Sustainable Environmental Systems Ltd.

Bedminster
In-Vessel Composting System

Budget Proposal for Capital Waste Authority
City Solutions

Revision 1.0 February 2003

working with people & nature for a better environment

Revison History

Rev. No.	Revision Details	Author	Date
0.1	First draft	IDH	27/01/2003
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Executive Summary

This budget proposal is for two 450-600 tonnes per day (150k – 200k tonnes per annum) Bedminster in-vessel composting facilities to deliver increased recycling and landfill diversion rates for the Capital Waste Authoriy at costs comparable to landfill and incineration.

The Bedminster process is one of integrated recycling and composting. It is differentiated from Mechanical Biological Treatment by not shredding the waste stream and by producing a high quality compost suitable for unrestricted use.

Each facility would handle up to 200,000 tonnes per annum of green waste, food waste, mixed MSW and residual waste. In addition to the mixed solid waste the Bedminster system would safely handle 100,000tpa of sewage sludge. This presents the possibility of dealing with two waste streams whilst reducing the cost of solid waste management to the authority.

These 200,000 tonnes per annum Bedminster facilities would each require an area of 5.4 hectares. The highest part of the structure will be the roof of the Tipping Hall which would be 18 metres above datum. Plan and elevation views are presented in appendix A.

To ensure that the facility does not give rise to an odour problem, all deliveries and processing would take place within an enclosed building that would be maintained under negative air pressure. All process air would be cleaned in enclosed biofilters before release to the atmosphere.

The proposed facilities would deliver over 63% composting/recycling rate from the proposed waste stream of 8.1.1. Each facility would convert the 200,000 tpa of solid waste and 100,000 tpa of biosolids into approximately 95,000 tpa of OrganaGro compost

The proposed Bedminster facility would provide employment for 21 people when processing at full capacity.

Budget estimates put the capital cost of each 200,000 tpa plant at £33M with an annual operational cost of £5.6M. Additional operational income streams of approximately £2.4M should be available from the sale of compost and approximately £4M from the gate-fee for sewage sludge or other high nitrogenous waste streams. The generation of Carbon Credits is another possible source of income.

The European Bedminster system can deliver the highest quality of compost from a mixed waste stream. This has been achieved by careful attention to screening and cleaning of the composting material and by a highly sophisticated in-house quality control process that guarantees the quality of each batch of compost produced. OrganaGro, the Bedminster compost, will meet or exceed the quality requirements of the most stringent of proposed European standards, making it suitable for unrestricted use.

The analysis of section 3.3 shows that the introduction of two 150,000tpa Bedminster facilities will enable the Capital Waste Authority to achieve their recycling targets of 25% by 2005. After expansion of each of the facilities to 200,000tpa the Capital Waste Authority recycling rate would be approximately 39% with approximately 106,000 tonnes of BMSW landfilled.

To deliver the Waste Strategy 2000 and Landfill Directive targets to 2020 would require the introduction of a source separated kerbside collection scheme or further Bedminster facilities. With the introduction of a kerbside scheme and a resultant reduction in waste increase to 1.5% per annum, such a scenario could deliver a Capital Waste Authority recycling rate of 48% and meet the Landfill Directive targets to 2027.

The figures presented in this budget proposal will need further confirmation by conducting a Feasibility Study.

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1 Introduction

This budget proposal is for two Bedminster in-vessel co-composting facilities for the Capital Waste Authority. The two facilities would be phased to come on stream at 150ktpa in 2005 and the expanded to 200ktpa by 2010.

Each facility would have an initial capacity of 450 tonnes per day, expandable up to 600 tonnes per day of solid waste (post-consumer mixed MSW, commercial/industrial waste, garden waste and food waste) and 225 - 300tpd of sewage sludge. . Each facility would process 7 days per week with deliveries 6 days per week. Allowing for 32 days maintenance per year, each plant would provide an annual capacity of 150,000 – 200,000 tonnes per annum

The Bedminster system is a two barrier composting process making it fully compliant with the proposed Animal By-Products (Amendment) (England) Order for the composting of food waste and post-consumer green waste. The Bedminster process is also compliant with the EU ABP Regulations 1774/2002 for the treatment of all Category 3 ABP waste provided that it is shredded to 12mm. The facilities would be operated under Hazard Analysis Critical Control Point (HACCP) controls to ensure production of a safe compost which would exceed the quality required by PAS100 and EU Class-1 compost quality standards, suitable for unrestricted use.

The major advantage of the Bedminster system is one of delivering a guaranteed high quality compost from post-consumer waste streams. Post-consumer waste streams are notoriously contaminated with contraries due to segregation errors and/or deliberate dumping of mixed waste into containers intended for segregated wastes. For this reason Bedminster always recommends the inclusion of its full range of separation and screening equipment to ensure a safe and reliable quality of compost to the consumer at all times. In-house quality control with monitoring for physical and chemical contaminants will be implemented for every production batch of compost. The resultant compost will normally be certified to the proposed EU Class-1 or PAS100 quality standard.

The proposed systems would be equally suited to running alongside other recycling systems to compost segregated organic wastes but could also be used to handle the residual mixed waste stream from non-participating households. The proposed systems utilise a maximum of four 150tpd Eweson digesters and four separate maturation streams within the Aeration Hall. This would allow the processing of three separated streams of waste, e.g. source separated green waste, residual waste from non-participating households within source-separated recycling schemes, ABP/Catering wastes, contaminated biowastes intended for final disposal. This would help to maximise recycling and landfill diversion rates across the Capital Waste Authority and thereby help to ensure that all Landfill Directive and recycling targets are met up to the year 2020 and beyond. Refer to section 3.3 for a full discussion of various different scenarios. In all cases a separate collection of hazardous household waste should be implemented on a monthly or 6 weekly basis as required.

2 The Sustainable Solution to Residual Waste

2.1 Bedminster Background

Bedminster AB is a Swedish company that was originally established in 1993 (as Rondeco) to produce high quality organic fertilizer pellets for the forestry industry in Sweden. The Bedminster process allows virtually all the organic fraction of mixed solid waste streams to be extracted and composted together with other high nitrogen sources such as sewage sludge, if available. The latest proposals from the European Commission have proposed stringent quality requirements for compost to ensure protection of the environment. The Bedminster facilities use a highly sophisticated process of screening and cleaning to ensure that the latest proposed EU quality standards and PAS100 standards can be achieved. Their in-house quality control systems ensure that all compost produced by their plants is of a guaranteed high quality.

2.2 The Bedminster process

The Bedminster process is one of integrated recycling and composting. It is differentiated from Mechanical Biological Treatment by not shredding the waste stream and by producing a high quality compost suitable for unrestricted use.

The process consists of a rapid in-vessel composting phase, lasting 3 days, followed by a slower maturation phase of up to 12 weeks during which time the rough compost is cured in windrows housed within a temperature and humidity controlled Aeration Hall. Once mature, the compost is finally screened to remove any glass and other fine physical contaminants.

The whole composting process is enclosed within buildings maintained under negative air pressure. All process air is extracted from the buildings and processed through enclosed biofilters where the volatile compounds are converted to water and carbon dioxide. After passing through the biofilters the cleaned process air is vented to atmosphere.

The design of the facility provides two barriers through which all of the material has to pass. The first barrier comprises the Loading Hall, Eweson Digesters and Separation Hall. The second barrier is the Aeration Hall. The material attains a temperature of greater than 60°C for longer than 2 days in the Eweson Digester and greater than 60°C for more than 8 days (with three turnings) in the windrows within the enclosed Aeration Hall. The process thereby complies with all of the proposed DEFRA safety requirements for the composting of food, green waste and MSW.

The mixed waste will be delivered into the Tipping Hall directly from standard 9-11 tonne capacity compacting refuse collection vehicles. Any oversize items will be manually removed on the tipping floor. Large pieces of wood will be removed and processed through the shredder and returned to the tipping floor before the waste is moved into the pits, onto the conveyor system and through to the bag splitter. The bag splitter will ensure that any plastic bags are opened and their contents released onto the conveyor belt. The waste will then pass through a system of electromagnetic and eddy-current separators to remove ferrous metals and aluminium. Once most of the metals have been removed the waste will be loaded into the Eweson Digesters (composting drums). At this point other high nitrogenous wastes like sewage sludge could be added to improve the nutrient quality and reduce the maturation period of the final OrganaGro compost.

The in-vessel process is a batch process with each rotating composting drum holding 150 tonnes of waste in each of its three compartments. The composting material will be transferred in batches from one compartment to the next at the end of each 24 hour period. During its three days in the drum the composting material will attain a temperature of greater than 60°C for longer than 48 hours thereby sanitising the waste and complying with the DEFRA requirements for Barrier 1 of an in-vessel composting system for catering waste.

After three days in the composting drum all organic material will be broken down into a rough compost. The organic fraction of tetra-packs, telephone directories, even cardboard and garden waste will be converted into a rough compost from which the remaining inorganic fractions will be removed by trommel screen, magnetic separator and de-stoner. The screened rough compost will then be matured in 2.5m high windrows within the temperature and humidity controlled Aeration Hall.

The maturing compost will be systematically turned as it gradually progresses along the length of the Aeration Hall. Its temperature and humidity will be carefully controlled by forcing air up through the windrows from the aeration floor. A minimum temperature of 60°C will be maintained for a period of longer than 8 days to ensure further pathogen reduction and to comply with DEFRA second barrier requirements for the composting of catering waste. Careful measurements of compost parameters will determine when the compost is sufficiently mature and suitable for use. This will take between 3 – 12 weeks dependent on many factors including: the composted waste stream; the carbon:nitrogen ratio; the lignin content of the maturing material; the temperature within the Aeration Hall; and the intended end use for the compost. During the summer months maturation will typically be achieved earlier than during winter months.

The whole maturation process will be contained within an enclosed Aeration Hall that will be maintained under negative air pressure to prevent the escape of process odours. All process air will be treated through biofilters to remove any process odours before release to the atmosphere.

A typical Bedminster process schematic is shown in Figure 1.

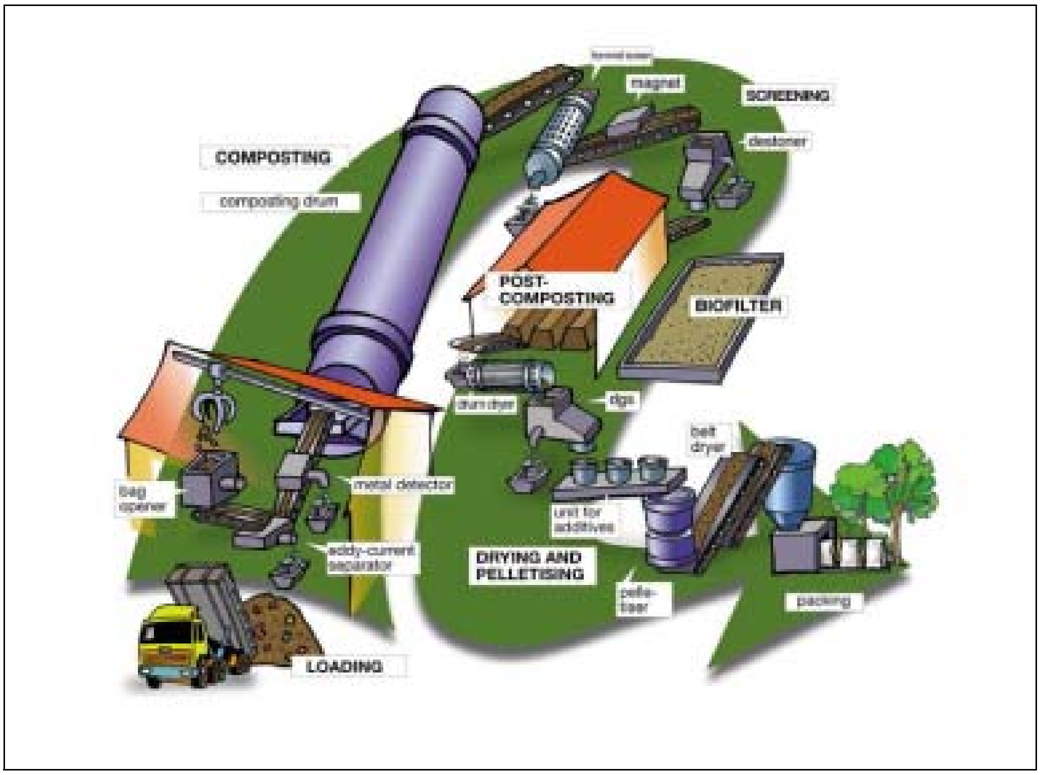


Figure 1: Schematic of Bedminster Process

The whole production process would be quality controlled by the Bedminster in-house quality control system, as shown in Figure 2. Such close quality control will enable each production batch of compost to be analysed before despatch. The resultant compost will be of the highest grade suitable for unrestricted use. Bedminster European facilities will be operated under an ISO14001 or EMAS compliant environmental management system.

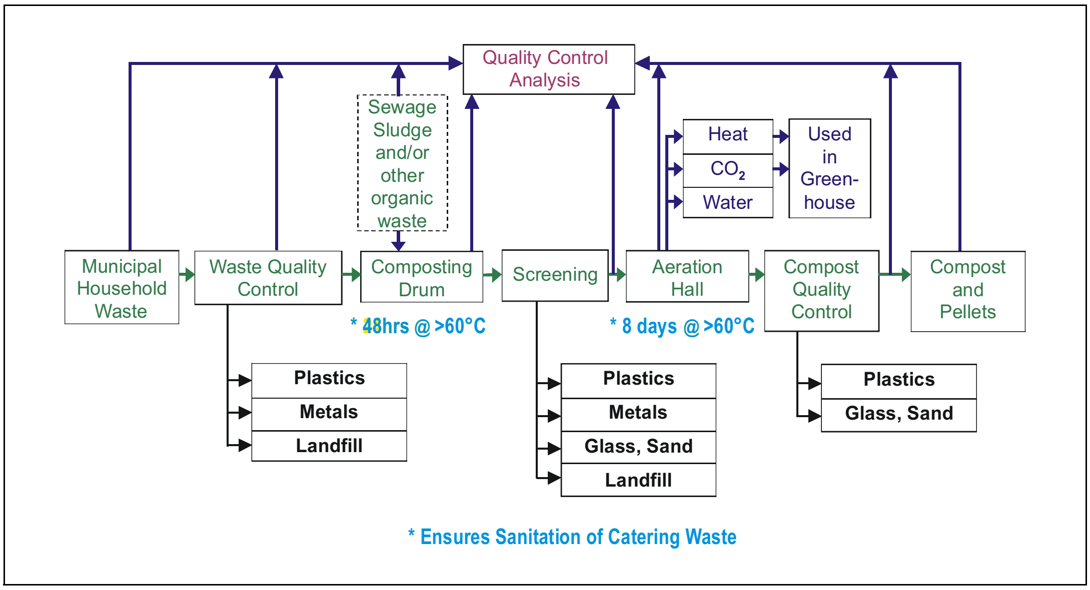


Figure 2: Bedminster In-House Quality Control

2.3 The OrganaGro high quality compost

Currently there are no statutory standards for compost in the UK. Recently the Composting Association, WRAP and the British Standards Institute have issued the PAS100 standard and the European Commission has brought out *proposed* statutory standards. These standards are summarized in Table 1 and compared to Bedminster OrganaGro made from mixed municipal solid waste.

The Bedminster compost, OrganaGro, will be of the highest grade and will generally comply with the latest EU proposals for Class-1 compost and PAS100 quality standards, suitable for unrestricted use. However, it should be noted that the PAS100 standard does not apply to compost made from mixed MSW, the PAS100 quality standard is used here as a benchmark.

OrganaGro is a high quality organic material that can be sold either as a loose compost or as a high grade pelletised fertilizer. The pellets are suitable for a range of applications including container plants, gardening, horticulture and agriculture. The loose compost is suitable as a top dressing for grass, sports pitches, golf courses and for hydro-seeding. Many trials have proven the benefit of OrganaGro. The most recent of such trials, using OrganaGro compost as a top dressing for sports pitches, was conducted by the Sports Turf Research Institute at Bingley, Yorkshire.

Table 1 shows that even when composting a mixed MSW waste stream it is possible to achieve compost of the highest quality standards. With the proposed waste stream of section 8.1.1 the heavy metal content of the compost should typically be much lower than shown in Table 1. The proposed facility will have three Eweson digesters and four separate maturation streams within the Aeration Hall. Infrastructure would be included to allow a fourth digester to be added at a later date. This would allow the processing of up to four separated streams of waste, for example:

1. source separated green waste;
2. residual waste from non-participating households within source-separated recycling schemes;
3. ABP/Catering wastes;
4. contaminated biowastes prior to final disposal.

It would therefore be possible to compost segregated green and food waste in one process stream and residual mixed MSW in the remainder. This would allow the facility to start processing mostly residual waste and gradually switch over to source separated organic waste as public participation rates increased. This would allow production of the highest possible quality of compost whilst guaranteeing to simultaneously meet all of the Capital Waste Authority recycling targets and EU Landfill Directive targets, independent of public participation rates.

