Wressle Wellsite Extension

Construction Quality Assurance Plan

Environmental Permitting (England and Wales) Regulations 2016

- Application to Vary Mining Waste Operation
- Application to Vary Water Discharge Activity
- Application to Vary Groundwater Activity
- Application for a New Installation for Gas Refining Activity

ISSUE No.	Description
240318	Draft for Client Review
240501	First Issue for Permit Application

Contents

1. Purpose and Context 5
2. Scope 5
3. Abbreviations and Definitions 6
4. Industry Quality Standards and Requirements 7
4.1 Legislative and Industry Quality Standards and Requirements 7
4.1.1 Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works 7
4.1.2 600 Series 7
4.1.3 LFE2 Cylinder Testing Geomembranes and their Protective Media 7
4.1.4 LFE5 Using Geomembranes in Landfill Engineering 7
4.1.5 LFE7 Using Non-Woven Geotextiles in Landfill Engineering 7
4.1.6 CIRIA 736 Containment Systems for the Prevention of Pollution 8
5. Roles and Responsibilities 9
6. Construction Quality Assurance 11
6.1 Scope of Works 11
6.1.1 Existing Working Platform 11
6.1.2 Extension to Existing Working Platform 11
6.2 Distribution of the Construction Quality Assurance Plan 12
6.3 Alterations to the Construction Quality Assurance Plan 12
6.4 Reviewing and Revising the Construction Quality Assurance Plan 12
7. Installation of the Secutex R301 Geotextile 13
7.1 CAQ Engineer 13
7.2 Secutex R301 Geotextile Manufacture 13
7.3 Delivery of the Secutex R301 Geotextile 13
7.4 Unloading Operations 14
7.5 Storage Arrangements 14
7.6 Conformance Testing 14
7.7 Subgrade Preparation 16
7.8 Secutex R301 Geotextile Placement 16
7.9 Protection of the Secutex R301 Geotextile 17
8. Installation of 2mm HDPE FML 18
8.1 CAQ Engineer 18
8.2 Delivery 18
8.2.1 Unloading Operations 19
8.3 Storage Arrangements 19
8.4 Conformance Testing 19
8.5 HDPE FML Placement 21
8.6 Trial Seams 22
8.7 Seaming 22
8.7.1 Fusion (Hot Wedge) Welding 23
8.7.2 Fusion (Hot Wedge) Welding 23
8.7.3 Extrusion Welding 24

8.8 Non-Destructive Seam Testing 24
8.8.1 Air Pressure Testing 24
8.8.2 HVE (Spark) Testing 24
8.8.3 Vacuum Box Testing 25
8.9 Qualitative Destruction Seam Testing 25
8.10 Quantitative Destruction Seam Testing 25
8.11 Repair Procedure 26
8.12 Installation Approval 27
9. Installation of the Secutex R801 Geotextile 28
9.1 Installation and Quality Control Procedure 28
9.2 Secutex R801 Manufacture 28
10. Installation of the Screened Blast Furnace Slag 29
10.1 CQA Engineer 29
10.2 Screened Blast Furnace Slag Placement 29
10.3 Plate Bearing Test 29
11. Installation of Perimeter Containment Ditch 30
11.1 CAQ Engineer 30
11.2 Drainage Aggregates 30
11.3 Drainage Stone Testing 31
11.4 Drainage Stone Placement 31
11.5 Drainage Pipework 31
11.6 Drainage Pipework Installation 31
12. Validation Report 32
13. References 33
Appendix 1 – CQA Forms 35
Appendix 2 – Plate Bearing Test Method 51
Appendix 3 – Construction Drawings 54

Tables

Table 1: Abbreviations and Definitions 6
Table 2: Roles and Responsibilities 10
Table 3: Secutex R301 Specification 13
Table 4: Secutex R301 Conformance Sampling and Testing 15
Table 5: HDPE FML Conformance Sampling and Testing 21
Table 6: Peel Strength and Shear Strength Parameters 26
Table 7: Secutex R801 Specification 28
Table 8: Drainage Aggregate Specification 30

1. Purpose and Context

This Construction Quality Assurance Plan has been prepared in support of an application to the Environment Agency to authorise the undertaking of specific 'permitted activities' at the Wressle Wellsite, with the intention of giving the Environment Agency assurance that the Operator will comply with the requirement to use Best Available Technique (BAT).

In accordance with the Environment Agency's onshore oil and gas sector guidance [Ref.1], a number of the permitted activities require containment measures to be deployed at the wellsite, with indicative BAT being the installation of an impermeable liner across all areas of the site before activities commence, the lifespan of materials used being capable of exceeding the lifespan of the site, the use of appropriate construction quality assurance standards for the materials being installed as part of the impermeable liner and checks on the integrity of seals in all areas of the impermeable liner.

2. Scope

This Construction Quality Assurance Plan is applicable to the Wressle Wellsite and all construction activities undertaken therein associated with the wellsite's containment measures.

3. ABBREVIATIONS AND DEFINITIONS

°C:	Degrees Centigrade
°:	Degrees
≥:	Equal to or greater than
“:	Inch – A unit of linear measure equal to one twelfth of a foot (2.54 centimetres)
%:	Percentage – A rate, number, or amount in each hundred.
CQAP:	Construction Quality Assurance Plan
BAT:	Best Available Technique
CWG:	Criteria Working Group series
DEFRA:	Department for Environment, Food & Rural Affairs
EPR 2016:	The Environmental Permitting (England and Wales) Regulations 2016, as amended
g/m^2:	Grams per square metre
g/m^3:	Grams per cubic metre
Ha:	Hectare
HDPE:	High Density Polyethylene
HSE:	Health, Safety and Environmental
kg:	Kilogram
km:	Kilometre
m:	Metre
m^2:	Metre squared
m^3:	Cubic Metre
mm:	Millimetre
MTN:	Material Transfer Note
N:	Newton
NORM:	Naturally Occurring Radioactive Material
OIT:	Oxidative Induction Time
PAHs:	Polycyclic Aromatic Hydrocarbons
PEDL:	Petroleum Exploration and Development Licence
UKAS:	The United Kingdom Accreditation Service
WRAP:	Registered charity that has developed quality protocols jointly with the Environment Agency

Table 1: Abbreviations and Definitions

4. INDUSTRY QUALITY STANDARDS AND REQUIREMENTS

4.1 Legislative and Industry Quality Standards and Requirements

A review of the design and construction methods to be implemented during the construction of an extension to the Wressle-1 wellsite has identified the following industry quality standards and guidance documents applicable to this CQAP:

- Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works [Ref. 2];
- Environment Agency Technical Guidance LFE2 - Cylinder testing geomembranes and their protective materials [Ref. 3];
- Environment Agency Technical Guidance LFE5 – Using geomembranes in landfill engineering [Ref. 4];
- Environment Agency Technical Guidance LFE7- Using non-woven protector geotextiles in landfill engineering [Ref. 5]; and
- Ciria C736 - Containment systems for the prevention of pollution [Ref. 6].

4.1.1 Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works

Volume 1 Specification for Highway Works, developed by the Department for transport, contains the requirements for the work and materials to be used in constructing and maintaining the UK's trunk road network.

4.1.2 600 Series

The 600 Series describes the acceptable materials to be used in earthworks which include recycled and secondary materials and specifies the tests that need to be carried out on them.

The 600 Series details that recycled materials are to contain no more than 1% of contaminants, such as wood, plastic and metal.

Recycled aggregates must be produced in accordance with the WRAP Quality Protocol [Ref. 7] for the production of aggregates from inert waste.

For clarity, the WRAP Quality Protocol sets out end of waste criteria for the production and use of aggregates from inert waste. If the criteria are met, the aggregates will normally be regarded as having been fully recovered and to have ceased to be waste.

The 600 Series also sets out the requirements for other techniques that can be used to increase resource efficiency in earthworks, such as stabilisation with lime and/or cement, use of geosynthetics, soil reinforcement, ground improvement and foundation drainage.

The 600 Series also provides definitions of the types of recycled material that are allowed to be used. It also provides specifications for each class of fill material and example types of material including recycled and secondary materials.

4.1.3 LFE2 Cylinder Testing Geomembranes and their Protective Media

LFE2 is a guidance document developed by the Environment Agency and describes a method for determining the effectiveness of a material in protecting a geomembrane against the long-term mechanical effects of static point loads. The cylinder test method tests performance under the actual conditions likely to be encountered.

4.1.4 LFE5 Using Geomembranes in Landfill Engineering

LFE5 Using geomembranes in landfill engineering is a guidance document developed by the Environment Agency and the British Geomembrane Association covering the use of geomembranes in landfill engineering.

Although the document covers the use of geomembranes in landfill engineering, it can be utilised to cover the use of geomembranes in other industries including onshore oil and gas exploration.

4.1.5 LFE7 Using Non-Woven Geotextiles in Landfill Engineering

LFE7 Using non-woven geotextiles in landfill engineering is a guidance document developed by the Environment Agency and covers the use of nonwoven geotextiles in landfill engineering.

Although the document covers the use of geotextiles in landfill engineering, it can be utilised to cover the use of geomembranes in other industries including onshore oil and gas exploration.

4.1.6 CIRIA 736 Containment Systems for the Prevention of Pollution

Developed by Ciria, the guidance covers secondary, tertiary and other containment measures for industrial and commercial premises.

5. ROLES AND RESPONSIBILITIES

A summary of specific role and responsibilities for quality management during the construction of the Wressle wellsite extension are identified within Table 2.

