1. INTRODUCTION

This outline business plan is intended to provide a commercial organisation interested in recycling construction, demolition and excavation waste (CD&EW) with sufficient costing and resource information to decide, with confidence, whether and under what circumstances to proceed with a detailed business plan for investing in CD&EW recycling in the UK.

Through the development of a spreadsheet-based financial model and a set of associated guidelines, practitioners can analyse a range of feedstock, process plant and recycled product scenarios to identify how to maximise product value in line with regional market conditions and demands.

The model is intended to both provide an initial feasibility appraisal and also allow users to identify the relative sensitivity of the business case to changes in key product or process variables [options?]. It is aimed at both organisations already engaged in recycling activities that wish to explore new opportunities and also at new start operators.

The outline business plan comprises the following sections [change order below to match that in the contents]:

Section 2 Products and services – defines the scope of the model in terms of feedstock materials, process options and recycled aggregate products;

Section 4 Operations and systems – highlights legislative, environmental and health and safety requirements for establishing and operating recycling facilities;

Section 3 Staff, equipment and transport – provides data describing key operational costs;

Section 5 Markets, legal issues and competition – characterises regional demand patterns, price information, legislative risk and funding opportunities; and

Section 6 Economic and financial issues – outlines the key variables used in the spreadsheet model and an overview of the model structure.

Formatted: Bullets and Numbering

2. PRODUCTS AND SERVICES

This section outlines:

- The arisings of CD&EW considered in this business planning guidance;
- The range of potential aggregate products that can be processed from these arisings; and
- The process plant required for such processing activities.

2.1 Construction and Demolition Waste Arisings

For the purpose of this guidance CD&EW is defined as:

Inert, non-hazardous and uncontaminated waste materials which arise from the construction or demolition of buildings and/or civil engineering infrastructure, including hard construction and demolition waste, and excavation waste, whether segregated or mixed.

where 'inert waste' is as defined in *The Quality Protocol for the Production of Aggregates from Inert Waste* (WRAP, 2004), further details are available at: <http://www.wrap.org.uk/publications/QualityProtocolAgg.pdf> or <http://www.wrap.org.uk/publications/QPScotland.pdf>.

More specifically, CD&EW is assumed to comprise the following arisings:

- Aggregates recovered from trench arisings;
- Concrete;
- Masonry;
- Bricks;
- Tiles and ceramics;
- Unbound materials (aggregates which do not have an added binder);
- Stone;
- Asphalt;
- Terracotta; and
- Mixed flows of the above materials.

Opportunities to use these arisings in aggregate products have been identified using experience within the project team and from the WRAP AggRegain website at <http://www.aggregain.org.uk/>. Waste arisings are grouped under three main headings to highlight their suitability for specific products (Table 2.1). A summary of the products identified under each heading is presented in Appendix A.

2.2 Products

Non-hazardous and uncontaminated CD&EW may be reprocessed to generate products with a wide range of potential applications. Each of these products has specific grading and composition requirements which are summarised in Appendix A. However, the processing requirements for many of these products are similar.

Table 2.1 Groupings applied to waste arisings.

Waste Arising	Category*
Aggregates recovered from trench arisings	RA
Concrete	RCA
Masonry	RA
Bricks	RA
Tiles and ceramics	RA
Unbound materials	RA
Stone	RA
Asphalt	RAP
Mixed flows of the above materials	RA

*Defined as (WRAP, 2004):
RA recycled aggregate: aggregate resulting from the processing of inorganic material previously used in construction;
RCA recycled concrete aggregate: recycled aggregate principally comprising crushed concrete;
RAP recycled asphalt planings: recycled aggregate consisting of crushed or milled asphalt.
Further details available at:
<http://www.wrap.org.uk/publications/QualityProtocolAgg.pdf>
or <http://www.wrap.org.uk/publications/QPScotland.pdf>

Consequently, products outlined in Appendix A are listed under the following generic product groups:

- Aggregates for concrete;
- Aggregates for asphalt;
- Other graded aggregates;
- Aggregates for Specification for Highways Works (SHW) sub base types 1, 2 and 3;
- Aggregates for SHW capping layer;
- Aggregates for SHW fill;
- Aggregates for general fill; and
- Fines generated from recycling.

These generic product groups form the basis of the analysis of process options presented below.

2.3 Process Options

Plant required to process the CD&EW arisings into each of the generic product groups are presented in Figures 2.1a to 2.1c, with brief descriptions of their individual operational function outlined in Appendix B. While Figures 2.1a to 2.1c highlight the need for more sophisticated plant to produce some product groups it is important to recognise that even sites using the most sophisticated plant will also produce lower grade products such as fills and capping. Legends defining the waste inputs and product outputs as used in Figures 2.1a to 2.1c are presented in Table 2.2.

Process options identified in Figures 2.1a to 2.1c form the basis of the following economic analysis and are the central elements of the enterprise forecasting tool outlined in Section 6.

It is important to recognise that each stream within the process options does not necessarily produce a distinct product. Rather, they can be used to produce constituent parts of a given product which are subsequently blended. The specifications for many aggregate products allow a range of different constituent materials to be used, consequently it is not possible to assign the products identified in Figures 2.1b and 2.1c to particular items of process plant. Operators are advised to consult AggRegain, the sustainable aggregate information service from WRAP, for the specifications for different products at <http://www.aggregain.org.uk>.

Table 2.2 Legends for waste inputs and product outputs used in Figures 2.1a to 2.1c.

Waste arisings	**Code**
Trench arisings	A
Concrete	B
Masonry	C
Bricks	D
Tiles and ceramics	E
Unbound materials	F
Stone	G
Asphalt	H
Terracotta	I
Mixed flows of the above materials	J
Product	
Aggregates for concrete	1
Aggregates for asphalt	2
Other graded aggregates	3
Aggregates for SHW sub base types 1, 2 and 3	4
Aggregates for SHW capping layer	5
Aggregates for SHW fill	6
Aggregates for general fill	7

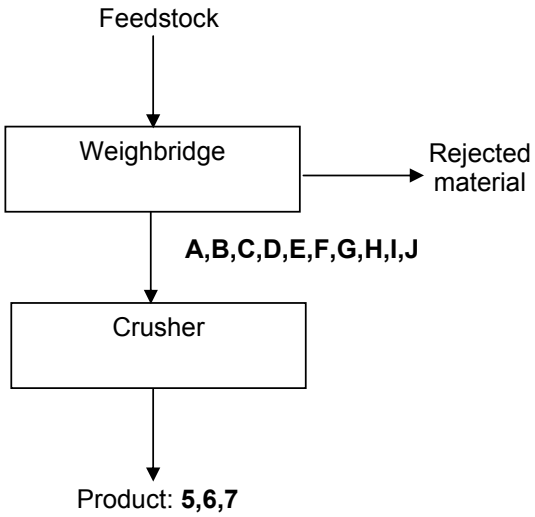


Figure 2.1a Process plant requirements for lower value aggregate products.

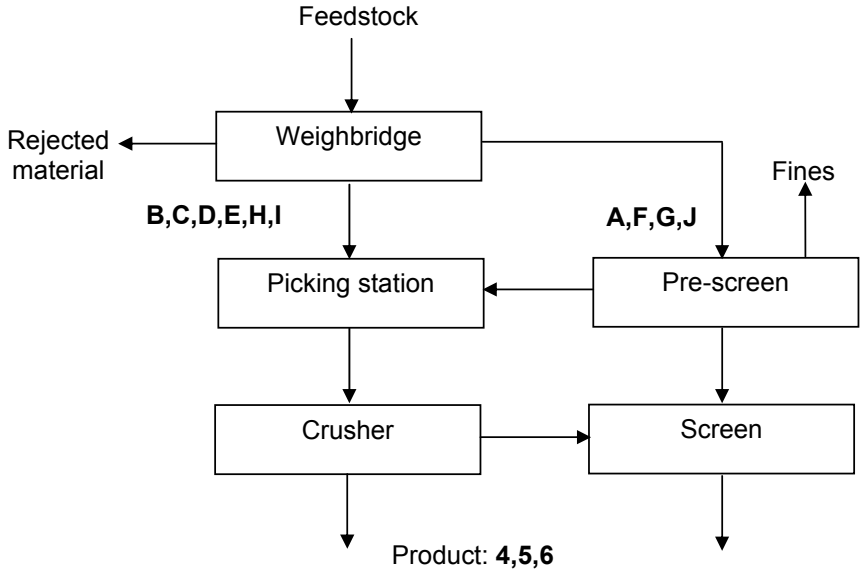


Figure 2.1b Process plant requirements for lower and mid-value aggregate products.

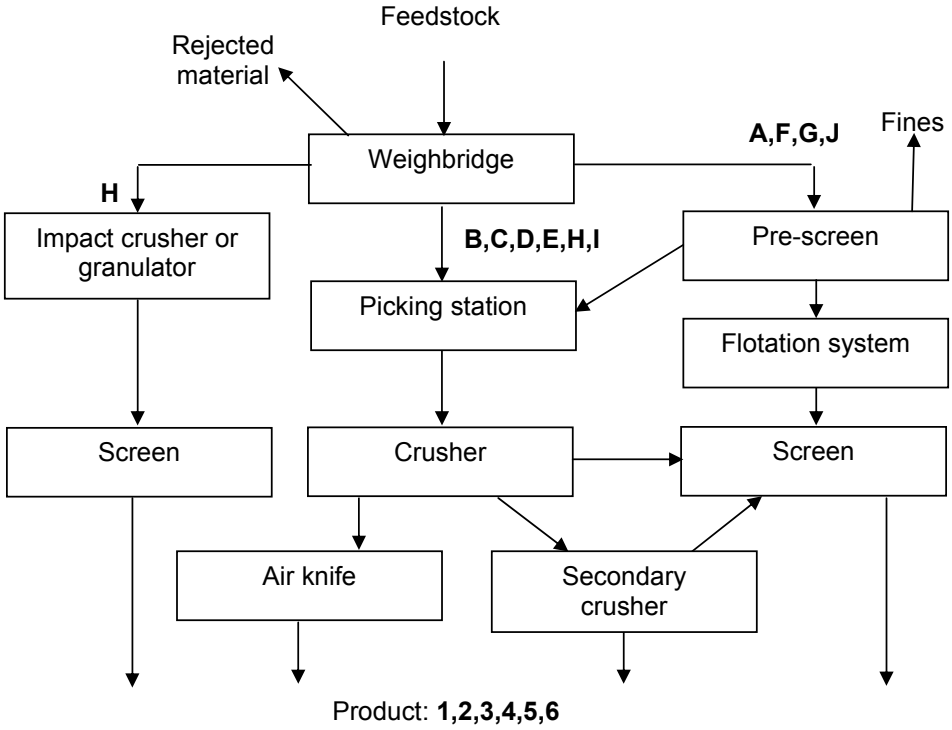


Figure 2.1c Process plant requirements for producing the full range of aggregate products.

3. STAFF, EQUIPMENT AND TRANSPORT COSTS

This section presents an overview of the typical capital, operational and maintenance costs associated with CD&EW aggregate recycling facilities. Costs provided are generic in nature and should be used for guidance purposes only. The data used and assumptions made are based on information supplied directly by plant and equipment manufacturers, or through information provided by the project steering group, in particular John Barritt, Head of Aggregates, Waste and Resources Action Programme (WRAP) who provided considerable expertise and data.

Only those costs that vary significantly as a result of different processing options or their direct staffing requirements are considered. Costs which are likely to be either fixed for all sites, or highly site specific, such as signage, utilities and boundary fencing, are outside the scope of the information presented in this section.

The review is based on consideration of costs associated with three processing options operating at three levels of annual throughput. The options are described in Section 2.3 and depicted schematically in Figures 2.1a to 2.1c. To investigate the impacts of scale, each option is considered at three levels of annual throughput which were developed in consultation with the project steering group:

50,000 tonnes/year;
100,000 tonnes/year; and
150,000 tonnes/year.

3.1 Summary of Process Costs

Overall estimated process costs based on the factors considered below in Sections 3.2.2 to 3.2.8 are summarised in Table 3.1 and Figure 3.1. Cost profiles are presented for process options where all plant and equipment is purchased as well as for process options where the higher value plant items are rented.

