

Frodsham Solar

Outline Landscape and Ecology Management Plan

~~May~~ November 2025

Cubico
SUSTAINABLE INVESTMENTS

PINS Ref: EN010153
Document Ref: EN010153/DR/7.13
Planning Act 2008; and Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations Regulation 5(2)(q)

Revision ~~P01~~P02

Document Control

Revision	Date	Prepared By	Reviewed / Approved By
P01	May 2025	[redacted]	[redacted]
P02	November 2025		

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1.0 INTRODUCTION

1.1 Purpose of the oLEMP

1.1.1 This document is the **outline Landscape and Ecology Management Plan** ('**oLEMP**') [**EN010153/DR/7.13**] for the Frodsham Solar Farm ('the Proposed Development'). The **oLEMP** is part of the information that accompanies the DCO Application for the Proposed Development. It sets out a framework for the successful implementation, establishment and longer-term management and maintenance of the proposed landscape and ecological works that form a key part of the Proposed Development.

1.1.2 Should the Proposed Development be consented, then the DCO will require that a final Landscape and Ecology Management Plan ('final LEMP') is produced and agreed with the local planning authority (Cheshire West and Cheshire Council ('CWaCC'). Details regarding the agreement of proposals within the Non Breeding Bird Mitigation Area ('NBBMA') are set out in **Appendix B**. The Proposed Development must be undertaken in accordance with the approved plan. This is secured via a Requirement in Schedule 2 of the **draft DCO [EN010153/DR/3.1]**.

1.1.3 The design of the Proposed Development has followed an iterative approach, which includes the identification of key landscape and ecological features to be retained and enhanced where feasible, along with opportunities to create new features. Measures to mitigate against adverse environmental effects, and to enhance the baseline environment, also form part of the design. For further details of the design process, refer to the **Design Approach Document** ('**DAD**') [**EN010153/DR/5.8**]. For further details of environmental effects, including mitigation and enhancement measures, refer to the **Environmental Statement** ('**ES**') [**EN010153/DR/6.1**].

1.1.4 Retained and proposed landscape and ecological features within the Order Limits will be managed and maintained through the life of the Proposed

Development (including during construction and decommissioning) unless otherwise stated in **Section 6.0**.

1.1.5 The **oLEMP** also provides an overview as to how habitats specified within the **Biodiversity Net Gain Report** ('**BNG Report**') [**EN010153/DR/7.12**] will achieve their targeted habitat type and conditions within the anticipated timeframe. The **oLEMP** outlines appropriate monitoring criteria and commits to identifying remedial/contingency measures to be implemented in the event that these targets are not achieved. Habitat condition assessment sheets for the relevant habitats are provided as **Appendix C**.

1.2 Other Relevant Documents

1.2.1 The DCO Application is accompanied by a series of documents, plans and strategies that that explain how Frodsham Solar Limited ('the Applicant') will ensure that the Proposed Development is built, operated, and decommissioned in a way that accords with the overall Design Vision and Project Design Principles as set out in the **DAD [EN010153/DR/5.8]**, and reflects the committed mitigation measures and enhancement identified in the **ES**. These are:

i) **Design Parameters Statement** [**EN010153/DR/7.1**] ('**DPS**') which sets out the design parameters within which different components of the Proposed Development must be implemented / maintained.
ii) **Works Plans** [**EN010153/DR/2.3**] which set out the location of the different components of the Proposed Development as set out in Schedule 1 of the draft DCO.
iii) **Outline Construction Environmental Management Plan** ('**oCEMP**') **[EN010153/DR/7.5]** which explains how the Applicant would manage and report the potential environmental effects of the Proposed Development during the construction period.
iv) **Outline Operational Environmental Management Plan** ('**oOEMP**') **[EN010153/DR/7.6]** which explains how the Applicant would manage and

report the potential environmental effects of the Proposed Development once it becomes operational.

v) **Outline Decommissioning Environmental Management Plan** ('**oDEMP**') [**EN010153/DR/7.7**] which explains how the Applicant would manage and report the potential environmental effects of the Proposed Development during the decommissioning period.

vi) **Outline Public Rights of Way Management Plan** [**EN010153/DR/7.9**] which describes how the public rights of way ('PRoW') running through the Order Limits will be managed by the Applicant.

vii) **BNG Report** [**EN010153/DR/7.12**] which describes how the Proposed Development would achieve a minimum increase of 10% in habitat and hedgerow units and no net loss in watercourse units, when excluding the NBBMA. When taking into account the NBBMA the Proposed Development achieves a minimum increase of 10% in habitat, hedgerow and watercourse.

1.2.2 Should the Proposed Development be consented, then the DCO will require that final versions of these documents are produced and agreed with CWaCC, and other key stakeholders as necessary. The final documents will be in substantial agreement with the outline documents. The Proposed Development must be undertaken in accordance with the approved plans. This is secured via a Requirement in Schedule 2 of the **draft DCO [EN010153/DR/3.1]**.

1.2.3 The **ES** includes other plans and documents that illustrate and/or explain aspects of the Proposed Development. Of particular relevance to the **oLEMP** are:

i) **ES Vol 3 Figure 2-1: Indicative Construction Site Layout [EN010153/DR/6.3]** which sets out the indicative layout of works within the Order Limits during construction.

ii) **ES Vol 3 Figure 2-2: Indicative Operational Site Layout [EN010153/DR/6.3]** which sets out the indicative layout of development

within the Order Limits once operational (being one way in which the Design Parameters and limits of deviation on the Works Plans could be built out).

iii) **ES Vol 3 Figure 2-3: (a-e) Illustrative Environmental Masterplan (IEM) [EN010153/DR/6.3]** which sets out the location of proposed environmental mitigation enhancement measures. The **IEM** is included as **Appendix A** to the **oLEMP**.

iv) **ES Vol 2 Appendix 9-1: Flood Risk Assessment and Drainage Strategy [EN010153/DR/6.2]** which describes the proposed measures to be implemented in respect of surface water drainage and how these will be managed.

1.3 Consultation

1.3.1 Consultation with stakeholder groups and members of the public has been carried out, both formally and informally, as part of the design development process. Of relevance to the **oLEMP** was consultation held with:

i) Natural England ('NE').
ii) CWaCC.
iii) Cheshire Wildlife Trust ('CWT').
iv) Environment Agency.
v) National Grid.
vi) United Utilities.
vii) SP Energy Networks.
viii) Frodsham Town Council ('CWT').

1.4 Structure of the oLEMP

1.4.1 The **oLEMP** is structured as follows:

i) **Section 1.0: Introduction** provides introduction and context to the document.

ii) **Section 2.0: The Order Limits** describes the landscape and ecological context of the Order Limits and their surroundings.

iii) **Section 3.0: Proposed Development** describes the proposed works.

iv) **Section 4.0: Design Approach and Design Principles** sets out the design vision and project design principles that the Proposed Development will fulfil.

v) **Section 5.0: Roles and Responsibilities** sets out the roles and responsibilities of those involved in implementing the final LEMP.

vi) **Section 6.0: Management and Maintenance** sets out details of the works required to implement and maintain the landscape and ecology proposals, including planting and seeding specifications.

vii) **Section 7.0: Monitoring and Review** sets out details of how the measures included in the final LEMP would be monitored and reviewed during the life of the Proposed Development.

viii) **Appendix A: Illustrative Environmental Masterplan** illustrates the spatial extent of the proposals.

ix) **Appendix B: Outline Non-Breeding Bird Mitigation Strategy** sets out an overview of implementation, management and monitoring requirements within the Non-Breeding Bird Mitigation Area

x) **Appendix C: Condition Assessment Sheets** sets out the condition assessment requirements for each of the proposed habitat types, reflecting the templates published by the Department for Environment, Food & Rural Affairs ('DEFRA').

2.0 THE ORDER LIMITS

2.1 Introduction

2.1.1 The Order Limits cover approximately 337.5 hectares of land within Frodsham Marshes, as illustrated on **ES Vol 3 Figure 1-1: Site Location [EN010153/DR/6.3]**. The Order Limits comprise a series of distinct sub-areas which are illustrated on **ES Vol 3 Figure 1-2: Proposed Development Areas [EN010153/DR/6.3]**, as follows:

i) Solar Array Development Area ('SADA').
ii) Main Site Access.
iii) Non-Breeding Bird Mitigation Area ('NBBMA').
iv) Skylark Mitigation Area.
v) SPEN Grid Connection.
vi) SPEN Substation Access.

2.1.2 The SADA is the principal component of the Proposed Development. It is located at the eastern end of Frodsham Marshes, between the Mersey Estuary and the M56. The northern boundary of the SADA is formed by the River Weaver, and the north-western boundary by the Manchester Ship Canal, with the Mersey Estuary lying beyond. The western boundary of the SADA is formed by two of the former Manchester Ship Canal Dredging Deposit Cells (Cell 3 and Cell 6). The southern boundary of the SADA is formed by agricultural fields and the M56 motorway.

2.1.3 The SADA comprises three relatively distinct areas:

i) The Eastern Cluster of Frodsham Wind Farm: This area forms the western half of the SADA. Six operational wind turbines with a maximum height of 125m to blade tip, are located in this area. The land forms part of the former Manchester Ship Canal Dredging Deposit Ground, and includes Cells 1, 2 and 5. The cells have been restored to agricultural land and are

now grazed by sheep / cattle. The land in this area lies between approximately 9.5m and 12.5m above ordnance datum (AOD).

ii) Former agricultural land used by Frodsham Wildfowlers: The central area of the SADA is former agricultural land which has been left fallow and managed to encourage use by wildfowl. This area is currently used for recreational shooting by Frodsham Wildfowlers. This area of the Site is crossed by a series of ditches which have been used to drain and manage water levels on Frodsham Marsh. The land in this area lies at approximately 6m AOD.

iii) Agricultural land: The south-eastern portion of the SADA is agricultural land. It is understood that the land has been used for growing crops and silage. Some areas of the fields appear to have been left fallow and have been colonised with scrub and wet grassland. Hedgerows demarcate boundaries between field units. The land in this area lies at approximately 5m AOD.

2.1.4 The Main Site Access runs from the west, leaving the public highway via Pool Lane roundabout and turning onto Grinsome Road (a private road). Vehicles would travel east for approximately 1.5km, turning north at Grinsome Road Roundabout, onto Road 1 of Protos. Vehicles would then turn east along Marsh Lane which leads to Frodsham Wind Farm. The Frodsham Wind Farm access tracks provide access to the SADA.

2.1.5 The NBBMA is located on Cell 3 of the Manchester Ship Canal Dredging Deposit Cells and adjacent areas of ponds and grassland. It is immediately west of the SADA.

2.1.6 The Skylark Mitigation Area is located within an arable field to the south of the SADA.

2.1.7 The SPEN Grid Connection would run from the SADA to the existing Frodsham National Grid Substation. The connection would cross over the River Weaver.

2.1.8 The SPEN Substation Access follows an existing dedicated private access road running north from the A56 to the substation complex.

2.2 Land Use

2.2.1 The SADA comprises agricultural and former agricultural land. The Main Site Access and the SPEN Substation Access both comprise existing private access roads. The NBBMA comprises existing farmland and wetland. The SPEN Grid Connection would cross over the River Weaver.

2.2.2 A series of Public Rights of Way (PRoW) cross the Order limits; these are illustrated on **ES Vol 3 Figure 1-5: Public Rights of Way [EN010153/DR/6.3]**. The PRoWs include footpaths and restricted byways, which allow access by walkers, riders and cyclists. National Cycle Route 5 runs along a section of the Main Access Route and along part of the southern edge of the SADA.

2.2.3 The SADA is crossed by a series of utilities including above and below ground high voltage electricity transmission lines, high pressure gas lines, water distribution mains, telecommunication lines and private pipelines associated with nearby petrochemical plants.

2.2.4 The closest settlement is Frodsham on the south side of the M56, approximately 140m from the SADA. To the south-west of Frodsham lies Helsby, approximately 2km from the SADA. Both Frodsham and Helsby lie at the foot of the northern extent of the Cheshire Sandstone Ridge, which rises to a height of approximately 150m to the south of Frodsham and Helsby. To the north and north-east of the SADA, on the north bank of the River Weaver/Weaver Navigation, is Runcorn.

2.2.5 There are large areas of industrial development along this section of the River Mersey corridor. The northern bank of the River Weaver/Weaver Navigation is occupied by the INEOS Inovyn Runcorn Site which produces a range of chemicals for industrial use. The INEOS Inovyn Runcorn Site also includes

an 800MW gas-fired power station. The Runcorn Energy from Waste Plant operated by Viridor is further to the north.

2.2.6 To the west of the SADA is the Western Cluster of Frodsham Wind Farm comprising 13 no. wind turbines with the same maximum height as the Eastern Cluster). Further development in the marshes is located to the west of the Wind Farm and this includes Stanlow Oil Refinery, the Former CF Fertilisers Plant (decommissioned during 2022), Encirc Glass, and a series of different renewable energy and energy management facilities at Protos (some existing, some under construction, with further development proposed).

2.2.7 As set out above, the Manchester Ship Canal forms the northern boundary of the Order Limits and is separated from the Mersey Estuary by Frodsham Score, a 100m-200 m wide strip of low-lying marshland. The Mersey itself is a wide body of water, and the northern shore is approximately 2.65km from the SADA.

2.3 Landscape Context

2.3.1 *A Landscape Strategy for Cheshire West and Chester Borough*[1] ('CWaCC Landscape Strategy') describes and classifies the landscape of the CWaCC area. Urban areas are excluded. The Order Limits are located almost entirely within LCA 4a: Frodsham, Helsby and Lordship Marshes. The western end of the Access Road extends into LCA 9a: Dunham to Tarvin Plain. LCA4a is where change in the landscape resulting from the Proposed Development would occur and hence is the most relevant LCA for the design process.

2.3.2 Key perceptual/visual sensitivities, qualities and values for LCA4a are:

i) The flat landform and long views contribute to the perception of a large scale, exposed landscape.
ii) Presence of man-made embankments foreshorten views to the north across the Mersey Estuary.
iii) Important views to and from the Frodsham Sandstone Ridge and Helsby Hill.
iv) The consistent field pattern through planned enclosure gives the perception of a reclaimed, tamed landscape.
v) Vegetation-fringed ditches and rough ground and lagoons provide texture in the landscape.
vi) Parts of the marsh are remote, but the presence of traffic on the M56 motorway brings noise and movement to the area; the presence of birds and proximity to John Lennon Airport also contribute to noise and movement.
vii) Sense of naturalness of the marsh is diluted by man-made features and development.

[1] Bayou Bluenvironment and The Planning & Environment Studio (2016). *A Landscape Strategy for Cheshire West and Chester Borough*. Cheshire West and Chester Council. *Available at https://www.cheshirewestandchester.gov.uk/residents/planning-and-building-control/total-environment/local-landscape-character-assessment-landscape-strategy-2016 [Last Accessed 15 July 2024]*

viii) No prominent skyline, but embankments, pylons and industrial development are visually prominent.

ix) The open character means there is little opportunity for screening any large scale elements or for mitigating visual impact without the mitigation measures in themselves being highly visible - making it a visually sensitive landscape. There are relatively few sensitive visual receptors in the area, limited to a few residential properties and users of the PRoW network, but in adjacent areas overlooking the marsh there are views from Frodsham and Helsby as well as visitors to the viewpoints at the top of Helsby Hill and the War Memorial above Frodsham.

2.3.3 The landscape condition of LCA 4a is identified as follows:

"Although much of the area is actively farmed, the degraded hedgerows and broken fencing shows this to be a landscape in need of improved management. Some land to north of Lordship Lane remains in use for canal dredgings and has undergone change as a result of the preliminary works for the permitted windfarm. Wet grassland species have been lost and ditches are eutrophic as a result of the intensive agricultural use of the land".

