TerraConsult
A BYRNELOOBY COMPANY

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RUABON LANDFILL

MANAGEMENT AND INSPECTION PLAN

Prepared for

WRG Midlands Ltd

(FCC Environment (UK) Ltd)

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Carried Out For:

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(FCC Environment (UK) Ltd)

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RUABON LANDFILL

MANAGEMENT AND INSPECTION PLAN

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1. INTRODUCTION

1.1 Report Context

This document prepared by TerraConsult Ltd (TCL) on behalf of FCC Environment (UK) Ltd (FCC) has been prepared to support an application to consolidate the Ruabon Landfill permits, the Site is also referred to as Gardden Lodge.

This document provides a summary of the current working plan for the Site and identifies which aspects are currently applicable, or now that the Site is restored and in the closure phase are no longer relevant. The working plan "Working Plan for Closed Site Operations" is dated December 2001.

Any aspect of this plan can bee changed or amended on written agreement with NRW.

2. WORKING PLAN

A. INTRODUCTION

A.1 This Working Plan will relate to Waste Management Licences WMBC L50 and WMBC L82 (*updated to a single environmental permit, application dated 2022*). The area of land edged around in red on the attached plan, Drawing No. SME0001A/030D. The deposit of waste has been restricted to the areas edged in green and black.

Drawings

Restoration Plan

Restored Site Contours & General Arrangement of Surface Water Drainage – Drawing No. JODA S2001/GL/001.

Gas Abstraction System

- Gas Abstraction System & Site Monitoring Plan – Drawing No. JODA S2001/GL/002A
- Typical Landfill Gas Extraction Well.

Surface Water Management System (Main Site Area)

- Surface Water Calculations for Capped Situation – Document Ref. JODA TOPOGRAPHIC DEC99.
- 'Proposed Surface Water Control Measures' Drawing No. JODA/CAD/RUABON/GL99007
- 'Proposed Surface Water Lagoon Arrangement' Drawing No. JODA S2000/GL/007.
- 'Post Closure Management of Surface Water Sections Through Enlarged Lagoons' Drawing No. JODA S2000/GL/012A.

Surface Water Management System (Site Entrance Area)

- Surface Water Control Measures – Document Ref. JODA TOPOGRAPHICS 02/01/01.
- 'Details of Installations near Site Entrance' Drawing No. JODA S2000-GL-016
- 'Details of Design of Surface Water Management System at Site Entrance' Drawing No. JODA S2000-GL-017.
- 'Surface Water Management Proposals' Drawing No. JODA S2000/GL/020A

Leachate Recirculation & Extraction System

- 'Proposed Leachate Management System Schematic Pipe Arrangement Plan' Drawing No. JODA S2000/GL/001.
- 'Leachate Storage Tank Arrangement Plan' Drawing No. JODA S2000/GL/002.
- 'Proposed Leachate Pumping Station Plan, Elevations and Notes' Drawing No. JODA S2000/GL/004A.
- Typical Landfill Gas – Leachate Extraction Well.

All reference to historic licence numbers are outdated, plans noted above are not available electronically – the consolidated permit will reference any applicable plans (e.g. MEPP accordingly). SME0001A/030D has been replaced by 4915/1/001.

B. TYPES AND QUANTITIES OF WASTE TO BE HANDLED

B.1 There will be no waste deposited on site other than construction, demolition and excavation waste which is of solid nature which will only be used where suitable, for maintaining site roads and restoration capping.

No longer applicable.

C. HOURS OF OPERTAION

C.1 In accordance with condition 6 of Planning Permission Ref. 6/RUA22338.

Emergency Work

C.2 Emergency work, other than essential maintenance pumping leachate and gas extraction will only be undertaken outside the hours permitted by the planning permission with the prior agreement of the Local Planning Authority and in conjunction with Natural Resources Wales (NRW).

Forms part of FCC procedures.

D. AMENDMENTS TO THE WORKING PLAN

D.1 Alterations and amendments to the Working Plan will only be carried out in consultation with NRW and agreed in writing.

No longer applicable, any future changes will be relevant to the issued, consolidated permit for the site

E. SITE OFFICE STORAGE OF LIQUIDS

E.1 The existing office already in use by FCC, adjacent to the site entrance will be retained. The office is used to provide accommodation for the Monitoring Technician. The office is served by mains water, electricity and toilet facilities and are also connected to the national telephone and facsimile systems.

E.2 Fuel and / or storage containers, leachate tanks and associated pipework will be situated within a bunded area. The base and bund walls shall be constructed with an impermeable material so as to contain at any time, 110% of the volume of the largest container present within the area. Any fuel spillages will be removed immediately. All tanks and containers will be accurately labelled to indicate their contents.

E.3 An emergency spillage kit containing oil absorbent booms and granules will be retained on site for use in mitigation of any fuel spillages on site. The emergency spill kit will be located within the site store.

Storage of liquids are minimal, but form part of FCC procedures.

F. FENCING AND SITE ROADS

F.1 All existing perimeter fences surrounding the site will conform to British Standard BS1722. The existing fence is 1.8 metre high chain link supported on steel angle posts superimposed with a cranked three-barbed wire strand barrier.

F.2 New steel palisade gates have been installed at the site entrance, they are 1.8 metre high lockable gates which will be maintained to BS1722, Part 1, 1986, as shown on Drawing No. JODA S2001/GL/001. These gates will be kept locked shut at all times when the site is unattended and a padlock to security standard will be provided for this purpose.

F.3 All site perimeter fences and gates will be inspected at intervals of not more than 7 days. Any damage (which impairs their effectiveness to prevent unauthorised pedestrian access) found during the course of these inspections or at any other time will be repaired by the end of the working day.

F.4 The storm water storage lagoons will be surrounded by a 1.8 metre high chain-link fence to the same standard as the perimeter fencing.

F.5 The gas flare and generator compound will be secured with a 2.5 metre high steel fence which will remain padlocked when access by site staff is not required.

F.6 The leachate pump house and control system is fully enclosed within a brick building which is secure with lockable steel doors.

F.7 The existing primary site road will be maintained in good repair. Any cracks or potholes will be repaired as necessary.

F.8 All subsidiary site roads will be laid to fall to encourage surface water run-off and be maintained free from potholes. Any potholes will be filled with compacted hard-core or rubble as necessary.

The site is securely fenced, control systems and associated maintenance forms part of FCC's procedures.

G. EARTHWORKS ON LANDFILL SITES

G.1 In the event of repairs being required to the clay cap or lining, they will be carried out in accordance with Appendix 1.

Any upgrades or repairs are undertaken to current standards / practices.

H. SURFACE WATER DRAINAGE

H.1 The existing surface water management system incorporating lagoons, drainage channels, holding tanks and pumps will be maintained as specified on Drawings JODA/CAD/RUABON/GL99007, JODA S2000/GL/007 and JODA S2000/GL/012A.

H.2 The surface water management system mentioned above will be maintained at all times in a satisfactory operating condition. All surface water management system will be inspected not less frequently than once each week and kept free from debris or blockage, silting up and vegetation.

H.3 In the event of contamination of surface water being detected, NRW will be notified forthwith and the discharge stopped by closing the discharge valve. The source of the contamination will be located and isolated using the emergency spill kit described in E.3. prior to the discharge re-commencing. If necessary and following discussions with NRW, contaminated water from the lagoon and drainage channels will be removed for disposal at a suitably licensed facility prior to the re-commencement of surface water discharge from the site.

No changes or amendments proposed. Plans are outdated, see section A.

I. LEACHATE AND LANDFILL GAS

I.1 The existing external groundwater and gas monitoring boreholes as specified in Drawing No. JODA S2001/GL/002A, will be maintained in good working order. In the event of failure,

they will be repaired or replace within a timescale specified within either licence or other timescale agreed with NRW.

I.2 The main leachate recirculation system is constructed as shown in Drawings JODA S2000/GL/001, JODA S2000/GL/002 and JODA S2000/GL/004A, and will be maintained in accordance with the manufacturer's recommendations. In the event of failure, the recirculation system will be repaired in accordance with the manufacturer's specification and if necessary, replaced in agreement with NRW.

I.3 Gas wells will be constructed within each cell and constructed to the standard specified in the Typical Well Drawings. The gas wells will be maintained in accordance with the FCC internal specification, and in the event of failure, will be replaced or repaired in accordance with the timescales specified in the licences or other such timescale agreed with NRW. The current location of these wells is in accordance with Drawing No. JODA S2001/GL/002A.

I.4 Water levels will be measured (in cms above the base of the monitoring point and prior to any pumping or purging operations) in all said groundwater monitoring boreholes and in all said leachate wells on a monthly frequency. Results of monitoring will be recorded in the Environmental Log (see K.3).

I.5 Water samples will be taken from the external groundwater monitoring boreholes in accordance with the attached schedule (see below) at monthly intervals and at any other time as requested by NRW. The samples will be analysed by an accredited analyst for the following parameters and for any other parameter as reasonably requested by NRW. Results of monitoring will be recorded in the Environmental Log.

I.6 In the event of groundwater contamination being detected by an unexpected change in the analysis, NRW will be notified forthwith, and further testing as agreed will be undertaken to identify the source of contamination. Any necessary mitigating engineering works to isolate the source of contamination from the groundwater will then be undertaken in agreement with NRW.

I.7 A full analysis of leachate has been undertaken, the determinands of which have been agreed with NRW. Regular leachate samples will be taken in accordance with the table below.

Within one month of the results of analysis of the above determinands being available and based on the actual parameters established from the analysis and in full consultation with NRW.

I.8 If the depth of leachate as measured in any leachate monitoring well is found to exceed 2 metres above the level of the base of the site at that point, hereinafter called the trigger level, then leachate will be removed by pumping until the depth of leachate falls below that trigger level. The levels will be recorded in the Environmental Log.

I.9 Leachate removed as required by Condition I.7 of each licence except for those leachates that can be reasonably recycled back into the site will be tankered off site to a suitably licensed facility, until such time that other methods of leachate disposal have been agreed in writing with NRW. Recycling of leachate will be undertaken as specified in Appendix 2 for the leachate recirculation system.

Table 1 Closure Monitoring Schedule

POINT	No.	PARAMETER	FREQUENCY
Surface Water WMP1, 4A, 5, 7	4	pH, EC, DO, Cl, BOD, COD, NH_3-N, SS	Monthly
Groundwater WB2A, 2B, 2C, 2D, 3A, 4A, 5A, 5B, BH13	9	Water level, pH, EC, DO, BOD, COD, NH_3-N, Cl, SO_4, Alk (as $CaCO_3$), TON, TOC, Na, K, Ca, Mg, Fe, Mn, Cd, Cr, CU, Ni, Pb, Zn	Monthly
Leachate GW(M1), GW(M3), GW(M4), GW(M5), GW(M10), LMP(2), LMP(6), LMP(7), LMP(8), LMP(9)	10	Leachate Level	Monthly
Leachate Main Eductor tank	1	As monthly plus: pH, EC, BOD, COD, NH_3-N, Cl, SO_4, Alk (as $CaCO_3$), TON, TOC, Na, K, Ca, Mg, Fe, Mn, Cd, Cr, Cu, Ni, Pb, Zn	Quarterly
Landfill Gas BH1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b, 5, 6, 7, 8, 9, 10, 11a, 11p, 12a, 12p, 13, 14, 15, 16, GP1 to 4, 6, 8 to 16, 18 to 21, A1 to A3, B1 to B3, C1 to C3, D1 to D3, E1 to E3, F1 to F3, GBH1, 2, 2a, 3 to 10, WB1a, 1b, 2a, 2b, 2c, 2d, 3a, 3b, 4a, 4b, 5a, 5b	81	CH_4, CO_2, O_2, Atmospheric Pressure, Water Level (except GPs)	Monthly

Or amended as per any permit variation

I.10 All water level data, leachate level data, and all water and leachate analysis results will be written into the Environmental Log. A true copy of the analytical results and other data will be forwarded at 3 monthly intervals to NRW.

I.11 Each cell has been engineered to prevent egress of leachate into surface water. In the event of any leachate egress from a defined cell, through the cap, then mitigation will be carried out in accordance with Appendix 3, NRW will be informed of the mitigation. Any deviation from the method stated in Appendix 3 will be agreed in writing with NRW.

I.12 All lagoons on site will be fenced to prevent unauthorised access and a warning notice erected to indicate DANGER DEEP WATER.

I.13 The top of each leachate monitoring point will be covered to prevent entry of material and unauthorised access. During normal working hours these monitoring chimneys will be opened for inspection as requested by an officer of NRW.

I.14 The emergency leachate contingency plan has been incorporated into the Working Plan, see Appendix 3.

I.15 In the event of leachate migrating from the licensed area of the landfill site, NRW will be informed immediately and will also be confirmed in writing within seven days. The cause will be investigated and suitable improvements or additional measures will be undertaken at the earliest practicable time to ensure leachate migration is reduced. The proposed improvements and additional measures will be agreed with NRW.

Landfill Gas Monitoring and Control

I.16 The existing gas control system will be retained as shown on Drawing No. JODA S2001/GL/002A.

I.17 Landfill gas venting to the atmosphere will be controlled and flared as necessary so as to ensure that odours do not cause a danger to public health or serious detriment to the amenity of the locality.

I.18 The existing flare pad is surrounded by security fencing to BS1722 standard together with a gate of similar construction to allow access for maintenance of the flare. The compound gate will remain locked at all times unless site personnel are present.

I.19 The landfill gas control system will be maintained at all times in a satisfactory condition for which it was originally designed. Copies of the maintenance manuals will be retained on site and made available for inspection by an officer of NRW.

I.20 The gas control system will be inspected weekly and problems associated with any damage, mechanical breakdown or extraneous material, including litter or debris, likely to impair its effectiveness will be rectified as necessary. There is currently a 10-15% redundancy factor engineered into the current abstraction system. NRW will be informed of what mitigation will be undertaken.

I.21 Monitoring for both methane, oxygen and carbon dioxide components of landfill gas will be carried out on each gas monitoring point as specified on Drawing No. JODA S2001/GL/002A. This monitoring will be carried out by taking readings from each monitoring point during the course of the same day in accordance with the attached monitoring schedule and the results will be recorded in the Environmental Log.

I.22 Monitoring will be carried out by the use of portable gas detection equipment.

I.23 Portable gas detection equipment used for landfill gas monitoring will be calibrated in accordance with the manufacturer's instructions for the gas it is intended to monitor.

I.24 Samples of landfill gas will be taken for Gas Chromatograph analysis in accordance with Condition 5 of planning permission Ref: RUA P/1999/0111 to determine the concentrations of methane, carbon dioxide, oxygen, nitrogen and agreed trace elements. These will be repeated as agreed with NRW.

I.25 The results of the routine gas monitoring and from the gas chromatograph will be written into the Environmental Log. A true copy of these results will be forwarded to NRW within one working week of receipt

I.26 If, during the course of and arising out of the monitoring for gas concentrations of flammable gas above 20% Lower Explosive Limit of carbon dioxide in excess of agreed trigger levels by volume is detected in any building, property, duct or statutory undertakers' services, NRW will be notified immediately. The situation will be treated as an emergency and the site's landfill gas emergency plan will be implemented, see Appendix 4.

