Datchet Quarry

Environmental Permit Application

Environmental Management and Monitoring Plan

May 2019

Prepared on behalf of CEMEX Materials UK Limited

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1.0 Introduction

1.1 Report Context

1.1.1 This section of the Environmental Permit application corresponds to Part B4 of the application form, specifically detailing the environmental monitoring and management plan for the importation of suitable inert fill using wastes to the Datchet Quarry.

1.1.2 The Environmental Permit application has been prepared by WYG on behalf of the Operator, CEMEX UK Materials Limited (CEMEX) to gain a bespoke waste recovery permit for the permanent deposit of waste to land at Datchet Quarry to facilitate the restoration scheme as approved under planning permission reference 13/01667.

1.2 Report Scope

1.2.1 This report has been prepared in accordance with Environment Agency (EA) Guidance for the Landfill Sector and LFTGN 02: Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water and with reference to the Hydrogeological Risk Assessment (HRA) and the Environmental Risk Assessment (ERA).

1.2.2 Background Environmental monitoring has been undertaken with respect to gas and groundwater to assess background levels prior to the commencement of operations.

1.2.3 The nearest surface water feature is Datchet Common Brook which runs in a west – east direction to the north of the application site and then flows into the site on the northern boundary, where it then flows south eastwards across the north east part of the site.

2.0 Groundwater Management and Monitoring

2.0.1 Adherence to the Waste Acceptance Criteria will ensure that the waste deposited at Datchet Quarry complies with the inert classification thereby mitigating any risk to groundwater.

2.0.2 A Hydrogeological Risk Assessment (HRA) was compiled by ESI in support of the Environmental Permit Application (Appendix F of the Environmental Permit Application). The objective of the HRA is to assess the potential risk of significant impacts on groundwater quality as a result of the proposed development, to derive control and compliance limits for groundwater and surface water.

2.1 Groundwater Monitoring Schedule

2.1.1 The HRA recommends that groundwater in the superficial aquifer will be monitored at boreholes BH1A, BH2A, BH3A, BH4A, BH7 and BH8 as shown on Drawing Number CEM/A097237/BH/01. It is recommended that no monitoring will be undertaken at boreholes BH5A and BH6 as these boreholes are located neither up or down gradient.

2.1.2 The proposed monitoring requirements for the are set out in Table 1 below.

Table 1: Proposed Groundwater Monitoring Determinands and Sampling Frequency

Locations	Monthly	Monthly Quality	Quarterly	Annually
Upgradient BH4A, BH7 **Downgradient** BH1A, BH2A, BH3A, **Downgradient** BH8, BH9 (to be installed)	Water Level (all Bhs)	**Monthly for 12 months** then as other Bhs. Field pH, EC, Temp, Lab pH, Electrical conductivity, Alkalinity as CACO3, Ammoniacal Nitrogen, Chloride, Nitrate and Nitrite as N, Sulphate, Calcium, Sodium, Magnesium, Potassium, Arsenic, Iron, Manganese, Antimony, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Zinc	Field pH, EC, Temp Lab pH, Electrical conductivity, Alkalinity as CACO3, Ammoniacal Nitrogen, Chloride, Nitrate and Nitrite as N, Sulphate, TOC filtered, Calcium, Sodium, Magnesium, Potassium, Arsenic, Ionic Balance	Iron, Manganese, Antimony, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Zinc

Compliance Levels

2.1.3 The HRA provides compliance limits for boreholes BH2A and BH3A for ammoniacal nitrogen, chloride and arsenic. Details of the control and compliance levels are set out in Table 2 below.

Table 2: Proposed Control and Compliance Levels

Borehole Reference	Determinand	Control Level (mg/l)	Compliance Level (mg/l)
BH2A	Ammoniacal Nitrogen	0.81	1.01
BH3A		0.41	0.93
BH2A	Chloride	48	68
BH3A		61	81
BH2A	Arsenic	0.001	0.01
BH3A		0.001	0.01

Contingency Plan

2.1.4 Once compliance levels have been agreed, should site monitoring identify an increase in the concentration of the selected determinands then a series of contingency actions will be required. Suggested contingency actions, which require agreement with the EA, are presented in Table 3.

2.1.5 In the event that any Control Level is exceeded in one sampling point on one occasion, the following action will be taken:

1. The Company database will be queried to identify the past 12 months results from the affected location. If less than two of the last four results have breached the Control Level, no further action will be taken, other than to note that a breach has occurred. However if two or more of the last four sampling results have breached the Control Level at this location, then the borehole will be re-sampled as soon as possible after receipt of the results.

2.1.6 If the repeat sample also exceeds the Control Level the following course of action will be taken:

2. Data from the monitoring point exceeding the Control Level and adjacent monitoring points will be reviewed by use of statistics and graphical presentation to establish the presence of any trends or patterns.