2.3.4 The overall management strategy for LCA4a is:

"…to enhance and restore the conditions of habitats and features of the marshes whilst safeguarding its open character"

2.3.5 More detailed guidelines for landscape management and for built development within LCA4a are:

i) Encourage recreational development as a means of managing some of the more derelict and degraded areas of the landscape. Encourage use of the area by walkers, cyclists, rowers and horse riders (including provision of picnic facilities and viewing opportunities) whilst safeguarding the nature conservation interest of the area, particularly its importance for birds.

ii) Maintain the distinctive field pattern that reveals the planned 19th century enclosure of the marsh.
iii) Seek to restore thorn hedgerows that are falling into decline.
iv) Maintain and ecologically enhance the ditch system and riparian habitats and land supporting breeding, over wintering and passage birds. Seek opportunities to re-create habitats such as species rich grassland and reed beds.
v) Increase the biodiversity of intensively managed grassland and arable land – create and link buffer strips along linear features such as hedgerows and ditches to create a continuous network of wildlife corridors.
vi) Improve water quality by encouraging less-intensive agricultural practices to reduce fertiliser run-off and nutrient levels in the ditches.
vii) Encourage restoration of derelict industrial land including re-creation of salt-marsh and reintroduction of grazing to maintain the open character of the marsh.
viii) Consider opportunities to create views across the Mersey Estuary.
ix) Conserve the 'remote' character of the marshes away from the main transport corridor of the M56.
x) Retain the open character of the marsh by restricting planting to low growing scrubby species typically found in the local landscape, taking into account the importance of the area for ground nesting birds and wintering/passage birds. Woodland planting /screening using tall or ornamental species is not appropriate in the open marsh.
xi) Conserve the remaining open, undeveloped areas of the marsh.
xii) Consider using native scrubby vegetation to screen views of traffic on the north side of the M56 motorway (taller species may be appropriate on the southern side of the motorway adjacent to the Helsby to Frodsham Undulating Enclosed Farmland).
xiii) Consider views to and from the Frodsham Sandstone Ridge and Helsby Hill when planning any change.

2.4 Ecological Context

2.4.1 Two internationally designated sites are located within 2km of the SADA, namely:

i) Mersey Estuary Special Protection Area ('SPA').
ii) Mersey Estuary Ramsar.

2.4.2 Four nationally designated sites are located within 2km of the SADA, namely:

i) Mersey Estuary SSSI.
ii) Flood Brook Clough SSSI.
iii) Dunsdale Hollow SSSI.
iv) Runcorn Hill LNR.

2.4.3 A small part of the Mersey Estuary SSSI overlaps the north-western edge of the SADA.

2.4.4 The Mersey Estuary is thus protected at both international and national level for its nature conservation interest.

2.4.5 Eighteen non-statutory Local Wildlife Sites (LWS) designated at local level are located within 2km of the SADA. The Frodsham, Helsby and Ince Marshes Local Wildlife Site ('LWS') extends across the majority of the SADA, the whole of the Skylark Mitigation Area, and sections of the Main Access Route.

2.4.6 The SADA largely comprises areas of neutral grassland, arable land and modified grassland, separated by ditches, watercourses, hedgerows and tree lines. Also present are areas of reedbeds, scrub, ponds, woodland and existing tracks/roads.

2.4.7 Ecological surveys (desk studies and field surveys) have established that the SADA supports a minimum of six species of bat (foraging and commuting), water vole, badger, common toad and a range of invertebrate species. The SADA also has the potential to support roosting bats, eels and other fish, brown hare, otter and European hedgehog.

2.4.8 Ornithological field surveys have confirmed that the SADA supports a range of bird species, including qualifying species for the Mersey Estuary SPA/Ramsar. A number of other bird species that are not qualifying features of the SPA/Ramsar have also been identified as either breeding within or near to the SADA, or wintering within the SADA.

2.4.9 The NBBMA predominantly comprises neutral grassland; areas of neutral grassland located towards the south and west of this area also contain scattered scrub and tall forbs. Also present are a number of ponds, ditches, reedbeds, scattered broadleaved trees and unsealed tracks.

3.0 THE PROPOSED DEVELOPMENT

3.1 Introduction

3.1.1 The Proposed Development comprises solar PV panels capable of generating more than 50MW of electricity, with a BESS facility and on-site Frodsham Solar Substation. The Proposed Development includes two potential locations for the BESS and Frodsham Substation, the decision made on which option to bring forward will be made at the detailed design stage.

3.1.2 The solar PV panels would be mounted in groups on a metal frame which would be fixed in position with panels facing south. The solar PV panels, BESS and Frodsham Solar Substation would be connected to one another by a series of below ground cables. Supporting infrastructure would include transformers, inverters, switchgear, security fencing, CCTV, internal access roads, fire suppression system. The BESS and Frodsham Solar Substation would also require security lighting and fire suppression systems.

3.1.3 The Main Site Access would follow existing private roads and tracks, and would join the public highway network at Pool Lane Roundabout

3.1.4 Electricity would be exported to the local distribution network via a series of above ground and below ground cabling running to the Frodsham SPEN Substation. This would include an above ground crossing over the River Weaver. Above ground cabling would be supported on wooden poles.

3.1.5 A separate underground private wire connection is provided for, which would follow the route of the Main Site Access. This would enable electricity generated by the Proposed Development to be exported directly to local businesses.

3.1.6 Works to retain, enhance, and create new green infrastructure would be carried out, including measures to maintain this for the life of the Proposed Development. These are set out in the following sections of this **oLEMP**.

4.0 DESIGN APPROACH AND DESIGN PRINCIPLES

4.1 Design Approach Document

4.1.1 The **DAD [EN010153/DR/5.8]** which also forms part of the DCO Application submission documents describes the following:

i) The approach that the Applicant has taken to design from the outset of the project.
ii) The Design Vision and Design Principles that have influenced decision making.
iii) The design evolution that has resulted in the development that is being applied for.
iv) How design measures will be secured through the provisions of the DCO.
v) The framework for delivering on design post-consent.

4.1.2 This **oLEMP** provides further detail regarding bullets iv) and v) in respect of the green infrastructure proposals within the Proposed Development.

4.2 Design Vision

4.2.1 The Design Vision for the Proposed Development is set out in the **DAD [EN010153/DR/5.8]**, as follows:

"We want to deliver a substantial amount of renewable energy to the National Grid and to local businesses, making a clear contribution towards national renewable energy targets.

We want to conserve and enhance the local environment, provide a benefit to local communities, and to be a responsible neighbour to local people, during the construction, operational and decommissioning stages of the project.

We will follow a clear design process from start to finish, reflecting project-specific design principles, demonstrating collaborative interdisciplinary working, engagement with stakeholders and local communities, and delivering good design outcomes that we will commit to delivering".

4.3 Project Design Principles

4.3.1 To achieve the Design Vision, a series of Project Design Principles have been identified and broken down into more detailed measures in the **DAD [EN010153/DR/5.8]**. The Project Design Principles are secured via the **draft DCO [EN010153/DR/3.1]**. Not all have direct relevance to the **oLEMP**. Those that do are set out below:

i) Project Design Principle 2: Landscape and Views. Develop the proposals in a manner sensitive to their landscape setting and reflecting the value placed on the landscape by local communities, reducing visual impacts from nearby properties, recreational routes and key viewpoints.

- i) Retain and enhance the open character of Frodsham Marshes, where feasible.
- j) Retain and enhance existing vegetation cover that defines character and provides visual screening.
- k) Undertake new planting of trees, scrub and hedgerows which is consistent with character and to provide further screening.
- l) Contain development within established field boundaries to retain landscape pattern.
- m) Provide development-free buffers alongside existing landscape features.
- n) Provide long-term management and maintenance of the landscape of the Order Limits.
- o) Retain open vistas looking across Frodsham Marshes and the wider estuary, where feasible.
- p) Give consideration to impacts upon the long-range views from Frodsham War Memorial and Helsby Hill.
- q) Consider, and seek to mitigate where possible, adverse impacts upon views from properties, with particular reference to those located at closer distances such as at the northern edge of Frodsham.

r) Consider potential impacts arising from glint and glare and mitigate if adverse effects are identified.

ii) Project Design Principle 3: Biodiversity and Green Infrastructure. Protect and enhance green infrastructure within the Order Limits and in doing so create the conditions for enhanced biodiversity locally.

a) Achieve a minimum of 10% increase in habitat and hedgerow units, and no net loss in watercourse units.
b) Manage, maintain and increase vegetation cover within the Order Limits for the lifespan of the Proposed Development.
c) Provide mitigation associated with potential impacts on the Mersey Estuary SSSI, SPA and Ramsar site.
d) Retain and enhance existing site features, and introduce development-free buffers around hedgerows, ditches and other features of biodiversity value. Buffers will be a minimum of 5m around hedgerows and a minimum of 10m around watercourses.
e) Reduce impacts on valuable habitat features through good design, e.g. minimising culvert crossings, avoidance of impacts on high value habitat, best practice construction methods.
f) Enhance ecological connectivity, both within the Order Limits and with features outside its boundary. Create and/or enhance wildlife corridors.
g) Provide interpretative material to explain the ecology of the Order Limits to visitors.

iii) Project Design Principle 4: Public Access and Recreation. Retain, enhance and encourage public access through the life of the proposals, including during construction and decommissioning where feasible.

a) Create new permissive pathways to link up existing routes, filling gaps in the existing network and creating loops where possible, to enhance appeal to users and to improve connectivity.
b) Provide wayfinding signage and information about the variety of routes available within the Order Limits and in respect of onward

connections. Information to consist of both physical signage on site and published material to provide guidance to potential visitors.

c) Design and install interpretative material along access routes, providing information regarding the social and natural history of the Order Limits and its present use for generating energy.

d) Provide and signpost potential formal public car parking area(s) within the Order Limits, where provided.

iv) Project Design Principle 6: Cultural Heritage. Develop the proposals so that they are sensitive to the presence of heritage assets, their settings, and the wider historic environment.

c) Maintain views from the Order Limits (and their surroundings) to heritage assets located on the higher ground.

d) Retain the legibility of the flat topography within the Order Limits and views to the river in views from the higher ground.

e) Provide interpretative material explaining the relationship between the Order Limits and the surrounding historic landscape.

4.4 Utility Easements and Other Buffers

4.4.1 A number of utilities cross the Order Limits which are shown on ES Vol 3 Figure 1-6: Utilities [EN010153/DR/6.3]. Easements are in place to enable the utility providers to access and maintain these, and the design of the Proposed Development secures this through the limits of deviation set out on the **Works Plans** [**EN010153/DR/2.3**] and the protective provisions of the **draft DCO** [**EN010153/DR/3.1**]. The easements are as follows:

i) Shell Grangemouth to Stanlow Pipeline: 3.05m either side of the pipe from the pipe edge.

ii) Shell/Essar Stanlow to Carrington Pipeline: 30.48m diameter for above ground pipe sections and 10m diameter for below ground section.

iii) Essar Stanlow to Runcorn: 30.5m either side of the pipe from the pipe edge.

iv) Buried gas supply: 6.0m easement centred on pipe with additional 3m access strip either side of easement.

v) Private water main: 6.0m centred on pipe.

vi) Windfarm HV Cables: 10.0m centred on the cable. 132kV Private Wire Connection will lie within this easement.

vii) Wind turbines. No dig within 10m diameter. No extraction or excavation within 75m diameter. No extraction or excavation deeper than 5m within 75m to 100m diameter.

viii) 400kV National Grid Overhead Line: 30m diameter from the tower base.

ix) 132kV SPEN Overhead Line: 30m diameter from the tower base.

Other Buffers

4.4.2 In addition, buffers to protect key environmental features will be adopted where practicable, as follows:

i) A 10m buffer between fencing surrounding solar PV modules and non-tidal watercourses.

ii) An 8m buffer surrounding retained ponds and reedbeds.

iii) A 16m buffer between fencing surrounding solar PV modules and tidal watercourse defence structures.

iv) A 6m buffer between fencing surrounding solar PV modules and hedgerows / areas of substantial vegetation.

v) A 10m buffer between fencing surrounding solar PV modules and public rights of way.

vi) A 10m buffer from the toe of existing earth bunds surrounding the Manchester Ship Canal Dredging Deposit Cells, to safeguard the stability of these structures.

4.4.3 These buffers have been applied to the development areas shown on the Works Plans [**EN010153/DR/2.3**].

4.5 Biodiversity Net Gain Objectives

4.5.1 While the Proposed Development is not subject to statutory BNG requirements, the Proposed Development has committed to achieving an increase of at least 10 % in both habitat and hedgerow units across the Site, together within no net loss of watercourse units, when excluding the NBBMA. With the NBBMA also taken into account the Proposed Development has committed to achieving at least 10% increase in watercourse units as well.

4.5.2 The implementation of the landscape and ecological works and their subsequent management will ensure the Proposed Development meets the above objectives (i.e., achieving the stated habitat type and condition), as summarised in Table 1~~Table 1~~ overleaf. Table 1~~Table 1~~ will serve as a guide to the future management and monitoring of created habitats, outlines timescales in which the objectives should be achieved, and offers a direct comparison between the habitats shown on the **IEM** (**Appendix A** of this document) and the habitat types utilised for the Biodiversity Metric for the Proposed Development. Additional details of the BNG Assessment are provided in the **BNG Report [EN010153/DR/7.12]**.

4.5.3 The habitat types and conditions set out in Table 1~~Table 1~~ are in accordance with the Biodiversity Metric for the Proposed Development, which utilised DEFRA's Statutory Biodiversity Metric Calculator[2]. Target condition, and the associated targeted criteria, are measured in accordance with the relevant condition assessment sheets for the particular habitat, as issued alongside the Statutory Biodiversity Metric (July 2024 version)[3] and provided in **Appendix C**. Time to target condition is pre-set within the Biodiversity Metric, and is the

[2] Department for Environment, Food & Rural Affairs (2023, last updated 21 Feb 2025). *Statutory Biodiversity Metric tools and guides*. [online] https://www.gov.uk/government/publications/statutory-biodiversity-metric-tools-and-guides [accessed 11 Apr 2025]
[3] Department for Environment, Food & Rural Affairs (2023, last updated 21 Feb 2025). *Statutory Biodiversity Metric tools and guides*. [online] https://www.gov.uk/government/publications/statutory-biodiversity-metric-tools-and-guides [accessed 11 Apr 2025]

timeframe in which it is expected the habitat type and condition would be achieved.

Table 1: Summary of Biodiversity Net Gain Objectives

Landscape Habitat Type	BNG Habitat Type	Condition Sheet	Target Condition	Targeted Criteria	Time to Target Condition (Years)
Proposed native woodland	Other woodland; broadleaved	Woodland	Poor	N/A – poor condition targeted	5
Proposed native woodland	Lowland mixed deciduous woodland	Woodland	Poor	N/A – poor condition targeted	10
Neutral grassland (NBBMA)	Other neutral grassland	Grassland (Medium, high and very high distinctiveness)	Moderate	A, B, C, D	5
Marshy grassland (NBBMA)					
Retained neutral grassland/grazing within solar array security fence line[4] (and elsewhere within the SADA)					
Skylark Mitigation Area			Good	A, B, C, D, E, F	10
Retained neutral grassland/grazing within solar array security fence line[5] (and elsewhere within the SADA)	Modified grassland	Grassland (Low distinctiveness)	Good	A, B, C, E, F, G	7
			Moderate	C, E, F, G	4
Reedbed	Reedbeds	Wetland	Moderate	B, C, D, E, F, I	7
Proposed native scrub (new and enhanced)	Mixed scrub	Scrub	Moderate	A, B, C, D	10
Proposed water storage area (NBBMA)	Ponds (non-priority habitat)	Pond	Moderate	A, B C, F, G, H, I or A, C, F, G, H, I	3
Proposed scrape					
Proposed ponds					

[4] 'Retained neutral grassland/grazing within solar array security fence line (and elsewhere within the SADA); Other neutral grassland' comprises areas which have been identified as other neutral grassland during baseline surveys, and will be retained as such during the construction and operation of the Proposed Development.
[5] 'Retained neutral grassland/grazing within solar array security fence line (and elsewhere within the SADA): Modified grassland' comprises areas where grassland would be created within the SADA during habitat creation.