I.27 In the event of gas levels migrating from the licensed area of the landfill site, greater than 1% flammable gas or agreed trigger levels of carbon dioxide by volume in air NRW will be informed immediately the results will be confirmed in writing within seven days. The cause will be investigated, and suitable improvements or additional measures will be undertaken at the earliest practicable time to ensure such gas levels are reduced below those indicated. The proposed improvements and additional measures will be agreed with NRW.

Updated monitoring detailed in report 4915/R/006/4 for the Site in the closure phase. Revised levels and schedules based on environmental risk and receptors (Reports 4915/R/003/2 and 4915/R/004/4).

J. SITE NOTICE BOARD

J.1 The existing site identification board will be retained showing any new licence number issued by NRW and the following information 'THIS SITE IS NO LONGER OPEN FOR THE RECEIPT OF WASTE'.

Remains valid.

K. SITE CONTROL

K.1 A proficient person will be designated as responsible for the security and satisfactory operation of the site and NRW will be notified of this person's name, address and telephone number. A technically competent person will be located within 2 hours travelling distance of the site. Any change will be communicated to NRW immediately and confirmed in writing.

K.2 The terms of the licence will be made known to all persons manning the site and copy of the site licence and the agreed working plan will be displayed at the site control office.

Site Records

K.3 An Environmental Log will be kept at the site office in which the following data shall be recorded:

1. Site fencing inspections.
2. Complaints regarding bad odours, noise etc.
3. Fires.
4. Times and dates of emergency work or other work done outside of normal licensing hours.
5. The Environmental Log will indicate where all the relevant information is located i.e. filing cabinets, etc.
6. Restoration and engineering cap, impairments and maintenance.
7. Current status of the leachate and gas management systems, including their maintenance and modifications.
8. On site monitoring results.

Plant and Equipment

K.4 Plant and equipment for the purpose of site engineering will provided and maintained in accordance with manufacturer's specifications. This will normally include:

- Tractor and attachments.
- The above plant will be supplemented from time to time to maintain good operational practice.

K.5 The best practicable means will be adopted at all times in the design, construction, silencing and maintenance of all plant and equipment operational on the site to reduce noise to a minimum.

Responsibilities and technical competency are detailed in report 4915/R/001/2, site records are kept electronically as required. Plant and equipment in regard to "engineering" is no longer valid. Engineering is complete.

L. SITE OPERATIONS

Vehicle and Fly Control

L.1 The site will be inspected monthly for infestation by insects and vermin. Disinfestation measures will be applied as necessary in consultation with the local Environmental Health Authority.

L.2 Records of dates of inspections, disinfestation measures applied and notification to the Local Authority under Section 3 of the Prevention of Damage by Pests Act, 1949, will be kept in the Environmental Log.

L.3 No waste will be stored on site.

Fires and Fire Precautions

L.4 No material will be burned within the boundaries of the licensed area of the site.

L.5 Any outbreaks of fire on the site will be treated as an emergency and steps taken to extinguish them immediately. Fires on the site will, if safe to do so, be addressed in accordance

with company procedures. All outbreaks of fire will be notified on the date of occurrence or, if outside office hours, at the beginning of the next day to NRW. Should the local action prove to be unsatisfactory the fire brigade will be alerted.

Waste is covered and the site is restored, flies relating landfilling are no longer valid, and fires are covered by FCC standard procedures.

M. NUISANCES

M.1 All reasonable measures, including proper maintenance and use will be undertaken to control the noise of vehicles operating at the facility to ensure it is not seriously detrimental to the amenities of the locality.

Remains valid, site operation is now limited to maintenance only.

N. ADDITIONAL PRECAUTIONS FOR PREVIOUSLY DEPOSITED ASBESTOS SPECIAL WASTE

N.1 A register containing copies of all consignment notes relating to Special Asbestos Waste deposited at the site will be kept in chronological order at the site control office. This register will be made available for inspection by any duly authorised officer of the Waste Regulation Authority at all reasonable times.

N.2 The location of all Special Asbestos Wastes deposited within the licensed site are recorded on a drawing of the site in accordance with the requirements of the Control of Pollution (Special Waste) Regulations 1980. The locations of each deposit are described by reference to the register of consignment notes.

N.3 The location of all deposits of Special Asbestos Wastes are shown on a 1/500 scale plan of the site. This drawing is divided into 5 metre squares and the location of each deposit is marked on the drawing as falling into one of these squares.

Not applicable.

O. ENVIRONMENTAL MONITORING AND INSPECTION

All aspects of the site's activities and operations are monitored by the Regional Technical Manager on a monthly basis. Records of the monitoring are held in the Environmental Log.

O.1 Gas Control Scheme

O.1.1 Throughout the site a positive gas abstraction system is installed which consists of a grid of gas wells to a minimum density of 2 per hectare (see Drawing JODA S2001/GL/002A). The Company Policy is to extract all landfill gas and to use it for the generation of electricity, wherever this is economically feasible and a planning permission has been granted to this effect. The gas will be positively abstracted and flared off until the generation system is

installed. FCC have considerable experience and expertise, having installed such facilities in several sites.

O.2 Gas Monitoring

O.2.1 Every 12 months a complete survey of the site perimeter will be undertaken using an instrument capable of detecting ppm levels of gas together with a spike bar. Vegetation around the perimeter of the site will be observed for any signs of deterioration and any likely passage for gas migration will be published and remedial action taken where necessary.

O.2.2 The nearest buildings to the proposed waste mass are those situated along Ruabon Road and Queen Street boundaries, within 60 metres of the site. Gas monitoring boreholes and probes are therefore installed at regular intervals around the site perimeter.

O.2.3 Services within the site buildings will also be monitored.

O.2.4 An annual interpretive report of all post closure monitoring results incorporating the results and a description of the trends in the results of the monitoring will be forwarded to NRW within two months of the period end, commencing year end March 2002.

O.3 Aftercare Monitoring

O.3.1 During the aftercare period, monitoring will continue at agreed frequencies and parameters in the areas of environmental monitoring (water, gas, leachate, cap function and settlement) and gas surveys until a certificate of completion has been issued by NRW.

O.4 Safety Inspections

O.4.1 Safety inspections of all aspects of site operations are performed quarterly by site management in conjunction with the site monitoring technician. The results of these surveys are forwarded to the Company Safety Manager to ensure appropriate safety standards are maintained. Safety audits are also undertaken by the Safety Manager In accordance with the Company Health & Safety Policy.

O.5 Q.A. Compliance Audits

O.5.1 Internal audits of the compliance monitoring reports and practices with Q.A. procedures occur at least once yearly, which may also include an annual review and yearly inspection of the procedures by an external consultant.

Updated monitoring schedules are included in report 4915/R/006/4 which are based on the information detailed in the ESID and associated assessments. The appendices to the current working plan are provided for completeness within this document however it is noted that

- ***Earthworks standards (Appendix 1) and leachate recirculation sizing (Appendix 2) are no longer relevant***
- ***Emergency Leachate Contingency Plan (Appendix 3) – Remains Valid***
- ***Landfill Gas Management and Emergency Plan (Appendix 4) – Updated with current information***
- ***Appendix 5 and 6 details current gas field management procedures (Newenco Ltd)***
- ***Leachate well and off-site monitoring borehole maintenance and inspection***

Appendix

Appendix 1 – Minimum Standards of Earthworks

1. Specification of Minimum Standards – Stage 1: Planning and Design – Laboratory and Field Testing

1.1 Representative samples of the material from each source to be used in any liner, final cap or specified bunds (hereinafter referred to as "the seal") shall be tested in an approved soils laboratory to satisfy NRW that is capable of being compacted (by the equipment to be used for its emplacement) to an extent which will achieve a permeability of not more than 1.0 x 10-9 m/sec as specified by NRW (hereinafter referred to as the specified permeability).

1.2 The number and distribution of the sample locations shall be as agreed with NRW.

The method of soils testing shall be in accordance with the following schedule:-

- Classification

  The natural moisture content and Liquid Limit and Plastic Limit of each sample shall be measure in accordance with BS1377: Tests 1, 2 and 3 respectively. The Particle Size Distribution and in particular the clay contents shall be determined by BS1377 Test 7 where "Boulder Clays" are involved these shall be tested using the procedures described in Head Vol. 1 Sections 4.6.7 & 4.8.5.

- Compaction

  The density / moisture content relationship of the material shall be determined in accordance with BS1377 Tests 12 and 13. The appropriate size of hammer (2.5kg or 4.5kg) shall be selected to reflect the actual compaction equipment it is proposed to use on site. Where there is any uncertainty regarding the type of plant the lighter hammer shall be used.

- Permeability

  Initially the permeability (k) of the recompacted sample shall be measure at field and optimum moisture contents. Should these approach the specified permeability then additional permeability measurements shall be made dry of optimum and wet of field values. This will establish the range of permeability's which may be achieved in the field at varying moisture contents (for either Standard of Modified Proctor densities). When testing the recompacted clay the permeability shall be measured directly by the falling head method preferably using the BS compaction mould (Head Vol. 2 p457-459. 1982).

  Alternatively tests may be carried out using:

  a. Falling head cell (Head Vol. 2 p449-457)
  b. Odometer cell*
  c. Triaxial cell under falling head of constant head – (Tavenas et al. 1983).

  * Note: the Odometer cell used in method (ii) above is modified to allow direct measurement of K.

  Indirect evaluation of the permeability from consolidation tests will not be acceptable as this method can lead to an underestimate of the K value.

- Specific Gravity

  The specific gravity of the soil particles shall be determined using BS1377: Test 6 (A) and 6 (B).

- Other tests

  Additional tests may need to be carried out to enable the Operator to design the structure of toes of slope stability and to avoid problems of unworkability and shrinkage, particularly with high plasticity clays and clay with high natural moisture contents.

- Testing of In-situ material

  Where in0-situ material is to be used to contain leachate or to form part of the seal it shall be tested to establish whether it exceeds the specified permeability. In the case of soils, permeability measurement shall be carried out in the laboratory by the falling head method (see 1.2 Permeability).

  The thickness of the in-situ material shall be measure to establish:-

  a. if sufficient material is present to meet the requirements of 1.0 metre below or,
  b. the additional quantity of material required.

- Reporting of Results

  A report containing the results of all laboratory and field tests along with a location plan show in the sampling positions shall be submitted to NRW for approval before earthworks proceed.

  Where material is to be compacted to form the seal, the report shall state the minimum moisture content to be achieved during its emplacement, the equipment to be used for its emplacement, the maximum thickness of each layer and the minimum number of passes per layer. These shall be selected by the Operator to satisfy the requirements of 2.7, 2.8 and 2.8 and to ensure that the specified permeability and a maximum of 5% air voids are not exceeded.

- Acceptance Criteria

  Where material is to be recompacted to form the seal it will only be accepted as suitable when the above testing programme proves that it is capable of achieving the specified permeability or less. The material shall have a minimum clay content (i.e. a particle size less than 0.002mm) of 10%. The Liquid Limit shall not exceed 90 and the Plasticity Index (Liquid Limit minus Plastic Limit) shall not exceed 65 (Appendix II). If it appears that certain tested samples do not meet these criteria the Operator will be required to carry out further sampling and tests to demonstrate that there is an adequate supply of suitable material available to complete the seal.

2. Specification of Minimum Standards – Stage 2: Construction

2.1 The seal shall be constructed with suitable material approved by NRW.

2.2 In the case of material becoming available from a specific source after earthworks have commenced, samples from that source shall be tested in the laboratory in accordance with the preceding schedule. Such material may be placed in advance of the test results at the Operator's greater risk but in the event of these results failing the acceptance criteria (1.2 Acceptance Criteria), the placed material shall either be removed from the seal or covered by addition suitable material to the approval of NRW.

2.3 In situations where material becomes available from various "uncontrolled" sources and is placed without prior testing, the permeability of the completed structure shall be tested in accordance with 3.2.

2.4 The following unsuitable material shall be rigorously excluded from the seal:

a) Peat logs, stumps and perishable material.
b) Material susceptible to spontaneous combustion.

c) Material in a frozen condition.
d) Any industrial commercial or domestic waste.
e) Rocks, concrete or boulders having a volume greater than 0.05 metres.
f) Other materials which may be defined by NRW.

2.5 The moisture content when placed shall be at or above that specified in the report required by '1.2 Reporting Results' but shall not be so high as to render it unworkable using the method and equipment agreed under 1.2.

2.6 If the material to be placed is in or reached a condition such that it cannot be compacted in accordance with 2.5 the Operator shall either:

1. Make good by removing the material either to tip or elsewhere until it is in a suitable condition for re-use and replacing it with suitable material; or.
2. Make good the material by wetting or drying; or
3. Cease work on the material until its physical condition is such that it can again be compacted in accordance with the stated procedure.

2.7 The material shall be placed in a series of thin layers and repeatedly tracked using the agreed compaction equipment. The maximum thickness of each layer and the minimum number of passes should comply with or exceed the minimum requirements of 0020 (Method 1) of Department of Transport Specification for Highway Works Part 2, 1986 and its associated definitions and requirements. (Appendix III). A greater number of passes or thinner layers may be necessary to ensure adequate compaction and that all discontinuities are removed.

2.8 Variations from the methods given in Appendix 1A Table 6/4 or the use of plant not included therein will be permitted only if the Operator demonstrates at site trials that an adequate state of compaction is achieved by the alternative method or equipment. Earth moving plant shall not be acceptable for this purpose.

2.9 The Operator shall only employ that plant which is suitable for the sols to be handled. He shall not at any time use plant which damages the natural strength of the fill materials either in its in-situ state or during its handling and placing, o its final compacted state.

2.10 The minimum thickness of clay liners and final caps shall be 1.0 metre or such other thickness as specified by NRW. The thickness shall be measured normal to the surface of the seal at the point of test.

2.11 Where in-situ material is to form part of or abuts onto the seal, all soil and other pervious material shall be removed to the satisfaction of NRW before the start of emplacement of the seal.

2.12 Specified bunds shall have a minimum crest width of 2.0 metres and shall be designed and constructed to provide a batter, which will remain stable, both during and after the operational life of the landfill. The design of each structure shall be submitted to NRW along with the report required under '1.2 Reporting Results' and shall be approved by NRW before the commencement of its formation.

2.13 The Operator shall provide suitably qualified and experienced engineering staff to plan, design and supervise the construction of the seal. All previous engineering works carried out on the site have been similarly supervised and the supporting records and documentation have been made available to NRW and these procedures will be continued.

2.14 The complete seal shall be protected immediately after quality control testing and inspections by NRW to prevent it drying out and the formation of cracks in the placed material.