ROLE	KEY RESPONSIBILITIES
CHIEF EXECUTIVE OFFICER	The Chief Executive Officer is overall responsible for all Egdon Resources U.K. Limited's business activities and has to ensure that suitable and sufficient systems, processes and resources are in place to adhere to quality standards, legislative and regulative requirements in relation to quality management. The Chief Executive Officer shall: • Apply quality standards and procedures throughout Egdon Resources U.K. Limited; and • Provide suitable and sufficient input and resources required to maintain quality standards; and • Define roles and responsibilities to ensure that a proactive and robust system is in place to assist in quality management.
HSE & PRODUCTION MANAGER	The HSE & Production Manager is responsible for: • The communication and implementation of the CQAP; • Providing assistance and guidance in the update and approval of the CQAP; • Ensuring that quality compliance is maintained through the provision of adequate competent resources; • Ensuring that defined practices and processes are communicated; • Ensuring that roles and responsibilities are identified and the assessment of individuals is recorded; • Ensuring that competent personnel are available to implement, monitor and assess the requirements of the CQAP; • Selecting contractors who can meet Egdon's quality standards through a robust tendering and/or selection process and the monitoring of contractors to ensure that these standards are being met; • The development and training of staff or assessing the competence of contractors so that they are competent and capable of carrying out their work to the required standards; • Conducting periodic audits of compliance with the CQAP; and • Communicating quality performance, significant findings and non-conformances.

ROLE	KEY RESPONSIBILITIES
CONSTRUCTION MANAGER	The Construction Manager is responsible for: • Overseeing the overall implementation of the CQAP; • Ensuring that design plans and quality information is communicated to the Principal Contractor and subcontractors; • Coordinating all project testing, inspections and reporting matters directly with the Project Manager. • Interceding directly and ceasing unsatisfactory work and control further processing, delivery or installation of non-conforming material. • Providing assistance and guidance in the update and approval of the CQAP; • Ensuring that defined practices and processes are communicated; • Ensuring that roles and responsibilities are identified and the assessment of individuals is recorded; • Conducting periodic audits of compliance with the CQAP; and • Communicating quality performance, significant findings and non-conformances.
PRINCIPAL CONTRACTOR	The Principal Contractor is responsible for: • Ensuring works are completed using materials and products identified within the design plans; • Ensuring works and materials are compliant with the design plans and relevant quality standards and guidance; • Ensuring materials and products delivered and used within the operations are in compliance with the design plans; • Ensuring compliance with the CQAP; and • Ensuring that subcontractors comply with the CQAP and relevant quality standards and guidance.
CQA INSPECTOR	The CQA Inspector shall: • Undertake the roles and responsibilities identified within this CQAP and manufacturers guidance; and • Ensure that a CQA Validation Report is compiled and submitted to the Principal Contractor following the installation of the geomembranes and cover material (re-graded blast furnace slag).
ALL PERSONNEL	All personnel are to follow the requirements of the CQAP and cooperate fully with senior management.

Table 2: Roles and Responsibilities

6. CONSTRUCTION QUALITY ASSURANCE

6.1 Scope of Works

The scope of works for which this CQAP is required consists of an extension to the existing Wressle wellsite, providing both an extension to the existing working platform (active area) and the existing office, welfare and parking area (non-active area). The intention is to provide a seamless transition between the existing platform and the extension platform, which, for clarity, includes the impermeable membrane, protective geotextiles and perimeter containment ditch.

6.1.1 Existing Working Platform

The works associated with the exiting working platform can be summarised as follows:

1. Carefully remove the drainage aggregate from the southern perimeter containment ditch and remove same from the southerly sections of the west and east perimeter containment ditches, exposing the drainage pipework;
2. Disconnect the drainage pipework and remove. Store on site for subsequent reuse;
3. Carefully remove the existing 300mm of BFS across the southern portion of the site, down to the layer of Secutext R801 protective geotextile. Store on site for subsequent reuse;
4. Roll back the Secutex R801 protective geotextile, exposing the HDPE FML;
5. Carefully peel back the HDPE FML, cutting it at various intervals so as not to overstress the existing welds;
6. Roll back the Secutex R301 to expose the subgrade, prior to commencing regrading of the soils to marry up the extension platform with the existing platform;
7. Scope described in items 2 – 9 in section 6.1.2 is then carried out; and
8. Once the extension platform has been married to the existing platform, recover with nominal 300mm of BFS and compact. Ensure nominal fall towards the perimeter containment ditch to facilitate surface run-off.

6.1.2 Extension to Existing Working Platform

The works associated with the extension working platform can be summarised as follows:

1. Remove the topsoil and place in a bund in the southwest corner of the site;
2. Cut and fill the subsoil to create the required level plateau, consistent with the level of the existing working platform, including backfilling of existing platform southern perimeter containment ditch;
3. Excavate for and construct new drilling cellars, using pre-cast concrete rings and concrete jacket;
4. Excavate new perimeter containment ditch around the western, southern and eastern boundary of the extension working platform and tie-in to existing platform containment ditch;
5. Install new Secutex R301 protective geotextile over the extension working platform and perimeter containment ditch, overlapping the existing working platform Secutex R301;
6. Install new 2mm HDPE FML, including liquid tight connections to the new drilling cellars and weld it to the existing working platform HDPE FML;
7. Install new Secutex R801 protective geotextile over the HDPE FML, overlapping the existing working platform Secutex R801;
8. Install new 300mm twin-wall perforated pipe within the perimeter containment ditch, connecting each end to the existing pipe within the existing working platform containment ditch;
9. Backfill the perimeter containment ditch with 40mm single size washed aggregate up to the working platform level (minimum 32% voids) to form a French drain;
10. Install new nominal 300mm of BFS across the extension working platform and compact. Ensure nominal fall towards the perimeter containment ditch to facilitate surface run-off;
11. Create new ramped bund across the new (secondary) compound access to provide/accommodate storm water attenuation; and
12. Full CQA regime to be employed throughout in conjunction with all specialist installation requirements of membrane supplier and principal contractor.

6.2 Distribution of the Construction Quality Assurance Plan

The Egdon Resources Construction Manager will communicate the CQAP to the Principal Contractor and sub-contractors. The CQAP may be issued as an electronic version or paper copy. A copy of receipt or transmittal will be recorded by the Egdon Resources Construction Manager. It will be communicated to all site personnel and a copy made available on site during operations.

A copy of the CQAP is to be held within the Principal Contractor's office and be available for review by the relevant regulators.

6.3 Alterations to the Construction Quality Assurance Plan

Any required changes or deviations from this CQAP are to be referred to the Egdon Resources Construction Manager in the first instance. No changes to, or deviations from, this CQAP are to be implemented until the required changes or deviations have been reviewed and approved by Egdon. However, alterations may be implemented as an immediate control measure to resolve an identified problem prior to notification to Egdon.

6.4 Reviewing and Revising the Construction Quality Assurance Plan

Egdon will periodically review the CQAP or when significant changes to operations or site equipment have occurred and amend where necessary in accordance with the Egdon Document Control Procedure.

7. INSTALLATION OF THE SECUTEX R301 GEOTEXTILE

The Principal Contractor will install a layer of Secutex R301 geotextile over the

7.1 CAQ Engineer

The CQA Engineer shall:

- ensure that the Secutex R301 geotextile supplied meets the requirements of the specification;
- ensure that the Principal Contractor provides the pre-installation information to include the manufacturer's QC data sheets and that they are in accordance with the requirements of the specification;
- ensure that each roll of geotextile delivered to site is unloaded, handled and stored in accordance with the requirements of the specification and or manufacturer's recommendations and that CQA testing is carried out in accordance with the specification;
- ensure that the geotextile is secured and weighted down adequately;
- ensure that the surface of the surface of the GCL is picked free of items likely to cause damage to the geotextile during or after installation;
- ensure that the geotextile is deployed in accordance with the specification using agreed, acceptable methods and record the methods used;
- ensure that the geotextile deployed meets the requirements of the specification for condition, seam overlap and heat bonding;
- ensure that deployment takes place only in compliant weather conditions; and
- instruct appropriate repair work in accordance with the specification and ensure that the repair work is completed and is compliant, with the specification.

7.2 Secutex R301 Geotextile Manufacture

The Secutex R301 protection geotextile shall be manufactured from non-woven polypropylene fibres bonded by needle punching. The Secutex R301 shall conform to the following criteria:

Protective Geotextile Criterion	Unit	Minimum Vale	Test
Tensile Strength Machine Direction	kN/m	22.5	Tensile Strength BSEN ISO 10319 [Ref. 8]
Tensile Strength Cross Machine Direction	kN/m	24	Tensile Strength BSEN ISO 10319
CBR Puncture Resistance/Plunger Displacement	N, mm	4200, 50	BSEN ISO 12236 [Ref. 9]
Mass Per Unit Area	g/m^2	≥270	BS EN 965 [Ref. 10]
Thickness	mm	1.6	BS EN 964-1 [Ref. 11]
Polymer		Polypropylene	
Bonding		Needle Punched	
Construction		Non-Woven	

Table 3: Secutex R301 Specification

The above values are typical which indicates the mean value derived from the samples taken for any one test as defined in the BSEN ISO standard (usually the mean of five (5) specimens).

7.3 Delivery of the Secutex R301 Geotextile

The Principal Contractor is responsible for ensuring that delivery procedures and quality control checks are undertaken ensuring that:

- the Secutex R301 geotextile is delivered to the site in the form of a roll, which has been prepared, packed and loaded in a manner, so as to prevent damage during transportation and handling;
- a copy of the manufacturer's Certificate of Compliance is received either with the consignment or as soon as reasonably practicable following receipt;
- each roll is to be visually inspected by the CQA Engineer for damage and defects;
- a copy of the manufacturers' quality control documentation shall accompany each roll to site and a copy passed to the Principal Contractor on the day it is delivered to site; and
- each roll shall be clearly labelled with the following information:
    - name of the manufacturer;
    - product name and type;
    - batch and roll number;
    - roll length in metres;
    - roll width in metres;
    - roll weight in kilograms; and
    - date of manufacture.

