CQA METHOD STATEMENT AND QUALITY PLAN

PHASE 4A CAPPING WORKS

Bryn Pica Landfill Site

Report Number 1384r1v1d0714

Commissioned by

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1. INTRODUCTION

1.1 Amgen Cymru proposes to cap part of Phase 4A at Bryn Pica Landfill Site. In order to provide the necessary reduction in precipitation infiltration and landfill gas migration, in compliance with the PPC Permit, a welded geomembrane capping system is proposed. The geomembrane will be placed within a multi-layer system, with both mineral and geosynthetic elements.

1.2 Amgen Cymru will appoint experienced contractors to undertake the works. Geotechnology Limited (Geotechnology) has been appointed as the independent third party consultant to supervise and control the works on Amgen Cymru's behalf. A Geotechnology representative will supervise and control the installation of the geomembrane and the associated mineral and geosynthetic elements and will instruct the Contractor with regard to the onsite testing requirements during installation. Conformance testing will be undertaken at approved independent geosynthetic and geotechnical testing laboratories.

1.3 This document represents the Construction Quality Assurance (CQA) Method Statement and Quality Plan for the works to be undertaken. This has been compiled with reference to the PPC Permit for Bryn Pica Landfill Site.

1.4 This CQA Method Statement and Quality Plan should be read in conjunction with the following drawings included in Appendix B:

- 1384r1v1d0714 Drawing 1 - Site Plan
- 1384r1v1d0714 Drawing 2 - General Arrangement of Capping and Surface Water Collection Systems
- 1384r1v1d0714 Drawing 3 - Construction Details

1.5 The following definitions shall apply during the works:

(a) "Employer" means Amgen Cymru;

(b) "Contractor" means the person or persons, firm or company that will supply services or plant under a contract awarded by the Employer. It includes the Contractor's representatives and staff on site;

(c) "CQA Engineer" means Geotechnology Limited (Geotechnology) and includes individuals assigned to the works;

(d) "Supplier" means the person or persons, firm or company that will supply materials under a contract awarded by the Employer.

(e) "Geosynthetics" means geomembrane, geotextile and geocomposite drainage material.

(f) "Standard" means a published British Standard (BS), European Standard (EN), International Standard (ISO) or an American Standard (ASTM).

2. DESIGN STATEMENT

Bryn Pica Landfill site was granted its PPC Permit (Number DP3732SQ) on 27 June 2006 following a formal application process. The application documents included an Environmental Setting and Installation Design report (ESID) which outlined the engineering systems to be used at the site. These were shown to be protective of the environment in a series of risk assessments which also accompanied the application. In particular, the hydrogeological risk assessment demonstrated how the proposed engineering systems provide appropriate environmental protection.

The ESID not only provided details on the basal lining system and leachate control systems but also identified the requirement for a capping system to control post-filling infiltration into the waste mass (Section 2.2.4). The design of the capping system proposed for the site comprised a low density polyethylene welded barrier membrane sandwiched between protective geocomposite layers. The geocomposites provide protection to the barrier membrane but also transmit water (above) and leachate (below) to the appropriate collection infrastructure. The synthetic elements are shown laid onto a mineral support layer and overlain by restoration soils. Restoration soils are described in the ESID as being site-won and supplemented with compost produced at the facility.

In order to demonstrate that the proposed capping system is not at risk from instability or excessive deformation its design was considered in detail in the stability risk assessment (SRA) which supports the application. The SRA concluded that instability was a risk when smooth membrane was used on slopes steeper than 1v in 6h. However, textured membrane improved the stability of the capping system and providing that textured membrane is used the SRA demonstrates adequate factors of safety against failure and integrity for slopes of up to 1v in 2.5h. The influence of temporary plant loading (during construction) and elevated gas pressures (during failure of the gas extraction system) were also considered in the SRA.

Since the permit was granted, several phases of permanent capping have been undertaken, the most recent being Phase 3B which abuts the area proposed in these works. The detailed design of the capping system for Phase 3B and the construction quality assurance (CQA) scheme was submitted to the Environment Agency (EA) in accordance with requirement 2.7.1 of the Permit. Having received assent for the works to be carried out in accordance with the submitted documents the capping works were undertaken in 20011/2012. Upon completion of the works a CQA Validation Report was submitted in accordance with requirement 2.7.6 of the Permit validating that the works were undertaken in accordance with the plan.

This report has been produced to describe the capping works proposed for part of Phase 4A. The proposals are closely in accordance with the previously approved works and will be constructed in accordance with the outline design approved in the Permit application. It will comprise a 1mm thick linear low density polyethylene double textured barrier membrane sandwiched between two layers of a cuspated core thermally bonded drainage geocomposite capable of providing adequate protection to the membrane between.

The lower geocomposite will discharge any perched leachate beneath the cap into the leachate drainage infrastructure, whilst the upper geocomposite will discharge percolating rainwater into the surface water collection system. The lower geocomposite will be placed upon a compacted smooth regulating layer comprising site-won screened colliery spoil whilst the upper geocomposite will be overlain with 1000mm of restoration soils or 700mm of

restoration soil placed above a 300mm blinding layer of selected finer material. There is little difference in design terms between the previous capping phases and this.

The whole of the construction works are to be supervised by an experienced CQA Engineer who is independent of the operator, the contractors, the suppliers and the testing laboratories. The CQA Engineer is to oversee the works and will compile construction records required by this specification/CQA Plan so that upon completion the works can be formally validated. Upon completion of the works the as-built records and the construction records will be compiled into a CQA Validation Report for submission to the EA.

3. DESCRIPTION OF WORKS

3.1 General

3.1.1 The works shall comprise:

(a) setting out;
(b) site clearance;
(c) construction of temporary access roads and temporary drainage and the diversion and modification of existing drainage ditches;
(d) placement of regulating layer
(e) placement of lower geocomposite layer;
(f) installation of geomembrane materials;
(g) placement of drainage geocomposite materials above the geomembrane;
(h) placement of restoration soils layer.

3.1.2 To achieve the requirements of a low permeability cap to limit leachate production and improve landfill gas control, a LLDPE geomembrane cap is to be constructed over Phase 4A. To achieve the performance requirements the geomembrane will be welded. The geomembrane will be installed and tested under a strict quality regime in line with the manufacturer's guidance document and the latest EA guidance document (LFE5).

3.1.3 Manufacturer's certificates will accompany each roll of geosynthetic material delivered to site. Laboratory testing of materials sampled prior to installation (including mineral as well as geosynthetic materials) will provide additional confidence in the conformance of the materials with the Specification.

3.1.3 All workmanship will comply with current best practice and will be formally scrutinised during the works as part of the CQA procedures.

3.2 Leachate Seepage Collection Trench

3.2.1 The leachate seepage collection trench is to be constructed as shown on the drawings, connecting the lower geocomposite drainage layer beneath the cap to the existing leachate collection system. It will be filled with free draining stone meeting the Specification in Section 4.1.

3.3 Regulating Layer

3.3.1 The regulating layer will be nominally 300mm thick and will comprise material meeting the Specification in Table 2, either sourced from onsite stockpiles or imported as necessary.