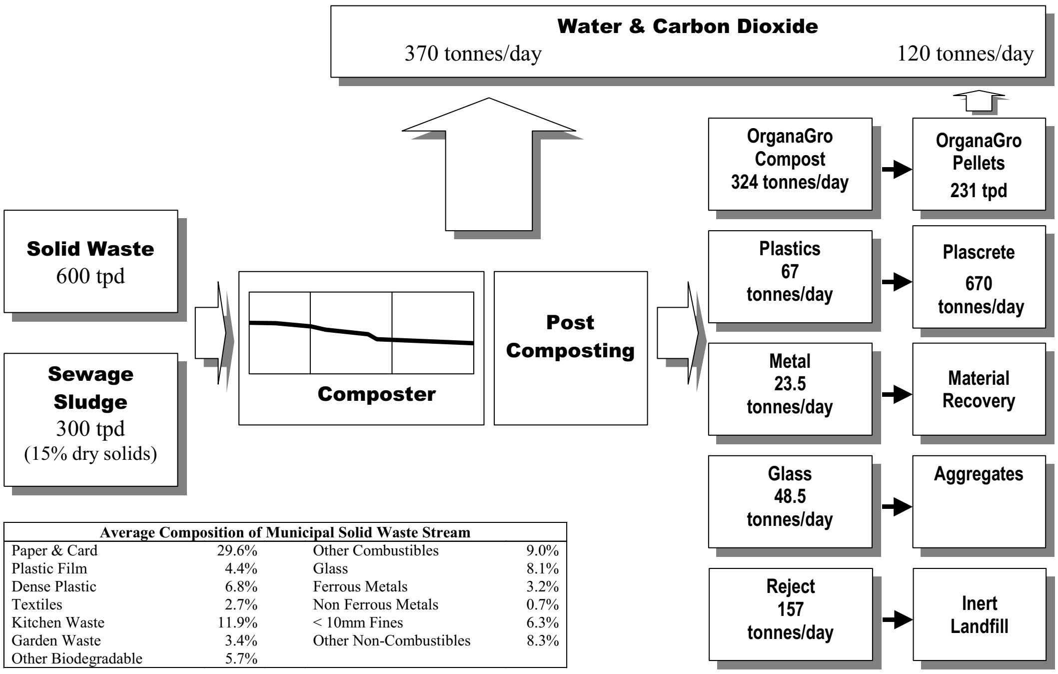
Substance	Bedminster OrganaGro	Proposed EU Limits		PAS100
		Class-1	Class-2	
Potentially Toxic Elements (mg/kg dm)				
Cadmium Cd	0.37	0.7	1.5	1.5
Chromium Cr	11.5	100	150	100
Copper Cu	90	100	150	200
Mercury Hg	0.31	0.5	1	1
Nickel Ni	7	50	75	50
Lead Pb	11	100	150	200
Zinc Zn	157	200	400	400
Polychlorinated Biphenols PCBs		-	-	-
Polycyclic Aromatic Hydrocarbons PAHs		-	-	-
Human Pathogens:				
Salmonella spp	Absent not detectable	Absent in 50g		Absent in 25 g
E.Coli	Absent	-	-	1000 CFU g^{-1}
Physical Contaminants:				
Impurities > 2mm	< 0.5% total contaminants	<0.5%	<0.5%	<0.5%% (plastic <0.25%)
Gravel and Stones >5mm		<5%	<5%	<7%
Weed Contaminants:				
Weed propagules	<1 viable/l	<3 germinating weed seeds per litre		5 viable/litre
Phytotoxins:				
Plant tolerance		N/A	N/A	20% below control
Sanitation temp-time regime	>= 70C for 18 hours >55C for 1 week >45C for 3-4 weeks	>60C for 1 week		>55C for 3 days
Inspection Requirements:				
	Continuous 1per 100m^3	12 per annum		1 per 2000m^3
All limits normalised to 30% organic content				

Table 1: Comparison of Bedminster compost with proposed standards

3 Process Mass Balance & Overall Recycling Rates

3.1 Bedminster Facility Recycling Rates

To determine an accurate mass balance for the Bedminster facility requires knowledge of the ingoing waste streams to be processed. For the purposes of this proposal a typical UK urban MSW stream has been assumed as detailed in section 8.1.1. With such a waste stream the recycling/composting/landfill diversion rate would be approximately 63%. The projected Mass Balance for the proposed Bedminster facility is shown in Figure 3.



Average Composition of Municipal Solid Waste Stream			
Paper & Card	29.6%	Other Combustibles	9.0%
Plastic Film	4.4%	Glass	8.1%
Dense Plastic	6.8%	Ferrous Metals	3.2%
Textiles	2.7%	Non Ferrous Metals	0.7%
Kitchen Waste	11.9%	< 10mm Fines	6.3%
Garden Waste	3.4%	Other Non-Combustibles	8.3%
Other Biodegradable	5.7%		

Note: In this diagram the sum of the masses input and output will not equate as water has to be added to the system and carbon is converted to carbon dioxide (3.7 times heavier) during composting.

Figure 3: Theoretical Mass Balance Obtainable from MSW

3.2 Statutory Recycling and Landfill Diversion Rates

The Capital Waste Authority is required to achieve a 25% recycling rate by 2005/6. In addition the Landfill Directive will require a reduction in landfilling of biodegradable municipal solid waste (BMSW). The resultant combined targets for the Capital Waste Authority are shown below:

- 2005/6: 25% materials recycling rate;
- 2010: 218,071 tonnes total BMSW to landfill
- 2013: 145,380 tonnes total BMSW to landfill
- 2020: 101,766 tonnes total BMSW to landfill

The Bedminster system offers guaranteed recycling and diversion rates that are not dependent upon voluntary source separation. Furthermore, the high degree of process and quality control produces a consistently high quality of compost that is not dependent upon the accuracy of source separation.

SES always recommends that a separate collection is introduced for hazardous household waste, this need only be collected once every 4-6 weeks due to the small quantities involved and the nature of the waste.

3.3 Predicted Capital Waste Recycling Rates

SES Ltd. has developed the FutureWaste-2G model to predict future waste management performance. The predictions are based on current waste data, current waste disposal charges, landfill tax charges, RPI inflation rate and predicted increase in waste arisings over a 25 year period. The model accommodates CA/Bring sites, source separated kerbside collections, mixed (black bag) collections, open air windrowing and in-vessel composting. The model allows the output materials to be assigned to recycling, open air or in-vessel composting, incineration and/or landfill. Additionally revenue streams or costs can be assigned to the output materials.

3.3.1 Waste Composition Data Input to Model

As there is no waste composition data currently available for the Capital Waste Authority, the composition of MSW arisings from a typical UK urban area has been used as a substitute. The resultant waste composition data input to the FutureWaste-2G model is as presented in section 8.1.1

The FutureWaste-2G model predicts future recycling/composting rates, landfill diversion of biodegradables, and costs. For comparison, the model has been run for three different scenarios using the same typical UK urban MSW data of section 8.1.1. The results are presented in sections 3.3.2 , 3.3.3 and 3.3.4.

3.3.2 Capital Waste Authority – Status Quo Scenario:

This scenario is based on the data presented in the City Solutions Scenario. It has been assumed that the current quoted level of recycling is all material collected and recycled by CA/Bring sites. This scenario has been used to match the capacities of the various waste management routes to that presented in the Total Capital Waste Authority section of the Disposal/Recycling Routes table.

Base Year	2003
Household MSW:	605,000 tpa (including solid commercial MSW)
Solid commercial MSW:	70,000 tpa
Street Sweepings etc:	70,000 tpa landfilled (of which 50% biodegradable)
Total MSW Collected:	**675,000 tonnes per annum (including CA/Bring sites)**
CA/Bring Sites:	121,600 tpa collected (of which 46,000tpa recycled)
Incineration	120,000 tpa
Bedminster Composting	0 tpa
Increase in waste arisings:	2.5% year on year
Households Covered:	100%
Particpation Rate:	100%
Materials collected:	All MSW

Figure 4 shows that Futurewaste-2G confirms the current Capital Waste Authority recycling rate to be 7.5% including metals recycled from the incinerator. However, to maintain the status quo requires all waste disposal methods to have sufficient capacity to allow their continued use in the same proportions. With the predicted 64% increase in waste arising (see Figure 5), incineration would have to rise to 196,000 tonnes per year.

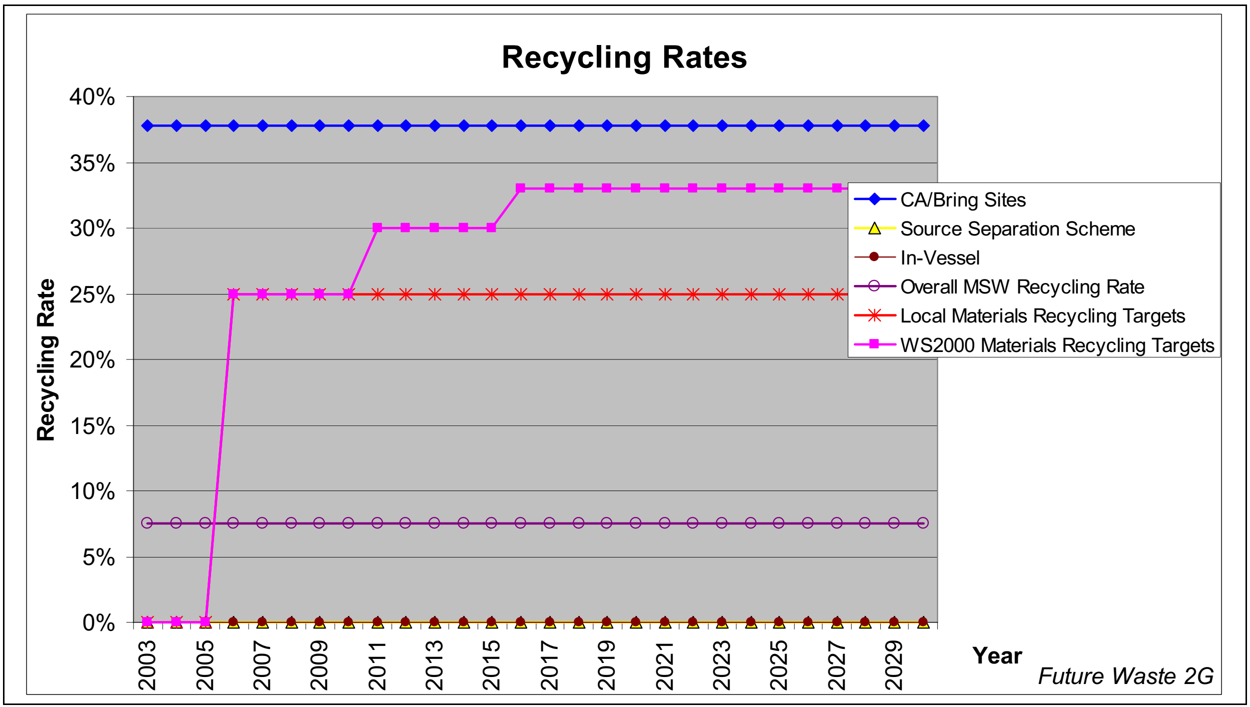


Figure 4: Capital Waste Authority - Status Quo

Figure 5 shows that FutureWaste-2G calculates the current likely amount of landfilled biowaste to be 283,000 tonnes. Figure 5 shows that if the current waste management options are not changed and waste arisings continue to increase at 2.5% per annum then there would be 336,000 tonnes of BMSW landfilled in 2010. This would exceed the Landfill Directive target by 118,000 tonnes per annum. The 2013 limit would be exceeded by 217,000 tonnes per annum and the 2020 limit exceeded by 329,000 tonnes per annum.

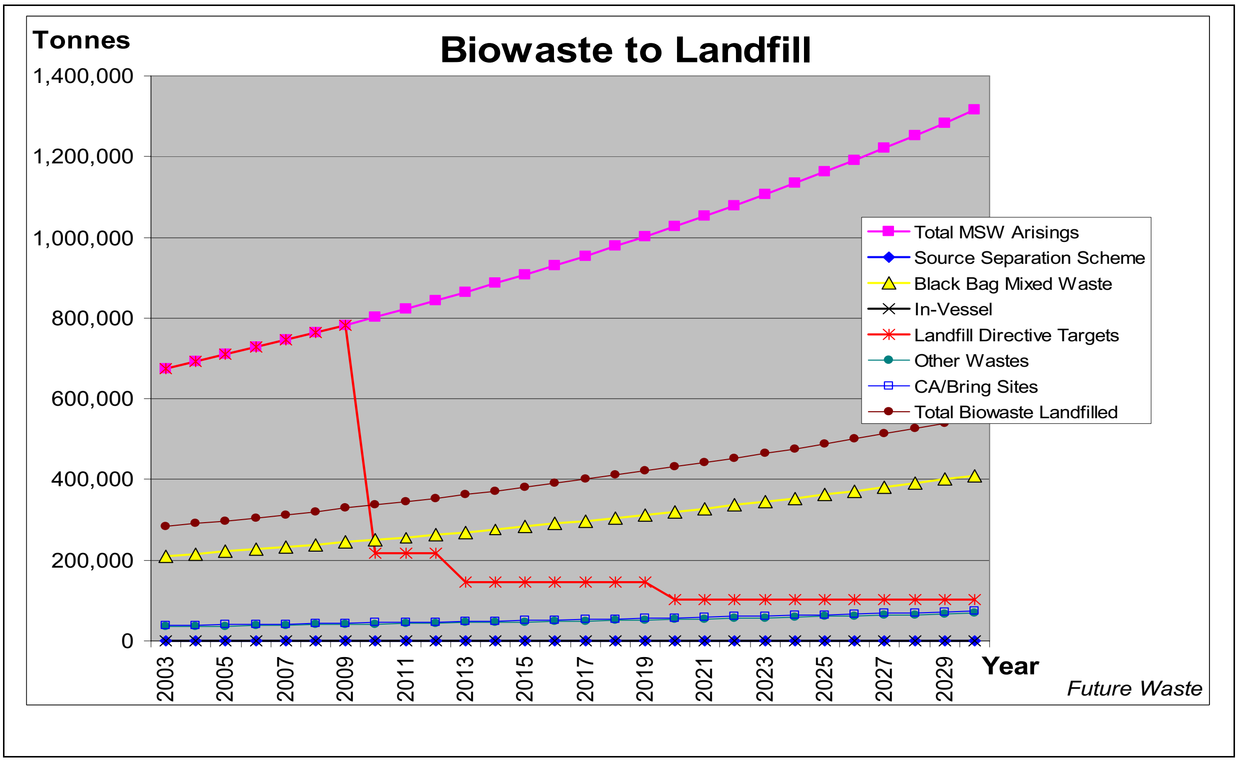


Figure 5: Capital Waste Authority – Status Quo

3.3.3 Capital Waste Authority – Bedminster 2 Scenario:

This scenario assumes that two Bedminster facilities of 150,000 tonnes per annum capacity are constructed and brought on stream by 2005. Each facility would then be expanded to 200,000 tonnes per annum ready for 2010. Initially 300,000 tonnes per annum of black bag/residual waste would be sent for composting. This would then be increased to 400,000 tonnes per annum in 2010. This scenario also assumes that the total amount of waste sent for incineration remains fixed at the 2003 level of 120,000 tonnes per annum.

Base Year	2003
Household MSW:	605,000 tpa (including solid commercial MSW)
Solid commercial MSW:	70,000 tpa
Street Sweepings etc:	70,000 tpa landfilled (of which 50% biodegradable)
Total MSW Collected:	**675,000 tonnes per annum (including CA/Bring sites)**
CA/Bring Sites:	121,600 tpa collected (of which 46,000tpa recycled)
Bedminster Capacity	200,000 tpa (157,000 tpa composted in 2005)
Increase in waste arisings:	2.5% year on year
Households Covered:	
Particpation Rate:	
Materials collected:	All MSW

Figure 6 shows that Bedminster 2 (300,000tpa) scenario will probably deliver an overall recycling rate of 33% in 2005. However, due to the Bedminster facilities running at maximum capacity, the Capital Waste Authority overall recycling rate decreases to 30% by 2010, due to increased waste arisings. To achieve the Waste Strategy 2000 targets for 2010 and beyound would require each Bedminster facility expanding to its maximum capacity of 200,000tpa as shown in Figure 7.

