiency and/or Health & Safety risks[27].

Factors affecting CA site recycling performance have been identified on the basis of research findings of the National Assessment of Civic Amenity Sites (NACAS) project. This research involved statistical analysis of a wide range of factors which are significant in affecting CA site recycling rates, and data for this analysis was sourced from detailed onsite assessments of 113 CA sites throughout the UK. Recycling rates for these sites ranged from 3% to 77% (BVPI definition). The following list indicates some, but by no means all, of the factors investigated during the onsite assessments:

- recycling and waste disposal infrastructure
- reuse systems
- staffing levels and policies
- contract management arrangements
- layout & traffic management
- signage
- public awareness raising measures
- trade abuse
- security issues
- cross-border usage
- the effect of other recycling infrastructure (ie kerbside recycling schemes)

For further details of the factors investigated by the NACAS site assessments, please refer to *NACAS Report, (Chapters 3.0 & 3.1* and *Appendix 3).*

Moreover, some site-specific factors affecting recycling performance, but not fully investigated in the NACAS report, have been addressed through the extensive onsite experience of the site assessors.

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[27] With regard to Health & Safety risks, we ask readers to note that this report has not been produced by qualified Health & Safety professionals. Therefore, whilst we have made every effort to identify existing risks and to note potential risks arising from the improvements we recommend, we strongly advise the relevant local authority and/or contractor to carry out full risk assessments of their existing site operations, and for all improvements recommended in this report, and to implement all necessary Health & Safety measures and procedures. For further details, please refer to Appendix 1 of this report.

During site assessments carried out for this report, information has been collected in a systematic manner relating to (i) current set-up of the site, and (ii) recommendations for improvements.

Calculation of projected recycling rate increases

Recycling rate increases have been assigned to many of the improvements recommended in this report, (see Section 4.3). These recycling rate increases have been determined on the basis of a multiple regression analysis[28] of the NACAS site assessment data described above. For each type of improvement, it is assumed a quantifiable effect on the relevant site's recycling rate will be achieved. For example, the NACAS research showed that the presence of a reuse system has a separate quantifiable effect on CA site recycling rates, amount to 5.4 percentage points. Therefore, if a site has a recycling rate of 30%, but no reuse system, and a reuse system is installed at this site, we can expect the recycling rate to increase by 5.4 percentage points, thus:

30% + 5.4% = 35.4%.

However it must be borne in mind that each recycling rate increase is an average increase that we would expect to see if the same improvement were to be introduced over a large number of sites. For any one individual site, it is in fact unlikely that recycling rates would increase in exactly the manner predicted. Therefore the recycling rate increases projected in this report should be regarded as a rough mathematical guide, which offer a broad indication of the recycling rate increases that can be expected overall through the implementation of all the recommended improvements.

It is important to note that the increases in recycling performance of the order projected in this report are only likely to occur if the whole range of issues identified is addressed. If only a select number of improvements are carried out, it is likely that the failure to address the remaining issues will undermine the projected recycling rate increases that would be expected from the implementation of the selected improvements. To illustrate this point, it can be imagined that recycling infrastructure and signage are upgraded, but that recommendations relating to trade waste and security are disregarded; in this case we can expect the problems in managing the site arising from trade abuse and security issues would be so great that recycling rate increases of the order projected for recycling infrastructure and signage improvements would not be attained.

For more details on the findings of the NACAS regression model of factors affecting CA site recycling rates, please refer to *NACAS Report, Chapter 3.1* and *NACAS Toolkit, pp 26-33*.

The NACAS model of factors affecting CA site recycling rates has been developed for this report to include factors not identified in the multiple regression model. The NACAS regression model accounts for 57.4% of variability in CA site recycling rates, which leaves 42.6% of variability unexplained. The NACAS report provides some hypothetical explanations for factors which are excluded from the regression model (and which would account for the remaining 42.6% variability in CA site recycling rates). This work has been developed in order to arrive at quantitative estimates for the effects of some site improvements on recycling rates. In

[28] A multiple regression analysis attempts to quantify the separate effects of each factor upon a variable which is affected by several factors, and in particular where the factors affecting the variable may be also affecting each other. In the case of the NACAS regression model, the variable is CA site recycling rate (BVPI definition), and a wide range of factors can be expected to affect this variable. As an example, one of these factors was found to be the presence of a reuse system, and the multiple regression analysis determined that reuse systems have a separately distinguishable effect on CA site recycling rates which can be quantified; in this case, it was found that the presence of a reuse system had a positive effect on CA site recycling rates amounting to 5.4 percentage points.

particular, estimates have been made for the effects of staff training & motivation, public awareness raising measures, layout improvements, reduction of trade abuse and dealing with severe security issues. These quantitative estimates are noted as appropriate in the projected recycling rate increase calculations presented in this report.

This report has also attempted to increase the sensitivity of the NACAS model for certain factors. For example, whilst the installation of a reuse system is calculated to add 5.4 percentage points to a site's recycling rate, the significant improvement of an existing reuse system is estimated to have half of this effect, ie adding 2.7 percentage points to the site's recycling rate.

Projected recycling rate increases due to the introduction of new materials are based on the NACAS regression model, but have been developed to take account of differences in composition between different sites. For example, we would expect that a site with a high composition of green waste would experience a higher increase in its recycling rate, due introducing green waste separation, as compared to a site with a low green waste composition. For the NACAS project, recycling rate increases arising from introducing new materials were related to the NACAS estimates of national CA site composition[29]. Using the example of green waste, NACAS estimates that green waste accounts for 24.6% of national CA throughput, and the model of factors affecting recycling rates calculates that the introduction of green waste separation accounts for 66.7% of this figure[30]. Once we exclude separated rubble from the recycling rate calculation (in order to apply the BVPI recycling rate definition), this corresponds to a recycling rate increase of 19.6 percentage points[31].