The most significant contributors to operational costs are labour, depreciation/rental and maintenance costs. Costs associated with the consumption and production of energy, water and waste account for between 2% and 10% of total operational costs. These costs suggest the complexity of a process option has a less significant impact on product costs as throughput increases.

Also, the financial case to purchase or hire expensive plant items may not be clear for the production of lower or mid-value products especially as throughput increases. In contrast, the financial case to purchase plant becomes stronger for the production of high-value products if operated at higher throughputs (Figure 3.1).

Table 3.1 Summary of process costs for different processing options.

Process option and throughput (t/yr)	Energy costs (£/t)	Labour costs (£/t)	Water costs (£/t)	Waste disposal costs (£/t)	Plant rental costs (£/t)	Depreciat'n costs (£/t)	Maint'nce costs (£/t)[1]	Total operat'l costs (£/t)
Costs associated with the purchase of all plant items								
a. 50,000	0.063	1.8	0.013	0	N/a	1.414	0.50	4.17
a. 100,000	0.063	1.2	0.007	0	N/a	0.707	0.50	2.51
a. 150,000	0.063	0.8	0.005	0	N/a	0.471	0.50	1.75
b. 50,000	0.112	3.0	0.015	0.063	N/a	2.258	0.50	6.78
b. 100,000	0.112	1.5	0.007	0.063	N/a	1.129	0.50	3.58
b. 150,000	0.112	1.2	0.005	0.063	N/a	0.753	0.50	2.72
c. 50,000	0.307	3.0	0.015	0.126	N/a	3.994	2.67	9.66
c. 100,000	0.307	1.5	0.008	0.126	N/a	1.997	2.67	5.16
c. 150,000	0.307	1.2	0.005	0.126	N/a	1.331	2.67	3.86
Costs associated with processes where larger plant items are rented								
a. 50,000	0.063	1.8	0.013	0	0.50	0.826	N/a	3.20
a. 100,000	0.063	1.2	0.007	0	0.50	0.413	N/a	2.18
a. 150,000	0.063	0.8	0.005	0	0.50	0.280	N/a	1.84
b. 50,000	0.112	3.0	0.015	0.063	0.50	1.670	N/a	5.28
b. 100,000	0.112	1.5	0.007	0.063	0.50	0.835	N/a	2.94
b. 150,000	0.112	1.2	0.005	0.063	0.50	0.560	N/a	2.55
c. 50,000	0.307	3.0	0.015	0.126	2.67	3.010	N/a	8.85
c. 100,000	0.307	1.5	0.008	0.126	2.67	1.505	N/a	5.84
c. 150,000	0.307	1.2	0.005	0.126	2.67	1.000	N/a	5.36

[1]Maintenance costs for hired plant assumed to be the responsibility of the leasing company.

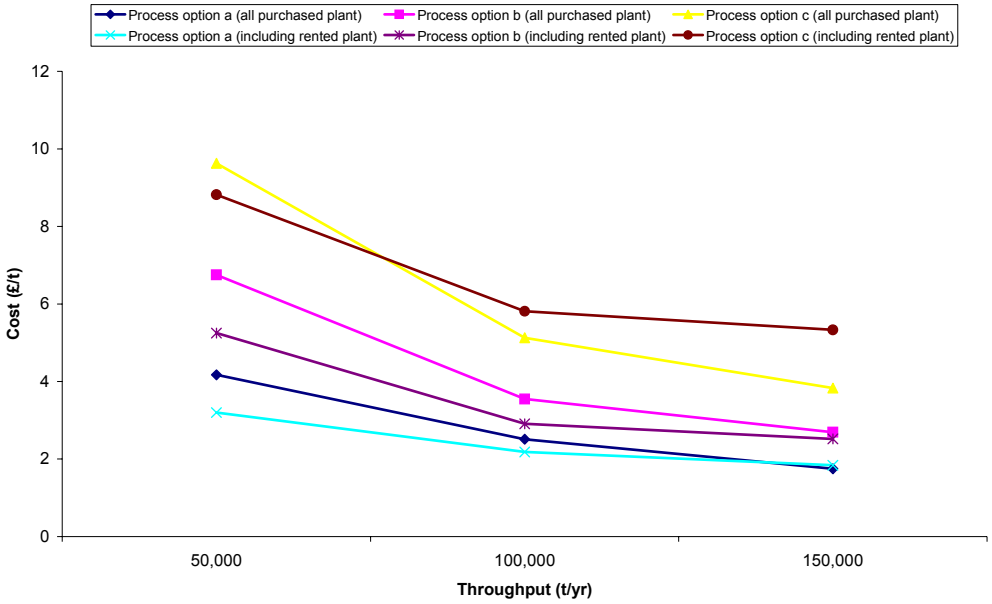


Figure 3.1 Operational costs for different processing options.

3.2 Capital Costs

3.2.1 Plant and Equipment

The principal plant and equipment required to develop the three process options outlined above are summarised in Table 3.2.

Table 3.2 Principal plant and equipment.

Plant/ Equipment	Purpose	Process Option a	Process Option b	Process Option c
Weighbridge	Determining load sizes	✔	✔	✔
Excavator	Moving feedstock	✔	✔	✔
Impact crusher	Sizing aggregate	✔	✔	✔
Wheeled loader	Moving product	✔	✔	✔
Pre-screen	Removing over-size items		✔	✔
Picking station	Removing foreign material		✔	✔
3 way screen	Sorting aggregate		✔	✔
Flotation system	Removing foreign matter			✔
Secondary crusher	Sizing aggregate			✔
Air knife	Removing foreign matter			✔
Impact crusher or granulator for asphalt	Sizing aggregate			✔
Screen for crushed asphalt	Sorting aggregate			✔

Indicative capital costs and examples of specific plant model, manufacturer and UK supplier for items of plant and equipment to meet the processing requirements of each process option are presented in Table 3.3. It should be stressed that specific items of plant and equipment are included for the purpose of reference only and are not intended as a recommendation.

In each case, plant or equipment with a throughput capacity of approximately 150 tonnes per hour has been selected. This represents a middle-range throughput capacity for mobile plant and equipment which could satisfy the annual throughput requirements outlined above. If maintained over extended periods this level of capacity could potentially exceed the upper level of these annual throughput requirements. However, it might be necessary in some cases to process large quantities of a given material quickly in order to meet orders within a short time frame (Barritt, 2004a). With the exception of the weighbridge, picking station, flotation system and air knife, all plant and equipment is ‘mobile’ to allow flexibility in processing options.

For higher value items of plant, such as crushers and granulators, plant rental may prove the most economic option, particularly when depreciation and maintenance costs are taken into account. Indicative daily rental rates for high value items are outlined in Table 3.3 while the impact of renting such plant on overall capital costs is presented in Table 3.4. The potential cost effectiveness of renting plant is considered in more detail in Section 3.2.6 below.

Table 3.3 Examples of typical plant and equipment capital costs.

Plant/equipment	Features	Installed Cost [rental cost/day]* (£)
Weighbridge	Transportable surface mounted weighbridge	16,500[a]
Excavator		75,000[b]
Pre-screen	Heavy duty track mounted open flow system.	135,000[c]
Picking station	Four-bay mobile picking unit	46,000[d]
Flotation system		35,000[e]
Impact crusher	Attached overband magnetic separator, track mounted, low noise and dust burden	147,000[f] [600]
Wheeled loader		115,000[b]
3 way screen	100% screening accuracy	30,000[g]
Secondary crusher	Attached overband magnetic separator, track mounted, low noise and dust burden	147,000[f] [600]
Air Knife		20,000[h]
Granulator for asphalt	Throughput of 60 t/h, semi-mobile, unlike impactors can be used during summer.	202,000[I] [800]
Screen for crushed asphalt	100% screening accuracy	30,000[g]

*Costs are for Summer 2004.
Plant costs from: a - Marsden Weighing Group; b – Volvo; c – Extec; d - LJH Group Ltd; e – Powerscreen; f APR Ltd; g – CRMS; h – Airtec; I - Proteus Systems Ltd.

The total capital plant and equipment costs for the different processing scenarios are summarised in Table 3.4. As a single capacity of plant is adopted the level of annual throughput does not affect capital costs and consequently only one cost is presented for each process option. Clearly, if larger plant items are rented the total capital costs will be lower than if all plant is purchased and the impact of renting such plant is presented in Table 3.4. Figures in the top half of Table 3.4 reflect the costs associated with the purchase of all plant, while those in the bottom half of Table 3.4 are based on the assumption that plant available for hire, as outlined in Table 3.3, has been rented. The capital costs therefore reflect costs associated with the remaining plant items that need to be purchased.

Table 3.4 Summary of capital costs.

Process option	Plant and equipment costs (£)*
Costs associated with the purchase of all plant items	
a	353,500
b	564,500
c	998,500
Costs associated with processes where larger plant items are rented	
a	206,500
b	417,500
c	752,500

*Based on those items of plant identified in Table 3.2.

3.2.2 Other Capital Costs

Other capital costs associated with an aggregate recycling facility are likely to include, but not be restricted to:

- Acquisition of land (if purchased);
- Civil engineering considerations:
  - Hard standing,
  - Bunding,
  - Drainage,
  - Sewerage and on-site water and waste water treatment;
- Site office and sanitary facilities;
- Access roads;
- Signage;
- Location (urban, rural);
- Boundary protection; and
- Environmental requirements:
  - Dust suppression,
  - Noise Abatement.

While such costs could be considerable, their impact is likely to be dependent on individual site considerations and as such are outside the scope of this document.

3.3 Operating Costs

3.3.1 Energy

Energy for the operation of the principal processing plant and equipment is generally provided by either mains electricity or diesel. Operational energy requirements and costs, of the different items of processing plant and equipment, are summarised in Table 3.5. Estimated total energy requirements for the different processing options outlined in Table 3.2 are presented in Tables 3.5 and 3.6.

Table 3.5 Typical plant and equipment energy consumption.

Plant/ Equipment	Electricity/fuel consumption	Cost per hour (£/hr)[1,2]	Cost per tonne of throughput[3] (£/t)
Weighbridge	3.1 kWh	0.20	0.001
Excavator	11.0 litres/hr	2.75	0.018
Pre-screen	18.5 litres/hr	4.63	0.031
Picking Station	9.6 litres /hr	2.4	0.016
Flotation System	N/a	N/a	0.065[4]
Impact Crusher	14.0 litres/hr	3.42	0.023
Wheeled Loader	12.0 litres/hr[5]	3.00	0.020
3 Way Screen	1.3 litres/hr	0.33	0.002
Secondary Crusher	14.0 litres/hr	3.42	0.023
Air Knife	4.0 kWh	0.25	0.002
Granulator for Asphalt	97.5 kWh	6.17	0.103
Screen for Crushed Asphalt	1.3 litres/hr	0.33	0.002

Notes: [1] Assuming mains electricity costs of £0.0633 per kWh <http://www.ukenergy.co.uk> npower tariff as at 23rd August 2004.
[2] Assuming red diesel costs of 25 pence per litre <http://www.bocmpauls.co.uk/F4F/news/index.jhtml?article_id=fwi15604> 23rd August 2004.
[3] Based on an assumed throughput of 150t/h unless otherwise stated.
[4] Figure provided directly by manufacturer (Bell, 2004).
[5] Assuming consumption associated with average operating conditions as outlined by the manufacturer.

Table 3.6 Summary of estimated process option energy costs.

Process option	Annual production (t/yr)	Cost per tonne of throughput (£/t)
a	50,000	0.063
a	100,000	0.063
a	150,000	0.063
b	50,000	0.112
b	100,000	0.112
b	150,000	0.112
c	50,000	0.307
c	100,000	0.307
c	150,000	0.307

3.3.2 Labour

Staff requirements are based on a single eight-hour shift pattern operating five days per week. The number of staff required to man the processing plant and equipment for the different aggregate processing options under this operational regime are outlined in Table 3.7.

Labour costs associated with this regime are presented in Table 3.8 and are based on an assumed salary of £25,000 per annum for each individual with an additional 20% for costs (Barritt, 2004b). Figures presented in Table 3.8 highlight the likely economies of scale that could be realised when operating at higher throughputs.

Table 3.7 Typical labour requirements for different process options.