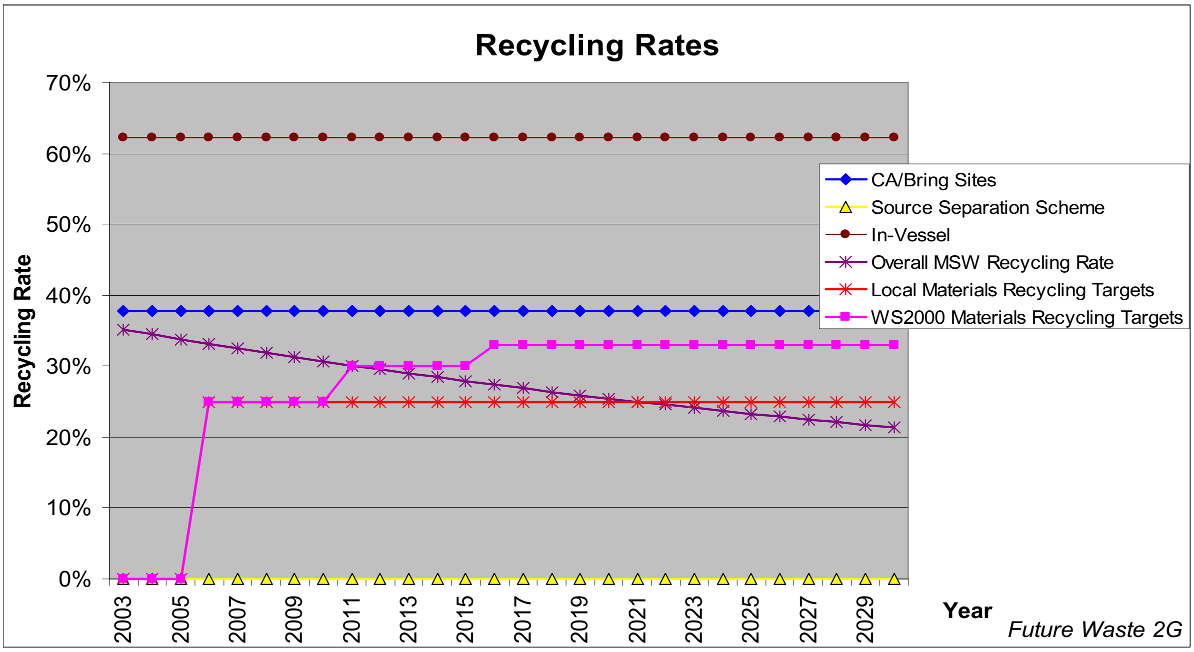


Figure 6: Capital Waste Authority – Bedminster 2 (300,000tpa)

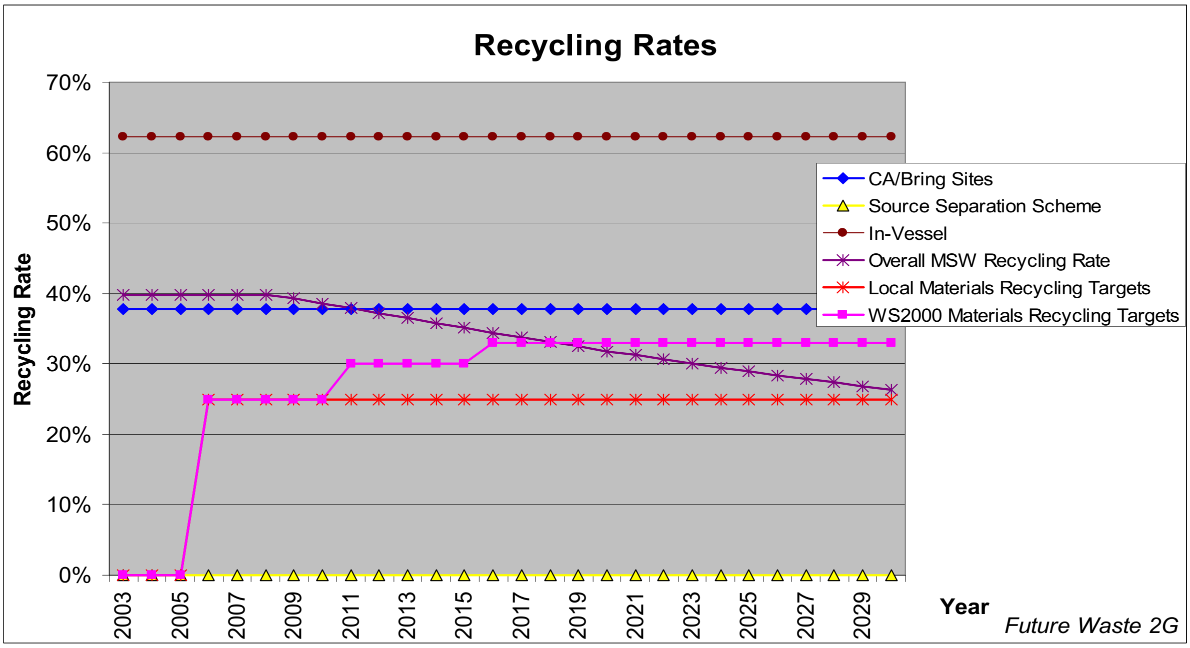


Figure 7: Capital Waste Authority – Bedminster 2 (400,000tpa)

Figure 8 shows that the predicted amount of landfilled BMSW from the Bedminster 2 (300,000tpa) scenario is likely to exceed the Landfill Directive targets for 2010. To further reduce the amount of landfilled BMSW to achieve the 2010 and 2013 targets would require each Bedminster facility expanding to its maximum capacity of 200,000 tpa and the amount of waste incinerated increased to 200,000tpa as shown in Figure 9

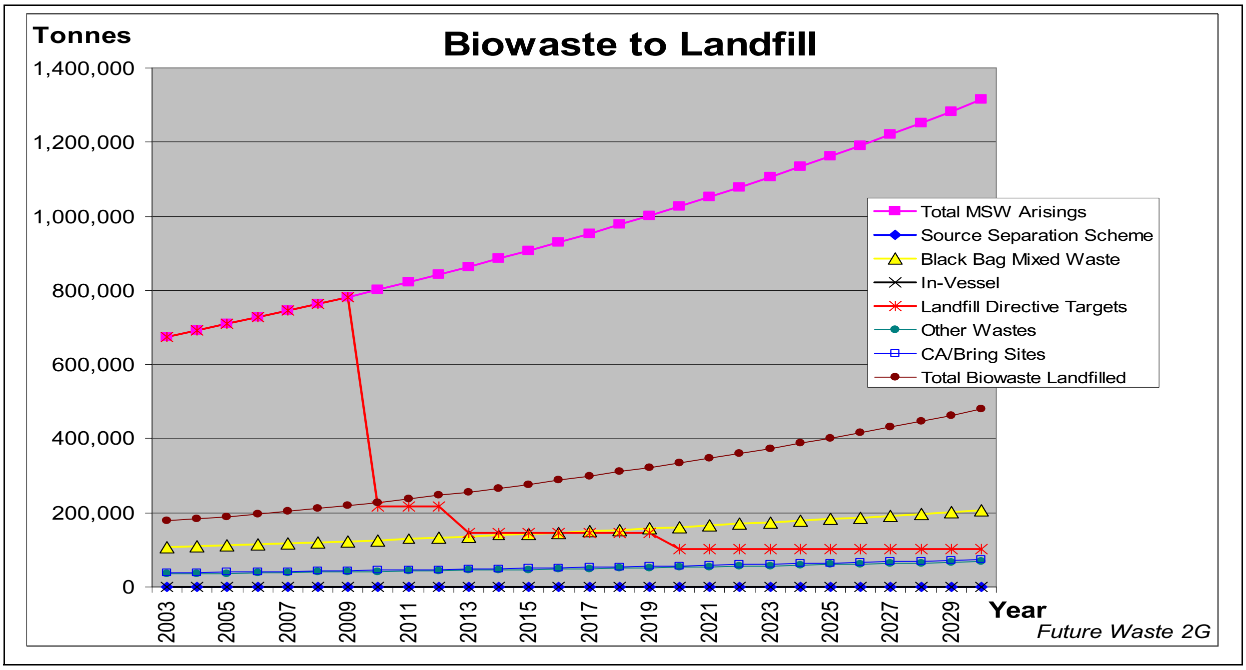


Figure 8: Capital Waste Authority – Bedminster 2 (300,000tpa)

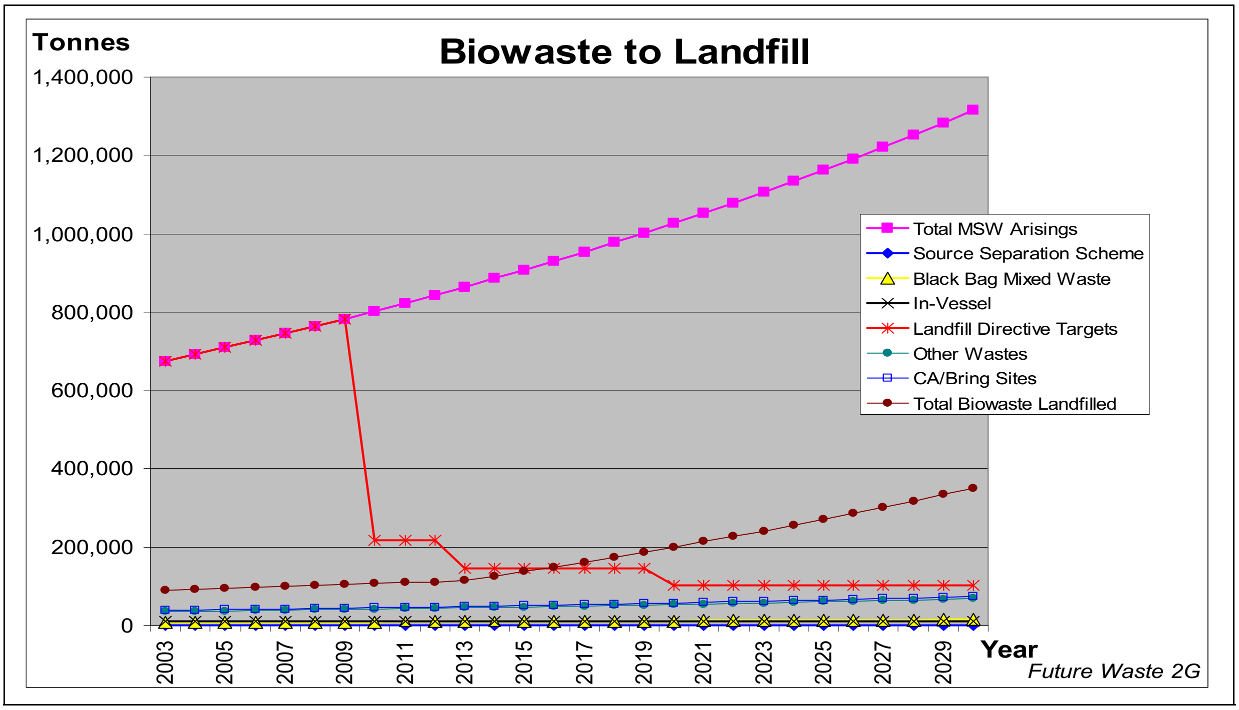


Figure 9:Capital Waste Authority – Bedminster 2 (400,000tpa)

Figure 7 shows that the Bedminster 2 (400,000tpa) scenario is likely to deliver the Waste Strategy 2000 targets for 2010 but that it is unlikely to deliver the targets for 2015. To further increase the recycling rate for 2015 would either require a third 200,000 tpa Bedminster facility or the introduction of source separated kerbside collections.

Figure 9 predicts that the Bedminster 2 (400,000tpa) scenario should just deliver the Landfill Directive targets for 2013 but that by 2015 the targets are likely to be breached due to the continued increase in the waste arisings from the Capital Waste Authority.

It is interesting to note that the 400,000tpa of waste that would be sent to the Bedminster facilities would be approximately 50% of the overall MSW in 2010. This would therefore leave scope for a source separated kerbside collection scheme to complement the Bedminster systems and to help to educate the Capital Waste Authority residents and thereby help to reduce the rise in waste arisings. This possibility is investigated in the Bedminster Residuals scenario of section 3.3.4.

3.3.4 Capital Waste Authority - Bedminster Residuals Scenario:

This scenario assumes that a multi-materials source separated kerbside collection scheme is implemented across the 62% of low-rise households within the Capital Waste Authority. It is further assumed that 50% of the residents covered by the scheme actually participate in the scheme by separating 90% of each material collected. This is to be complimented by a total of 400,000 tonnes per annum of Bedminster capacity by 2010 and a maximum of 200,000tpa of incineration.

Base Year	2003
Household MSW:	605,000 tpa (including solid commercial MSW)
Solid commercial MSW:	70,000 tpa
Street Sweepings etc:	70,000 tpa landfilled (of which 50% biodegradable)
Total MSW Collected:	**675,000 tonnes per annum (including CA/Bring sites)**
CA/Bring Sites:	121,600 tpa collected (of which 46,000tpa recycled)
Bedminster Composting	300,000 tpa rising to max. 400,000 tpa by 2015
Incineration	120,000 tpa rising to max. 200,000 tpa by 2018
Increase in waste arisings:	2.5% year on year
Households Covered:	62% source separation scheme
Particpation Rate:	50% (with 90% of materials recovered from each)
Materials collected:	Garden Waste, paper, cardboard, textiles, ferrous, non-ferrous, glass, plastic bottles (kitchen waste collected as black bag waste due to ABPO).

Figure 10 shows that Futurewaste-2G predicts the probable overall recycling rate to be 45% up to 2014. By 2015 the Bedminster facilities will have reached full capacity with a corresponding decrease in recycling rate as the Capital Waste Authority arisings continue to increase. This scenario would still deliver 41% recycling rate by 2015, thereby comfortably delivering the Waste Strategy 2000 targets of 33%.

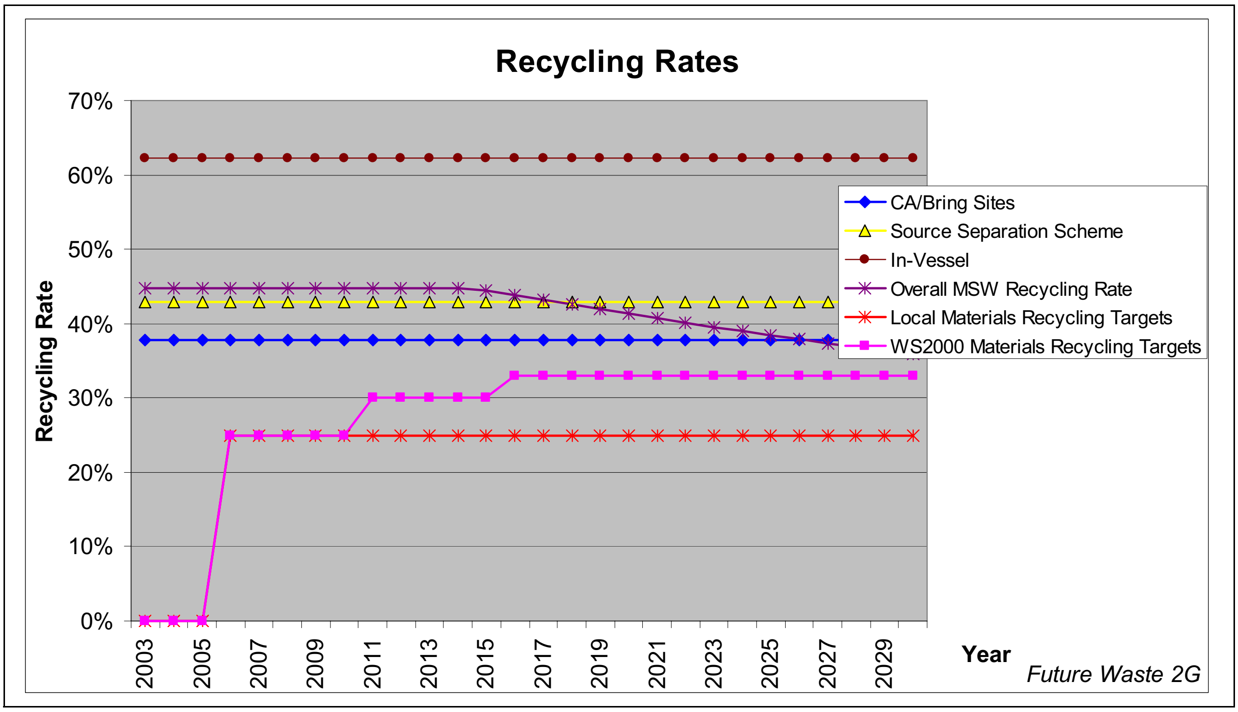


Figure 10: Capital Waste Authority – Bedminster Residuals

Figure 11 shows that the Bedminster Residuals scenario is likely to deliver the Landfill Directive targets up to 2019 but that even this scenario fails to achieve the 2020 targets with a continued 2.5% year on year growth in waste.

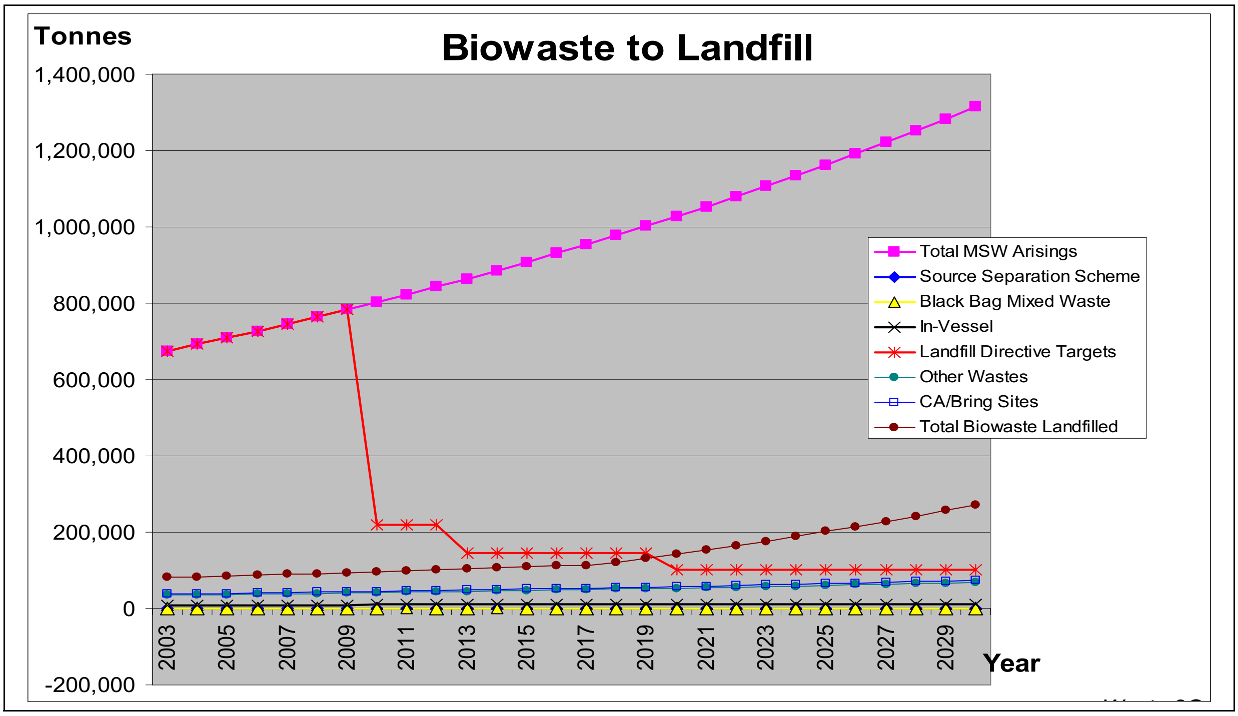


Figure 11: Capital Waste Authority – Bedminster Residuals

Should the increase in waste arisings remain at 2.5% per annum then extra capacity would be required by 2020 for composting (or incinerating) of the biowaste arisings from CA/Bring Sites and other MSW arisings such as street sweepings, litter and park waste. However, if the introduction of a source separation scheme managed to slow the growth in waste to 1.5% per annum then this scenario would deliver the Landfill Directive targets up to 2027 together with an overall recycling rate of 48%.

