25. SCHEDULE 25: ORGANIC FRACTION

Schedule 25

Organic Fraction Measurement Protocol

Purpose

1. The purpose of this Schedule 25 (Organic Fraction Measurement Protocol) is to define:

1.1 **(In Part 1)** The monitoring method required to measure the MBT Organic Fraction within the MBT Acceptable Waste received at the Reception Hall (that is following sorting of MBT Unacceptable Waste upon initial reception). This will be used to ascertain if the required Minimum Organic Fraction Percentage has been achieved. This method will be used for the duration of the Contract;

1.2 **(In Part 2)** The monitoring method required to measure the performance in the reduction in Biodegradability of the material within the MBT Facility Composting Hall. This will be used to:

1.2.1 ascertain the Minimum Organic Fraction Percentage which is consistent with a reduction in the Biodegradability of material of 75% over seven weeks within the Composting Hall of the MBT Facility. This method will be used for the duration of the MBT Input Review Period, as detailed in Schedule 24; and

1.2.2 to measure the reduction in Biodegradability of waste material within the Composting Hall of the MBT Facility for the purposes of assessing the Biodegradable Contract Waste (BCW) arising from the Composting Hall and thereby the performance of the Contractor in relation to the Contract Targets to the extent arising from the MBT Facility. This method will be used for the duration of the Contract Period from the Initial Acceptance Date.

1.3 **(In Part 3)** The monitoring method required for measuring the Biodegradability of other Contract Waste not treated at the MBT Facility and sent to Landfill for the purposes of assessing the performance of the Contractor in relation to the Contract Targets;

1.4 **(In Part 4)** The method required for assessing the performance of the Contractor in relation to the Contract Targets;

1.5 **(In Part 5)** The reporting method to the Authority of the MBT Organic Fraction measurement for the duration of the Contract, the reduction in Biodegradability measurement for the duration of the MBT Input Review Period and the reduction in Biodegradability of waste material within the MBT Facility and the Biodegradability of other Contract Waste not treated at the MBT Facility and sent to Landfill for the purpose of assessing the performance of the Contractor in relation to the Contract Targets for the duration of the Contract Period;

1.6 **(In Part 6)** The monitoring method required for measuring the Biodegradability within the Composting Hall of the MBT Facility and other Contract Waste not treated within the MBT Facility and sent to Landfill for the purpose of assessing the Authority's performance against the Landfill Allowance Trading Scheme (LATS).

1.7 The action that will be taken to resolve any dispute over either the reported MBT Organic Fraction or the reported results of the experimentations undertaken during the MBT Input Review Period or the reduction in Biodegradability during the Contract Period.

1.8 Subject to the proviso to this paragraph 1.8 the measurement, reporting, calculations and monitoring described in this Schedule 25 shall be carried out by an external consultant appointed by the Contractor **(the Waste Consultant)** who is suitably qualified and experienced to carry out the such tasks and for the purposes of Part 6 is a person either approved by the EA or having qualifications and experience required by the EA. PROVIDED THAT in the event that an employee of the Contractor or any Contractor Related Party has sufficient experience and training to perform the role of Waste Consultant, the Contractor may provided that the Authority has consented to such appointment (such consent not to be unreasonably withheld or delayed) arrange for such employee to perform the role of Waste Consultant.

1.9 The Authority or its authorised representative shall be entitled (but not obliged) to witness the tests, measurements and monitoring carried out pursuant to this Schedule 25.

Part 1 Monitoring of the MBT Organic Fraction

2. The following definitions and methods are based on the EA Guidance 2005 (although as amended herein to reflect the specific requirements of this Project). For the avoidance of doubt, any changes in or replacement to these publications or their interpretation or application relative to the position as at the Contract Commencement Date with which the Contractor is bound to comply under this Contract shall be treated as a Specific Change of Law notwithstanding any other provision of this Contract.

Composition Analysis	Devised from composite input samples and separated into non biodegradable fraction and biodegradable organic fraction. The test is based on wet weight or 'as received or delivered' to the Reception Hall of MBT Acceptable Waste.
Biodegradable Organic Fraction	Defined 'as green waste (garden waste), kitchen waste, wood, textiles, sanitary, paper, card and cardboard, and any fines that are not recognised in other categories'.
Wet weight	refers to the Waste in its state "as delivered" to the Reception Hall. Wet Weight is the total weight of the Waste including any water that is present in the material when it is collected.