3. Specification of Minimum Standards – Stage 3: Quality Control

3.1 On completion of the structure the following quality control tests shall be carried out on the placed material:

1. In-Situ Density – BS 1377: Test 15
2. Moisture Content – BS 1377: Test 1
3. Classification Tests – BS 1377: Tests 2, 3 & 7
4. Depth Profiling – By levelling surveys

The above tests shall be carried out across the seal at locations and at depths as agreed with NRW. The number of test positions shall be 25 per hectare or such greater frequency as required by NRW.

3.2 The Operator is required to take undisturbed samples for falling head permeability measurement in the laboratory should the above tests identify areas where:

1. The material differs significantly in terms of its Liquid and Plastic Limits from those established in '1.2 Classification'.
2. The material has a clay content of less than 10%.
3. The material contains air voids in excess of either those actually achieved during the laboratory compaction tests or 5% whichever is greater.
4. The material has a moisture content less than that stated in '1.2 Reporting Results'.

   Or, if the material was placed without prior testing in accordance with the schedule set out in Stage 1 above. Under these circumstances the frequency of permeability measurement shall be at least 25 per hectare, the exact number, locations and depths being as required by NRW.

In the event of these permeability measurements exceeding the specified permeability, or if there are any cracks or fissures apparent on the surface of the structure, the suspect area must be excavated and recompacted to the above standard and / or unsuitable material replaced by suitable material as required by NRW.

3.3 The results of all quality control tests and a plan showing all the sample locations shall be submitted to NRW as soon as practicable.

3.4 In case of liners and specified bunds no tipping shall take place until the structure has been inspected and approved by NRW.

Appendix 1A - Table 6/4 Specification for Highway Works & Associated Definition and Requirements

(Department of Transport "Specification for Highway Works, Part 2". This table is to be read in conjunction with Clause 612.10).

Type of Compaction Plant	Ref. No.	Category	Method 1	
			D	NI
Smooth wheeled roller (or vibratory roller operating without vibration)		Mass per metre width of roll:		
	1	Over 2100kg up to 2700kg	125	8
	2	Over 2700kg up to 5400kg	125	6
	3	Over 5400kg	150	4
Grid Roller		Mass per metre width of roll:		
	1	Over 2700kg up to 5400kg	150	10
	2	Over 5400kg up to 8000kg	150	8
	3	Over 8000kg	150	4
Tamping Roller		Mass per metre width of roll:		
	1	Over 4000kg	225	4
Pneumatic-tyred Roller		Mass per wheel:		
	1	Over 1000kg up to 1500kg	125	6
	2	Over 1500kg up to 2000kg	150	5
	3	Over 2000kg up to 2500kg	175	4
	4	Over 2500kg up to 4000kg	225	4
	5	Over 4000kg up to 6000kg	300	4
	6	Over 6000kg up to 8000kg	350	4
	7	Over 8000kg up to 12000kg	400	4
	8	Over 12000kg	450	4
Vibratory Roller		Mass per metre width of a vibrating roll:		
	1	Over 270kg up to 450kg	Unsuit	able
	2	Over 450kg up to 700kg	Unsuit	able
	3	Over 700kg up to 1300kg	100	12
	4	Over 1300kg up to 1800kg	125	8
	5	Over 1800kg up to 2300kg	150	4
	6	Over 2300kg up to 2900kg	175	4
	7	Over 2900kg up to 3600kg	200	4
	8	Over 3600kg up to 4300kg	225	4
		Over 4300kg up to 5000kg		

Type of Compaction Plant	Ref. No.	Category	Method 1	
			D	NI
	9	Over 5000kg	250	4
	10		275	4
Vibrating Plate Compactor		Mass per metre^2 of base plate:		
	1	Over 880kg up to 1100kg	Unsuit	able
	2	Over 1100kg up to 1200kg	Unsuit	able
	3	Over 1200kg up to 1400kg	Unsuit	able
	4	Over 1400kg up to 1800kg	100	6
	5	Over 1800kg up to 2100kg	150	6
	6	Over 2100kg	200	6
Vibro-tamper		Mass:		
	1	Over 50kg up to 65kg	100	3
	2	Over 65kg up to 75kg	125	3
	3	Over 75kg up to 100kg	150	3
	4	Over 100kg	225	3
Power Rammer		Mass:		
	1	100kg up to 500kg	150	4
	2	Over 500kg	275	8
Dropping-weight Compactor		Mass of rammer over 500kg height drop:		
	1	Over 1 metre up to 2 metres	600	4
	2	Over 2 metres	600	2

D = Maximum depth of compacted layer (mm)

N = Minimum number of passes

For the purpose of Table 6/4 the following shall apply:-

1. The minimum number of passes ‘N’ is the minimum number of times that each point on the surface of the layer being compacted shall be traversed by the item of compaction plant in its operating mode, or struck by power rammers or falling weight compactors. ‘D’ is the maximum depth of the compacted layer.
2. In column headed ‘N’ the number of passes shown is to be doubled for material Classes 1A, 1B, 2A, 2B, 2C and 2D when such material occur within 600mm of sub-formation if a capping is required, or formation. Such extra compaction shall, unless otherwise described in Appendix 6/3. Either be carried out for the full width of the embankment or, in other areas of fill which are to receive a pavement, between the outer extremities of the verges.
3. The compaction plant in Table 6/4 is categorised in terms of static mass. The mass per metre width of roll is the total mass on the roll divided by the total roll width. Where a roller has more than

one axle the category of the machine shall be determined on the basis of the axle giving the highest value of mass per metre width.

4. A grid roller is a machine with a compacting roll or rolls constructed of heavy steel mesh of square pattern.
5. A tamping roller is a machine with a roll or rolls from which 'feet' project and where the projected and area of each foot exceeds 0.01 metres2 and the sum of the areas of the feet exceeds 15% of the area of the cylinder swept by the ends of the feet. The requirements for tamping rollers apply to machines that have 2 rolls in tandem. If only one tamping roll traverses each point on the surface of the layer on any one pass of the machine, the minimum number of passes shall be twice the number given in Table 6/4 plus any further doubling required to satisfy (iii) above.
6. For pneumatic-tyred rollers the mass per wheel is the total mass of the roller divided by the number of wheels.
7. For vibratory rollers the following shall apply:-
    a. (a) Vibratory rollers are self-propelled or towed smooth-wheeled rollershaving means of applying mechanical vibration to one or more rolls except that vibratory rollers employed for Method 5 compaction shall be single roll types.
    b. (b) The requirements for vibratory rollers are based on the use of the lowest gear on a self-propelled machine with mechanical transmission and a speed of 1.5-2.5km/h for a towed machine, or a self-propelled machine with hydrostatic transmission. If higher gears or speeds are used an increase number of passes shall be provided in proportion to the increase in speed of travel.
    c. (c) Where the mechanical vibration is applied to two rolls in tandem, the minimum number of passes shall be half the number given in Table 6/4 for the appropriate mass per metre width of one vibrating roll but if one roll differs in mass perm metre width from the other the number of passes shall be calculated as for the roll with the smallest value. Alternatively the minimum number of passes may be determined by treating the machine a having a single vibrating role with a mass per metre width equal to that of the roll with the higher value.
    d. (d) Vibratory rollers shall be operating without vibration will be classified as smooth-wheeled rollers.
    e. (e) Vibratory rollers shall be operated with their vibratory mechanism operating at the frequency of vibration which produces the highest measurement of amplitude unless the manufacturers recommend otherwise for the material being compacted.
    f. (f) Vibratory rollers shall be equipped or provided with devices indicating the frequency at which the mechanism is operating and the speed of travel. Both devices shall be capable of being read by an inspector alongside the machine.
8. Vibrating-plate compactors are machines having a base-plate to which is attached a source vibration consisting of one or two eccentrically weighted shafts and:
    a. (a) The mass per square metre of the base-plate of a vibrating-plate compactor is calculated by dividing the total mass of the machine in its working condition by its area in contact with the material to be compacted.
    b. (b) Vibrating-plate compactors shall be operated at a frequency of vibration recommended by the manufacturers. They shall normally be operated at travelling speeds, are necessary the number of passes shall be increased in proportion to the increase in speed of travel.
9. Vibro-tampers are machines in which an engine-driven reciprocating mechanism acts on a spring system through which oscillations are set up in a base-plate.

10. Power rammers are machines which are actuated by explosions in an internal combustion cylinder, each explosion being controlled manually by the Operator.
11. Dropping weight compactors are machines in which a dead weight is dropped from a controlled height using a hoist mechanism and they include self-propelled machines with mechanical traversing mechanisms capable of compacting soil in trenches and close to structures.
12. In the case of power rammers and dropping weight compactors one pass will be considered as made when the compacting shoe has made one strike on the area in question.
13. For items marked* in the Method 3 column the roller shall be towed by track-laying tractors. Self-propelled rollers are unsuitable.
14. Where combinations of different types or categories of plant are used, the following shall apply:
    a. The depth of layer shall be that for the type of plant requiring the least depth of layer, and
    b. The number of passes shall be that for the type of plant requiring the greatest number of passes.

Appendix 2 - Management Objectives, Description and Justification of Sizing of Leachate Extraction and Recirculation System

Introduction

The control leachate is an essential requirement for the aftercare management of a completed landfill site. The removal of leachate that accumulates in the leachate collection network is necessary to prevent excessive hydraulic pressure on the engineered containment liner.

Leachate extraction is required for an indefinite period after the cessation of landfilling activities and consequently the system employed must be capable of reliable long-term operation. A completed landfill will not necessarily be permanently manned, and the leachate extraction system must be capable of operation with minimum supervision.

The eductor pump is a static pump, comprising of a jet and throat within the eductor body. It operates on the venturi principle whereby suction is created within the eductor body when leachate is forced under pressure through the jet and into the throat. For the extraction of leachate from the landfill site, leachate is removed from a header tank located on the surface of the site. It is then pumped to each eductor located in the leachate collection system using a high head low flow pump. The feed leachate enters the eductor body, creates suction and draws leachate into the eductor. The feed leachate and extracted leachate is then returned to the header tank where the extracted leachate is removed on demand. The extracted leachate is then returned to the site via a separate pump ad is absorbed into the site, thereby utilising the absorptive capacity within the waste. Should any leachate not be absorbed into the site it is collected in a separate tank for disposal off site.

Extracted leachate can either be removed from site by road tanker or be recirculated back into the upper layers of the waste using an engineered recirculation system. The recirculation of leachate is recognised as good landfill practice as it accelerates microbial degradation of putrescible waste and increase landfill gas production, thereby reducing the stabilisation period.

1. Management Objectives

1.1 The leachate recirculation system must utilise the absorptive capacity to facilitate acceptance of the leachate removed by the leachate collection system at all times. Leachate has been recirculated at the site as part of a study into the sustainability or recirculation as a long-term option for leachate management. The proposed leachate recirculation system comprises two individual recirculation legs, in the centre and Eastern areas of the site, to enable the recirculation pipework to be rested periodically and to provide an alternative option should a leg become saturated or blocked.

1.2 Landfill sites are known to undergo settlement, which can be differential. The recirculation network operates under gravity and the areas for recirculation have been selected to enable pipe falls to be installed, which will be capable of maintaining a satisfactory gradient. Settlement rates can be in order of 25%, however the majority of settlement occurs within 5 years of waste deposition.

1.3 In order to confirm that the gradients in the recirculation network are satisfactory the pipework and inspection points will be surveyed to AOD on installation and resurveyed at 2 year intervals for verification of acceptable gradients.

1.4 Containment of leachate from spillages and catastrophic failure of tanks, valves and pipework have been included in the design. Containment features include:-

1.4.1 Transfer pipework that is not contained by the liner / cap of the landfill will be double skinned.

1.4.2 The pump house has contained area of 12.2m3 with an effective capacity of 9.9m3 of the enclosed tank capacities are excluded. The largest tank has a capacity of 3m3 and the return line from the eductor system has a maximum volume of 5.6m3. The maximum combined pipe and tank capacity is, therefore 8.6m3 which is within the 110% capacity guidelines.

1.4.3 All pumps and valves are located within the contained area. Spillages will be collected in the sump area and removed using a small portable transfer pump.

1.4.4 Service ducting to and from the pump house will be sealed.

1.5 The leachate storage tank is located on site of the former site access road. The tank is located on an engineered raft even though the underlying material did not form part of the site infilled with waste.

1.6 Off-gasses from the tanks in the pump house will be vented through a collection manifold and carbon filter to control odours.

1.7 Access for articulated tankers is provided for the removal of leachate or solids from the settlement tank, if required. The access point for tankers contains an apron area for collection of spillage prior to removal.

1.8 The eductor system may require priming using portable water after shut down for routine maintenance. The priming tank is for storage of water prior to use.

1.9 The equipment should be operated and maintained in accordance with the recommendations contained within the operating manual a copy of which will be retained on site.

2. Basis for Design Criteria

2.1 A leachate extraction and recirculation investigation has been carried out at the site since 1994. All accessible leachate chimneys and boreholes have been subject to a physical evaluation of rate and volume of leachate removal compared with the saturated depth of waste as measured by dip tapes at the point of leachate removal. On cessation of leachate extraction the rate of recharge was also measured.

2.2 The evaluation on cell 11 began in August 1996 and the equipment is still in operation. As cell 11 is the largest individual cell at Gardden Lodge, and the only cell with an engineered leachate collection network, it can be assumed that the data generated during this part of the trial is a worst case situation. On occasions leachate depths of 8.7 metres have been recorded in leachate chimney 11, however, the leachate level has been controlled and effectively reduced to zero by the removal of approximately 2100m3 of leachate over a 3.5 year period.

2.3 A summary of the maximum amount of leachate removed per day, and the average volume removed per day, until 1998 is shown below, Monthly reporting, Environment Agency (now NRW), ceased in January 1998 and subsequently leachate levels have continued to be monitored in accordance with the waste management licence.

Reporting Month	Maximum volume removed (m^3/day)	Average volume removed (m^3/day)
Sept 1996	33.6	17.9
Nov 1996	28.8	20.6
Dec 1996	13.6	17.0
Jan 1997	18.6	5.2

Reporting Month	Maximum volume removed (m^3/day)	Average volume removed (m^3/day)
Mar 1997	12.0	3.7
Apr 1997	7.4	1.6
Jun 1997	10.5	1.7
Jul 1997	2.5	0.6
Sept 1997	14.2	2.4
Nov 1997	11.0	1.9
Jan 1998	6.5	1.6

2.4 The results indicate that once the backlog of leachate has been reduced, a process that can take a number of months, the recharge characteristics of the cell are relatively small even in a cell with a leachate collection network. In a cell with no engineered drainage network the recharge characteristics will reduce as leachate permeates through irregular voids and areas of relatively high permeability.

2.5 It has been concluded that the leachate levels in cell 11 can be controlled by the removal of approximately 2.0m3 per day of leachate on a continuous basis. The design criteria for the site was to remove 2.0m3 of leachate per day from each available leachate chimney using an eductor extraction system.