3. Groundwater levels will be reviewed to establish flow direction in order to determine whether the site is the most likely cause of any change in groundwater quality.

4. A preliminary inspection will be carried out to determine whether there has been:

    a. Any unusual activity or occurrence on or around the site that could account for the increase in the parameter.

    b. Any spillage of contaminants at the surface in the vicinity of the affected boreholes.

5. The Company will assess the results of all of the above information and specify its course of action on future monitoring.

2.1.7 In the event that any Trigger Level is exceeded in one sampling point on one occasion, the following action will be taken:

1. The monitoring point will be re-sampled as soon as possible after receipt of the results; whether the elevated determinand was derived from field or laboratory analysis the re-analysis will be carried out in the laboratory. This initial procedure will be used to eliminate errors that might be introduced during sampling, field analysis or laboratory analysis, before continuing. If this second sample does not exceed the Trigger Level then no further action will be taken unless it exceeds the Control Level in which case the procedures set out above will be followed.

2.1.8 If the additional repeat sample also exceeds the Trigger Level then:

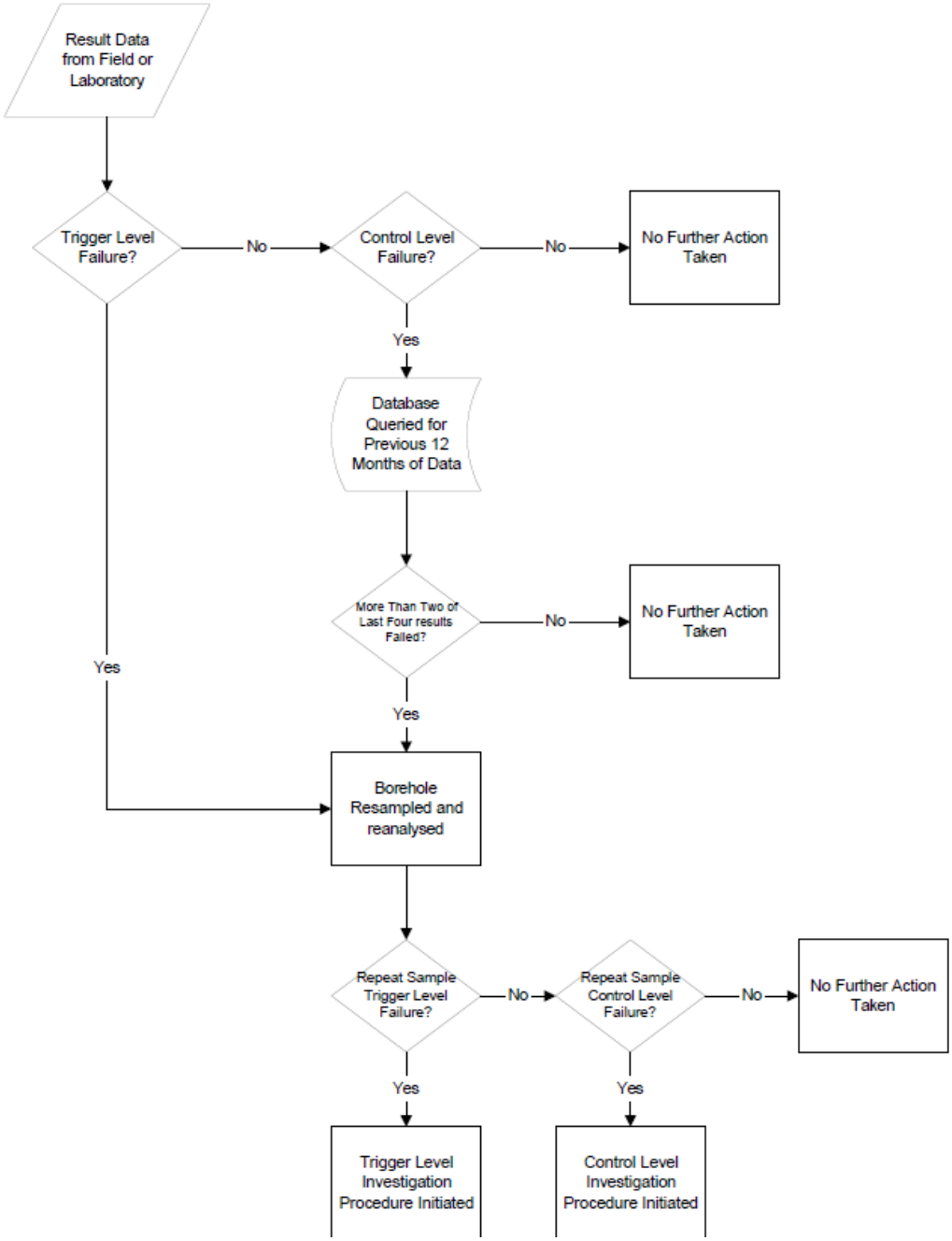
2. The actions described in 2 to 4 above will be carried out; and

3. The monitoring frequency will be increased to monthly for an agreed set of monitoring determinands by laboratory analysis in the affected borehole and adjacent boreholes on a monthly frequency until the determinand concentration falls below the Trigger Level.