3.3.2 The regulating layer will be prepared in a manner that provides a smooth, dry, clean and firm surface for the installation of the overlying geosynthetics layers. Any stones, sharp objects or other material within the bedding layer which, in the opinion of the CQA Engineer, could damage the regulating geosynthetics will be removed by hand picking.

3.3.3 The surface of the regulating layer upon which the geosynthetics are to be placed will be prepared such that a uniform surface is achieved. The surface shall be smooth and firm and will be free of any objects that may puncture the geosynthetic.

Smooth in this context means that there should be no sharp angles in the subgrade which exceed 10mm under a 1000mm lath (for example at changes of grade due to rutting), and no large rounded irregularity should exceed 50mm under a 3000mm lath. Measurements of smoothness and flatness will be taken at a rate of 5 measurements per hectare and recorded in the CQA report.

In general, firm in this context means that indentations cannot easily be made in the surface. For clays the shear strength of the clay should be >50kN/m^2 to ensure that no movement will occur during or after placement of the restoration soils

3.3.4 Written certification from the CQA Engineer as to the suitability of the regulating layer surface will be required to gain approval for the geosynthetic installation to commence.

3.4 Lower Geocomposite Drainage Layer

3.4.1 The geocomposite will be delivered, handled and stored in accordance with the manufacturer's recommendations.

Each roll of geocomposite delivered to site shall have a label conforming with EN 30320. The label shall be the name, address and telephone number of the manufacturer, product name and type, batch number, date of manufacture and physical dimensions.

3.4.2 The geocomposite will be securely stored on the designated part of the site in a level, dry and well-drained area such that the material is protected from:

(a) site traffic;
(b) standing water;
(c) UV radiation;
(d) extreme temperature (<0^{O}C >60^{O}C);
(e) animal and plant infestation;
(f) chemicals;
(g) puncture;
(h) any other environmental condition that could impact on its physical properties.

3.4.3 The lower geocomposite drainage layer will comprise a cuspated HDPE core thermally bonded to a filter geotextile on both sides and shall meet the requirements of Section 4.3. The geocomposite layer shall be secured at the free edge by the weight of the restoration soil layer. The lower edge shall be lapped onto the leachate drainage geocomposite from previous phases.

3.4.4 The geocomposite drainage material will be installed in accordance with the manufacturer's recommendations. A copy of the manufacturer's installation recommendations will be provided by the lining contractor to the employer and CQA Engineer prior to works commencing. Works will not commence until the installation method is agreed.

3.4.5 All fixing and cutting details adopted for the geocomposite drainage material shall be in accordance with the manufacturer's instructions. Adjacent sheets of the geocomposite will be installed such that either the cores of each adjacent sheet are abutting each other or that the sheets are overlapped such that the upslope sheet overlies the downslope sheet (ie shingled like a slate roof). The geotextile flap on the edge of adjacent drainage sheets shall be extended across the joint shiplap style. Jointing of the sheets shall be carried out as soon as possible after the sheets have been laid.

3.4.6 Geocomposite panels shall be installed free from tension or stress and without wrinkles or folds. The panels will be rolled out as close as possible to their final position and will not be dragged into position across the subgrade except where necessary to obtain the correct overlap with adjacent sheets.

3.4.7 All exposed edges of the geosynthetic sheets shall be suitably weighted down at the end of the working day and the contractor must accept full responsibility for the adequacy of the temporary fixing.

3.4.8 The geocomposite drainage layer will discharge into the gravel filled leachate seepage collection trench in accordance with the detail shown on Drawing 3.

3.4.9 At the end of each panel, the overlap will be a minimum of 1000 mm and the geocomposite sheets will be correctly shingled.

3.4.10 Any damage to the geocomposite drainage layer shall be identified and repaired by either cutting out the damaged section and replacing the material or by placing further material beneath the damaged section. The minimum overlap shall be achieved on all edges of the repair.

3.4.11 The lower geocomposite drainage material shall be placed with the cuspated side facing down. Sheets will be installed down the slope using a spreader bar.

3.5 Geomembrane Capping

3.5.1 The geomembrane shall be delivered, handled and stored in accordance with the manufacturer's recommendations.

Each roll of geomembrane delivered to site shall have a label conforming with EN 30320. The label shall be the name, address and telephone number of the manufacturer, product name and type, batch number, date of manufacture and physical dimensions.

3.5.2 The geomembrane shall be securely stored on the designated part of the site in a level, dry and well-drained area such that the material is protected from:

(a) site traffic;
(b) standing water;
(c) UV radiation;
(d) extreme temperature ($<0^{O}C$ $>60^{O}C$);
(e) animal and plant infestation;
(f) chemicals;
(g) puncture;

(h) any other environmental condition that could impact on its physical properties.

3.5.3 The capping geomembrane layer will be fabricated from 1mm thick, textured linear low density polyethylene (LLDPE) as Specified in Section 4.4.

3.5.4 The geomembrane material shall be placed over the whole of the area to the lines and levels shown on Drawing 2. However, in the event that additional material meeting the specification is available the limits of the works may be revised a little to accommodate the available materials.

3.5.5 The works shall be supervised and monitored by the CQA Engineer to ensure that the installation is in accordance with the Design Drawings and Method Statement.

3.5.6 Prior to the delivering any geomembrane material to site the Contractor shall supply a statement from the manufacturer showing that the minimum requirements set out in this Specification can be met by the proposed material.

3.5.7 The Contractor shall supply a manufacturers quality control certificate for each roll of material delivered to site. If the Quality Control Certificate shows that any roll does not meet any one of the minimum requirements listed in Section 4.4, then that particular roll will be rejected.

3.5.8 The Contractor will be required to cut off and discard the first lap of each and every roll. This material may be used for test welds only and shall not for part of the works and shall not be used for quantitative testing.

3.5.9 Geomembrane rolls delivered to site will be subjected to a sampling regime as described in Section 5.4.1

3.5.10 Prior to the commencement of installation the Contractor shall submit to the CQA Engineer a detailed Method Statement which shall include the:

(a) proposed seaming technique or techniques and their proposed applications for a textured geomembrane. It should be noted that only thermal methods are permissible and the CQA Engineer will require double track fusion welding to be carried out wherever practical. Extrusion welding is to be kept to an absolute minimum.
(b) proposed welding machine and working procedures;
(c) proposed seam overlap and their preparation prior to seaming (see clause 3.5.12);
(d) proposed acceptable temperature ranges (or setting) for extrudate and/or hot wedge welders;
(e) proposed acceptable maximum seaming speed if automated machinery is to be used;
(f) proposed testing techniques;
(g) proposed method of sealing around protruding pipework;
(h) proposed method of connecting capping layer to existing capping geomembrane.

The contractors method statement will become part of the CQA Procedure and a copy will be forwarded to the Environment Agency for approval once approved by the CQA Engineer.

3.5.12 The Contractor shall overlap fusion and extrusion seams a minimum of 150mm. During construction this overlap shall be clearly marked on the edge of the underlying sheet prior to seaming. Failure to maintain the minimum overlap may be cause for rejection of the seam.