7.4 Unloading Operations

The Principal Contractor is responsible for ensuring that unloading procedures and quality control checks are undertaken ensuring that:

- unloading operations are to be undertaken by authorised personnel only, using a crane or suitable available construction equipment;
- on delivery to the site, each roll will be off-loaded to a suitable storage area nominated by the Principal Contractor and the CQA Engineer; and
- slings are supplied with each roll delivered to facilitate unloading operations.

7.5 Storage Arrangements

The Principal Contractor is responsible for ensuring that storage procedures and quality control checks are undertaken ensuring that:

- the storage area shall be clean, firm, dry, and free of rocks or other detritus;
- the storage area is to be located so as to preclude damage from impact or puncture by working plant, vandals, etc.; and
- rolls shall be stacked not more than three (3) high and stored in accordance with the manufacturer's recommendations.

7.6 Conformance Testing

Samples shall be taken from rolls of protective geotextile selected by the CQA Engineer. Samples shall be submitted by the CQA Engineer for conformance testing at a laboratory to confirm that the properties of the material meet the manufacturer's specification. All conformance testing shall be undertaken at an independent laboratory with UKAS accreditation for the tests specified. Samples shall be 1m long by the roll width and shall not include material from the first five (5) linear metres of the roll.

The CQA Engineer will reject protective material not achieving the requirements of the conformance testing as set out in paragraph 6.2 of the Environment Agency's document LFE 7 "Using Nonwoven protector geotextiles in landfill engineering".

The Principal Contractor shall note that a consignment (delivery lot) is considered to fail if one or more samples tested do not meet one or more of the declared values on the CE declaration or relevant application properties. The Principal Contractor may choose to replace the rejected lot or to carry out further testing (to enable the evaluation of conformity by statistical procedure to be undertaken) on new samples from the product delivered to the Site. The results on the previously tested samples shall be included in the evaluation.

The Principal Contractor is required to inform the Egdon Resources Construction Manager before proceeding.

In addition to the above conformance procedure, if any material appears to be visually defective upon installation it shall be removed to an extent as directed by the CQA Engineer who may request additional conformance testing. This additional testing shall be carried out at the expense of the Principal Contractor.

Secutex R301 material shall conform to the criteria in Table 4 below.

Property	Test Method	Units	Typical Mean Value	Test Frequency	Tolerance
Thickness @ 2kPa	BSEN ISO 9863-1 [Ref. 12]	mm	1.6	1/2500m^2 or part thereof	
CBR Puncture Resistance Displacement	BSEN ISO 12236	kN mm	4.2 50	1/6000m^2 or part thereof	-10%
Tensile Strength (md)	BSEN ISO 10319	KN/m	22.5	1/6000m^2 or part thereof	-10%
Tensile Strength (cmd)	BSEN ISO 10319	KN/m	24	1/6000m^2 or part thereof	-10%
Extension (md)	BSEN ISO 10319	%	40	1/6000m^2 or part thereof	+/- 30% of typical mean value
Extension (cmd)	BSEN ISO 10319	%	45	1/6000m^2 or part thereof	+/- 30% of typical mean value
Resistance to perforation (cone drop test)	BSEN ISO 13433 [Ref. 13]	mm	10.8	1/6000m^2 or part thereof	+2mm
Mass per unit area	BS 965	g/m^2	≥270	1/2500m^2 or part thereof	
Durability (according to annex B: EN 13253) [Ref. 14]					
Resistance to weathering (UV) @ 50MJ/m^2 radiant exposure	BSEN 12224	Retained Strength			>80% of typical mean value
Resistance to Oxidation (100 years)	EN ISO 13438 [Ref. 15]	Retained Strength after 65 days			>50% of typical mean value
Resistance to liquids	BSEN 14030 [Ref. 16]	Retained Strength			>50% of typical mean value
	Durability test data supplied by the manufacturer – with a test frequency not exceeding 3 years will be admissible.				

Table 4: Secutex R301 Conformance Sampling and Testing

7.7 Subgrade Preparation

The subgrade shall comprise the upper surface of the cut to fill plateau, consisting primarily of sand.

The Principal Contractor shall ensure that the subgrade surface is free of foreign matter, free of sharp objects and also free of abrupt changes in the gradient which could be bridged by the geotextile. All the foregoing to be to the satisfaction of the CQA Engineer.

The area of subgrade accepted by the CQA Engineer for laying shall be delineated on a daily basis with an agreed location system. Any areas unacceptable to the CQA Engineer and any necessary remedial work required shall be notified to the Principal Contractor for action. The CQA Engineer shall record his acceptance of areas of subgrade on a subgrade release form.

Areas of the subgrade which are unacceptable shall, after remediation, be reinspected by the CQA Engineer to ensure they are acceptable. The geotextile shall only be laid on areas accepted in writing by the CQA Engineer on the day of installation.

Prior to any geotextile installation, the CQA Engineer shall inspect the receiving surface to verify that it is acceptable. No geotextile shall be installed on an area until it has been accepted by the CQA Engineer.

7.8 Secutex R301 Geotextile Placement

The Principal Contractor shall provide a proposed panel layout showing the location of the Secutex R301 geotextile panels.

The Principal Contractor and the CQA Engineer shall inspect the subgrade preparation each day to verify suitability of the subgrade prior to the commencement of the installation of the Secutex R301 geotextile ensuring that:

- equipment, plant and tools used shall not damage the Secutex R301 geotextile by handling, trafficking, leakage of hydrocarbons or by other means;
- personnel working on the Secutex R301 geotextile will not smoke, wear damaging shoes, or otherwise engage in any activity that could damage the Secutex R301 geotextile;
- Secutex R301 geotextile shall be installed by hand and shall be deployed in such a manner as to avoid any damage to the Secutex R301 geotextile or damage/disturbance to the GCL;
- adjacent geotextile panels shall be overlapped by a minimum of 300mm and secured using an in-situ heat bonding technique or stitching technique acceptable to the CQA Engineer. Any alternative (proposed) jointing technique shall be accepted in writing by the CQA Engineer prior to use;
- no plant or wheeled traffic are to traverse across the prepared surface;
- the prepared GCL subgrade shall be protected from deterioration after acceptance using plastic sheeting or temporary sand layer. The subgrade surface shall remain acceptable up to the time of Secutex R301 geotextile deployment;
- sand bags or equivalent ballast shall be used temporarily to hold the Secutex R301 geotextile material in position. This protection shall remain in place until the overlying layers are placed over the panel;
- exposed edges of the Secutex R301 geotextile shall be similarly weighted down at the end of each working day;
- the Secutex R301 geotextile shall not be allowed to "bridge over" voids or low areas in the subgrade. The Secutex R301 geotextile shall rest in intimate contact with the GCL sub grade. Indentations in the subgrade surface shall be repaired by the placement and compaction of bentonite sand (min. nominal 20% bentonite to 80% sand) and the surface reinstated and compacted to level;
- the CQA Engineer shall inspect the Secutex R301 geotextile at regular intervals each day to ensure that that the Secutex R301 geotextile integrity is maintained and any faults identified can be repaired effectively and efficiently;
- the CQA Engineer shall verify that the Secutex R301 geotextile has been installed in accordance with the CQA Plan, approved method statement and panel layout and shall maintain detailed records of the delivery and installation of the Secutex R301 geotextile. These shall be incorporated into the CQA Engineer's CQA validation report; and

- the CQA Engineer shall ensure that conformance testing is carried out in accordance with paragraph 9.6 of the specification.

7.9 Protection of the Secutex R301 Geotextile

The Principal Contractor is responsible for ensuring protection of the Secutex R301 geotextile following deployment ensuring that:

- direct contact with the Secutex R301 geotextile is minimised in areas where excessive foot traffic may be expected;
- no wheeled traffic will be allowed to travel on the Secutex R301 geotextile; and
- following deployment of the Secutex R301 geotextile, all unnecessary trafficking or activity on the Secutex R301 geotextile shall be avoided.

8. INSTALLATION OF 2MM HDPE FML

Following deployment of the Secutex R301 geotextile over the subgrade, the 2mm thick HDPE FML shall be installed over the Secutex R301 geotextile using skilled and experienced operators.

The Principal Contractor will assign a Project Manager who will be responsible for providing the CQA Engineer with the relevant details of proposed personnel, their experience and accreditation.

8.1 CAQ Engineer

The CQA Engineer shall:

- ensure that the HDPE FML proposed to be supplied meets the requirements of the specification;
- review and provide acceptance of the Principal Contractor's preinstallation information including method statement, panel layout, field quality control forms, ensuring that the information is in accordance with the specification;
- ensure that technical matters arising are dealt with in accordance with the specification or brought to the attention of the EA for agreement;
- ensure that all rolls delivered to site are accompanied by a manufacturer's QC data sheet, covering the minimum required information as listed in the specification;
- record the delivery of each batch of rolls;
- assess the QC data sheets all to confirm that the material supplied meets the requirements of the specification, prior to installation;
- ensure that each roll of HDPE FML delivered to site is unloaded, handled and stored in accordance with the requirements of the specification and that CQA is carried out in accordance with the specification;
- ensure that all welders are accredited in accordance with the requirements of the specification;
- take samples of the HDPE FML and arrange for destructive seam and conformance testing in accordance with the specification;
- assess the destructive seam and conformance test results and confirm whether the requirements of the specification have been met;
- ensure that the HDPE FML is deployed on a compliant subgrade surface and that the HDPE FML is weighted down (temporary surcharge) in accordance with the agreed Principal Contractor's method statement and or the specification;
- ensure that the HDPE FML is deployed in accordance with the specification by the specified, accredited technicians using agreed, acceptable methods and record the methods used;
- ensure that the HDPE FML deployed meets the requirements of the specification for condition, thickness, panel layout and seam overlap;
- ensure that all pre-weld tests and trials are carried out and are compliant with the specification;
- ensure that seaming takes place only after compliant pre-weld trials, in compliant weather conditions and on compliant sheet and seam conditions;
- ensure that all seams and welds undergo the appropriate non-destructive and destructive testing in accordance with the specification and that the results are compliant;
- instruct appropriate repair work in accordance with the specification and ensure that the repair work is completed, tested and is compliant, in accordance with the specification; and
- ensure that the Principal Contractor undertakes surveying in accordance with the requirements set out in the specification and that the results of the surveying meet the needs for the production of a validation report.