3. Design Calculations

3.1 The primary design criteria is to achieve an extraction capacity of at least 2.0m3 of leachate per day from 10 extraction points as indicated on drawing prepared by JODA Topographics number S2000/GL/001A. The required rate of removal is small and the smallest manufactured eductor, model EHI1/05 is satisfactory for the application. The unit has a maximum removal capacity, under ideal conditions, of up to 0.5m3 of leachate per hour. A maximum daily extraction capacity of 12m3.

3.2 There are 2 benefits in the over design of the system:-

3.2.1 The additional flow rates through the pipework are required for self-cleaning of the pipework due to the scouring properties of the liquid under pressure.

3.2.2 The increased capacity will enable the required removal rate of leachate to be maintained in the event that calcium salts are deposited as scale on the inner surfaces or the pipe causing friction losses.

3.3 The backpressure in an eductor system is generated in a return leg at the point of greatest flow and maximum head in relation to the motive pump. At the Gardden Lodge site this is at the point where the junction point for GW(M7) flows to the pump house.

3.4 The cumulative flow at the point of maximum backpressure from the 6 eductors in that leg of the system is 9m3/hour (6 eductors @ 1.5m3/hr/unit).

3.5 Friction losses for pipework are obtained from empirical charts as metres of hear per 100m of pipe run. The empirical data is for steel pipes and a factor of 0.8 is used to compensate for MDPE smooth bore pipe.

3.6 The 125mm o/d pipe for the return line has nominal 100mm i/d.

3.7 The pipe run which generates maximum backpressure between GW(M7) and the pump house has a length of 120m, giving a frictional resistance of:-

RsRp x 120 = 0.1152m Rs Frictional resistance of steel

100 Rs Frictional resistance of MDPE

A frictional loss of 0.1152m over a 120m pipe run is negligible.

3.8 With a negligible friction loss in the pipework, the motive pump specification has to achieve the required flow rate at a pressure to overcome the resistance in the worst-case borehole or chimney i.e. the borehole or chimney which has the greatest negative head from the motive pump.

3.9 Each eductor requires at least 1m3 of feed leachate per hour to remove the 0.5m3/hour of yield liquid. With a 10 point extraction system this equates to a minimum feed flow of 10m3/hour. This is the flow requirement.

3.10 The pressure requirement is a function of the pipe resistance, the worst case head deficit between the eductor pump and the pump house and the pressure required at the eductor pump to create the venture conditions. At Gardden Lodge site the worst case eductor is in GW(M9) with a negative head of 10.05m (AOD GW(M9) 133.75m AOD pump house 123.7m).

3.11 The pressure required at the eductor is equivalent to 6m. The pressure in the pipework to operate the system is therefore:-

P-EDP+F+WCH

P Pressure requirement

EDP Eductor drive pressure (6m/eductor)

F Friction losses (negligible with 125mm pipe)

WCH Worst case negative head (10.05m in GW(M9))

With a 10 eductor unit the operating pressure is equivalent, therefore, to 70m of head.

3.12 The minimum motive pump requirement, therefore, is a flow rate of 10m3/hr at a head of 70m.

3.13 The discharge pump to the carousel has to be rated at the maximum output of the eductor (5m3/hour) at the negative head between the pump house (AOD 123.7m), and the distribution manifold of the carousel (AOD 138m), i.e. 14.3m. The use of 110mm pipe eliminates the contribution due to friction.

3.14 It is normal practice to uprate the specification to 10% above the calculated minimum flow rate and 10m above the pressure rating to enable surplus capacity for the expected reduction in pump performance due to normal wear and tear, in future years.

3.15 The minimum design specification for the pumps, installation specification and duty point are shown below:-

Pump	**Minimum specification & duty**		**Installation specification**	
	Pressure	Flow	Pressure	Flow
Motive	70m	$10m^3$/hour	80m	$11m^3$/hour
Recirculation	14.3m	$5m^3$/hour	24.3m	$5.5m^3$/hour

3.16 Maintenance / monitoring and any necessary repairs to the system will be contained and carried out in accordance with the maintenance manual, a copy of which will be retained on site.

Appendix 3 - Emergency Leachate Contingency Plan

In the event of a leachate breakout being detected on site, the following action will be taken.

- The breakout will be bunded using suitable on site materials and / or the emergency spill kit to prevent contamination to the surface water collection systems.
- The leak will be traced back to its origin and the leak repaired. The repair being dependant on the nature of the outbreak in agreement with NRW.
- The repair will be monitored on a daily basis for a period of two working weeks to ensure the repair has been effective.
- Should the repair prove ineffective, the leak will be channelled to the nearest leachate eductor point to ensure it is controlled within the leachate recirculation system using suitable pipework to the same specification as the existing system.
- In the event of the nearest eductor abstraction point being unsuitable, an additional eductor abstraction point will be constructed in agreement with NRW.

LEACHATE COMPLIANCE LEVELS AND ACTION PLAN

Compliance levels

The compliance levels that will apply to the monitoring of internal leachate infrastructure (pending further agreement with Natural Resources Wales, NRW) and are detailed within the associated site Permit.

Leachate monitoring and sampling programme

The leachate wells (with a 1m compliance limit below adjacent superficial groundwater levels, unless otherwise agreed) will be monitored in accordance with the current permit, as detailed in the agreed monitoring schedules.

Submission of records

Results will be submitted to NRW as per the requirements of the sites Environmental Permit and reporting process.

Leachate level action plan

Liaison between site operations and the local NRW regulation staff would be undertaken in the event that leachate levels are consistently above the compliance level (i.e. 3 consecutive readings whereby the 1m differential between groundwater levels and leachate level are not maintained). A monthly email update would be adequate considering the risk profile of the Site. Email notification can be stopped at the agreement of NRW.

It should be noted that a reduction in the head differential to less than 1m is not a loss of hydraulic containment. It is also noted that the compliance levels are set based on “low groundwater” levels, a re-appraisal of water table elevations should be undertaken periodically (for example every 6 years to assess the appropriateness of the assigned leachate level limits).

Investigation procedure for breaches of compliance limits

In the event that any compliance level is exceeded in one monitoring well on one occasion, the following action will be taken:

- The well will be re-measured as soon as possible after receipt of the data; if the re-measurement does not exceed the compliance limit then no further action will be taken. If the level is exceeded then:
- NRW will be informed and actions will be considered as described below:
    - Increasing the frequency of leachate level and quality monitoring;
    - Increasing the frequency of groundwater level and quality monitoring; and
    - Consider installing additional leachate abstraction wells;

The findings of the investigations and any proposed further action will be reported to NRW for agreement.

Reversal Strategy for leachate compliance limits

In the event that leachate compliance levels are maintained at approved limits (in accordance with hydraulic containment and approved Permit monitoring Schedules) yet there are potentially associated compliance exceedances reported (e.g. increased perimeter gas levels or deterioration in water quality, that continue for a period of at least 3 months) then a plan of investigation will be submitted to NRW for approval.

The plan will outline investigation methods, monitoring, sampling and a reporting period for the investigations.

Leachate levels limits will be reviewed and interim amendments (lowering) will be instigated in an attempt to understand causal or associated interactions (on agreement with NRW) if required and based on the findings of an associated risk appraisal.

In the event of infrastructure issues, or non-compliance with a particular well (after re-measuring), leachate removal will increase as required to maintain compliance (an alternative strategy such as recirculation is not proposed). If targeted areas of leachate removal are necessary, then additional tankers will be utilised as necessary to lower levels to those specified in the permit.

Increased leachate removal will continue until levels are reduced to compliance, the increase in tankering will be instigated and undertaken within 1 week (as a maximum timeframe) and continue as required.

Appendix 4 - Landfill Gas Management and Emergency Plan (dated June 2020)

1.0 LANDFILL GAS MANAGEMENT

1.1 Introduction

A gas management system has been installed at the Gardden Lodge, Ruabon Landfill Site for the long-term control of landfill gas, to prevent migration beyond the landfill boundaries, and to minimise any uncontrolled emissions of landfill gasses to the atmosphere.

The system comprises of a series of gas extraction wells installed in a grid pattern across the landfill and linked via pipework to one mini gen gas engine with a maximum output of 0.15Mw and a 1000 m^3 flare. The pipework is partially surface laid overland to allow for differential settlement of the waste mass, due to the two different licensed areas and timescales of filling.

1.2 LANDFILL GAS RISK ASSESSMENT

A basic quantitative landfill gas risk assessment has been used to derive the necessary mitigation measures that are required at the site to ensure that risks associated with the generation of gas are acceptable.

1.3 LANDFILL GAS GENERATION ASSESSMENT

As part of ongoing reviews of the gas Risk Assessment, gas production calculations will be periodically undertaken. Gas yields are consistently reviewed to inform the gas mitigation measures.

1.4 LANDFILL GAS EMERGENCY PLAN

In view of the potentially hazardous nature of landfill gas, an Emergency Plan has been developed to outline the action that will be taken in the event of landfill gas migration giving rise to potentially dangerous situations. The situation is further complicated by the presence of a Transco gas main that traverses the site from the eastern boundary to Tatham Road, exiting the site some 150 meters to the right of the main entrance gates.

In the event that landfill gas is detected in site buildings at concentrations in excess of 20% of the lower explosive limit (LEL) above background levels, the alarm will be raised by fixed gas alarms or by monitoring personnel. The following measures will be taken:

- All affected buildings, or other potentially confined spaces will be evacuated;
- Electrical switches and buttons will not be operated;
- If it is safe to do so, any possible sources of ignition will be isolated and locked off. For example, fuses from electrical systems will be removed;
- All shutters, windows and doors in buildings within the site will be opened to ventilate the area and landfill gas levels should be determined immediately using additional monitoring equipment brought to site as necessary;
- The nearest FCC site manager will be informed immediately;
- Any entry of vehicles to the site will be prevented;
- FCC's Site Manager and Compliance Advisor will be appraised of the situation;
- Follow FCC Escalation Procedure;
- Buildings will not be entered until it is deemed safe to do so;
- Newenco Ltd number on the Contact List will be contacted;
- If the area of migration is adjacent to site boundaries or buildings, the gas extraction

field will be adjusted to increase suction in that area;
- Where elevated levels are close to site boundaries, perimeter monitoring boreholes will be monitored at an increased frequency;
- If migration continues, and is assessed as being likely to have crossed site boundaries, the local emergency services and the Public Protection Department will be called, and a joint monitoring exercise will be carried out on any properties at risk;
- If local residents need to be evacuated, the Police will be contacted; and
- The site manager will note down any actions taken and inform Natural Resources Wales (NRW) at the earliest opportunity.

1.5 PHASED DEVELOPMENT PLAN

Details on the phasing of the gas management system are provided in the table below, with further details provided.

PHASED DEVELOPMENT PLAN FOR GAS COLLECTION, TREATMENT AND UTILISATION

Landfilling Phase	Date of maximum gas production	Required Gas Flare Capacity/$m^{3/}$ hr-1
All	2003	1000

Description of Installation	Capacity m3/hr-1	Status
GUP Engines	Up to 100cu.m/hr	Installed 2022
Gas Flare	1000	Installed 2010

The development philosophy for the landfill, with regard to landfill gas management, is as follows:

- As the site has been capped and closed for over twenty years now, gas generation rates are likely to have peaked. As gas generation rates decrease, the ability to sustain gas utilisation equipment will be kept under review.
- Gas flaring capability will be retained throughout the closure period, so that gas control can continue during periods of generator maintenance and breakdown.

A flare of suitable capacity will remain on site after the generation equipment has been decommissioned and will continue to operate until the gas quality and quantity declines to an extent that flaring is no longer viable, and the risk to any neighbouring properties is considered minimal.

1.6 COLLECTION EFFICIENCY

The landfill gas extraction system has been designed to have an overall collection efficiency of between 75 and 85 percent.

1.7 SYSTEM CAPACITY

The capacity of the utilisation and flaring plant that has been installed is summarised in Table 11.1. This demonstrates that the plant has sufficient capacity to handle the maximum gas generation predicted by the site.

1.8 DESIGN AND CONSTRUCTION QUALITY ASSURANCE (CQA)

1.8.1 Design

The control systems have been designed and assessed with reference to the considerations listed below. The design of the control system has considered the following aspects:

- Performance required to achieve necessary standards;
- The context i.e. whether they are temporary or permanent systems; in the case of Gardden Lodge, they are all permanent systems;
- Selection of materials and products;
- Compatibility of the installed elements of the control system in terms of the phased development of the site e.g. appropriate sizing of gas extraction plant;
- Operational and maintenance requirements; and
- Health and safety issues.

Any future installation of landfill gas control wells and other collection infrastructure will be subject to CQA procedures.

The renewal of the day to day collection pipework, ring main and knockout pots may be undertaken by trained Newenco Ltd technicians, or their contractors, and will normally be subject to CQA procedures, even though the works will follow an agreed method statement and will be risk assessed prior to the works being carried out.

A record will be made after the completion of a program of works, to record a description of the works, when it was undertaken and by whom. Drawings will then be updated to include any new landfill gas infrastructure.

1.8.2 CONSTRUCTION QUALITY ASSURANCE

During the installation of any new vertical landfill gas wells, a Construction Quality Assurance Plan will be followed for each phase of works. This CQA plan will specify procedures for the installation, testing and sampling of the landfill gas well system, and its new infrastructure. This will be part of the Landfill Gas Management System CQA.

The CQA Plan will incorporate the following:

- Roles and responsibilities;
- Quality assurance principles;
- As built documentation;
- Provision for the preparation of a validation report.

A suitably qualified person, through either qualification or experience will control the application of all engineering specifications and relevant CQA procedures. The records of any new Landfill Gas Management System CQA will be submitted to Natural Resources Wales (NRW). Factors that will provide the necessary assurance for the quality of the gas system include:

- The use of suitably experienced and competent contractors;
- Surveying gas well positions to determine available depth of waste,
- Provision of as–built drawings.

1.9 GAS SYSTEM DESIGN AND SPECIFICATION

The various elements of the landfill gas management system are described below: -

1.9.1 ENGINEERED CONTAINMENT SYSTEM

The site was developed with an engineered basal, sidewall and capping containment system, which provides the primary protection against the migration of landfill gas. The mineral lining system at the site pre-dates engineering CQA procedures, with the site having been capped, and restored by early 1998.

1.9.2 GAS EXTRACTION WELLS

Vertical gas extraction wells were installed within each cell following permanent capping operations. Any new wells will be drilled to a specific diameter according to the design and to approximately 80% of waste depth following an allowance for predicted future settlement or no lower than 3 meters above the cell base. This will ensure that settlement of the waste will not cause excessive damage to the new wells or the landfill basal sealing liner.

1.9.3 METERING STATIONS/MANIFOLDS

No manifolds are installed on-site, and are unlikely to be used.

1.9.4 CONNECTION PIPE-WORK AND CONFIGURATION

The gas wells are linked via appropriate pipe work. Wherever possible the pipe work is laid to a fall to encourage drainage of condensate to a low point. Settlement is monitored by visual and physical surveys. The positioning of the pipework will continue to be assessed against the results of these surveys, to determine the need to re-lay or re-position them and to ensure drainage is encouraged. When the rate of settlement has further reduced, consideration will be given to sub-surface placement.