For this report we have applied an estimated CA site composition typology for each site; (see Appendix 3 for more details on composition typologies). Projected recycling rate increases due to the separation of new materials are based upon these typologies. Using the example of green waste again, the composition typology with the lowest composition figure for green waste estimates that 13.5% of the relevant site's throughput is green waste; and the introduction of green waste separation at this site would correspond to a projected recycling rate increase of 10.8%. These figures have been arrived at using the same method as described above for the NACAS findings on the effects of material separation on CA site recycling rates.

Some of the CA sites assessed in this report may already be achieving good recycling rates. In these cases our recommendations have taken this fact into account, but we have nevertheless recommended those improvements which are considered are easy to implement. Moreover, some improvements will necessarily apply across all sites within a CA site network, ie contractor incentives, staff incentives or trade waste controls. Therefore recycling rate increases arising from such improvements will also apply to sites with good recycling performance. However it is not considered that unrealistically high recycling rates are projected for these sites, since the mass balance modelling automatically restricts the degree to which recycling rates can be increased.

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[29] Refer to *NACAS Report, pp 87 -90.*

[30] ie it is assumed that 66.7% capture of green waste is achieved simply through installing suitable green waste containerisation.

[31] Refer to *NACAS Report, pp 88-89.*

APPENDIX 3: METHODOLOGY FOR FINANCIAL CASE FOR SITE IMPROVEMENTS

For an overview of the methodology used to produce the financial case, see Section 3.3.

CA site composition typologies: general comments

An essential part of the financial case is the modelling of how recycling rate increases are accounted for in terms of the extra diversion of different types of materials. It is thus important to be able to estimate quantities of various materials that are available to capture in each site's waste stream. As a starting point, it is necessary to estimate the waste composition of each site assessed in this report. The current understanding of CA site composition is poor[32], although the National Assessment of Civic Amenity Sites (NACAS) has provided the best available estimate of national CA site waste composition to date. This national estimate is unable to account for differences in waste composition between different sites. Therefore several different CA site waste composition typologies have been identified, as part of the work for this report.

Waste composition estimates were calculated for 91 sites from a broad geographical range of locations in nationally[33]. These sites all achieved relatively high recycling rates, of at least 60% including separated inert waste, during the period 2003/04. The recycling rates (included separated inert waste) for these sites ranged from 60% to 82% for individual sites. These sites are situated in a wide variety of locations which generally reflect the broad variety of site catchments of CA sites nationally, ranging from sites in densely populated urban areas to sites in sparsely populated rural areas.

Bin tonnages for the period 2003/04 were obtained for all 91 CA sites, and this tonnage data accounts for between 60% to 82% of site throughput (depending on the site's overall recycling rate). Therefore bin tonnage data describes a significant proportion of waste throughput for these sites and can be reasonably expected to provide a reliable basis for estimating overall waste composition at these sites.

The composition of residual waste at these sites, which would account for between 20% and 40% of site throughput has been estimated through assuming that a certain proportion of the types of materials separated have not been captured in recycling containers, and therefore constitute a fraction of the residual waste. The proportions of uncaptured materials are assumed to be fairly low, since it is considered that high performing CA sites will generally capture a high proportion of the materials that they attempt to separate, particularly with regard to bulk recyclables. Capture rates for separated materials have been estimated on the basis of the overall recycling performance of each individual site, with a higher overall recycling rate being assumed to correspond to higher capture rates for individual materials. The remainder of residual waste which has not been allocated to in this manner has been included in a category described as "Other Waste"[34].

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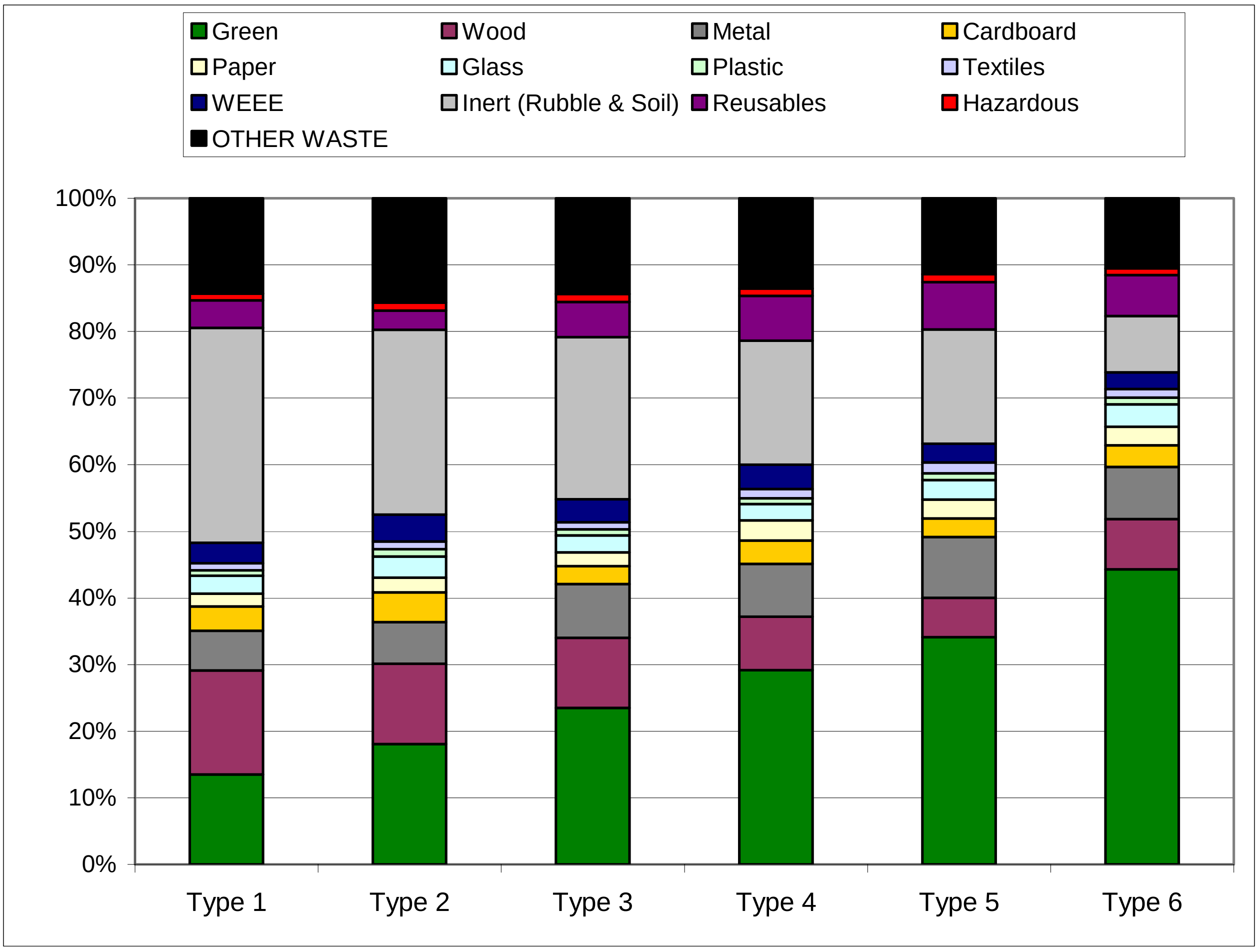
[32] See *NACAS Report pp 51-54* for further comments on this issue.