3.5.13 The Contractor shall also include in the Method Statement details of the welders to be engaged on the works. The welders are required to hold a current third party certification for welding and installation to a recognised Agency/Industry standard. A typical example is the British Geomembrane Association (BGA) / Thermal Welding Institute (TWI/CSWIP) third party accreditation scheme.

3.5.14 Geomembrane panels shall be installed free from tension or stress and without wrinkles or folds. The panels will be rolled out as close as possible to their final position and will not be dragged into position across the subgrade except where necessary to obtain the correct overlap with adjacent sheets.

3.5.15 Prior to the commencement of installation the Contractor shall submit to the CQA Engineer the proposed panel layout for the geomembrane. The drawing shall show the Contractor's proposed start point and proposed direction of working. The Contractor shall arrange the panels so that seams are aligned parallel to the line of maximum slope (i.e. normal to contours), wherever practicable, in accordance with accepted good practice.

3.5.16 The Contractor shall perform trial seams with each seaming machine and operator at the start of each shift. Trial seams shall also be carried out following any stoppage of more than one hour or where weather conditions have changed sufficiently to affect welding efficiency of the machine.

3.5.17 Trial seams shall be at least 3m long and will be marked with the time, date, temperature (ambient and membrane), welding machine type and welding machine number. On completion of the trial seam, the Contractor shall cut 6 No. 110mm long by 25mm wide field tabs normal to the seam at the start, centre and end of the seam. The tabs shall be subjected to field destructive testing in the peel and shear mode. The test will have failed if any of the 6 tabs fail by anything other than film tear bond mode (ASTM) D6392-99).

3.5.18 If a trial seam fails destructive testing (as specified above) then the seaming machine and operator shall not be allowed to perform field seaming until the deficiencies are corrected and both machine and operator have achieved two consecutive satisfactory trial seams. Trial seaming and destructive testing shall be observed by the CQA Engineer.

In the event that a particular machine fails five times in any 48 hour period then the machine shall not be used on site until it has been returned repaired from the manufacturer.

3.5.19 The Contractor shall perform field seams only after satisfying the trial seam conditions as specified above. The Contractor shall ensure that following procedures are carried out to the satisfaction of the CQA Engineer:

(a) all pre-treatment measures (e.g. grinding and cleaning);
(b) extrudate and/or wedge temperatures or settings are maintained within a range approved by the CQA Engineer.

3.5.20 Seaming of the sheets shall be carried out as soon as possible after the sheets have been laid.

3.5.21 The Contractor is not permitted to carry out any welding operations above ponded water, saturated soils or frozen ground. Seaming is not permitted during rain or snow unless proper precautions are taken which allow the seam to be made on dry geomembrane materials. Any seaming undertaken below 5ºC or above 35ºC should be demonstrated to be of the same standard as that undertaken between 5ºC and 35ºC.

3.5.22 Sheets shall be rolled out as closely as possible to the position in which they will eventually lie. For maximum cleanliness, unrolled sheets or groups of welded sheets shall not be dragged across the site. The geomembrane shall be suitably weighted down once installed on the slope, including all sheets to be subsequently welded.

3.5.23 All exposed edges of the geomembrane shall be suitably weighted down at the end of the working day.

3.5.24 Excessive creases or folds left in the geomembrane after welding shall be cut out and rewelded with the insertion of a fillet if necessary, but care should be taken during deployment of the geomembrane to keep the necessity for such repairs to a minimum.

3.5.25 Anchor trenches shall be constructed in accordance with the Design Drawings to allow the edges of the geomembrane to be securely fixed in position.

3.5.26 All field seams shall be completed to the back edge of the anchor trench (i.e. the edge furthest away from the slope or toe bund). Any seam defects falling within the anchor trench shall be suitably repaired.

3.5.27 All discontinuities in the geomembrane (whether caused by damage, failure of the geomembrane or seams which fail to conform with the Method Statement, sampling and testing, or other factors) shall be repaired by the Contractor in the following manner:

Point Defects

3.5.28 The area shall be suitably prepared and an extra layer of extrudate applied.

Large Fault

3.5.29 The faulted area shall be cut back to remove all imperfections and shall be overlain with a single piece of compatible geomembrane to give a minimum overlap of 100mm in all directions. The area shall then be suitably prepared and seamed.

Seam Faults

3.5.30 Faulty extrusion seams shall be overlain with a single piece of compatible geomembrane with a minimum overlap of 100mm in all directions to form a cap strip. The repair shall then be completed in accordance with the requirements for large faults.

3.5.31 Faulty fusion seams shall be cut back to remove the upper flap. The area to be repaired shall be suitably prepared and extruded.

3.5.32 The Contractor shall test all repairs in accordance with the test methods stated in Sections 5.5 and 5.6

3.6 Upper Geocomposite Drainage Layer

3.6.1 The geocomposite shall be delivered, handled and stored in accordance with the manufacturer's recommendations.

Each roll of geocomposite delivered to site shall have a label conforming with EN 30320. The label shall be the name, address and telephone number of the manufacturer, product name and type, batch number, date of manufacture and physical dimensions.

3.6.2 The geocomposite shall be securely stored on the designated part of the site in a level, dry and well-drained area such that the material is protected from:

(a) site traffic;
(b) standing water;
(c) UV radiation;
(d) extreme temperature ($<0^{O}C$ $>60^{O}C$);
(e) animal and plant infestation;
(f) chemicals;
(g) puncture;
(h) any other environmental condition that could impact on its physical properties.

3.6.3 The upper geocomposite drainage layer shall comprise a cuspated HDPE core thermally bonded to a filter geotextile on both sides and shall meet the requirements of Section 4.5. The geocomposite layer at the free edge shall be secured the weight of overlying restoration soils.

3.6.4 The geocomposite drainage material shall be installed in accordance with the manufacturer's recommendations. A copy of the manufacturer's installation recommendations will be provided by the lining contractor to the employer and CQA Engineer prior to works commencing. Works will not commence until the installation method is agreed.

3.6.5 All fixing and cutting details adopted for the geocomposite drainage material shall be in accordance with the manufacturer's instructions. Adjacent sheets of the geocomposite shall be installed such that either the cores of each adjacent sheet are abutting each other or that the sheets are overlapped such that the upslope sheet overlies the downslope sheet (ie shingled like a slate roof). The geotextile flap on the edge of adjacent drainage sheets shall be extended across the joint shiplap style. Jointing of the sheets shall be carried out as soon as possible after the sheets have been laid.

3.6.6 Geocomposite panels shall be installed free from tension or stress and without wrinkles or folds. The panels will be rolled out as close as possible to their final position and will not be dragged into position across the subgrade except where necessary to obtain the correct overlap with adjacent sheets.

3.6.7 All exposed edges of the geosynthetic sheets shall be suitably weighted down at the end of the working day and the contractor must accept full responsibility for the adequacy of the temporary fixing.

3.6.8 The upper geocomposite drainage material shall be placed with the cuspated side facing up. Sheets will be installed down the slope using a spreader bar.