3. In order to carry out the Composition Analysis, a composite sample of MBT Acceptable Waste will be taken every fortnight from the Reception Hall and tested for its MBT Organic Fraction. This will be carried out for the duration of the Contract by the Waste Consultant.

4. A composite sample of between 300 to 500kg of MBT Acceptable Waste will be taken from the Reception Hall. This will consist of several incremental samples (approximately 10kg each) taken from different areas of the waste 'mass' and at different times during the day.

5. The samples will be spread out on to a large plastic sheet and sorted out into the two different fractions, non biodegradable fraction and Biodegradable Organic Fraction.

6. Each fraction will be placed into a separate container, weighed and the weight recorded. The MBT Organic Fraction will be calculated as a wet weight percentage of the total composite sample.

Part 2 Monitoring of the reduction in Biodegradability of material within the Composting Hall during the MBT Input Review Period and thereafter

7. The following is based on the EA Guidance 2005. For the avoidance of doubt, any changes in or replacement to these publications or their interpretation or application relative to the position as at the Contract Commencement Date with which the Contractor is bound to comply under this Contract shall be treated as a Specific Change of Law notwithstanding any other provision of this Contract.

8. For the purposes of the MBT Input Review Period in Schedule 24, the measurement of the reduction in Biodegradability of material within the Composting Hall will be carried out as and when required. That is, to compliment the suite of experiments, as stated in Schedule 24, which will be carried out as part of the MBT Input Review Period.

9. For the purposes of measuring the reduction in Biodegradability of material within the Composting Hall used for the purposes of assessing the BCW arising from the Composting Hall and thereby the performance of the Contractor in relation to the Contract Targets to the extent arising from the MBT Facility, the measurements will be carried out on a fortnightly basis or such other period as the Parties (acting reasonably) agree.

10. Samples will be collected from the input and output of the Composting Hall. As the process within the Composting Hall is a continuous feed system samples will be collected in relation to time intervals rather than as batches.

That is, an input sample will be taken on day one with the output sample being taken after seven weeks from the same batch.

11. The sample size and location will be agreed from time to time following the development and periodic review of a monitoring plan for the MBT Facility. This will be carried out in conjunction with the EA.

12. The suite of tests will be:

Composition Analysis	Devised from composite input samples and separated into non biodegradable fraction and biodegradable organic fraction (as defined above).

Gravimetric Tests	Dry Matter Content (DM), Loss on Ignition (LOI), Total Organic Carbon (TOC), and Total Nitrogen (TN).
Dynamic Respiration (DR4)	An aerobic method for determining organic waste biodegradability and taking four days at 35°c.
Biochemical Methane Potential (BM100)	An anaerobic method for determining the biogas (landfill gas) production and taking 100 days at 35°c.

13. The sampling will be carried out either by the Waste Consultant or the Contractor employee agreed pursuant to paragraph 1.8.

14. The calculation to measure the reduction in Biodegradability (so as to derive tonnage figure of BCW Landfilled) for the purposes of assessing the performance of the Contractor in relation to the Contract Targets to the extent arising from the MBT Facility will be derived by applying the methodology and tests set out in this Part 2 on the basis set out (and in accordance with) in Appendix 1 to this Schedule 25.

Part 3 Monitoring of the Biodegradability of other Contract Waste not treated at the MBT Facility and sent to Landfill

15. In respect of Contract Waste not treated at the MBT Facility, such as Ad Hoc Waste and MBT Unacceptable Waste (for avoidance of doubt, this includes MBT rejects) which is sent to Landfill, the Biodegradability of such Contract Waste will be measured for the purpose of assessing the Contractor in relation to the Contract Targets.

16. A sample will be isolated once per Contract Year until such time as the Parties acting reasonably agree to lengthen the time between measurements. A Composition Analysis will be carried out using the methodology described in Part 1, paragraphs 5 and 6 Biodegradability levels will be assigned to each fraction as guided by the EA and EA Guidance 2005. For example, textiles will be given a 50% biodegradability level. It is acknowledged by the Parties that any sample prior to the Full Service Commencement Date is for information only since the Contract Targets do not apply until after the Full Service Commencement Date.