[33] More precisely, 90 sites are located in England and one site is located in Wales.

[34] For the purposes of producing mass balance estimations for individual sites, the "Other Waste" category for some CA sites has been further analysed into subcategories, on the basis of background waste audit data from the NACAS project, derived from 35 CA sites - refer to *NACAS Report, p 57.* This is particularly the case for sites where recommended improvements have included the additional separation of a range of small recyclables.

From these calculations, the waste composition of 91 sites was estimated, and these individual site compositions were arranged into 6 groups. The main variable used to determine which group a particular site composition profile belonged to was green waste composition. For each of the 6 groups of site compositions, an average CA site composition profile was calculated. These average figures were then assumed to represent 6 different and fairly typical types of CA site composition, or 6 composition typologies, as illustrated in the following figure:



The sites grouped in each typology were analysed in order to ascertain whether factors such as levels of deprivation or urban/rural location appeared to be associated with different types of composition. No strong correlations were found between these factors and types of composition, which indicates that these typologies cannot be reliably determined on the basis of site catchments alone. A weak correlation between population densities of CA site catchments of different composition profiles was detected.

A summary of the typologies with average population densities for each typology is presented in the following table:

Typology	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Average population density	4.8 inh/ha	3.3 inh/ha	3.1 inh/ha	2.7 inh/ha	2.5 inh/ha	1.3 inh/ha

Note: inh/ha = inhabitants per hectare; average population density for England = 3.8 inh/ha.

This indicates that the population density of catchment may be used to assist in identifying the 'best-fit' composition typology for a particular site, but that this should not be the only criterion used. Therefore various factors have been taken into account when allocating typologies to each site, including nature of site catchment, existing bin tonnages, observation of materials entering sites, the experience of site assessors, opinions of site staff and managers regarding likely throughputs of materials, and any suitable waste audit data made available for this report.

Where suitable waste composition data is available for particular sites, the composition of these sites has been estimated separately, usually by combining bin tonnage data with residual waste audit data. Where possible, seasonal variations in green waste throughputs have been accounted for when interpreting residual waste audit data; all seasonal adjustments to waste audit data are carried out on the basis of NACAS project background data on seasonal variations in green waste inputs (derived from waste audit and bin tonnage data from 56 sites; refer to *NACAS report pp 57 & 62*).

APPENDIX 4: METHOD FOR CALCULATING BMW LANDFILL DIVERSION TONNAGES

June 2005

CA Site Improvement Cost Modelling

Discussion document on methods for calculating BMW landfill diversion tonnages arising from improving CA site recycling performance

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1. INTRODUCTION

Network Recycling has developed a tool, (with some assistance from Eunomia Research & Consulting), for modelling the economic effects of improving the recycling performance of CA sites. This tool has been applied to produce financial cases for improving CA sites in various England local authorities; all of this work has, to date, been carried out on behalf of Defra WIP.

In basic terms, the cost modelling process works as follows:

(i) The relevant CA sites are assessed in detail through onsite visits and a set of improvements is recommended.

(ii) The effect of these improvements on each site's overall recycling performance is projected by applying the NACAS[35] findings on factors affecting CA site recycling rates[36].

(iii) The recycling rate increases for each site are modelled on a mass balance basis[37].

(iv) The costs of implementing improvements are estimated. These costs usually include a capital element (ie investment in new containers, etc) and a revenue element (ie investment in new staff).

(v) Costs relating to the increased diversion of certain materials (as predicted by the mass balance, point (iii) above) are estimated. This calculation will take into account avoided disposal costs (including transport, gate fees and Landfill Tax, but excluding LATS); and costs/savings for the diversion of different materials (transport and gate fees/income).