	Staff Required					
Plant/Equipment	**Process option a throughput 50,000t/yr**	**Process option a throughput 100,000t/yr**	**Process option a throughput 150,000t/yr**	**Process option b/c* throughput 50,000t/yr**	**Process option b/c* throughput 100,000t/yr**	**Process option b/c* throughput 150,000t/yr**
Weighbridge	1	1	1	1	1	1
Excavator	0.5	1	1	1	1	1
Loader	0.5	1	1	0.5	0.5	2
Crusher(s)	1	1	1	1	1	1
Picking Station/ Screens				1.5	1.5	1
Total	**3**	**4**	**4**	**5**	**5**	**6**

* Staff required for process options b and c are deemed to be the same.

Table 3.8 Labour costs for different process options.

Process option and throughput (t/yr)	Number of staff	Annual cost (£)	Cost per tonne (£)
a. 50,000	3	90,000	1.80
a. 100,000	4	120,000	1.20
a. 150,000	4	120,000	0.80
b. 50,000	5	150,000	3.00
b. 100,000	5	150,000	1.50
b. 150,000	6	180,000	1.20
c. 50,000	5	150,000	3.00
c. 100,000	5	150,000	1.50
c. 150,000	6	180,000	1.20

3.3.3 Water

Water consumption at aggregate recycling facilities is dependent on process plant requirements and staff activities. Estimates of the potential consumption patterns and the associated cost of water for each of the process options are presented in Table 3.9.

Estimated water discharge costs reflect discharges associated with staff use, as well as surface and highway run-off which are accounted for in the volumetric charge of the water company. As most of the water used for processing operations is lost through evaporation and incorporation into the processed aggregate it is assumed to have no associated discharge costs.

For the purpose of this business planning guidance, wastewater generated from non-operational activities is assumed to be equal to the volume consumed. Volumetric service charges are likely to account for the fact that some of the water used will not enter the sewers (<http://www.nwl.co.uk/content/forbusiness>, 25th August 2004). Estimated water discharge costs for the various process options are summarised in Table 3.10. The combined water supply and sewerage costs per tonne of output are presented in Table 3.11. Figures presented in Tables 3.9, 3.10 and 3.11 are provided for illustration only and are based on current charges in the Southern Water region. Recycling facility operators should be aware that regional water charges are likely to vary.

Table 3.9 Estimated water supply costs for different processing options.

Process option and throughput (t/yr)	Staff water consump'n (litres/day)[1]	Plant and equipment water consump'n (litres/day)[2]	Annual water consump'n[3] (m^3/yr)	Annual consump'n costs[4] (£/yr)	Fixed annual costs[5] (£/yr)	Total annual costs (£/yr)	Total costs per tonne (£/t)
a. 50,000	150	90	60.0	55.40	269	324.40	0.0065
a. 100,000	200	90	72.5	66.94	269	335.94	0.0034
a. 150,000	200	90	72.5	66.94	269	335.94	0.0022
b. 50,000	250	90	85.0	78.48	269	347.48	0.0069
b. 100,000	250	90	85.0	78.48	269	347.48	0.0035
b. 150,000	300	90	97.5	90.02	269	359.02	0.0024
c. 50,000	250	190	110.0	101.56	269	370.56	0.0074
c. 100,000	250	190	110.0	101.56	269	370.56	0.0037
c. 150,000	300	190	122.5	113.10	269	382.10	0.0025

Notes: [1] Assuming 50 litres/day/person (The approximate consumption for offices quoted by DEFRA is 50 litres/day/person (<http://www.defra.gov.uk/environment/envrp/water/07.htm>, 25th August 2004)).
[2] Where crushers consume 90 litres/day for dust suppression, and flotation tanks require 10 litres /day for topping up (based on manufacturer's data).
[3] Assuming consumption over 250 working days per year.
[4] Based on Southern Water's measured water tariff volume charge of £0.9233/m^3 for 2004/5.
[5] Including standing charge and water infrastructure charge.

Table 3.10 Wastewater costs for different processing options.

Process option and throughput (t/yr)	Staff water discharge (litres/day)	Annual water discharge (m^3/yr)	Annual discharge costs[1] (£/yr)	Fixed annual costs[2] (£/yr)	Total annual costs (£/yr)	Total costs per tonne (£/t)
a. 50,000	150	37.5	72.00	260.24	332.24	0.0066
a. 100,000	200	50.0	97.33	260.24	357.57	0.0036
a. 150,000	200	50.0	97.33	260.24	357.57	0.0024
b. 50,000	250	62.5	121.66	260.24	381.90	0.0076
b. 100,000	250	62.5	121.66	260.24	381.90	0.0038
b. 150,000	300	75.0	145.00	260.24	405.24	0.0027
c. 50,000	250	62.5	121.66	260.24	381.90	0.0076
c. 100,000	250	62.5	121.66	260.24	381.90	0.0038
c. 150,000	300	75.0	145.00	260.24	405.24	0.0027

Notes: [1] Based on Southern Water's volume charge tariff for foul, surface and highway discharges of £1.9466/m^3 for 2004/5.
[2] Including standing charge and sewerage infrastructure charge.

Table 3.11 Combined water supply and sewerage charges for different processing options.

Process option and throughput (t/yr)	Combined water supply and sewerage costs (£/t)
a. 50,000	0.013
a. 100,000	0.007
a. 150,000	0.005
b. 50,000	0.015
b. 100,000	0.007
b. 150,000	0.005
c. 50,000	0.015
c. 100,000	0.008
c. 150,000	0.005

3.3.4 Waste

The amount of waste generated at an aggregate recycling facility is largely dependent on the level of contamination arriving in the feedstock and the complexity of the process option in use. The waste implications of selecting process options of different complexity are summarised in Table 3.12. Only options a and c are considered as they represent the best and worst case scenarios. Clearly, the impacts of such implications will be dependent on local site conditions and need to be considered on a site-by-site basis by recycling facility operators.

Table 3.12 Waste implications of different process options.

Option	Advantages	Disadvantages
a	Less stringent material requirements; Lower volumes of waste generated; Lower waste disposal costs.	Lower product value
c	More stringent material requirements; Higher volumes of waste generated; Higher waste disposal costs.	Higher product value

Management of feedstock quality is an important aspect of site management (see Section 4). For the purpose of this business planning guidance it is assumed that hazardous materials will be rejected at the gate and will not become a waste issue at the site. Metals removed during processing will be sold for scrap leaving wood and plastics as the principal waste materials.

Estimates of waste arisings and disposal costs associated with each process option are summarised in Table 3.13.

Table 3.13 Estimated waste arisings and disposal costs for different processing options.

Process option and throughput (t/yr)	**Skips/week[1]**	**Annual arisings (t/yr)[2]**	**Annual landfill costs[3] (£/yr)**	**Cost per tonne (£/t)**
a. 50,000	0.0	0	0	0.000
a. 100,000	0.0	0	0	0.000
a. 150,000	0.0	0	0	0.000
b. 50,000	0.5	93	3,145	0.063
b. 100,000	1.0	185	6,290	0.063
b. 150,000	1.5	278	9,442	0.063
c. 50,000	1.0	185	6,290	0.126
c. 100,000	2.0	370	12,580	0.126
c. 150,000	3.0	555	18,870	0.126

Notes: [1] Assuming a skip capacity of 6.12 cubic metres.
[2] Assuming 50 working weeks/year and 3.7 tonnes per skip (3.7 tonnes of wood waste per 6.12 cubic metre capacity skip is estimated on the basis of 1 cubic metre of wood waste is equivalent to approximately 600kg (Adler, 1999)).
[3] Assuming average landfill costs of £34/tonne for active waste based on Southern Region £20/tonne gate fee plus £15 landfill tax; Midlands and Northern region £18/tonne gate fee plus £15 landfill tax (Holloway, 2004).

3.3.5 Rental

As outlined in Section 3.2.1, under some circumstances it may be more cost effective for re-processors to hire the more expensive items of plant and equipment to meet the fluctuating demands of the market as and when they occur.

Indicative rental costs per tonne of production for each process option are presented in Table 3.14 and are derived from daily rental charges for high value processing plant outlined above (Table 3.3). Prospective operators should note that it might be possible to obtain discounted rates, particularly if equipment is to be leased over longer periods.

Table 3.14 Rental costs for each process option.

Process option & thro'put (t/yr)	Plant item	Rental (£/day)	Daily throughput[1] (t/day)	Cost (£/t)	Total Cost (£/t)
a. 50,000	Crusher	600	1,200	0.50	0.50
a. 100,000	Crusher	600	1,200	0.50	0.50
a. 150,000	Crusher	600	1,200	0.50	0.50
b. 50,000	Crusher	600	1,200	0.50	0.50
b. 100,000	Crusher	600	1,200	0.50	0.50
b. 150,000	Crusher	600	1,200	0.50	0.50
c. 50,000	Crusher	600	1,200	0.50	
	Secondary Crusher	600	1,200	0.50	
	Asphalt Granulator	800	480	1.67	2.67
c. 100,000	Crusher	600	1,200	0.50	
	Secondary Crusher	600	1,200	0.50	
	Asphalt Granulator	800	480	1.67	2.67
c. 150,000	Crusher	600	1,200	0.50	
	Secondary Crusher	600	1,200	0.50	
	Asphalt Granulator	800	480	1.67	2.67

Notes: [1]Assuming hourly throughput of 150t/hr for crushers and 60t/h for the granulator, operational for 8 hours per day.

3.3.6 Depreciation

Depreciation of the processing plant and equipment can represent a significant cost for aggregate recycling operators. Following consultation with the project steering group, plant and equipment values are, for the purpose of this business planning guidance, assumed to depreciate linearly from the prices indicated in Tables 3.3 and 3.4 to zero over a five-year period.

The impacts of depreciation in terms of each tonne of saleable product are considered for process options where all plant are purchased and also for process options where items of plant are hired in line with data presented in Table 3.4 (Table 3.15). Consequently, for process options where some plant are assumed to be hired, depreciation is applied only to the remaining plant that is purchased (Table 3.4).

3.3.7 Servicing and Maintenance

Maintenance and servicing costs associated with aggregate recycling facilities will reflect the age of the item and the amount of work that it carries out over a fixed period. To account for these effects, maintenance costs are estimated as a percentage of initial typical equipment costs, over a five-year period and are presented in Table 3.16. Such costs are based on capital costs associated with all plant being purchased as outlined in Table 3.4. No allocation is made for maintenance costs associated with hired plant which are assumed to be the responsibility of the leasing company rather than the recycling facility operator.

3.4 Transport

Total vehicle operating costs are dependent on vehicle type and size, the annual distance travelled, the type of journey for example urban or rural, and whether vehicles are purchased or leased. The impact of such factors on the overall cost of producing recycled aggregate is in turn dependent on the patterns of distribution. Clearly, by minimising journeys where vehicles are empty operators can reduce the impacts of these costs for each tonne of product. As transport costs are dependent

on these factors it is not possible to provide indicative values. However, the enterprise modelling tool outlined in section 6 will enable the implications of transport costs to be explored more fully and allow site-specific regimes to be analysed.

Table 3.15 Depreciation costs for different processing options.

Process option and throughput (t/yr)	Total capital costs[1] (£)	Annual depreciation[2] (£/yr)	Depreciation (£/t)
Costs associated with the purchase of all plant items			
a. 50,000	353,500	70,700	1.41
a. 100,000	353,500	70,700	0.71
a. 150,000	353,500	70,700	0.47
b. 50,000	564,500	112,900	2.26
b. 100,000	564,500	112,900	1.13
b. 150,000	564,500	112,900	0.75
c. 50,000	998,500	199,700	3.99
c. 100,000	998,500	199,700	2.00
c. 150,000	998,500	199,700	1.33
Costs associated with processes where larger plant items are rented			
a. 50,000	206,500	41,300	0.83
a. 100,000	206,500	41,300	0.41
a. 150,000	206,500	41,300	0.28
b. 50,000	417,500	83,500	1.67
b. 100,000	417,500	83,500	0.84
b. 150,000	417,500	83,500	0.56
c. 50,000	752,500	150,500	3.01
c. 100,000	752,500	150,500	1.51
c. 150,000	752,500	150,500	1.00

Note: [1] From Table 3.4; [2] Assuming five year asset life.

Table 3.16 Maintenance costs associated with different processing options.