The pipework has been sized to take account of the volume and rate of gas abstraction and configuration of the abstraction wells, to maintain suction pressure loss at acceptable levels, maintain effective controls against migration, and ensure effective gas abstraction is achievable throughout the gas field.

1.9.5 CONTROL SYSTEMS

VALVES

Control valves are situated at appropriate locations throughout the gas collection system to permit isolation of sections for monitoring, instrumentation, repair or modifications. The location of control valves has been determined by the landfill configuration. They allow regulation of vacuum to, and flow rates from, different parts of the site, to accommodate temporal and spatial variations in gas production.

TELEMETRY

The GUP plant on-site incorporates an engine management system which is linked to a central station to permit remote monitoring of the facility 24 hours a day.

ALARM SYSTEMS
In the event of problems with the GUP plant or the flare unit, the telemetry unit automatically alarms a 24 hour manned station.

INTERLOCK
There are no interlock systems.

1.9.6 DEWATERING FACILITIES

Landfill gas is extracted at temperatures often in the region of 40 to 50ºC and is often saturated with water vapour. As the gas is conveyed through the collection pipe network, it cools, and landfill gas condensate forms.

Dewatering facilities have therefore been constructed at strategic low points within the system, to avoid blockages caused by accumulation of condensate within the pipe work. The condensate is discharged via the site leachate management system.

Dewatering facilities may comprise of pumped condensate knockout pots installed in the low points of the system.

1.9.7 GAS PRE-TREATMENT

Gas pre-treatment or clean-up is a multi-stage operation that can help reduce environmental emissions and reduce engine maintenance wear. Pre-treatment processes fall into two groups: primary pre-treatment processes are aimed at dewatering and particulate removal, whereas secondary pre-treatment processes are aimed at the removal of a percentage of specific components of the supply gas for example halogens, sulphur or siloxane compounds. The gas pre-treatment technologies that are undertaken at the installation are summarised within the table below.

GAS PRE-TREATMENT TECHNOLOGIES

Technology	Comment
Water/condensate knockout	
Liquid water capture	
Vapour reduction	
Contaminated water management	
Particulate filtration	

1.9.8 Gas Flare

A permanent gas flare is provided at the site. It is located within the GUP plant compound.

The gas flare is of an enclosed design. This permits a homogenous temperature distribution across the combustion chamber. The flue is lined with refractory material on the interior and the flare is contained.

The design specification for the flare is detailed in the table below

GAS FLARE DESIGN SPECIFICATION

Feature	Specification	Yes/No/Comment
Manufacturer	Jenbacher	
Model	Ht enclosed	
Design capacity	1000 m^3/hr	
Turndown range	10:1	
Combustion control	Automatic	
Retention time	0.3 secs minimum	
Minimum temperature	1000^0C	
Flame detector		Yes
Automatic flame temperature control		Yes
Slam shut valve		Yes
Flame arrestor on flare feed line		Yes
Flame arrestor on any other point		Yes

The combustion air supply is controlled so as to achieve a minimum temperature and retention time of 1,000^{o}C and 0.3 seconds respectively during all operational conditions.

The flare has been designed to satisfy current emissions standards.

The flare is maintained in accordance with the manufacturer's recommendations, to ensure continued effective operation. These requirements are provided in the Flare Service Manual kept centrally by Newenco Ltd. Full maintenance records are maintained.

1.9.9 UTILISATION PLANT

Gas Utilisation Plant (GUP) is provided at the site. It consists of acoustically insulated and containerised generating sets. The sets house a landfill gas driven prime mover and alternator set with engine management and remote monitoring facilities. The specification of the plant is provided within the table below.

GAS UTILISATION PLANT SPECIFICATION

Feature	Specification	Comment
Type of Generator	Spark Ignition	
Manufacturer	Scania	
Model	SGI 12L	
Gas flow rate	up to 100 cu.m/hour	

The objective is for the landfill gas to be used to generate power and to reduce fugitive emissions. Gas generation rates will be kept under review, as the in-situ waste continues to decay.

1.9.10 TEMPORARY AND EMERGENCY PROVISIONS

In the event of generator shut down for planned maintenance or an unplanned event, the excess gas will automatically flow to the flare, with no disruption to flow rate or applied vacuum to the field.

In the event of a power failure, both the flare and generator will shut down. The gas plant will be restarted upon the resumption of supply to the site. As a contingency measure a generator will be placed on stand-by at one of our other nearest sites, so it can be called upon in the event of such power failure.

1.10 SYSTEM OPERATION

Operational procedures for the landfill gas management system are described below.

1.10.1 OPERATIONS MANUAL

The landfill gas flares and engines are subject to an operational maintenance and servicing programme in accordance with the manufacturer's recommendations. These requirements are referred to in the Engine Service Manual and Flare Service Manual.

The Service Manual will include the following aspects: -

- System description (construction, process and operational parameters) including full as built drawings, together with a record of all subsequent changes;
- Commissioning measurement data;
- Operating instructions;
- Commissioning into service and out of service procedures;
- Specification for routine operational monitoring;
- Register of all routine adjustments;
- Record of all non-routine incidents; and
- Health and safety instructions for routine operation and further guidance on procedures to adopt in the event of an accident or emergency.

The flare and engines are subject to inspection and maintenance, which includes the following;-

- Inspection programme with inventories and frequencies (including responsibilities for monitoring, inspection and maintenance, daily, weekly and monthly requirements, documentation and recording procedures, procedures for implementing corrective actions);
- Register of fault conditions and corrective actions taken to overcome faults;
- Details of routine repairs and replacements;
- Review requirements for fault conditions and repairs; and
- Inventory of replacement parts and contact details for relevant suppliers and manufacturers.

Personnel responsible for the operation and maintenance of the gas flare and engines are fully conversant with the operational procedures and safety and maintenance programmes.

The integrity of the gas system is also be subject to routine monitoring, and any identified problems affecting the operation of the system are remedied to ensure continued effective control of landfill gas.

1.10.2 START UP AND SHUT DOWN PROCEDURES

The procedures incorporate the gas engine manufactures start-up and shutdown procedures to ensure maximum reliability of the gas engines. These are contained in the Engine and Flare Service Manuals.

The gas engine will be started up and shutdown using fully documented Start Up and Shutdown Procedures. These procedures include the actions required by the operator to ensure the engine is commissioned safely, and is left in a safe condition (i.e. gas free and isolated) when shutdown. The procedures endeavour to ensure that the environmental impact of start-up and shutdown is minimised. The procedures are integrated with the gas bypass procedure to ensure release of unburnt gas is minimised.

1.10.3 ENGINE BYPASS PROCEDURES

In the case that the gas engines are shutdown, for example for routine maintenance, the engines automatically bypass to the gas flare to ensure that gas bypassing the engine is fully burnt in a safe manner in the flare, which is designed to cope with the gas flow rates usually handled by the gas engines.

1.10.4 ROUTINE OPERATIONAL PROCEDURES

The results of the routine monitoring for gas quality, flow and pressure will be used to adjust and 'balance' the gas system, in order to optimise the extraction and control of the gas.

This will be achieved by manually adjusting the control valves at the wellheads and the suction that is applied to individual wells or groups of wells, thus minimising the potential for atmospheric ingress and gas migration.

1.10.5 PRIORITISING MIGRATION CONTROL

The extraction system is designed and configured to enable individual parts of the gas field to be isolated and controlled. This enables appropriate adjustments to be made to individual wells or groups of wells to ensure migration control is maximised.

1.10.6 COLLECTION AND CONTROL DURING LOW METHANE GENERATION

During the post closure aftercare period, there may be insufficient gas to support continual combustion of the flare.

In these circumstances, the results of the routine system monitoring, which will provide data on the gas flows and concentrations within the different parts of the site, will be used to determine the most appropriate operational regime both in respect of the suction applied to the wells and the operational sequence of the flare, with the objective of ensuring that extraction and flaring of gas is optimised, and migration from site prevented.

1.11 SYSTEM MAINTENANCE

Maintenance programmes for the landfill gas management system are described below.

1.11.1 PLANNED AND UNPLANNED MAINTENANCE

The various components of the landfill gas management system are subject to a maintenance programme in accordance with the manufacturer's instructions.

GAS COLLECTION SYSTEM

The gas pipelines, wellheads and condensate knockout systems shall be checked by Newenco Ltd' monitoring technicians, or their nominated contractors for the following: -

- Wellhead damage including damage to any security padlocks where these are used;
- Settlement, which may affect wellhead connections and pipework falls;
- Condensate, which may block pipelines or restrict flow;
- Integrity of couplings and connections;

- Pipework damage and leaks; and
- Functioning of condensate pumping systems.

The requirement for unplanned remedial work or replacement wells will be identified during the routine inspection programme carried out by Newenco Ltd' monitoring technicians or checks carried out by their contractors as outlined above.

GAS FLARE

The gas plant equipment is subject to a visual inspection at least weekly, to check that all systems are functioning according to the manufacturer's specification.

Visual inspections include the following: -

- Check all instrumentation;
- Check ignition systems;
- Check joints and pipework for signs of damage, leaks or fatigue; and
- Check performance indicators such as differential pressure and flow

These inspections are used to indicate potential problems between services and any signs of malfunction will be reported immediately and arrangements made for repairs to be carried out.

In addition to the above, approved contractors service the gas flare on at least a six monthly basis, in accordance with the manufacturers recommendations. Servicing of the gas plant is currently carried out with minimal interruption to its potential operation.

GAS UTILISATION PLANT (GUP)

The Gas Utilisation Plant and its equipment are serviced by nominated contractors on behalf of Newenco Ltd. The servicing allows for planned and unplanned maintenance activities, with the degree of servicing reflecting the hours of operation of the generator.

1.12 SYSTEM MONITORING

Monitoring provisions for the landfill gas management system are described below.

1.12.1 FLOW, PRESSURE AND COMPOSITION

The gas collection system is monitored for gas flow rate, gas quality, temperature and pressure.

The Waste Management Licences require all active gas boreholes and gas wells to be monitored weekly. Historically, some of the probes surrounding the site have routinely recorded elevated levels of carbon dioxide. Similarly, GP1, GP9 and occasionally GP13 recorded hydrocarbons above the normally accepted triggers for perimeter boreholes. The levels in GP1 and GP9 were investigated by Shanks and McEwan back in 1995-1996 and were determined to be unlikely to be of landfill origin. FCC's monitoring section is in the process of reviewing all monitoring data for these points, and will look to set revised levels in conjunction with Natural Resources Wales (NRW). As referred to above, in the event of abnormal readings, additional monitoring will be carried out weekly and in some instances daily, until normal operating conditions are re-established.
This monitoring will be carried out throughout the post closure stages of the installation.

1.12.2 METEOROLOGICAL MONITORING

Meteorological monitoring is carried out at another nearby installation (Chirk / Pen-y-Bont) and is used where necessary to assist in the management of gas.

1.13 ACTION PLAN

1.13.1 AIR INGRESS

Air ingress into the system can be caused by several different factors, such as, damage to a wellhead. Should air ingress be identified, the cause of the ingress will be investigated to enable any necessary remedial action to be undertaken as soon as practicable, to prevent further air ingress into the system.

1.13.2 LEAKS

The integrity of the gas system is subject to routine monitoring, and any identified problems affecting the operation of the system are remedied, to ensure continued effective control of landfill gas.

Priority is to undertake temporary repairs pending more permanent replacements or resealing of components.

1.14 DATA MANAGEMENT AND RECORDING

Records of the design, specification, operation, inspection, maintenance and/or monitoring of the gas system are maintained centrally by Newenco Ltd. Specifically, the following records are maintained:

- Records of all inspections carried out on the system;
- Planned and unplanned maintenance and servicing;
- Records of monitoring for gas composition, flow and volume.

These records comprise both hard copy data sheets, and centrally held electronic records of system operation. All records will be available for inspection by Natural Resources Wales NRW) on request.

Newenco Ltd maintain a central Site Diary and it is used to record all visits, significant alterations to the gas field extraction regime, and any unusual occurrences.

2.1 LANDFILL GAS MONITORING

2.2 Introduction

The Landfill Gas Monitoring Plan will assist to ensure that: -

- Gas quality and quantity from each section of the site is identified and controlled;
- Perimeter monitoring is adequate to cover the pathways of migration to identified potential off-site receptors;
- Leaks in the gas collection system can be identified;
- Enable the volumes of landfill gas being sent for utilization / flaring to be quantified;
- Ingress of air into installation can be detected;
- Adequate balancing of the gas collection system;
- Borehole performance can be maintained to design specification;
- Concentration and composition of trace gases can be determined; and
- Quality and quantity of emissions from the flare and GUP plant can be determined.

2.3 LOCATIONS, DESIGN AND CONSTRUCTION OF MONITORING POINTS

2.2.1 In Waste Boreholes and Wells

Monitoring of landfill gas inside the landfill is carried out at individual active gas extraction wellheads, which are installed at intervals across the gas field. A sample port is provided for each well.

2.2.2 PERIMETER BOREHOLES

Perimeter borehole monitoring locations are shown on drawings previously submitted to Natural Resources Wales (NRW).

2.4 MONITORING MEASUREMENTS AND SCHEDULES

2.3.1 Internal Gas Monitoring

Landfill gas monitoring will be carried out using a portable infra-red gas analyser for the following determinands:

- Methane (% by vol.)
- Carbon Dioxide (% by vol.)
- Oxygen (% by vol.)
- Temperature (^{0}C)
- Carbon Monoxide (ppm)

In addition, Newenco Ltd will monitor for trace component compounds annually (in accordance with Natural Resources Wales Guidance for Monitoring Trace Components in Landfill Gas) at the inlet to the electricity generation compound from the site ring main.

Routine gas monitoring of the gas extraction system and extraction plant is carried out on a regular basis, despite the site having been closed and capped for over ten years. As a minimum, monitoring of the manifold outlets and gas plant is carried out monthly. If there are prolonged periods where there is no off-site gas migration as detected in the exterior monitoring wells, the extent and frequency of the monitoring may be altered from this regime following consultation with Natural Resources Wales (NRW). Conversely if perimeter monitoring suggests that off-site gas migration could potentially present a hazard, the frequency and extent will be increased.

2.3.2 PERIMETER GAS MONITORING

The WMLs requires the perimeter gas boreholes to be monitored weekly for methane, carbon dioxide and oxygen. The monitoring locations are as detailed on plans previously submitted to Natural Resources Wales, together with the monitoring protocols.
Monitoring is currently taking place on a weekly basis.

No compliance levels have been agreed for the perimeter gas boreholes to date due to ongoing site investigation works to establish background levels. Current control levels for wells are at,

- >1% v/v methane and
- >1.5% v/v carbon dioxide.

Although GP1, GP9 and GP13 have historically and consistently read higher than these levels, and investigations demonstrated the gas is not from landfill in origin.