4. If the laboratory results from the monthly monitoring show no indication of decline over a four month period (or other period assessed appropriate with respect to the rate of flow of groundwater at the site), and the evidence indicates that the site is the most likely cause of the increase in concentrations, then a hydrological risk assessment will be carried out (see below).

5. The Company will conclude the risk assessment with an explanation of the effect of the groundwater quality changes on the groundwater and surface water resource with recommendations for any remedial action if it is considered necessary. A course of action will be agreed with the Environment Agency.

2.1.9 The control and trigger level procedure is summarised on the flow chart below.



2.2 Quality Control Procedures

Monitoring Personnel

2.2.1 Monitoring will be undertaken by suitably trained person(s) appointed by the site management, who are familiar with the monitoring procedures. The monitoring personnel will have access to

the Environmental Permit and any relevant accompanying application documents to gain an understanding of the conditions applicable to groundwater monitoring (levels and quality). Personnel will also be familiar with the assessment criteria to identify compliance and assessment levels.

Monitoring Procedures

2.2.2 The monitoring procedures for groundwater are provided as Appendix B to this report.

Recording and Reporting

2.2.3 All field monitoring results for gas, water level and water quality and all laboratory results are stored in the Cemex Environmental Database, and can be made available on request to the site staff and the EA. The Cemex Database team will ensure that data reports are sent to the EA in an agreed format at quarterly frequencies.

3.0 Surface Water Management and Monitoring

3.0.1 The nearest surface water feature to Datchet Quarry is Datchet Common Brook runs in a west – east direction to the north of the application site and then flows into the site on the northern boundary, where it then flows south eastwards across the north east part of the site.

3.0.2 The Jubilee River flows to the west of the site and is located approximately 480m at its closest point. It joins the River Thames which flows in a west – east direction and is located approximately 800m south west of the application site.

3.0.3 The Queen Mother reservoir is located approximately 400m from the application site.

3.1 Abstractions

3.1.1 Information regarding abstraction licences was obtained from the Environment Agency. There are four surface water abstractions, covered by three surface water abstraction licences, within 3km of the Site. These are summarised in Table 3 below.

Table 3: Licenced surface water abstractions within 3km

Licence	Distance from Site (m)	Holder	Source	Use	Max Daily Volume (m^3/d)
Non-water company abstraction licenses					
28/39/28/0301	2957	J Raynor & Sons Ltd.	Surface water	Spray Irrigation	1273
Water company abstraction licenses					
28/39/M/0002	1089	Thames Water	Surface water	Public water supply	2273000
28/39/27/0064	1718	Veolia Water	Surface water	Public water supply	227300

3.2 Flood Risk

3.2.1 According to the Flood Map from Planning Service (FMPS), The Site is situated within both a Flood Zone 3 and a Flood Zone 2. The areas prone to flooding lie around the perimeter of the Site, with the area in the centre not listed as being susceptible to flooding as it lies at a higher elevation.

3.2.2 Areas that lie within a Flood Zone 3 have a 1 in 100 or greater chance of flooding each year, whilst areas in a Flood Zone 2 have up to a 1 in 1,000 chance of flooding each year.

3.3 Surface Water Monitoring Schedule

3.3.1 The HRA recommends that surface water monitoring should continue to be carried out at SW1, SW3 and SW4 along with new locations SW5 and the proposed amenity lake (Point reference LAKE). The monitoring locations are shown on Drawing Number CEM/A097237/BH/01.

3.3.2 Monitoring point SW1 is located upstream on the unnamed surface water stream which flows from the north west of the site, while point SW3 is located downstream of the same stream. Point reference SW4 monitors Datchet Common Brook down-gradient of the site. A new monitoring point (SW5) has been proposed in the HRA to monitor the stream that rungs along the north eastern boundary of the site.

3.3.3 Monitoring at the proposed amenity lake will commence once the water body has been established.

3.3.4 Table 4 contains the proposed surface water monitoring schedule.

Table 4: Proposed Surface Water Monitoring Determinands and Sampling Frequency

Locations	Monthly Quality	Quarterly
SW1, SW3, SW4 (new), SW5 (new), SWP1 – SWP9 LAKE	Field pH, EC, Temp, Visual oil and grease Lab pH, Electrical conductivity, Dissolved Oxygen, BOD, Alkalinity as CACO3, Ammoniacal Nitrogen, Chloride, Nitrate and Nitrite as N, Sulphate, Calcium, Sodium, Magnesium, Potassium, Ionic Balance	Field pH, EC, Temp Lab As monthly plus Iron, Manganese, Arsenic, Antimony, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Zinc

3.4 Compliance Limits

3.4.1 The HRA recommends that control levels and compliance limits are set for ammoniacal nitrogen, chloride and arsenic for locations SW3, SW4 and SW5. It is not recommended to set control levels or compliance limits for SW1 due to the fact that it is upstream of the site.