The CQA Engineer shall ensure that all elements are documented and that the records and test results are presented in the validation report.

8.2 Delivery

The Principal Contractor is responsible for ensuring that delivery procedures and quality control checks are undertaken in accordance with the manufacturer's HDPE Geomembrane Installation Guidelines ensuring that:

- the HDPE FML is delivered to the site in the form of a roll, which has been prepared, packed and loaded in a manner, so as to prevent damage during transportation and handling;

- a copy of the manufacturer's Certificate of Compliance is received either with the consignment or as soon as reasonably practicable following receipt;
- damage or defects identified are marked, recorded on the appropriate record sheet and the damaged roll segregated / quarantined for further investigation;
- a copy of the manufacturers' quality control documentation accompanies each roll to site and a copy passed to the Principal Contractor on the day it is delivered to site;
- each roll is clearly labelled with the following information:
    - Name of the manufacturer;
    - Product name and type;
    - Batch and roll number; and
    - Roll length in metres;
- roll width in metres;
- roll weight in kilograms; and
- date of manufacture.

8.2.1 Unloading Operations

The Principal Contractor is responsible for ensuring that unloading operations and quality control checks are undertaken in accordance with the manufacturer's HDPE Geomembrane Installation Guidelines and this CQAP ensuring that:

- unloading operations are to be undertaken by authorised personnel only, using a crane or suitable available construction equipment;
- on delivery to the site, each roll will be off-loaded to a suitable storage area agreed by the Principal Contractor and the CQA Engineer; and
- two (2) slings are supplied with each roll delivered to facilitate unloading operations.

8.3 Storage Arrangements

The Principal Contractor is responsible for ensuring that storage arrangements and quality control checks are undertaken in accordance with the manufacturer's HDPE Geomembrane Installation Guidelines and this CQAP ensuring that:

- the location of the storage area shall be agreed between the Principal Contractor and CQA Engineer;
- the storage area shall be clean, firm, dry, and free of rocks or other detritus;
- the storage area is to be located so as to preclude damage from impact or puncture by working plant, etc.;
- if required, a layer of sand (minimum 100mm thick) or a geotextile (≥ 800g/m^2) is to be provided if stones are within the surface of the storage area;
- stones ≥ 6mm within the surface of the storage area shall be removed;
- rolls shall be stacked not more than three (3) high and stored in accordance with the manufacturer's recommendations; and
- if HDPE FML rolls are to be stored on site for a period exceeding two (2) months, they shall be covered by a secured tarpaulin or similar.

8.4 Conformance Testing

The Principal Contractor is to ensure that conformance testing and quality control checks of the HDPE FML rolls are undertaken in accordance with the manufacturer's HDPE FML Geomembrane Installation Guidelines and manufacturer's Technical Data Sheet, ensuring that:

- as soon as reasonably practicable after delivery of the rolls, the CQA Engineer is to undertake conformance testing of the HDPE FML;
- test samples will be recovered from selected rolls of the material at the following frequency:
    - 1 sample per 5,000m^2 of HDPE FML delivered to site; or
    - 1 sample for every batch of HDPE FML whichever is the greater frequency.
- test samples will be 1m long and the full width of the roll. If required, more than one (1) sample will be recovered from any particular roll;

- test samples shall be clearly marked with the date and roll number by the CQA Engineer and forwarded to the testing laboratory by the CQA Engineer for conformance testing in accordance with the manufacturer's Technical Data Sheet;
- if the test results fail to meet the requirements as detailed within the manufacturer's Technical Data Sheet, the roll shall be clearly marked and rejected;
- rolls with adjacent sequential numbers shall be sampled and tested. The results of this testing shall be recorded by the CQA Engineer and reviewed by the Egdon Resources Construction Manager and Principal Contractor;
- results are recorded by the UKAS accredited laboratory and forwarded to the Principal Contractor as soon as reasonably practicable. An interim report may be produced;
- the CQA Engineer undertakes thickness measurements on each roll delivered to site and also at a frequency of five (5) measurements per 100 metres, separated by 10m or 20m of HDPE FML. This may be undertaken during deployment of the HDPE FML;
- the CQA Engineer shall record the outcome of the thickness measurements and relevant reference numbers of each roll tested on the appropriate record sheet; and
- if, in the opinion of the CQA Engineer, the HDPE FML thickness does not meet the requirements of the manufacturer's Technical Data Sheet, the HDPE FML panel shall be removed until further analysis is undertaken from the laboratory. However, the overall thickness conformity shall be reviewed against the results of the conformance test at the UKAS accredited laboratory.

The testing parameters, test method and frequencies have been summarised within Table 5 below.

Property	Minimum Required Values (all values minimum average)		Test Method	Frequency
	Textured	Smooth		
Thickness (min. ave)	2.00mm (+/-10%)	2.00mm (+/-10%)	In accordance with Table 1b or 2b of the GRI Test Method GM13 Standard Specification.	One sample per 5,000m^2 or every 5 rolls delivered to site whichever is the greatest number of tests. In the event that materials from different resin sources or manufacturing lines are supplied, at least one additional sample of such material shall be taken and tested.
Density (min. ave)	0.940g/cc	0.940g/cc		
Puncture Resistance (min. ave)	534N	640N		
Tear Resistance (min. ave)	249N	249N		
Carbon Black Content (range)	2.0% - 3.0%	2.0% - 3.0%		
Carbon Black Dispersion	Min. 9 of 10 in categories 1 or 2; All of 10 in category 3	Min. 9 of 10 in categories 1 or 2; All of 10 in category 3		
Tensile Properties (min. ave)				
Yield Strength	29kN/m	29kN/m		
Break Strength	21kN/m	53kN/m		
Yield Elongation	12%	12%		
Break Elongation	100%	700%		
Stress Crack Resistance	500hrs	500hrs		One sample per 10,000m^2. In the event that materials from different resin sources or manufacturing lines are supplied, at least one additional sample of such material shall be taken and tested.

Table 5: HDPE FML Conformance Sampling and Testing

8.5 HDPE FML Placement

The Principal Contractor is to ensure that the HDPE FML is installed in accordance with the manufacturer's HDPE FML Installation Guidelines.

The Principal Contractor is to ensure that precautions are taken by personnel trafficking the HDPE FML and awareness of the potential risk of slips, trips and falls, due to the extremely slippery properties of the HDPE FML is communicated to all site personnel.

The Principal Contractor, the CQA Engineer and the HDPE FML installer shall inspect the site surface and the deployed Secutex R301, Secutex R801 each day to verify suitability of the site surface and previously deployed materials prior to the commencement of the installation of the HDPE FML ensuring that:

- the temperature of the unrolled HDPE FML is taken and recorded;
- no HDPE FML material is unrolled and deployed if the HDPE FML material temperature is lower than 0°C;
- equipment, plant and tools used do not damage the HDPE FML by handling, trafficking, leakage of hydrocarbons or by other means;
- personnel working on the FML do not smoke, wear damaging shoes, or otherwise engage in any activity that could damage the HDPE FML;
- HDPE FML is installed by hand and shall be deployed in such a manner as to avoid any damage to the HDPE FML or any damage/disturbance to the protection layer;
- no plant or wheeled traffic are to traverse across the prepared surface;
- the Secutex R301 geotextile underlying the HDPE FML will not deteriorate after acceptance and shall remain acceptable up to the time of HDPE FML deployment;
- sand bags or equivalent ballast will be used temporarily to hold the HDPE FML material in position. This protection shall remain in place until the overlying layers are placed over the panel;
- exposed edges of the HDPE FML are similarly weighted down at the end of each working day;
- precautions are taken to prevent the ingress of water below the panels;
- HDPE FML placement is not undertaken if moisture prevents preparation of the sub grade, panel placement, or panel seaming;
- damaged panels which have been rejected shall be marked and removed from the work area. The CQA Engineer shall decide which panels must be replaced and which may be repaired;
- the HDPE FML does not "bridge over" voids or low areas in the sub grade. In these areas, HDPE FML shall rest in intimate contact with the sub grade;
- the HDPE FML installer minimises the formation of wrinkles caused by panel placement or thermal expansion;
- the CQA Engineer inspects the HDPE FML at regular intervals each day to ensure that that the HDPE FML integrity is maintained and any faults identified can be repaired effectively and efficiently;
- the CQA Engineer verifies that the HDPE FML has been installed in accordance with the CQAP, approved method statement and panel layout and shall maintain detailed records of the delivery, installation and testing of the HDPE FML. These shall be incorporated into the HDPE FML installer's CQA validation report;
- Individual panels shall be positioned with a minimum overlap of 100mm between the adjacent panels. In any case the specific overlap must suit the equipment to be used by the HDPE FML installer to enable compliance with the requirements specified. On any slopes the HDPE FML panels shall be installed parallel to the direction of slope (i.e. downslope). Horizontal seams shall not be permitted on the slope unless otherwise agreed with the LPA and EA and instructed by the Designer; and
- The method of installation of the HDPE FML shall ensure that:
    - panels are deployed and seamed one at a time;
    - seaming takes place immediately following deployment;
    - scratches or crimps do not occur as a result of deployment;
    - undulations in the installed HDPE FML are minimised as far as practicable;
    - the HDPE FML shall not be allowed to fold over or have the potential to fold once loading is applied;
    - equipment does not cause excessive heat or leak hydrocarbons on the HDPE FML;

- adequate and suitable temporary weighting, e.g. sandbags, is provided to ensure no movement occurs during deployment or seaming or at any subsequent time prior to approval by the CQA Engineer of the completed HDPE FML installation;
- no vehicles travel on the HDPE FML;
- sufficient allowance is made for the potential expansion and or contraction of the HDPE FML; and
- each panel of HDPE FML is marked up with the roll reference and a unique panel identification number.