(vi) Avoided revenue costs arising from reduced tonnages of BMW being landfilled (and therefore resulting in avoided usage of LATS permits) are calculated.

The final point, (vi) above, is the subject of this document, which sets out methods for calculating the diversion of BMW tonnages from CA site residual waste, under the proposed monitoring system for calculating usage of LATS permits.

Whilst this document discusses methods for calculating the effects of CA site improvements on BMW landfill tonnages and (avoided costs due to avoided use of LATS permits), it is worth noting that this these methods could, in principle, be applied for the purposes of producing business cases for other MSW recycling systems, ie kerbside recycling collections.

<u>Note:</u>

Throughout this document:

BMW recycled is defined as BMW source separated for recycling, composting & reuse

MSW recycled is defined as MSW source separated for recycling, composting & reuse

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35 NACAS = National Assessment of Civic Amenity Sites, Network Recycling & Future West, 2004. This report can be viewed by following the relevant links at www.networkrecycling.co.uk/casites

36 These findings are based on a regression model based on detailed survey data from over 100 CA sites throughout the UK.

37 This process involves estimating the composition of each CA site, which is a problematic issue. However, Network Recycling has made progress on this issue through producing a set of composition typologies for different types of CA sites.

2. FUTURE LATS MARKET PROJECTIONS

Network Recycling currently considers its local authority clients are best placed to make future projections of LATS permit values. With this in mind, our financial cases include providing each local authority client with a simple equation for calculating annual overall revenue costs/savings on the basis of different LATS permit values. Local authorities would, for example, be able to estimate annual costs/savings arising from CA site improvements with LATS permits set at an average value of, say, £15, £30, £50, £100, etc. This tool also enables local authorities to better assess the financial risks associated with improving their CA sites, for instance through calculating the average LATS permit market value that would result in the CA site improvement business case to "break-even".

However, one important prerequisite to producing such an equation is estimating the additional BMW tonnage that would be diverted from landfill due to implementing the CA site improvements that we recommend. Methods for calculating these diverted tonnages of BMW from CA site residual waste, under the currently proposed systems for monitoring BMW landfill tonnages, are the subject of the rest of this document.

3. CALCULATION OF AVOIDED BMW LANDFILL TONNAGES

As discussed in Section 1 above, the CA site improvement tool models the effects of increasing a site's recycling rate in terms of mass balance calculations, through which the additional diversion of various materials may be estimated. A certain proportion of this additionally diverted material is likely to consist of BMW. The BMW content of additionally diverted materials has been determined as shown in the following table (copied from the Environment Agency's website):

Type of waste	Amount of BMW (expressed as a percentage by weight)
Card	100%
Paper	100%
Putrescible waste	100%
Vegetable oil	100%
Footwear	50%
Furniture	50%
Textiles	50%
Carpet	50%
Mineral oil	0%
Batteries	0%
Electrical and electronic equipment	0%
End-of-life vehicles	0%
Fluorescent tubes	0%
Glass	0%
Inert construction and demolition waste	0%
Metal	0%
Plastic	0%
Soil	0%

To illustrate this method for calculating BMW diversion from landfill due to CA improvements, a crude example is provided:

Material	**Tonnes recycled/composted**			
	No improvements	Improvements implemented	Additional diversion from CA residual waste	BMW content of additional diverted tonnage
Green waste	1,000	2,500	1,500	1,500
Metal	800	1,200	400	0
Textiles	200	450	250	125
TOTAL	**2,000**	**4,150**	**2,150**	**1,625**

For this example CA site, the implementation of our recommended improvements is projected to result in the *additional diversion* from CA residual waste of 2,150 MSW, of which 1,625 is BMW.

If we could assume that, for a given authority, each tonne of additionally diverted BMW would ultimately result in one tonne of BMW diverted from landfill, this would imply that the authority would avoid revenue costs equal to 1,625 tonnes x the market value of LATS permits. Therefore, if LATS permits were to have a market value of £40/tonne, the authority would avoid revenue costs of £40 x 1,625 tonnes = £65,000. In other words, this authority would either avoid having to buy £65,000 worth of LATS permits, or would be able to sell £65,000 worth of LATS permits, and these avoided costs could be set against any other costs arising from implementing improvements to their CA site.

However, the diversion of one tonne of BMW from CA residual waste equates to the diversion of one tonne of BMW from landfill *only for authorities with no incineration and/or residual waste treatment capacity*, as described in Section 3.1. Calculation methods for authorities with incineration or other residual waste treatment capacity are discussed in Section 3.2 onwards.

3.1 Basic terms and equations used for calculating diversion of BMW from landfill

For the sake of consistency, the terms used by Defra in the table of provisional local authority LATS permit allocations are used in this document, as follows[38]:

Term	Definition	Equivalent to
a	Total MSW	
b	Total MSW recycled	
c	Total BMW recycled	
d	MSW landfilled	
e	Total BMW	**e = a x 68%**
f	MSW disposed	**f = a – b**
g	BMW disposed	**g = e – c**
h	Biodegradable % of MSW disposed	**h = g / f**
i	BMW landfilled	**i = h x d** (or, i = dh)

Since we are ultimately interested in the effect of CA improvements on BMW landfilled, it is useful to express this variable in a number of ways, as follows:

i = dh = dg/f = d(e-c)/(a-b) [1]

[38] In the Defra provisional allocations table, these terms refer specifically to the period 2001/02, though in this document these terms are considered to be applicable to any particular period (ie if CA site improvements are projected to take place in the period 2005/06, these terms would refer to waste arisings, etc, for the period 2005/06).

We note that problems arise in applying equation [1] above for authorities with incineration and/or residual waste treatment capacity, where residue tonnages from these treatments are unaccounted for, (see Sections 3.3.1 and 3.4.1).

