



ENVIROARM LIMITED

H EVASON & CO

DORRINGTON QUARRY LANDFILL SITE

**CONSTRUCTION QUALITY
ASSURANCE PLAN**

**FOR THE INSTALLATION OF THE
ENGINEERED GEOLOGICAL BARRIER**

REF: ARM/SCM/DQL/CQA/1.00/2021

REVISION 1.00

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1. **INTRODUCTION**

- 1.1 The Dorrington Quarry Landfill Site is to operate as an inert landfill site, in accordance with the Environmental Permitting Regulations and will comply with the Environment Agency Guidance on Inert Landfills.
- 1.2 The landfill lining system proposed for Dorrington Quarry is to be constructed by the placement of low permeability selected soils containing clays and silts, and having a fines content of +20%, and achieving a permeability of 1×10^{-7} m/s. This report presents the Construction Quality Assurance Plan (CQAP) for the mineral lining to produce an artificial geological barrier.
- 1.3 Definitions
- (a) "Client" means Permit Operator;
 - (b) "Contractor" means appointed earthworks plant hire firm and includes the Contractor's personal representatives;
 - (c) Engineer means Third Party Consulting Engineers and includes the Engineer's personal representatives;
 - (d) Mineral Liner System means a 1.0 metre thick soil liner with a permeability of not greater than 1×10^{-7} m/s, though an anticipated field target value of 1×10^{-8} m/s should be achievable and a lower value of 1×10^{-9} m/s.

2. **DESCRIPTION OF THE WORKS**

2.1 General

2.1.1 The Works to be performed by the Operator will comprise:

2.1.1.1 All setting out necessary for the Works.

2.1.1.2 All initial preparation works to allow the earthworks contractor to commence the contract for bulk earthworks and mineral lining.

2.1.1.3 The construction of associated temporary access roads and temporary drainage and the diversion and modification of existing drainage ditches.

2.1.2 The Works to be performed by the appointed Contractor will comprise:

2.1.2.1 The transport and placing of the basal seal with suitable material within the acceptance criteria as defined in the Source Evaluation

2.1.3 The Works to be performed by the Engineer will comprise:

2.1.3.1 The Construction Quality Control (CQC) by way of independent testing on a part time basis.

2.1.3.2 Construction Quality Assurance (CQA) by way of independent verification that the mineral lining Works have been carried out in accordance with the Construction Quality Assurance Plan (CQAP), source evaluation report, acceptance criteria and design

2.1.3.3 The production of the Construction Quality Assurance Validation Report (CQAVR).

3. EARTHWORKS

3.1 General

3.1.1 The landfill mineral geological barrier shall be constructed so that upon completion it shall be 1.0m compacted thickness and shall conform to the lines, levels and dimensions shown on supplied drawings issued prior to commencement of the contract.

3.2 Fill Materials for the Mineral Liner

3.2.1 Selected soils that have a high clay content or high fines content shall be classified as **SUITABLE MATERIAL** which is to be used in the construction of the mineral geological barrier and is further categorised thus; it is to be a low permeability material which when compacted in uniform layers is capable of achieving a permeability of 1×10^{-7} m/s or less. The material will then be tested using either a Nuclear Density Gauge (NDG), or Core Cutters (CC), to check that it falls within the acceptable moisture content range.

3.2.2 **SUITABLE MATERIAL** to be used shall have a liquid limit not greater than 90% and a plastic limit not greater than 65% and a minimum fines fraction of 20%, determined by particle size sedimentation BS1377: Part 2:1990 Clause 9.4.

3.2.3 Material not suitable for compaction shall include clays, rocks or boulders having a size greater than 75mm in diameter, sands, gravels and silts which, whether in isolation or in combination following compaction in uniform layers, may not be capable of achieving a permeability of 1×10^{-7} m/s or less. Rejected fill will be bladed away from the compaction area and loaded onto a dump truck for removal for use as restoration material, daily cover or, if shown to be acceptable, used as supporting engineering fill.

3.2.4 The following materials shall not be contained within the **SUITABLE MATERIAL**:

- Material from swamps, marshes and bogs;
- Peat, logs, stumps and perishable materials;
- Material susceptible to spontaneous combustion;
- Material in a frozen condition;
- Industrial, commercial or household waste.

3.3 Compaction

3.3.1 Compaction shall be carried out in uniform layers as soon as practicable after deposition. Plant and methods will only be used that are in accordance with the Highways Specification Table 6/2 and Table 6/4 and corroborative core cutter tests will be taken on an ad hoc basis to confirm suitable density and air voids are less than 5%.

3.3.2 The methodology for compaction will be established following compaction trials. The earthworks shall therefore be carried out in the following sequence.

3.3.2.1 Deposition of suitable clay with no material stones or boulders greater than 165mm in diameter.

3.3.3.2 Blading out of material to a uniform uncompacted thickness (**D**), as defined by the compaction trials, to achieve a compacted 250mm lift.