4 Project Proposal

The proposal is for two identical Bedminster facilities with a maximum capacity of 600 tonnes per day. Each of these would be constructed to provide an initial capacity of 450 tonnes per day by 2005 but with infrastructure to enable easy expansion to 600 tonnes per day by 2010. The proposed facilities are shown in Appendix A. The total land area required for each facility, including site access roads is 5.4 hectares. It is anticipated that such sites would only be available on the outskirts of London within the M25 or possibly further afield if river transport was used. The highest part of the construction would be 18m above datum. It must be noted that the exact size of the Maturation Hall can only be determined once a waste audit has been conducted to establish the various biodegradable fractions of the waste stream. The facility presented in drawing G5347/2 has been based on an average UK MSW stream. Prior to placement of construction contracts Bedminster would undertake a detailed Feasibility Study that would include an investigation into waste quantity, quality and markets for compost of various stages of maturity.

4.1 Loading Hall

The Loading Hall will measure approximately 58m x 55m by 13.5m maximum height. It will be constructed with lower walls of concrete (2m) and cladding to upper walls and roof. The Loading Hall will contain the Tipping Floor, Feed Pits and shredder. During normal weekday operation, waste would be tipped onto the floor in front of the Feed Pits. Any oversize items will be manually removed prior to the waste being loaded into the pits by front-end loader. Towards the end of the week, waste will be stockpiled in the 625m^2 Waste Storage Area to allow continuous processing over the weekend when there are no deliveries. The storage area would have sufficient capacity for 1 day's waste therefore the facility would require deliveries over 6 days per week.

The Loading Hall will also house the shredder for large woody items and the bag splitter and metal separators. A Sludge Pit will also be provided to accept deliveries of dewatered sludge or other semi-wet nitrogenous waste materials. Material will be fed from the Sludge Pit directly to the Eweson Digesters via screw augers.

The Loading Hall will be maintained under negative air pressure with air curtains used at the delivery entrances which will be provided with automatic roller shutter doors.

4.2 Eweson Digesters

Initially three Eweson Digesters (rotating composting drums) would be provided, each of which would be 6.3m in diameter and 84m in length. Each digester would have a nominal capacity of 150 tpd of solid waste and 75tpd of sewage sludge and a maximum usable capacity of just over 200tpd solid waste and 75d of sewage sludge for short periods.

The Eweson Digesters use patented technology to ensure that all of the processed material is constantly turned and aerated to ensure total waste sanitation. Each digester will be turned at a rate of approximately 1 rpm by hydraulic motors.

The patented Eweson Digester contains three separate compartments with the waste material being retained for 1 day in each section. A time temperature regime of 48 hours at >60°C and 18 hours at > 70°C will be achieved with the correct C:N ratio.

4.3 Separation Hall

The Separation Hall will measure approximately 12m x 69m by 12.5m maximum height. It will be constructed with cladding to walls and roof.

After 3 days in the digesters the rough compost is automatically unloaded onto a conveyor in the Separation Hall. The rough compost is screened through a trommel screen and destoner to remove unwanted inorganic materials and any large woody pieces. Pieces of wood will be returned to the Loading Hall for shredding and re-composting. Inorganic materials will be collected in a RORO skip ready for further recycling or disposal. The cleaned rough compost will then be transferred to the Aeration Hall by covered conveyor.

4.4 Aeration Hall

The Aeration Hall will measure approximately 140m x 115m by 15m maximum height. It will be constructed with concrete walls topped with a cladding roof. The Aeration Hall will house four computer controlled cranes which will be responsible for all normal compost movements within the Aeration Hall. A small skid-steer loader will be used for maintenance and periodic cleaning of the aeration floor.

To produce fully mature compost it is necessary to process the compost for between 6 – 12 weeks. This is dependent upon many factors including the carbon:nitrogen ratio and the lignin content of the composting material. Shorter maturation periods can be used to produce less mature compost that would be ideal for many applications such as agriculture, landscaping, soil blending and land remediation. However, immature compost can have a strong smell and could not be sold directly to the consumer for garden or container use.

The proposed Aeration Hall will be capable of producing fully mature compost (very little smell) from 200,000 tpa of typical mixed MSW when it is composted with 100,000tpa of sewage sludge.

The temperature, moisture content, and carbon dioxide levels of the composting material will be monitored and adjusted to obtain optimum maturation. Air will be circulated through the windrows by forcing air from the Fan Arrays up through the aeration floor into the base of the windrows. In addition the material will be turned on a frequent basis by the computer controlled overhead cranes. This will ensure that aerobic conditions are maintained within the windrows.

Once the compost is sufficiently mature it will be transported by crane to the end of the Aeration Hall and loaded onto a conveyor that will transport it to the Pelletising (optional), Bagging and Storage Area.

Leachate from the maturing compost will be collected under the aeration floors, filtered and re-circulated within the Aeration Hall to maintain moisture levels. The composting process consumes water therefore there will be no process effluent for disposal.

The Aeration Hall will be maintained under negative air pressure to ensure that non of the process odours can escape. All process air will be treated by the enclosed biofilters prior to release to atmosphere.

4.5 Drying, Bagging and Storage Area

The Drying, Bagging and Storage area will measure approximately 103m x 26m by 12.5m maximum height. It will be constructed with cladding to walls and roof.

Once the compost has matured sufficiently it will be further screened by the Dry Gravity Separator to remove all shards of glass, large grit and most plastics. After final screening the loose compost will either be bagged in $1m^3$ Big Bags or stockpiled ready for bulk transportation.

Loose compost will be loaded onto bulkers by front-end loader. Big Bags will be loaded onto curtain-sided flatbed trucks by forklift.

Optionally the loose compost could be pelletised if required.

4.6 Biofilter

Each enclosed biofilter will measure approximately 25m x 140m by 4m maximum height.

All process air will be extracted from the Loading Hall, Eweson Digesters, Separation Hall and Aeration Hall and piped to the biofilter. The biofilter will capture and convert the volatile compounds and bioaerosols liberated by the composting process. The microbes within the biofilter will convert the captured substances to carbon dioxide and water.

5 Other Bedminster Information

5.1 Carbon Capture

The Bedminster composting process enables virtually all of the organic material present in the waste stream to be recycled back to the land. This completes the Organic Ecocycle which forms an important part of the Carbon Cycle.

At present there is an excess of approximately 3,300 million tonnes of carbon being added to the atmosphere each year which cannot be recycled by the Earth through the carbon cycle. This is resulting in the build up of the atmospheric carbon dioxide levels that are helping to drive global climate change. The Bedminster system is a carbon negative process, a large fraction of the organic carbon within the waste stream is converted into compost which when applied regularly to the soil will increase soil organic content (SOC). This increase in SOC results in a decrease in atmospheric carbon. This carbon capture qualifies the Bedminster process for the generation of Carbon Credits which can result in an additional revenue stream. Work conducted by the US EPA[1] predicts an overall capture of 50kg of carbon (183kg of CO_2) for every wet tonne of organic material composted in a centralised facility.

5.2 Soil Conditioning

The high quality compost produced by the Bedminster process is a good soil conditioner as well as fertilizer. It can be used to replace peat as a growing medium and has many nutritional and fungicidal advantages over peat.

- Soils with high SOC levels are more productive, especially during drought conditions.
- Increased SOC levels prevent soil erosion during periods of heavy rainfall.
- The nitrogen within OrganaGro is released by the micro-organisms within the soil at a rate that is matched to plant uptake. This reduces eutrophication of ground waters caused by nitrate runoff.

5.3 EU Sixth Environment Action Programme

The global environment is rapidly changing as a result of human pressures. Two of the most serious threats that Europe faces over the next ten years is climate change and soil degradation. On the 22nd July 2002 the European Council finally adopted the Sixth Environment Action Programme of the European Community 2001-2010 entitled “Environment 2010: Our future, Our Choice”. This programme seeks to deliver a healthy environment essential for the long term prosperity and quality of life of the citizens in Europe and simultaneously deliver a high level of environmental protection.

[1] US Environmental Protection Agency. Solid Waste Management and Greenhouse Gases: A Life Cycle Assessment of Emissions and Sinks 2nd Edition. EPA530-R-02-006. May 2002. 65

To deliver a sustainable European environment the Sixth Environment Action Programme identifies four Priority Areas for action:

- Tackling Climate Change
- Nature and biodiversity – protection of soils against erosion
- Environment and Health – reduction of environmental pollutants
- Sustainable use of natural resources and management of wastes

Current UK waste management practices focus on landfill and incineration both of which destroy the valuable organic fraction of the waste stream and produce harmful greenhouse gases (GHG). If the biodegradable fraction of the UK waste stream is safely composted, substantial amounts of organic carbon will be available to increase the soil organic content (SOC) across the UK. Increasing SOC levels would help deliver all four Action Points of the EU Sixth Environment Action Programme.

5.4 Community Support for Bedminster

Major environmental groups like Friends of the Earth and Greenpeace recognise the advantage of using the Bedminster system to compost separately collected green and food waste and to compost residual mixed municipal waste from non-participating households. Many local communities, when faced with the threat of less sustainable waste management solutions, have expressed their preference for Bedminster technology.

6 The Company

Bedminster AB (publ) is a Swedish public company with headquarters at Torpangsvagen 2, SE-148 60, Stora Vika, Sweden. Bedminster AB is listed on the Nordic Growth Market NGM AB and has approximately 3,300 shareholders. The major shareholders include: Banco Teknik & Innovationsfond; CKE Investment Corporation; Catella Trygghetsfond; Industrifonden, Stiftelsen and Skandia Livoforsakringsaktiebolaget.

Bedminster AB wholly owns Bedminster Sweden AB (operators of Stora Vika), Bedminster Poland, Rondeco BBC AB and Bedminster Corporation Ltd.

Table 2 shows the locations of operational Bedminster facilities worldwide

Operational:	Solid Waste	Biosolids	Year
Big Sandy, Texas, USA:	20 tpd	10 tpd	1971
Pinetop-Lakeside, Arizona, USA:	10 tpd	5 tpd	1991
Sevierville, Tennessee, USA:	220 tpd	110 tpd	1992
Cobb County, Georgia, USA:	300 tpd	100 tpd	1997
Sumter County, Florida, USA:	50 tpd	25 tpd	1997
Marlborough, Massachusetts, USA:	100 tpd	50 tpd	1999
Nantucket, Massachusetts, USA:	50 tpd	25 tpd	1999
Edmonton, Alberta, Canada:	1,100 tpd	350 tpd	2000
Port Stephens, NSW, Australia:	100 tpd	50 tpd	1999
Stora Vika, Sweden:	70 tpd		2000
Saitama, Japan:	60 tpd		2001
Ongoing Projects:			
Cairns, Queensland, Australia	Perth, WA, Australia	Huelva, Spain	
Shijiazhuang, Hebei, China	Lima, Peru	Kallerup, Denmark	
Huiyang, Guangzhou, China			

Table 2: Locations of operational Bedminster facilities and projects worldwide

7 Environmental Impacts

7.1 Releases to Air

Major releases to air are carbon dioxide and water vapour from the composting process. All CO_2 released from the composting process is from biomass and therefore is carbon neutral.

The inorganic materials that will be recycled from the facility, 6400t of steel, 1400t of aluminium, 16000t of glass will save substantial amounts of CO_2 generation. The quantification of this effect would require a complete lifecycle analysis and is beyond the scope of this proposal.

The process will consume 24,000 MWh of electricity per annum which will be purchased from a renewable energy source through a supplier such as Green Energy (UK) plc. Budgetary figures have been obtained and included in the projected operational costs of the facility.

In addition to the above there will be emissions from two diesel powered front-end loaders within the facility. Each front-end loader will consume approximately 40,000 litres per year. However, as all of these releases will be internal, the emissions to atmosphere will be attenuated by passing through the biofilters. No data is currently available on the attenuation factor.

Releases to air will also include emissions from the transportation of waste to the facilities. Two smaller 600tpd facilities have been proposed, rather than one 1200tpd facility, to reduce the number of 'waste miles' and thereby minimize emissions from transportation. To further reduce the impacts of transportation use should be made of the River Thames if accessible.

7.2 Releases to Land

Releases to land are predicted to be:

- 22,500 tpa plastic waste
- 5,400 tpa textiles
- 24,000 tpa Other combustibles
- 23,000 tpa Other non-combustibles.

Each of the above will require landfilling at present. However, SES Ltd. are currently working on the Plascrete process which it is hoped will eventually be able to recycle all of the mixed plastic residue from a Bedminster process.

7.3 Releases to Water

The composting process is a net consumer of water. Liquid leachate from the Maturation Hall will be captured and recirculated. Therefore the only release to water would be storm water runoff and foul water from the washroom facilities.

As a consequence of the proposed ABP Amendment Order there may be a requirement to disinfect all waste delivery vehicles that carry catering waste. The effect of this cannot be quantified until DEFRA have finalised the amendments to the Order.

8 Budget Proposal

To enable a budget costing to be determined for this project it has been necessary to make some assumptions about the waste stream to be composted, the final end markets for the compost, the ground conditions and proximity of services and supplies. The following sub-sections specify the assumptions made, the project deliverables, capital costs, operational costs and excluded items.

8.1 Assumptions

8.1.1 Waste Stream

To enable accurate predictions of recycling/composting rates, tonnage of compost produced for sale, amount of water and nitrogen to be added to the composting process, together with other operational details, it is necessary to know the average composition of the proposed waste stream. Bedminster would normally undertake a waste audit as part of a Feasibility Study to determine the percentages of waste in each of 15 different fractions of the waste stream. In the absence of such detailed waste data, an estimation of the 15 different waste fractions has been made from other UK urban MSW streams, as shown in Table 3:

Waste Fraction	Percentage Wet Weight w/w
Food waste	11.9%
Fruit	0.0%
Garden waste (grass etc)	3.4%
Paper, newspapers etc.	21.0 %
Paper packing, cardboard	8.6%
Other Biodegradable	5.7%
Plastic bags, plastic film	4.4%
Other plastic	6.8%
Textiles	2.7%
Other combustibles	9.0%
Metal	3.2%
Aluminium	0.7%
Glass	8.1%
Other non combustibles	8.3%
Fines <10mm	6.0%
Hazardous	0.3%
Sewage sludge (15% dry solids)	225 tpd
Note: The total may not amount to 100% due to rounding errors.	

Table 3: Assumed waste stream fractions

8.1.2 Financial Assumptions

For the purposes of this proposal certain assumptions have been made concerning the capital and running costs of the plant. Any errors in the assumed costs will reflect in the projected running costs of the facility and hence the projected gate fees. The magnitude of such differences will be dependent upon the magnitude of error in the assumptions and their individual impacts on the overall running cost of the facility. Sustainable Environmental Systems would be pleased to provide a revised budget quotation in the event of any serious error having been made in the following assumptions:

Description		**Rate Assumed (£)**
Exchange Rates:	1 GBP = 15 SEK	
RPI:	Inflation Rate (per annum) – assumed fixed. *Assumed that gate fees, rates, services etc are linked to RPI*	2.0%
Corporation Tax	Annual Corporation Tax	30%
Land Prices:	Not included (not known)	0
Utilities:	Gas (per m^3) *Assumed that gas is not available*	N/A
	Water (per m^3) *Assumed connection available at site perimeter*	1.00
	Green Electricity (per kWh) *Connection fees and line rates have not been included as these will be site specific. A line with a spare capacity of approximately 1.8 MWatts will be required for a 450tpd facility.*	0.044
	Sewerage (per m^3) *Assumed connection available at site perimeter*	1.00
Fuels:	Heavy Fuel Oil (per m^3)	140
	Heating Oil (per m^3)	140
	Diesel (per litre)	0.74
Labour Costs:	Plant Manager	45,000
per annum	Lab Technicians	33,000
(Inc. all overheads)	Mechanical Technicians	25,000
	Electrical Technicians	25,000
	Semi-skilled Labourers	16,500
	Labourer	15,000

Description		Rate Assumed (£)
	Contract Labour (to cover sickness etc)	20,000
	Office Administrator	20,000
	Office Junior	15,000
Rates:	Estimated annual rates (not known)	0
Expenses:	Cost of incineration of residuals (per tonne) including transportation, containers etc	40
	Cost of landfill of residuals (per tonne) including transportation, containers etc	40
Revenues:	Steel for recycling (per tonne)	10
	Aluminium for recycling (per tonne)	450
	Glass for recycling (per tonne)	0
	Compost pellets for agriculture (per tonne)	0
	Compost pellets for the consumer market (per tonne)	0
	Loose compost (per tonne)	0

Table 4: Assumed income/expenditure

8.2 Scope of Supply

This section details all deliverables included in this budget proposal. Items not specified within this section are not included in the project costings of section 8.3.

Item	Details
Loading Hall	All construction as shown on drawings G5347/2 and 400-3. Estimated piling. Electrical lighting, building services, fire protection, Feed Pits, Sludge Pits, shredder, 2.8m^3 front-end loader, air collection system and air curtains, bag splitter, metal separators, screw augers and associated conveyor belts.
Eweson Digesters	Three 150tpd Eweson Digesters and four sets of concrete bearing pedestals.
Separation Hall	All construction as shown on drawings G5347/2 and 400-3. Estimated piling. Electrical lighting, building services, fire protection, trommel screen, destoner, magnetic separator, RORO loading chute and associated conveyor belts.