17. The sample size, location and assessment criteria will be agreed from time to time following the development and periodic review of a monitoring plan for the MBT Facility. This will be carried out in conjunction with the EA.

Part 4 Monitoring of the assessment of the performance of the Contractor in relation to the Contract Targets

18. The reduction in Biodegradability in the Composting Hall together with the Biodegradability of any other Contract Waste not treated at the MBT Facility and sent to Landfill will be compared with the Contract Targets and used to assess the performance of the Contractor against those Contract Targets.

Part 5 Reporting of the MBT Organic Fraction, the reduction in Biodegradability of material within the Composting Hall during the MBT Input Review Period, the

reduction in Biodegradability of waste material within the Composting Hall of the MBT Facility and the Biodegradability of other Contract Waste not treated at the MBT Facility for the duration of the Contract Period and the assessment of the performance of the Contractor in relation to the Contract Targets.

19. The MBT Organic Fraction will be recorded and reported to the Authority on a monthly basis but will be applied for the purposes of Clause 54 (MBT Organic Fraction) on the basis set out in Clause 54.

20. The reduction in Biodegradability of the material within Composting Hall during the MBT Input Review Period will be recorded and reported to the Authority when each experiment has been completed. This will be in the form of a report detailing the objectives, methods used, results obtained and conclusions drawn from the experiment. It will where practicable include photographs and the 'raw data' from the suite of tests carried out.

21. The reduction in Biodegradability (as a tonnage figure of BCW Landfilled) of material within the Composting Hall during the Contract Period following the MBT Input Review Period, for the purposes of assessing the performance of the Contractor in relation to the Contract Targets to the extent arising from the MBT Facility, will be recorded and reported to the Authority on a Quarterly basis and in respect of each Contract Year for the purposes of the Contract Targets. This will be in the form of a detailed report and will where practicable include the 'raw data' from the suite of tests carried out.

22. The Biodegradability (as a tonnage figure of BCW Landfilled) of Contract Waste not treated at the MBT Facility and sent to Landfill, for the purposes of assessing the performance of the Contractor in relation to the Contract Targets to the extent arising from the MBT Facility, will be recorded and reported to the Authority on a Quarterly basis and in respect of each Contract Year for the purposes of the Contract Targets. This will be in the form of a detailed report and will where practicable include the 'raw data' from the suite of tests carried out.

23. The assessment of the performance of the Contractor in relation to the Contract Targets (as a tonnage figure of BCW Landfilled) will be recorded and reported to the Authority on a Contract Year basis as provided for in section 12 of Schedule 26 (the Payment Mechanism). This will be in the form of a detailed report.

Part 6 Monitoring of the Biodegradability in the Composting Hall of the MBT Facility and other Contract Waste not treated within the MBT Facility and sent to Landfill for the purpose of assessing the Authority's Landfill Allowance Targets (LATs)

24. The Waste Consultant shall monitor and measure the Biodegradability in the Composting Hall of the MBT Facility and other Contract Waste not treated within the MBT Facility and sent to Landfill for the purpose of assessing the Authority's performance against the Landfill Allowance Trading Scheme (LATS).

25. In carrying out monitoring and measurements provided in paragraph 24 above, EA Guidance 2005 will be followed and a monitoring plan will be developed in conjunction with the EA.

26. The reduction in Biodegradability in the Composting Hall together with the Biodegradability of any other Contract Waste not treated at the MBT Facility and sent to Landfill will be submitted to the EA every Quarter.

26.1 For the avoidance of doubt:

26.1.1 this process is not applicable to the Contract Targets which are measured on the basis set out in this Schedule 25 (save for this Part 6).

26.1.2 The Contractor shall report the reduction in Biodegradability in the Composting Hall together with the Biodegradability of any other Contract Waste not treated at the MBT Facility and sent to Landfill in accordance with EA requirements notwithstanding any divergence between the testing regime and measurements of this Schedule 25 (but for this Part 6) and the requirements of the EA.