If gas migration is identified then the action plan presented further down in this procedure will be followed and gas monitoring may take place on a more frequent basis than proposed above. The monitoring frequency will be subject to regular review and may be subject to change in consultation with Natural Resources Wales (NRW).

2.3.3 GAS FLARE MONITORING

Emissions from the enclosed gas flare will be subject to a programme of monitoring. The monitoring will be undertaken in accordance with Natural Resources Wales Guidance for Monitoring Enclosed Landfill Gas Flares.

If the flare is in use for more than 10% of the time on an annual basis, emissions monitoring will be carried out for the following determinands:

- Nitrogen oxides (NO_X) 150 mg/Nm^3
- Carbon Monoxide (CO) 50 mg/Nm^3
- Total Volatile Organic Compounds (VOCs) 10 mg/Nm^3

2.3.4 UTILISATION PLANT MONITORING

Gas engine emissions monitoring is undertaken from the emissions stack in accordance with Natural Resources Wales (NRW) 'Guidance for Monitoring Landfill Gas Engine Emissions.'

The following principles have been adopted for the monitoring of all landfill gas engines:

- Discharges from new installations will be vertically upwards and unimpeded by cowls or any other fixture on top of the stack;
- Sampling sockets will be fitted to all new installations;
- Crankcase emissions will be managed to minimise their release to the environment;
- Continuous monitoring will be undertaken for methane concentration and flow in the inlet gas;
- Monitoring will be undertaken for NO_X and CO in the emissions.

A summary of the parameters to be monitored, the test reference method, sampling and analytical technique and testing frequency are provided in the table below.

GAS ENGINE EMISSION TESTING REQUIREMENTS

Emission	Reference Method*	Sampling & Analytical Technique	Testing Frequency
Nitrogen Oxides	ISO 10849:1996	Extractive sampling	Annually
Carbon Monoxide	ISO 12039:2001	Extractive sampling and Non- Dispersive Infra-Red analysis (NDIR)	Annually
Organic Total Volatile Compounds	BS EN 12619:1999[a] BS EN 13526:2002[b]	Extractive sampling and FID analysis	Annually
Non-Methane Volatile Organic Compounds	BS EN 13649:2002	Extractive sampling onto sorbant, Extraction by CS2 analysis by GC with appropriate detector.	Annually

a At sites with low total VOC concentrations
b At sites with low to moderate total VOC concentrations
* Alternative methods will only be used if they are demonstrated as fit for purpose, to the satisfaction of the Natural Resource Wales

2.3.5 SURFACE EMISSIONS

FID and flux monitoring of gas emissions from the surface of the landfill will be undertaken, in accordance with the Monitoring Protocol previously submitted.

Surface emissions monitoring will be undertaken in accordance with the Monitoring Protocol.

METHODOLOGY FOR UNDERTAKING SURFACE EMISSIONS MONITORING

Stage	Comments
FID (flame ionisation detector) surface scanning	The capped parts of the landfill, site perimeter and well heads will be traversed in a systematic manner using a portable FID, held as close to the landfill surface or well head as possible.
Processing and interpretation of results	Control levels will be as follows; Site perimeter 50 ppm CH4, landfill cap 100 ppm CH4, well heads 1000 ppm CH4
Reporting and definition of remedial actions	The results will be submitted to the Natural Resource Wales, and appropriate investigations will be undertaken if control levels are breached and remedial action will be undertaken where necessary.

2.3.6 Aerial Emissions/Air Quality

If monitoring of air quality in respect of particulates or odour is necessary, the principles that will be adopted with respect to such monitoring will be agreed with Natural Resources Wales (NRW).

2.3.7 OFF-SITE MONITORING/RECEPTOR MONITORING

Apart from a visual inspection of vegetation on surrounding land for signs of stress, it is considered that off-site monitoring and receptor monitoring will only be undertaken with appropriate consent and in response to complaints of odour, particulate emissions, or as part of the action plan relating to the detection of landfill gas in perimeter monitoring boreholes.

2.5 CONTROL AND TRIGGER LEVELS AND CONTINGENCY ACTION PLAN

2.4.1 Control and Trigger levels

The control levels that will apply to the monitoring of internal and external gas concentrations at the site (pending further agreement with Natural Resources Wales (NRW) are detailed within the Waste Management Licences. The trigger levels for perimeter landfill gas boreholes are still to be agreed.

2.4.2 CONTINGENCY ACTION PLAN

The landfill gas monitoring action plan will be followed in the event of:-

- Reports of abnormal changes in monitoring data;
- Operational problems or failure of the control system;
- Migration and release of landfill gas; and
- Impact on local air quality.

The landfill gas monitoring action plan that will be followed in the event of any of the circumstances identified above is as follows:

EXTERNAL BOREHOLES

- Methane concentrations in external boreholes in the zero to 1% above background levels range are considered to show normal variability and routine monitoring will be maintained.
- If methane concentrations in external boreholes exceed 1% above background levels then the following actions will be carried out and appropriate contacts with Natural Resources Wales (NRW) and FCC Site Manager and Compliance Advisor made using the Emergency Contact List of telephone numbers below;

If carbon dioxide concentrations in external boreholes exceed 1.5% above background levels then the following actions will be carried out and appropriate contacts with Natural Resources Wales (NRW) and FCC contacts using the Emergency Contact List of telephone numbers below.

- FCC Site Manager and Compliance Advisor will be informed before the monitoring technician leaves the site;
- The details of the trigger level breaches will be forwarded to the FCC Site Manager and Compliance Advisor together with Newenco Ltd' Regional Manager for action;
- Follow FCC Escalation Procedure;
- The affected external borehole(s) will be re-monitored to verify the results and establish that the trigger level has been exceeded. If it is established that the trigger level has actually been exceeded, then the monitoring frequency will be increased within the affected and adjacent boreholes;
- An assessment will be made as to whether there are any properties immediately at risk from gas migration. Emergency procedures will be implemented if gas concentrations were found to be above trigger levels inside the building(s);
- An assessment will be made of the possible causes of the increase in methane levels, e.g.
    - Gas plant failure;
    - Vandalism or tampering to the extraction system by unauthorised persons;
    - Fluctuations in leachate and/or groundwater levels;
    - Rapid drop in atmospheric pressure;
    - Snow, frost, heavy rain.
- The previous monitoring results for the site will be verified;
- Newenco Ltd will adjust the gas extraction system where appropriate in order to increase the extraction of gas adjacent to the affected area;

- Newenco Ltd will inspect the gas extraction system for well failures, damaged pipework and condensate blockages;
- The surrounding area will be inspected for signs of gas or leachate escape or vegetation die back;
- Natural Resources Wales (NRW) will be informed at the earliest opportunity;
- If, after four weeks, gas levels are showing no signs of stabilizing, the following will be considered:
  - Review of the quantitative landfill gas risk assessment;
  - Sampling of gasses for laboratory analysis to verify source;
  - Installation of additional boreholes;
  - Installation of additional gas extraction wells or capacity.
- Routine gas monitoring would recommence once methane levels have stabilised

INTERNAL GAS WELLS / MONITORING POINTS

Internal gas wells and monitoring structures are monitored for oxygen, carbon dioxide, methane, relative pressure and temperature. Suction pressure is also recorded.

Abnormal readings will be assumed where oxygen levels exceed 5% v/v, suction exceeds 90 mb, methane is less than 20% v/v, temperature exceeds 50^{o}C and carbon monoxide exceeds 100 ppm.

- If an abnormal reading is monitored (as referred to above) Newenco Ltd monitoring technician will close the gas well control valve by 50% from the existing valve position. This action will be recorded and reported as an 'Exceptions Report' to the FCC Site Manager and Compliance Advisor along with Newenco Ltd Regional Manager the same day. Any reports will be forwarded to Natural Resources Wales (NRW) within an agreed timescale.
- The gas Technician will re-monitor the affected gas well / monitoring point the day the exceptions report is received. The well will be adjusted to try and get normal (as opposed to abnormal) readings by using his/her judgement. If the well cannot be readjusted so that the readings are no longer abnormal it will be turned off i.e. the valve will be closed.
- Any closed wells will continue to be monitored in accordance with the Monitoring Schedule.
- If the well continues to show abnormal readings the valve will be kept closed and may be locked (where practicable).
- Newenco Ltd will undertake investigations to ascertain the reason for the abnormal readings. This may include;
  - Dipping the well to determine head space, which may for example indicate silting
  - Assessment of well integrity by visual external inspection and internal camera survey
  - Visual observations for settlement
  - Assessment of the integrity of nearby structures

- Investigations into abnormal carbon dioxide readings will include;
  - Collecting a bag sample within 1 week to determine the level of carbon monoxide under controlled laboratory conditions

- Newenco Ltd will record the results of the monitoring and any site investigations following an abnormal reading. Information will be held centrally by Newenco Ltd.
- If the results of the site investigation concludes that the well requires to be re-drilled or discontinued, Natural Resources Wales (NRW) will be informed of the action to be taken.
- If an underground fire is suspected at any time due to visible smoke or flames, the Fire Action

Plan will be followed immediately.

- If temperature readings exceed 50ºC or carbon monoxide exceeds 100ppm after being verified by laboratory analysis the Fire Action Plan will be followed immediately.

2.6 MONITORING TECHNIQUES

Monitoring of perimeter and internal gas monitoring points is carried out in accordance with the procedures detailed in the Environmental Monitoring Protocols.

2.5.1 EQUIPMENT AND MAINTENANCE

- Gas monitoring is carried out using a portable infra-red gas analyser, capable of reading methane, carbon dioxide, oxygen and atmospheric pressure; and
- The instruments are serviced in accordance with the manufacturer's recommendations.

2.5.2 PRE-MONITORING CHECKS

Prior to undertaking gas monitoring, the following checks are carried out: -

- In-line hydrophobic filters are checked and replaced if necessary;
- Battery life is checked to ensure there is sufficient charge to carry out the monitoring;
- The calibration status of the instrument is checked; and
- Before and after every monitoring event test gas is used to check the accuracy of the instrument, the results of which are recorded.

2.5.3 SITE RECORDS

A record is made of the following: -

- Name of technician;
- Date of sampling;
- Atmospheric pressure and trend;
- Instrument type and serial number;
- On-site weather conditions;
- Observations including vegetation die-back, leachate outbreaks, surface water ponding;
- Damage to borehole headworks, caps or taps;
- For internal gas monitoring, the position of the valve between open and closed will be recorded.

2.5.4 MONITORING PROCEDURE

- The sample tube will be attached to the sample tap;
- The tap will be opened and the analyser pump will be switched on;
- When constant readings are achieved, the data will be recorded on the logger;
- Borehole pressure readings will be taken at gas extraction wells;
- The gas tap will be closed, the tube will be removed, and the pump will be allowed to run to flush out any residual gas before taking the next sample;
- If water level data is required, the borehole cap will be removed and an electronic dip tape will be used to measure the water level relative to the cover level or other agreed datum point.
- The borehole cap will be replaced;

Monitoring of the gas flare, GUP, and surface emissions is carried out in accordance with the methods and procedures identified in relevant Natural Resources Wales guidance, or alternative methods agreed with Natural Resources Wales (NRW).

2.7 DATA MANAGEMENT AND REPORTING PROCEDURES

The recording of gas monitoring data is held centrally by both Newenco Ltd and FCC. Historical data can also be obtained from the previous gas contractor, Infinis. FCC also hold information centrally, relating to maintenance and inspection issues. Results of landfill gas monitoring are submitted to Natural Resources Wales (NRW) at intervals that will be agreed with them.

An annual environmental monitoring report is compiled which includes both raw and aggregated data, charts and trends. The report provides an interpretation of the data, including exception reports to highlight where deviations have occurred.

All complaints regarding landfill gas are recorded, and include the following details:

- Complaints received including address of complainant;
- Nature of problem including date, time, duration, prevailing weather conditions and cause of the problem;
- Details on the corrective action taken, and any subsequent changes to monitoring and operational procedures; and
- An evaluation of the effectiveness of the techniques used.

2.8 QUALITY ASSURANCE

2.7.1 Construction Quality Assurance

Should any well, headworks or monitoring connection point become damaged they will be repaired or replaced as soon as practicably possible to ensure that the integrity and operating efficiency of the system is not impaired.

Where new boreholes or wells are installed, the borehole/well logs and as-built installation details will be forwarded to Natural Resources Wales (NRW) and shall provide the following information:

- Borehole/well identification;
- Date of drilling/installation;
- Geological strata descriptions where applicable;
- Groundwater level (and any perched water levels) where applicable;
- Design of the borehole/well if more than one type is being used on the site;
- Depth of borehole/well (m) and level of the bottom of the borehole in m AOD;
- The surveyed height of the top of the borehole/well in m AOD, and the surveyed ground level at the point if it differs; and
- The National Grid Reference of the borehole/well (10 figure).

2.7.2 Monitoring Quality Assurance

Landfill gas monitoring at the site is undertaken in accordance with the national Company monitoring procedures

Landfill Gas Emergency Plan

Ruabon Landfill Site

FCC Site Manager; Colin Shaw 07773 813228

FCC Compliance Manager; Leon Terrace 07395 833753
Newenco LFG Engineer; Mark Nicol 07768 822576 Newenco
Gas Engine Supervisor; Sam Mason 07825 894460
Newenco MD; Nick Lewis 07767 408963

National Resources Wales (NRW) Action Plan

Event: Gas Plant Fire

INDICATED BY :

Telemetry Alarm to Newenco or visible smoke and fire at site

PERSONNEL:

Site Manager	Compliance Manager	LFG Engineer	Gas Engine Supervisor	Newenco MD

Initial action:

If the fire occurs during working hours the Gas Engineer Supervisor will inform the Emergency Services isolate the power in the LV room cordon of the area close the site and contact Newenco MD.

If the fire occurs out of working hours Newenco will attend site and will inform the Emergency Services isolate the power in the LV room. Newenco will inform the Site Manager.

If the fire is local to the electrical panel the gas to the gas plant will be isolated and the fire tackled with a Carbon Dioxide extinguisher.

If Landfill Gas is burning no attempt will be made to tackle the fire until the Emergency Services arrive. Newenco will isolate the gas at the entry to the compound.

If the fire is localised and has naturally been extinguished Newenco will inform the Site Manager.

Site Manager to be informed and attend site if the fire occurs out of hours.

FURTHER ACTIONS:

Newenco will make effective repairs if the fire is a localised electrical fire and restart the gas plant.

LFG Engineer will arrange monitoring for migration and odours.

If the fire is catastrophic it will be repaired or a replacement gas plant will be installed if it cannot be repaired within 48 hours. Newenco will seek resolution by calling in a contractor repair team to install a hire flare for environmental control. The Compliance Manager will inform NRW.

RESOLUTION:

The incident will be considered resolved when the gas plant is running.

Event: Fire in Engine Container

INDICATED BY:

Smoke emanating from the generator container
Fire Alarm activating on generator container

PERSONNEL:

Site Manager	Compliance Manager	LFG Engineer	Gas Engine Supervisor	Newenco MD

Initial Actions:

Engines will shut down.