3.4.2 There is only one data point available for SW3 and there are no data for SW4 or SW5. Therefore, it is not possible to set control levels or compliance limits at these locations. It is proposed to commence monitoring SW4 and SW5 immediately and collect the necessary dataset. Data will be collected monthly for one year, after which control levels and compliance limits will be set.

3.4.3 Control and action levels for internal surface water bodies are provided within the HRA and are provided in Table 5 below:

Table 5: Proposed Control and action levels for internal surface water bodies

Borehole Reference	Determinand	Action Level (mg/l)
SWP1 – SWP9	Ammoniacal Nitrogen	1.01
	Chloride	81
	Arsenic	0.01

3.5 Contingency Plan

3.5.1 In the unlikely event of a pollution incident caused by a direct discharge of contamination e.g. leaking pipework, fuel spillage, the following emergency procedure will be implemented:-

- Immediately report incident to the Site Manager; and
- Identify source and prevent further leak/spillage.

3.5.2 For major fuel/oil spillage implement the following procedures:-

i) Clear the area immediately and extinguish any naked flames. Attempt to make a bund to contain the fuel/oil in order to limit the extent of the spillage;
ii) If possible, try and contain the spill using absorbent materials available on site;
iii) Phone 999, ask for the Fire and Rescue Service and request assistance;
iv) Ring the EA the explain what has happened so they can take appropriate action;
v) At no time put staff, customers or the public at risk;
vi) If appropriate close the site, wait at the gate for emergency services and explain the situation prior to allowing access to site;
vii) Do not allow staff or the public to go back into the site until authorised to do so;
viii) Keep customers, and if appropriate public, informed about what is going on at all times;
ix) Once it is safe to enter the site, re-open to customers and update the EA;
x) Complete the site diary and any other paperwork about the incident; and

xi) The resultant spillage material should be disposed of in accordance with Environmental Permitting requirements. Specialist advice must be sought in the event of any doubt.

3.5.3 For minor fuel/spillage implement the following procedure: -

i) Clear the area immediately and extinguish any naked flames;
ii) Lay absorbent material over the spill to soak up the spillage and if any drains are nearby place the absorbent material around the drain to stop any liquid going into any surface water gullies; and
iii) Once the liquid has all been absorbed use a shovel to clear up the waste, put it in a plastic sack and then place it in the fullest container for non-recyclable waste for disposal via the normal route.

3.5.4 In the event of the pollution reaching a surface water course, implement remedial measures in accordance with the EA guidance. Undertake additional monitoring to ensure water quality does not exceed assessment criteria.

4.0 Gas Management and Monitoring

4.0.1 A Gas Risk Assessment (GRA) has not been prepared for Datchet Quarry, as the Environment Agency's 'Landfill and other Permanent Deposits of Waste: How to Surrender you Environmental Permit' (EPR 5.02) guidance, notes that gas generally develops from biodegradable wastes. Given that the site proposes to accept inert wastes, it is considered that the risk for gas to develop at Datchet Quarry is low.

4.0.2 Nevertheless, a screening report has been prepared which has been submitted with the Environmental Permit application as Appendix H.

4.1 Management

4.1.1 The Gas Screening Report indicates that due to the inert nature of the proposed waste types, the site will not give rise to significant quantities of gas. The negligible quantities of gas generated are unlikely to be under significant pressure which will minimise the likelihood of gas migration. The risk to nearby sensitive receptors associated with the generation and migration of gas is low.

4.1.2 Due to this low risk, it is considered that no active gas management will be required for the site.

4.2 Monitoring

4.2.1 In accordance with the Environment Agency's 'Waste Recovery Plans and Permits' guidance, if an operator intends to deposit waste more than 2m below the surrounding the ground surface, they must monitor the waste for methane, carbon dioxide and oxygen. The atmospheric pressure must also be recorded when taking gas readings.

4.2.2 Gas monitoring boreholes have been installed around the site, as shown on Drawing Number CEM/A097237/BH/01. The boreholes are currently monitored on a monthly basis for concentrations of methane, carbon dioxide and oxygen.

4.2.3 Gas monitoring will be carried out in accordance with the procedures set out in Environment Agency's 'Waste Recovery Plans and Permits' guidance. The proposed monitoring programme is detailed in Table 5 below. Procedures for the monitoring of gas are provided as Appendix A to this report.