26.1.3 Without prejudice to the generality of Clause 105, any divergence between the testing regime and measurements in this Schedule 25 and the requirements of the EA or revised EA Guidance with which the Contractor is bound to comply shall be treated and assessed as a Specific Change in Law in accordance with Clause 105.8. Save as required by any Change of Law with which the Contractor is bound to comply, the Authority shall not be bound to accept (nor shall there be deemed) amendments to this Schedule 25 (so as to realign the testing regime and measurements for Contract Target purposes with those for LATS purposes) but it is acknowledged that if the Authority requires such realignment, it shall do so through the Authority Change Mechanism (Clause 107).

Appendix

Calculation of the Reduction in Biodegradability of Biodegradable Contract Waste (BCW) (in tonnes of BCW sent to Landfill) treated in the Composting Hall of the MBT Facility

The following is based on the EA Guidance 2005' subject at all times to the provisions of Schedule 25 (Organic Fraction Measurement Protocol).

The calculation of BCW sent to landfill following treatment in an MBT Facility is based on estimating the difference in potential biogas production of the treated waste (output) and that of the untreated waste (input). It takes into account the losses in organic matter (as LOI), moisture content (as DM), the different percentage BCW in the output compared with input (as waste composition) and change in biodegradability, which is measured using DR4 and BM100.

Table 1: Data required on MBT input and outputs going to landfill

Data Required	Units	Symbol: MBT input	Symbol: MBT output to landfill
Tonnes wet weight of MBT Acceptable Waste (CW) per	tCW	tM_1	tM_0
Percentage wet weight of BCW fraction of the MBT Acceptable Waste (CW)	%BCW	$\%B_1$	$\%B_0$
Percentage dry matter (DM) content of BCW fraction	%DM	$\%DM_1$	$\%DM_0$
Percentage loss on ignition (LOI) of dry matter content of the BCW fraction	%LOI	$\%LOI_1$	$\%LOI_0$
Anaerobic biodegradability (BM100) of the BCW fraction **or**	litres biogas/kg LOI	$BM100_1$	$BM100_0$
Aerobic biodegradability (DR4) of the BCW	mg O/kg LOI	$DR4_1$	$DR4_0$

Note – The subscript I and O on the symbols refer to Input and Output parameters respectively.

The calculation is as follows:

1. Calculation of tonnes BCW in the MBT input ($tBCW_I$)

The calculation of MBT Facility output BCW Landfilled requires an estimate of the tonnes BCW in the MBT Facility input (i.e. MBT Acceptable Waste) per quarter ($tBCW_I$). This can be calculated from the MBT Acceptable Waste input measured as tonnes Contract Waste (tCW_I) and the %BCW (measured at the input to the Composting Hall of the MBT Facility) of the CW ($\%B_I$) as follows:

$$tBCW_I = tCW_I \times \%B_I/100$$

This can be adjusted if any other Local Authority uses the MBT Facility, to the corresponding BCW content.

2. Calculation of LOI content ($tLOI_I$) of the BCW in the MBT Acceptable Waste input

This calculates the amount of biodegradable organic matter in the MBT Acceptable Waste input in terms of tonnes LOI per quarter:

$$tLOI_I = tM_I \times \%B_I/100 \times \%DM_I/100 \times \%LOI_I/100$$

3. Calculation of LOI content ($tLOI_O$) of the BCW in the MBT Facility output landfilled

This calculates the amount of biodegradable organic matter in the MBT Facility output landfilled in terms of tonnes LOI per quarter. :

$$tLOI_O = tM_O \times \%B_O/100 \times \%DM_O/100 \times \%LOI_O/100$$

4. Estimation of biogas production in MBT Facility input (BG_I)

The estimated biogas production (BGI) in m^3 that would occur if all the untreated MBT Facility input MBT Acceptable Waste was landfilled is estimated from:

$$BG_I = tLOI_I \times BM100_I$$

Note – BM100 units of litres biogas/kg LOI are equivalent to m^3 biogas/t LOI.