Landscape Habitat Type	BNG Habitat Type	Condition Sheet	Target Condition	Targeted Criteria	Time to Target Condition (Years)
Proposed native hedgerow	Native hedgerow (species rich)	Hedgerow	Moderate	A1, A2, B1, B2, C2, D1, D2	5
Proposed native hedgerow (maintained at a low height)	Native hedgerow (species rich)	Hedgerow	Poor	B1, B2, C2, D1, D2	5
Proposed native trees and shrubs	Native hedgerow with trees (species rich)	Hedgerow	Poor	A1, A2, C2, D1, D2, E2	10
Proposed ditch	Ditches	Ditch	Poor	N/A – poor condition targeted	1
Existing drainage ditch (NBBMA) (enhanced)	Ditches	Ditch	Moderate	A, B, C, D, E, F, G	n/a

4.6 The Landscape and Ecological Proposals

4.6.1 To achieve the Project Design Principles, and having regard to the Biodiversity Net Gain objectives, the landscape and ecological proposals would include the following habitat creation/enhancement and access enhancement measures. All measurements stated are approximate:

vii) Approximately 36.1 ha of public access/biodiversity enhancement zones, as shown on the **IEM** (**Appendix A**), comprising enhancement of existing vegetation (trees and scrub, grassland and wetland) and provision of new vegetation.

viii) Creation/enhancement of approximately 132 ha of other neutral grassland.

ix) Creation of approximately 75.7 ha of modified grassland.

x) Specific habitat creation and enhancement measures within Items i-iii above including:

a) Approximately 2.2 ha of new native woodland.

b) Approximately 0.87 ha of new native mixed scrub, and enhanced management of approximately 1.43 ha of existing scrub.

c) Enhancement of approximately 6.4km of existing hedgerows and hedgerow with trees.

d) Approximately 2.5km of new native hedgerow, and approximately 5km of new belts of native trees and shrubs.

e) Approximately 1 ha of new ponds, approximately 335m of new ditches, and approximately 2.1 ha of new reedbed. Enhanced management of approximately 0.9 ha of existing ponds, approximately 10.9km of existing ditches and approximately 12.1 ha of existing reedbed.

xi) NBBMA including:

a) Approximately 53.51 ha suitable for new and enhanced habitats (wetland and other neutral grassland) to benefit wetland birds.

b) Approximately 13.19 ha of additional grassland habitat.

xii) Skylark Mitigation Area, comprising 5.58 ha of other neutral grassland creation, which will support invertebrate prey, offering a foraging resource and which can also be used by nesting skylark through the breeding season, as well as providing wider ecological benefits.

xiii) New habitat creation structures, including:

a) 60 no. new bat boxes including a minimum 5 no hibernation boxes and a minimum 5 no. maternity boxes.
b) A minimum 2 no. barn owl boxes.
c) A minimum 2 no. kestrel boxes.
d) A minimum 30 no. bird nesting boxes.
e) 10 no. reptile/amphibian refugia.
f) 20 no. hedgehog boxes.
g) 10. no. insect hotels.

xiv) Enhanced access provision including:

a) Enhancements to the existing PRoW network.
b) Approximately 5.34km of new permissive paths.
c) New signage.
d) New interpretation material.
e) New benches
f) New litter bins and dog bins
g) New visitor car park (subject to the process set out in **Section 6.0** below).
h) New bicycle parking.

4.6.2 The amount of new habitat types provided would exceed any loss of the equivalent habitat type due to the construction of the Proposed Development. The management and maintenance measures set out in this **oLEMP** would ensure that ecological function of the new/enhanced habitats exceeds that of any lost due to construction.

4.6.3 Additionally, the Applicant proposes to reach out to local interest groups and nearby educational institutions, with the intention that the habitat creation and enhancement works will be available for research and educational purposes,

thereby providing added value from the Proposed Development to the local community.

5.0 ROLES AND RESPONSIBILITIES

5.1 Introduction

5.1.1 Specific roles and responsibilities during construction are set out indicatively in the **oCEMP [EN010153/DR/7.5]**. Key construction roles and responsibilities relevant to the final LEMP are anticipated to include:

i) **Principal Contractor** – This is a formal role established in the CDM Regulations (2015)[6]. The Principal Contractor will be appointed by the Applicant and have responsibility for co-ordinating the Construction Phase of the project.

ii) **Site Manager** – The Principal Contractor will identify a Site Manager who will have overall responsibility for implementation of the CEMP and all other DCO and legislative requirements.

iii) **Environmental Manager** – The Principal Contractor will identify an Environmental Manager who will have responsibility for management of environmental matters related to the Construction Phase of the Proposed Development, including ensuring compliance with legislation, ensuring that mitigation, management and monitoring measures are implemented, and that best practice is applied during works. The Environmental Manager will be a point of contact with environmental bodies and other third parties as required to perform their duties.

iv) **Environmental Clerk of Works** – The Applicant will appoint an Environmental Clerk of Works (ECoW) who will be a suitably qualified environmental professional responsible for on-site management and monitoring of environmental impacts including for soil management, pollution control, noise and dust monitoring, and surface water.

v) **Ecological Clerk of Works** – The Applicant will appoint an Ecological Clerk of Works (EcoCoW) who will be a suitably qualified ecologist

[6] HMSO (2015). *The Construction (Design and Management) Regulations 2015.* Available at: https://www.legislation.gov.uk/uksi/2015/51 [Last Accessed: 26 February 2025]

responsible for on-site managing and monitoring of the works in relation to habitats, protected species, and other wildlife.

vi) **Community Liaison Officer** – The Applicant will appoint a Community Liaison Officer who will ensure that a Community Liaison Group (CLG) is established and will be the point of contact for the CLG, ensuring that regular updates are issued during the construction of the Proposed Development.

5.1.2 Specific roles and responsibilities once the Proposed Development is operational are set out indicatively in the **oOEMP** and are not repeated in detail here. Key roles and responsibilities relevant to the final LEMP are anticipated to include:

i) **Site Manager** – The Applicant will appoint a Site Manager who will have overall responsibility for implementation of the final LEMP and all other DCO and legislative requirements.

ii) **Environmental Manager** – The Applicant will appoint an Environmental Manager who will have responsibility for management of environmental matters related to the operational phase of the Proposed Development, including ensuring compliance with legislation, ensuring that mitigation, management and monitoring measures are implemented, and that best practice is applied during works. The Environmental Manager will be a point of contact with environmental bodies and other third parties as required to perform their duties.

iii) **Quality Manager** – The Applicant will appoint a Quality Manager who will have responsibility for quality assurance and compliance, document management and record keeping, inspections for quality control, management of risks, and process improvement related to quality control and assurance. For the final LEMP they will have responsibility for quality assurance of procedures and for management of documentation, records, and monitoring of the systems relating to the same

iv) **Ecological Clerk of Works** – The Applicant will appoint an Ecological Clerk of Works who will be a point of contact for the Applicant to discuss

any issues relevant to ecology, if they were to arise during the management of the operational phase i.e. regarding protected species and habitats.

v) **Community Liaison Officer** – The Applicant will appoint a Community Liaison Officer who would be the point of contact, ensuring that regular updates are issued during the operational life of the Proposed Development.

5.1.3 It is envisaged that the NBBMA would be managed separately by an independent conservation organisation or suitably qualified personnel reporting into the Site Manager. Details of this would be provided in the final NBBMS (see **Appendix B** for the outline NBBMS).

6.0 MANAGEMENT AND MAINTENANCE

6.1 Introduction

6.1.1 This section identifies the management and maintenance works required in order to successfully achieve the Project Design Principles that relate to landscape, ornithology and ecology.

6.1.2 Land within the Frodsham National Grid Substation (which also includes the SPEN Substation) and along the route of the Main Access Road would be handed back post-construction. Management and maintenance of those area would thus be the responsibility of the current landowners (or any successor) and falls outside the scope of the final LEMP.

6.1.3 It is envisaged that the NBBMA will be managed separately by an independent conservation organisation or suitably qualified personnel. Details of the management of the NBBMA are set out in **Appendix B** of this document.

6.2 Advanced Works

6.2.1 Timescales for new planting and new seeding are set out in **Section 6.6** and **Section 6.7** below, and implementation will typically follow the substantial completion of the Proposed Development or agreed phases thereof.

6.2.2 However, advanced planting and other works will be undertaken prior to the start of construction in some locations. These works will comprise the following:

i) Planting of new woodland along the south-eastern perimeter of the SADA at the boundary with the M56 corridor, to provide mitigation against glint and glare effects.
ii) Planting of new hedgerows along the southern boundary of the SADA.
iii) Creation of the NBBMA (refer to **Appendix B**).
iv) Implementation of the proposed bird screening measures (see Section 6.11).

6.2.3 An Arboricultural Method Statement (AMS) will be prepared detailing the requirement for protective fencing, tree pruning, signage, timings, methods of works and any other protection measures prior to any vegetation clearance being undertaken.

6.3 Security

6.3.1 Security measures will be addressed as part of the detailed design phase and will be set out in the final OEMP as appropriate. These would include:

i) Measures to prevent access to PRoWs and permissive paths by unauthorised motor vehicles.
ii) Measures to prevent other unauthorised access.
iii) Measures to reduce anti-social behaviour.
iv) Measures required to ensure that security infrastructure (e.g. fencing, CCTV, etc) can be adequately maintained, and that this is not impeded by landscape and ecological management/maintenance.

6.3.2 Measures to prevent unauthorised access, such as to exclude motorcycles from routes will also need to retain access for the intended user groups, i.e. for example these should not prevent access by less mobile pedestrians, and thus will need to reflect what can reasonably be achieved in order to do this.

6.3.3 If use of any of the proposed permissive paths leads to persistent anti-social behaviour or security issues that cannot be otherwise managed (for instance, if a permissive path is misused in a way that threatens wildlife in the NBBMA or the security of the solar farm), then permissive access may be reviewed and potentially removed in the interest of safety and conservation. Any such decision would involve consultation and agreement with CWaCC.

6.4 Climate Change

6.4.1 Given the 40-year operational lifespan of the Proposed Development, it is possible that changes to the climate may affect the management of the works, necessitating changes to what is proposed.

6.4.2 The species mixes that will be specified in the final LEMP (which are outlined in **Section 6.6** and **Section 6.7**) will be stress tested against UKCP18 projections. Good practice guidance published by the Forestry Commission[7] recommends that in relation to specifying native tree species (including shrubs and hedgerow species) that local provenance stock should be supplemented with stock originating between 2 degrees and 5 degrees further south at a similar altitude and distance from the Atlantic Ocean.

6.4.3 Regular monitoring will be undertaken as set out in **Section 7.0**, which will identify the need for changes to management and maintenance, and the implementation of any remedial measures required to address potential adverse effects arising from climate change. This may include the substitution of species where high rates of climate-related failure have occurred, with more resilient alternative species.

[7] Forestry Commission, 2020. *Managing England's woodlands in a climate emergency.*

6.5 General Management

6.5.1 The tasks set out below will be carried out across the Order Limits for the operational life of the Proposed Development, or as otherwise required.

Fencing

6.5.2 Fencing shall be installed as specified in the **oCEMP [EN010153/DR/7.5]** and/or **oOEMP [EN010153/DR/7.6]** and subject to details approved by CWaCC. Additionally, in areas where grassland management by grazing is proposed, stock-proof fencing shall be installed around all existing hedgerows within these areas (and this would need to enclose the extents of the 6m buffers described in Section 4.4).

6.5.3 Suitably sized (approximately 20 cm x 25 cm) gaps or mammal gates would be installed at suitable intervals and locations along the perimeter fence line to allow small mammals, including badgers, free movement into and out of the SADA. Gaps should be in positions close to existing mammal pathways and habitat features providing connectivity within the landscape (e.g., hedgerows). The locations of the gaps/gates would be determined during a pre-commencement survey; this approach would allow for any changes in populations, sett locations and mammal paths which may change prior to the commencement of construction to be taken into account.

6.5.4 Gaps or mammal gates will not be installed along the perimeter fence of the NBBMA, to prevent predatory terrestrial mammal species entering the NBBMA and potentially predating roosting, foraging and/or nesting birds (or eggs/chicks).

6.5.5 All fencing, including any gates, stiles or other associated structures shall be maintained in good condition throughout the life of the Proposed Development.

Litter

6.5.6 Litter and debris shall be removed as required as part of each regular maintenance visit, including from ditches/waterbodies.

Weeding

6.5.7 Problem perennial weeds will be controlled by hand pulling, or if necessary careful targeted application of a non-residual herbicide via spot spraying with a knapsack (low pressure to avoid spray drift) or weed wiping. Herbicide application may be used in April, June and August. Species to be removed shall be identified on-site as part of regular monitoring.

6.5.8 Within or adjacent to ponds, wetland areas, watercourses and ditches, weed growth shall be controlled by either cutting, or by hand pulling. Use of herbicide is not permitted within 10m of watercourses, ditches, ponds, or wetland areas unless mandated as part of an invasive non-native species management requirement.

6.5.9 If invasive non-native species listed under Schedule 9 of The Wildlife & Countryside Act 1981 (as amended) or the EU Invasive Alien Species Regulation (1143/2014) are encountered within or immediately surrounding the Order Limits at any time, the advice of a suitably qualified ecologist will be sought, and the appropriate best practice measures for the species in question shall be taken to prevent the establishment and spread of such plants around the Order Limits.

6.5.10 Where required, a suitably experienced specialist management company will be instructed to eradicate the invasive non-native species from the Site. Any arisings will be disposed of offsite to a suitably licenced waste disposal facility.

6.5.11 As set out in the outline NBBMS (**Appendix B** to this document), New Zealand Pygmyweed is known to be present in the ponds to the north of dredging Cell 3. As such, a New Zealand Pygmyweed Control and Management Strategy

will be produced prior to the commencement of work in this area as specified in the **oCEMP [EN010153/DR/7.5].**

6.5.12 The **oOEMP [EN010153/DR/7.6]** requires that an Invasive Non-Native Species Management Plan (INNSMP) ~~which~~ will be ~~required~~ prepared to set out monitoring and control measures for invasive species, including New Zealand Pygmyweed. Should herbicide use be required to control invasive species, the INNSMP must contain measures to ensure that these do not enter watercourses or groundwater.

Badgers

6.5.13 The Proposed Development has been designed to avoid impacting habitats most likely to be used by badgers for both sett building and foraging and commuting (field boundary features). These habitats will be largely retained and protected during the construction process as outlined in the **oCEMP [EN010153/DR/7.5]** with further detail to be provided as necessary in the final CEMP.

6.5.14 Specifically, a pre-construction badger survey would be undertaken immediately prior to the commencement of the site clearance works. If this identifies any changes to baseline conditions in respect of the presence of badger activity and/or setts, then design changes may need to be made, and a disturbance/mitigation licence would need to be obtained from NE. Any outcomes that remain relevant post-construction and that might affect the management/maintenance of the landscape and ecological proposals would be reflected in an updated LEMP.

Access

Access Routes

6.5.15 The locations of PRoWs within the Order Limits are illustrated on **ES Vol 3 Figure 1-5: Public Rights of Way [EN010153/DR/6.3].** Those within and proximate to the SADA and NBBMA are also illustrated on the **IEM** (**Appendix**

A). Details of the management of each PRoW are set out in the **Outline Public Rights of Way Management Plan [EN010153/DR/7.9]**.

6.5.16 **Figure 1** illustrates the proposed indicative hierarchy of routes within and proximate to the SADA and NBBMA, distinguishing between the types of access and intended user groups for each route.

6.5.17 The locations of proposed permissive paths are illustrated on the **IEM** (**Appendix A**), and are as follows:

i) A: Approximately 845m length of path linking Brook Furlong and Moorditch Lane.
ii) B: Approximately 1.77km length of path running along the River Weaver, linking the terminus of the public byway at Frodsham Marsh farm with Brook Furlong and with public footpath Frodsham FP 81.
iii) C: Approximately 750m length of path linking restricted byway Frodsham RB 99 with public footpath Frodsham FP81.
iv) D: Approximately 255m length of path linking Moorditch Lane and Brook Furlong.
v) E: Approximately 805m length of path linking Brook Furlong and public footpath Frodsham FP81.
vi) F: Approximately 710m length of path linking public footpath Frodsham FP81 and public footpath Frodsham FP93.
vii) G: Between approximately 150m and 225m of path on boardwalks within the wetland habitat areas to be created at Marsh Farm.

6.5.18 Permissive paths will be designed with regard to good practice design guidance including:

i) *Access for all design guide*[8].
ii) *Outdoor Access Design Guide*[9].

[8] Environmental Agency, 2013. *Access for all design guide*.
[9] Paths for All and Scottish Natural Heritage, 2016. *Outdoor Access Design Guide*.

iii) *Paths for Everyone*[10].

iv) *Outdoor Accessibility Guidance*[11].

6.5.19 Permissive paths A, B, D and F will be maintained for pedestrian access only and will comprise a corridor up to 2m wide. Surfacing would comprise either close-mown grass, gravel or boardwalks, to suit the conditions along specific sections of each route.

6.5.20 Permissive paths C and E will be maintained for cycle and equestrian access (in addition to pedestrian access) and will comprise a corridor up to 3m wide. A gravel surface will be provided which will be suitable for all intended users.

6.5.21 Within the wetland habitat areas to be created to the east of Marsh Farm, timber boardwalks carrying permissive path G will run into the wetland from the adjacent public right of way. The boardwalks shall be of sufficient width to allow two people to pass safely.