3.2 BMW landfill diversion calculations for authorities with no incineration etc capacity

For authorities with no incineration and/or residual waste treatment capacity, it appears that for each tonne of BMW diverted from CA residual waste, one tonne of BMW would be calculated by the Environment Agency to be diverted from landfill. Applying one form of equation [1] (in Section 3.1 above), we see that:

$$i = d(e-c)/(a-b) \quad [2]$$

where **i** = BMW landfilled, **d** = MSW landfilled, **e** = BMW total, **c** = BMW recycled,
a = MSW total, **b** = MSW recycled

For an authority where recycling is the only option for MSW landfill diversion, it follows that MSW landfilled = MSW total *minus* MSW recycled, ie

$$d = (a - b) \quad [3]$$

Therefore the equation for calculating BMW landfilled simplifies to:

$$i = e - c \quad [4]$$

ie, BMW landfilled = BMW total *minus* BMW recycled

On this basis, each additional tonne of BMW recycled (in this instance, through introducing improvements to CA sites) would result in one tonne of BMW diverted from landfill. Expressed algebraically, if we denote BMW landfilled *with CA improvements* as **I**, and additional BMW tonnage diverted at the CA site as **R**,

$$I = e - (c + R) \quad [5]$$

If we denote the avoided disposal of BMW tonnage *due to CA improvements* as **S**,

$$S = i - I = (e - c) - [e - (c + R)] = R \quad [6]$$

Therefore:

$$S = R \quad [7]$$

where **S** = reduction in BMW landfilled due to CA improvements and **R** = BMW tonnage diverted from CA residual waste due to CA improvements.

3.3 BMW landfill diversion calculations for authorities with incineration capacity

The calculations for BMW landfill diversion as a result of CA site improvements are less simple for authorities with incineration and/or residual waste treatment capacity. In this Section we are concerned with authorities with only incineration capacity. Authorities with other residual waste treatment capacity (ie MBT) are discussed in Section 3.4.

Applying one form of equation [1] (from Section 3.1 above), we see that:

i = dg/f [8]

where **i** = BMW landfilled, **d** = MSW landfilled, **g** = BMW disposed, **f** = MSW disposed

For an authority with incineration capacity[39], we can say that MSW Landfilled = MSW disposed *minus* MSW incinerated. If we introduce a new term, **p**, to denote MSW tonnage incinerated (ie incineration capacity), and we can describe MSW landfilled, **d**, as:

d = f – p [9]

Applying this to equation [8], we find:

i = g(f-p)/f [10]

We may now turn our attention to modelling the situation with improvements at the authority's CA sites, resulting in additional MSW and BMW being diverted from CA residual waste. If we denote BMW landfilled *with CA improvements* as **I**, additional BMW tonnage diverted at the CA site(s) as **R** and additional MSW tonnage diverted at the CA site(s) as **T**, we see that, compared to the situation with no improvements:

- BMW disposed after improvements becomes BMW disposed before improvements *minus* additional BMW diverted at CA = **g – R**
- MSW disposed after improvements becomes MSW disposed before improvements *minus* additional MSW diverted at CA = **f – T**
- MSW landfilled after improvements becomes MSW landfilled before improvements *minus* additional MSW diverted at CA = **d – T** ; since **d = f – p**, MSW landfilled after improvements can be expressed as **f – (p + T)**

BMW landfilled after improvements can then be calculated as:

{BMW disposed} / {MSW disposed} x {MSW landfilled}, which can be expressed as:

I = (g-R).[f-(p+T)]/(f-T) [11]

The reduction in BMW landfilled *due to implementing CA site improvements* can be calculated as:

{BMW landfilled before improvements} *minus* {BMW landfilled after improvements}. If we denote this tonnage reduction in BMW landfilled *due to CA site improvements* as **S,** we can expressed this calculation as:

S = i – I [12]

Applying equations [10] and [11] above, we find that:

S = {g(f-p)/f} – {(g-R).[f-(p+T)]/(f-T)} [13]

This equation reduces[40] to the following:

S = R + (<u>(gpT/f)-pR</u>)
(f-T) [14]

$$S = R + \frac{(gpT/f) - pR}{f - T} \quad [14]$$

We can thus consider a hypothetical authority, with the following basic waste & recycling data:

Waste/recycling data	Amount for example authority (tonnes)	Algebraic term
Total MSW arisings	80,000	**a**
MSW recycled *before improvements*	20,000	**b**
MSW disposed *before improvements*	60,000	**f = a – b**
BMW recycled *before improvements*	10,000	**c**
Total BMW arisings (@68% total MSW)	54,400	**e**
BMW disposed *before improvements*	44,400	**g = e – c**
Incineration capacity	25,000	**p**
Additional MSW diverted from CA residual waste *after improvements*	10,000	**T**
Additional BMW diverted from CA residual waste *after improvements*	5,000	**R**

Applying equation [14] above, we calculate additional BMW diverted from landfill as a result of implementing CA site improvements as:

S = 5,000 + {[(44,400 x 25,000 x 10,000 / 60,000) – (25,000 x 5,000)] / (60,000 – 10,000)}

= 5,000 + {[(185,000,000) – (125,000,000)] / 50,000} = 5,000 + 1,200 = **6,200 tonnes**

We can test the validity of this equation against a mass balance model, as follows:

	No CA improvements		***With CA improvements***	
	MSW	**BMW**	**MSW**	**BMW**
Total waste arisings	80,000	54,400	80,000	54,400
Recycled	20,000	10,000	**30,000**	**15,000**
Disposed	60,000	44,400	50,000	39,400
Incineration	25,000	18,500	25,000	19,700
Landfill	35,000	**25,900**	25,000	**19,700**

The mass balance shows a reduction in BMW to landfill as a result of CA improvements of 25,900 – 19,700 = **6,200 tonnes**. Equation [14] has been tested against several mass balance scenarios and has produced valid results in all instances.