Process option and throughput (t/yr)	Year 1 Maint'nce costs (%)* *(£)*	Year 2 Maint'nce costs (%)* *(£)*	Year 3 Maint'nce costs (%)* *(£)*	Year 4 Maint'nce costs (%)* *(£)*	Year 5 Maint'nce costs (%)* *(£)*	Average Annual Maint'nce Costs (%)* *(£)*	Average Maint'nce Costs per tonne (£/t)
a. 50,000	7.5 *26,513*	10 *35,350*	12.5 *44,188*	15 *53,025*	17.5 *61,863*	12.5 *44,188*	0.88
a. 100,000	10 *35,350*	12.5 *44,188*	15 *53,025*	17.5 *61,863*	20 *70,700*	15 *53,025*	0.53
a. 150,000	12.5 *44,188*	15 *53,025*	17.5 *61,863*	20 *70,700*	22.5 *79,538*	17.5 *61,863*	0.41
b. 50,000	7.5 *42,338*	10 *56,450*	12.5 *70,563*	15 *84,675*	17.5 *98,788*	12.5 *70,563*	1.41
b. 100,000	10 *56,450*	12.5 *70,563*	15 *84,675*	17.5 *98,788*	20 *112,900*	15 *84,675*	0.85
b. 150,000	12.5 *70,563*	15 *84,675*	17.5 *98,788*	20 *112,900*	22.5 *127,013*	17.5 *98,788*	0.67
c. 50,000	7.5 *74,888*	10 *99,850*	12.5 *124,813*	15 *149,775*	17.5 *174,738*	12.5 *124,813*	2.50
c. 100,000	10 *99,850*	12.5 *124,813*	15 *149,775*	17.5 *174,738*	20 *199,700*	15 *149,775*	1.50
c. 150,000	12.5 *124,813*	15 *149,775*	17.5 *174,738*	20 *199,700*	22.5 *224,663*	17.5 *174,738*	1.17

Notes: *As a percentage of total capital investment (Barritt, 2004c).

4. Operations and Systems

This section outlines operational and management system requirements that should be considered when establishing and operating aggregate recycling facilities. Good business planning assesses risks which can be considered under the following headings:

- Planning and waste management licences;
- Operational environmental management;
- Management of health and safety;
- Quality management; and
- Site layout.

It is important to note that this report contains simplified guidance based on complex and changing legislation, and does not constitute legal guidance.

4.1 Planning and Waste Management Licences

It will generally be necessary to obtain planning consent and either applicable waste management licensing or a registered exemption from waste management licensing prior to commencing operations.

4.1.1 Planning

Planning consent will generally be required for the operation of plant, machinery and other facilities associated with the crushing, screening, grading and washing of CD&EW to create aggregate. It is important to allow sufficient time for the planning process, which under normal circumstances will take between 8 and 16 weeks. However, if the decision is taken to appeal, the process can take considerably longer, possibly years.

The first stage in obtaining a planning consent is the submission of a planning application to the Waste Planning Authority under the terms of the Town and Country Planning Act (1990). This may be the County Council, London Borough Council or Unitary Authority depending upon the location.

Two types of application can be submitted; Outline Planning Application or Full Planning Application. An outline Planning Application can be submitted to establish whether or not, in principle, the proposed development is acceptable in planning terms at the location concerned. Whereas a Full Planning Application not only seeks to establish the principal of the proposed development at that location, but also presents all the necessary detail of the proposal at one time.

Depending upon the nature, size and location of the proposal, it may be necessary to provide an Environmental Statement describing the predicted impacts of the proposed development on the application site and its surroundings, including proposed mitigation. Environmental Statements should be developed in line with guidance provided in the European Union Environmental Impact Assessment Directive (Council Directive 97/11/EC).

Once a planning application is received the Planning Authority registers the application, advertises the application and conducts consultations with various interested parties. Planning Authorities generally provide their decision within sixteen weeks of receipt of the application; if the decision is favourable planning permission is granted.

Granting of planning consent is usually accompanied by conditions relating to issues such as:

- Hours of operation of the plant;
- Visual screening measures;
- Noise limits and attenuation measures;
- Access and routing for vehicles to and from the site;
- The installation of dust suppression equipment;
- Dust limits; and
- A limit on heights of stockpiles.

Additional commitments or obligations may also be imposed.

Where proposed sites are in close proximity to areas of particular interest, for example Sites of Special Scientific Interest, operators are advised to engage and work proactively with the local community and special interest groups.

Applicants are advised to seek further information from the appropriate Waste Planning Authority. Further information is also available from the Department for Environment, Food and Rural Affairs (DEFRA) website and the Department of the Environment in Northern Ireland (<http://www.defra.gov.uk> or <http://www.doeni.gov.uk>).

4.1.2 Waste Management Licensing

Waste Management Licensing (WML) applies to activities that involve the deposition, storage, treatment (including recycling and using mobile plant) or disposal of controlled waste in or on any land or by means of a mobile plant. If the land for the site of the proposed activity requires planning permission, licences can only be issued if permission has been granted or the relevant planning authority has issued an 'established use'. Applications should be made to the environmental regulator on the specified form and include: details of the site and operator, demonstrating that the applicant is a 'fit and proper person'. Further information on WML regulations is available on the CIRIA website (<http://www.ciria.org/cwr/pdf/waste_management_licensing_regulations.pdf>).

Lower risk activities such as reclamation and recycling activities are frequently exempt from the need to obtain a WML although they do need to be registered with the Regulator. Regulatory bodies include the Environment Agency (EA) (England and Wales), the Scottish Environment Protection Agency (SEPA) (Scotland), and the Department of the Environment (Environment and Heritage Service) (EHNIS) (Northern Ireland). Higher risk activities, for example recycling involving hazardous materials or contaminants, may need other authorisations and permits in respect of emissions and effluent discharges (see below).

The Waste Management Licensing Regulations 1994 (as amended), Schedule 3, Activities Exempt from Waste Management Licensing, identify 43 different categories of exemptions. Those relating to construction and demolition waste are summarised in Appendix C.

Whether a WML or an exemption is required is dependant upon the duration of storage, types and quantities of wastes handled and the activity carried out. Exempt

activities are usually subject to specific constraints on waste types, quantities, capacities and duration of storage.

Environmental objectives must be met for exemptions to apply. These are set out in paragraph 4 of schedule 4 and are:

- Risk to water, soil and plants or animals;
- Causing a nuisance through noise or odour; and
- Adversely affecting the countryside or places of special interest.

Household, industrial, and commercial waste, including materials that are destined for recycling is defined as 'controlled waste' under the Environmental Protection Act (1995). CD&EW is controlled waste. Waste that is potentially hazardous or dangerous, which may require extra precautions during handling, storage, treatment or disposal is now defined as 'hazardous waste'. Technical Guidance WM2: Hazardous Waste provides an interpretation of the definition and classification of hazardous waste and is available from EA/SEPA/EHNIS or downloadable from their website <http://www.environment-agency.gov.uk>. Operators are advised to contact the regulator in order to establish the type of licence required.

In addition it is important to recognise that recycled aggregates will remain a waste and subject to Duty of Care unless they are produced in accordance with the Quality Protocol referenced in Section 4.4. It is therefore important to implement procedures to control feedstock arriving either on site or before it gets to site to ensure that only inert and uncontaminated waste is accepted.

Further guidance on WML is currently available from the EA website: <http://www.environment-agency.gov.uk> which includes links to the HMSO website which in turn has copies of the legislation.

A summary of Schedule 3 exemptions is currently given in the EA document: *Exemptions from Needing a Waste Management Licence* available at <http://www.environment-agency.gov.uk/commondata/105385/ld3_exemptions_ta627862ble>. This is however, not relevant in Scotland, further details of which can be obtained from SEPA at <http://www.sepa.org.uk>

4.1.3 Management of Controlled Waste - The Duty of Care

Those producing or dealing with controlled waste must follow the Duty of Care (DEFRA, 2003) under which they must take reasonable steps to ensure that:

- Waste is securely contained to prevent it escaping to the environment both during storage and transit;
- Waste is transferred only to authorised persons, for example, a registered or exempt waste carrier, local authority waste collectors or licensed waste manager;
- Waste consigned to a disposal contractor or transporter is accompanied by a transfer note which provides a detailed, written description containing information necessary for the safe handling, treatment and disposal of the waste; and
- Periodic checks are carried out to ensure that others involved in the handling and disposal of waste do so in accordance with the law.

All persons handling material which is subject to Duty of Care are required to prepare and retain for two years written descriptions of waste and transfer notes and to furnish copies on request. Transfer notes should contain both a description of the waste and all parties in the transaction, including the ultimate destination and all transfers en route.

Failure to comply is a criminal offence, with no statutory limit to fines that may be imposed. Further information on the Duty of Care is available from the Department for Environment, Food and Rural Affairs (DEFRA) (DEFRA, 2003), there is also a short leaflet available from DEFRA (PB7501 Waste Duty of Care).

4.1.4 Management of Hazardous Waste

Hazardous waste is designated using the revised European Waste Catalogue (EWC) the relevant extracts of which are summarised in Appendix D (Note: the EWC will be transposed into English legislation via the List of Wastes Regulations later in 2005). The EWC lists all controlled wastes with a six-digit code based on the source of the waste, grouping wastes according to generic industry, process or waste type. There are three categories of waste: non-hazardous, hazardous 'Absolute Entry' and hazardous 'Mirror Entry'. As with previous legislation, the onus is on the holder to determine the classification of its wastes and deal with them accordingly. If the chemical constituents of the waste are unknown, it should be treated as *hazardous* unless tested.

'Absolute Entries' are automatically classed as hazardous waste regardless of any threshold concentrations, for example coal tar and tarred construction and demolition wastes (17 03 03*).

'Mirror Entry' wastes are considered as hazardous waste only if dangerous substances are present above the specified threshold concentrations, for example mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances (17 01 06*). Waste producers are responsible for identifying and/or testing for hazardous content in wastes and their knowing where it sits within the classification system.

Waste defined as hazardous by the EWC can only go to a landfill site classified as hazardous and which is therefore equipped to handle such waste. Implementation of the EU Landfill Directive has lead to the cessation of the co-disposal of general and hazardous wastes thereby greatly reducing the number of sites able to absorb hazardous wastes. Disposal of hazardous waste is likely to be considerably more expensive than disposal of non-hazardous waste and is very likely to become increasingly more expensive in the future.

The Special Waste Regulations, 1996, currently regulate the movement of hazardous wastes which are classed as 'Special Wastes' and which are considered dangerous or difficult to keep, treat or dispose of. The Regulations impose procedures that are additional to those for 'Controlled Wastes' covered by the Duty of Care. Under the Environmental Protection Act (1990), Special Waste may be corrosive, reactive, explosive, oxidising, carcinogenic or flammable e.g. acids, alkaline solutions, oily sludges, waste oils and wood preservatives.

DEFRA are currently finalising a review of the Special Waste Regulations in England, and which are due to be superseded by the Hazardous Waste Regulations on 16th

July 2005. Further details are available at <http://www.defra.gov.uk/corporate/consult/wastereg-haz/letter.htm> and < http://www.defra.gov.uk/environment/waste/special/index.htm>.

The Special Waste Regulations provide for a Consignment Note system, which allows the EA or SEPA to monitor movements. Special Waste producers must notify the regulators (EA or SEPA) in advance of the movement of waste. Producers are all required to pay a fee (£15/consignment) for most consignments and producers, carriers and disposers are required to keep a register of consignment notes for at least three years. Unless authorised under EPA Part I or the Waste Management Licensing Regulations, mixing of different categories of 'Special Waste' is prohibited, as is mixing of special waste with non-special waste.

Compliance with the documentation requirements of the Special Waste Regulations will also discharge the Duty of Care Requirements.

European Waste Catalogue (2002) classifications relating to CD&EW are reproduced in Appendix D. Table 4.1 highlights examples of building components and materials which may contain harmful or hazardous substances and should therefore be stripped prior to demolition so as to avoid contamination of CD&EW waste.

4.2 Operational Environmental Management

It is recognised that the production of recycled and secondary aggregates offers national and global environmental benefits. Indeed, it is national policy that aggregates and products made from aggregates should be recycled wherever possible, and that where technically, economically and environmentally acceptable, mineral and construction wastes should be used instead of primary materials (DoE, 1994). However, local environmental impacts can also be significant. Good environmental management is necessary in order to minimise local environmental impacts and secure planning permission.