3.6.9 At the beginning and end of each panel, the overlap width shall be a minimum of 1000 mm. Any drainage layer sheets installed with overlaps less than the minimum overlap will be rejected.

3.6.10 At intervals down the slope – as indicated on the drawings – the surface water collection geocomposite will fold around a water collection drain comprising perforated structured pipes.

3.6.11 Any damage to the geocomposite drainage layer shall be identified and repaired by either cutting out the damaged section and replacing the material or placing further material beneath the damaged section. The minimum overlap shall be achieved on all edges of the repair.

3.6.12 The upper geocomposite drainage pipes will discharge into the surface water collection ditches, which will be tied into the existing surface water collection system.

3.7 Restoration Soils

3.7.1 Suitable soils meeting the requirements of Section 4.6 will be placed directly over the upper drainage geocomposite. The restoration soil placement shall be undertaken in such a way that the material will not damage the underlying capping system.

3.7.2 The soils will be free of any timber, steelwork or similar material likely to penetrate the capping system. A stockpile of material will be maintained on site for use in the works

3.7.3 The soil placement works shall be monitored by the CQA Engineer.

3.7.4 The soils shall be placed in a single loose lift with light compaction being achieved by the machine tracks. Compaction plant shall not be used. As with all cover materials, placement will commence at the base of the slope and move progressively uphill.

3.7.5 In the event that Amgen does not have readily available soils that are suitable to overlie the upper geocomposite directly then a blinding layer of selected materials will be placed in a 100 - 300mm thick layer over the geocomposite. The CQA Engineer will examine the proposed blinding layer materials and will approve these if cylinder testing reveals that they are suitable for placing directly against the synthetic layer.

3.7.6 The upper surface of the soil restoration layer will be profiled to form surface water runoff collection grips. These will pass across the sloping cap at a very shallow gradient as shown on Drawing 3. Wherever the grip exceeds an invert gradient of 1 in 10 the grip shall be lined with a degradable jute fabric to prevent soil erosion.

4. MATERIAL REQUIREMENTS

4.1 Leachate Drainage Stone

4.1.1 Stone used to fill the trench shall be hard, clean, crushed rock or gravel and shall conform to the requirements contained in Table 1 below:

TABLE 1 – LEACHATE DRAINAGE STONE SPECIFICATION

Material Property	Test Method	Requirement
Particle Size Distribution	BS 1377 Part 2 Method 9 BS 13242	Material passing sieve: 63mm ------ 98 to 100% 40mm 80 to 100% 31.5mm 20 to 90% 20mm 0 to 20% 10mm 0 to 5%
10% Fines Value	BS 812 Part III	>100KN

4.2 Regulating Layer Fill

4.2.1 The fill used to form the regulating layer shall be a natural or recycled aggregate or fill and shall conform to the requirements contained in Table 2 below:

TABLE 2 – REGULATING LAYER FILL SPECIFICATION

Material Property	Test Method	Requirement
Particle Size Distribution	BS 1377 Part 2 Method 9	Material passing sieve: 63mm ------ 100% 40mm 50 to 100% 10mm 50 to 100% 2mm 30 to 100% 0.6mm 10 to 70%

4.3 Lower Geocomposite Layer

4.3.1 The lower geocomposite drainage layer shall conform to the requirements set out in Table 3 below:

TABLE 3 – SPECIFICATION FOR GEOCOMPOSITE DRAINAGE LAYER

Properties	Test Method	Requirements
Tensile strength MD/XD average Geocomposite Geotextile	EN ISO 10319	 19 kN/m 8 kN/m
CBR puncture resistance Geocomposite Geotextile	BS EN ISO 12236	 3 KN 1.3 KN
In plane water flow (min) Hydraulic gradient =1.0 100 kPa 200 kPa	EN ISO 12958	 0.5 l/s/m (min. ave.) 0.35 l/s/m (min. ave.)
Pore size of geotextile (mean) Mean Pore Size O_{90}	EN ISO 12956	0.115 mm $\pm$ 30%

4.4 Capping Geomembrane

4.4.1 The geomembrane shall conform to the requirements set out in Table 4 below:

TABLE 4 – SPECIFICATION FOR TEXTURED LLDPE GEOMEMBRANE

Properties	Test Method	Requirements	MQC Test Frequency
Thickness (min)	ASTM D5994	0.95mm (min. ave) 0.90mm (lowest of 8 of 10) 0.85mm (lowest individual of 10)	Per roll
Density (max)	DIN EN ISO 1183-1/A	0.939g/ml (maximum)	Per 90,000kg
Asperity Height (min)	GRI-GM 12	0.2mm (min. ave)	Every second roll
Tensile Properties average of 5 MD and 5 XMD	DIN EN ISO 527-3 (Type 5:100mm/min; Lo = 50mm)		
Strength at Break (min)		12 MPa	Per 90,000kg
Elongation at Break (min)		250% (min. ave)	Per 90,000kg
Tear Resistance (min. ave)	DIN ISO 34-1/B	100N (min. ave)	Per 20,000kg
Puncture Resistance (min. ave)	ASTM D4833-07	300N (min. ave)	Per 20,000kg
Carbon Black Content (range)	ASTM D1603 (ASTM D4218 if correlation with D1603 can be established)	2.0% min to 3.0% max	Per 20,000kg
Carbon Black Dispersion (min)	ASTM D5596	9 of 10 in Category 1 or 2 and 1 in Category 3	Per 20,000kg
Oxidative induction time (min)	Standard OIT by ASTM D3895	100minutes (min. ave)	Per 90,000kg
UV Resistance	High pressure OIT by ASTM 5885, GRI-GM11	35% retained after 1600hrs (min. ave)	Per batch

4.5 Upper Geocomposite Drainage Layer

4.5.1 The upper geocomposite drainage layer shall conform to the requirements set out in Table 5 below:

TABLE 5 – SPECIFICATION FOR UPPER GEOCOMPOSITE DRAINAGE LAYER

Properties	Test Method	Requirements
Tensile strength (longitudinal) Geocomposite Geotextile	EN ISO 10319	 19 kN/m 8 kN/m
CBR puncture resistance Geocomposite Geotextile	BS EN ISO 12236	 3 KN 1.3 KN
In plane water flow(min) Hydraulic gradient =1.0 100 kPa 200 kPa	EN ISO 12958: 1997	 0.5 l/s/m (min. ave.) 0.35 l/s/m (min. ave.)
Pore size of geotextile Mean Pore Size O_{90}	BS EN 12956	0.1 mm (min. ave.)

4.6 Restoration Soil Layer

4.6.1 The soil used to form the restoration layer shall be a natural geological material (soil or crushed rock) and shall conform to the requirements contained in Table 6 below. In the event that available sources have coarser constituents then either the soils will be placed above a blinding layer meeting this grading or a cylinder test will be undertaken to evaluate suitability. In the event that the materials are won from sites that are not greenfield sites then the chemistry of the soils shall be shown to be suitable for the proposed works by a review of source contamination reports.