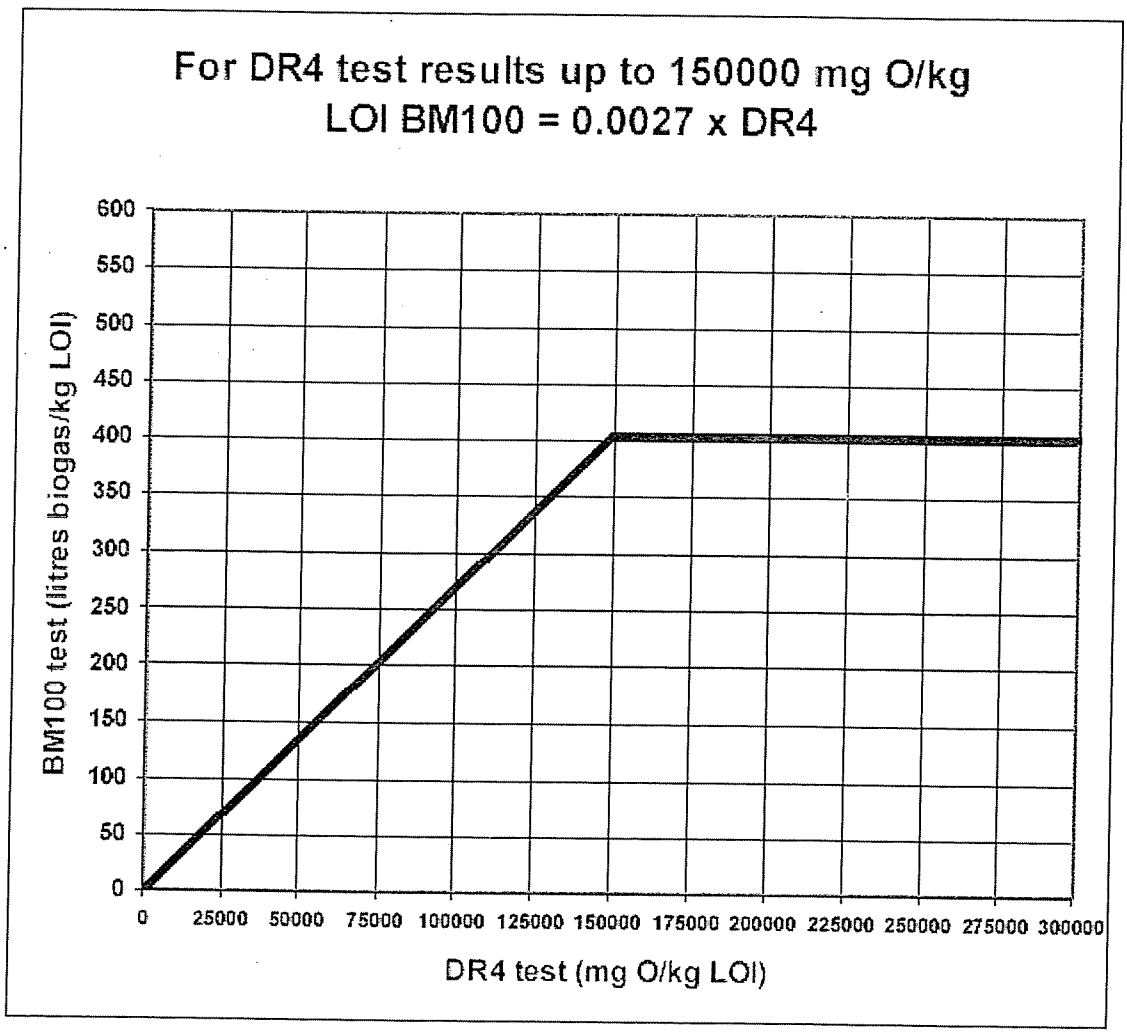
5. Estimation of biogas production in MBT Facility outputs (BG_O)

The estimated biogas production (BGO) in m^3 that would occur from landfilling the MBT Facility outputs is estimated from:

$$BG_O = tLOI_O \times BM100_O$$

Note: Although the graph shown in, Figure 1, is taken from the EA Guidance 2005 and shows a good correlation between DR4 and BM100 tests, a graph showing the actual DR4 and BM100 data of MBT Facility input and output for the MBT Facility during the initial assessment phase will be plotted and therefore once the ongoing monitoring program has been established the number of BM100 tests will be reduce significantly.