CD&EW recycling activities have the potential to adversely affect the local environment in a number of ways, including impacts upon receptors such as human beings (on-site and off-site), the natural environment, landscape character, neighbouring industries, agriculture, cultural heritage and so forth. Operators should seek to avoid impacts. However, where this is not possible, it will be necessary to minimise adverse impacts through mitigation and achieve legal compliance as a minimum.

Site characteristics are central to determining sensitivity to environmental impacts. For example, sites located in residential areas or close to sensitive natural habitats are likely to have greater environmental sensitivity than sites within existing demolition or construction activities.

Disturbance to natural habitats is an offence that can result in fines and imprisonment. Operators should ensure that surveys and information (including any protected species and designated areas such as Sites of Special Scientific Interest or Local Nature Reserves) in the local area are obtained in order to establish the basis of local conditions upon which the site may impact. Badgers, bats and reptiles are particularly sensitive and must always be protected.

Table 4.1 Examples of hazardous substances found in building components and materials*.

SUBSTANCE	BUILDING COMPONENTS AND/ OR MATERIALS**
Asbestos	Roofs and tiles Glue Sound deadening sealing Fire resistant sealing Wall plaster
PVC	Gutters and pipes
Lead	Roofs and tiles Electrical cables
Cadmium	Plastic (e.g. cable, pipes and plates etc.) Occurring with zinc Occurring with concrete
Mercury	Fluorescent tube Switches and relays (Electrical installations) Others (e.g. concrete)
Nickel	Stainless steel Surface treatment
Chromium	Stainless steel Others (e.g. painted surfaces)
Copper	Cables and wires: - Permanent installations - Temporary installations Roofs, pipes etc. Screws, locks etc. Pigments and dyes
Zinc	Gutters/pipes and galvanised products Plastic (especially gutters and pipes)
PCB	Small capacitors and electric installations Double-glazed windows (glue) Sealant (softener) Paint (pigments) Fire resistant additive (paint, glue/binder)
Chlorinated paraffins	Plastic (in general) Sealant (softener) Others (e.g. glue)
CFCs	Thermal insulation – PUR foam Other insulation materials
HCFCs and HCFs	Thermal insulations – PUR foam Foam for joints
Sulphur hexaforide	Soundproof windows

*Source: (Strufe, 2004)
**Note: CD&EW arising from roads constructed before 1970 is likely to contain tar products rather than bitumen which are classified as a hazardous waste in the forthcoming revisions to waste regulations expected in 2005.

The principal potential environmental impacts associated with recycling of CD&EW are summarised below. It is, however, essential to consider each site on its merits when determining what activity or mitigation is required and what legislation is applicable. Operators should consult the Regulatory Body, for example the EA (England and Wales), SEPA (Scotland), and EHNIS (Northern Ireland).

Further guidance on environmental management is available from:
Department of Environment Transport and the Regions, *Controlling the Environmental Effects of Recycled and Secondary Aggregates Production, Good Practice Guidance*, February 2000, currently available from the Office of the Deputy Prime Minister (ODPM) on
<http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/pdf/odpm_plan_pdf_606242.pdf>

Whilst all operators will have to develop management systems to manage or mitigate environmental impacts, it may be appropriate for some operators to develop a formal environmental management system (EMS) and seek certification of the EMS by an external organisation. The unilaterally accepted standard for EMSs is ISO 14001.

4.2.1 Integrated Pollution Prevention and Control

Pollution from industrial sources applies to recycling facilities and is controlled through the Integrated Pollution Prevention and Control (IPPC) system, which provides a single regulatory framework. IPPC is implemented through the Pollution Prevention and Control (PPC) (England and Wales) Regulations 2000; PPC Regulations (Scotland) and PPC Regulations (Northern Ireland) 2003.

Operators of installations under IPPC have to apply for a permit from the EA or Local Authority, or SEPA in Scotland prior to operation. The operator will need to demonstrate that they will operate the installation in a way that prevents emissions to air, land and water or, where this is not practical, to reduce them to an acceptable level.

The PPC regulations are concerned with the regulation of 'installations', which contain one, or more listed activities. The range of activities to which PPC applies is specified within Schedule 1 of the PPC Regulations, referred to as 'listed activities'. The crushing, grinding or other size reduction, with machinery designed for that purpose, of bricks, tiles or concrete and also the screening of the products of this activity are listed as Part B activities (Section 3.5 – Other Mineral Activities, Part B, Sections c and d) and are therefore subject to Local Air Pollution Control and Local Air Pollution Prevention and Control, which are regulated by local authorities (England and Wales), SEPA (Scotland) or District Councils (Northern Ireland).

Depending on the type of process, nature and value of materials, the duration of operations, and the associated environmental impacts, a consent or exemption may be required. Mobile crushing plant may require a temporary IPC authorisation or consent in addition to the WML or exemption, although mobile screening plant does not usually require a permit.

4.2.2 Noise and Vibration

Excessive noise levels on a site can represent a hazard to site workers and annoy neighbours. Noise must be considered in applications for planning consent and environmental impact assessments.

Generic activities that are likely to involve significant noise and vibration include:

- Equipment and vehicle engines;
- Material processing;
- Vehicle movements on-site and off-site (especially empty vehicles on un-made surfaces); and
- Vehicle reversing alarms.

Local authorities can designate noise abatement zones in which specific types of development may not exceed specified noise levels.

4.2.3 Control of Noise and Vibration on Site

Facility operators should note that where nuisance is likely to cause disturbance and/or complaint they should agree a Section 61 Consent, in accordance with the Control of Pollution Act (1974), with the local authority before start-up.

A range of control methods can be applied to prevent noise and vibration associated with site activities becoming a nuisance:

- Arrange the site so as to position plant to reduce noise and vibration impact on neighbours;
- Consider operational noise when selecting plant and equipment;
- Enclose noise sources, use barriers and screening;
- Consider vehicle routes, avoid unnecessary reversing and sensitive areas;
- Arrange delivery times to suite the area;
- Liase with nature conservation bodies to minimise noise disturbance to any sensitive wildlife, it is advisable to consult a noise control specialist;
- Manage and control the way plant is used and ensure appropriate maintenance regimes are adopted;
- Minimise the drop height into hoppers, lorries or other plant; and
- Restrict the hours during which particularly noisy work is carried out.

Because the effects of transmitting vibration are highly dependant upon local conditions, each situation should be considered separately. If it appears that the work is likely to generate vibrations approaching the intensities considered as putting adjacent structures at risk then a detailed study should be undertaken by specialists.

To minimise noise and vibration impacts, operators should:

- Ensure all plant is in good condition and that exhausts are effective;
- Repair or replace any noisy plant; and
- Use screens or plant trees or bushes at perimeters to absorb some noise.

4.2.4 Dust and Air Pollution

High concentrations of dust, emissions and odours arising from a site can cause health problems such as eye irritation or asthma, whilst lower levels may lead to complaints from neighbours. There is also the potential for legal action under

statutory nuisance legislation. With dust, emissions and odour there are frequently no imposed standards, regulators become involved only once problems have been noted and complaints received.

Activities that may produce air pollution include:

- Material processing (e.g. crushing, screening and segregation);
- Material transport;
- Vehicles travelling over un-made surfaces;
- Engine exhausts;
- Wind blow from open areas of site, roadways, stockpiles etc.; and
- Evaporative emissions from fuel and volatile waste materials.

Dust and air pollution may be controlled through a combination of site planning and management.

To minimise dust impacts associated with site layout:

- Site plant away from sensitive receptors and consider prevailing wind directions;
- Use buildings or vegetation as screens or enclosures;
- Specify equipment with purpose designed dust control;
- Ensure plant is maintained and in good working order;
- Maintain plant and machinery in accordance with supplier's recommendations;
- Use appropriate buildings, bays, bunkers etc.; and
- Install vehicle wheel and chassis wash equipment.

To minimise dust becoming airborne at source during operations:

- Use water spray dust suppression equipment to damp down during periods of dry weather (operators should keep in mind the environmental impacts of water use);
- Avoid tracking dirt onto working areas and the public highway;
- Minimise drop heights of materials;
- Sheet or wet material during transport; and
- Avoid over filling containers.

4.2.5 Water Pollution / Ground Contamination

Pollution of watercourses either directly or via surface water drain or groundwater can damage the aquatic environment and result in prosecution.

Sites frequently have both surface water and foul water drainage. Surface water drains are designed to carry uncontaminated rainwater directly to a stream, river or soak away. Road drains and surface water gullies generally discharge into controlled waters. Nothing that could cause pollution should enter controlled waters under any circumstances and a discharge consent or exemption should be considered in every instance, both permanent and temporary. It is strongly advised that operators contact the EA or SEPA (<http://www.environment-agency.gov.uk> and <http://www.sepa.org.uk/>) and discuss site drainage options and possible consent conditions.

Foul water drains carry contaminated water to a sewage works for treatment before discharge. It may be possible to pump dirty water to a foul sewer, provided prior

consent has been obtained from the sewerage contractor. Where no foul water drainage is available, alternative arrangements will be required for sewage and foul water disposal (i.e. 'hazardous waste' disposal).

The discharge of trade effluent to public sewer requires the consent of the relevant water service company. Consents to discharge will contain conditions relating to the volume and quality of effluent. Consultation with the local authority and water service company will determine the most appropriate approach to the management of water on site.

Activities that may give rise to water pollution or land contamination include:

- Material processing (e.g. crushing, screening and segregation);
- Material storage;
- Material transport;
- Run-off from dust suppression activities;
- Contaminants (e.g. oil) in feedstock;
- Spillage or leaks of oil and fuel from equipment during fuelling, maintenance or operation;
- Escape of contaminated fire fighting waters; and
- Run off from heavy rainfall.

The layout of the site can reduce the risk of water pollution or land contamination, for example:

- Prepare and maintain a site plan that details the drainage system, in order to plan site activities and also respond rapidly to any future emergency;
- Site plant away from sensitive receptors;
- Ensure site facilities and drainage is appropriate and adequate e.g. areas of hard standing, bunds, settlement ponds and silt traps / oil interceptors; and
- Where appropriate install segregated drainage for potentially contaminated areas.

Also, the application of operational procedures can reduce the risk of water pollution or land contamination, for example:

- Introduce precautions to prevent pollution during the initial sorting and separation of feedstock;
- Minimise the generation of fines during reprocessing;
- Ensure staff are aware of the need to reduce water consumption;
- Ensure that all staff are aware of receptors on site and can identify both surface and foul water drains (colour code manhole covers at fixed sites e.g. blue = surface water, red = foul water);
- Ensure that staff are aware of potential pollution hazards and how to store, handle, and use materials in order to prevent pollution incidents;
- Provide spill kits and ensure staff are trained in their use;
- Ensure that all staff are aware of the correct disposal methods for contaminated materials; and
- Ensure senior management is aware of when a pollution incident becomes a reportable incident and when the appropriate agency should be contacted.

4.2.6 Landfill Tax

Under the Finance Act (1996) and Landfill Tax Regulations (1996) all waste that is disposed of to landfill, unless specifically exempted, is subject to landfill tax. Inactive or inert wastes which do not undergo significant physical, chemical or biological reactions or cause environmental pollution when deposited at a landfill under normal conditions, e.g. bricks, soil and rock etc., are subject to a reduced rate of landfill tax, £2 per tonne. Active wastes are those that are not inactive, e.g. acids, pesticides, bitumen etc., and are subject to standard rate landfill tax, currently £15 per tonne. Although, the Chancellor committed to increasing standard rate landfill tax by £3/year from 2005-6 onwards, with a projected medium to long-term rate of £35/tonne. It is important to recognise that future changes in the Landfill Tax are likely to be a driver in determining the economic feasibility of operating recycling facilities.

4.2.7 Waste Management on Site

Waste management is an essential element of both environmental and quality management. To manage waste on site the recycler should:

- Minimise waste arisings on site;
- Implement quality controls to prevent contaminated material being brought on to site;
- Manage controlled waste in accordance with the Duty of Care;
- Manage Hazardous Waste in accordance with current requirements (The Hazardous waste Regulations);
- Monitor waste arisings;
- Segregate different types of waste as they are generated.
- Mark waste containers clearly with their intended contents (recyclable materials, inert waste, active / special waste);
- Minimise the risk of accidental spillages or leaks, provide covers and bunds to prevent evaporation and spillage of waste; and
- Reduce disposal costs; where a consignment of waste contains both active and inactive materials, the whole load is subject to the standard rate of landfill tax.