TABLE 6 – RESTORATION SOIL LAYER

Material Property	Test Method	Requirement
Particle Size Distribution	BS 1377 Part 2 Method 9	Material passing sieve: 40mm ------ 100% 10mm 50 to 100% 2mm 30 to 100% 0.6mm 10 to 70%

4.7 Pipe Boot Pipework

4.7.1 Pipe boots will be fabricated on-site by the welding crew by welding a 600mm diameter annulus of geomembrane around a 315mm diameter HDPE pipe. The pipe shall be 315mm diameter SDR 17 PE80 black pipe 1100mm long with the annulus welded to the bottom of the pipe, as shown on Figure 3. The gas management contractors will fill the space between their landfill gas extraction pipe and the pipe boot with bentonite pellets after the capping works are complete.

5. SAMPLING AND TESTING REQUIREMENTS

5.1 Leachate Drainage Stone

5.1.1 The potential source of the drainage stone shall be evaluated by undertaking a series of three source evaluation tests. Should the material conform to Section 4.1 then the material can be brought to site and thereafter sampled at a frequency of 1 sample per 250 tonnes delivered.

5.1.2 The leachate drainage stone shall be tested in accordance with the requirements of Table 7.

TABLE 7 – LEACHATE DRAINAGE STONE TESTING REQUIREMENTS

Material Property	Test Method	CQA Test Frequency
Particle Size Distribution	BS 1377 Part 2 Method 9	1/250 tonnes
10% Fines Value	BS 812 Part III	1/250 tonnes

5.2 Regulating Layer Fill Material

5.2.1 The potential source of the regulating layer fill shall be evaluated by undertaking a series of three source evaluation tests. Should the material conform to Section 4.2 then the material can be brought to site and thereafter sampled at a frequency of 1 sample per 1000 tonnes delivered.

5.2.2 The regulating layer fill shall be tested in accordance with the requirements of Table 8.

TABLE 8 – REGULATING LAYER TESTING REQUIREMENTS

Material Property	Test Method	CQA Test Frequency
Particle Size Distribution	BS 1377 Part 2 Method 9	1/1000 tonnes

5.3 Geocomposite Drainage Materials

5.3.1 The Contractor will be required to cut 1m wide conformance samples from the full width of rolls at a frequency of 1 sample per 5000m^2 of geocomposite delivered to site.

5.3.2 The contractor will be required to submit one part of each sample to an approved independent laboratory for quantitative analysis and will only be permitted to incorporate materials into the works if this testing reveals that the material meets the requirements of Section 4.3. The laboratory shall be independent of the Contractor and shall be UKAS accredited for each individual test to be undertaken. All of the parameters listed in Table 9 shall be tested at the frequency specified. The Contractor shall furnish to the CQA Engineer a copy of the laboratory test results immediately on receipt.

TABLE 9 –GEOCOMPOSITE DRAINAGE LAYER TESTING REQUIREMENTS		
Properties	**Test Method**	**CQA Test Frequency**
Tensile strength MD/XD average Geocomposite Geotextile	EN ISO 10319	1/5000m^2 NR
CBR puncture resistance Geocomposite Geotextile	BS EN ISO 12236	 1/5000m^2 NR
In plane water flow (min) Hydraulic gradient =1.0 100 kPa 200 kPa	EN ISO 12958	 1/10000m^2 NR
Pore size of geotextile (mean) Mean Pore Size O_{90}	EN ISO 12956	 1/10000m^2

5.3.3 In the event that a conformance test fails to meet the requirements of the Specification that roll shall be rejected and will not be incorporated into the works. The rolls numbered numerically on either side of the failed sample will then be subjected to conformance testing. This procedure will continue until the extent of the sub-specification material has been determined by bracketing. The contractor will supply any replacement rolls at his own cost. Construction of the drainage layer will not commence until the results of the conformance tests are known and have been accepted by the CQA Engineer.

5.4 Geomembrane Conformance Sampling and Testing

5.4.1 The Contractor will be required to cut 1m wide conformance samples from the full width of rolls:

- At a frequency of 1 sample per 5000m^2 of membrane delivered to site from within the same batch
- So that rolls from every batch of membrane are sampled

5.4.2 The contractor will be required to submit one part of each sample to an approved independent laboratory for quantitative analysis and will only be permitted to incorporate materials into the works if this testing reveals that the material meets the Specification in Section 4.4 The laboratory shall be independent of the Contractor and shall be UKAS accredited for each individual test to be undertaken. All of the parameters listed in Table 10 shall be tested. The Contractor shall furnish to the CQA Engineer a copy of the laboratory test results immediately on receipt.

5.4.3 In the event that a conformance test fails to meet the requirements of the Specification that roll shall be rejected and will not be incorporated into the works. The rolls numbered numerically on either side of the failed sample will then be subjected to conformance testing. This procedure will continue until the extent of the sub-specification material has been determined by bracketing. The contractor will supply any replacement rolls at his own cost. Construction of the capping membrane will not commence until the results of the conformance tests are known and have been accepted by the CQA Engineer.

TABLE 10 –TEXTURED LLDPE GEOMEMBRANE TESTING REQUIREMENTS		
Properties	**Test Method**	**CQA Test Frequency / Value**
Thickness (min)	ASTM D5994-10	1/5000m^2
Density (max)	ASTM D1505-10/D792	1/5000m^2
Asperity Height (min)	GRI GM 12	1/5000m^2
Tensile Properties average of 5 MD and 5 XMD Strength at Break (min) Elongation at Break (min)	ASTM D6693, Type IV 50mm gauge length at 50 mm/min	1/5000m^2 1/5000m^2 1/5000m^2
Tear Resistance (min)	ASTM D1004-13	
Puncture Resistance (min)	ASTM D4833-07	1/5000m^2
Carbon Black Content (range)	ASTM D1603-12 (ASTM D4218 if correlation with D1603 can be established)	1/5000m^2
Carbon Black Dispersion (min)	ASTM D5596-03	1/5000m^2
Oxidative induction time (min)	Standard OIT by ASTM D3895-07	1/5000m^2

5.5 Geomembrane Seam Non-destructive Sampling and Field Testing

5.5.1 The Contractor shall perform non-destructive testing along the entire lengths of all field seams including patches and repairs. The Contractor shall submit to the CQA Engineer, for approval, a Method Statement detailing his proposed non-destructive test technique or techniques.

5.5.2 The non-destructive testing shall include as a minimum:

- Double track fusion welds – air pressure test carried out on all welds
- Extrusion welds – vacuum box test carried out on all welds

5.5.3 During air pressure tests the channel between the two tracks of the fusion welder shall be inflated to a pressure of between 1.9 and 2.2 bar. After an initial stabilisation period of 1 minute the pressure shall not decrease by more than 10% in 5 minutes. The pressure will be released from the opposite end of the channel to the inflation needle to verify seam continuity.

5.5.4 During vacuum tests a vacuum of -0.4 bar shall be applied after the box is seated over the prepared seam. The seam will be viewed for a full 30seconds before releasing the vacuum and moving along the seam. A minimum overlap of 50mm is required between adjacent box positions along the seam.