8.6 Trial Seams

At the start of each shift, prior to seaming of the HDPE FML, trial seams shall be carried out to confirm the set-up of each piece of seaming equipment proposed to be used that work shift in ambient conditions. Trial seams shall be produced under the same conditions as the installation seams and shall be performed with the HDPE FML in contact with the same formation type.

A trial seam of minimum length 3m shall be carried out for each piece of seaming equipment proposed for use at the beginning of each seaming period, every four (4) hours, on the introduction of a new welding technician, following a prolonged period of shut down and following any significant changes in environmental or operating conditions. All trial seams shall be carried out in the presence of the CQA Engineer.

From each trial seam, six (6) tab samples of at least length 105mm by 25mm shall be extracted at random from the length of the seam. The tabs shall be examined by the CQA Engineer to confirm that the seam exhibits a homogenous fusing of the two (2) sheets with no definable boundary or layer. The HDPE FML installer in the presence of the CQA Engineer shall test the tabs, three (3) for peel failure and three (3) for shear failure. The mode of failure shall be yield of the sheet material outside the seam. No samples shall fail in the seam. The mode of failure shall be recorded using the standard code descriptions.

If the field testing of the trial seams proves unsatisfactory further trial seams shall be performed and the procedure repeated until the CQA Engineer is satisfied with the setup of the particular item of seaming equipment. The CQA Engineer shall not allow seaming of the HDPE FML to commence until successful trial seams are achieved.

8.7 Seaming

The HDPE FML installer shall make a log of apparatus temperatures and speeds, extrudate temperatures and ambient temperatures at appropriate intervals. All information shall be given to the CQA Engineer on request.

All seams shall be individually numbered and recorded by the HDPE FML installer. All “T” junctions of adjoining seams shall be covered with an extrusion weld extending to a minimum of 200mm in each direction from the apex of the “T”.

The HDPE FML installer shall only commence seaming when the following conditions are met:

- the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material;
- sheet temperatures are between 0°C and 35°C;
- if seam overlap grinding is required, that seaming is completed not later than one hour after grinding in order to mitigate oxidation of the sheet;
- if seam overlap grinding is required, less than 10% of the nominal thickness shall be removed;
- grinding does not extend beyond the edges of the weld;
- seams are aligned with the fewest possible number of wrinkles and “fishmouths”;
- seaming shall not take place during rain or snow or high relative humidity unless proper precautions are taken which allow the seam to be made on dry FML materials;
- seaming shall not take place during high winds;
- seaming shall not take place above saturated subgrade soils;
- seaming shall not take place with standing water on the subgrade soil surface;
- seaming shall not take place over frozen subgrade soil;
- where wrinkles greater than 100mm in height (from the upper surface of the clay liner are identified as being present these shall be removed and patched; and

- on the side slopes the seams shall be installed parallel to the direction of slope (i.e. downslope) and without any horizontal seams on the slope.

Any seaming undertaken on sheet with a temperature below 0ºC or above 35ºC shall be demonstrated to be of the same standard as that undertaken between 5ºC and 35ºC. The HDPE FML installer shall make a written application to the CQA Engineer to undertake seaming outside the specified sheet temperatures. The application shall include a method statement detailing how the HDPE FML installer would demonstrate that the seams would be to the same standard as that undertaken between 0ºC and 35ºC. The LPA and EA shall be consulted for acceptance.

Only suitably qualified, trained and experienced staff shall install the HDPE FML liner. This must include both of the following:

a) a lead technician and a foreman accredited to at least standard level (level1) of the BGA/TWI/CSWIP welding standard [Ref. 17] (developed by the British Geomembrane Association (BGA), Thermal Welding Institute (TWI) and the Certification Scheme for Welding Inspection Personnel (CSWIP) and;
b) all welders accredited to a minimum of entry level (level 2) of the BGA/TWI/CSWIP welding standard.

In addition, the Principal Contract must use a company that is accredited, or working towards being accredited, to the BGA accreditation scheme for geomembrane installers.

The HDPE FML installer shall provide the CQA Engineer with the relevant details of his proposed sub-contractor and its personnel and their experience including for primary evidence of compliance with the above accreditation requirements.

At any time there may be present on site additional crew members who may not be accredited as above and who will carry out duties other than welding activities. There may also be present in any site crew persons who shall be designated as Trainee Technicians. A limit of one (1) Trainee Technician per crew will apply Trainee Technicians may be allowed to carry out welding activities providing they are at all times under the direct supervision of the Lead Technician accredited to Level 1 of the BGA/TWI/CSWIP welding standard and they have been registered by their employer for examination for the purpose of accreditation to Level 2 of the BGA/TWI/CSWIP welding standard within three (3) months of their employment date. Personnel who have failed to achieve Level 2 accreditation within three (3) months of their employment date shall not be permitted to undertake any further welding activities on site until they have achieved level 2 accreditation. Copies of Certification shall be provided to the CQA Engineer.

8.7.1 Fusion (Hot Wedge) Welding

The HDPE FML installer shall ensure that:

a) the conditions detailed at the section above are met prior to the commencement of seaming;
b) following the completion of the welding of a main panel >25 metres in length a tab/strip sample is removed from each end of the seam and that each sample is tested destructively in the field using peel and shear test methods;
c) following the completion of the welding of a seam <25 metres in length a tab/strip sample is removed from one end of the seam and that sample is tested destructively in the field using peel and shear test methods;
d) adequate temporary anchorage is provided to ensure no movement occurs during seaming;
e) no full width horizontal seams occur on slopes; and
f) the weld temperature and speed are the same as those used when the trial seam was passed.

8.7.2 Fusion (Hot Wedge) Welding

The HDPE FML installer shall ensure that:

a) the conditions detailed at the section above are met prior to the commencement of seaming;
b) following the completion of the welding of a main panel >25 metres in length a tab/strip sample is removed from each end of the seam and that each sample is tested destructively in the field using peel and shear test methods;
c) following the completion of the welding of a seam <25 metres in length a tab/strip sample is removed from one end of the seam and that sample is tested destructively in the field using peel and shear test methods;
d) adequate temporary anchorage is provided to ensure no movement occurs during seaming;

e) no full width horizontal seams occur on slopes; and
f) the weld temperature and speed are the same as those used when the trial seam was passed.

8.7.3 Extrusion Welding

The HDPE FML installer shall ensure that:

a) the conditions detailed at the section above are met prior to the commencement of seaming;
b) the area to be welded is adequately buffed (no more than 10% of the sheet thickness shall be removed);
c) grinding does not extend beyond the edges of the weld;
d) prior to forming an extrusion seam, adjacent panels shall be temporarily secured by heat bonding;
e) the procedure used to temporarily bond adjacent panels, together with any pre- heating during seaming, shall not cause any damage or overheating to the HDPE FML;
f) temporary bonding using adhesives shall not be permitted;
g) a copper wire is placed at the join of the two HDPE FML sheets if HVE testing is to be undertaken;
h) when abrasions are made the weld is constructed within one (1) hour;
i) the abrasions extend no further than 10mm either side of the edge of the weld;
j) the extrudate material used shall be identical in composition to that of the HDPE FML sheet;
k) Welding rods used in extrusion welding will be delivered, in vacuum packed plastic bags by the manufacturer. The packaging should be opened just before the rod is used; and
l) A certificate for each welding rod is included within the plastic package.

8.8 Non-Destructive Seam Testing

The HDPE FML installer shall maintain full records of all non-destructive testing which shall be provided to the CQA Engineer on a regular basis.

8.8.1 Air Pressure Testing

All twin track fusion seams shall be pneumatically tested. The air channel formed between the twin tracks shall be sealed at its ends and inflated to a minimum pressure of 2 bar (30psi, 200kPa). Following removal of the pressure source the pressure shall be allowed to equalise for two (2) minutes. Thereafter there shall be no loss of pressure in the first minute and the pressure shall not decrease by more than 10% over a five (5) minute period.

The air compressor shall be turned off during the test period.

To confirm that the full length of seam is pressurised the test shall be carried out such that either:

- The pressure source and gauge are applied to opposite ends of the seam and, on completion of the test, the pressure drop is observed on the gauge following removal of the pressure source; or
- If pressure source and gauge are applied to the same end of the seam, on completion of the test, the channel is deflated from the opposite end of the seam and the pressure drop observed on the gauge.

If a seam fails air pressure testing or indicates a channel blockage, the test length shall be incrementally reduced until the failure area has been clearly identified. In the case of identifiable points of failure, the seam shall be repaired in accordance with the Repair Procedure section, below. If specific points of failure cannot be identified or if the CQA Engineer is not satisfied with the integrity of the seam, the seam shall be repaired by replacement or capping.