4.3 Health and Safety in Aggregates Recycling

A recent report on health and safety standards demonstrated that the overall accident rate amongst employees in the waste sector is nearly 5 times greater than the national average (HSE, 2004). As the aggregate recycling industry expands and more people are employed, it will be incumbent on service providers to improve their performance in this regard and ensure that better safeguards are put in place to protect workers and anyone else who may be affected.

In addition to the daily hazards and risks associated with manual handling, slips and falls, vehicle and machinery, greater attention will need to be paid to employee exposure to hazardous substances present in the materials to be recycled and dust inhalation. Increasing pressure to develop brown field sites means that all parties involved in recycling need to understand the risks imposed by changes in the classification of wastes and to take health and safety seriously.

It is not the intention here to describe the full implications of the UK health and safety legislative framework on the aggregates recycling sector, however relevant legislative

devices are outlined in Appendix F. A general Health and Safety Executive (HSE) leaflet*, Waste industry safety and health – Reducing the risks*, is already available and can be downloaded from the HSE website at <http://www.hse.gov.uk>.

4.4 Quality

Quality management during the recycling of construction and demolition waste is an essential element of process management in order to:

- Provide a clear audit trail demonstrating compliance with waste management legislation;
- Produce a quality managed product to conform to standards common to both recovered and primary aggregates; and
- Help control environmental risks associated with feedstock.

To provide potential customers with high confidence in the quality of their product, operators are advised to follow *The Quality Protocol for the Production of Aggregates from Inert Waste* produced by WRAP, the Quarry Products Association and the Highways Agency. The Quality Protocol defines a formalised quality management scheme that controls the management of environmental risk associated with feedstock and also the management of aggregate processing to industry standards.

A key purpose of the Quality Protocol is to provide a uniform control process for producers from which they can reasonably state and demonstrate that their product has been fully recovered and is no longer a waste.

The Quality Protocol provides guidance on:

- Factory production control;
- Description of products being provided, including reference to the specification requirements for aggregate products;
- Acceptance criteria for incoming waste;
- Method statement of production;
- Inspection and testing regime including frequency and methods of test for a finished product;
- Maintenance of records;
- Quality Statement; and
- Provision of product information.

The Quality Protocol for the Production of Aggregates from Inert Waste is available from The Waste and Resources Action Programme, The Old Academy, 21 Horse Fair, Banbury, Oxon OX16 0AH, Tel: 01295 819900, and at <http://www.wrap.org.uk/publications/QualityProtocolAgg.pdf> & <http://www.wrap.org.uk/publications/QPScotland.pdf>

5. MARKETS, LEGAL ISSUES AND COMPETITION

This section outlines factors likely to influence the demand for aggregates produced from recycled CD&EW. Due to their relatively low value and high mass, transport costs are likely to be relatively high and it is therefore generally uneconomic to transport aggregates long distances. Consequently, reprocessing sites tend to serve local markets with producers being subject to local market forces rather than national patterns of demand. As a result, the fact that the market for recycled aggregates is influenced by local conditions means local prices are likely to vary (Barritt, 2004d).

5.1 National Market for Aggregates

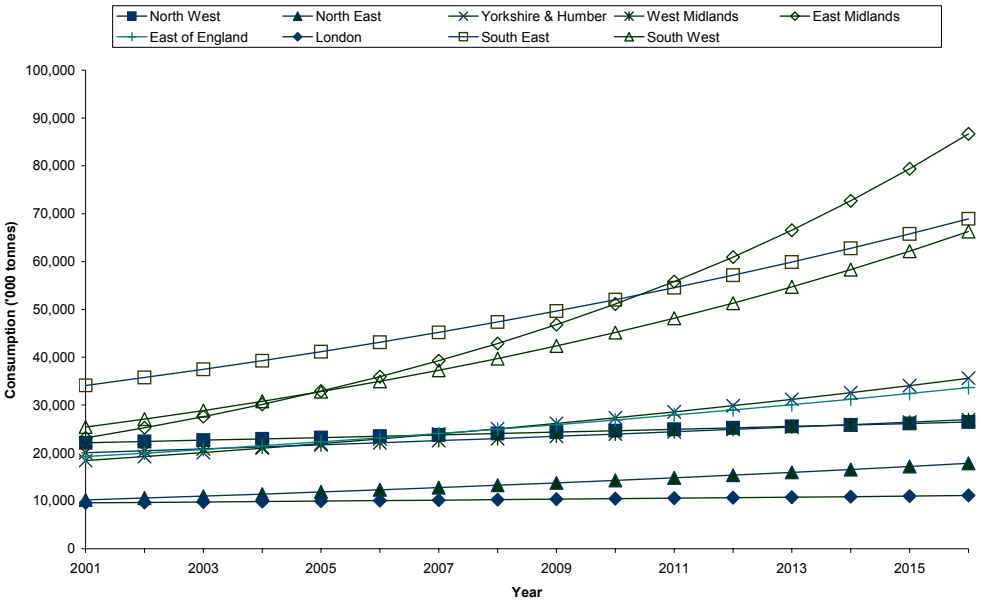
Although the price of recycled CD&EW tends to vary on local or regional basis and is dependent on local or regional levels of construction activity, general trends in national or regional demand, in terms of both current and projected demand and price, provide an indicator of the anticipated market for aggregate products.

Available data highlight significant regional differences in the consumption of primary aggregates in England and Wales (Table 5.1). Projected demand estimates suggest that the absolute magnitude of consumption will increase over the next fifteen years, and also patterns of regional consumption may change in response to levels of construction activity (Figure 5.1). Consequently, while it is difficult to predict market movements it seems likely that both price and demand for aggregate products will be firm, particularly in the South East, South West and East Midlands. Given that recycled aggregate products compete directly in this market, demand for such products is also likely to be firm.

Table 5.1 Regional comparison of primary aggregate consumption in 2001*.

Region	Consumption (000 tonnes)
North West	22,100
North East	10,200
Yorkshire & Humber	18,400
West Midlands	20,000
East Midlands	23,200
East of England	19,200
London	9,600
South East (excluding London)	34,100
South West	25,400
North Wales	22,100
South Wales	10,200
Total	214,500

*Source: (BGS, 2003).



Source: current consumption data from (BGS, 2003) extrapolated in accordance with projections from (ODPM, 2003).

Figure 5.1 Projected regional changes in demand for aggregates in England between 2001 and 2016.

5.2 Market Conditions for Recycled CD&EW

It is estimated that approximately 94Mt of CD&EW arisings were produced in England and Wales in 2001, of which 38Mt were recycled as aggregate. Over 93% of the remaining arisings are thought to comprise of waste soil and excavation waste (ODPM, 2002). Regional patterns of re-use are summarised in Table 5.2.

Data regarding haul distances for CD&EW suggest that as little as 1% or 2% travels more than 40km with less than 10% travelling further than 24km. Furthermore, recycling operations, particularly the use of crushers, situated in urban or urban fringe locations have a higher average throughput than those in rural locations. These findings provide further evidence that recycled aggregate products are likely to be used to satisfy local demands in areas of higher levels of construction activity.

Opportunities to increase the levels of CD&EW recycling are unclear. UK Government research suggests that a large proportion of the arisings not currently recycled comprise of waste soil and excavation waste which have little scope for recycling as aggregate. Also, very little of the CD&EW that could be readily processed into aggregate is currently disposed of to landfill. Therefore, improvements in on-site separation are seen as the key to increasing the proportion of CD&EW recycled as aggregate. Consequently, the ODPM has set a target for the use of recycled and secondary aggregates at 60 million tonnes per annum by 2011 (ODPM, 2002).

Table 5.2 Regional estimates of CD&EW re-use*.

Region	CD&EW crushed and/or screened for use as aggregate (Mt/yr)	Mixed CD&EW screened for use as soil (Mt/yr)	Total (Mt/yr)
North West	4.44	0.91	5.35
North East	3.59	0.66	4.25
Yorkshire & Humber	3.58	0.77	4.35
West Midlands	3.71	0.57	4.28
East Midlands	4.09	0.78	4.86
East	5.03	0.89	5.91
London	4.34	0.52	4.86
South East	4.90	0.95	5.84
South West	2.80	0.78	3.58
Total	36.48	6.83	43.28

*Source: (ODPM, 2002).

Research carried out by WRAP suggests that prevailing market and legislative conditions are likely to favour higher future levels of demand for recycled and secondary aggregates than the target set by ODPM. For example:

- The introduction of European Aggregate Standards which do not discriminate against recycled and secondary aggregate;
- Changes to UK waste licensing regulations currently being considered by the Environment Agency; and
- Increased availability of competitive process plant, particularly washing plant;

are expected to increase levels of re-use. WRAP estimate that such changes together with the necessary developments in the market, which include:

- Increased competitiveness of recycling plant;
- Higher value recycling improving the economic viability of recycling plant;
- Broader market demand due to a wider product range and increased awareness and confidence; and
- Demand created through public and private procurement policy;

could increase the use of recycled and secondary aggregate to approximately 72 million tonnes per annum by 2015. While CD&EW is only one element of the total recycled and secondary resources available it represents the largest constituent group (approximately 72% in 2001) and shows the greatest potential for growth (15% between 2001 and 2015) (Table 5.3) (Barritt, 2004e).

Table 5.3 Potential for growth in recycled and secondary aggregates (ODPM, 2002).

Major secondary and recycled resources in England	Recycled as aggregate in 2001 (Mt)	Potential for recycling as aggregate in 2015 (Mt)	Growth (%)
Recycled CD&EW	36.5	51.4	14.9
Asphalt planings	5.0	5.6	0.6
Spent rail ballast	1.2	1.3	0.1
Blast furnace and steel slag	1.6	2.0	0.4
Colliery spoil	0.8	1.0	0.2
Pulverised fuel ash/furnace bottom ash	2.4	3.0	0.6
China clay aggregates	2.3	4.6	2.3
Used foundry sand	0.2	0.5	0.3
Incinerator bottom ash	0.4	1.4	1.0
Slate waste	0.3	0.5	0.2
Tyres	0.1	0.2	0.1
Glass	0.1	0.2	0.1
Total	50.9	71.7	20.8

It is important for recycling operators to note that while there is uncertainty regarding the amount of aggregate recycling that could be achieved cost-effectively, the introduction of Government targets and the prevailing legislation are likely to support continued demand.

5.3 Price and Legislative Risk

It is difficult to provide regional and/or local price data for recycled and primary aggregates, since:

- Such data are seen as commercially sensitive;
- Local market conditions may vary considerably across different regions; and
- Price is often very dependent on the mass of material purchased.

Consequently, the use of indicative prices in developing a business case for the production of recycled aggregate products could be misleading. Therefore, for the purpose of this business planning guidance a decision support tree is presented in Figure 5.1. This decision support tree is designed to provide recycling facility operators with a structured approach to considering the most important factors for determining the preliminary business case for developing recycling facilities. Given that recycled and primary aggregates compete directly in the same market it is often the cheapest source that is most likely to be selected. Consequently, the decision support tree is intended to re-enforce the need for site or facility operators to investigate local market conditions to more fully determine the likely cost effectiveness of any recycling operation.