5.5.5 In the event of a field seam failing non-destructive testing (including the air pressure continuity test), the Contractor shall identify and repair the failed area. The Contractor shall then subject the repair to further non-destructive testing. Seams will not be accepted until they pass the non-destructive test, the qualitative destructive test and the quantitative destructive test (if relevant).

5.5.6 The Contractor shall advise the CQA Engineer when non-destructive testing is ready to commence and shall not perform any testing in the absence of the CQA Engineer.

5.6 Geomembrane Seam Qualitative Destructive Sampling and Field Testing

5.6.1 The Contractor shall cut a 25mm wide field tab from the beginning and end of each field seam and subject it to qualitative destructive testing in peel and shear modes using a suitable field tensiometer or hand tools.

5.6.2 The field seam will be deemed to have passed the qualitative destructive testing if:

(a) the failure occurs solely in the parent material and does not enter the seam.

5.6.3 The seam will be deemed to have failed qualitative destructive testing if:

(a) any of the failure enters the seam.

5.6.4 If the seam fails the qualitative destructive testing, the Contractor shall either:

(a) reconstruct the seam between two field tabs which have been shown to pass the qualitative destructive testing; or
(b) take further qualitative tests to identify the area of the field seam that is deemed as inadequate.

5.6.5 The Contractor shall undertake further qualitative testing by cutting further tabs on either side of the location of the failed field tab. The additional tabs shall be taken approximately 3 metres from the location of the failed tab. These further field tabs shall be subjected to qualitative destructive testing in accordance with the Method Statement. If both tabs pass the qualitative destructive testing, then the Contractor shall cut a laboratory sample from a section of the passed seam. If either sample fails, the Contractor shall cut and test further field tabs approximately 3 metres from the location of the failure until he can identify an area bounded by two passed field tabs.

5.6.6 The Contractor shall reconstruct the failed seam between the locations of the passed tabs in accordance with the Method Statement.

5.6.7 The CQA Engineer reserves the right to request the cutting and destructive testing of further field tabs at any locations along the length of a seam.

5.7 Geomembrane Seam Quantitative Destructive Sampling and Laboratory Testing

5.7.2 The Contractor shall cut laboratory samples from the field seams when instructed by the Engineer and in any case at a frequency of not less than 1 sample per 200m of

seam performed by an individual machine. Where instructed by the CQA Engineer, the Contractor shall cut two samples from the field seam at the same location and provide one sample to the CQA Engineer for retention.

5.7.3 The Contractor shall without delay despatch a sub-sample to an approved geosynthetic laboratory for destructive testing in accordance with the Specification. The laboratory shall report quantitative results and the mode of failure for the tests carried out. The Contractor shall issue copies of the test result certificates to the CQA Engineer immediately upon receipt.

5.7.4 The seam will be deemed to have passed quantitative destructive testing if the:

(a) failure occurs solely in the parent material and does not enter the seam;
(b) peel strength exceeds or equals the tensile strength indicated in the specification;
(c) shear strength exceeds or equals the tensile strength indicated in the specification.

5.7.5 The seam will be deemed to have failed quantitative destructive testing if:

(a) any laboratory tabs fails an individual test;
(b) any of the failure enters the seam;
(c) the peel strength is less than the tensile strength indicated in the Specification;
(d) the shear strength is less than the tensile strength indicated in the Specification.

5.7.6 If a seam fails the quantitative destructive testing, the Contractor shall investigate the seam to each side of the failed sample. The Contractor shall cut further laboratory samples from each side of the failed section and perform laboratory tests upon them until the failed seam is bounded by two passed locations. The Contractor shall then reconstruct the failed seam in accordance with the approved Method Statement.

5.8 Quantitative Destructive Testing – Geocomposite Drainage Material

5.8.1 The Contractor will be required to cut 1m wide conformance samples from the full width of rolls at a frequency of 1 sample per 5000m^2 of geocomposite delivered to site

5.8.2 The contractor will be required to submit one part of each sample to an approved independent laboratory for quantitative analysis and will only be permitted to incorporate materials into the works if this testing reveals that the material meets the requirements of Section 4.5. The laboratory shall be independent of the Contractor and shall be UKAS accredited for each individual test to be undertaken. All of the parameters listed in Table 11 shall be tested. The Contractor shall furnish to the CQA Engineer a copy of the laboratory test results immediately on receipt.

5.8.3 In the event that a conformance test fails to meet the requirements of the Specification that roll shall be rejected and will not be incorporated into the works. The rolls numbered numerically on either side of the failed sample will then be subjected to conformance testing. This procedure will continue until the extent of the sub-specification material has been determined by bracketing. The contractor

will supply any replacement rolls at his own cost. Construction of the drainage layer will not commence until the results of the conformance tests are known and have been accepted by the CQA Engineer.

TABLE 11 –GEOCOMPOSITE DRAINAGE LAYER TESTING REQUIREMENTS		
Properties	**Test Method**	**CQA Test Frequency**
Tensile strength MD/XD average Geocomposite Geotextile	EN ISO 10319	1/5000m^2 NR
CBR puncture resistance Geocomposite Geotextile	BS EN ISO 12236	 1/5000m^2 NR
In plane water flow (min) Hydraulic gradient =1.0 100 kPa 200 kPa	EN ISO 12958	 1/10000m^2 NR
Pore size of geotextile (mean) Mean Pore Size O_{90}	EN ISO 12956	 1/10000m^2

5.9 Blinding Layer Fill Material

5.9.1 The potential source of the blinding layer shall be evaluated by undertaking a series of three source evaluation tests.

5.9.2 The blinding layer shall be tested in accordance with the requirements of Table 12.

TABLE 12 – BLINDING LAYER TESTING REQUIREMENTS		
Properties	**Test Method**	**Testing Requirements**
Particle Size Distribution	BS1377 Part 2 Method 9	1/1000 tonnes

5.10 Restoration Soil

5.10.1 The potential source of restoration soils shall be evaluated by undertaking a series of three source evaluation tests. Should the material conform to Section 4.6 and be chemically suitable for its purpose then it may be delivered to site as an approved source.

5.10.2 The restoration soils shall be tested in accordance with the requirements of Table 13.

TABLE 13 – RESTORATION SOIL TESTING REQUIREMENTS		
Properties	**Test Method**	**Testing Requirements**
Particle Size Distribution	BS1377 Part 2 Method 9	1/2000 tonnes
Chemical Test	Inert WAC	1/2000 tonnes

6. CQA ARRANGEMENTS

6.1 CQA Personnel

6.1.1 Personnel from Geotechnology shall carry out various quality control procedures during construction of the capping works and all personnel shall have relevant experience in landfill construction and earthworks control. Geotechnology shall provide full time, independent supervision for the duration of the works. Supervisory staff shall include a full time CQA Engineer for the duration of the capping works. The anticipated personnel to be involved in the Phase 3b capping works are listed below but suitable substitution, using personnel with equivalent experience, may be made due to unavailability:

CQA Engineer Ewan Thomas/Ben Rees/Arwel Jones/Keir Thomas

6.1.2 The main duties of the CQA Engineer shall be:

(a) to supervise the construction of the capping works to ensure compliance with all aspects of this Method Statement and the Design;
(b) to supervise and check all surveying or other such procedures involved in the recording of the works;
(c) to keep full daily records of all site operations, testing and site conditions. The records shall be used to provide certification of the preparatory and engineering works and shall be made available to the Environment Agency if and when required.
(d) Liaison with EA staff and the Employer

6.1.3 Examples of the site record proformas are included in Appendix A of this Method Statement and Quality Plan.

6.1.4 A daily meeting shall be held on site between the CQA Engineer and the Contractor.

6.1.5 The purpose of the daily meeting is to:

(a) review the work activity and location for the day;
(b) note the contractor's installation personnel for the day/shift;
(c) review the previous days work activity;
(d) review the work schedule;
(e) discuss any interfacing with other contractors/site operations;
(f) discuss/highlight any problems and solutions.