Item	Details
Aeration Hall	All construction as shown on drawings G5347/2 and 400-3. Estimated piling. Electrical lighting, building services, fire protection, four cranes, fan arrays, aeration floor, leachate capture and re-circulation system, 0.36m^3 skid-steer loader and associated conveyor belts.
Bagging and Storage Area	All construction as shown on drawings G5347/2 and 400-3. Estimated piling. Electrical lighting, building services, fire protection, belt dryer, Dry Gravity Separator, Additives Unit, bagging station.
Biofilter	All construction as shown on drawings G5347/2 and 400-3. Estimated piling. Electrical lighting, building services, fire protection, biofilter material. All pipework required to duct process air from Loading Hall, Eweson Digesters, Separation Hall and Aeration Hall through the biofilter.
External Works	Excavation (**500mm over entire site**), surfacing, drainage, services (**estimated**), limited work to existing roads (**estimated**), fencing and gates.
Project Overheads	Detailed design of structures, architectural plans and elevations, detailed project management, site management, site accommodation, temporary site services (**estimated**), insurance.
Documentation	Full set of "as built" design drawings, maintenance manual and quality control manual.

8.3 Budget Capital Costs

The total capital cost for each composting facility is £33M. This figure is likely to be a worst-case scenario and will in all probability be substantially reduced as a result of a Feasibility Study. This figure does not include items listed in section 8.4.

8.4 Excluded Capital Items

This section identifies items that are specifically excluded from this budget proposal as they have still to be determined due to current lack of information.

Item	Details
Feasibility Study	Required to identify waste composition, compost markets, sub-soil ground conditions, site contamination etc.
Planning Approvals	All planning issues can be undertaken by Posford Haskoning. An Environmental Impact Assessment can be carried out if required but would be subject to additional costs.
Fees to statutory authorities	Not included.
IPPC Authorisation	Not included.
Waste Management Licence	Cost of licensing the facility is not included.
Site clearance	The extent and cost of site clearance will be determined as part of a Feasibility Study
Site remediation and contamination issues	To be determined after a thorough site investigation including geotechnical survey which will form part of a Feasibility Study. There will be a possibility of the presence of unexploded munitions within the alluvium beneath the site.
Architectural	Any aesthetic work required. The buildings quoted will have a painted cladding finish except the Aeration Hall which will have a concrete finish.
Pelletising Equipment	Pelletising equipment can be provided as an optional extra at a cost of approximately £700k. Viability will depend on compost markets.
Connection to utilities	All utilities have been assumed available at site boundary but connection fees have not been included.
Works outside site boundary	Rerouting of roads, traffic signage etc. will be the responsibility of site owner.
Land	The land value of the site is not included. (not known)
Planning Inquiries	No contingency has been allocated for planning inquiries.
Deep Piling	An estimate of piling requirements has been made. The full extent of piling requirements will be determined after a geotechnical survey of the site has been carried out.

8.5 Gate Fees

The total operating costs of each proposed facility are estimated at £5.6M/year (£28/tonne of solid waste) at 2002 prices.

The gate fee required to cover financing and operational costs would be £40/tonne at today's prices (linked to RPI) over a 25 year contract period. However, a profit sharing agreement would enable the additional revenue streams from the sale of 95,000 tonnes of compost (approx. £2.5M/year) and the gate-fees charged for disposal of sewage sludge or other high nitrogenous wastes (approx. £4.0M/year) to potentially reduce the gate fee by £16/tonne.

The estimated operational cost does not include items listed in section 8.6. It should also be noted that residual waste disposal is included at the rates assumed in section 8.1.2. The amount of residual waste is highly dependent on waste stream contents but the assumed MSW composition should produce conservative recycling rates and hence over estimate the amount of residuals. Vehicle maintenance is estimated on 2005 requirements.

8.6 Excluded Operational Income and Expenditure

This section identifies items that are specifically excluded from this budget proposal as they have still to be determined.

Item	Details
Rates	Commercial rates are not included.
Pelletising	Pelletising equipment can be provided as an optional extra. The operational cost of the pelletising equipment is approximately £2/tonne of compost.
Compost	A zero income/cost has been assumed per tonne of compost manufactured.
Sewage	A zero income has been assumed per tonne of sewage sludge processed.
Insurance	No commercial or efficacy insurance included.
Carbon Credits	Centralised composting is a carbon negative process and should therefore be eligible for Carbon Credits. These offer an additional source of income which has not been included.

8.7 Project Timeline

The commencement of detailed design work will require a Feasibility Study, see section 10, which will take 16 weeks prior to the start of the detailed design work. Detailed design and architectural work will take an additional 12 weeks prior to commencement of construction. It is anticipated that construction will take 40 weeks. Following completion of construction there will be an additional 10 weeks for final installation and commissioning of the Bedminster plant prior to startup. The overall project timescale, including Feasibility Study, is therefore estimated to be 78 weeks from commencement to startup, assuming planning consent is obtained with no complications.

9 Project Partners

9.1 Posford Haskoning

Detailed site design, development and project management would be undertaken by Posford Haskoning. Posford Haskoning, formerly Posford Duvivier, have an annual turnover of £20M and are part of the Royal Haskoning group with an annual turnover of £106M. They have considerable experience in this field having designed many large, high profile projects including waste management facilities:

Project	Description	Capital Value £
SELCHP 1991 to 1994	Design and build.	£40M
Chineham MSW Incinerator	Design and build.	£35M
AVIRA Waste Processing Company	Design and build.	£50M
VVI-West	Design of integrated waste disposal centre.	£100M
Canary Wharf	Design of underground station at London Docklands.	
International Airport	Newcastle international airport.	
Palm House	Palm House, Kew Gardens, London.	

The company has considerable experience of liaison with Local Authorities, the Environment Agency and many local interest groups in order to obtain necessary consents.

Posford Haskoning also have considerable expertise in remediation of brownfield sites.

9.2 Costain Limited

Costain are a major UK construction company with a annual turnover of £750M. Recent projects include:

Project	Description	Value £
SELCHP 1991 to 1994	1200 CFA piles. Costain placed 18,000m³ of structural concrete, 500 tonnes of structural steel, 11,000m² of cladding and 4,000m² of architectural brickwork. Posford Duvivier were the consulting engineers.	£14M
Victoria Wharf 1995- 1996	Ground excavation and foundations for the structural steel, powerfloated floor slabs, structural steel, wall cladding, roof, and roller shutter doors, associated external works including concrete aprons, drainage and a new fire main were undertaken by our direct labour.	£0.35M

Project	Description	Value £
Port of Tilbury London Ltd. 1994-1999	Demolition of existing buildings and construction of new warehouses, large span bulk storage shed and cold store. Large span animal feed bulk storage facility 18,000m^2.	£9M
Dwr Cymru – Welsh Water 1997-1999	Construction of a waste water Treatment Works using the Sequential Batch Reactor process. Civil, building, mechanical, electrical and process works.	£28M
National Power plc Gale Common 1993 - 1997	Principal Contractor for ash disposal lagoons. Supply and installation of 150,000m^2 of geomembrane liner to two lagoons, raising of reinforced concrete structures, dismantling and relaying of some 6km of 600mm diameter steel pipes, maintenance of site roads and landscaping and restoration works. Environmental management and protection of groundwater regime.	£4.2M
Cory Environmental Ltd. Wallbrook Wharf 1995-1996	Modernisation of waste transfer station and construction of riverside walk. Filling of existing docks and slabbing of entire area, supply and installation of compactor, dust control and crane. Upgrading of M&E and HVAC systems.	£3.6M

9.3 Rabo Bank

Rabo Bank is one of the world's largest financial institutions and has already indicated its willingness to finance Bedminster facilities in the UK.

9.4 Houlder Insurance

Houlder Insurance is a major Lloyds underwriters that has experience in insurance of Bedminster plants. They can provide all necessary commercial and efficacy insurance for the project.

10 Feasibility Study

10.1 Scope of Study

To provide the most accurate costings for the proposed project it will be necessary to conduct a Feasibility Study. The study would include:

- Topographic site survey.
- Contamination survey.
- Sub-soil survey to determine foundation and piling requirements.
- Waste audit to determine waste stream composition and contamination.
- Determine availability of sludge or other nitrogenous waste streams.
- Determine proximity and capacity of site services
- Identify compost market – how much to local market, to agriculture, to land remediation, to sports turf applications – determine maturation periods required.
- Preliminary design work based on study findings to more accurately determine site-specific construction costs.

10.2 Study Timeline

A typical Feasibility Study would take 4 months to complete.

A. Construction Drawings

This section contains the following drawings:

Description	Drawing Number
450tpd Facility: Plan view	G5347/2
450tpd Facility: Side Elevations	400-3

B. Curriculum Vitae

Sustainable Environmental Systems Ltd.

Bedminster
In-Vessel Composting System

Budget Proposal for City Solutions

Livingston Unitary

Revision 1.0 February 2003

working with people & nature for a better environment

Revison History

Rev. No.	Revision Details	Author	Date
0.1	First draft	IDH	27/01/2003
1.0	First Issue	IDH	06/02/2003

Executive Summary

This budget proposal is for a 450tpd (150,000tpa) Bedminster in-vessel composting facility to deliver increased recycling and landfill diversion rates for Livingstone Unitary Authority at costs comparable to landfill and incineration.

The proposal is for a facility that would handle 150,000 tonnes per annum of green and food waste. In addition to the mixed solid waste the Bedminster system would safely handle 75,000tpa of sewage sludge. This opens the possibility of dealing with two waste streams whilst reducing the cost of solid waste management.

This 150,000 tonnes per annum Bedminster facility would fit onto an area of 5.4. The highest part of the structure will be the roof of the Tipping Hall which would be 18 metres above datum. Plan and elevation views are presented in appendix A.

To ensure that the facility does not give rise to an odour problem, all deliveries and processing would take place within an enclosed building that would be maintained under negative air pressure. All process air would be cleaned in enclosed biofilters before release to the atmosphere.

The proposed facility would deliver over 63% composting/recycling rate from the proposed waste stream of 8.1.1. The 150,000 tpa of solid waste and 75,000 tpa of biosolids would be converted into approximately 75,000 tpa of OrganaGro compost

The proposed Bedminster facility would provide employment for 18 people when processing at full capacity.

Budget estimates show that the capital cost of the 150,000 tpa plant would be £30M with an annual operational cost of £4.4M. Additional operational income streams of at least £2M should be available from the sale of compost and at least £3M from the gate-fee for sewage sludge or other high nitrogenous waste streams. The generation of Carbon Credits is another possible source of income.

The European Bedminster system can deliver the highest quality of compost from a mixed waste stream. This has been achieved by careful attention to screening and cleaning of the composting material and by a highly sophisticated in-house quality control process that guarantees the quality of each batch of compost produced. OrganaGro, the Bedminster compost, will meet or exceed the quality requirements of the most stringent of proposed European standards, making it suitable for unrestricted use.

The analysis of section 3.3 shows that the introduction of a 150,000tpa Bedminster facility will enable the Livingstone Unitary Authority to achieve their recycling targets of 25% by 2005.

The figures presented in this budget proposal will need further confirmation by conducting a Feasibility Study.

Table of Contents

1 Introduction

This budget proposal is for a Bedminster in-vessel co-composting facility, for Livingstone Unitary Authority, capable of safely processing up to 450tpd of solid waste (post-consumer mixed MSW, commercial/industrial waste, garden waste and food waste) and up to 225tpd of sewage sludge. The Bedminster facility is a two barrier composting process making it fully compliant with the proposed Animal By-Products (Amendment) (England) Order for the composting of food waste and post-consumer green waste. The Bedminster process is also compliant with the EU ABP Regulations 1774/2002 for the treatment of all Category 3 ABP waste provided that it is shredded to 12mm. The facility would be operated under Hazard Analysis Critical Control Point (HACCP) controls to ensure production of a safe compost which would exceed the quality required by PAS100 and EU Class-1 compost quality standards, suitable for unrestricted use.

The major advantage of the Bedminster system is one of delivering a guaranteed high quality compost from post-consumer waste streams. Post-consumer waste streams are notoriously contaminated with contraries due to segregation errors and/or deliberate dumping of mixed waste into containers intended for segregated wastes. For this reason Bedminster recommends the inclusion of its full range of separation and screening equipment to ensure a safe and reliable quality of compost to the consumer at all times. In-house quality control with monitoring for physical and chemical contaminants will be implemented for every production batch of compost. The resultant compost will normally be certified to the proposed EU Class-1 or PAS100 quality standard.

The proposed system would be equally suited to running alongside other recycling systems to compost segregated organic wastes but could also be used to handle the residual mixed waste stream from non-participating households. The proposed system utilizes three 150tpd Eweson digesters and four separate maturation streams within the Aeration Hall. This would allow the processing of three separated streams of waste, e.g. source separated green waste, residual waste from non-participating households within source-separated recycling schemes, ABP/Catering wastes, contaminated biowastes intended for final disposal. This would help to maximise recycling and landfill diversion rates across the Livingstone area and thereby help to ensure that all Landfill Directive and recycling targets are met up to the year 2020 and beyond. In all cases a separate collection of hazardous household waste should be implemented on a monthly or 6 weekly basis as required.

2 The Sustainable Solution to Residual Waste

2.1 Bedminster Background

Bedminster AB is a Swedish company that was originally established in 1993 (as Rondeco) to produce high quality organic fertilizer pellets for the forestry industry in Sweden. The Bedminster process allows virtually all the organic fraction of mixed solid waste streams to be extracted and composted together with other high nitrogen sources such as sewage sludge, if available. The latest proposals from the European Commission have proposed stringent quality requirements for compost to ensure protection of the environment. The Bedminster facilities use a highly sophisticated process of screening and cleaning to ensure that the latest proposed EU quality standards and PAS100 standards can be achieved. Their in-house quality control systems ensure that all compost produced by their plants is of a guaranteed high quality.

2.2 The Bedminster process

The Bedminster process is one of integrated recycling and composting. It is differentiated from Mechanical Biological treatment by not shredding the waste stream and by producing a high quality compost suitable for unrestricted use.

The process consists of a rapid in-vessel composting phase, lasting 3 days, followed by a slower maturation phase of up to 12 weeks during which time the rough compost is cured in windrows housed within a temperature and humidity controlled Aeration Hall. Once mature, the compost is finally screened to remove any glass and other fine physical contaminants.

The whole composting process is enclosed within buildings maintained under negative air pressure. All process air is extracted from the buildings and processed through enclosed biofilters where the volatile compounds are converted to water and carbon dioxide. After passing through the biofilters the cleaned process air is vented to atmosphere.

The design of the facility provides two barriers through which all of the material has to pass. The first barrier comprises the Loading Hall, Eweson Digesters and Separation Hall. The second barrier is the Aeration Hall. The material attains a temperature of greater than 60°C for longer than 2 days in the Eweson Digester and greater than 60°C for more than 8 days (with three turnings) in the windrows within the enclosed Aeration Hall. The process thereby complies with all of the DEFRA safety requirements for the composting of food, green waste and MSW.

The mixed waste will be delivered into the Tipping Hall directly from standard 9-11 tonne capacity compacting refuse collection vehicles. Any oversize items will be manually removed on the tipping floor. Large pieces of wood will be removed and processed through the shredder and returned to the tipping floor before the waste is moved into the pits, onto the conveyor system and through to the bag splitter. The bag splitter will ensure that any plastic bags are opened and their contents released onto the conveyor belt. The waste will then pass through a system of electromagnetic and eddy-current separators to remove ferrous metals and aluminium. Once most of the metals have been removed the waste will be loaded into the Eweson Digesters (composting drums). At this point other high nitrogenous wastes like sewage sludge could be added to improve the nutrient quality and reduce the maturation period of the final OrganaGro compost.

The in-vessel process is a batch process with each rotating composting drum holding 150 tonnes of waste in each of its three compartments. The composting material will be transferred in batches from one compartment to the next at the end of each 24 hour period. During its three days in the drum the composting material will attain a temperature of greater than 60°C for longer than 48 hours thereby sanitising the waste and complying with the DEFRA requirements for Barrier 1 of an in-vessel composting system for catering waste.

After three days in the composting drum all organic material will be broken down into a rough compost. The organic fraction of tetra-packs, telephone directories, even cardboard and garden waste will be converted into a rough compost from which the remaining inorganic fractions will be removed by trommel screen, magnetic separator and de-stoner. The screened rough compost will then be matured in 2m high windrows within the temperature and humidity controlled Aeration Hall.

The maturing compost will be systematically turned as it gradually progresses along the length of the Aeration Hall. Its temperature and humidity will be carefully controlled by forcing air up through the windrows from the aeration floor. A minimum temperature of 60°C will be maintained for a period of longer than 8 days to ensure further pathogen reduction and to comply with DEFRA second barrier requirements for the composting of catering waste. Careful measurements of compost parameters will determine when the compost is sufficiently mature and suitable for use. This will take between 3 – 12 weeks dependent on many factors including: the composted waste stream; the carbon:nitrogen ratio; the lignin content of the maturing material; the temperature within the Aeration Hall; and the intended end use for the compost. During the summer months maturation will typically be achieved earlier than during the winter months.

The whole maturation process is contained within an enclosed Aeration Hall that is maintained under negative air pressure to prevent the escape of process odours. All process air is treated through biofilters to remove any process odours before release to the atmosphere.

A typical Bedminster process schematic is shown in Figure 1.