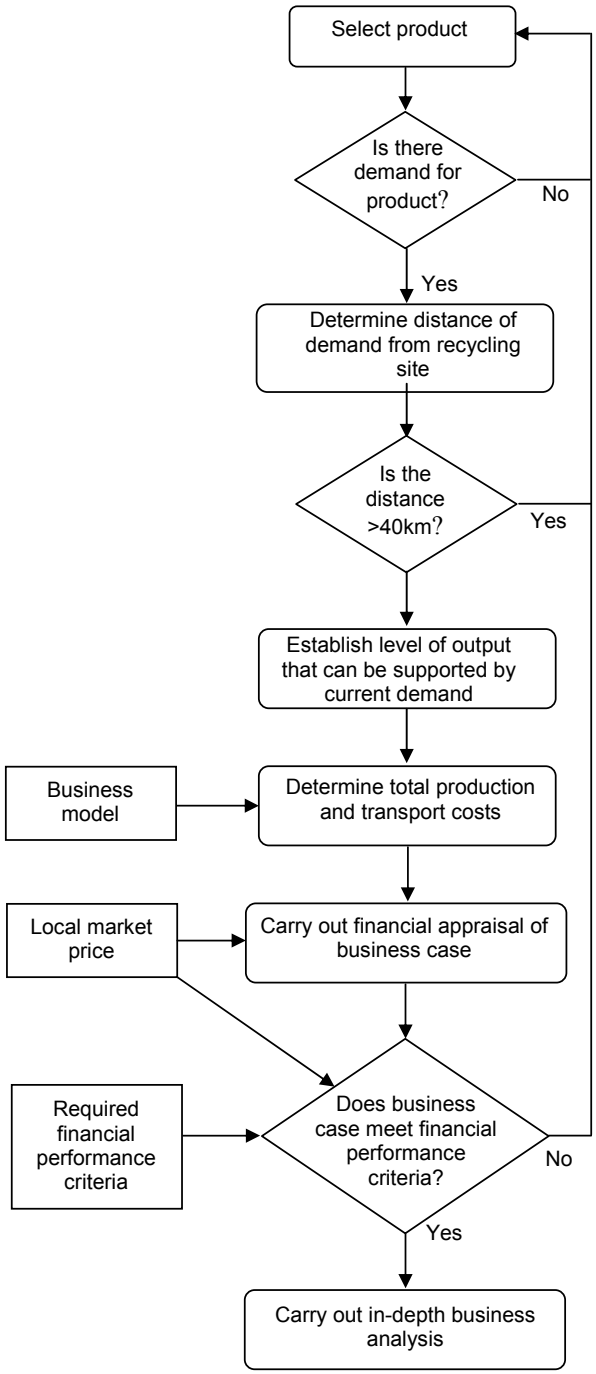


Figure 5.1 Decision support tree for carrying out a preliminary analysis of the business case for recycling.

Clearly, factors which influence the cost of production need careful consideration. In addition to process costs outlined in Section 4, a number of economic instruments have influenced costs and shaped the current market:

- Landfill Tax – a rate of £2/tonne applies to inert waste. Although there are currently no anticipated increases in this rate any changes will affect the relative cost effectiveness of recycled or secondary aggregates;
- Aggregates levy - a rate of £1.60/tonne applies to primary sources. The levy is considered to have had a significant impact on the increased use of secondary and recycled aggregates in low value fill applications at the expense of by-products from quarry sites, particularly at a local level (BAA, 2004). Changes in the levy could have further implications for local markets;
- Working Time Directive (WTD) - could have an impact on haulage capacity in March 2005 when the current opt out for the road haulage sector ceases. The net effect is likely to be an increase in haulage rates which will penalise suppliers travelling longer distances by road.

5.4 Funding Opportunities

As of summer 2004, two key funding opportunities tailored specifically to the UK recycling sector are available:

- The Recycling Fund - established by WRAP, £5.5M is available through this fund which is designed to provide equity finance to between 10 and 15 early stage recycling or waste management small and medium-sized enterprises (SME's). The overall aim is to demonstrate successful equity provision and so encourage equity providers into the recycling market.
- The eQuip Residual Value Guarantee (RVG) Scheme – this scheme, also introduced by WRAP, is designed to help recycling companies lease plant and equipment. Effectively a rental agreement , it allows payments to be spread over a fixed term related to the life of the equipment under negotiable terms which can be tailored to meet the expected cash flow of a given business. The scheme guarantees the future residual value of the machinery needed.

Operators are advised to consult the WRAP website for further details of these existing schemes and any new schemes developed since this business planning guidance was compiled at: <http://www.wrap.org.uk>.

More general advice and guidance on starting up and developing businesses is available through Business Links, which is a web-based resource designed to provide advice and information across a wide range of business activities to small and medium-sized businesses. The website is published and maintained by the Small Business Service which is an agency of the Department of Trade and Industry. Further information is available from: <http://www.businesslink.gov.uk>.

6. ENTERPRISE FORECASTING TOOL

This section provides an outline of how the range of economic and financial issues outlined above will be considered in the enterprise forecasting tool. A schematic diagram of the key elements of the tool is presented in Figure 6.1. User Inputs reflect the range of input data requirements that are likely to be necessary depending on the scenario being modelled. For ease of development, separate modules will be used to process fixed data held within the model and the appropriate user input data. Outputs from these modules can then be used to carry out the economic analysis. Figure 6.2 highlights which data are held within each module and the main elements of data flow.

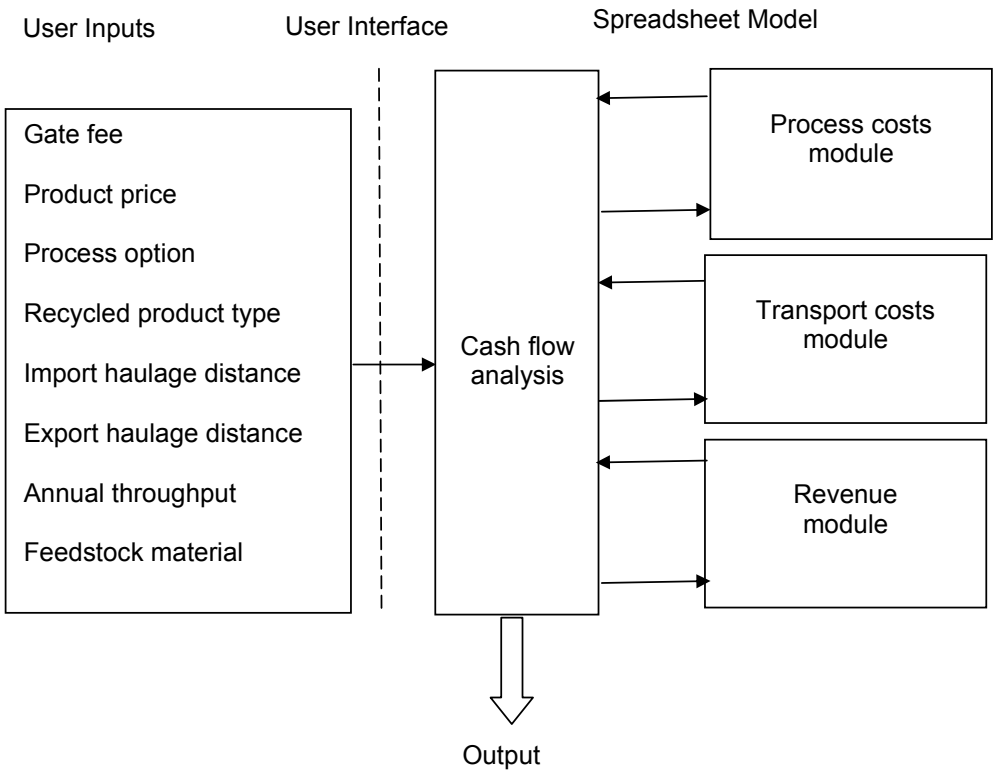


Figure 6.1 Schematic outline of enterprise forecasting tool.

Data outlined in previous sections of the report will form the basis of the modules. The tool will output the following financial appraisal criteria:

- Net Present Value (NPV) - the present value of an investment project found by discounting all present and future revenues and outgoings at an appropriate rate of interest. If the NPV thus calculated is positive it is worthwhile investing in the project;
- Internal Rate of Return (IRR) – the interest rate at which the NPV of a project is zero. A project is worth investing in if the IRR is greater than

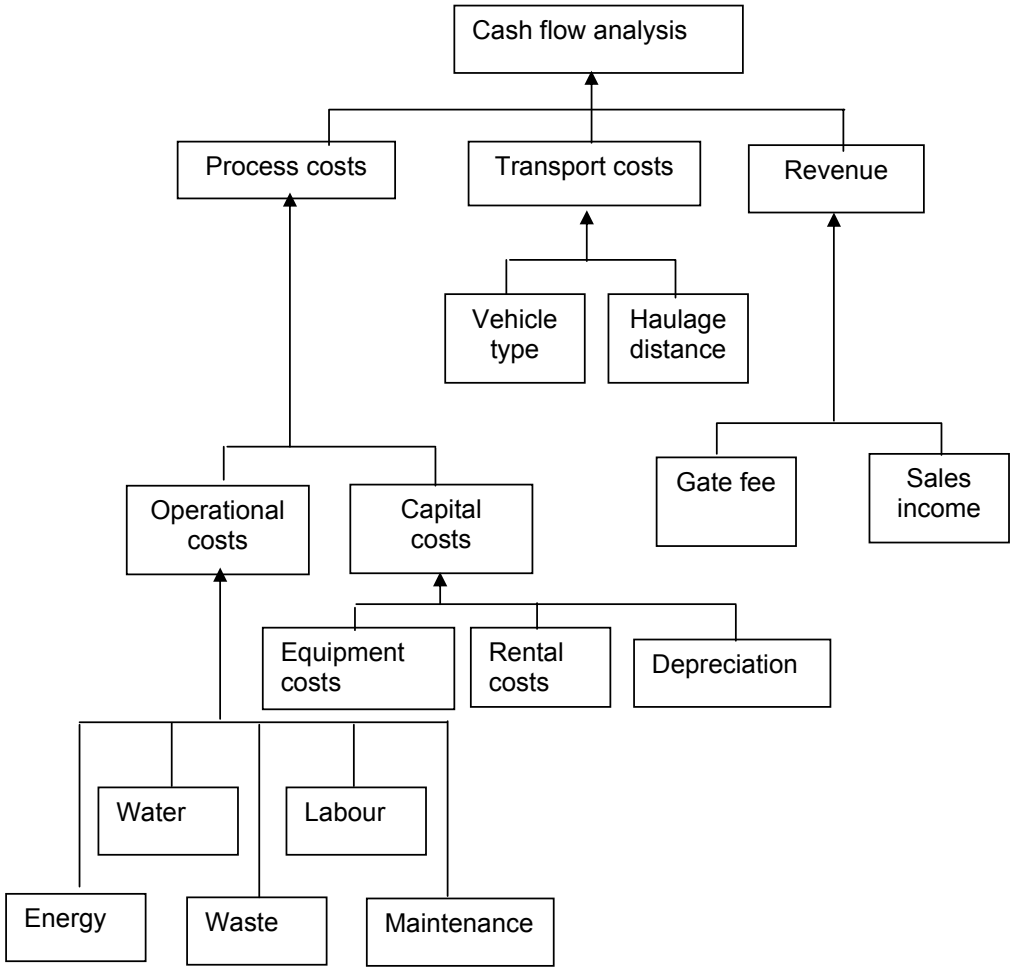


Figure 6.2 Outline of key elements of spreadsheet model modules.

the rate of interest, including an appropriate risk premium. Consequently, if the IRR over the project life exceeds the current commercial borrowing rate, the project is worth investing in;

- Payback Period – the period over which the cumulative net revenue from an investment project equals the original investment (capital or capital + rental); and
- NPV/tonne of product – the NPV of producing a given product normalised to the annual amount of production.

Formatted: Bullets and Numbering

The financial analysis is based on the following assumptions:

- Discount rate 12%
- Interest rate 3%

It should be recognised that costs associated with the planning process outlined in Section 4 are not included in this analysis. Such costs are likely to reflect individual site characteristics and could be considerable.

Although the asset life of the process plant is assumed to be five years, as highlighted above, the model will allow both five and fifteen year business cycles to be analysed. This will enable options that might become more cost effective over time to be more readily identified.