Table 5: Monitoring Programme

Borehole Reference	Parameter	Monitoring Frequency
BH1A, BH2A, BH3A, BH4A, BH5, BH6, BH7 and BH8	Methane, carbon dioxide, oxygen, meteorological data, atmospheric pressure, differential pressure, temperature.	Monthly for 12 months (i.e. 12 data sets) then quarterly.

4.3 Compliance Levels

4.3.1 Compliance levels has been set for each borehole, based on guidance set out in LFTGN03 and the Industry Code of Practice for Perimeter Soil Gas Emissions. These Compliance Levels are detailed within Table 6.

Table 6: Compliance Limits

Borehole reference	Parameter	Proposed Compliance Levels (% by vol)	Monitoring Frequency	Proposed Action Levels
BH1A, BH2A, BH3A, BH4A, BH5, BH6, BH7 and BH8	Methane	1.0	Monthly	0.5
BH1A	Carbon Dioxide	-	Monthly	2.4
BH2A		-		2.2
BH3A		-		3.8
BH4A		-		4.6
BH5A		-		6.9
BH6		-		6.6
BH7		-		2.4
BH8		-		-
BH9		-		-

4.3.2 These compliance levels are based on concentrations of 1% above agreed background levels for methane. Compliance Levels will be reviewed following the collection of 12 months of gas monitoring data, and if required they will be revised accordingly.

4.3.3 The Gas Risk Screening Report has demonstrated that the potential for high concentrations of gas is low. However, an appropriate Action Plan is required in the unlikely event that action levels set for each borehole are exceeded. Action Levels have been set at a level which enables the site management to take timely and appropriate action, so that Compliance Levels are not exceeded. Further actions are however documented, in the event that both Action Levels and

Compliance Levels are exceeded. As with the compliance levels, the proposed action levels will need to be reviewed following a period of 12 months of background (pre-operational) monitoring. The following sections set out the proposed Action Plan for Datchet Quarry.

4.4 Action Plan

Investigation Procedure

4.4.1 The procedures for the assessment of gas monitoring results in relation to trigger limits are as follows:

1. For methane and carbon dioxide concentrations below the Control Level - allow as normal variability.

2. If methane or carbon dioxide concentrations exceed the Control Level then check previous two readings from the gas database and:

    i) If the previous readings do not exceed the Control Level then no further action is required other than to note that a breach has occurred.

    ii) If the previous two readings do exceed the Control Level, then increase monitoring frequency to fortnightly of limits in affected and adjacent boreholes; and assess the possible cause of the increase in concentrations by problem solving described in Section 2.5.3.

3. If methane or carbon dioxide concentrations exceed the Trigger Level then check the previous reading from the gas database and:

    i) If the previous reading in the affected borehole was below the Control Level then take no further action except to note that the trigger level has been breached.

    ii) If the previous reading was above Control Level, then increase monitoring frequency to weekly in affected boreholes until concentrations reduce below Trigger Level %.

    iii) Assess the possible cause of the increase in concentrations by problem solving described in Section 2.5.3, and review previous monitoring results to see if there is any indication of a trend.

    iv) Monitor borehole pressure to determine likelihood of significant gas flow rates.

4.4.2 The procedures for the assessment of gas flow monitoring results in relation to trigger limits

are as follows:

4.4.3 If significant flow rates are absent then continue monitoring weekly until gas concentrations reduce below Trigger Level.

4.4.4 If significant flow rates are absent but methane concentrations do not reduce below the Trigger Level within three months and the source of the gas has been identified as the permitted site, then consider the initiation of appropriate gas control measures in association with the Environment Agency.

4.4.5 If significant flow rates are present and readings persist above the Trigger Level % for more than 6 weeks with no signs of decreasing levels then carry out a gas survey of street services (for methane and carbon dioxide). Dependent on the results of the street survey, consider carrying out a gas survey of potentially affected properties after discussion with the Environment Agency.

4.4.6 The Company will make immediate arrangements to install gas control measures after consultation with the Environment Agency.

Problem Solving

4.4.7 In the preceding section, the first course of action proposed following any breach of trigger limits is to "assess the possible cause of the increase in gas concentrations". The routine to be followed to perform this instruction is set out below:

1. Check whether the barometric pressure was rising, falling or steady on the day and in the day(s) preceding the date of monitoring.

2. Check the results against those of other site monitoring boreholes to determine if the result is part of a general deterioration in the gas levels in the area, or a localised occurrence.

3. Check oxygen and carbon dioxide concentrations to determine if these correlate to a deterioration in methane concentrations.

4. Ensure that monitoring equipment is functioning effectively and in any case take a confirmatory sample for gas-chromatographic analysis.

5. Attempt to identify the most likely source of methane, in relationship to the history of the site, and previous monitoring results.