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[39] but no other type of residual waste treatment capacity (ie MBT)
[40] S = {g(f-p)/f} – {(g-R).[f-(p+T)]/(f-T)} = {g(f-p)/f} – {(g-R).(f-p-T)/(f-T)}
= {g[1-(p/f)]} – {(g-R)[1- (p/(f-T))]} = {gp[(1/(f-T))-(1/f)]} + {R[(1-p)/(f-T)]}
= {gpT/[f(f-T)]} + {R[1-(p/(f-T))]} = R + {[(gpT/f)-pR]/(f-T)}
(Many thanks to Prof. John Bridgwater for algebraic assistance.)

A basic assumption in both equation [14] and the mass balance presented above is that the proportion of BMW in incinerated MSW is equal to the proportion of BMW in overall disposed MSW. So, for instance, we see from the mass balance that with *No CA improvements*, incinerated MSW as a proportion of disposed MSW is 25,000 / 60,000 x 100 = 41.7%; and the tonnage incinerated BMW is calculated to be the same proportion of disposed BMW:
44,400 x 41.7% = 18,500 tonnes.

3.3.1 Calculations including incinerator ash

The calculations presented in the above Section have not accounted for incinerator ash. Using the mass balance example in Section 3.3 above, we can imagine that this authority's incinerator produces 5,000 tonnes of ash per annum. This ash arising will obviously not impact on the inputs to the incinerator, and the BMW content of the ash will equally obviously be zero. However, total MSW landfill tonnages will be affected, with the addition of this 5,000 tonnes of ash as shown below:

	No CA improvements		***With CA improvements***	
	MSW	**BMW**	**MSW**	**BMW**
Total waste arisings	80,000	54,400	80,000	54,400
Recycled	20,000	10,000	**30,000**	**15,000**
Disposed	60,000	44,400	50,000	39,400
Incineration	25,000	18,500	25,000	19,700
Incinerator ash	5,000	0	5,000	0
Landfill	40,000	**25,900**	30,000	**19,700**

We can see that BMW landfill tonnages have not been affected, with the additional diversion of BMW due to CA site improvements still being 25,900 – 19,700 = 6,200 tonnes. We therefore conclude that our proposed method for calculating additional BMW tonnage diversion due to CA site improvements presented in Section 3.3 above, and equation [14] in particular, does not need to account for incinerator ash tonnages in order to arrive at valid results.

However, we can see that applying equation [1] (see Section 3.1) to calculate BMW landfilled will now produce an incorrect result:

$$\mathbf{i = dg/f} \qquad [1]$$

where **i** = BMW landfilled, **d** = MSW landfilled, **g** = BMW disposed, **f** = MSW disposed.

We need to introduce a new term, **y**, for incinerator ash tonnage, to arrive at the correct calculation:

$$\mathbf{i = (d-y)g/f} \qquad [15]$$

Testing this equation using figures from the above mass balance table, for *No CA improvements*, we find that equation [15] calculates BMW landfilled as:

i = [(40,000 – 5,000) x 44,000] / 60,000 = 25,900 tonnes[41].

[41] Equation [1] calculates BMW landfilled to be 29,333 tonnes, an overestimate of 3,433 tonnes in this example.

3.3.2 Economic modelling constraints for authorities with incineration capacity

It is interesting to note that modelling the effects of CA improvements for authorities with incineration (and/or residual waste treatment capacity) requires knowledge of more variables than for authorities with no such capacity. For authorities with no such capacity, only the variable **R** (additional BMW diverted from CA residual waste) is required to calculate additional BMW diversion from landfill[42]. However, for authorities with incineration capacity, it appears that equation [14] (from Section 3.3 above) must be applied in order to predict additional BMW diverted from landfill due to implementing CA site improvements:

$$S = R + \frac{(gpT/f)-pR}{f-T} \qquad [14]$$

For authorities with incineration capacity, it follows that the following variables must also be known:

T = Additional MSW diverted from CA residual waste due to improvements

p = MSW incinerated

g = BMW disposed *before CA improvements*; this in turn would have to be calculated from:

> **e** = BMW total arisings
>
> **c** = BMW recycling before CA improvements (including recycling from non-CA collection systems)

f = MSW disposed *before CA improvements*; this in turn would have to be calculated from:

> **a** = MSW total arisings
>
> **b** = MSW recycling before CA improvements (including recycling from non-CA collection systems)

It therefore appears that, for authorities with incineration capacity, the outcome of the CA improvement financial model is affected by several factors not directly related to CA sites. The reason for this is that we must assume that a proportion of CA residual waste will be incinerated, and this proportion will depend on the authority's incineration capacity relative to its disposed MSW arisings. Disposed MSW will in turn be affected by the amount of MSW recycling achieved by an authority, including any additional MSW recycling projected to take place in the CA site improvement model, or through other collection systems (ie kerbside recycling). Moreover, the proportion of BMW arising in disposed MSW, and thus available to 'burn off' during incineration, will depend on the amount of BMW recycling achieved by the authority, including any additional BMW recycling projected to take place as a result of CA site improvements, or through other collection systems.