3.3.3.3 Compaction by **N** passes of the approved compactor, confirmed during the compaction trial.

- 3.3.3.4 A tamping roller will be used on each of the four lifts to enable the next layer to be keyed in, with a minimum penetration of the previous layer by 30mm.

4. QUALITY CONTROL

4.1 British Standards

- 4.1.1 All materials and workmanship shall comply with the appropriate British Standard Specification as described in the British Standard Yearbook, or such other standards as approved in writing by the Engineer. The abbreviation BS is used when referring to a British Standard and CP when referring to a Code of Practice.
- 4.1.2 The primary control documents are BS1377: 1990 Methods for Testing Soils for Civil Engineering Purposes and BS 5930:1999 Code of Practice for Site Investigation.
- 4.1.3 Additional reference is to be made to American Society for Testing Materials, (ASTM) methods.

4.2 Test Definitions

- 4.2.1 Throughout this CQAP unless otherwise stated, the following test definitions shall apply for tests carried out on the base, during compaction trials and mineral liner placement:
- 4.2.2 **In-situ Dry Density** shall mean the dry density determined by *Method 2.5 in BS 1377, Part 9: 1990*, or if approved in writing by the Engineer, *Methods 2.1 or 2.4 in BS 1377, Part 9: 1990*.
- 4.2.3 **Moisture Content** shall be determined by *method 3.2 in BS 1377, Part 2: 1990* or any other method approved in writing by the Engineer. Additional field test results will be by way of NDG as per BS1377 or speedy moisture tester ASTM D-4944 Calcium Carbide Gas Pressure Test.
- 4.2.4 **Classification Tests** shall be that defined in *Methods 4.3, 5.3 and 5.4,8 in BS 1377, Part 2: 1990*.
- 4.2.5 **Particle Size Distribution** shall be that defined in *Method 9 of BS 1377, Part 2: 1990*.
- 4.2.6 **Permeability Measurement** shall be in a Triaxial Cell as defined by *Method 6 of BS 1377, Part 6; 1990*.
- 4.2.7 **Quick Undrained Triaxial Tests** shall be determined as defined by *Method 8 of BS 1377, Part 7; 1990*.

4.3 Testing Schedule

- 4.3.1 During the various phases of the Works, the Engineer will undertake testing and will take samples for laboratory testing to ensure the integrity of the base and perimeter seals. These tests will include:
- 4.3.1.1 In-situ Density (CC/NDG) 1No.test per 2000m³.
- 4.3.1.2 Moisture Content (CC/NDG) 1No.test per 2000m³
- 4.3.1.3 Classification (Atterberg Limits, Natural Moisture Content and Specific Gravity) 1No.test per 4000m³
- 4.3.1.4 Particle Size Distribution 1No.test per 4000m²

- 4.3.1.5 Permeability 1No.test per lift of each section as per Agency Guidance.
 - 4.3.1.6 BS Triaxial Permeability two per Phase
 - 4.3.1.7 Shear Vane Test using hand held vane 1No.test per 1000m³
- 4.3.2 In addition to the above, thickness surveys are to be carried out by the Engineer to demonstrate that the correct thickness of geological barrier has been constructed. In addition the Engineer shall carry out visual and physical observations and shall verify observations using a staff and photographs.

4.4 Material Sampling Procedures

- 4.4.1 All material samples shall be taken in accordance with *BS 5930 (2015)*. All samples shall be given a unique reference and placed in sealed containers before removal to a secure site store for transfer to the approved soils laboratory. Both a despatch advice note and two copies of the Laboratory Testing Schedule, all signed by the Engineer on site, shall accompany the samples during their transfer.

4.5 Material Testing Procedures

- 4.5.1 All materials sampled will be taken to a UKAS accredited laboratory. Upon receipt at the laboratory the samples will be logged into the sample store (and into the computer system) where they will be kept until required for testing. All laboratory testing will be in accordance with *BS 1377; 1990*, or other approved method.

4.6 Excavated Material

- 4.6.1 Source materials shall be taken by the Engineer for independent laboratory testing in accordance with Clause 4.4.1. Samples shall be taken from excavation areas at a minimum rate of three samples per 25,000m³ and a further sample per 8,000m³. Source testing shall consist of:

4.6.1.1 **Dry Density/Moisture Content Relationship** *BS 1377: 1990 Part 4 test 3 with 4.5 kg rammer.*

4.6.1.2 **Triaxial Permeability Testing** as per Environment Agency Guidance

4.6.1.3 **Classification Tests** PL, LL, NMC, SG, *BS 1377: 1990; Part 2: Tests 3,4 and 5*

4.6.1.4 **Particle Size Distribution** *BS 1377: 1990: Part 2: Test 9.*

4.7 Site Clearance

- 4.7.1 The surface to be occupied by the mineral liner shall be graded. Any debris, angular or sharp rocks shall be removed as well as any other deleterious materials. The sub-grade should be compacted if appropriate so that no significant rutts are observed prior to placement of the geological barrier.
- 4.7.2 Materials removed in the clearing operations shall be stockpiled for removal or landfilling.
- 4.7.3 The Contractor shall take all reasonable precautions against the site being flooded or water-logged. The Contractor shall conduct his cleaning operations in such a way as to minimise the disturbance to the ground surface. In the event of surface deterioration by any cause, the Engineer may direct the Contractor to trim, scarify and roll the formation as

appropriate. The Engineer must certify that surfaces are suitable for lining on or against.