6.5.22 Full details of the permissive paths will be set out in the final LEMP~~,~~ and will be agreed with CWaCC~~,~~ along with the maintenance regime for the PRoW and permissive paths across the Site.

6.5.23 All public rights of way and permissive paths within the Order Limits would be kept free from obstruction, save where required to be crossed for maintenance, which may require temporary obstructions/closures. Any temporary closures or diversions to public rights of way must be agreed with CWaCC.

Car Park

6.5.24 The potential visitor car park on Moorditch Lane will only be provided should the proposed access enhancements result in a demonstrable increase in cars informally parking along Moorditch Lane, and if this causes access/egress

[10] Sustrans, 2018. *Paths for Everyone*.
[11] Paths for All and Sensory Trust, 2023. *Outdoor Accessibility Guidance*.

issues for other users of Moorditch Lane. Its provision will be agreed with CWaCC. The Applicant commits to addressing any unforeseen access/egress issues on Moorditch Lane that are caused by the Proposed Development, either by constructing the car park or via alternative measures. If delivered, the car park will include security features (e.g. height-restricting barriers and a lockable gate), and the Applicant reserves the right to remove the car park later, if it gives rise to persistent anti-social behaviour. Suitable evidence of such behaviour would first be presented to CWaCC and potential solutions discussed. The proposed location of the potential car park is indicated on the **IEM** (**Appendix A**).

6.5.25 Details of the potential car park, including security measures would be set out in the final LEMP.

Bicycle Parking

6.5.26 Bicycle parking facilities would be provided at strategic locations within the Order Limits, including at the point where permissive path A meets Moorditch Lane, and at the proposed car park described above. Indicative locations are shown on the **IEM** (**Appendix A**).

6.5.27 Details of these would be set out in the final LEMP.

Street Furniture

6.5.28 Interpretation panels will be provided within the Order Limits at the locations shown indicatively on the **IEM** (**Appendix A**). These will provide content providing information on subjects including local biodiversity, cultural heritage assets, renewable energy generation and climate change. Full details of the interpretation panels, including location, content and specification will be set out in the final LEMP.

6.5.29 Signage will comprise waymarking signs mounted on timber posts (or attached to fenceposts) located at each route intersection. The purposes of signage will be to indicate the direction that each route follows, and to provide

any other information pertinent to the health and safety of users. In particular, the need for dogs to be kept on leashes along routes close to the NBBMA and to the River Weaver would be shown on signage. Full details of signage, including location and specification will be set out in the final LEMP.

6.5.30 All signage and interpretation material will be maintained in good condition, so that the information that they show is unobscured and easy to read. Any damage will be made good as soon as feasible.

6.5.31 Benches/seating will be provided at strategic locations along the routes, including at points where opportunities for birdwatching are available. Details of these, including locations will be set out in the final LEMP.

6.5.32 Litter bins/dog bins will be provided along the routes, subject to agreeing a suitable refuse collection strategy with CWaCC. Details and locations will be set out in the final LEMP.

Utilities

6.5.33 The implementation and management of all landscape and ecological proposals shall have regard to the presence of underground and overhead utilities, reflecting the easements set out in **Section 4.4**, and shall not interfere with the operation and maintenance of these.

Pollution Control

6.5.34 Vehicular access to the Proposed Development will be controlled as described above and will be limited to maintenance activities. Pollution prevention measures for vehicles and machinery are set out in the oCEMP, oOEMP and oDEMP. Access tracks will be inspected as part of regular monitoring activities (see **Section 7.0**) to ensure no unacceptable erosion is occurring, and remedial action would be taken where appropriate.

6.6 Existing Trees and Shrubs, and Proposed Planting

Planting Specification

Native Woodland

6.6.1 The following indicative species mix is proposed for areas of new native woodland, with full details to be confirmed in the final LEMP.

i)	Oak (*Quercus robur*)	35%.
ii)	Silver Birch (*Betula pendula*)	15%.
iii)	Field Maple (*Acer campestre*)	20%.
iv)	Holly (*Ilex aquifolium*)	10%.
v)	Hazel (*Corylus avellana*)	10%.
vi)	Hawthorn (*Crataegus monogyna*)	10%.

6.6.2 All plants are to be of certified local provenance (seed zone 302), subject to availability. Stock from seed zones 303, 305, and 404 is also considered suitable and inclusion is encouraged to add resilience against potential adverse climate-change related effects (see **Section 6.4**).

6.6.3 Planting density to be 2m centres. Stock will be predominantly bare root transplants (typically either 40-60cm 1+1 transplants, or 60-80cm 1+2 transplants). Holly will be container grown (typically either 40-60cm 2L pot, or 60-80cm 3L pot). Larger stock may be planted within the woodland plots at lower densities (typically feathered trees c. 2m high) where early screening is required.

Native Scrub

6.6.4 The following indicative species mix is proposed for areas of new native scrub, with full details to be confirmed in the final LEMP.

i)	Hazel (*Corylus avellana*)	30%.
ii)	Hawthorn (*Crataegus monogyna*)	45%.
iii)	Blackthorn (*Prunus spinosa*)	25%.

6.6.5 All plants are to be of certified local provenance (seed zone 302), subject to availability. Stock from seed zones 303, 305, and 404 is also considered suitable and inclusion is encouraged to add resilience against potential adverse climate-change related effects (see **Section 6.4**).

6.6.6 Planting density to be 2m centres. Stock will be bare root transplants (typically either 40-60cm 1+1 transplants, or 60-80cm 1+2 transplants).

6.6.7 Mixed scrub will be planted to ensure that at least three woody species are planted in any one stand of scrub, and that no single species consists more than 75% of the mix.

Native Tree and Shrub Belts

6.6.8 The following indicative species mix is proposed for new native tree and shrub belts, with full details to be confirmed in the final LEMP.

i)	Oak (*Quercus robur*)	20%.
ii)	Silver Birch (*Betula pendula*)	20%.
iii)	Field Maple (*Acer campestre*)	22.5%.
iv)	Hazel (*Corylus avellana*)	10%.
v)	Hawthorn (*Crataegus monogyna*)	12.5%.
vi)	Dog Rose (*Rosa canina*)	7.5%
vii)	Blackthorn (*Prunus spinosa*)	7.5%

6.6.9 All plants are to be of certified local provenance (seed zone 302), subject to availability. Stock from seed zones 303, 305, and 404 is also considered suitable and inclusion is encouraged to add resilience against potential adverse climate-change related effects (see **Section 6.4).**

6.6.10 Planting density to be 2m centres. A minimum of five different species will be planted per 30m length. Areas of less dense planting/gaps are to be identified on-site, in order to retain long-range views.

6.6.11 Stock will be predominantly bare root transplants (typically either 40-60cm 1+1 transplants, or 60-80cm 1+2 transplants). Larger stock may be planted at lower densities (typically feathered trees c. 2m high) where early screening is required.

Native Hedgerows

6.6.12 The following indicative species mix is proposed for new native hedgerows , with full details be confirmed in the final LEMP.

i) Field Maple (*Acer campestre*) 15%.
ii) Dog Rose (*Rosa canina*) 15%.
iii) Hawthorn (*Crataegus monogyna*) 35%.
iv) Blackthorn (*Prunus spinosa*) 25%.
v) Holly (*Ilex aquifolium*) 10%.

6.6.13 All plants are to be of certified local provenance (seed zone 302), subject to availability. Stock from seed zones 303, 305, and 404 is also considered suitable and inclusion is encouraged to add resilience against potential adverse climate-change related effects (see **Section 6.4**).

6.6.14 Plant in double staggered rows, 5 plants per linear metre. All five proposed species will be planted within each 30m length of hedgerow.

6.6.15 Stock will be predominantly bare root transplants (typically either 40-60cm 1+1 transplants, or 60-80cm 1+2 transplants). Holly will be container grown (typically either 40-60cm 2L pot, or 60-80cm 3L pot). Larger stock may be planted within the hedgerows at lower densities (typically feathered trees c. 2m high) where early screening is required.

Implementation

6.6.16 Planting will be carried out in the first available season following the substantial completion of the Proposed Development; earlier planting will be carried out, as and where possible, subject to the completion of any ground

works (including land associated with temporary laydown) required in the location of specific planting or seeding works.

6.6.17 Bare root and rootballed stock will be planted while dormant (between the months of November and February, inclusive). Containerised stock will be used where necessary, as advised by the supplier.

6.6.18 Transplants and holly will be notch planted. Feathered stock will be pit planted, with pit details to be set out in the final LEMP.

6.6.19 It is expected that ground conditions and climate will allow for earlier planting (i.e. before January), this will allow the plants more time to establish a network of feeder roots before the onset of spring. Earlier planting will be carried out where possible.

6.6.20 Planting of trees and shrubs will not be carried out when the ground is wet/waterlogged or frost bound, or during periods of excessive cold drying winds or drought.

6.6.21 In areas of existing dense bramble scrub, these will be cleared of bramble prior to planting with the proposed native scrub species.

6.6.22 On completion, all plants will be thoroughly watered-in and will be protected from damage by individual spirals/guards, supported by a high-quality stake that suits the height of the tube. Where there is risk of damage from livestock, stock-proof fencing may also be installed (and this would need to enclose the 6m buffer described in **Section 4.4**).

6.6.23 After planting a 50mm layer of compost fine bark mulch (nominal size 1-10mm) will be spread to 1m wide diameter around the stem of each plant.

Establishment Management

General

6.6.24 The establishment management period for new planting will last for the first five years following practical completion of the landscape works.

6.6.25 All canes, stakes, guards, spirals and ties, and any stock-proof fencing will be regularly checked, replaced as required and removed from Site and disposed of once plants have established. This is to be checked annually.

6.6.26 Bark mulch will be topped up annually or as required, to maintain 50mm deep layer, until the plants have established.

6.6.27 During the establishment management period (the first 5 years), all dead, dying or diseased stock will be replaced with stock of similar size and species by the appointed contractor at their own cost. If the failure of the plant is due to disease and the disease is considered likely to re-occur, then an alternative native species of local provenance may be used as a replacement, to be agreed with CWaCC. The exact timing of the planting of replacement scrub/tree is dependent on the ground conditions; however, planting will take place between the months of November and February, inclusive.

6.6.28 An annual inspection will be undertaken each September to identify stock in need of replacement.

Weeding and Litter

6.6.29 The planting areas (1m radius around each stem) will be kept mulched to the original specification and weed-free during the establishment period, using approved hand-weeding or if necessary, herbicide treatment (applications in April, June and August). The herbicide handbook (English Nature, 2003) provides guidance on appropriate herbicide use in relation to nature conservation works. Where used, herbicides will be sprayed in appropriate weather conditions (i.e. during periods of low wind and no excessive rainfall) in accordance with the supplier's instructions, to avoid affecting adjacent grassland areas and will not be used within 10m of watercourses, ditches, ponds, or wetland areas.

6.6.30 The bases of all hedgerows are to be kept weed-free. Manual removal of weeds should be undertaken in the first instance, if this is not successful a minimum of 3 no. applications of systematic herbicide per growing season

should be actioned, with a combination of visits to manually remove weeds in conjunction with the use of herbicide, during the first 3 years. Where a hedgerow is within 10m of a watercourse, ditch, pond or wetland, weed removal shall be carried out manually.

6.6.31 Any litter accumulated around hedgerow bases is to be cleared at the same time as weed control operations.

6.6.32 All plants will remain upright and canes/guards adjusted as necessary during treatment of weeds.

Watering and Fertiliser

6.6.33 During the establishment period, trees and shrubs will be inspected during periods of warm weather and drought. If it is considered that the ground conditions are too dry, the planted areas will be watered on a regular basis until weather conditions are considered suitable for watering to cease. Plants shall receive an application of slow-release fertiliser for the first 3 years.

6.6.34 All hedgerow lines shall be regularly watered in times of drought to field capacity and shall receive an application of slow-release fertiliser for the first 3 years.

Long-term Management

General

6.6.35 Long-term management prescriptions will apply once establishment is complete. Existing trees, shrubs and hedgerows will be subject to long-term management from practical completion of the landscape works. Any new planting required to enhance existing vegetation shall be specified and implemented as set out above.

6.6.36 All guards and stakes shall be removed from plants once they are no longer required. These shall be disposed of off-site. Biodegradable guards may be left on-site.

6.6.37 As set out above, in areas where grassland management by grazing is proposed, stock-proof fencing will be required around all existing hedgerows within these areas (and this would need to enclose the extents of the 6m buffers described in **Section 4.4**). This will need to be maintained for the operational life of the Proposed Development.

6.6.38 No cutting or trimming of trees, shrubs or hedgerows will be undertaken during the bird breeding season (01 March to 31 August, inclusive) unless under the supervision of an appropriately qualified ecologist to ensure compliance with wildlife legislation.

6.6.39 Prior to the removal or trimming of any established trees, suitable checks for roosting bats will be undertaken in advance of any removal in accordance with guidance applicable at the time. If bats are confirmed to be roosting within any tree suspected to be impacted by the proposed works, the data gathered would be used to inform potential design amendments in order to avoid or reduce impacts, or failing that, support a European Protected Species (EPS) mitigation licence application to NE to destroy/disturb the bat roost.

6.6.40 Management will ensure that trees and shrubs do not present a hazard to human health, to the operation of the Proposed Development, or to utilities. Where hazards are identified, remedial measures will be taken.

6.6.41 Any arisings from management, e.g. cuttings from thinning/coppicing or from hedge trimming, may be left in piles (typically around the edges of woodland areas), in order to provide additional habitat for invertebrates, amphibians and reptiles and small mammals (if present). Arisings left in piles should only be removed from Site for essential reasons such as to retain access to infrastructure

Woodland

6.6.42 Following the initial establishment maintenance period, the woodland planting areas will be managed to enable the development of a diverse structure in the longer-term. Management shall be on a minimum intervention basis.

6.6.43 Selective thinning of weaker specimens, and/or coppicing of selected species will be undertaken with the aim being to diversify the structure of woodland. The need for thinning and coppicing will be determined every five years by the Environmental Manager, commencing in the first year of the final LEMP. The Update Report will record the species coppiced, and the timescales of the coppicing regime proposed.

6.6.44 Key management objectives for woodland are as follows:

i) Provide visual screening of glint and glare impacts.
ii) Meets the UKHab definition of Other Broadleaved Woodland.
iii) Greater than 80% of species are broadleaved.
iv) Natural regeneration occurs.
v) At least four native tree or shrub species are present.
vi) Woodland is developing a complex structure including ground flora, understory, shrub and canopy species.

Scrub

6.6.45 Scrub will not be allowed to develop into large/dense areas of woodland, and remedial action shall be taken to prevent this, as necessary.

6.6.46 Key management objectives for scrub are as follows:

i) Achieves UKHab definition of Mixed Scrub.
ii) At least three native woody species.
iii) Ensure no single species consists greater than 75% of the habitat.
iv) Promote natural regrowth.
v) Ensure complementary edge habitat is present.

Native Trees and Shrubs

6.6.47 Belts of trees and shrubs will be left to grow. Management will ensure that any gaps in these belts that are intended to allow longer views across the Order Limits are retained.

6.6.48 Key management objectives for trees and shrubs (classified as hedgerows with trees within the Metric) are as follows:

i) Provide screening of views of the proposed new structures, but retain strategic gaps/less dense/lower sections where necessary to preserve existing long-range views towards the Mersey Estuary or to Frodsham Hill and Helsby Hill.
ii) Achieves UKHab definition of Native Species Rich Hedgerow
iii) Maintain a minimum of five woody species per 30m length.
iv) Maintain a bushy growth, on average, of at least 1.5m height and width.
v) Avoid damage from human activities.
vi) Maintain trees in a healthy condition.

Hedgerows

6.6.49 Existing and established hedgerows will be left to grow with minimal selective thinning and then maintained at a height of approximately 3m. Typically, hedgerows will be maintained to a minimum width 1.5m and where space allows hedgerows will be allowed to grow out sideways to a maximum width of 3m.

6.6.50 Typically, hedgerows will be cut on a 3-year rotational basis, i.e. not all hedgerows cut in the same year. A third of the total of hedgerows will be cut each year, but the length cut will not be one long stretch, but will be distributed across smaller sections of each hedgerow. This will maintain a resource of flowering and fruiting plants and create nesting and foraging habitat for wildlife. Any existing trees located within hedgerows will be left to grow naturally and not cut. These will be clearly marked to ensure that they are not cut back during hedgerow trimming/maintenance works.