If Newenco or FCC are on site and notice smoke and an engine is down they will cordon of the compound, monitor the container for fire and smoke breakout and stop any unauthorised entry to the engine container.

If Newenco or FCC see flames and smoke or hot spots on the containers paint they will call the Emergency Services. No attempt will be made to enter the container until the Emergency Services arrive.

If Newenco arrive to an out of hours call out and notice indication of fire they will check for fire and smoke breaching the container or for hot spots on the paint. If this is seen they will call the Emergency Services and inform the Site Manager. No attempt will be made to enter the container until the Emergency Services arrive.

If no smoke, fire or hot spots are seen and the engine has been shut down for more than 1 hour they will carefully enter the container with a Carbon Dioxide extinguisher and check the alarm panel.

If there is no significant smell of smoke or visible signs in the container they will investigate further.

If when opening either door fire or smoke is seen they will immediately close the container and call the Emergency Services.

If the alarm is deemed to be false the engines will be re-started.

Site Manager to be informed and attend site if the fire breaches the container out of hours.

RESOLUTION:

The fault will be considered resolved when the generator is back online.

Event: Failure on the Gas Collection System

INDICATED BY:

Visible failure on the extraction system pipe work, high oxygen in the gas, reduction in suction on parts of the site and/or lack of gas to the generator.

PERSONNEL:

Site Manager	Compliance Manager	LFG Engineer	Gas Engine Supervisor	Newenco MD

Initial Actions:

Newenco to be informed by Site/Compliance Manager if they observe a potential problem/failure on the gas system. If Newenco identify problem from O2 in the gas Newenco to walk site looking for damaged pipe and isolate the damaged area if possible.

FURTHER ACTIONS:

Newenco carry out an effective repair or a temporary repair until an effective repair can be carried out.

LFG Engineer to arrange check for migration and odours from site if the damage could have led to such.

Newenco to restart the gas plant and generators if there off and check gas quality and repair is intact.

If Newenco cannot make a permanent repair (but can make a temporary repair) the gas plant will be restarted.

If Newenco cannot make a temporary repair. Newenco will seek resolution by calling in a contractor repair team.

RESOLUTION:

Gas extraction resumed on the site and a permanent repair has been made.

Event: Generator Trip

INDICATED BY:

Telemetry alarm call Newenco

PERSONNEL:

Gas Engine Supervisor	Newenco MD

Initial action:

Newenco will attend site to determine cause and re start the generator if possible. They will check that flare and air compressor are working when at site if out of hours.

FUTHER ACTION:

Appropriate works to be made if required to the get the generator back online.

RESOLUTION:

The generator fault will be considered resolved when the generator is back online

Event: Gas Plant Failure.

INDICATED BY:

Loss of gas extraction to the site following generator shut down.

PERSONNEL:

Site Manager	LFG Engineer	Gas Engine Supervisor	Newenco MD

Action:

Newenco shall attend site as soon as possible (within 48 hours as a maximum).

If immediate repairs cannot be made and the gas plant cannot operate Newenco shall inform the Compliance Manager who will inform the NRW

If the fault has not been rectified by the next working day the Compliance Manager will check for odours and migration. If odours and migration are identified and the gas plant cannot be repaired within 24 hours a temporary hire flare will be obtained to flare gas on the site.

If an electrical supply fault from the national grid is identified a generator will be provided if power cannot be restored within 24 hours.

The Site Manager will arrange checks each day for odours and migration until the problem is resolved.

RESOLUTION:

The Gas Plant Failure will be considered resolved when the Gas Plant is running and flaring gas.

Event: Gas Migration

INDICATED BY :

CH_4 in gas borehole > 1%

PERSONNEL:

Site Manager	Compliance Manager	LFG Engineer	Newenco MD

Initial action:

Compliance Manager to inform NRW

Compliance Manager to inform Newenco and to check past bore hole monitoring data.

LFG Engineer to re-balance gas field

FURTHER ACTION:

If gas migration persists:

- LFG Engineer & Compliance to carry out search bar tests between borehole(s) and closest receptor. Search bar tests to be carried out on a line parallel to the site boundary on 10 m spacing's 50 m from the effected boreholes.
- LFG Engineer to re-balance gas field

If search bar test is positive for gas >10% LEL:

- Compliance Manager to inform NRW.
- LFG Engineer & Compliance Manager to carry out FID sweep of closest receptors if within 250 m. If FID test shows gas at the closest receptor above 1% of the LEL, receptor to be informed and evacuated (if necessary) and the NRW to be informed by the Compliance Manager. Compliance Manager & Newenco MD to prepare action plan and submit to the NRW.

If search bar test is negative continue bi-weekly monitoring and redo search bar tests if gas migration increases.

RESOLUTION:

Gas migration issue will be considered resolved when Gas Monitoring Boreholes show <1% CH_4.

Event: Odour Complaint (Off Site Odours)

INDICATED BY:

Complaint from public

PERSONNEL:

Site Manager	Compliance Manager	LFG Engineer	Newenco MD

Initial Actions:

Site Manager to be informed

Compliance Manager to carry out odour survey of receptor

Compliance Manager to identify source of odour on the site by carrying out an odour survey

FURTHER ACTIONS:

If source of odour is a point source from a gas well or leachate well Newenco or Site Manager to effect temporary fix.

Newenco (for gas well) or Site Manager (for Leachate Well) to arrange sealing works within 24 Hours and inform NRW of outcome.

LFG Engineer will carry out a survey and balance to find any problems with the Gas Collection System. Any problems found to be identified and rectified. Action plan to be submitted to NRW by the Compliance Manager.

Once actions complete Site Manager to carry out odour survey to check efficacy of actions and inform NRW of results.

RESOLUTION:

Gas Odour issue considered resolved when source has been identified and prevented.

Routine monitoring will be carried out at the site in accordance with FCC internal work instructions.

1. The monitoring undertaken will check levels of:
- Methane
- Carbon dioxide
- Oxygen

- Sampling point pressures (for gas field)
- Atmospheric pressures

2. The flare rig is maintained by the manufacturer on a three monthly inspection frequency, together with a guaranteed 24 hour call out facility in the event of an emergency inclusive of Bank Holidays.

3. The gas field is maintained on a monthly inspection and a contractor provides a 24 hour call out response inclusive of Bank Holidays in the event of urgent repairs being identified.

4. Additional flares can be hired if circumstances dictate the need to supply.

Migration Monitoring

5. Action to be taken in the event of methane being detected at 1% (1) volume or above in the perimeter boreholes.

a) Re-check the instrument for zero readings and blockages and re-take reading after 10 minutes.
b) If readings persist, adjust the gas field as appropriate and re-check.
c) Notify the following of results:

(i) Compliance Advisor
(ii) Site Manager or Nominated Deputy
(iii) Natural Resources Wales

(1) NOTE – Probe GP1 has background methane level above 1% volume.

6. Action to be taken in the event of Carbon Dioxide being detected at 1.5% (2) volume or above in the perimeter boreholes.

a) Re-check the instrument for zero readings and blockages and re-take reading after 10 minutes.
b) If readings persist, adjust the gas field as appropriate and re-check.
c) Notify the following of results:

(i) Compliance Advisor;
(ii) Site Manager or Nominated Deputy;
(iii) Natural Resources Wales.

(2) NOTE – Some probes and boreholes have higher background levels than 1.5% Carbon Dioxide by volume, see Annex B below.

7. For persistent elevated methane and carbon dioxide readings, adjust the gas field:
a)

(i) Increase suction on wells;
(ii) Report defects to Compliance Advisor and / or Site Manager.
(iii) See Annex A for spares holdings.

b) After remedial action in 5a) to 5c) for Methane and 6a) to 6c) for Carbon Dioxide, re-check readings after 30 minutes. If elevated readings are still present but appear to be falling, continue checks at one hourly intervals. Check for evidence beyond boreholes towards the site boundary by spike testing. If readings still show elevated gas levels at the site boundary then instigate a 250 metre search using the current Landfill Gas Emergency Plan and Borehole Log reference which are kept in the site office, checking of all monitoring points, surface cracks, services and if necessary carry out further spike tests.

c) Landfill Gas Emergency Pack contains:
(i) List of site key holders and telephone numbers;
(ii) Landfill Gas Emergency Plan;
(iii) Borehole Log Reference Sheets and Borehole Logbook;
(iv) Site Plan showing borehole locations and Gas Wells/Lines;
(v) Wrexham County Borough Council 'off-site' Emergency Plan

N.B. Off-site search areas plan kept in sub-station.

d) Above, the readings indicate a threat, then the following will be notified by NRW.
(i) Local Environmental Health Office
(ii) British Gas TRANSCO;
(iii) Emergency Services;
(iv) Rail track (if migration is affecting the site boundary adjacent to the railway line);

e) Continue measures set out to reduce / eliminate elevated readings and any other measures advised by appropriate authority.

Access to Third Party Premises with Local Authority and for TRANSCO Staff.

8. In determining the threat posed to public safety, entry to third party premises may be required. FCC staff have no statutory rights of entry, and no entry to premises or buildings for gas monitoring purposes will be made by staff. Local Environmental Health Office are responsible for monitoring within private premises and buildings. TRANSCO will implement emergency procedures if human health is at risk and the waste regulation / Environmental Health Authorities are not present.

Mains Power Failure.

9. In the event of a mains power failure at the site, the following actions will be undertaken:

a) Contact FCC Site Manager and Compliance Advisor
b) If the power failure is the result of loss of supply, contact the relevant electricity provider.
c) If the provider is unable to reconnect supply within 4 hours, then contact a) above, who will arrange, with Newenco Ltd to hire a generator.
d) The flare has a remote telemetry facility which calls relevant persons in the event of flare failure or loss of power supply.

Flare Breakdown.

10. Notify FCC Site Manager and/or FCC Compliance Advisor in the event of a flare breakdown.

Emergency Telephone Numbers.

11. The following emergency contact numbers are applicable to the site:

EXTERNAL CONTACTS

Contact	Telephone Number
Site Manager	Colin Shaw 07773 813228
Compliance Advisor	Leon Terrace 07395 833753
Newenco Ltd	Nick Lewis 07767 408963
Natural Resources Wales	0300 0653000
Wrexham Environmental Health	01978 292040
Electricity Provider	Scottish Power 0800 0270072
British Gas	0333 2029802

Annex A – Inventory of Gas Abstraction Field: - Spares

Item	Quantity
160 mm Pipe	200metres
63 mm Canoflex Pipe	25 metres
160 mm Straight Connectors	6 no.
160 mm T Pieces	4 no.
160 mm Blank Ends	4 no.
225 mm Straight Connectors	6 no.
160 mm to 75mm Reducers	6 no.
300 mm to 160 mm Reducers	4 no.
T2000 Monitoring Poles	12 no.

Annex B – Table showing Carbon Dioxide trigger levels at Gardden Lodge Landfill Site in operation from the beginning of May 2020. These will run for 12 months and will then be reviewed.

GBH Series		BH Series	
Borehole No.	Trigger %	Borehole No.	Trigger %
1	6.2	1a & b	1.5
2	1.6	2a & b	1.5
2A	5.1	3a & b	1.5
3	1.5	4a & b	1.5
4	1.5	5	Flooded
5	1.5	6	1.5
6	4.2	7	1.4
7	1.5	8	1.8
8	1.5	10	1.8
9	1.5	11 a p	1.5
10	2.7	12a	1.7
		12p	1.5
		13	1.5
		14	1.5
		15	1.5
		16	1.5

RUABON LF Emergency Procedure Test Record	*Comments*
Fire in Plant or Buildings ☐ **Raise** the alarm ☐ **Evacuate** any Buildings near the fire ☐ **Dial 999** and state Fire - follow the instructions given ☐ **Do not put yourself at risk** ☐ Inform your Site Manager/Compliance Advisor or next available Manager immediately ☐ All electrical supplies should be isolated and made safe in the area of the fire ☐ Assemble at fire point and check that all visitors, contractors and staff are accounted for.	999 /112 CS 07773 813228 Office 01978 810620 LT 07395 833753 Newenco Ltd 07767 408963
Fire ☐ Inform your line Site Manager/Compliance Advisor immediately ☐ Evacuate all personnel and equipment from the area. ☐ **Stop** personnel and vehicles entering area. ☐ Follow instructions ☐ Set fire watch to ensure the fire is fully out before leaving site	999 /112 CS 07773 813228 Office 01978 810620 LT 07395 833753 Newenco Ltd 07767 408963
Accident/Injury • **Remove** casualties from immediate danger • If injuries are serious Dial 999 and ask for an ambulance - follow the instructions given • Summon the first aider • Do not move any plant or equipment involved other than to rescue casualties • Inform your Site Manager/ Compliance Advisor immediately • Contact the SHE manager • Record details in accident book	999 / 112 CS 07773 813228 Office 01978 810620 LT 07395 833753 SHEQ 01302 303030
Electrical • Isolate supply and/or casualty, • Do not touch anything until supply is isolated. • Summon Help / Call emergency services • Give first aid	999 / 112 CS 07773 813228 Office 01978 810620 LT 07395 833753 Newenco Ltd 07767 408963
Spillage or Leakage • Report all spillages or leaks to Site Manager / Compliance Advisor immediately. • For small spillage's use absorbent materials • For large spillages bund with soil or other suitable inert material • Consult the COSHH file for hazards. • If possible move leaking container to bunded area • If spillage cannot be contained call the NRW	999 / 112 CS 07773 813228 Office 01978 810620 LT 07385 833753 NRW 0300 0653000
Exposure to Chemicals/unknown substances • Remove casualty from danger • Remove contaminated clothing and use emergency shower • Consult the COSHH file for hazards. • Contact Site Manager / Compliance Advisor immediately • Send casualty to hospital along with details of the material and sample • Contact Group SHE manager for further advice	999 / 112 CS 07773 813228 Office 01978 810620 LT 07395 833753 SHEQ 01302 303030
Explosives/Bombs • Evacuate area and keep clear • Dial 999 and state nature of emergency • Contact Site Manager / Compliance Advisor immediately	999 / 112 CS 07773 813228 Office 01978 810620 LT 07395 833753 Newenco Ltd 07767 408963

Gas (Landfill or other) • Evacuate area and keep clear • Contact Site Manager / Compliance Advisor immediately • Contact FCC Environmental Management Team • Contact Newenco Ltd • Contact NRW	999 / 112 CS 07773 813228 Office 01978 810620 LT 07395 833753 Newenco Ltd 07767 408963 NRW 0300 0653000

Appendix 5 - Gas field Monitoring, balancing and inspection method statement (Newenco Ltd dated 12/09/2022) – Document EC5.3.1

Health and Safety

On arrival at site sign in at the site office or weighbridge.