The HDPE FML installer shall record on the HDPE FML using a white indelible paint marker pen, next to the seam, the date, time and air pressures from each air pressure test.

8.8.2 HVE (Spark) Testing

Extrusion seams shall be tested over their entire length using a high frequency continuous coil spark tester. The equipment shall be adjustable in voltage between 0kV and 30 kV and shall generally be operated at a voltage of 10kV per mm of membrane thickness. The spark tester shall be passed slowly in close proximity to the weld to test all points on the weld. Any anomalies in the seam will be identified by the presence of a spark. The location of any sparks shall be marked and the seam repaired in accordance with this specification and re-tested until no sparking is evident.

The HDPE FML installer may employ "vacuum box" testing in place of spark testing and the CQA Engineer may request vacuum box testing of any seams at his discretion.

8.8.3 Vacuum Box Testing

Vacuum testing shall employ purpose made equipment, which produces a vacuum over the tested area. A detergent/water solution shall be applied to the full test area prior to application of the test equipment, which will display any leaks by bubbling of the solution. The CQA Engineer shall confirm that no leaks are present under application of the vacuum.

If the seam fails during vacuum box testing, repairs shall be undertaken in accordance with this specification.

8.9 Qualitative Destruction Seam Testing

The HDPE FML installer shall cut tab samples from the completed seam and subject them to qualitative destructive testing in peel and shear modes. The seam will be deemed to be acceptable if failure in the tab sample solely occurs in the parent material and does not enter the seam. Should a field tab fail the destructive test the HDPE FML installer shall:

- reconstruct the seam between the two (2) tab locations and re-test; or
- cut further tabs from each side of the failure point and undertake such destructive testing until a successful result is achieved. The seam shall then be repaired as necessary.

The CQA Engineer may request further tabs for destructive testing at any location on the seams. Under no circumstances shall the cutting of test specimens, HDPE FML material or any other materials be permitted above installed HDPE FML.

8.10 Quantitative Destruction Seam Testing

The HDPE FML installer shall take instruction from the CQA Engineer who shall select where seam samples will be cut for laboratory testing. Those locations will be established as follows:

- fusion welds will be tested at a minimum frequency of one (1) suite per 200m of seam length;
- extrusion welds will be tested at a minimum frequency of one (1) suite per 200m of seam length (with a minimum of one (1) if total length of seam <200m) and one (1) suite on every day in which 25m or more of seam is completed;
- test locations shall be determined during seaming at the CQA Engineer's discretion. Suspicion of excess crystallinity, contamination, offset seams, or any other potential of imperfection may prompt the selection of such locations; and
- samples shall be cut from the HDPE FML by the HDPE FML installer. The CQA Engineer shall witness the sample cutting, and shall number the sample and record the location on the Panel Layout Plan. The CQA Engineer shall also record the reason for sampling at this location (e.g. statistical routine, suspicious HDPE FML feature, suspicious welding techniques, etc.).

The HDPE FML installer shall cut two (2) 1,000mm long by 300mm wide seam samples from both fusion and extrusion welds for destructive testing by a geosynthetics testing laboratory. One sample shall be retained by the CQA Engineer and the other sent for testing. The testing laboratory shall have UKAS accreditation for each of the tests being undertaken. The frequency of testing shall be in accordance with the specification. However, the CQA Engineer may increase this frequency of sampling if test results indicate problems or poor workmanship.

The HDPE FML installer shall ensure that all holes in the HDPE FML resulting from destructive seam sampling are immediately repaired in accordance with this specification.

The samples shall be forwarded to the independent testing laboratory on the same day that they are cut.

Two (2) 25mm wide qualitative tab samples shall be taken associated with each quantitative destructive seam test sample and shall be tested in the field by the HDPE FML installer for peel, and shall not fail in the seam.

Laboratory testing shall be carried out on each quantitative destructive seam test sample in accordance with test method ASTM D4437 [Ref. 18] as modified in NSF, with no requirement for sample conditioning time or in accordance with test method ASTM D6392 [Ref. 19] with 25mm wide strip, testing at 50mm per minute.

The minimum acceptable values to be obtained in the destructive seam tests are those indicated in GRI – GM19 [Ref. 20] and Table 10.10, below. At least five (5) specimens will be tested for each test method. Specimens will be selected alternately by test from the samples (e.g. peel, shear, peel, shear, etc.).

A destructive test failure is deemed to occur if:

- two (2) or more specimens fail in “peel separation”; or
- two (2) or more specimens fail in “shear elongation”

Failure is deemed to have occurred if either the hand tensiometer OR the CQA Engineer’s samples fail within the seam.

In the event of a test failure, the HDPE FML installer shall have the following two (2) options:

- To reconstruct the seam (e.g. remove the old seam and reseam) between any two test locations where tests have confirmed the seam meets the Specification; or
- To trace the welding path to an intermediate location, 3m minimum from the location of the failed test (in each direction) and take a small sample for an additional field test at each location. If these additional samples pass the field tests, then full laboratory samples shall be taken. If these laboratory samples pass the tests, then the seam shall be reconstructed between these locations by capping. If either sample fails, then the process shall be repeated to establish the zone in which the seam shall be reconstructed. All acceptable seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 50m of reconstructed seam, a sample will be taken from within the reconstructed zone. This sample must pass the destructive testing or the procedure described in this section must be repeated.

Property	Test Method	Units	Required Values	Conformance Testing Frequency
Fusion:				
Shear Strength	ASTM 6392	N/mm	28 (min)	1 suite per 200m seam
Shear Elongation	ASTM 6392	%	50 (min)	1 suite per 200m seam
Peel Strength	ASTM 6392	N/mm	21 (min)	1 suite per 200m seam
Peel Separation	ASTM 6392	%	25 (max)	1 suite per 200m seam
Extrusion:				
Shear Strength	ASTM 6392	N/mm	28 (min)	1 suite per 200m of seam (with a minimum of 1 if total length of seam <200m) and 1 suite on every day in which 25m or more of seam is completed.
Shear Elongation	ASTM 6392	%	50 (min)	
Peel Strength	ASTM 6392	N/mm	18 (min)	
Peel Separation	ASTM 6392	%	25 (max)	

Table 6: Peel Strength and Shear Strength Parameters

8.11 Repair Procedure

The HDPE FML installers shall discuss and agree with the CQA Engineer his proposed repair procedures, materials and techniques prior to the commencement of repair work. In addition, the HDPE FML installer shall ensure:

i. all surfaces are clean and dry at the time of repair; and
ii. all abraded areas are completely covered by the weld or patch; patches or caps shall extend at least 150mm beyond the edge of the defect and all corners of patches shall be rounded to a radius not less than 75mm.

8.12 Installation Approval

The installed HDPE FML shall be subject to the inspection and approval of the CQA Engineer prior to the placement of the protective geotextile at any location. Approval shall be made on the basis of the following:

- visual inspection to confirm that all stones, extrusion weld materials or any other potentially deleterious materials have been removed from the surface of the HDPE FML;
- that there are no visible surface defects such as excessive scratching and no folds or excessive undulations;
- that the appropriate overlap between adjacent panels has been achieved;
- all necessary repairs have been made and their locations recorded;
- all tests to seams, patches and repairs have been completed and recorded and the results of respective laboratory destructive seam testing have been received and assessed as satisfactory by the CQA Engineer; and
- areas for approval have been clearly defined by suitable means.

The CQA Engineer will confirm approval of installation compliance. Approved areas not covered in a timely manner will be subject to re-cleaning and re- inspection.

On completion of installation the HDPE FML installer shall submit to the CQA Engineer a fully referenced as-constructed layout plan showing panel/roll reference numbers, seam types and any repair and sample locations.

9. INSTALLATION OF THE SECUTEX R801 GEOTEXTILE

Following deployment of the HDPE FML, the Principal Contractor will install a layer of Secutex R801 geotextile over the HDPE FML to protect the topside of the HDPE FML.

9.1 Installation and Quality Control Procedure

The installation and quality control procedures to be implemented during the installation of the Secutex R801 geotextile over the HDPE FML are to be the same as those applied to the Secutex R301 geotextile (in accordance with section 7 of this document).

9.2 Secutex R801 Manufacture

The Secutex R801 shall conform to the following criteria.

Protective Geotextile Criterion	Unit	Minimum Vale	Test
Tensile Strength Machine Direction	kN/m	46.8	Tensile Strength BSEN ISO 10319
Tensile Strength Cross Machine Direction	kN/m	54.4	Tensile Strength BSEN ISO 10319
CBR Puncture Resistance/Plunger Displacement	N, mm	9540, 45	BSEN ISO 12236
Mass Per Unit Area	g/m^2	800 g/m^2 (≥720 g/m^2)	BS EN 965
Thickness	mm	5.3mm (≥4.8mm)	BS EN 964-1
Polymer		Polypropylene	
Bonding		Needle Punched	
Construction		Non-Woven	

Table 7: Secutex R801 Specification

The above values are typical which indicates the mean value derived from the samples taken for any one test as defined in the BSEN ISO standard (usually the mean of five (5) specimens).

10. INSTALLATION OF THE SCREENED BLAST FURNACE SLAG

Following deployment of the Secutex R801, a layer of 300mm screened blast furnace slag (BFS) will be installed across the platform area of the wellsite.

10.1 CQA Engineer

For the BFS, the CQA Engineer shall:

- assess the quality control test results provided by the HDPE FML installer and the results of the independent CQA particle size distribution testing to ensure that the proposed slag meet the requirements of the specification and provide approval prior to placement;
- continuously monitor BFS placement operations ensuring that the characteristics of the material do not change and that the lining system is not compromised; and
- ensure that the BFS is placed in accordance with the specification using agreed, acceptable methods, in accordance with the accepted method statement and record the methods used.