6. Investigate the surrounding area for signs of gas or leachate escape.

4.4.8 If a problem is identified, it will be rectified as soon as possible. The Site Manager or his nominee will be informed immediately, and he will co-ordinate any action required.

4.4.9 Record all actions in the Site Diary.

Gas Control Procedure

4.4.10 Gas control measures may include one or more of the following:

- Cut-off barrier;
- Passive vent trench;
- Pumped wells.

4.4.11 The selection of the appropriate control measures will be discussed with the Agency prior to installation, and will take into account the nature and depth of the waste deposited. As this site contains only inert waste, it is highly unlikely that gas control procedures will be required, however if they were a passive vent trench or passive venting boreholes would probably be the most effective remedy.

4.4.12 Increased gas monitoring in the affected boreholes will continue throughout and after installation of the control measures and until values drop below the Control Level. Monthly monitoring will then resume unless the Control Level is exceeded again.

4.5 Completion Criteria

4.5.1 Monitoring of gas will continue until the maximum concentration of methane in in-waste and external monitoring installations remains below 1.0% by volume and the concentration of carbon dioxide remains below 1.5% above the background level or the rate of gas flow remains below 15 litres/hr.

4.5.2 Monitoring will be carried out over a 24 month period on at least 4 occasions, including 2 occasions when the atmospheric pressure is falling and is less than 1000 mb.

5.0 Meteorological Monitoring

5.0.1 Due to the acceptance of inert waste at the site and with reference to the HRA, it is considered unnecessary to manage and monitor leachate. This negates the need to monitor meteorological conditions for the purpose of using water balance calculations as a tool for evaluating leachate production.

5.0.2 Atmospheric pressure, and ground conditions will be monitored and recorded during all gas monitoring visits.

5.0.3 Weather conditions that may be unfavourable to the proposed recovery operations particularly dry loads will be used to determine the acceptability of such wastes on a particular day, for example strong winds given as severe weather warnings from the Meteorological Office.

5.0.4 Details on weather conditions will be recorded in the Site Diary on a daily basis.

6.0 Amenity Management and Monitoring

6.0.1 An Environmental Risk Assessment (ERA) has been prepared in accordance with the Environment Agency's Risk Assessment guidance. It specifically deals with the following:-

- Particulate Matter Management and Monitoring;
- Noise Management and Monitoring;
- Odour Management and Monitoring;
- Mud Management and Monitoring;
- Litter Management and Monitoring; and
- Birds, Vermin and Insect Management and Monitoring.

6.0.2 Due to the inert nature of the waste, the site will not produce odour or litter nor will it attract birds, vermin and insects.

6.0.3 The ERA concluded that the risk of particulate matter and noise annoyance was not significant and therefore it is not proposed to implement monitoring regimes for these potential hazards.

6.0.4 The ERA also considered the risk of mud being transferred to the local highways as not significant. A wheel washing facility will be employed on site which will be used by HGVs before they leave the site. Water sprays will also be employed to dampen the access road. However, in the unlikely event that mud is deposited on the road then a road sweeper will be utilised as necessary.

6.0.5 The site is covered by planning permission 13/01667. This consent has planning conditions covering noise, dust, and mud on the highway.

7.0 Health Impact Monitoring

7.0.1 Due to the inert nature of the waste, it is considered unnecessary to undertake health impact monitoring on the surrounding population.

Drawings

CEM/A097237/BH/01 – Location of Existing and Proposed Boreholes

Appendix A – Gas Monitoring Procedures

1.0 General

1.0.1 Gas monitoring will be undertaken by personnel trained in the use of the monitoring equipment and familiar with the monitoring procedures set out below.

1.0.2 All equipment will be maintained and calibrated in line with manufacturers recommendations.

2.0 Pre-Sampling Procedures

1. Check the gas monitoring instrument(s) to ensure that it is in within its calibration date.
2. Check the battery life of each instrument is sufficient for the sampling round. If fitted, check that the equipment filter is clean, if not then replace it.
3. Take a dip meter for checking the depth of water in boreholes.
4. Take a notebook or data recording device.
5. Ensure that the sampler has the means to gain access to the monitoring points that require sampling (e.g. keys, spanners, screwdrivers etc.).
6. If a sample(s) of gas is to be taken ensure that the appropriate sample container(s) is carried and that it is clearly labelled.

3.0 Monitoring Equipment

3.0.1 The company has, or has access to, several gas measuring devices including:

- Analox 1200 IR Gas Analyser or equivalent;
- Research Engineers Gas Tec;
- GA94
- GA2000
- GEM2000
- Differential 3 Scale Pressure Gauge;
- Flow Meter.