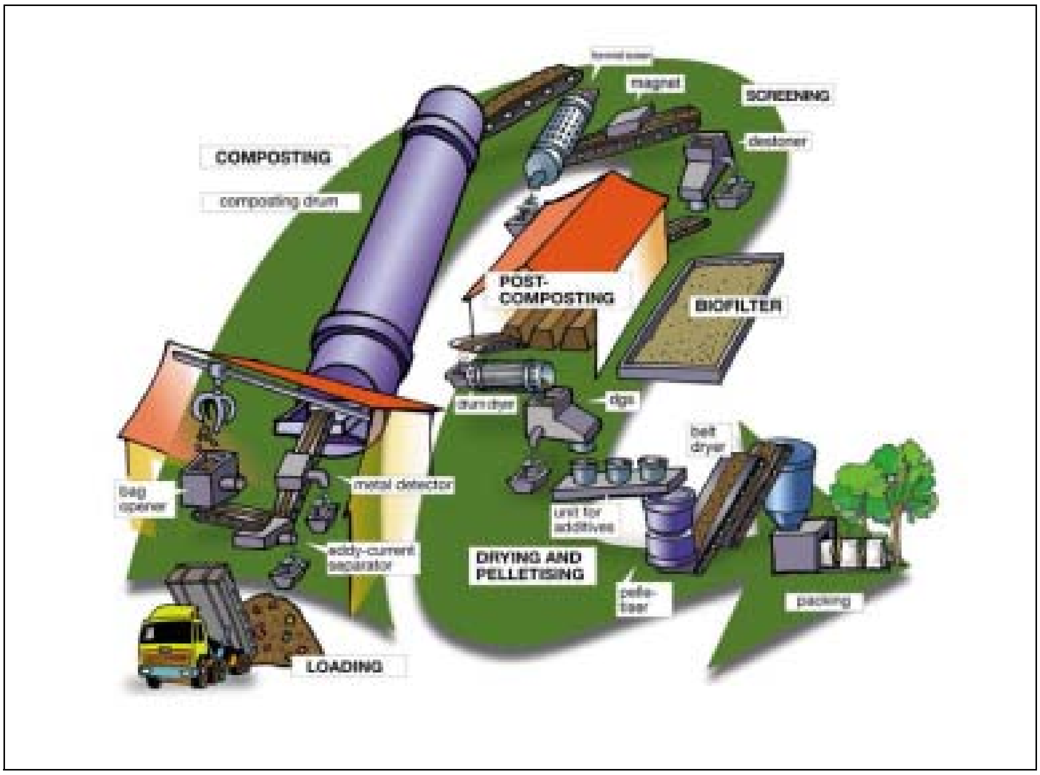


Figure 1: Schematic of Bedminster Process

The whole production process would be quality controlled by the Bedminster in-house quality control system, as shown in Figure 2. Such close quality control will enable each production batch of compost to be analysed before despatch. The resultant compost will be of the highest grade suitable for unrestricted use. Bedminster European facilities will be operated under an ISO14001 or EMAS compliant environmental management system.

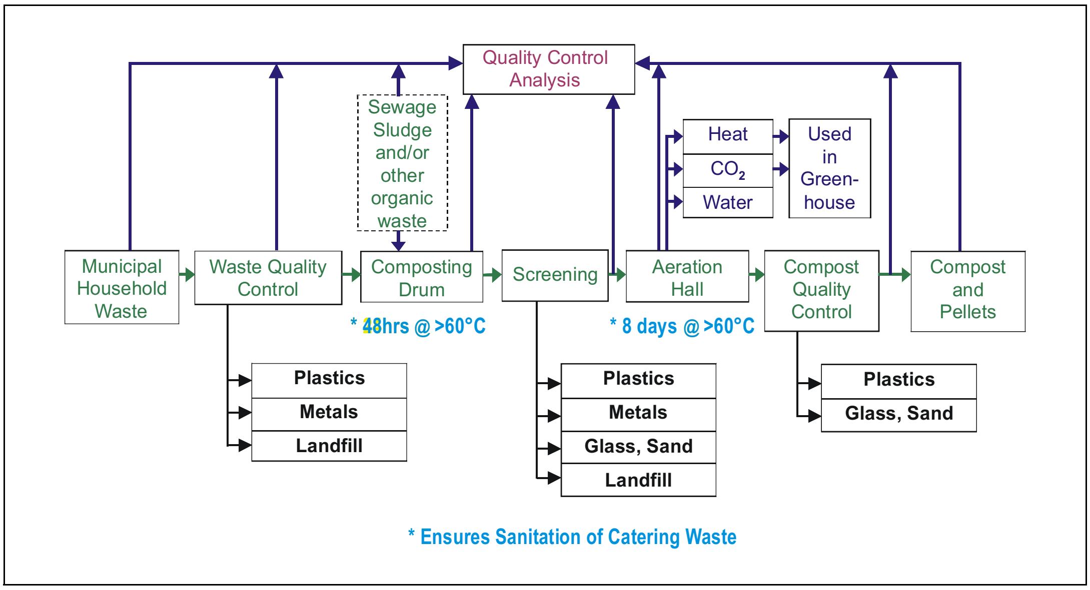


Figure 2: Bedminster In-House Quality Control

2.3 The OrganaGro high quality compost

Currently there are no statutory standards for compost in the UK. Recently the Composting Association, WRAP and the British Standards Institute have issued the PAS100 standard and the European Commission has brought out *proposed* statutory standards. These standards are summarized in Table 1 and compared to Bedminster OrganaGro made from mixed municipal solid waste.

The Bedminster compost, OrganaGro, will be of the highest grade and will generally comply with the latest EU proposals for Class-1 compost and PAS100 quality standards, suitable for unrestricted use. However, it should be noted that the PAS100 standard does not apply to compost made from mixed MSW but the PAS100 quality standard is used here as a benchmark.

OrganaGro is a high quality organic material that can be sold either as a loose compost or as a high grade pelletised fertilizer. The pellets are suitable for a range of applications including container plants, gardening, horticulture and agriculture. The loose compost is suitable as a top dressing for grass, sports pitches, golf courses and for hydro-seeding. Many trials have proven the benefit of OrganaGro. The most recent of such trials, using OrganaGro compost as a top dressing for sports pitches, was conducted by the Sports Turf Research Institute at Bingley, Yorkshire.

Table 1 shows that even when composting a mixed MSW waste stream it is possible to achieve compost of the highest quality standards. With the proposed waste stream of section 8.1.1 the heavy metal content of the compost should typically be much lower than shown in Table 1. The proposed facility will have three Eweson digesters and four separate maturation streams within the Aeration Hall. Infrastructure would be included to allow a fourth digester to be added at a later date. This would allow the processing of up to four separated streams of waste, for example:

1. source separated green waste;
2. residual waste from non-participating households within source-separated recycling schemes;
3. ABP/Catering wastes;
4. contaminated biowastes prior to final disposal.

It would therefore be possible to compost segregated green and food waste in one process stream and residual mixed MSW in the remainder. This would allow the facility to start processing mostly residual waste and gradually switch over to source separated organic waste as public participation rates increased. This would allow production of the highest possible quality of compost whilst guaranteeing to simultaneously meet all of the Livingstone recycling targets and EU Landfill Directive targets, independent of public participation rates.

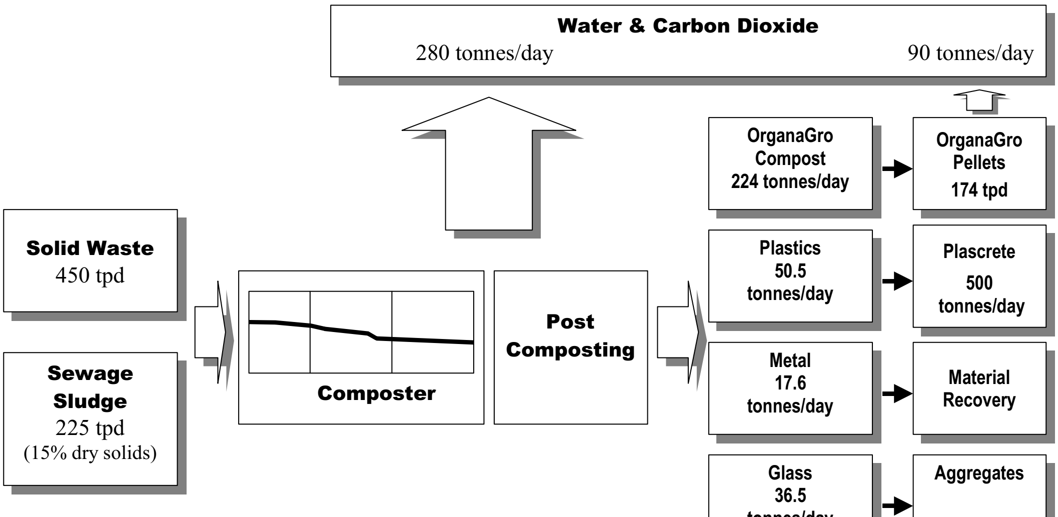
Substance	Bedminster OrganaGro	Proposed EU Limits		PAS100
		Class-1	Class-2	
Potentially Toxic Elements (mg/kg dm)				
Cadmium Cd	0.37	0.7	1.5	1.5
Chromium Cr	11.5	100	150	100
Copper Cu	90	100	150	200
Mercury Hg	0.31	0.5	1	1
Nickel Ni	7	50	75	50
Lead Pb	11	100	150	200
Zinc Zn	157	200	400	400
Polychlorinated Biphenols PCBs		-	-	-
Polycyclic Aromatic Hydrocarbons PAHs		-	-	-
Human Pathogens:				
Salmonella spp	Absent not detectable	Absent in 50g		Absent in 25 g
E.Coli	Absent	-	-	1000 CFU g^{-1}
Physical Contaminants:				
Impurities > 2mm	< 0.5% total contaminants	<0.5%	<0.5%	<0.5%% (plastic <0.25%)
Gravel and Stones >5mm		<5%	<5%	<7%
Weed Contaminants:				
Weed propagules	<1 viable/l	<3 germinating weed seeds per litre		5 viable/litre
Phytotoxins:				
Plant tolerance		N/A	N/A	20% below control
Sanitation temp-time regime	>= 70C for 18 hours >55C for 1 week >45C for 3-4 weeks	>60C for 1 week		>55C for 3 days
Inspection Requirements:				
	Continuous 1per $100m^3$	12 per annum		1 per $2000m^3$
All limits normalised to 30% organic content				

Table 1: Comparison of Bedminster compost with proposed standards

3 Process Mass Balance & Overall Recycling Rates

3.1 Bedminster Facility Recycling Rates

To determine an accurate mass balance for the Bedminster facility requires knowledge of the ingoing waste streams to be processed. For the purposes of this proposal a typical UK urban MSW stream has been assumed as detailed in section 8.1.1. With such a waste stream the recycling/composting/landfill diversion rate would be approximately 63%. The projected Mass Balance for the proposed Bedminster facility is shown in Figure 3.



Average Composition of Municipal Solid Waste Stream			
Paper & Card	29.6%	Other Combustibles	9.0%
Plastic Film	4.4%	Glass	8.1%
Dense Plastic	6.8%	Ferrous Metals	3.2%
Textiles	2.7%	Non Ferrous Metals	0.7%
Kitchen Waste	11.9%	< 10mm Fines	6.3%
Garden Waste	3.4%	Other Non-Combustibles	8.3%
Other Biodegradable	5.7%		

Note: In this diagram the sum of the masses input and output will not equate as water has to be added to the system and carbon is converted to carbon dioxide (3.7 times heavier) during composting.

Figure 3: Theoretical Mass Balance Obtainable from MSW

3.2 Statutory Recycling and Landfill Diversion Rates

Livingstone is required to achieve a 25% recycling rate by 2005/6. In addition the Landfill Directive will require a reduction in landfilling of biodegradable materials. The resultant combined targets for Livingstone are shown below:

- 2005/6: 25% materials recycling rate;
- 2010: 61,141 tonnes total BMSW to landfill
- 2013: 40,761 tonnes total BMSW to landfill
- 2020: 28,533 tonnes total BMSW to landfill

The Bedminster system offers guaranteed recycling and diversion rates that are not dependent upon voluntary source separation. Furthermore, the high degree of process and quality control produces a consistently high quality of compost that is not dependent upon the accuracy of source separation.

SES always recommends that a separate collection is introduced for hazardous household waste, this need only be collected once every 4-6 weeks due to the small quantities involved and the nature of the waste.

3.3 Predicted Livingstone Recycling Rates

SES Ltd. has developed the FutureWaste-2G model to predict future waste management performance. The predictions are based on current waste data, current waste disposal charges, landfill tax charges, RPI inflation rate and predicted increase in waste arisings over a 25 year period. The model accommodates CA/Bring sites, source separated kerbside collections, mixed (black bag) collections, open air windrowing and in-vessel composting. The model allows the output materials to be assigned to recycling, open air or in-vessel composting, incineration and/or landfill. Additionally revenue streams or costs can be assigned to the output materials.

3.3.1 Waste Composition Data Input to Model

As there is no waste composition data currently available for the Livingstone area, the composition of MSW arisings from a typical UK urban area has been used as a substitute. The resultant waste composition data input to the FutureWaste-2G model is as presented in section 8.1.1

The FutureWaste-2G model predicts future recycling/composting rates, landfill diversion of biodegradables, and costs. For comparison, this model has been run for two different scenarios using the same typical UK urban MSW data of section 8.1.1. The results are presented in sections 3.3.2 and 3.3.3.

3.3.2 Livingstone Separated Scenario:

This scenario is based on a kerbside source separated recycling scheme across the 84,000 low-rise households of Livingstone. It is assumed that of the 70% of the population covered 66% participate in the scheme and separate out 100% of the required material.

Household MSW:	150,000 tpa
Solid commercial MSW:	20,000 tpa
Street Sweepings etc:	20,000 tpa landfilled (of which 50% biodegradable)
Total MSW Collected:	190,000 tonnes per annum (including CA/Bring sites)
CA/Bring Sites:	37,000 tpa collected (of which 12,000tpa recycled)
Increase in waste arisings:	2.5% year on year
Households Covered:	70%
Particpation Rate:	66%
Materials collected:	garden waste, paper, cardboard, textiles, metals and glass.

Figure 4 shows that Futurewaste-2G predicts the probable overall recycling rate to be 24%.

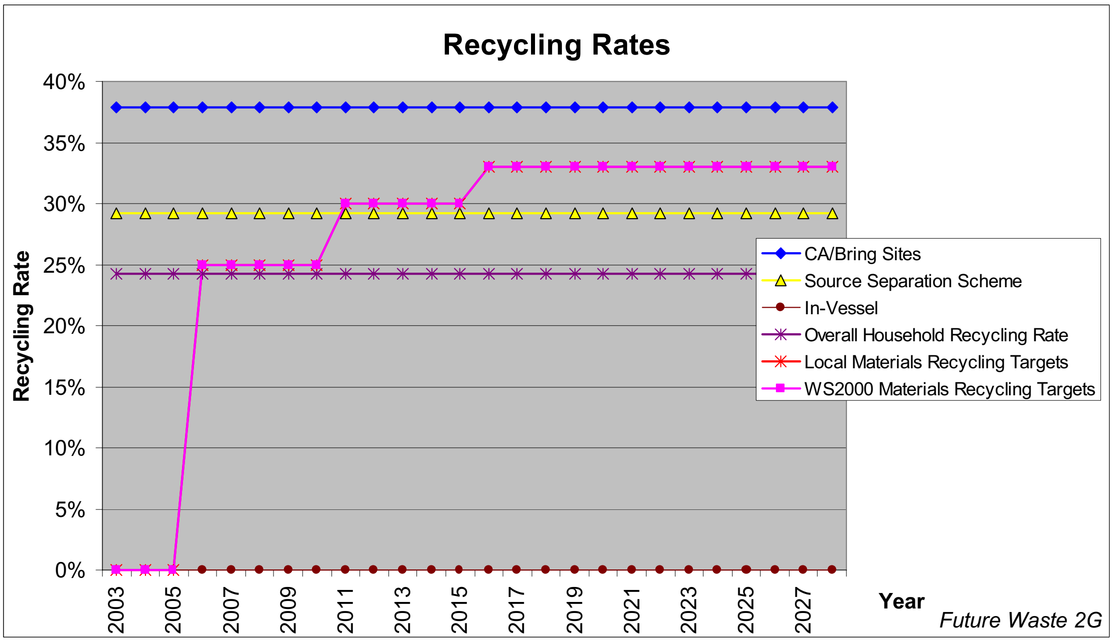


Figure 4: Livingstone Separated - Recycling Rate with 66% Participation

Figure 5 shows the predicted amount of landfilled biowaste from the source separated scenario. The high level of biowastes landfilled is largely due to kitchen waste that would otherwise have to be in-vessel composted to comply with the ABP Amendment Order or incinerated together with biowastes in the residual mixed MSW collected from non-participating households. Figure 5 shows that this scenario is very unlikely to deliver the Livingstone Landfill Directive targets for 2010, 2013 or 2020.