10.2 Screened Blast Furnace Slag Placement

The Principal Contractor shall inspect the active area of the wellsite prior to deployment of the screened re-graded BFS to ensure that there has been no deterioration to the HDPE FML or geotextile layers.

The Principal Contractor is to ensure that:

- equipment, plant and tools used shall not damage the HDPE FML and geotextile layers by handling, trafficking, leakage of hydrocarbons or by other means;
- personnel working on the active area of the wellsite will not smoke, wear damaging shoes, or otherwise engage in any activity that could damage the HDPE FML or geotextile layers;
- care is to be taken when deploying the screened re-graded BFS on to the active area of the wellsite. For clarity, the screened re-graded BFS will be transferred from the stockpile by CQA Engineer approved plant type applying and methods;
- following infilling of the site surface, the screened re-graded BFS will be rolled and compacted to provide a level working plateau;
- the Principal Contractor shall verify that the screened re-graded BFS has been installed in accordance with the CQA Plan and approved method statement; and
- the Principal Contractor shall maintain detailed records of the placement of the screened re-graded BFS. These shall be incorporated into the Health and Safety File and the Site Handover Pack.

10.3 Plate Bearing Test

Upon completion of the wellsite working platform, a number of in-situ Plate Bearing Tests will be undertaken upon the surface aggregates by the CQA Engineer to determine the ultimate bearing capacity of the ground and to also verify against the original wellsite design criteria.

The CQA Engineer shall complete a plate load test using a 600mm diameter plate in accordance with the test method attached at Appendix 2.

The results of the plate bearing tests will be kept on record by the Operator to demonstrate the adequacy of the site in respect of future load-bearing operations.

11. INSTALLATION OF PERIMETER CONTAINMENT DITCH

Following placement of the screened BFS across the area of the platform, the Principal Contractor will install a 300mm perforated twin wall pipe within the base of the perimeter ditch. Where access ramps are installed, a 300mm concrete encased solid pipe will be installed within the perimeter ditch located directly beneath the access ramp.

Following installation of the perforated twin wall pipe or the concrete encased solid pipe within the perimeter ditch, the Principal Contractor will infill the perimeter ditch with drainage stone to the platform level required across the active area of the wellsite.

11.1 CAQ Engineer

For the drainage stone, the CQA Engineer shall:

- ensure that the Contractor supplies quality control test results carried out on the quarry product proposed to form the drainage stones in accordance with the requirements of the Civil and Structural Design Statement;
- assess the quality control test results provided by the Contractor to ensure that the proposed aggregates meet the requirements of the specification and provide approval prior to delivery to site;
- collect representative samples of the aggregates and arrange for compliance testing in accordance with the specification;
- assess the results of the compliance testing and confirm whether the requirements of the specification have been met;
- continuously monitor aggregate placement operations ensuring that the characteristics of the material do not change and that the lining system is not compromised; and
- ensure that the aggregate is placed in accordance with the specification using agreed, acceptable methods, in accordance with the accepted method statement and record the methods used.

For the pipework and chamber, the CQA Engineer shall:

- ensure that the Contractor provides the product details with supporting calculations on the product/s proposed for each diameter of pipe to be used to form the drainage pipework in accordance with the requirements of the Civil and Structural Design Statement;
- assess the product details and supporting calculations to ensure compliance with the requirements of the specification for each diameter of pipe to be used;
- ensure that all pipework associated with the drainage system is delivered, stored and handled in accordance with the manufacturer's recommendations and or the specification;
- ensure that the pipework is installed at the locations shown on the relevant drawings;
- ensure that the pipework joints are constructed in accordance with the manufacturer's recommendations;
- ensure that the pipe installation, pipe bedding and gravel haunch over the pipework is in accordance with the specification; and
- ensure that the Principal Contractor surveys the level of the top of the pipework and the end points of each drainage pipe.

11.2 Drainage Aggregates

The drainage aggregate shall be clean fines free single 40mm stone approved by the CQA Engineer. The Principal Contractor shall ensure the stone, as placed, complies with the following specification:

Test	Acceptance Criteria
10% fines value (BS 812 Part 111: 1990) [Ref. 21]	>100 kN (Soaked Test)
Particle Size Distribution (BS 812 Part 103)	As BS 13242 [Ref. 22] (see below)

Table 8: Drainage Aggregate Specification

11.3 Drainage Stone Testing

The CQA Engineer will collect three (3) samples evenly distributed across the platform of the drainage stone after placement for 10% fines values and particle size distribution and shall evaluate the results to ensure the grading of the drainage stone has not changed substantively from that stated in section 11.2 above.

11.4 Drainage Stone Placement

The Principal Contractor shall undertake the placement of the drainage stone material with minimal trafficking and handling and in such a manner that causes no damage to, or displacement of, underlying layers and such that no wrinkles develop in the protection geotextile.

Plant used to place the drainage stone shall under no circumstance be driven directly on the underlying layers other than for safety of the Works.

In general, the methods employed shall comprise the following:

- tipping of fresh material on previously placed material;
- casting material by 360° excavator (using a bucket without teeth);
- pushing of material up and over the face of the tipped load allowing it to fall vertically onto the geotextile; and
- pre-loading of the geotextile with discrete mounds of material, to prevent the generation of excessive wrinkles or folds, and in-filling between mounds.

The Principal Contractor shall remediate any damage to the underlying material in accordance with the specification and to the satisfaction of the CQA Engineer who will determine the extent of the remedial work.

11.5 Drainage Pipework

The manufacturer or supplier of pipe shall provide the following information for each separate consignment of pipes delivered to the Site:

- product name and number;
- name and address of producer/supplier;
- manufacturing characteristics and constituents;
- consignment number and delivery dates; and
- copy of the manufacturers' recommendations for storage and installation.

Each consignment shall be numbered and the delivery date recorded. A consignment is considered to be the number of lengths of pipe delivered at one time.

11.6 Drainage Pipework Installation

The Principal Contractor shall make the joints between lengths of the pipe and junctions between pipe runs only with purpose made fittings supplied by the manufacturers of the pipe. The Principal Contractor shall submit to the CQA Engineer his proposal for the method of jointing for his approval.

The Principal Contractor shall install the pipes with a full haunch of drainage stone under each side ensuring that the pipe is properly bedded to provide the required support.

The drainage stone surrounding the pipework shall be firmly compacted to support the pipework.

12. VALIDATION REPORT

Following completion of the works, the CQA Engineer will report fully on the quality control testing and observations undertaken during all construction elements. The report shall be submitted to the LPA and EA within three (3) months of the works completion date.

The Construction Quality Assurance (CQA) validation report will constitute a Compliance Document and shall include details of construction quality assurance together with an assessment of the works. As a minimum the CQA validation report shall include:

- description of the works;
- daily records and completed CQA forms;
- manufacturer's and Contractor's certificates and documentation;
- test reports, both laboratory and field;
- photographic records;
- any non-compliance records; and
- as-built drawings.

The quality assurance programme outlined in this CQAP is not an exhaustive list of procedures to be undertaken during the works but a summary of the minimum requirements and constitutes the basic quality control procedures.

13. REFERENCES

1. The Environment Agency Onshore Oil and Gas Sector Guidance.

   Available at: https://www.gov.uk/guidance/onshore-oil-and-gas-sector-guidance

2. Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works

   Available at: https://www.standardsforhighways.co.uk/mchw

3. Environment Agency Technical Guidance LFE2 - Cylinder testing geomembranes and their protective materials

   Available at: https://www.gov.uk/government/publications/cylinder-testing-geomembranes-and-their-protective-materials-lfe2

4. Environment Agency Technical Guidance LFE5 – Using geomembranes in landfill engineering

   Available at: https://www.gov.uk/government/publications/using-geomembranes-in-landfill-engineering-lfe5

5. Environment Agency Technical Guidance LFE7- Using non-woven protector geotextiles in landfill engineering

   Available at: https://www.gov.uk/government/publications/using-non-woven-protector-geotextiles-in-landfill-engineering-lfe7

6. CIRIA C736 – Containment systems for the prevention of pollution

   Available at: https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductCode=C736F

7. Waste & Resources Action Programme (WRAP) Quality Protocol

   Available at: https://www.gov.uk/government/publications/quality-protocol-production-of-aggregates-from-inert-waste

8. BS EN ISO 10319:2015 – Geosynthetics Wide-width tensile test

   Available at: https://www.iso.org/standard/57696.html

9. BS EN ISO 12236:2006 – Geosynthetics Static puncture test (CBR test)

   Available at: https://www.iso.org/standard/40762.html

10. BS EN 965:1995 – Geotextiles and geotextile-related products. Determination of mass per unit area

    Available at: https://knowledge.bsigroup.com/products/geotextiles-and-geotextile-related-products-determination-of-mass-per-unit-area?version=standard

11. BS EN 964-1 – Geotextiles and geotextile-related products. Determination of thickness at specified pressures - Single layers

    Available at: https://knowledge.bsigroup.com/products/geotextiles-and-geotextile-related-products-determination-of-thickness-at-specified-pressures-single-layers?version=standard

12. BSEN ISO 9863-1 – Geosynthetics – Determination of thickness at specified pressures, Part 1: Single layers

    Available at: https://www.iso.org/standard/59641.html

13. BSEN ISO 13433 – Geosynthetics – Dynamic perforation test (cone drop test)

    Available at: https://www.iso.org/standard/36718.html#:~:text=Abstract,are%20dropped%20on%20its%20surface.