3.0.2 The equipment will conform to BS 6020 or certified to BASEEFA certification standard SFA 3007/1981.

4.0 Monitoring and Sampling Procedure for Boreholes

4.1 General

4.1.1 Ensure that any sample taken from a gas monitoring borehole is representative of the gases in the ground. Gases present in the well may not be representative of the ground atmosphere on the day of sampling since they may have become stratified or "stagnant".

4.1.2 Ensure that sufficient time is allowed for sampling each well to enable fresh gases to be drawn into the well. The period of pumping will vary from well depending on its size and depth.

4.1.3 Ensure that air is not drawn into the well during the sampling process. The well should be fitted with a removable but airtight cap that contains an integral gas-sampling tap.

4.1.4 A safe system of work should be observed; personnel must wear protective clothing and not smoke in the vicinity of the monitoring point.

4.2 Monitoring Procedure

1. At each well check the appearance and condition of the cover and note any damage or unusual occurrence. Damage must be reported to the Site Manager or his nominee as soon as possible and arrangements for repair or replacement actioned.
2. Switch on the gas meter(s) and take a sample of air to "zero" the meter. Ensure that the reading is zero for methane (CH4) and carbon dioxide (CO2) and is approximately 21% for oxygen (O2).
3. If appropriate measure the gas pressure within the well first by connecting the pressure meter to the sampling tap by means of a piece of (rubber) tubing and note the reading obtained.
4. Connect the gas analyser to the sampling tap and pump a sample of gas from the well through the analyser.
5. Note the gas level indicator continuously for changes and pump from the well for at least 2 minutes, or longer until a stable reading is obtained.
6. It is preferable for gas measurements to be taken simultaneously, as there may be limited quantities of sample in the well. With multi-gas analysis this situation is catered for by the

instrument but if separate gas monitors are used a compromise can be established by connecting them in series. If this is done then the carbon dioxide (CO2) meter should be the first instrument in the gas pathway as methane (CH4) could be oxidised during its passage through a catalytic oxidation detector giving rise to an enhanced carbon dioxide (CO2) reading.

7. Note the peak readings of methane (CH4) and carbon dioxide and also note the lowest reading of oxygen (O2) and whether the readings stabilise after the peak reading have been obtained or whether they fluctuate.
8. Disconnect the analyser and pump air through the machine to return it to "zero".
9. Note the atmospheric pressure.
10. Remove the well cap and dip the well to determine the water level to the marked datum point. Record the water depth and replace the well cap tightly.
11. Proceed to the next well and repeat the procedure.
12. Before leaving site, make a note in the Site Diary to record the date of the monitoring round.

5.0 Monitoring Records

5.0.1 A permanent record of all gas monitoring is maintained at the Company's Head Office, a copy of which will be kept in the site office during the operational phase. A copy of the results will be submitted to the Environment Agency in accordance with the Permit.

5.0.2 The following information is to be collected and recorded:

- Site code;
- Monitoring point reference code;
- Field equipment reference code;
- Name of sampling personnel;
- Date of monitoring event;
- Time of monitoring event;
- Parameter measured;
- Value;

- Measured value unit;
- Atmospheric pressure;
- Comments on sampling.

6.0 Limitations of Monitoring Equipment

6.0.1 Catalytic Oxidation detectors (LEL Range of GMI Landsurveyor) require a minimum percentage of oxygen to be present in the sample. Thus in an oxygas instrument such as the Landsurveyor LEL readings must be treated with suspicion at oxygen concentrations of less than 12%. The 100% gas range of the instrument is unaffected by the presence of oxygen but is inaccurate at the low end of the scale.

6.0.2 Flame Ionisation Detectors such as the Gas Tec are very sensitive but are not intrinsically safe. They must not be taken into buildings unless the internal atmosphere has been checked with an instrument such as the Landsurveyor.

6.0.3 The pellisters used in flammable gas detectors are prone to poisoning by a wide range of chemicals many of which may be present in trace amounts in gas. It is for this reason that gas instruments should be regularly recalibrated.

6.0.4 Some gases interfere with the performances of the gas detectors. Hydrogen can significantly increase the response of catalytic oxidation and thermal conductivity meters to methane. Carbon dioxide, on the other hand can depress the response of the meter to methane.

6.0.5 Where the concentrations of gases present in a sample appear strange (e.g. low oxygen, low methane, low carbon dioxide) it may be appropriate to take a gas sample for confirmatory analysis in the laboratory.

Appendix B – Groundwater Monitoring Procedures

1.0 Monitoring Equipment

- Dipmeter;
- Appropriate sample bottles with any necessary preservatives;
- Labels and waterproof markers;
- Flexible hose;
- Graduated bucket;
- Notebook or data recording device;
- Equipment for accessing boreholes (e.g. keys, spanners, screwdrivers, etc);
- Gloves and other relevant PPE;
- Spare waterproof plasters.