Figure 1: Conversion of aerobic biodegradation DR4 test result values to anaerobic biogas BM100 test values



6. Estimation of tonnes BCW landfilled

The percentage of the MBT Acceptable Waste input BCW that has been diverted from landfill is then determined by estimating the percentage reduction in biogas production between the MBT Acceptable Waste input and the MBT Facility output landfilled.

$$\%BMW_{diverted} = (BG_I - BG_O)/BG_I \times 100\%$$

where: $\%BCW_{diverted}$ is the percentage BCW diverted following MBT Facility treatment

The estimated tonnes of MBT Facility output BCW Landfilled is therefore:

$$tBCW_O = tBCW_I \times (1 - \%BCW_{diverted}/100)$$

where: $tBCW_O$ is the estimated tonnes of MBT Facility output BCW landfilled

Note: The $tBCW_O$ is not an actual mass of MBT Facility treated BCW landfilled but an estimate of the equivalent amount of untreated BCW that would give the same

biogas production as the landfilled MBT Facility treated output. Therefore the tonnages calculated can be directly compared with untreated BCW.

An Example Calculation

Based on a hypothetical batch MBT process treating 1000 t MSW per batch and producing one MBT Facility treated output stream (A) that is Landfilled. The data collected is shown in Table 2 below.

Table 2. Data collected from monitoring

Data Required	Units	MBT input	MBT output A to landfill	
Tonnes wet weight of MBT Acceptable Waste (CW) per	tCW	1000	200	
Percentage wet weight of BCW fraction of the MBT Acceptable Waste (CW) measured	%BCW	64	52	
Percentage dry matter (DM) content of BCW fraction	%DM	50	70	
Percentage loss on ignition (LOI) of dry matter content of the BCW fraction	%LOI	65	40	
Anaerobic biodegradability (BM100) of the BCW fraction	litres biogas/kg LOI	405*		
Aerobic biodegradability (DR4) of the BCW	mg O/kg LOI	$DR4_1$	50000**	

Note – *BM100 value for untreated BCW (405 litres/kg LOI).
**Measure in aerobic DR4 test and assuming it has been confirmed that DR4 data correlates with BM100 as in Figure 1 for the plant.

Therefore:

1. Calculation of tonnes BCW in the MBT Facility input ($tBCW_I$)

$$tBCW_I = 1000 \times 64/100 = 640 \text{ tonnes}$$

2. Calculation of LOI content ($tLOI_I$) of the BCW in the MBT Facility input

$$tLOI_I = 1000 \times 64/100 \times 50/100 \times 65/100 = 208 \text{ t LOI}$$

3. Calculation of LOI content ($tLOI_O$) of the BCW in the MBT Facility output A to landfill

$$tLOI_{O(A)} = 200 \times 52/100 \times 70/100 \times 40/100 = 29.12 \text{ t LOI}$$

4. Estimation of biogas production in MBT Facility input (BG_I)

BG_I (using biodegradability of untreated BCW as 405 litre/kg LOI) = 208 x 405 = 84240 m^3

5a. Estimation of biogas production in MBT Facility output A to landfill

$BG_{O(A)}$ (using DR4 value of 50000 mg O2/kg LOI and figure 1) = 29.12 x 135 = 3931.2 m^3

6. Estimation of tonnes BCW landfilled

$$\%BCW_{diverted} = (84240 - 3931.2)/ 84240 \times 100\% = 95.3\%$$

$tBCW_O$ = 640 x (1 –95.3/100) = 30.08tBCW in terms of equivalent untreated BCW

Therefore:

- The MBT input of 1000 t MSW (680 tonnes untreated BCW) contains 208 t of biodegradable LOI with potential biogas production of 84240 m3.
- 200 tonnes of pre-treated outputs were landfilled this contains 29.12 t of biodegradable LOI with potential biogas production of 3931.2 m3.
- The percentage of the MBT input BCW diverted from landfill based on these potential biogas production values is 95.3%.
- The MBT output landfilled is equivalent to 30 tonnes of BCW.