6.6.51 Where the **IEM** (**Appendix A** of this document) shows that proposed hedgerows will be 'maintained at a lower height' these will be cut to maintain a maximum height of no more than 1.5m in order to retain views over these

from the adjacent public rights of way and permissive paths. These will be cut annually to maintain the intended height.

6.6.52 Hedgerows alongside all access routes (whether for maintenance access or for recreation/amenity) will receive an additional annual cut on the side facing the routeway where necessary, to ensure they will not encroach or impede access.

6.6.53 Hedgerows will be cut between late September and February, and no cutting or trimming is to be undertaken during the bird breeding season (01 March to 31 August inclusive) unless supervised by a suitably qualified ecologist.

6.6.54 Key management objectives for hedgerows are as follows:

i) Provide screening of views of the proposed new structures, but retain strategic gaps/lower sections where necessary to preserve existing long-range views towards the Mersey Estuary or to Frodsham Hill and Helsby Hill
ii) Achieves UKHab definition of Native Species Rich Hedgerow.
iii) Maintain a minimum of five woody species per 30m length.
iv) Maintain a bushy growth of at least 1.5m height and width (excluding the lengths to be maintained at a low height).
v) Lengths to be maintained at a low height to have a maximum height of 1.5m, to allow views over them.
vi) Avoid vertical ('leggy') and horizontal gaps along the length of the hedgerow.
vii) Maintain species diverse margins of at least 1m.
viii) Avoid damage from human activities.

6.7 Existing and Proposed Grassland

Seeding Specification

Other Neutral Grassland

6.7.1 The following indicative species mix is proposed for other neutral grassland, with full details to be confirmed in the final LEMP.

6.7.2 Where other neutral grassland is to be created via new seeding, these areas will be sown with Emorsgate EM2 Standard General Purpose Meadow Mixture or similar (indicative species mix set out below) at a rate of 4g/m^2. Seeding will be carried out in accordance with the supplier's instructions.

Grasses

i)	Common Bent (*Agrostis capillaris*)	8.5%.
ii)	Crested Dogstail (*Cynosurus cristatus*)	29.75%
iii)	Red-fescue (*Festuca rubra*)	25.5%
iv)	Smaller Cat's-tail (*Phleum bertolonii*)	4.25%
v)	Smooth-stalked Meadow-Grass (*Poa pratensis*)	17%

Herbs/Wildflowers

i)	Yarrow (*Achillea millefolium*)	0.75%.
ii)	Common Knapweed (*Centurea nigra*)	2.25%.
iii)	Wild Carrot (*Daucus carota*)	1.2%.
iv)	Lady's Bedstraw (*Galium verum*)	0.3%.
v)	Field Scabious (*Knautica arvensis*)	0.6%.
vi)	Oxeye Daisy (*Leucanthemum vulgare*)	1.95%.
vii)	Musk Mallow (*Malva moschata*)	0.75%.
viii)	Ribwort Plantain (*Plantago lanceolata*)	2.25%
ix)	Salad Burnet (*Poterium sanguisorba ssp. sanguisorba*)	1.5%.
x)	Cowslip (*Primula veris*)	0.45%.
xi)	Meadow Buttercup (*Ranunculus acris*)	1.5%.

xii) Yellow Rattle (*Rhinanthus minor*)	0.75%.
xiii)Bladder campion (*Silene vugaris*)	0.75%.

Modified Grassland

6.7.3 The following indicative species mix is proposed for modified grassland, with full details to be confirmed in the final LEMP.

6.7.4 Where modified grassland is to be created via new seeding, these areas will be sown with Emorsgate EG22 Strong Lawn Grass Mixture or similar (indicative species mix set out below) at a rate of 4g/m^2. Seeding will be carried out in accordance with the supplier's instructions.

Grasses

i) Common Bent (*Agrostis capillaris*)	5.0%
ii) Red Fescue (*Festuca rubra*)	39.0%
iii) Perennial Ryegrass (*Lolium perenne*)	25.50%
iv) Smooth-stalked Meadow-grass (*Poa pratensis*)	15.5%

Herbs/Wildflowers

i) Common Knapweed (*Centaurea nigra*)	2.25%
ii) Wild Carrot (*Daucus carota*)	1.75%
iii) Lady's Bedstraw (*Galium verum*)	0.5%
iv) Oxeye Daisy (*Leucantheum vulgare*)	1.25%
v) Musk Mallow (*Malva moschata*)	0.25%
vi) Ribwort Plantain (*Plantago lanceolata*)	2.5%
vii) Salad Burnet (*Poterium sanguisorba ssp sanguisorba*)	2.25%
viii)Self Heal (*Prunalle vulgaris*)	1.75%
ix) Meadow Buttercup (*Ranunculus aris*)	1.75%
x) Red Campion (*Silene dioica*)	0.75%.

Marshy Grassland

6.7.5 The following indicative species mix is proposed for marshy grassland, with full details to be confirmed in the final LEMP.

6.7.6 Where marshy grassland is to be created via new seeding, these areas will be sown with Emorsgate EM8 Meadow Mixture for Wetlands or similar (indicative species mix set out below) at a rate of 4g/m^2. Seeding will be carried out in accordance with the supplier's instructions.

Grasses

i) Common Bent (*Agrostis capillaris*)	4%.
ii) Sweet Vernal-grass (*Anthoxanthum odoratum*)	4%.
iii) Grey sedge (*Carex divulsa subsp. divulsa*)	0.8%.
iv) Crested Dogstail (*Cynosurus cristatus*)	33.6%.
v) Tufted Hair-grass (*Deschampsia cespitosa*)	1.6%.
vi) Red-fescue (*Festuca rubra*)	20%.
vii) Meadow Barley (*Hordeum secalinum*)	3.2%.
viii) Smaller Cat's-tail (*Phleum bertolonii*)	5.6%.
ix) Rough-stalked Meadow-grass (*Poa trivialis*)	5.6%.
x) Tall Fescue (*Schedonorus arundinaceus*)	1.6%.

Herbs/Wildflowers

i) Yarrow (*Achillea millefolium*)	0.7%.
ii) Agrimony (*Agrimonia eupatoria*)	0.6%.
iii) Wild Angelica (*Angelica sylvestris*)	0.1%.
iv) Betony (*Betonica officinalis*)	0.2%.
v) Common Knapweed (*Centurea nigra*)	3.2%.
vi) Meadowsweet (*Filipendula ularia*)	1.4%.
vii) Hedge Bedstraw (*Galium album*)	0.4%.
viii) Lady's Bedstraw (*Galium verum*)	2%.
ix) Meadow Vetchling (*Lathyrus pratensis*)	0.8%.
x) Rough Hawkbit (*Leontodon hispidus*)	0.6%.

xi) Oxeye Daisy (*Leucanthemum vulgare*)	1.2%.
xii) Birdsfoot Trefoil (*Lotus corniculatus*)	0.6%
xiii)Greater Birdsfoot Trefoil (*Lotus pedunculatus*)	0.1%.
xiv) Black Medick (*Medicago lupulina*)	1%.
xv) Ribwort Plantain (*Plantago lanceolata*)	2%.
xvi) Cowslip (*Primula veris*)	0.4%.
xvii) Selfheal (*Prunella vulgaris*)	0.8%.
xviii) Meadow Buttercup (*Ranunculus acris*)	1.2%.
xix) Yellow Rattle (*Rhinanthus minor*)	0.8%.
xx) Common Sorrel (*Rumex acetosa*)	0.6%.
xxi) Great Burnet (*Sanguisorba officinalis*)	0.3%.
xxii) Ragged Robin (*Silene flos-cuculi*)	0.5%.
xxiii) Dandelion (*Taraxacum officinale*)	0.2%.
xxiv) Tufted Vetch (*Vicia cracca*)	0.3%.

Implementation

6.7.7 Grassland seed will be sown in the first September following the substantial completion of the Proposed Development, to allow establishment prior to winter and to provide optimal conditions for Yellow Rattle to establish. Seed will be surface sown, broadcast by machine and rolled where possible. The seed will be divided into two parts for each section and sown in two passes perpendicular to each other where possible.

6.7.8 Seeding will not be carried out when the ground is wet/waterlogged or frost bound, or during periods of excessive cold drying winds or drought.

Establishment Management

6.7.9 The establishment period for new grassland will last for the first year following practical completion of the landscape works.

Other Neutral Grassland and Modified Grassland

6.7.10 Following seeding in autumn, a high spring cut to between 70-100mm will be undertaken around the following April with no further mowing until mid-July. It will then receive a monthly cut, to a height of between 40mm and 60mm, until the end of the growing season to prevent annual weeds from establishing.

6.7.11 Mowing will only take place during periods of dry weather to ensure that waterlogged ground is not damaged by machinery.

6.7.12 The grassland will not be improved by chemical fertiliser or slurry and nutrient levels in the soil should be allowed to reduce over time.

6.7.13 All arisings should remain on Site for 3-5 days following the cut to allow seeds to disperse, and then removed from Site.

Marshy Grassland

6.7.14 In marshy grassland areas, most of the sown meadow species are perennial and are slow to establish. Soon after sowing there is likely to be a flush of annual weeds, arising from the soil seed bank. These weeds can look unsightly, but they will offer shelter to the sown seedlings, provide habitat for invertebrates, and they will die before the year is out. Therefore cutting of the wetland grass will not occur until mid to late summer. Cuttings will be removed.

6.7.15 The grass will then be kept short by mowing through to the end of March of the following year. Any residual perennial weeds such as docks will be manually dug out.

Long-term Management

General

6.7.16 Long-term management prescriptions will apply once establishment is complete. Existing vegetation will be subject to long-term management from practical completion of the landscape works.

Within Solar Array

6.7.17 Grassland within the extent of the Solar Array security fencing (i.e. the areas where the solar PV models are located) will be managed via low-intensity sheep grazing (between September to February) which could be supplemented by mowing via an optional hay cut in August with subsequent aftermath grazing to further reduce fertility.

6.7.18 If grazing is unable to be undertaken during the operation of the solar farm, mechanical cutting will be undertaken instead to replicate the sward height for early March described below.

6.7.19 Moderate trampling will expose ground for colonisation by annuals the next spring; however, heavy trampling can lead to ground poaching and infestations by weed species that will be detrimental to the Site.

6.7.20 The approach outlined in **Table 2** will be followed to allow summer flowering plants to set seed during spring and summer, and to allow low-intensity grazing during winter.

Table 2: Low-Intensity Grazing Annual Regime

Timing	Action
January - February	Light grazing on any new growth.
End of February	Remove grazing; this allows forbs to grow and allows a good habitat for ground nesting birds to develop.
End of August	An optional hay cut may be taken. Cut hay once the wildflowers have seeded from August onwards. The arisings can be collected as a hay crop, mechanically raked and piled up or removed. Arisings must be removed with one or more of these methods to avoid the harmful effects of grass mulch on plant species diversity
September to the end of December	The main grazing period with light grazing down to a short sward height; a mosaic of plant heights helps encourage insects.

6.7.21 The intended outcome of a conservation grazing scheme will be to have a sward of the following height structure at the beginning of March:

i) 75% at a height of approximately 5cm; and

ii) 25% at a height of approximately 25cm.

6.7.22 A stocking density of between 0.5 – 1 livestock units (LSUs) per hectare is recommended between late September and February. This is a typical stocking density for conservation grazing. However, the stocking density and timing of grazing will be at the discretion of the land manager, in order to achieve the desired sward structure given above. More animals could be used for shorter grazing periods.

6.7.23 It is important to regularly monitor the Site to ensure the grassland is not under or over grazed and stock density and duration altered accordingly to deliver the Target Condition specified in Table 1. The stocking density should be reduced in wet periods or in conditions when poaching would lead to a break-up of the sward and colonisation by aggressive weed species.

6.7.24 The following indicators will be used to review and amend stocking densities:

i) An increase in the amount of uneaten grass, the accumulation of litter, an increase in vigorous rank and unpalatable grasses, and a reduction in low growing herbs indicates stocking density is too low (increase density).
ii) A reduction in density of plants, excessive poaching, weed invasion and the development of bare patches indicates stocking density is too high (reduce density).

6.7.25 Grazing is only to be undertaken by sheep. Cattle grazing is not proposed due to the damage this livestock may cause to the solar panel equipment.

6.7.26 Should the sward height become a problem, with plants starting to shade the lower levels of the panels, a strip of no more than 1 m wide can be cut at the base of the panel to shorten the sward height in this area. This cutting can occur at any time, in such cases cuts should reduce sward height to no lower than 200 mm to retain habitat for biodiversity.

Outside Solar Array (excluding NBBMA)

6.7.27 Outside of the Solar Array security fencing and/or stock proof fencing surrounding panel areas, grassland will be managed via mechanical cutting.

6.7.28 Following establishment, one or possibly two cuts will be taken per year comprising an early cut in February (if necessary) to manage regrowth, and a second later in the season between August and September (each cut reducing sward height to approximately 150 mm). No cutting will take place throughout the summer to allow the seeds of the later flowering species to fall prior to the cut. There may be circumstances when an additional summer cut is required to prevent vegetation obscuring panels, in such cases cuts should reduce sward height to no lower than 200 mm to retain habitat for biodiversity.

6.7.29 Cutting should adopt a systematic method (i.e., working outwards towards the boundary features); this will allow fauna such as invertebrates, amphibians, birds and small mammals to temporarily and safely vacate the area.

6.7.30 The management will take a flexible approach and the exact dates will be dependent upon weather conditions. A phased (rotational) cutting regime is recommended (i.e., ideally the entire area should not be cut at the same time) in order to allow for more structured grassland.

6.7.31 Cuttings will remain on-Site for three to five days following the cut to allow seeds to disperse and then be removed or heaped in designated areas within the Solar Array Development Area in order to remove nutrients and promote the development of a botanically diverse sward.

Management Objectives for Grassland

6.7.32 Key management objectives for modified grassland are as follows:

i) Achieves UKHab definition of Modified Grassland.
ii) Ensure at least six species per m^2 on average.
iii) Varied sward height is present.
iv) Scrub accounts for less than 20% of the total grassland area.

v) Cover of bare ground is between 1% and 10%.

6.7.33 Key management objectives for other neutral and marshy grassland (other neutral) are as follows:

i) Achieves UKHab definition of Other Neutral Grassland.
ii) Ensure at least nine species per m^2 on average.
iii) Varied sward height is present.
iv) Scrub accounts for less that 5% of the total grassland area.
v) Cover of bare ground is between 1% and 10%.
vi) Species indicative of nutrient enrichment are not present.

6.8 Wetland (outside the NBBMA)

Planting/Seeding Specification

6.8.1 The following indicative species mix is proposed for wetland, with full details to be confirmed in the final LEMP.

6.8.2 The following species mixes are proposed.

Marginal planting

6.8.3 Grass species. To be seeded around the edges of the new or enhanced ditches and waterbodies.

i)	Common Bent (*Agrostis capillaris)*	~~11~~11%.
ii)	Marsh Foxtail (*Alopecurus geniculatus*)	11%.
iii)	Meadow Foxtail (*Alopecurus pratensis*)	11%.
iv)	Marsh Marigold (*Caltha palustris*)	2%.
v)	Cuckoo Flower (*Cardamine pratensis*)	3%.
vi)	Greater Tussock Sedge (*Carex paniculata*)	~~11~~12%.
vii)	Pendulous Sedge (*Carex pendula*)	~~11~~12%.
viii)	Greater Pond Sedge (*Carex riparia*)	~~11~~12%.
ix)	Crested Dog's-tail (*Cynosurus cristalus*)	3%.
x)	Red Fescue (*Festuca rubra*)	2%.
xi)	Water Avens (*Geum rivale*)	3%.
xii)	Floating Sweet Grass (*Glyceria fluitans*)	11%.
xiii)	Purple Loosestrife (*Lythrum salicaria*)	2%.
xiv)	Water Mint (*Mentha aquatica*)	3%.
xv)	Water-cress (*Nasturtium officinale*)	2%.
~~xvi)~~	~~Reed Canary Grass (*Phalaris arundinacea*)~~	~~3%.~~

6.8.4 Plant plugs at density 7/m^2 in single species groups of 20-30, around the edges of the ditch/waterbody.

i)	Greater Tussock Sedge (*Carex paniculata*)	~~10~~14%.

ii) Greater Pond Sedge (*Carex riparia*) ~~10~~13%.
iii) Floating Sweet Grass (*Glyceria fluitans*) ~~10~~13%.
iv) Purple Loosestrife (*Lythrum salicaria*) 10%.
~~Reed Canary Grass (*Phalaris arundinacea*) 10%.~~

In-channel (aquatic) planting

6.8.5 Plant plugs at density 7/m^2 in single species groups of 20-30, within the permanently wet part of the ditch/waterbody.

i) Common Water Plantain (*Alisma plantago-aquatica*) 10%.
ii) Soft Rush (*Juncus effusus*) 10%.
iii) Yellow Flag Iris (*Iris pseudacorus*) 10%.
iv) Branched Bur Reed (*Sparganium erectum*) 10%.
v) Bull Rush (*Typha latifolia*) 10%.