The net result of this is that it is not possible to predict with any certainty the effects of CA site improvements on BMW landfill diversion for authorities with incineration capacity, particularly where significant changes in the amount of non-CA site MSW and BMW recycling cannot also be accurately predicted. This could raise serious issues for authorities attempting to carry out long-term financial planning. On the other hand, in many instances the levels of financial risk involved are likely to be more sensitive to the market price of LATS permits. It is nevertheless a concern that we will be unable to offer local authorities accurate long term financial cases for

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[42] see equation [7], Section 3.2.

improving their CA sites, where those authorities have incineration capacity and where reliable projected recycling tonnages for non-CA collection systems are not available.

The above mentioned constraints on economic modelling also apply to authorities which have (or in future will develop) other types of residual waste treatment capacity.

3.4 BMW landfill diversion calculations for authorities with non-incineration residual waste treatment capacity

As far as calculating BMW landfill diversion tonnages is concerned, residual waste treatment processes such as MBT differ principally from incineration insofar as not all BMW content will be recovered, with some BMW still going to landfill. However, the equation arrived at to calculate BMW landfill diversion due to CA improvements for authorities with incineration capacity[43] can be modified to cope with treatment types that do not achieve 100% recovery of BMW, by introducing two new terms:

u = Residual waste treatment annual tonnage capacity

v = percentage recovery of BMW from residual waste treatment process

The following equation results:

$$\mathbf{S = R + \left(\frac{(guvT/f)-uvR}{f-T}\right)} \qquad [16]$$

where **S** = additional BMW tonnage diverted from landfill due to CA site improvements
R = additional BMW tonnage diverted from CA residual waste due to improvements
T = additional MSW tonnage diverted from CA residual waste due to improvements
g = total BMW disposed by authority *before improvements*
f = total MSW disposed by authority *before improvements*

We can test this equation against a mass balance model, using the same example authority as presented in Section 3.3. However, this authority now has no incineration capacity, but has an MBT plant with a capacity of 10,000 tonnes per annum. An arbitrary rate for the recovery of MSW and BMW of 60% has been set for this example.

	No CA improvements		***With CA improvements***	
	MSW	**BMW**	**MSW**	**BMW**
Total waste arisings	80,000	54,400	80,000	54,400
Recycled	20,000	10,000	**30,000**	**15,000**
Disposed	60,000	44,400	50,000	39,400
MBT: total input	10,000	7,400	10,000	7,880
MBT: recovery %	60%	60%	60%	60%
MBT: landfilled after treatment	4,000	2,960	4,000	3,152
Landfill	54,000	**39,960**	44,000	**34,672**

[43] equation [14] (Section 3.3): $S = R + \left(\frac{(gpT/f)-pR}{f-T}\right)$

From the above mass balance, we can calculate that BMW landfill diversion as a result of CA improvements as 39,960 – 34,672 = 5,288 tonnes. Applying the relevant figures for this example to equation [16] above arrives at the same figure.

We note that using equation [1] (see Section 3.1) to calculate BMW landfill tonnages will arrive at a correct result, so long as the recovery rates for MSW and BMW in the residual waste treatment process are the same. However, if recovery rates for MSW and BMW were to differ for any reason, the application of equation [1] would arrive at an incorrect figure for BMW landfilled; calculations would then have to account for other variables, in particular, MSW and BMW being treated and the respective recovery rates for MSW and BMW. However, differing recovery rates for MSW and BMW would not affect the output of equation [16] above.

3.4.1 Authorities with more than one type of residual waste treatment process

It is possible that some authorities may develop more than one type or residual waste treatment process, and this may particularly be the case for some of the larger WDAs. Equation [16] (Section 3.4 above) can be easily modified to cope with these different process if we include the following terms:

$\mathbf{u_1}$ = MSW treated by **first** residual waste process
$\mathbf{v_1}$ = percentage recovery of BMW from residual waste treatment for **first** process type
$\mathbf{u_2}$ = MSW treated by **second** residual waste process
$\mathbf{v_2}$ = percentage recovery of BMW from residual waste treatment for **second** process type

and so forth, to:

$\mathbf{u_n}$ = MSW treated by $\mathbf{n^{th}}$ residual waste process
$\mathbf{v_n}$ = percentage recovery of BMW from residual waste treatment for $\mathbf{n^{th}}$ process type

The calculation for additional BMW landfill diversion due to implementing CA site improvements for authorities with multiple residual waste treatment processes can then be expressed as:

$$\mathbf{S = R + \{ [gT\{u_1v_1+u_2v_2+\ldots u_nv_n\} / f) - (R\{u_1v_1+u_2v_2+\ldots u_nv_n\})] / (f - T) \}} \qquad [17]$$

where **S** = additional BMW tonnage diverted from landfill due to CA site improvements
R = additional BMW tonnage diverted from CA residual waste due to improvements
T = additional MSW tonnage diverted from CA residual waste due to improvements
g = total BMW disposed by authority *before improvements*
f = total MSW disposed by authority *before improvements*

In fact, this equation will apply to all authorities:

- For authorities whose residual waste treatment processes include (or solely consists of) incineration, annual incineration capacity can be included as, say, the term $\mathbf{u_1}$, and the corresponding percentage recovery of BMW, $\mathbf{v_1}$, should be set at 100%.
- For authorities with no residual waste treatment capacity at all, the terms $\mathbf{\{u_1v_1+u_2v_2+\ldots u_nv_n\}}$ in equation [17] would equate to zero, thus reducing the equation to **S = R**, (ie equation [7], Section 3.2).

We can test this equation against a mass balance model for our example authority. In order to fully test the equation, we can assume that the authority has:

- Residual Waste Treatment process 1 (RWT 1), with an annual MSW input of 10,000 tonnes and 60% recovery of both MSW and BMW;
- Residual Waste Treatment process 2 (RWT 2), with an annual MSW input of 8,000 tonnes and 45% recovery of both MSW and BMW;
- Incineration capacity of 15,000 tonnes MSW per annum.