Before you begin work check the site DSEAR zoning plan and ensure that non-ATEX approved items for example, mobile phones, cameras etc. are not used in any zoned areas

Review the site's H2S register for areas of site that may emit H2S and ensure the relevant site inductions are completed and in date. Follow any site specific rules included in the site induction. If Proximity Warning System (PWS) tag systems are in use on site these must be signed out and tested daily when working on the gas field

1. The Risk Assessments for this task include:

- **General Access:** Landfill
- **Core:** CoSHH, Driving on Site, DSEAR and Lone Working
- **Specified Task:** Working on Gas Wells

Make sure that the control measures identified on the assessments are understood and implemented. Before starting this task, personnel should be wearing appropriate PPE to complete the task which includes hard-hat, hi-viz vest or jacket, safety boots (incorporating midsole & toe protection), eye protection, nitrile gloves and a fully functioning and recently calibrated personal multi-gas alarm.

If you are working alone ensure that you initiate a Lone Worker session on your mobile phone to cover the duration of the work.

Ensure that you monitor conditions at site throughout the duration of the work and if at any time you feel that your personal safety is at risk make the area safe and leave the site as quickly as possible.

In the event of an emergency situation ensure that you follow the instructions in the site emergency plan.

2. Prior to any monitoring / balancing exercise, the following tasks must be completed:

1.1 The current Newenco Ltd site specific identification (ID) file must be loaded onto the gas analyser

1.2 The current Newenco Ltd comments cards if applicable must be available for reference when storing comments

1.3 If required, the last file of balancing data for the site should be loaded onto the analyser for reference on the field

1.4 The accuracy of the analyser must be checked by performing a calibration check against a gas of a known concentration and the results recorded. Where a significant variance is identified (i.e. > + / - 2%), the following steps must be taken:

1.4.1 The Technician will arrange for the analyser to be repaired and inform the Compliance team

1.4.2 The analyser sent away for repair

1.4.3 A suitable replacement analyser sourced for completion of the exercise

1.5 Any list of wells closed due to high levels of CO, H_2S or H2 should be checked.

1.6 The person completing the balancing must be competent and familiar with the operation of the portable gas analyser being used, consulting the manual as necessary

2 MONITORING & BALANCING REQUIREMENTS

The monitoring and balancing at each location is to include:

2.1 Methane (CH_4), Oxygen (O_2), Carbon Dioxide (CO_2) and balance gases (upon arrival and following any adjustment(s) made).

2.2 Vacuum at the monitoring point (upon arrival and following any adjustment(s) made).

2.3 A suitable comment from the current Newenco Ltd standard comments list must be stored to reflect the condition of the well at the time of balancing.

2.4 Any trace gas components or other parameters (e.g. temperature) stipulated in the site permit or agreed with the landfill operator.

3. COMPLETING GAS BALANCING

Whilst balancing any monitoring point, the following tasks must be completed:

3.1 Before completing the balancing , a 'site gas and flow' reading must be recorded from the incoming line at the compound showing the CH_4, O_2,CO_2, balance gas, vacuum, flow (where available) and engine output (if applicable).

3.2 Before taking a gas reading, the analyser pump must be run until the last reading has been purged; typically this will require a minimum purge time of 20 seconds (longer if the Hydrogen sulphide (H_2S) filter pack is being used or high levels of Hydrogen (H) or Carbon monoxide (CO) have been detected).

3.3 After selecting the relevant monitoring point ID, the analyser pump must be run for the time recommended in the user manual for the model of analyser used (longer if a stable reading has not been obtained after the recommended pump run time). Where H_2S filter packs are being used, or high levels of H or CO are detected, the analyser pump must be run for a minimum of 120 seconds to obtain a stable gas reading; It will take longer for the gas reading to stabilise when a H_2S filter pack is being used with the analyser, or where high levels of H or CO are detected.

3.4 If the well is closed on arrival, you must check whether there are any specific requirements for the well before recording the gas level.

- 3.4.1 If the well is to be purged first, store the suction reading and then open the well to a low vacuum (<5 mbar) and run the analyser pump for at least three minutes or until the gas levels stabilise unless the well has been closed due to high levels of H_2S. Store the gas reading indicating the adjusted valve position before closing the well and storing a second reading indicating the valve arrive position and valve depart position as 0.
- 3.4.2 If the well is not to be purged, take the reading in the normal way.

3.5 Where off-site gas monitoring points are monitored (such as in-rock extraction points or monitoring boreholes), the pump run time minimum can be 30 seconds where no CH_4 is detected within the 30 second period.

3.6 Upon storing readings the valve positions must be recorded as a percentage, ranging from 0% (indicating that the valve is fully closed) through to 100% (indicating that the valve is fully open).

3.7 A suitable comment must be selected from the comments file provided with the site ID file to reflect the condition of the well at the time of balancing.

3.8 In the event that a suitable comment does not exist in the comments file, an appropriate comment must be recorded against the well ID in a field note book and the comment uploaded into GARD

3.9 Where the valve on a monitoring point is adjusted, another reading must be stored for the well to illustrate the changes made to both the gas composition, vacuum and valve position.

3.10 For multiple adjustments; a reading for each adjustment must be stored to reflect this.

3.11 Where levels of CO and / or H_2S are recorded in excess of any trigger level, a bag sample must be taken for laboratory analysis (EC 5.4 Bag sampling procedure). If this is to be competed on a later visit to site a Maximo work order must be raised.

4. GAS FIELD INSPECTION

Whilst balancing the monitoring points the following inspections must also be completed:

4.1 The pipework will be visually inspected for damage, settlement, condensate build up or any other issues

4.2 Each knock out pot (KOP) will be inspected and a record made of a counter reading and any issues identified

4.3 Where possible minor issues with gas wells, KOP and pipework can be repaired during the balancing process. Where this is not possible a follow on work order should be raised in Maximo for the works to be completed as soon as practicable

5. FOLLOWING GAS FIELD BALANCING

4.1 A ‘site gas and flow (where available) reading must be recorded from the incoming line at the compound showing the CH_4, O_2,CO_2, balance gas, vacuum, flow and engine output (if applicable).

4.2 Upon completion of the balancing the calibration of the analyser must be checked to ascertain whether the accuracy of the unit has drifted during the monitoring tasks as per 1.4

Appendix 6 - Gas field balancing and inspection (Newenco Ltd dated 12/09/2022 – Document EC5.3.

PURPOSE

- To ensure the effective balancing and inspection of the gas collection system for the purpose of meeting Newenco Ltd environmental and contractual obligations.

SCOPE

- This procedure defines the steps required to effectively balance the gas collection system in adherence with the company's and all stakeholders' requirements.

ASSOCIATED DOCUMENTS

- EC 5.4 - Bag sampling procedure
- EC 5.6 – Gas field flows procedure
- EC 5.7 – H2S Gas field monitoring
- EC 5.8 - Hydrogen gas field monitoring guidance note

- **RESPONSIBILITIES**

- The Manager responsible will be accountable for ensuring this procedure is followed and all associated documents are available.
- The Technician responsible, or contractor is responsible for ensuring that this procedure is followed at all times.

INTRODUCTION

Balancing and inspection of the gas extraction system as part of routine monitoring is necessary to ensure the field is operated and optimised in line with all business and stakeholder requirements by giving consideration to the following:

- Any site GOP, trigger and control levels for CH_4, O_2, balance gases and vacuum (prior to and following any adjustment(s) made)
- Any gas trigger levels for bag sampling stipulated in the permission, agreed with the landfill operator or deemed appropriate by the Regional Manager.
- Any current compliance issues at the site e.g. migration, odour, presence of hot-spots etc
- Site conditions e.g. site engineering, leachate levels
- Inspecting KOP's, pipework falls and any damage to infrastructure

PROCEDURE

1. Prior to going out on the field, the current site GOPs / PPC permit / permission levels set for CH_4, O_2, balance gases and vacuum, and trace gas trigger levels must be checked, and the last file of monitoring data for the site loaded onto the analyser for reference once up on the field if required.

2. When breaches of any trigger of control levels are identified, appropriate adjustments must be made with the aim of returning breaching parameters to within acceptable levels. When adjustments have been made before and after readings must be stored

3. Where a breach of CO and / or H_2S trigger levels are identified, a bag sampling exercise as detailed in EC 5.4 'Bag sampling' will be carried out.

4. In the event that the balancing is being performed by a contractor, all data must be provided to Newenco Ltd in the downloaded and un-edited CSV format, along with the results of the calibration check and any gas report or summary produced.

5. If any issues are identified such as, but not limited to, damaged infrastructure, odours or signs of subsidence on the gas field, these should be communicated out to the site business manager and compliance advisor for follow on works and investigations to be completed

Appendix 7 – Leachate Well Maintenance and Inspection Plan

All leachate wells will be inspected as follows:

Weekly

- Check of all Eductor pumps to ensure that they are working; and if not then action as follows:
    - restart pump using standard procedures for re-activating a pump without removing pump from well; and
    - if pump still does not work, then replace with a spare pump at the appropriate depth for the well and return the failed pump to contractor for service/repair.
- Check all pumps to ensure that they are working; and if not then action as follows:
    - attempt to reactivate pump and re-set; and
    - if pump still does not work, then remove from well, inspect and replace with a spare pump and return pump to contractor for service/repair.
- Check of well head integrity (for leaks, odours, and air ingress); and if any issues are identified then repair, if possible, otherwise they will be reported to the Site Manager for further action.

As a minimum the following will be recorded during the weekly inspections:

- The date the well was inspected.
- Whether the pump was functioning as anticipated; and if not what steps were taken to re-activate it.
- A record of whether the original pump was removed from the well and the depth at which it (or a replacement) was positioned.
- Details of the replacement pump if one was installed within the well.
- Total volume of leachate abstracted from the well (if possible)
- Any issues noted with the integrity of the well head and any actions taken. If the issues could not be resolved then details of the further action required will be recorded. These details will then be copied to the Site Manager for further action.

Note that weekly inspection of each pump will ensure that as a maximum there will be a 7 day period between a pump stopping and this being identified. The actions outlined above describe the process that will be undertaken to ensure that such situations are resolved as soon as possible.

To provide an adequate number of spare pumps based on historic failure rates a minimum of two spare pumps will be available on site at any one time in the event that replacement pumps need to be deployed.

Monthly (abstraction wells only)

- The total volume pumped from each abstraction well in the preceding month will be calculated.

6 Monthly (all wells)

- The base of each leachate well will be measured with an appropriately weighted device. The measurement will be compared against the preceding measured depth; in the event that the difference in depth is greater than 0.5 m then the depth will be re-measured. If, after the re-

measurement, the indication is that fine material has accumulated on the base of the well then this will be recorded and reported to the Site Manager for further action. If wells are de-silted then the depth before and after the work will be recorded along with a description of the work undertaken and any other relevant observations.

Annually (all wells)

- Check for excessive silting based on basal dip readings

As required (all wells)

- Re-survey the datum point of any well that has its datum point altered or changes are suspected based on the data collected (on an annual basis). Any significant differences will be identified and any necessary changes to datum points will be applied to future measurements (e.g. leachate level) and retrospectively to previous measurements if this is appropriate. Survey all new infrastructure once installed.

Note all measurements of depth down the well (e.g. leachate level, well base, position of pump) will be made with reference to the datum point. All inspection and maintenance records will be collated and retained on site.

2.1 Associated leachate pumping infrastructure

The associated leachate pumping infrastructure will be inspected as follows:

Weekly

- The total volume of leachate abstracted will be recorded and the date and time of inspection.

Monthly

- Check of leachate pipework to assess its integrity. If any issues are identified they should be recorded and repaired if possible. Otherwise any issues will be recorded and reported to the Site Manager for further action.
- Check compressed air pipework to assess its integrity. If any issues are identified they should be recorded and repaired if possible. Otherwise any issues will be recorded and reported to the Site Manager for further action.
- Check that all the equipment is working by confirming that the pumps to the leachate holding tanks, the VIA eductor units are running. If any issues are identified they should be recorded and the equipment should be re-started if possible. Otherwise any issues will be recorded and reported to the Site Manager for further action.

As required

- The eductor units will be serviced in accordance with the manufacturers' instructions (normally after 2000 hours run). Details of servicing undertaken will be recorded.

Appendix 8 – Off-site Monitoring Infrastructure Maintenance and Inspection Plan

1.1 Sampling

Sampling will be undertaken by staff / contractors appropriately trained in environmental monitoring procedures, and who are familiar with the equipment and its limitations.

Personnel engaged in monitoring activities are trained to undertake the task. These will comprise the company's own technical personnel, the Landfill Manager or nominated deputy or 3rd party contractor. All monitoring staff undergo a period of on the job training and in addition external courses are used to supplement internal training.

Results will be validated by the technical personnel detailed above.

Reuse of disposable bailers or the storage of bailers within the groundwater boreholes shall be avoided to reduce the potential for cross-contamination of groundwater samples within separate monitoring periods. All equipment used will be clean and fit for purpose to avoid cross-contamination and/or incorrect sample representation.

1.2 Groundwater and Gas Perimeter Monitoring Infrastructure

The monitoring installations shall be inspected during each routine monitoring visit to ensure that they are fit for purpose. In the event that repairs are required these shall be undertaken within a period of one month.
Examples of the kind of issues to be considered are:

- Wear and tear: damage by machines, plant or through vandalism. Failure of the seals /cap;
- Access: are the monitoring points accessible safely;
- Identification: are the monitoring points clearly labelled and easily distinguishable from neighbouring monitoring points.
- Settlement: is the installation leaning over, has it dropped noticeably;
- Surface water ingress: is there water pooling around the base of the installation, is there signs of previous ponding / rivulets of running water in the vicinity of the installation;

The operator will measure the depth to base and water level of the borehole each time it is sampled. This is to calculate the standing volume of water in order to satisfy the requirement to remove 3 well volumes before a sample is taken (relevant to groundwater monitoring). The depth of the borehole will be determined by the installation log. If the borehole has become silted up or obstructed, a shortening of the depth will indicate this when compared to the original log.

Some degree of siltation is expected over the life of the borehole and this may need to be removed periodically to ensure the groundwater horizon is being sampled at the required depth and / or to retrieve representative quality samples.

If there is an excessive build-up of silt, the operator will arrange for the borehole to be cleared. This may require simple use of a surge block on the Waterra pipe to disturb the silt and pump it from the chamber. If this is not effective, it may be necessary to bring in a more powerful pump to remove the silt. The operator will attempt to remove any physical obstructions using rods or a hook and line. If this is not successful then specialist contractors may be needed e.g. use of CCTV to inspect the blockage.

If it is not practically possible to remove a blockage or the installation has become irreparably damaged, then the borehole may need to be re-drilled if it is critical for compliance assessment purposes.

Any replacement will replicate the original installation or if that was not suitable, drilled to the target strata using geological or other relevant information. Any replacement infrastructure would be approved by Natural Resources Wales prior to any works being undertaken.

1.3 Gas Action Plan

Details provided in Appendix 4.

1.4 Groundwater Action Plan

There are no groundwater compliance limits, annual monitoring reviews are submitted to NRW containing all collected data. Trends noted at any given location will be discussed between FCC and NRW if required.

Drawings