Reedbeds

6.8.6 Common reed (*Phragmites australis*) to be planted in the margins of the new reedbeds at a density of approximately 5 plants per m^2.

Implementation

6.8.7 Details of the physical measures required for the creation or enhancement of existing ponds/open water environments, e.g. the wetland area ~~around~~ to the east of Marsh Farm and The Lum, will be set out in the final CEMP, and relevant details will be carried forward into the final LEMP.

6.8.8 ~~-~~Scrapes will be created by excavating shallow depressions, the depths of which will be set out in the final LEMP. Locations shall be broadly as indicated on the **IEM** (**Appendix A**), with the final locations determined on site.

6.8.9 Wetland seed will be sown between late July to early September, to allow establishment prior to winter and likely winter flooding. Alternatively, it may be sown during spring if there is a risk of flooding during the autumn.

6.8.10 Wetland plug planting will take place March/April or September/October when ground and climate conditions are suitable. Ground should be damp to wet prior to planting and where possible planting will be undertaken during rainy weather. Planting will not be carried out when the ground is frost bound, or during periods of excessive cold drying winds or drought.

Establishment Management

General

6.8.11 The establishment period for wetland vegetation shall last for the first year following practical completion of the landscape works.

6.8.12 Litter and debris will be removed as required, at a minimum on a monthly basis.

6.8.13 Weed growth shall be controlled by either cutting, or by hand pulling. Use of herbicide is not permitted. Species to be removed shall be identified on-site as part of regular monitoring.

6.8.14 No establishment cutting of vegetation is required.

Long-term Management

General

6.8.15 Long-term management prescriptions shall apply once establishment is complete. Existing vegetation shall be subject to long-term management from practical completion of the landscape works.

6.8.16 Management of vegetation shall not impede the drainage function of any wetland feature, including ditches.

~~6.8.16~~6.8.17 The wetland area to the east of Marsh Farm and The Lum will be managed to create habitats which are suitable for SPA birds. The long-term management prescriptions shall be determined in consultation with the conservation organisation responsible for the management of the NBBMA.

Ditches

~~6.8.17~~6.8.18 Once established, bankside vegetation will be cut on a rotational basis, with 25% being cut each year. Areas to be cut shall be cut to 50mm in September with arisings being left for 5-7 days before removal.

~~6.8.18~~6.8.19 Other maintenance actions may be required, such as removal of sediment, which would impact the landscape proposals as grass and plants are likely to be damaged in the process. When this occurs, the affected areas will be re-seeded with the same mix as originally specified, or similar, as available. Additional plug planting will be carried out with the original species and sizes. New planting and seeding will revert to a year of establishment maintenance before being incorporated back into the long-term maintenance operations. Prior to these actions taking place, a review shall be undertaken of the potential for the temporary extraction and subsequent replanting of the affected vegetation. This extraction and replanting shall be carried out if considered to be viable, ecological benefit and if the desired maintenance outcomes are not impacted.

~~6.8.19~~6.8.20 Management shall control the spread of non-native species, which shall typically be removed in the winter following identification. If best practice for the control of particular species requires removal at other times, then this shall be followed.

~~6.8.20~~6.8.21 Vegetation growth shall be encouraged along ditches, as long as this does not prejudice drainage. Where the presence of vegetation is inhibiting drainage, this shall be cleared (all arisings to be removed from the ditch) or other appropriate steps taken to remedy the situation. As a guide no more than approximately 60%-80% of the surface area shall be covered by vegetation at any one-time. Any management decisions to clear vegetation will be undertaken in consultation with the ECoW to confirm that the proposed maintenance actions do not prevent the achievement of the intended ecological outcome for the ditch in question.

~~6.8.21~~6.8.22 Key maintenance objectives for new and enhanced ditches are as follows:

i) Achieves UKHab definition of Ditch.
ii) Maintaining good water quality, with no obvious signs of pollution or eutrophication.
iii) Range of emergent, submerged and floating plants are present.
iv) Fringe of aquatic marginal vegetation is present.
v) Avoid damage from human activities.
vi) Maintain a summer water depth of at least 50 cm.

~~6.8.22~~6.8.23 Retained ditches will also be enhanced and managed for the benefit of water voles as described below.

~~6.8.23~~6.8.24 Enhancement measures for the benefit of water voles will focus on diversifying the bankside vegetation, and also managing the dense bramble scrub to maintain a mix of structure and age and reducing any encroachment/shading of scrub on the channel.

~~6.8.24~~6.8.25 Rotational cutting of the existing dense scrub would maintain a range of successional stages and therefore structure, whilst also encouraging the growth of grass and other bankside vegetation, which would provide more varied cover and food sources for water vole.

~~6.8.25~~6.8.26 The following actions may be undertaken (adapted from *Helping Water Voles on Your Land,* People's Trust for Endangered Species)[12].

i) Cut vegetation on a two-year rotation (or longer), leaving one bank uncut each year. Maintain 15cm of vegetation when cutting and leave gaps of 10-20m as untouched refuge areas. Vegetation to be cut in late Summer (September).

[12] People's Trust for Endangered Species (undated). *Helping Water Voles on Your Land*. [online] Available at [redacted] [Accessed April 2025.]

ii) Where ditches have filled in or overgrown, de-silt ditches on a five-year rotation. Carry out work between mid-September and late January. Avoid de-silting more than half a ditch in any winter, and avoid scraping the bank edges as this can destroy burrows. This will encourage the growth of marginal and in channel vegetation.

iii) Selectively coppice bankside trees and manage hedgerows adjacent to ditches to encourage the growth of marginal and in channel vegetation and reduces leaf fall into the channel. Vegetation removal to be undertaken in winter.

Reedbeds

~~6.8.26~~6.8.27 Reedbeds shall be cut on a five-year rotation (i.e. approximately one-fifth of vegetation shall be cut each year and arisings removed from the reedbed). Cutting shall take place in the autumn, avoiding the main bird breeding season (March to August, inclusive). The aim shall be to provide a diversity of reeds of different heights and ages.

~~6.8.27~~6.8.28 Management shall control the spread of non-native species if necessary, which shall typically be removed in the winter following identification. If best practice for the control of particular species requires removal at other times, then this shall be followed.

~~6.8.28~~6.8.29 Key maintenance objectives for reedbed are as follows:

i) Achieves UKHab definition of Reedbed.
ii) Maintaining good water quality, with no obvious signs of pollution or eutrophication.
iii) There is an absence of scrub and trees.
iv) There is an absence of bare ground.
v) Maintain a diverse structure, with 60-80% reeds and at least 10% open water.

~~6.8.29~~6.8.30 In order to provide additional benefits for water vole within the areas of new reedbed, islands and high banks will be created and managed within the reedbeds. High banks or islands allow refuge during times of flooding.

Waterbodies

~~6.8.30~~6.8.31 Vegetation growth shall be encouraged within the waterbodies, as long as this does not prejudice drainage. Where the presence of vegetation is inhibiting drainage, this shall be cleared (all arisings to be removed) or other appropriate steps taken to remedy the situation. Any management decisions to clear vegetation will be undertaken in consultation with the ECoW to confirm that the proposed maintenance actions do not prevent the achievement of the intended ecological outcome for the ditch in question

~~6.8.31~~6.8.32 Once established, marginal vegetation will be cut on a rotational basis, with 25% being cut each year. Areas to be cut shall be cut to 50mm in September with arisings being left for 5-7 days before removal.

~~6.8.32~~6.8.33 Other maintenance actions may be required, such as removal of sediment, which would impact the landscape proposals as grass and plants are likely to be damaged in the process. When this occurs, the affected areas will be re-seeded with the same mix as originally specified, or similar, as available. Additional plug planting will be carried out with the original species and sizes. New planting and seeding will revert to a year of establishment maintenance before being incorporated back into the long-term maintenance operations. Prior to these actions taking place, a review shall be undertaken of the potential for the temporary extraction and subsequent replanting of the affected vegetation. This extraction and replanting shall be carried out if considered to be viable, ecological benefit and if the desired maintenance outcomes are not impacted.

~~6.8.33~~6.8.34 As set out in Section 6.5, management shall control the spread of non-native species, which shall typically be removed in the winter following

identification. If best practice for the control of particular species requires removal at other times, then this shall be followed.

~~6.8.34~~6.8.35 Key Maintenance objectives for waterbodies (ponds) are as follows:

i) Achieves UKHab definition of Pond (non-priority).
ii) Maintaining good water quality, with no obvious signs of pollution or eutrophication.
iii) There is an absence of artificially stocked fish.
iv) Emergent submerged or floating plants cover at least 50% of the pond area which is less than 3m deep.
v) Pond surface is no more than 50 % shaded by trees/scrub.

6.9 Non-Breeding Bird Mitigation Area

6.9.1 Proposals within the NBBMA will be implemented and managed as described in **Appendix B** of this document, and are not repeated in detail here.

6.9.2 The principal aim of the NBBMA is to deliver mitigation for the loss of habitat for foraging curlew, lapwing and golden plover through the provision of higher quality habitat.

6.9.3 Measures that are proposed are:

i) Provision of additional habitats for SPA species through the creation of scrapes with extensive wet edges.
ii) The inclusion of island features to provide high-tide and safe roosting opportunities for SPA species.
iii) Provide improved foraging opportunities for winter and passage SPA species through control of water levels (i.e., ensuring grassland and scrapes remain wet under normal conditions).
iv) Preventing possible spread of New Zealand Pigmy Weed across Frodsham Marsh, and in particular into existing wetland features associated with mitigation measures for Frodsham Wind Farm.
v) Re-engineering of soil, with re-seeding of grassland and subsequent control of grazing/mowing regime will remove the existing seedbed and therefore solve on-going issues of ruderal vegetation encroachment.
vi) Removal of a small stand of semi-mature sycamore trees, thereby increasing the attractiveness of surrounding habitats to grassland waders (SPA species) and reducing perching/nesting opportunities for avian predators.
vii) Removal of the Canal Pools and associated recreational fishing will lead to a cessation of public access to the NBBMA and therefore reduced disturbance.
viii) Conservation focussed grazing (or cutting) management across the NBBMA area throughout the lifetime of the Proposed Development (with the cessation of the current grazing lease).

ix) Installation of predator fencing around the perimeter of the NBBMA.

6.10 Skylark Mitigation Area

6.10.1 The Skylark Mitigation Area would be managed as 'other neutral grassland' for the operational life of the Proposed Development. This will provide invertebrate habitat, thus acting as a forging resource, and will also be suitable for use by nesting skylark. Refer to **Section 6.7** for details of management and maintenance.

6.11 Physical Habitat Creation Structures

Bird Screening Measures

6.11.1 Bird Screening Measures would be installed in the broad locations illustrated on the **IEM** (**Appendix A**) unless local topography can provide the desired screening. These measures would have a dual purpose and would be intended to prevent disturbance to birds by movement of people along adjacent routes and also to provide opportunities for bird watching.

6.11.2 The screening measures are anticipated to comprise timber fencing of sufficient height to screen people from view (e.g. up to c.2m), but with 'windows' to allow views though for bird-watchers. Hides may also be installed some locations.

6.11.3 Details of the locations, design, installation and maintenance of the bird screening measures will be specified in the final LEMP. The **DAD [EN010153/DR/5.8]** provides further information and discussion in relation to the design of these measures.

Bat Boxes

6.11.4 A total of 60 no. bat boxes, including a minimum of 5 no. hibernation boxes and 5 no. maternity boxes would be installed. Approximate locations will be specified within the final LEMP.

6.11.5 Bat roost boxes will be installed on suitable mature and semi-mature trees along field boundaries and within woodland within the Order Limits. If the

required number of suitable trees cannot be identified, then boxes will be pole mounted. Precise locations will be subject to confirmation during the installation depending on the box and condition of trees. Boxes will be erected in suitable habitats, at an appropriate height (ideally above 4m in height) and with clear flight paths to utilise the Site field boundary features. Bat boxes should ideally be sited in clusters of two or three boxes, in open sunny positions facing different directions to provide a variety of micro-habitats.

6.11.6 Details of the design, installation and monitoring of each different type of bat box will be set out in the final LEMP.

Bird Boxes

6.11.7 A minimum of 2 no. barn owl nest boxes will be installed on suitable mature trees or poles within the SADA, but at least 1km from the M56. The two barn owl boxes would ideally be located between 200 m and 500 m apart; precise locations will be agreed upon with the project ecologist and will be subject to confirmation during the installation depending on tree condition at that time.

6.11.8 A minimum of 2 no. kestrel boxes will be installed, positioned within mature hedgerows or on mature trees or poles within the SADA, in close proximity to areas of grassland to be retained/created.

6.11.9 A minimum of 30 no. small, open-fronted and hole-fronted nest boxes of various designs will be installed, positioned within existing hedgerows, tree belts, or woodland within the SADA. Boxes will be erected at an appropriate height of between 1 to 5 metres. If the required number of suitable trees cannot be identified, then boxes will be pole mounted. Positioning within or close to hedgerows, tree belts and woodland will increase chances of occupation.

6.11.10 All boxes will be angled so that they face away from the prevailing wind, and all boxes will be positioned so that the front of the boxes are not obstructed and there is a clear flight path into the box.

6.11.11 Details of the design, installation and monitoring of each different type of bird box will be set out in the final LEMP.

Reptile/Amphibian Refugia

6.11.12 A total of 10 no. reptile/amphibian refugia will be installed at locations to be specified within the final LEMP. Refugia will be located adjacent to either a hedgerow or woodland; each will measure approximately 2m x 2m x 1m in height. The hibernacula will be constructed from logs and/or clean bricks/rubble sourced locally as far as possible, or with 'clean' materials brought in from elsewhere where this is not possible and topped with soil and earth. The hibernacula will provide shelter and over-wintering refuge for amphibians, reptiles, small mammals and invertebrates.

6.11.13 Details of the design, installation and monitoring of refugia will be set out in the final LEMP.

Hedgehog Boxes

6.11.14 A total of 20 no. hedgehog boxes will be installed at locations to be specified within the final LEMP. Precise locations will be subject to confirmation during the installation but will be concentrated within sheltered and undisturbed locations within woodland and along boundary features such as hedgerows. The entrances will be placed out of the weather, ideally facing east to south.

6.11.15 Details of the design, installation and monitoring of hedgehog boxes will be set out in the final LEMP.

Insect Hotels

6.11.16 A total of 10 no. insect hotels will be installed at locations to be specified within the final LEMP. Precise locations will be subject to confirmation during the installation depending on the box/hotel and condition of trees (if required). Boxes will be erected at sheltered undisturbed locations and be angled so that they face away from the prevailing wind. A selection of boxes/hotels will be used, providing suitable habitat for a variety of invertebrate species.

6.11.17 Details of the design, installation and monitoring of insect hotels will be set out in the final LEMP.

6.12 Management and Maintenance Schedules

6.12.1 The schedules set out below in **Table 3, Table 4 and Table 5** outline the anticipated timing of the proposed landscape and ecological management and maintenance works.