14. EN 13253 – Geotextiles and geotextile-related products - Characteristics required for use in erosion control works

    Available at: https://standards.iteh.ai/catalog/standards/cen/6aeb3390-ea6b-419b-bd98-1b89b654b745/en-13253-2016

15. EN ISO 13438 – Geosynthetics Screening test method for determining the resistance of geotextiles and geotextile-related products to oxidation

    Available at: https://www.iso.org/standard/65541.html

16. BSEN 14030 – Geotextiles and geotextile-related products. Screening test method for determining the resistance to acid and alkaline liquids

    Available at: https://knowledge.bsigroup.com/products/geotextiles-and-geotextile-related-products-screening-test-method-for-determining-the-resistance-to-acid-and-alkaline-liquids?version=standard

17. BGA/TW1/CS WIP Welding Standard (BS EN 13067:2020) – Plastics welding personnel. Qualification of welders. Thermoplastics welded assemblies

    Available at: https://knowledge.bsigroup.com/products/plastics-welding-personnel-qualification-of-welders-thermoplastics-welded-assemblies?version=standard

18. ASTM D4437 – Standard Practice for Nondestructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes

    Available at: https://www.astm.org/d4437_d4437m-16r18.html

19. ASTM D6392 – Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

    Available at: https://www.astm.org/d6392-12r18.html

20. GRI – GM19 – Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers

    Available at: https://geosynthetic-institute.org/grispecs/gm19a.pdf

21. BS 812 Part 111 – Testing aggregates - Methods for determination of ten per cent fines value (TFV)

    Available at: https://knowledge.bsigroup.com/products/testing-aggregates-methods-for-determination-of-ten-per-cent-fines-value-tfv?version=standard

22. BS 13242 – Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction

    Available at: https://knowledge.bsigroup.com/products/aggregates-for-unbound-and-hydraulically-bound-materials-for-use-in-civil-engineering-work-and-road-construction-1?version=standard

APPENDIX 1 – CQA FORMS

CQA Form #1	Daily Report				
Staff Member:			Day/Date:		
Client:			Site:		
Project:					
Weather:					
List of Visitors:					
1.	2.	3.	4.	5.	6.
7.	8.	9.	10.	11.	12.

Details of Site Work and CQA Work:

Progress / Works Completed

Problems Encountered

Miscellaneous Plant and Workers Used

Contract Personnel:	Position:	On-Site:	Contract Personnel:	Position:	On-Site:

Plant:	Working Area:	Hours Worked:	Standing:	Breakdown:

CQA Form #2	Weekly Report		
Staff Member:		Week:	
Client:		Site:	
Project:			

Progress

Deliveries

Problems Encountered

Environmental Issues

Plant Used

CQA Form #3	Hand Vane – Shear Strength Test Record
Site:	
Job No:	
Project:	
Engineer:	
Material:	

Date:	Location:	CQA Test Grid Ref:	Shear Strength (kN/m^2):			Average (kN/m^2):

CQA Form #4	Formation Subgrade Approval Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Formation Panel Reference:	Remedial Works Completed:	Time/Day Approved:	Remarks:

CQA Form #5	FML Roll Delivery Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Material Type:	Date Delivered:	Resin Batch Ref:	Roll No:	Wrapping Intact (Y/N?)	Roll Damage:	QC Certificates Assessed & Passed:	QC Certificate:	Date Sampled:	Sample Ref:	Sample Type:	Remarks:

CAQ Form #6	FML Trial Seam Summary
Site:	
Job No:	
Date:	
CQA Inspector:	

Date:	Time:	Trail Seam No:	Weld Type (Fusion/ Extrusion):	Welder Machine No:	Ambient Temp (°C):	Pre-Heat Temp (°C):	Weld Temp (°C):	Welder Speed (m/min):	Welder Tech:	Tab Results (Peel):	Tab Results (Shear):	Remarks:

CQA Form #7	FML Laying Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Date:	Time:	Weather:	Resin Batch No:	Roll No:	Panel No:	Left Thickness (s mm):	Right Thickness (s mm):	Lead Thickness (s mm):	Tail Thickness (s mm):	Mean Thickness (s mm):	Length (m):	Width (m):	Area (m^2):	Cumulative Area:	Visual Inspection:

CQA Form #8	FML Fusion Welded Seam Construction & Destructive Testing Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Date:	Weld Machine No:	Seam Reference:	Sheet Temp (°C):	Weld Start Time:	Weld Finish Time:	Welder Tech:	Weld Temp (°C):	Welder Speed (m/min):	Seam Length (m):	Cum Length (m):	Field Tab Peel / Shear Tests (P/F?):	Remarks:

CQA Form #9	FML Fusion Welded Seam Construction Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Date:	Weld Machine No:	Panel Number:	Sheet Temp (°C):	Weld Start Time:	Weld Finish Time:	Welder Tech:	Pre-heat Temp (°C):	Weld Temp (°C):	Seam Length (m):	Cum Length (m):	Remarks:

CAQ Form #10	FML Non-Destructive Seam Testing Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Date:	Seam Reference:	Seam Length (m):	Weld Type (Fusion/ Extrusion):	Start*		End*		Pressure Loss %:	Spark / Vacuum Test:	Passed By:	Remarks:
				Time:	Pressure (bar):	Time:	Pressure (bar):				

CAQ Form #11	FML Defects and/or Repair Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Date:	Defect Information				Repair Information		
	Repair Reference:	FML Seam / Panel Ref:	Location:	Defect Description:	Repair Type:	Repair Technician:	Remarks:

CQA Form #12	Geotextile Delivery Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Date Delivered:	Batch Ref:	Roll No:	Wrapping Intact (Y/N?):	Roll Damage:	Area (m^2):	Cumulative Area (m^2):	Date Sampled:	Sample Ref:	QC Certificates Assessed & Passed:	Remarks:

CQA Form #13	Geotextile Laying Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Date:	Panel Number:	Roll No:	Role Length (m):	Overlap Width Satisfied?:	Seaming Requirements Satisfied?:	Remarks:

CAQ Form #14	Geotextile Defects and/or Repair Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Date:	Defect Information				Repair Information		
	Repair Reference:	Geotextile Seam / Panel Ref:	Location:	Defect Description:	Repair Type:	Repair Technician:	Remarks:

CQA Form #15	Non-Compliance Record
Site:	
Job No:	
Date:	
CQA Inspector:	

Non-Compliance with:	Reason for Non-Compliance:	Action Taken:	Remarks:

APPENDIX 2 – PLATE BEARING TEST METHOD

PLATE BEARING TEST METHOD STATEMENT

1. SCOPE

To define the processes involved in undertaking plate load tests.

2. DEFINITIONS

Plate load tests (PLT) are used to determine the vertical deformation and strength characteristics of soil in situ by assessing the force and amount of penetration with time when a rigid plate is made to penetrate the soil. Uses are to evaluate the ultimate bearing capacity, the shear strength and deformation parameters of the soil beneath the plate without entailing the effects of sample disturbance.

3. HEALTH & SAFETY MANAGEMENT

All works are to be carried out at the site require pre-authorisation under the Egdon Resources permit to work system. Method statements and corresponding risk assessments must be provided in advance of mobilisation to allow sufficient time for them to be reviewed and, as such, reduces delays on site.

4. RESPONSIBILITIES

The engineer or technician undertaking the test is responsible for ensuring that:

- all necessary equipment is brought to site in good working order;
- that testing is carried out to the appropriate specification; and
- that results are passed to the Egdon Resources Construction Manager as appropriate.

5. PROCEDURES

Testing should be undertaken as per the procedures given in BS 1377: 1990 [Ref.1].

Test locations and depths should be provided by the Contract Specification or the Designer/Client on site. Where tests are to be undertaken below 1.20m below ground level or in ground that is deemed to be prone to failure, the excavation should be battered back or shored prior to entry. Tests should not be undertaken below the water table or where water is entering the trial pit.

Test locations should be checked for services and a permit to work issued prior to the test being undertaken. It should be noted that buried pipes are susceptible to damage from the loads applied during plate load tests.

Test results should be presented as per BS 1377: 1990.

6. METHOD

The method for carrying out plate bearing tests is as follows:

- determine appropriate kentledge (reaction mass) for test;
- a circular plate (diameter to be specified by client) shall be used;
- make sure that the area for the plate is generally level and is undisturbed as possible;
- the plate shall be placed on a thin layer (10-15 mm thick) of clean dry sand to produce a level surface on which to bed the plate;
- ensure the plate is level by use of a spirit level;
- place the jack in the centre of the plate underneath the reaction load, making sure that this is done on a solid part of the machine being used;
- place the beam alongside the plate and position the dial gauge evenly across the plate;
- pump the jack up to biting point, during this operation a small seating load may be applied to the plate to enable adjustments to be made: this seating load shall be less than 5kN/m^2;
- take zero mm penetration readings off the dial gauges;
- the load shall be applied in even increments and written on the work sheet provided in bar;

  - if the ground being tested appears to be soft use small increments e.g. in 10 or 20 bar;
  - if the ground being tested appears to be firm increments of 40 to 50 bar can be used.
- at each increment the pressure shall be maintained as near as possible constant; and
- after each increment and when satisfied that there is no further movement from the dial gauge, readings can be taken from the dial gauges;

7. REFERENCES

1. BS 1377: 1990. Method of Test for Soils for Civil Engineering Purposes. Part 9: In-situ tests.

   Available at: https://knowledge.bsigroup.com/products/methods-of-test-for-soils-for-civil-engineering-purposes-general-requirements-and-sample-preparation-1?version=standard

APPENDIX 3 – CONSTRUCTION DRAWINGS

Note: The plans contained in this Appendix are indicative construction layout plans, the purpose of which is to give the reader of this CQAP an understanding of the proposed construction. Once planning permission and environmental permits have been granted, detailed construction drawings will be prepared, replacing the indicative construction layout plans.