7. REFERENCES

ADLER, D (1999)
"Structure"
In: D Adler (ed), Metric Handbook Planning and Design Data
2nd edn, Architectural Press, Oxford, p41-2

BARRITT, J (2004a) WRAP, personal communication

BARRITT, J (2004b) WRAP, personal communication

BARRITT, J (2004c) WRAP, personal communication

BARRITT, J (2004d) WRAP, personal communication

BARRITT, J (2004e)
"The WRAP aggregates programme; achieving the potential of recycled aggregates"
Proc Intl Conf on Sustainable Waste Management and Recycling, London 14-15 Sept
Thomas Telford, London, pp13-23

BRITISH AGGREGATES ASSOCIATION (BAA) (2004)
"The aggregates levy: between a rock and a hard place"
<http;//www.british-aggregates.com>

BRITISH GEOLOGICAL SURVEY (BGS) (2003)
"Collation of the results of the 2001 aggregate minerals survey for England and Wales"
HMSO, London, pp103

HOLLOWAY, J (2004) Biffa Waste Services, personal communication

BELL, B (2004) Powerscreen Ltd, personal communication

DEPARTMENT OF ENVIRONMENT (DOE) (1994)
"Minerals Planning Guidance 6: Guidelines for aggregates provision in England"
HMSO, London, pp46

DEPARTMENT OF ENVIRONMENT, FOOD AND RURAL AFFAIRS (DEFRA) (2003)
"Waste management. The duty of care: a code of practice"
HMSO, London, pp66

OFFICE OF THE DEPUTY PRIME MINISTER (ODPM) (2002)
"Survey of arisings and use of construction and demolition waste in England and Wales in 2001"
HMSO, London, PP82

OFFICE OF THE DEPUTY PRIME MINISTER (ODPM) (2003)
"National and regional guidelines for aggregate provision in England 2001 – 2016"
ODPM, London, pp10

HEALTH AND SAFETY EXECUTIVE (HSE) (2004),
"Mapping health and safety standards in the UK waste industry"
Research Report 240, HMSO, London, pp268

WRAP (2004) *The Quality Protocol for the production of aggregates from inert wastes* Waste and Resources Action Programme (WRAP), UK, pp12

STRUFE, N (2005)
"Hazardous substances in demolition waste: how to identify the materials and plan and conduct the demolition work"
Proc int conf on sustainable waste management and recycling, London 14-15 Sept
Thomas Telford, London, pp85-96

Appendix A Specifications for Aggregates

Appendix B Definitions of Plant and Equipment

Crusher – a piece of mechanical plant or equipment for breaking irregular over-sized blocks of hard materials into a more regular aggregate with a predictable distribution of particle sizes. Some crushers have integral screens (see below).

Screen – stand alone mechanical system for sorting, separating and sizing mixed materials.

Air knife – air driven system for separating smaller sized particles from a product stream.

Flotation system – water based system for separating lighter materials such as wood and plastic from aggregate product streams.

Picking station – conveyor belt system that allows the manual separation of materials.

Granulator – a piece of mechanical plant for shredding oversize asphalt based waste into a more regular material.

Weighbridge – mechanical device for determining vehicle load weight.

Excavator – wheeled or track driven plant used to supply feedstock to process plant.

Loader – wheeled plant used for moving and loading aggregates.

Appendix C Selected Exemptions from Waste Management Licensing

Feedstock / Material for Reprocessing	Activity	Waste management Licensing Regulations Paragraph	Summary of Conditions
Waste consisting of soil, rock, ash or sludge, or of waste from dredging any inland waters of arising from construction and demolition work NB Exemption currently under review	Spreading for land reclamation or improvement	9(1)	By reason of industrial or other development the land is incapable of beneficial use without treatment; The spreading is carried out in accordance with planning permission for the reclamation or improvement of the land and results in benefit to agriculture or ecological improvement; and no more than 20,000 m^3/ hectare of such waste is spread on the land. This exemption does not apply to sites designed for or adapted for the final disposal of waste to landfill.
Waste arising from demolition or construction work or tunnelling or other excavations (also waste which consists of ash, slag, clinker, rock, wood, bark, paper, straw or gypsum)	Manufacture of bricks, blocks, road stone or aggregate	13.1 (14 for Northern Ireland)	Waste for processing must be stored at the place where the activity is to be carried out. Storage limited to 50,000 tonnes (in the case of road stone from road planings) or in any other case 20,000 tonnes.
Waste arising from demolition or construction work or tunnelling or other excavations (also waste which consists of ash, slag, clinker, rock, wood, bark, paper, straw or gypsum)	Manufacture of soil or soil substitute	13.2 (14 for Northern Ireland)	Reprocessing to take place either where the waste is produced, or, the product is to be applied to the land. The total amount manufactured does not exceed 500 tonnes/day. Storage of waste for processing at the place where the activity is to be carried out limited to 20,000 tonnes.

Feedstock / Material for Reprocessing	Activity	Waste management Licensing Regulations Paragraph	Summary of Conditions
Waste arising from demolition or construction work or tunnelling or other excavations (also waste which consists of ash, slag, clinker, rock, wood, bark, paper, straw or gypsum)	Treatment of waste soil or rock for the purpose of spreading on land as described under paragraphs 7 or 9 (9 or 11 for Northern Ireland).	13.3 (14 for Northern Ireland)	Treatment to be carried out at the place where the waste is produced or the treated product is to be spread. The total amount treated does not exceed 100 tonnes/day. Storage of waste for processing at the place where the activity is to be carried out is limited to 20,000 tonnes.
Waste which arises from demolition or construction work or tunnelling or other excavations (also waste which consists of ash, slag, clinker, rock, wood, bark, paper, straw or gypsum) NB Exemption currently under review	Storage of waste to be used for 'relevant work'	19.1	Waste must be suitable for 'relevant work'. Storage of waste not produced on the site, limited to three months before work starts. Relevant work means construction work, including the deposit of waste on land in connection with: the provision of recreational facilities on that land; or the construction, maintenance or improvement of a building, highway, railway, airport, dock or other transport facility on that land, but not including either any deposit of waste in any other circumstances or any work involving land reclamation. NB Some of these activities may require planning permission.

Waste which arises from demolition or construction work or tunnelling or other excavations (also waste which consists of ash, slag, clinker, rock, wood, bark, paper, straw or gypsum) NB Exemption currently under review	Use of the waste for 'relevant work'	19.2	Waste suitable for 'relevant work' i.e. construction for the provision of recreational facilities or construction, maintenance and improvement of a building, highway, railway, airport or dock. 'Relevant work' means construction work, including the deposit of waste on land in connection with: the provision of recreational facilities on that land; or the construction, maintenance or improvement of a building, highway, railway, airport, dock or other transport facility on that land, but not including either any deposit of waste in any other circumstances or any work involving land reclamation.

Feedstock / Material for Reprocessing	Activity	Waste management Licensing Regulations Paragraph	Summary of Conditions
Waste which arises from demolition or construction work or tunnelling or other excavations (also waste which consists of ash, slag, clinker, rock, wood, bark, paper, straw or gypsum) NB Exemption currently under review	Storage of road planings which are to be used for 'relevant work' carried out elsewhere	19.3	No more than 50,000 tonnes of such waste may be stored at the site The waste may be stored for no- longer than three months. Relevant work means construction work, including the deposit of waste on land in connection with: the provision of recreational facilities on that land; or the construction, maintenance or improvement of a building, highway, railway, airport, dock or other transport facility on that land, but not including either any deposit of waste in any other circumstances or any work involving land reclamation.
Waste bricks, tiles or concrete	Crushing, grinding or other size reduction for recovery or reuse	24	Activity must be authorised under Part 1 of the 1990 Environmental Protection Act, to the extent that it is or forms part of a process within paragraph (c) of Part B of Section 3.4 (other mineral processes) of Schedule 1 to the 1991 Environmental Protection Regulations. The total quantity of such waste for reprocessing limited to a maximum of 20,000 tonnes.

Appendix D Extract from the Consolidated European Waste Catalogue Relating to Construction and Demolition Waste

17 Construction and Demolition Wastes (including Excavated Soil from Contaminated Sites)

17 01 concrete, bricks, tiles and ceramics

17 01 01 concrete
17 01 02 bricks
17 01 03 tiles and ceramics
17 01 06* mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances
17 01 07 mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06

17 02 wood, glass and plastic

17 02 01 wood
17 02 02 glass
17 02 03 plastic
17 02 04* glass, plastic and wood containing or contaminated with dangerous substances

17 03 bituminous mixtures, coal tar and tarred products

17 03 01* bituminous mixtures containing coal tar
17 03 02 bituminous mixtures other than those mentioned in 17 03 01
17 03 03* coal tar and tarred products

17 04 metals (including their alloys)

17 04 01 copper, bronze, brass
17 04 02 aluminium
17 04 03 lead
17 04 04 zinc
17 04 05 iron and steel
17 04 06 tin
17 04 07 mixed metals
17 04 09* metal waste contaminated with dangerous substances

17 04 10* cables containing oil, coat tar and other dangerous substances
17 04 11 cables other than those mentioned in 17 04 10

17 05	soil (including excavated soil from contaminated sites), stones and dredging spoil

17 05 03* soil and stones containing dangerous substances
17 05 04 soil and stones other than those mentioned in 17 05 03
17 05 05* dredging spoil containing dangerous substances
17 05 06 dredging spoil other than those mentioned in 17 05 05
17 05 07* track ballast containing dangerous substances
17 05 08 track ballast other than those mentioned in 17 05 07

17 06 insulation materials and asbestos-containing materials

17 06 01* insulation materials containing asbestos
17 06 03* other insulation materials consisting of or containing dangerous substances
17 06 04 insulation materials other than those mentioned in 17 06 01 and 17 06 03
17 06 05* construction materials containing asbestos

17 08 gypsum-based construction material

17 08 01* gypsum-based construction materials contaminated with dangerous substances
17 08 02 gypsum-based construction materials other than those mentioned in 17 08 01

17 09 other construction and demolition wastes

17 09 01* construction and demolition wastes containing mercury
17 09 02* construction and demolition wastes containing PCB (for example PCB-containing sealants, PCB-containing resin-based floorings, PCB-containing sealed glazing units, PCB containing capacitors)
17 09 03* other construction and demolition wastes (including mixed wastes) containing dangerous substances
17 09 04 mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03

European Waste Catalogue 2002 Note

The EWC 2002 differentiates between non-hazardous and hazardous entries by identifying hazardous waste entries are identified with an asterisk (*).

Absolute entries are indicated by red font

Hazardous mirror entries have been highlighted in blue and marked with an M in the consolidated version of the EWC 2002.

Appendix E Health and Safety Legislation and Requirements

Driver	Legislation	Requirement
Health and Safety Management	Health and Safety at Work, etc Act Management of Health and Safety at Work Regulations	Ensure that employers: Provide and maintain safe equipment and systems of work Identify and minimise risks to health and safety during work activities through the provision and maintenance of a safe working environment Provide information, instruction, training and supervision of all employees and visitors, with particular regard to disabled, new or expectant mothers and young people
Working environment	Workplace (Health and Safety) Regulations	Ensure a safe workplace also includes the provision of facilities for the general welfare of employees while at work.
First Aid	Health and Safety (First Aid) Regulations	Ensure that employers make suitable provisions for first aid in the event of illness or injury at work. Such provisions to include facilities and equipment, first aid training and information.
Accident reporting	Reporting of Injuries, Diseases and Dangerous Occurrences (RIDDOR) Regulations	Record injuries, diseases or dangerous occurrences, ensuring that any fatalities, major injuries or dangerous occurrences are reported to the enforcing authority
Work Equipment	Provision and Use of Work Equipment (PUWER) Regulations Supply of Machinery (Safety) Regulations	Ensure that all work equipment is safe, used and maintained correctly.
Hazardous Substances	Control of Substances Hazardous to Health (COSHH) Regulations	Employers must control the exposure of their personnel, or anyone else likely to be affected during work, to substances hazardous to health. Hazardous substances include all materials labelled as harmful, irritant, toxic/very toxic, corrosive, inflammable, poisons – and other unlabelled substances – e.g. those formed upon mixture, combustion, abrasion etc. (i.e. dusts, gases, fumes)
Manual Handling	Manual Handling Operations Regulations	Employers must assess the risks associated with manually lifting and handling activities and provide suitable measures to reduce their impact on employees, etc.

Personal Protective Equipment (PPE)	Personal Protective Equipment at Work Regulations	Ensure that employers provide suitable personal protective equipment and clothing which affords protection against risks to health and safety. Equipment includes eye protectors, harnesses, respirators, etc; clothing includes aprons, gloves, footwear, headwear, high visibility jackets and wet/cold weather clothing.
Lifting operations	Lifting operations and Lifting Equipment Regulations	Ensure lifting equipment is and remains capable in relation to loads, particularly mounting or fixing points. New equipment and components to comply with CE standards. Ensure staff are properly trained and are safe. Mark equipment with 'safe working loads'. Have equipment inspected upon installation and periodically thereafter by a competent person and implement any identified corrective actions.
Operation of equipment	Provision and Use of Work Equipment Regulations	Assess risks for use and maintenance. Ensure that machinery is properly constructed or adapted for its intended purpose. Install safety guards, protection devices and appliances, protective zones and warnings etc. Ensure start/stop and operating controls are accessible and can isolate or stop operations when necessary. Maintain machinery in good working order.