Table 3: Implementation Works

Management Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Other neutral grassland seeding				✓					✓			
Marshy grassland seeding (*preferred month)			✓	✓			✓	✓*	✓*			
Tree, shrub and hedge planting (*preferred month)	✓	✓									✓*	✓*
Wetland plug planting			✓	✓					✓	✓		
Watering		Water directly following planting, and as required to ensure establishment e.g. during periods of drought										

Table 4: Establishment Management

Management Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Initial cut of other neutral grassland – if autumn sown				✓ (70-100mm)			✓ (40-60mm)	✓ (40-60mm)	✓ (40-60mm)	✓ (40-60mm)		
Initial cut of other neutral grassland – if spring sown				✓ (40-60mm)	✓ (40-60mm)	✓ (40-60mm)	✓ (40-60mm)	✓ (40-60mm)	✓ (40-60mm)	✓ (40-60mm)		
Initial cut of marshy grassland – if autumn sown	✓	✓	✓							✓	✓	✓
Initial cut of marshy grassland – if spring sown	✓	✓	✓					✓	✓	✓	✓	✓
Wetland plug planting cut									✓			
Check of planting stock, stakes, guards, and mulch levels			✓						✓			
Replanting of failed tree and shrub species (* preferred month)	✓	✓									✓*	✓*
Herbicide treatment to tree planting stations and hedgerows – if required				✓		✓		✓				
Fertiliser treatment for trees									✓			
Annual review							✓		✓			
Watering	As required to ensure establishment e.g. during periods of drought											
Litter control	Each visit											

Table 5: Long-term Management

Management Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cut other neutral grassland (August/September leave arisings 5-7 days before removal)		✓							✓			
Grazing (land within solar security fencing)	✓	✓							✓	✓	✓	✓
Management of wetland bankside vegetation – 25% of area cut to 50mm annually (leave arisings 5-7 days before removal)										✓		
Cut reedbeds – 25% of area cut annually (arisings removed)										✓		
Thinning, coppicing or other cutting of trees/shrubs										✓	✓	✓
All hedgerows – 3-year rotational routine: cut $^{1}/_{3}^{rd}$ of site hedgerows each year										✓	✓	✓
Annual review									✓			
Litter control	Every visit											
Maintenance of fencing and access routes	As required											

7.0 MONITORING AND REVIEW

7.1 Introduction

7.1.1 Regular monitoring of the landscape and ecology works is key to identifying whether or not they are likely to meet identified targets and are ultimately meet the Project Design Principles and Design Vision for the Proposed Development.

7.2 General Monitoring

7.2.1 A Site Inspection shall be undertaken every two years, up to Year 10, once the Proposed Development becomes operational, and then every five years[13], to review management successes/ failures gauged against the Project Design Principles outlined in **Section 4.0** of the **oLEMP** (or the equivalent section of the final LEMP), and to make any adjustments to the management/maintenance regime that the findings of such inspections indicate would be appropriate.

7.2.2 Representatives from CWaCC and other key stakeholders, envisaged to include FTC, CWT and the Royal Society for the Protection of Birds ('RSPB'), would be invited to attend the Site Inspections with representatives of the Applicant. Any modifications to management would be made in agreement with CWaCC.

7.2.3 Monitoring will consider the potential effects of climate change upon the works. A changing climate may affect the success of particular species. As such, it may be necessary to substitute particular species, with alternative, more resilient species. Additionally, changes to management and maintenance operations may also be deemed necessary to address specific climate change related issues.

[13] E.g. Years 2, 4, 6, 8, 10, 15, 20, 25, 30, 35, and 40.

7.2.4 An Update Report would be submitted to CWaCC following each visit and would include details of any observations made during the Site inspection, other observations made during ongoing maintenance, results of all monitoring undertaken by the Applicant, and any changes to management and maintenance operations agreed with CWaCC. This allows for further detail regarding the management and restoration of the Site to be provided to CWaCC, as and when such details become available.

7.2.5 The Update Report would include set out details of the activities carried out since the previous Site Inspection[14], and activities programmed up to the next Site Inspection.

7.3 Biodiversity Net Gain Monitoring

7.3.1 While not subject to statutory BNG requirements, the Proposed Development has made a commitment to achieving a minimum of 10% increase in habitat and hedgerow units, and no net loss in watercourse units, and as such the development of the biodiversity interest of the Site will be monitored over time by a suitably experienced ecologist. A walkover survey will be undertaken in Years 1, 2, and 5, and then every five years throughout the operational phase.

7.3.2 This will involve an inspection of the created and retained habitats to ensure that they are being managed in a manner suitable for the enhancement of wildlife interest. The results of these monitoring surveys will be used to inform remedial actions required to achieve the relevant Project Design Principles and/or adhere to relevant wildlife conservation legislation at that time.

7.3.3 Monitoring will include a habitat survey undertaken between May and September, following industry standard UK Habitat Survey ('UKHab') methodology, as used for the BNG assessment, and condition assessment using the relevant condition criteria contained within the Statutory Biodiversity Metric Condition Assessment Guide to ensure created habitats are achieving

[14] Or in the case of the first Update Report, works carried out since implementation.

the stated habitat type and condition. Following completion of monitoring, a report will be compiled and distributed to CWaCC, including any proposed remedial measures.

7.4 Ornithological Monitoring

7.4.1 The requirements for ornithological monitoring will be agreed with NE and CWaCC, and will be detailed within the final LEMP. However, as set out in the outline NBBMS (Appendix B of this document) this is not a reliable method to determine the success or otherwise of achieving target habitat conditions due to other factors which may influence bird populations and distribution.

7.5 Additional Survey Requirements

7.5.1 Further measures to ascertain the success of habitat management will be considered, for example, within the NBBMA and will be subject to further discussions with NE and CWaCC along with other pertinent stakeholders such as RSPB. The outline NBBMS (Appendix B of this document) identifies a series of objectives which the strategy seeks to achieve. The document sets out that measurable targets on which to determine the success of the outline NBBMS and on-going management will be set and agreed with key consultees in the final NBBMS document.

7.5.2 An assessment of species enhancement measures (including the bat, bird and hedgehog boxes, reptile/amphibian refugia and insect hotels), including an assessment of the integrity of such features, would also be undertaken. Where appropriate, usage of such features will also be assessed.

7.5.3 All surveying/assessment would be undertaken by a suitably qualified ecologist/ornithologist.

7.6 Remedial Measures

7.6.1 If the monitoring outlined above identifies that a habitat is not meeting the target condition or is not meeting the description for the proposed habitat type

then contingency measures appropriate for habitat in question would be followed.

7.6.2 In all cases, where a failure is identified, the root cause should be identified and remedial measures implemented.

7.6.3 Remedial measures appropriate for each habitat type will be set out in the final LEMP

7.7 Additional Monitoring

7.7.1 A management and monitoring plan to mitigate any adverse effects to protected and notable habitats and species would be prepared, details of which would be set out within the final LEMP and approved by regulatory authorities prior to implementation. It is expected this would include for monitoring of water quality within surrounding surface watercourses and surveying such as invertebrate abundance monitoring.

7.7.2 Bird, bat, insect and hedgehog boxes, and log piles and hibernacula will be checked to ensure they are in place and in working order. The results of these monitoring surveys will be used to inform the need or otherwise to replace missing boxes/hotels or re-build damaged hibernacula.

7.7.3 As set out in **Section 6.5**, monitoring would be undertaken of any potential car parking along Moorditch Lane and any resulting access issues this may cause for other users of Moorditch Lane. The results of this monitoring would inform the provision of the potential visitor car park, or other potential solutions.

7.8 NBBMA

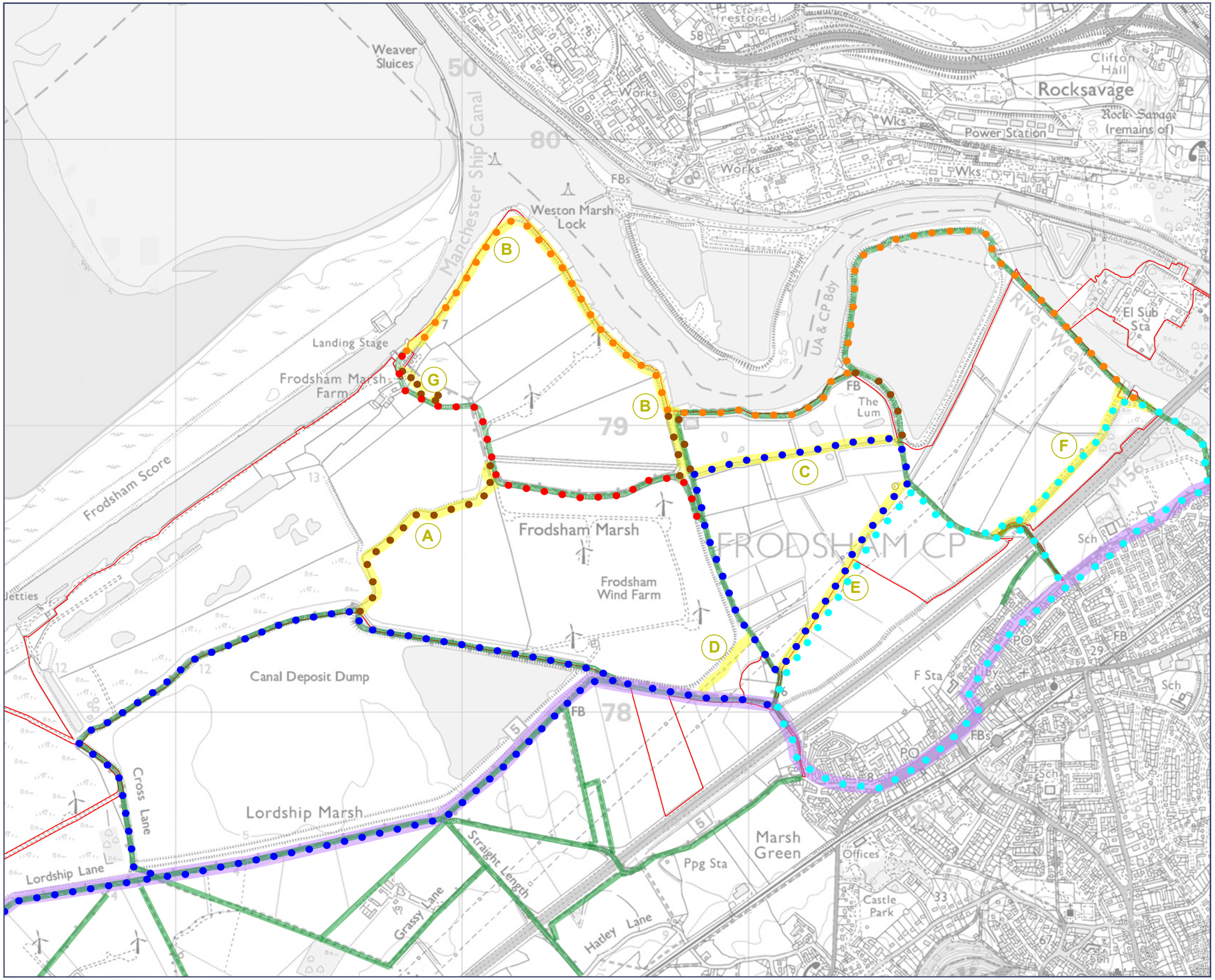
7.8.1 As set out above the proposed monitoring and review measures for the NBBMA are set out in **Appendix B**.

7.8.2 A management and monitoring plan to mitigate effects on wading birds during the large-scale excavation works required for the creation of the NBBMA will also be prepared to cover works within Cell 3 and the ponds to the north. It is

anticipated that this will entail a watching brief by a suitably qualified ecologist/ornithologist, monitoring of water quality within surrounding surface watercourses, and surveying such as invertebrate abundance monitoring. This would cover the construction period and the first year of operation. This monitoring is detailed in the **oCEMP [EN010153/DR/7.5]** and full details will be set out in the final CEMP, and provisions for implementation will be included in the final LEMP as necessary.

7.8.3 The outline **Soil Management Plan (oSMP) [EN010153/DR/7.10]** describes how soils across the Site will be managed in order to facilitate the proposed landscaping and ecological works across the Site. The oSMP also includes details of how soils which may be subject to contamination would be managed, this is also controlled through measures set out in the oCEMP. Full details will be set out in the final SMP and CEMP, and provisions for implementation will be included in the final LEMP as necessary.

Figures



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N

0 500 750 1000 1250m

- Order Limits
- Public Right of Way
- Proposed Permissive Path
- National Cycle Route 5
- Restricted Byway (current access levels retained)
- Access for All
- Cycle/Equestrian Loop
- Continuous Waterside Trail (pedestrians only)
- Pedestrian Access

Refer to the Outline Landscape and Ecology Management Plan document for details of permissive paths A-G

Case Reference: EN010153
Document Reference: EN010153/DR/7.13
Regulation 5(2)(a) Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Document
Outline Landscape and Ecology Management Plan

Project
FRODSHAM SOLAR

Figure Number
Figure 1

Figure Title
Indicative Route Hierarchy

Scale
1:12,500 @A3

Date
May 2025

Appendix A – Illustrative Environmental Masterplan

INTERPRETATION PANELS

- Welcome to Frodsham Solar Park (general information and maps
- A. Bird Mitigation Area Information
- B. Pipelines
- C. Reedbeds
- D. Manchester Ship Canal
- E. Mersey Estuary View
- F. Frodsham Wind Farm
- G. Geography/Geology - e.g. River/Sandstone Ridge
- H. Weston Bank Industry and River Weaver
- I. River Weaver and Weaver Navigation

1
2
3
4

- Order Limits
- Solar PV Modules
- Principal Public Access / Biodiversity Enhancement Zones
- Retained/created neutral grassland or modified grassland
- Public Right of Way
- Proposed Permissive Path
- Existing Vegetation
- Proposed Native Woodland
- Proposed Native Scrub
- Proposed Native Trees and Shrubs
- Proposed Native Hedgerow
- Proposed Native Hedgerow (maintained at a low height)
- Area for Potential Skylark Mitigation plots
- Non Breeding Bird Mitigation Area

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N

0 250 500 750 1000 1250 1500m

Case Reference: EN010153
Document Reference: EN010153/DR/7.13
Regulation 5(2)(a) Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Outline Landscape and Ecology Management Plan

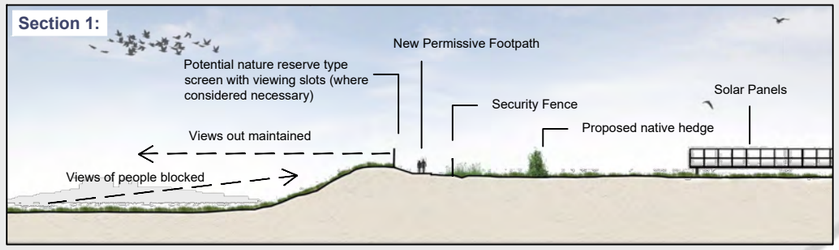
Figure Number: **Figure A1.1**

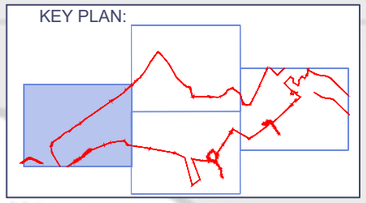
Revision: **P01**

Figure Title: **Illustrative Environmental Masterplan Key Plan**

Scale: **1:15,000 @A3**

Date: **May 2025**





Potential viewing point over the NBBMA

Frodsham Marsh Farm

Existing tree cover removed

Neutral grassland areas to be managed to provide foraging habitat

Proposed water storage area on raised bank

Neutral grassland areas to be managed to provide foraging habitat

Manchester Ship Canal

New island within scrapes to provide roosting and nesting locations for birds

Existing drainage ditch

New wet (marshy) grassland area adjacent to existing and proposed scrapes

New islands within scrapes to provide roosting and nesting locations for birds

New wet (marshy) grassland area adjacent to existing and proposed scrapes

Existing drainage ditch

Potential bicycle parking

Potential bird screening measures (where considered necessary): Timber structures with viewing slots

Proposed permissive path A links Brook Furlong to Moorditch lane, creating a new loop in the network and providing for a wide variety of currently unavailable route options

Sheet 1 (Figure 2-3b)

Sheet 2 (Figure 2-3c)

Sheet 3 (Figure 2-3a)

- Order Limits
- Solar PV Modules
- Solar Array Security Fence (indicative draft layout)
- Solar Array Utility Fence (indicative draft layout)
- Bird Screening Measures
- Public Right of Way
- Proposed Permissive Path
- Existing Vegetation
- Neutral Grassland
- Marshy Grassland
- Raised Bank
- Existing Drainage Ditch
- Existing Scrape
- Proposed Scrape
- Proposed Water Storage Area
- Section Line

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Case Reference: EN010153
Document Reference: EN010153/DR/7.13
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Outline Landscape and Ecology Management Plan