The resulting mass balance is shown below:

	No CA improvements		***With CA improvements***	
	MSW	**BMW**	**MSW**	**BMW**
Total waste arisings	80,000	54,400	80,000	54,400
Recycled	20,000	10,000	**30,000**	**15,000**
Disposed after recycling	60,000	44,400	50,000	39,400
RWT 1: total input	10,000	7,400	10,000	7,880
RWT 1: recovery %	60%	60%	60%	60%
RWT 1: landfilled after treatment	4,000	2,960	4,000	3,152
(Disposed after RWT 1)	54,000	39,960	44,000	34,672
RWT 2: total input	8,000	5,920	8,000	6,304
RWT 2: recovery %	45%	45%	45%	45%
RWT 2: landfilled after treatment	4,400	3,256	4,400	3,467
(Disposed after RWT 2)	50,400	37,296	40,400	31,835
Incineration	15,000	11,100	15,000	11,820
Incinerator ash	3,000	0	3,000	0
Landfilled	38,400	**26,196**	28,400	**20,015**

The reduction in BMW landfilled as a result of implementing CA site improvements is calculated as 26,196 – 20,015 = **6,181 tonnes.** The same BMW landfill diversion figure is arrived at through applying equation [17] above.

We conclude this document by noting that the various mass balance models presented in this report have been tested by using a draft version of Defra's M-BEAM tool[44] for managing LATS permits; and that the mass balance results presented here and in M-BEAM are in agreement.

[44] M-BEAM can be downloaded by visiting http://lasupport.defra.gov.uk/ and clicking on the "M-BEAM" link.

POSTSCRIPT

Following discussions with David Wood at Defra (Environmental Protection Economics) in August 2005, it became clear that M-BEAM (and, by inference, Defra and the EA) use a different method for defining BMW landfill calculations. However, the two methods appear to produce identical results for the purposes of modelling the effects of CA site improvements. The M-BEAM calculation method excludes MSW landfill and is:

BMW Landfilled = BMW arisings (ie MSW x 68%)

minus BMW recycled

minus BMW input to RWT[45] {MSW input to RWT x (BMW disposed [after recycling]) / (MSW disposed [after recycling]}

plus BMW output from residual facilities to landfill.

Using the same algebraic terms as used elsewhere in this document, this can be expressed as (but introducing a new term, 'x' for BMW landfill output from RWT):

$i_M = e - c - [u.(e - c) / (a - b)] + x$ [18]

$= g - ug/f + x$ [19]

where

i_M = BMW landfilled, calculated using M-BEAM's method

e = total BMW arisings

c = BMW recycled

g = BMW disposed [after recycling]

a = total MSW arisings

b = MSW recycled

f = MSW disposed [after recycling]

u = RWT capacity

x = BMW landfill output from RWT.

If we take the example of incineration (as dealt with in Section 3.3), x = 0 (because all BMW is burnt) and u = p (incineration capacity).

Thus for incineration, the M-BEAM method would say:

$i_M = g - pg/f$ [20]

Using the method applied in this document (equation [10] in Section 3.3)

$i_N = g(f - p)/f$ [21]

where i_N = BMW landfilled, calculated using Network Recycling's method.

Applying algebra to equation [20]:

$f.i_M = g(f - p)$

$i_M = g(f - p)/f$ [22]

45 RWT = Residual Waste Treatment

From equations [21] and [22] we can see that $i_N = i_M$, indicating that the two methods are equivalent in terms of calculating BMW landfill diversion.

Now we can check to see if the methods are the same for calculating the marginal effects of CA site improvements on BMW landfilled. Once again, the example of incineration as the only RWT option is examined here. Using the M-BEAM method, BMW landfilled after CA site improvements would be calculated as:

$I_M = g – R – \{p(g – R) / (f – T)\}$ [23]

where

I_M = BMW landfilled *after* improvements using M-BEAM method

g = BMW disposed [after recycling] *before* improvements

R = additional BMW recycled due to improvements

f = MSW disposed [after recycling] *before* improvements

T = additional MSW recycled due to improvements

p = incineration capacity (ie MSW incinerated).

Applying the method used in this document, BMW landfilled after improvements would be calculated as per equation [11]:

$I_N = (g – R).[f – (p + T)] / (f – T)$

$= (g – R).(f – p – T) / (f – T)$ [24]

where

I_N = BMW landfilled *after* improvements using Network Recycling method.

Applying algebra, we see:

$I_M.(f – T) = (g – R).(f – T) – p.(g – R)$

$I_M.(f – T) / (g – R) = f – T – p$

$I_M.(f – T) = (f – p – T).(g – R)$

$I_M = (g – R).(f – p – T) / (f – T)$ [25]

From equations [24] and [25], we can see that $I_N = I_M$, indicating that calculations of BMW landfilled after improvements are identical for both methods. This shows that equation [14] in Section 3.3 produces results which are identical to those that would be produced by M-BEAM. This equation was used to determine marginal BMW landfill diversion due to CA site improvements *for authorities either with no RWT or with incineration as their only available RWT* and used in Network Recycling's cost modelling work for Defra WIP's DCS programme (specifically for Stoke-on-Trent City Council in July 2005).

We note that the M-BEAM calculation method would appear to correct for discrepancies in BMW landfill calculations noted in section 3.3.1.

Unfortunately time does not currently allow for us to assess whether the calculation methods presented in this document would be valid for RWT other than incineration, though we note that the M-BEAM calculation method presented in this postscript is described as the 'best available estimate at this time of the calculation that [the EA] will undertake'.

Eric Bridgwater, Network Recycling, 8 August 2005.