6.1.6 The CQA Engineer shall report weekly in summary form to the Environment Agency and will highlight any unusual or unexpected occurrences immediately for discussion. Full records shall be kept by the CQA Engineer on a day to day basis detailing all site operations, tests carried out and the site conditions. The records will be made available for inspection by representatives of the Environment Agency.

6.2 Site Visits

6.2.1 It is anticipated that the Environment Agency will periodically visit the site during the construction works. During these visits, the CQA Engineer supervising the works shall make available to the Environment Agency all test results compiled to date.

6.3 Design Changes

6.3.1 Any significant design changes, required to ensure the suitability of the construction works, shall be referred to the Environment Agency for approval.

6.4 Validation Report

6.4.1 Following completion of the capping works, the CQA Engineer will report fully on the quality control testing undertaken during construction. The report will constitute a Compliance Document and will include details of construction quality control assurance, the testing carried out and the results obtained together with an assessment of the works in relation to this Method Statement. In addition, copies of photographic records, as built drawings, including repairs, and test location plans will be included in the Validation Report.

CQA METHOD STATEMENT AND QUALITY PLAN

PHASE 4A CAPPING WORKS

Bryn Pica Landfill Site

Appendix A
CQA Proformas

Report Number 1384r1v1d0714

Daily Site Record Sheet

CQA1

Site:	Bryn Pica 4A	Date:	

CQA Staff		On Site From / To	
Weather			

Contractors Plant and Personnel	Hours of Operation	Comments

Prepared by:		Signed:	

Surface Condition Record

CQA2

Site:	Bryn Pica 4A	Surface:	Regulating Layer	Material:	

Date	Location	Total Area	1m Lath	3m Lath	Strength	Pass/Fail	Comment	Non-Con No

Subgrade Acceptance Record CQA3

Site:	Bryn Pica Phase 4A	Date:	07/09/2011

Area of Subgrade Under Consideration
The subgrade for the geosynthetic elements has been prepared in accordance with the Specification and its surface has been inspected visually. Testing has confirmed that this part of the subgrade has an acceptably smooth finish and survey work has shown the surface has been prepared to the correct line and level. There is no evidence of soft spots, ponded water, ice, snow, frozen ground, peat, vegetation, stones, rocks or any protrusions. Both the CQA Engineer and the Contractors Representative consider that the area is suitable for lining works to proceed and the Contractor accepts responsibility to maintain the subgrade in this condition until covered with lining materials.

Engineer		Signature	

Contractor		Signature	

Geosynthetic Materials Inventory

CQA4

Site	Bryn Pica Phase 4A	Manufacturer & Material Type	

Date	Batch No	Roll No	Length	Width	MQC Received?	MQC Pass?	Sample Number	Handle Store	Visual Check	Approved

Geosynthetic Panel Deployment

CQA5

Site:	Bryn Pica 4A	Material:	HDPE DRS 1mm	Installer:	

Date	Roll No	Panel No	Thickness L	Thickness R	Thickness F	Thickness B	Length	Width	Visual Check	Non-Con No

Geomembrane Seam Construction

CQA6

Site:	Bryn Pica Phase 4A	Membrane:		Installer:	

Date	Seam No	Panel Nos	Length	Machine	Operator	DS Number	NDT Type	APT Start	APT Finish	Approved

Geosynthetic Repair Record

CQA7

Site:	Bryn Pica Phase 4A	Material:		Installer:	

Date	Repair No	Location	Defect Type	Repair Type	Machine	Operator	NDT	Test Time	Pass/Fail	Approved