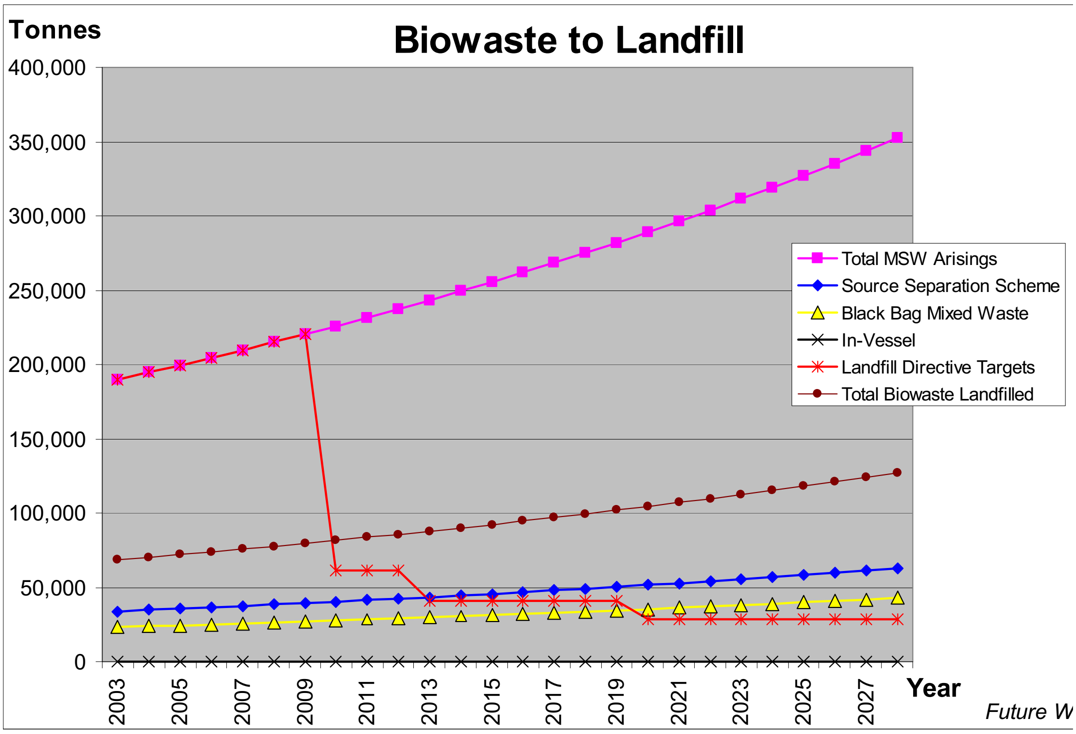


Figure 5: Livingstone Separated - Landfilled Biowastes

3.3.3 Livingstone Bedminster Scenario:

This scenario assumes that all households are provided with a mixed MSW collection and that all household MSW collected is processed through the Bedminster facility:

Household MSW:	150,000 tpa (70% of households covered by box scheme)
Solid commercial MSW:	20,000 tpa
Street Sweepings etc:	20,000 tpa landfilled (of which 50% biodegradable)
Total MSW Collected:	190,000 tonnes per annum (including CA/Bring sites)
CA/Bring Sites:	37,000 tpa collected (of which 12,000tpa recycled)
Increase in waste arisings:	2.5% year on year
Households Covered:	100% (mixed MSW collections)
Materials collected:	All MSW excluding hazardous household

Figure 6 shows that Futurewaste-2G predicts the probable overall recycling rate to be 59%.

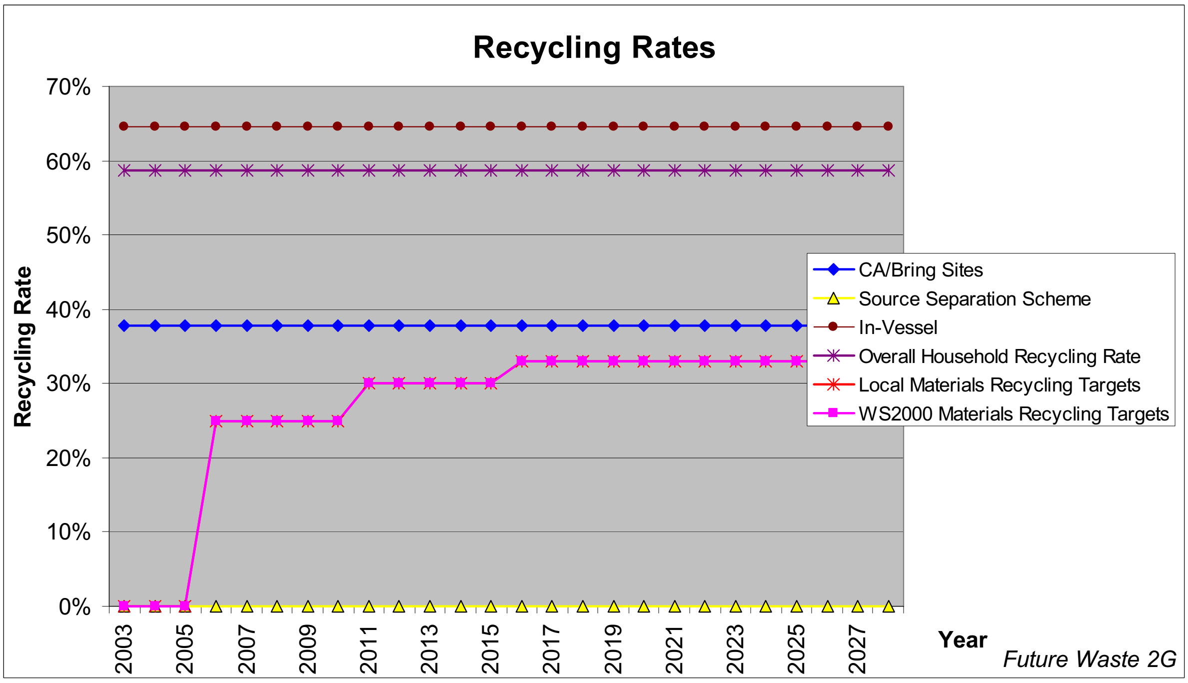


Figure 6: Livingstone Bedminster - Recycling Rate

Figure 7 shows the predicted amount of landfilled biowaste from the Bedminster scenario.

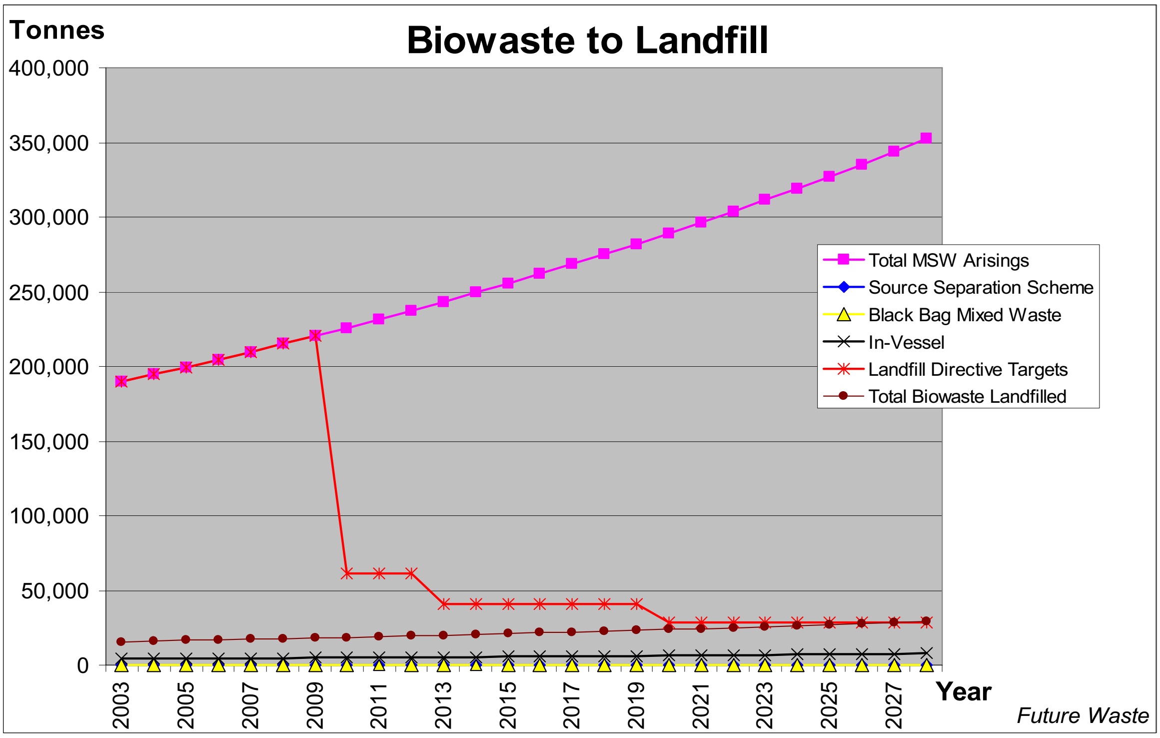


Figure 7: Livingstone Bedminster – Landfilled Biowastes

Figure 7 shows that this scenario is likely to deliver the Landfill Directive targets for 2010, 2013 and 2020. The low level of landfilled biowastes in Figure 7 is due to the very high conversion ratio of all biowaste into compost. To further reduce the amount of landfilled biowaste in years 2025 onwards would require treatment of the biodegradable fraction of the street sweepings and other municipal wastes from CA/Bring sites.

4 Project Proposal

The proposed 450 tonnes per day Bedminster facility for Livingstone is shown in Appendix A. The total land area required for the facility, including site access roads is 5.4 hectares. It is anticipated that such a site would only be available on the outskirts of London within the M25. The highest part of the construction would be 18m above datum. It must be noted that the exact size of the Maturation Hall can only be determined once a waste audit has been conducted to establish the various biodegradable fractions of the waste stream. The facility presented in drawing G5347/1 has been based on an average UK MSW stream. Prior to placement of construction contracts Bedminster would undertake a detailed Feasibility Study which would include an investigation into waste quantity and quality and markets for compost of various stages of maturity.

4.1 Loading Hall

The Loading Hall will measure approximately 58m x 55m by 13.5m maximum height. It will be constructed with lower walls of concrete (2m) and cladding to upper walls and roof. The Loading Hall will contain the Tipping Floor, Feed Pits and shredder. During normal weekday operation, waste would be tipped onto the floor in front of the Feed Pits. Any oversize items will be manually removed prior to the waste being loaded into the pits by front-end loader. Towards the end of the week, waste will be stockpiled in the 625m^2 Waste Storage Area to allow continuous processing over the weekend when there are no deliveries. The storage area would have sufficient capacity for 1.5 days of waste therefore the facility would require deliveries over 5.5 days per week.

The Loading Hall will also house the shredder for large woody items and the bag splitter and metal separators. A Sludge Pit will also be provided to accept deliveries of dewatered sludge or other semi-wet nitrogenous waste materials. Material will be fed from the Sludge Pit directly to the Eweson Digesters via screw augers.

The Loading Hall will be maintained under negative air pressure with air curtains used at the delivery entrances which will be provided with automatic roller shutter doors.

4.2 Eweson Digesters

Three Eweson Digesters (rotating composting drums) would be provided, each of which would be 6.3m in diameter and 73m in length. Each digester would have a nominal capacity of 150 tpd of solid waste and 75tpd of sewage sludge and a maximum usable capacity of just over 200tpd solid waste and 75d of sewage sludge for short periods.

The Eweson Digesters use patented technology to ensure that all of the processed material is constantly turned and aerated to ensure total waste sanitation. Each digester will be turned at a rate of approximately 1 rpm by hydraulic motors.

The patented Eweson Digester contains three separate compartments with the waste material being retained for 1 day in each section. A time temperature regime of 48 hours >60C and 18 hours at > 70C will be achieved with the correct C:N ratio.

4.3 Separation Hall

The Separation Hall will measure approximately 12m x 69m by 12.5m maximum height. It will be constructed with cladding to walls and roof.

After 3 days in the digesters the rough compost is automatically unloaded onto a conveyor in the Separation Hall. The rough compost is screened through a trommel screen and destoner to remove unwanted inorganic materials and any large woody pieces. Pieces of wood will be returned to the Loading Hall for shredding and re-composting. Inorganic materials will be collected in a RORO skip ready for further recycling or disposal. The cleaned rough compost will then be transferred to the Aeration Hall by covered conveyor.

4.4 Aeration Hall

The Aeration Hall will measure approximately 120m x 115m by 15m maximum height. It will be constructed with concrete walls topped with a cladding roof. The Aeration Hall will house four computer controlled cranes which will be responsible for all normal compost movements within the Aeration Hall. A small skid-steer loader will be used for maintenance and periodic cleaning of the aeration floor.

To produce fully mature compost it is necessary to process the compost for between 6 – 12 weeks. This is dependent upon many factors including the carbon:nitrogen ratio and the lignin content of the composting material. Shorter maturation periods can be used to produce less mature compost that would be ideal for many applications such as agriculture, landscaping, soil blending and land remediation. However, immature compost can have a strong smell and could not be sold directly to the consumer for garden or container use.

The proposed Aeration Hall will be capable of producing fully mature compost (very little smell) from 150,000 tpa of typical mixed MSW when it is composted with 75,000tpa of sewage sludge.

The temperature, moisture content, and carbon dioxide levels of the composting material will be monitored and adjusted to obtain optimum maturation. Air will be circulated through the windrows by forcing air from the Fan Arrays up through the aeration floor into the base of the windrows. In addition the material will be turned on a frequent basis by computer controlled overhead cranes. This will ensure that aerobic conditions are maintained within the windrows.

Once the compost is sufficiently mature it will be transported by crane to the end of the Aeration Hall and loaded onto a conveyor that will transport it to the Pelletising (optional), Bagging and Storage Area.

Leachate from the maturing compost will be collected under the aeration floors, filtered and re-circulated within the Aeration Hall to maintain moisture levels. The composting process consumes water therefore there will be no process effluent for disposal.

The Aeration Hall will be maintained under negative air pressure to ensure that non of the process odours can escape. All process air will be treated by the enclosed biofilters prior to release to atmosphere.

4.5 Drying, Bagging and Storage Area

The Drying, Bagging and Storage area will measure approximately 42m x 26m by 12.5m maximum height. It will be constructed with cladding to walls and roof.

Once the compost has matured sufficiently it will be further screened by the Dry Gravity Separator to remove all shards of glass, large grit and most plastics. After final screening the loose compost will either be bagged in $1m^3$ Big Bags or stockpiled ready for bulk transportation.

Loose compost will be loaded onto bulkers by front-end loader. Big Bags will be loaded onto curtain-sided flatbed trucks by forklift.

Optionally the loose compost could be pelletised if required.

4.6 Biofilter

Each enclosed biofilter will measure approximately 25m x 115m by 4m maximum height.

All process air will be extracted from the Loading Hall, Eweson Digesters, Separation Hall and Aeration Hall and piped to the biofilter. The biofilter will capture and convert the volatile compounds and bioaerosols liberated by the composting process. The microbes within the biofilter will convert the captured substances to carbon dioxide and water.

5 Other Bedminster Information

5.1 Carbon Capture

The Bedminster composting process enables virtually all of the organic material present in the waste stream to be recycled back to the land. This completes the Organic Ecocycle which forms an important part of the Carbon Cycle.

At present there is an excess of approximately 3,300 million tonnes of carbon being added to the atmosphere each year which cannot be recycled by the Earth through the carbon cycle. This is resulting in the build up of the atmospheric carbon dioxide levels that are helping to drive global climate change. The Bedminster system is a carbon negative process, a large fraction of the organic carbon within the waste stream is converted into compost which when applied regularly to the soil will increase soil organic content (SOC). This increase in SOC results in a decrease in atmospheric carbon. This carbon capture qualifies the Bedminster process for the generation of Carbon Credits which can result in an additional revenue stream. Work conducted by the US EPA[1] predicts an overall capture of 50kg of carbon (183kg of CO_2) for every wet tonne of organic material composted in a centralised facility.

5.2 Soil Conditioning

The high quality compost produced by the Bedminster process is a good soil conditioner as well as fertilizer. It can be used to replace peat as a growing medium and has many nutritional and fungicidal advantages over peat.

- Soils with high SOC levels are more productive, especially during drought conditions.
- Increased SOC levels prevent soil erosion during periods of heavy rainfall.
- The nitrogen within OrganaGro is released by the micro-organisms within the soil at a rate that is matched to plant uptake. This reduces eutrophication of ground waters caused by nitrate runoff.

5.3 EU Sixth Environment Action Programme

The global environment is rapidly changing as a result of human pressures. Two of the most serious threats that Europe faces over the next ten years is climate change and soil degradation. On the 22nd July 2002 the European Council finally adopted the Sixth Environment Action Programme of the European Community 2001-2010 entitled “Environment 2010: Our future, Our Choice”. This programme seeks to deliver a healthy environment essential for the long term prosperity and quality of life of the citizens in Europe and simultaneously deliver a high level of environmental protection.

[1] US Environmental Protection Agency. Solid Waste Management and Greenhouse Gases: A Life Cycle Assessment of Emissions and Sinks 2nd Edition. EPA530-R-02-006. May 2002. 65

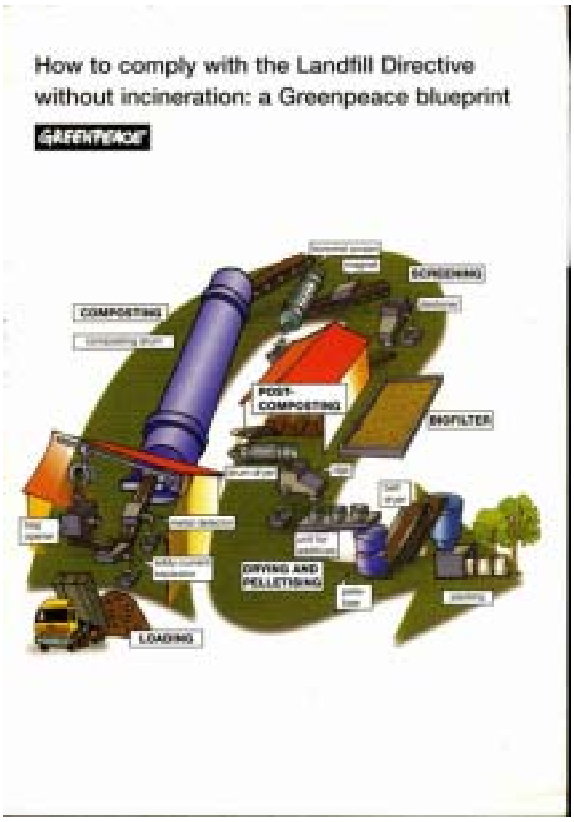
To deliver a sustainable European environment the Sixth Environment Action Programme identifies four Priority Areas for action:

- Tackling Climate Change
- Nature and biodiversity – protection of soils against erosion
- Environment and Health – reduction of environmental pollutants
- Sustainable use of natural resources and management of wastes

Current UK waste management practices focus on landfill and incineration both of which destroy the valuable organic fraction of the waste stream and produce harmful greenhouse gases (GHG). If the biodegradable fraction of the UK waste stream is safely composted, substantial amounts of organic carbon will be available to increase the soil organic content (SOC) across the UK. Increasing SOC levels would help deliver all four Action Points of the EU Sixth Environment Action Programme.