4.8 Emplaced Material

- 4.8.1 The in-situ density tests and moisture content shall be performed using either Core Cutters at a frequency of one per 1,000m³.
- 4.8.2 If the results of the above tests show densities which indicate the state of compaction to be inadequate, then further compaction shall be carried out and the area retested using Core Cutters or alternatively the Engineer may instruct that the material be removed.
- 4.8.3 All holes produced using the CC shall be sealed. Core cutters shall be taken at different depths to ensure satisfactory compaction is achieved throughout each lift.
- 4.8.4 Additional field tests will be carried out by the Engineer as a corroborative check on the placed field moisture content. This will typically be by way of speedy moisture tester as per ASTM D-4944 or on site weighing and drying as per ASTM D-4959. These results will be reported in the Daily Log Sheets on each day that samples are tested.
- 4.8.5 Field permeability determinations shall be carried out on in-situ sample U100 cores at a rate of one per 4000m³ or one per cell of emplaced material. Testing locations for permeability will be recorded on a lift test plan.
- 4.8.6 Classification tests (PD, LL, NMC, PI, SG) shall be carried out on emplaced material every 4,000m³ on a regular grid pattern. Test locations shall be reported on the lift test plan.
- 4.8.7 Particle size distribution gradings shall be carried out on emplaced material every 4000m³ on a regular grid pattern and reported on the lift test location plan.

4.9 Adverse Conditions

- 4.9.1 The Contractor shall not carry out any placing or compaction of fill materials when conditions are such that, in the opinion of the Engineer, the quality of the work or adjacent completed works would be adversely affected. After any operation has been stopped due to adverse conditions, it shall not be re-started without the verbal approval of the Engineer, and recorded on the daily logs.

4.10 Instability

- 4.10.1 The Contractor shall take all necessary precautions to prevent instability in any part of the Works. The Contractor shall make good both any damage or defect and remove reject material caused by instability and provide backfill or other reinstatement to the written approval of the Engineer. The sub-grade formation and all mineral liner should achieve minimum 50kPa shear strength.

4.11 Placement Methodology

- 4.11.1 The Contractor shall place uncompacted lifts of thickness D, and traverse with N passes, to achieve a minimum 250mm compacted thickness.
- 4.11.2 Placement of the liner system will be in uncompacted lifts of thickness D, and traversed with N passes, in uniform strips, to allow for visual examination.

5. DRAINAGE

5.1 General

5.1.1 The Contractor shall construct all necessary drainage works as required or as approved by the Engineer.

5.1.3 No surface water will be allowed to freely enter the site from adjacent completed area and should at all times be intercepted by temporary surface water cut-off ditches constructed around the cell and will be progressively infilled.

6. WORKS SUPERVISION

6.1 Quality Control Procedures for Supervision of the Works shall be in accordance with those specified within this document. When lining works are being carried out, the Engineer shall be on site on a part time basis, at least once per week during placement works. The Engineer shall be a Civil Engineer, Geotechnical Engineer, Engineering Geologist or other persons with relevant experience and suitable training. Details of the proposed and final engineers used on site shall be forwarded to the Environment Agency.

7. PROJECT MANAGEMENT STRUCTURE

7.1 Staff and their responsibilities are to be identified and forwarded to the Environment Agency prior to commencement of works. Curriculum Vitae for the Engineer will be forwarded to the Agency on appointment. The Agency shall be notified of any permanent changes in personnel.

8. CONSTRUCTION QUALITY ASSURANCE REPORTS

8.1 Upon completion of each of the phase of lining, the Engineer will present a Construction Quality Assurance Validation Report describing the construction work undertaken in each phase, together with the quality control monitoring of the Works and the results of all field and laboratory testing, test locations, photographs, as built plans and cross sections, and details of any non conformances. This will be known as the Construction Quality Assurance Validation Reports (CQAVR) and shall be submitted in writing to the Agency.

REFERENCES

BRITISH STANDARDS AND CODES OF PRACTICE

BS 1377: 1990: Methods of Testing for Soils for Civil Engineering Purposes. British Standards Institution.

BS 5930: 2015: Code of Practice for Site Investigations. British Standards Institution.

ORDNANCE SURVEY MAPS

OS Sheet 1:50,000 topographical map. Landranger Series. Sheet 139 Birmingham & surrounding area. Ordnance Survey.

PUBLICATIONS AND REPORTS

Environment Agency Earthworks on Landfill Sites.

Environment Agency Guidance on Inert Landfill Sites

Department of Transport Highways Specification