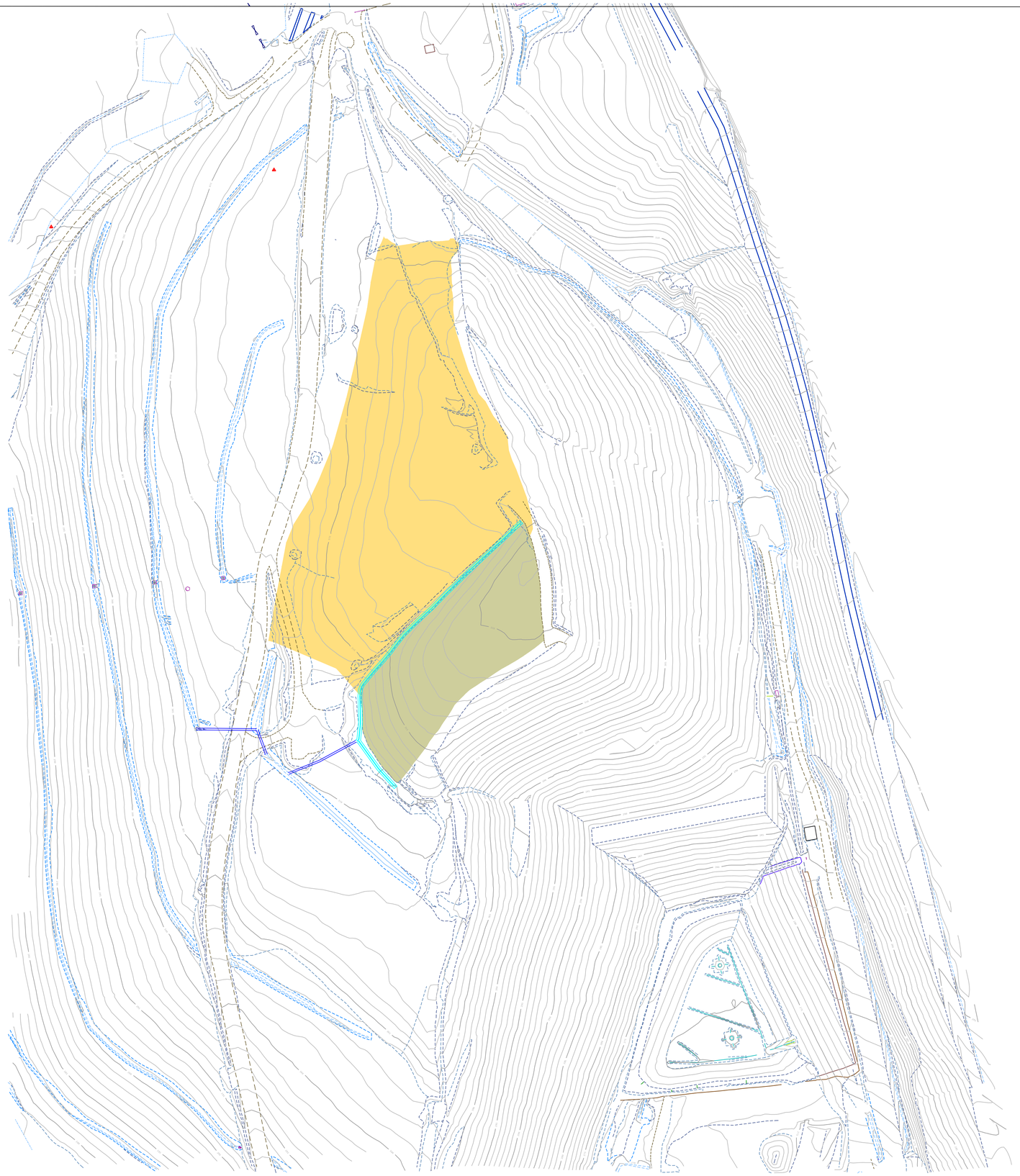
CQA METHOD STATEMENT AND QUALITY PLAN

PHASE 4A CAPPING WORKS

Bryn Pica Landfill Site

Appendix B Drawings

Report Number 1384r1v1d0714



Legend

- Phase 4A Cap (proposed)
- Phase 3B Cap (completed)
- Drainage Channel

AMGEN CYMRU
BRYN PICA
LLWYDCOED
ABERDARE
CF44 OBX

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FAX: 01685 874684

AMGEN Cymru
ALTERNATIVE SOLUTIONS IN WASTE MANAGEMENT

BRYN PICA LANDFILL CAPPING PHASE 4A

General Site Plan

DRAWING NUMBER	REVISION
1384r1v1d0714/1	0

SCALE	DATE	DRAWN	CHECKED
1:1000	07.14	ET	

Geotechnology
Ty Coed, Cefn-yr-Allt,
Aberdulais, Neath
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01639 775293
www.geotechnology.net

GEO TECHNOLOGY

Tie In To Phase 3b

Free Edge

Free Edge

Tie In To Phase 1

B

B

E

E

Legend

- Provisional Capping Area
- Surface Water Drainage
- Water Flow Direction

AMGEN CYMRU
BRYN PICA
LLWYDCOED
ABERDARE
CF44 OBX

TEL: 01685 870770
FAX: 01685 874684

AMGEN Cymru
ALTERNATIVE SOLUTIONS IN WASTE MANAGEMENT

BRYN PICA LANDFILL CAPPING PHASE 4A

General Site Plan

DRAWING NUMBER	REVISION
1384r1v1d0714/2	0

SCALE	DATE	DRAWN	CHECKED
1:400	07.14	ET	

Geotechnology
Ty Coed, Cefn-yr-Allt,
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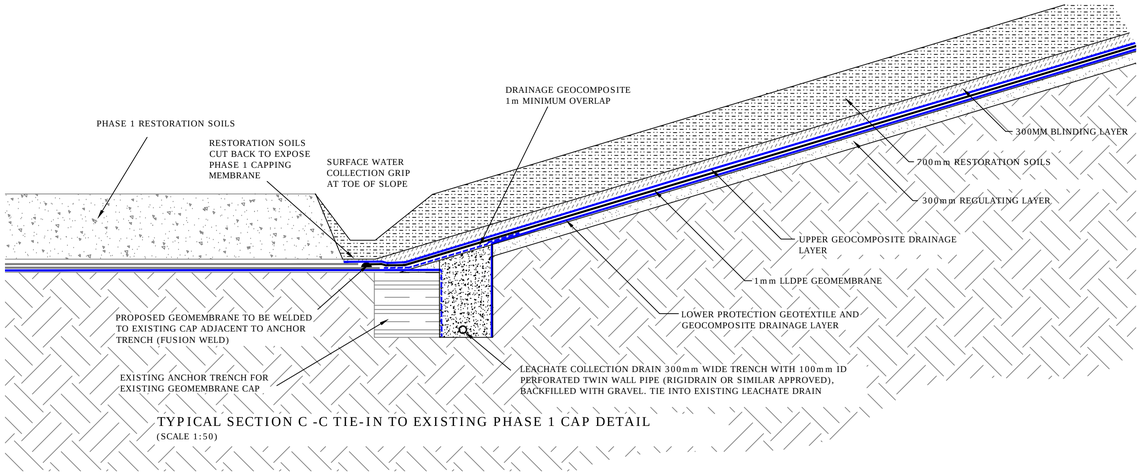
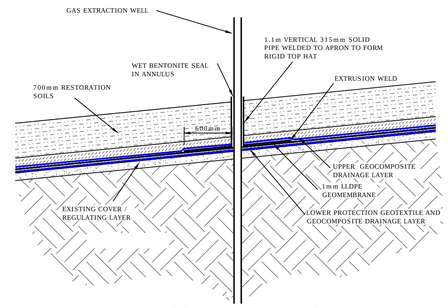
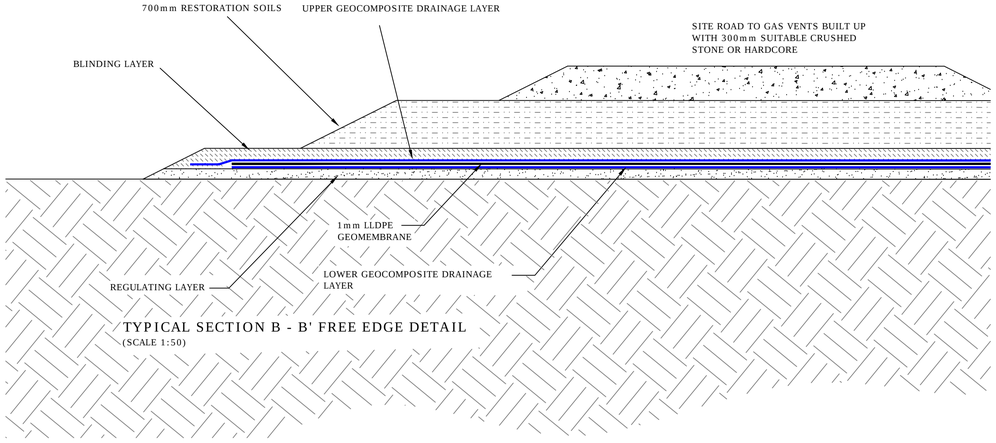
geo TECHNOLOGY



TYPICAL SECTION C -C TIE-IN TO EXISTING PHASE 1 CAP DETAIL
(SCALE 1:50)



CAPPING DETAIL 'TOP HAT' AT EXISTING GAS EXTRACTION WELL
(SCALE 1:50)



TYPICAL SECTION B - B' FREE EDGE DETAIL
(SCALE 1:50)

Legend

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BRYN PICA LANDFILL
CAPPING PHASE 4A

CONSTRUCTION DETAILS

DRAWING NUMBER	REVISION
1384r1v1d0714/3	0

SCALE	DATE	DRAWN	CHECKED
As Shown	07.14	ET	

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