5.4 Community support for Bedminster

Major environmental groups like Friends of the Earth and Greenpeace recognise the advantage of using the Bedminster system to compost separately collected green and food waste and to compost residual mixed municipal waste from non-participating households. Many local communities, when faced with the threat of less sustainable waste management solutions, have expressed their preference for Bedminster technology.


How to comply with the Landfill Directive
without incineration: a Greenpeace blueprint
COMPOSTING
SCREENING
POST-COMPOSTING
BIOFILTER
DRYING AND PELLETISING
LOADING

6 The Company

Bedminster AB (publ) is a Swedish public company with headquarters at Torpangsvagen 2, SE-148 60, Stora Vika, Sweden. Bedminster AB is listed on the Nordic Growth Market NGM AB and has approximately 3,300 shareholders. The major shareholders include: Banco Teknik & Innovationsfond; CKE Investment Corporation; Catella Trygghetsfond; Industrifonden, Stiftelsen and Skandia Livoforsakringsaktiebolaget.

Bedminster AB wholly owns Bedminster Sweden AB (operators of Stora Vika), Bedminster Poland, Rondeco BBC AB and Bedminster Corporation Ltd.

Table 2 shows the locations of operational Bedminster facilities worldwide

Operational:	Solid Waste	Biosolids	Year
Big Sandy, Texas, USA:	20 tpd	10 tpd	1971
Pinetop-Lakeside, Arizona, USA:	10 tpd	5 tpd	1991
Sevierville, Tennessee, USA:	220 tpd	110 tpd	1992
Cobb County, Georgia, USA:	300 tpd	100 tpd	1997
Sumter County, Florida, USA:	50 tpd	25 tpd	1997
Marlborough, Massachusetts, USA:	100 tpd	50 tpd	1999
Nantucket, Massachusetts, USA:	50 tpd	25 tpd	1999
Edmonton, Alberta, Canada:	1,100 tpd	350 tpd	2000
Port Stephens, NSW, Australia:	100 tpd	50 tpd	1999
Stora Vika, Sweden:	70 tpd		2000
Saitama, Japan:	60 tpd		2001
Ongoing Projects:			
Cairns, Queensland, Australia	Perth, WA, Australia	Huelva, Spain	
Shijiazhuang, Hebei, China	Lima, Peru	Kallerup, Denmark	
Huiyang, Guangzhou, China			

Table 2: Locations of operational Bedminster facilities and projects worldwide

7 Environmental Impacts

7.1 Releases to Air

Major releases to air are carbon dioxide and water vapour from the composting process. All CO_2 released from the composting process is from biomass and therefore is carbon neutral.

The inorganic materials that will be recycled from the facility, 4000t of steel, 1000t of aluminium, 12000t of glass will save substantial amounts of CO_2 generation. The quantification of this effect would require a complete lifecycle analysis and is beyond the scope of this proposal.

The process will consume 18,000 MWh of electricity which will be purchased from a renewable energy source through a supplier such as Green Energy (UK) plc. Budgetary figures have been obtained and included in the projected operational costs of the facility.

In addition to the above there will be emissions from two diesel powered front-end loaders within the facility. Each front-end loader will consume approximately 40,000 litres per year. However, as all of these releases will be internal the emissions to atmosphere will be attenuated by passing through the biofilters. No data is currently available on the attenuation factor.

7.2 Releases to Land

Releases to land are predicted to be:

- 16,500 tpa plastic waste
- 4,000 tpa textiles
- 18,000 tpa Other combustibles
- 17,000 tpa Other non-combustibles.

Each of the above will require landfilling at present.

7.3 Releases to Water

The composting process is a net consumer of water. Liquid leachate from the Maturation Hall will be captured and recirculated. Therefore the only release to water would be storm water runoff and foul water from the washroom facilities.

As a consequence of the proposed ABP Amendment Order there may be a requirement to disinfect all waste delivery vehicles that carry catering waste. The effect of this cannot be quantified until DEFRA have finalised the amendments to the Order.

8 Budget Proposal

To enable a budget costing to be determined for this project it has been necessary to make some assumptions about the waste stream to be composted, the final end markets for the compost, the ground conditions and proximity of services and supplies. The following sub-sections specify the assumptions made, the project deliverables, capital costs, operational costs and excluded items.

8.1 Assumptions

8.1.1 Waste Stream

To enable accurate predictions of recycling/composting rates, tonnage of compost produced for sale, amount of water and nitrogen to be added to the composting process, together with other operational details, it is necessary to know the average composition of the proposed waste stream. Bedminster would normally undertake a waste audit as part of a Feasibility Study to determine the percentages of waste in each of 15 different fractions of the waste stream. In the absence of such detailed waste data, an estimation of the 15 different waste fractions has been made from other UK urban MSW streams, as shown in Table 3:

Waste Fraction	Percentage Wet Weight w/w
Food waste	11.9%
Fruit	0.0%
Garden waste (grass etc)	3.4%
Paper, newspapers etc.	21.0 %
Paper packing, cardboard	8.6%
Other Biodegradable	5.7%
Plastic bags, plastic film	4.4%
Other plastic	6.8%
Textiles	2.7%
Other combustibles	9.0%
Metal	3.2%
Aluminium	0.7%
Glass	8.1%
Other non combustibles	8.3%
Fines <10mm	6.0%
Hazardous	0.3%
Sewage sludge (15% dry solids)	225 tpd
Note: The total may not amount to 100% due to rounding errors.	

Table 3: Assumed waste stream fractions

8.1.2 Financial Assumptions

For the purposes of this proposal certain assumptions have been made concerning the capital and running costs of the plant. Any errors in the assumed costs will reflect in the projected running costs of the facility and hence the projected gate fees. The magnitude of such differences will be dependent upon the magnitude of error in the assumptions and their individual impacts on the overall running cost of the facility. Sustainable Environmental Systems would be pleased to provide a revised budget quotation in the event of any serious error having been made in the following assumptions:

Description		**Rate Assumed (£)**
Exchange Rates:	1 GBP = 15 SEK	
RPI:	Inflation Rate (per annum) – assumed fixed. *Assumed that gate fees, rates, services etc are linked to RPI*	2.0%
Corporation Tax	Annual Corporation Tax	30%
Land Prices:	Not included	0
Utilities:	Gas (per m^3) *Assumed that gas is not available*	N/A
	Water (per m^3) *Assumed connection available at site perimeter*	1.00
	Green Electricity (per kWh) *Connection fees and line rates have not been included as these will be site specific. A line with a spare capacity of approximately 1.8 MWatts will be required for a 450tpd facility.*	0.044
	Sewerage (per m^3) *Assumed connection available at site perimeter*	1.00
Fuels:	Heavy Fuel Oil (per m^3)	140
	Heating Oil (per m^3)	140
	Diesel (per litre)	0.74
Labour Costs:	Plant Manager	45,000
per annum	Lab Technicians	33,000
(Inc. all overheads)	Mechanical Technicians	25,000
	Electrical Technicians	25,000
	Semi-skilled Labourers	16,500
	Labourer	15,000

Description		Rate Assumed (£)
	Contract Labour (to cover sickness etc)	20,000
	Office Administrator	20,000
	Office Junior	15,000
Rates:	Estimated annual rates	0
Expenses:	Cost of incineration of residuals (per tonne) including transportation, containers etc	40
	Cost of landfill of residuals (per tonne) including transportation, containers etc	40
Revenues:	Steel for recycling (per tonne)	10
	Aluminium for recycling (per tonne)	450
	Glass for recycling (per tonne)	0
	Compost pellets for agriculture (per tonne)	0
	Compost pellets for the consumer market (per tonne)	0
	Loose compost (per tonne)	0

Table 4: Assumed income/expenditure

8.2 Scope of Supply

This section details all deliverables included in this budget proposal. Items not specified within this section are not included in the project costings of section 8.3.

Item	Details
Loading Hall	All construction as shown on drawings G5347/1 and 400-2. Estimated piling. Electrical lighting, building services, fire protection, Feed Pits, Sludge Pits, shredder, 2.8m^3 front-end loader, air collection system and air curtains, bag splitter, metal separators, screw augers and associated conveyor belts.
Eweson Digesters	Three 150tpd Eweson Digesters and four sets of concrete bearing pedestals.
Separation Hall	All construction as shown on drawings G5347/1 and 400-2. Estimated piling. Electrical lighting, building services, fire protection, trommel screen, destoner, magnetic separator, RORO loading chute and associated conveyor belts.

Item	Details
Aeration Hall	All construction as shown on drawings G5347/1 and 400-2. Estimated piling. Electrical lighting, building services, fire protection, four cranes, fan arrays, aeration floor, leachate capture and re-circulation system, 0.36m^3 skid-steer loader and associated conveyor belts.
Bagging and Storage Area	All construction as shown on drawings G5347/1 and 400-2. Estimated piling. Electrical lighting, building services, fire protection, belt dryer, Dry Gravity Separator, Additives Unit, bagging station.
Biofilter	All construction as shown on drawings G5347/1 and 400-2. Estimated piling. Electrical lighting, building services, fire protection, biofilter material. All pipework required to duct process air from Loading Hall, Eweson Digesters, Separation Hall and Aeration Hall through the biofilter.
External Works	Excavation (**500mm over entire site**), surfacing, drainage, services (**estimated**), limited work to existing roads (**estimated**), fencing and gates.
Project Overheads	Detailed design of structures, architectural plans and elevations, detailed project management, site management, site accommodation, temporary site services (**estimated**), insurance.
Documentation	Full set of “as built” design drawings, maintenance manual and quality control manual.

8.3 Budget Capital Costs

The total capital cost of this project is estimated at £30M. This figure is likely to be a worst-case scenario and will in all probability be substantially reduced as a result of a Feasibility Study. This figure does not include items listed in section 8.4.

8.4 Excluded Capital Items

This section identifies items that are specifically excluded from this budget proposal as they have still to be determined due to current lack of information.

Item	Details
Feasibility Study	Required to identify waste composition, compost markets, sub-soil ground conditions, site contamination etc.
Planning Approvals	All planning issues can be undertaken by Posford Haskoning. An Environmental Impact Assessment can be carried out if required but would be subject to additional costs.
Fees to statutory authorities	Not included.
IPPC Authorisation	Not included.
Waste Management Licence	Cost of licensing the facility is not included.
Site clearance	The extent and cost of site clearance will be determined as part of a Feasibility Study
Site remediation and contamination issues	To be determined after a thorough site investigation including geotechnical survey which will form part of a Feasibility Study. There will be a possibility of the presence of unexploded munitions within the alluvium beneath the site. The nearby presence of the River Lea will require detailed contamination and pollution investigations.
Architectural	Any aesthetic work required. The buildings quoted will have a painted cladding finish except the Aeration Hall which will have a concrete finish.
Pelletising Equipment	Pelletising equipment can be provided as an optional extra at a cost of approximately £700k. Viability will depend on compost markets.
Connection to utilities	All utilities have been assumed available at site boundary but connection fees have not been included.
Works outside site boundary	Rerouting of roads, traffic signage etc. will be the responsibility of site owner.
Land	The land value of the site is not included.
Planning Inquiries	No contingency has been allocated for planning inquiries.
Deep Piling	An estimate of piling requirements has been made. The full extent of piling requirements will be determined after a geotechnical survey of the site has been carried out.

8.5 Gate Fees

The total operating costs of the proposed facility are estimated at £4.4M/year (£29.70/tonne of solid waste) at 2002 prices.

The gate fee required to cover financing and operational costs would be £50/tonne at today's prices. However, a profit sharing agreement would enable the additional revenue streams from the sale of 75,000 tonnes of compost (approx. £2.0M/year) and the gate-fees charged for disposal of sewage sludge or other high nitrogenous wastes (approx. £3.0M/year) could potentially reduce the gate fee by £15/tonne.

The estimated operational cost does not include items listed in section 8.6. It should also be noted that this figure is dependent upon disposal costs and waste stream contents. Vehicle maintenance is estimated on 2005 requirements.

8.6 Excluded Operational Income and Expenditure

This section identifies items that are specifically excluded from this budget proposal as they have still to be determined.

Item	Details
Rates	Commercial rates are not included.
Pelletising	Pelletising equipment can be provided as an optional extra. The operational cost of the pelletising equipment is approximately £2/tonne of compost.
Compost	A zero income/cost has been assumed per tonne of compost manufactured.
Sewage	A zero income has been assumed per tonne of sewage sludge processed.
Insurance	No commercial or efficacy insurance included.
Carbon Credits	Centralised composting is a carbon negative process and should therefore be eligible for Carbon Credits. These offer an additional source of income which has not been included.

8.7 Project Timeline

The commencement of detailed design work will require a Feasibility Study, see section 10, which will take 16 weeks prior to the start of the detailed design work. Detailed design and architectural work will take an additional 12 weeks prior to commencement of construction. It is anticipated that construction will take 40 weeks. Following completion of construction there will be an additional 10 weeks for final installation and commissioning of the Bedminster plant prior to startup. The overall project timescale, including Feasibility Study, is therefore estimated to be 78 weeks from commencement to startup, assuming planning consent is obtained with no complications.

9 Project Partners

9.1 Posford Haskoning

Detailed site design, development and project management would be undertaken by Posford Haskoning. Posford Haskoning, formerly Posford Duvivier, have an annual turnover of £20M and are part of the Royal Haskoning group with an annual turnover of £106M. They have considerable experience in this field having designed many large, high profile projects including waste management facilities:

Project	Description	Capital Value £
SELCHP 1991 to 1994	Design and build.	£40M
Chineham MSW Incinerator	Design and build.	£35M
AVIRA Waste Processing Company	Design and build.	£50M
VVI-West	Design of integrated waste disposal centre.	£100M
Canary Wharf	Design of underground station at London Docklands.	
International Airport	Newcastle international airport.	
Palm House	Palm House, Kew Gardens, London.	

The company has considerable experience of liaison with Local Authorities, the Environment Agency and many local interest groups in order to obtain necessary consents.

Posford Haskoning also have considerable expertise in remediation of brownfield sites.

9.2 Costain Limited

Costain are a major UK construction company with a annual turnover of £750M. Recent projects include:

Project	Description	Value £
SELCHP 1991 to 1994	1200 CFA piles. Costain placed 18,000m³ of structural concrete, 500 tonnes of structural steel, 11,000m² of cladding and 4,000m² of architectural brickwork. Posford Duvivier were the consulting engineers.	£14M
Victoria Wharf 1995- 1996	Ground excavation and foundations for the structural steel, powerfloated floor slabs, structural steel, wall cladding, roof, and roller shutter doors, associated external works including concrete aprons, drainage and a new fire main were undertaken by our direct labour.	£0.35M

Project	Description	Value £
Port of Tilbury London Ltd. 1994-1999	Demolition of existing buildings and construction of new warehouses, large span bulk storage shed and cold store. Large span animal feed bulk storage facility 18,000m^2.	£9M
Dwr Cymru – Welsh Water 1997-1999	Construction of a waste water Treatment Works using the Sequential Batch Reactor process. Civil, building, mechanical, electrical and process works.	£28M
National Power plc Gale Common 1993 - 1997	Principal Contractor for ash disposal lagoons. Supply and installation of 150,000m^2 of geomembrane liner to two lagoons, raising of reinforced concrete structures, dismantling and relaying of some 6km of 600mm diameter steel pipes, maintenance of site roads and landscaping and restoration works. Environmental management and protection of groundwater regime.	£4.2M
Cory Environmental Ltd. Wallbrook Wharf 1995-1996	Modernisation of waste transfer station and construction of riverside walk. Filling of existing docks and slabbing of entire area, supply and installation of compactor, dust control and crane. Upgrading of M&E and HVAC systems.	£3.6M

9.3 Rabo Bank

Rabo Bank is one of the world's largest financial institutions and has already indicated its willingness to finance Bedminster facilities in Europe.

9.4 Houlder Insurance

Houlder Insurance is a major Lloyds underwriters that has experience in insurance of Bedminster plants. They can provide all necessary commercial and efficacy insurance for the project.

10 Feasibility Study

10.1 Scope of Study

To provide the most accurate costings for the proposed project it will be necessary to conduct a Feasibility Study. The study would include:

- Topographic site survey.
- Contamination survey.
- Sub-soil survey to determine foundation and piling requirements.
- Waste audit to determine waste stream composition and contamination.
- Determine availability of sludge or other nitrogenous waste streams.
- Determine proximity and capacity of site services
- Identify compost market – how much to local market, to agriculture, to land remediation, to sports turf applications – determine maturation periods required.
- Preliminary design work based on study findings to more accurately determine site-specific construction costs.

10.2 Study Timeline

A typical Feasibility Study would take 4 months to complete.

A. Construction Drawings

This section contains the following drawings:

Description	Drawing Number
450tpd Facility: Plan view	G5347/1
450tpd Facility: Side Elevations	400-2