2.0 Pre-Sampling Procedures

2.0.1 Two weeks (or more) prior to sampling:

1. Check with the laboratory in advance to ensure it will be able to cope with the number of samples and the determinands required on the appointed day. Commercial laboratories may require less notice than in-house facilities; but it is recommended that the laboratory is contacted at least two weeks before the sampling round is due.

   NOTE: Analysis must be carried out by laboratories holding NAMAS accreditation for the procedures that are to be employed. Proof of NAMAS accreditation together with details of the analytical techniques must be obtained for each laboratory.

2. Check the amount of sample required, whether any special fixatives are necessary and what type of sampling container(s) should be used and that suitable sampling containers are available or there is still time for the laboratory to supply them.

3. Check that required bottles have been ordered and delivered to agreed location. Allow for QA samples if required (see B1.3.4 below).

2.0.2 The day before or immediately prior to sampling:

2.0.3 Before proceeding on a monitoring round a number of preliminary checks should be made by monitoring personnel to ensure that they:

1. Have all their necessary protective equipment (including gloves).
2. Have any cuts on the hands or forearms covered with waterproof plasters and the equipment should include a spare pack of waterproof plasters.
3. Have all the necessary sampling equipment and that it is clean and in good working order (bailer, dipper, portable Waterra pump, graduated bucket, cool box etc.).
4. Have their notebook or data recording device.
5. Have at least 2 waterproof marker pens (i.e. 1 plus a spare).
6. Have the means to gain access to the monitoring points that require sampling (e.g. keys, spanners, screwdrivers etc).
7. Have a sufficient number of clean sample containers (with any necessary preservatives) and labels available (N.B. allow for at least one spare container).
8. Have a measuring container for gauging the volume of groundwater removed during purging of the boreholes.
9. Have details of the depths and diameters of the monitoring wells so that purging volumes can be calculated.

3.0 Groundwater Monitoring and Sampling Procedure

3.1 General

3.1.1 Ensure that any sample taken is representative of the groundwater in the ground.

3.1.2 Ensure that sufficient time is allowed for sampling each monitoring point to enable fresh groundwater to be taken.

3.1.3 Ensure that the sample is not contaminated by the sampling procedure.

3.1.4 A safe system of work should be observed; personnel must wear protective clothing and not smoke in the vicinity of the monitoring point.

3.2 Groundwater Level Monitoring Procedure

1. Check the monitoring location and reference number and write this in the notebook (or data recorder).
2. Note anything unusual about the monitoring location e.g. damage.
3. Lower the dip-meter probe until the buzzer sounds.
4. Raise the probe slowly until the buzzer stops.
5. Lower the probe slightly until the buzzer just begins to sound.
6. Read the level of groundwater below the datum point from the tape and note the depth.

3.3 Groundwater Sampling Procedure

1. Check the monitoring location and reference number and write this in the notebook (or data recorder).
2. Note anything unusual about the monitoring location, e.g. damage.
3. Measure the level of groundwater in the monitoring well using dip meter.
4. Note depth in notebook and calculate approximate depth of water column within the well.
5. Calculate the volume of groundwater within the well.
6. Pump out three times the standing volume of groundwater and discard.
7. Provided that the sample bottle does not contain fixative chemicals, rinse sample bottle twice with groundwater form latter part of purging operation and rinse outer part of sampling tube. Discard groundwater. If the sample bottle contains fixative do not rinse.
8. Re-insert the rinsed tube to the base of the bottle and fill bottle with the water sample. Continue to pump water into the bottle once full so that excess sample overflows from the bottle. Ensure that the equivalent of several bottle-volumes of water are passed through the bottle, unless the bottle contains fixative chemicals in which case ensure that none of the fixative is lost.
9. Carefully withdraw the sample tube whilst still pumping so that the bottle is completely full.

10. Seal so that it is airtight (i.e. there is no airspace). This procedure ensures that the minimum amount of air is allowed in contact with the sample.

11. Label the sample bottle with the following information, Date, Time, Site, Contents, Location and/or Sampling Point Number.

12. Note anything unusual about the sample e.g. its odour, colour, presence of foreign bodies etc.

3.4 Sample Storage and Delivery

3.4.1 Complete, sign and date a chain of custody record to accompany the sample to the laboratory.

3.4.2 Provide the analyst with a written order that details which determinands are to be tested for and any pre-analysis preparation that is required (e.g. filtering of the sample), ensuring that it is clear that the standard procedures for the CEMEX contract are to be followed.

3.4.3 Before leaving site, make a note in the Site Diary to record the date of the sampling round and the date the samples were delivered to the laboratory.

3.4.4 On handing over samples ensure that the person receiving completes the chain of custody record and retain a signed copy.

3.5 Analysis Results

3.4.5 The analysis results will be entered onto the Company environmental database. The original certificates of analysis will be also be electronically stored in the database.