Figure Number: **Figure A1.2**

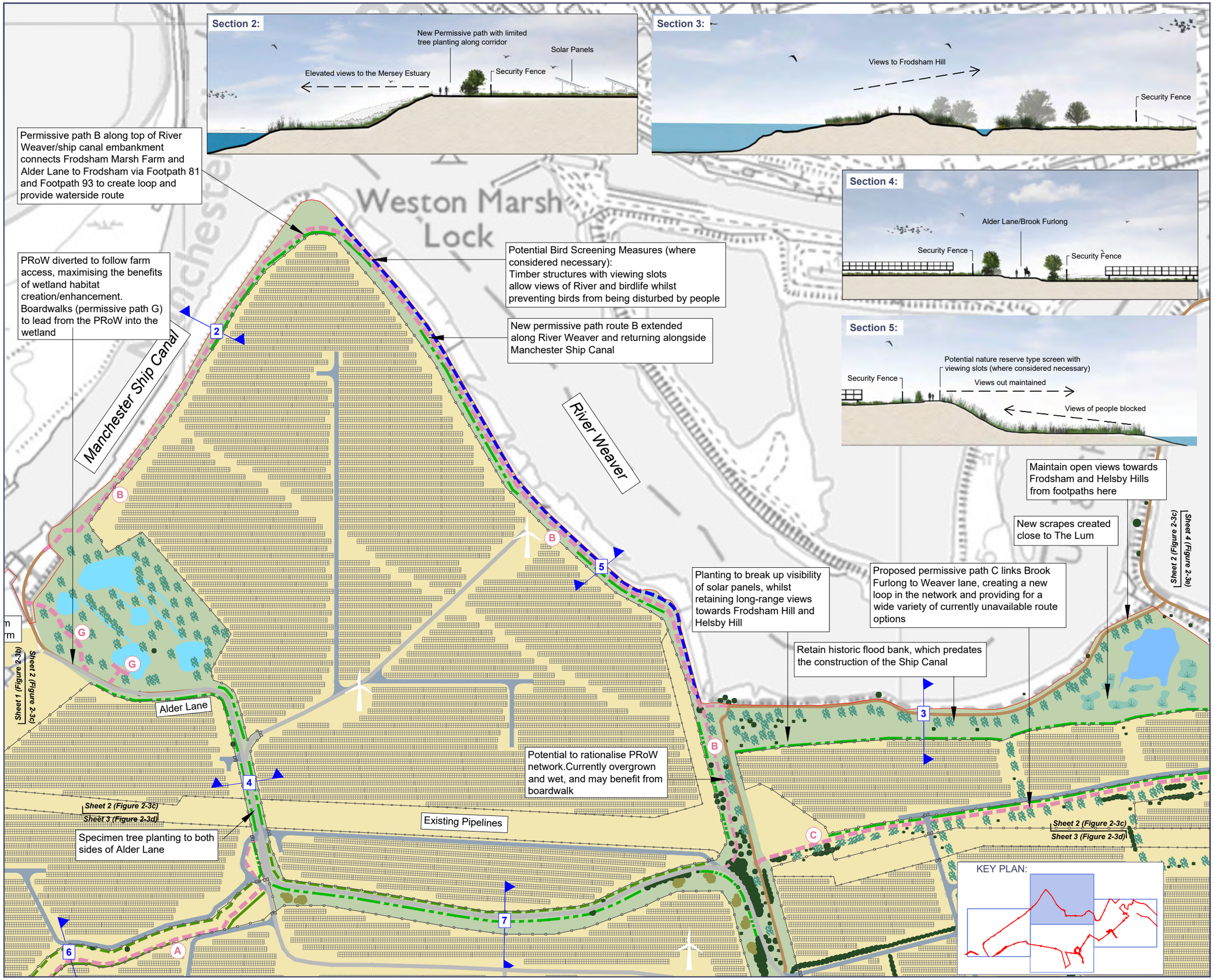
Revision: **P01**

Figure Title

Illustrative Environmental Masterplan Sheet 1

Scale: **1:5000 @A3**

Date: **May 2025**



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- Order Limits
- Solar PV Modules
- Solar Array Security Fence (indicative draft layout)
- Solar Array Utility Fence (indicative draft layout)
- Indicative Access Track
- Potential Overhead HV Line
- Principal Public Access / Biodiversity Enhancement Zones
- Retained/created neutral grassland or modified grassland
- Retained/created reedbed
- Proposed pond/ditch
- Public Right of Way
- Proposed Permissive Path
- Existing Vegetation
- Proposed Native Woodland
- Proposed Native Scrub
- Proposed Native Trees and Shrubs
- Proposed Native Hedgerow
- Proposed Native Hedgerow (maintained at a low height)
- Section Line

Case Reference: EN010153
Document Reference: EN010153/DR/7.13
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Outline Landscape and Ecology Management Plan

Figure Number: **Figure A1.3**
Revision: **P01**

Figure Title:

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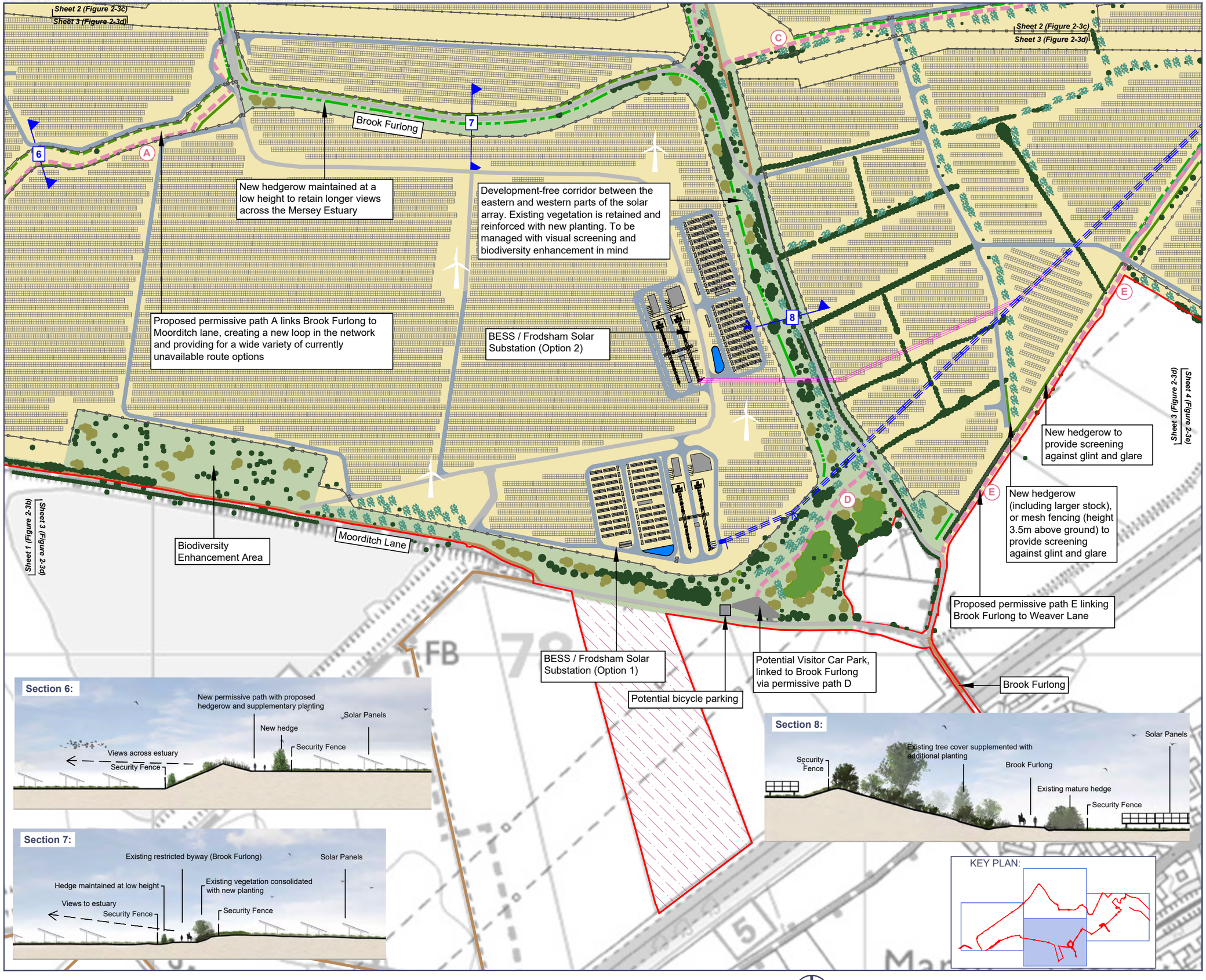
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Date:

May 2025

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- Order Limits
- Solar PV Modules
- Solar Array Security Fence (indicative draft layout)
- Solar Array Utility Fence (indicative draft layout)
- Indicative Access Track
- Potential Overhead HV Line
- Principal Public Access / Biodiversity Enhancement Zones
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- Proposed Permissive Path
- Existing Vegetation
- Proposed Native Woodland
- Proposed Native Scrub
- Proposed Native Trees and Shrubs
- Proposed Native Hedgerow
- Proposed Native Hedgerow (maintained at a low height)
- Section Line

Case Reference: EN010153
Document Reference: EN010153/DR/7.13
Regulation 5(2)(a) Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Outline Landscape and Ecology Management Plan

Figure Number: **Figure A1.4**
Revision: **P01**

Figure Title:

Illustrative Environmental Masterplan Sheet 3

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NB. This area is not open water, but is now covered with grassland and scrub

Planting to break up visibility of solar panels, whilst retaining long-range views towards Frodsham Hill and Helsby Hill

River Weaver

Viaduct

Permissive path F to enhance and connect Weaver Lane to River Weaver

Proposed screen planting to provide glint and glare mitigation

Permissive path F to enhance and connect Weaver Lane to River Weaver

New tree and hedgerow planting to screen solar panels from the south

Weaver Lane

Proposed screen planting to provide glint and glare mitigation

Frodsham

Frodsham Bridge

Viaduct

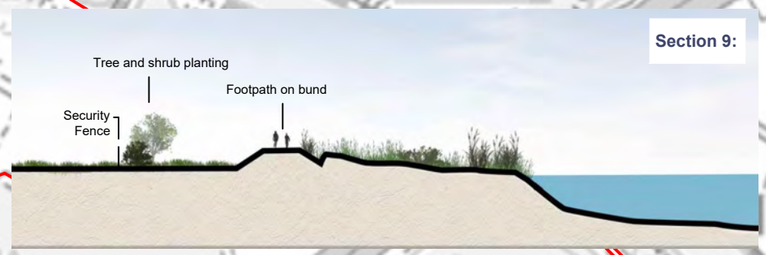
Sheet 2 (Figure 2-3c)

Sheet 4 (Figure 2-3e)

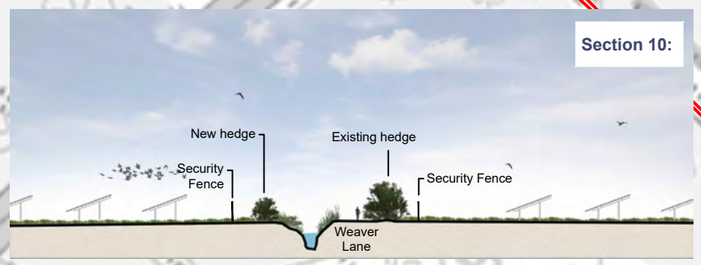
Sheet 4 (Figure 2-3e)

Sheet 3 (Figure 2-3d)

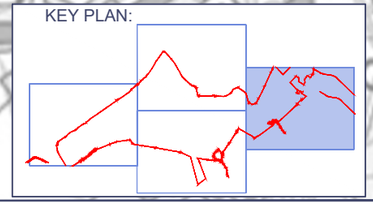
Section 9:



Section 10:



KEY PLAN:



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- Order Limits
- Solar PV Modules
- Solar Array Security Fence (indicative draft layout)
- Solar Array Utility Fence (indicative draft layout)
- Indicative Access Track
- Potential Overhead HV Line
- Potential Underground 132kV Cable
- Principal Public Access / Biodiversity Enhancement Zones
- Retained/created neutral grassland or modified grassland
- Retained/created reedbed
- Proposed pond/ditch
- Public Right of Way
- Proposed Permissive Path
- Existing Vegetation
- Proposed Native Woodland
- Proposed Native Scrub
- Proposed Native Trees and Shrubs
- Proposed Native Hedgerow
- Proposed Native Hedgerow (maintained at a low height)
- Section Line

Case Reference: EN010153
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Figure Number: **Figure A1.5**

Revision: **P01**

Figure Title: **Illustrative Environmental Masterplan Sheet 4**

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Date: **May 2025**

Appendix B – Outline Non-Breeding Bird Mitigation Strategy

Outline Landscape and Ecological Management Plan

Appendix B - Outline Non-Breeding Bird Mitigation Strategy (oNBBMS) [EN010153/DR/7.13~~]~~ P02] V2

Frodsham Solar, for Frodsham Solar Ltd



avian ecology

Document Control				
Project Name:	Frodsham Solar			
Project Number:	AxisL-043-3114			
Report Title:	Outline Non-Breeding Bird Mitigation Strategy			
Issue	**Date**	**Notes**	**Prepared**	**Reviewed**
v1	16.05.25		K. Doneo *BSc MSc MCIEEM* Principal Ornithologist	H. Fearn *MSc MCIEEM* Managing Director
v2	16.11.25		H. Fearn *MSc MCIEEM* Managing Director	K. Doneo *BSc MSc MCIEEM* Principal Ornithologist

This report has been prepared in accordance with the terms and conditions of appointment for Habitat Management Plan [on request]. Avian Ecology Ltd. (6839201) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

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ANNEXES

Annex 1: SPA Species Required Mitigation Habitat Calculations ('Cleeve Hill Approach')

Annex 2: Frodsham Wind Farm Year Five Monitoring Report (separate document)

Annex 3: ~~Site~~Frodsham Solar: Ground Investigations Report (separate document)

Annex 4: Frodsham Solar: Cell 3 Water Balance Update Report (separate document).

1 INTRODUCTION

1.1.1 This Outline Non-Breeding Bird Mitigation Strategy ('ONBBMS') has been prepared by Avian Ecology Ltd. on behalf of Frodsham Solar Ltd ('the Applicant'), for the proposed Frodsham Solar project (the 'Proposed Development').

1.1.2 The measures proposed will provide mitigation for the anticipated displacement of wetland birds associated with the Mersey Estuary Special Protection Area (SPA), Ramsar and Site of Special Scientific Interest (SSSI) as a result of the Proposed Development.

1.1.3 The proposed measures, primarily the creation of high-quality wetland habitats, represent an ambitious conservation strategy, which will deliver mitigation for the Proposed Development combined with substantial enhancements that will benefit multiple wetland bird species, including SPA species. ~~The habitats will be managed over a 40-year period~~The habitats will be managed over a 40-year period, with the intention that this is undertaken by a suitably experienced and reputable nature conservation organisation. If agreement with a suitably experienced nature conservation organisation cannot be reached, suitably qualified and experienced personnel will be employed and / or contracted by the Applicant. Within this document, the managing body is referred to as the 'nature conservation professional'.

1.2 Terms of Reference

1.2.1 The following terms of reference are used throughout this document:

- Outline Non-Breeding Bird Mitigation Strategy (ONBBMS), which will be finalised through DCO Requirement in to the final Non-Breeding Bird Mitigation Strategy ('NBBMS').
- The ~~Site: the~~ Order Limits ~~for~~: the site of the Proposed Development (as shown on **Figure 1**).
- The Solar Array Development Area ('SADA'): land within the Site where the main solar development and associated infrastructure will be located.
- The Non-breeding Bird Mitigation Area ('NBBMA'); all land covered as part of the ONBBMS – primarily Cell 3, but also including 'the Canal ~~Pools~~Pools', part of Cell 2 and land adjacent to the Manchester Ship Canal (as shown on **Figure 2**).
- Manchester Ship Canal ('MSC') Dredging Deposit Cells numbered 1 – 6 (as shown on **Figure 1** and referred to as 'Cells' throughout this document).
- The 'Canal Pools' (as shown on **Figure 2**), part of which falls within the Mersey Estuary SSSI (Unit 1011753).
- Frodsham Wind Farm ('FWF') existing mitigation measures (as shown on **Figure 2**).

1.3 The Mersey SPA, Ramsar and SSSI.

1.3.1 The Mersey Estuary is designated as an SPA, Ramsar and SSSI and is located adjacent to the ~~north western~~northwestern boundary of the ~~Site~~Order Limits. The SPA and Ramsar designations are consistent; however, the SSSI ~~also~~ extends to a wider area and includes the MSC and ~~part~~a section of the Canal Pools (see **Plate 2** for the extent of the SSSI).

1.3.2 **Box 1.1** presents the qualifying features (species) of the Mersey Estuary SPA~~, hereafter referred to as 'SPA species'. No additional bird species are named as Ramsar or SSSI features and therefore the~~

~~designations are considered concurrently. i.e., the term SPA species also includes bird species for which the Ramsar and SSSI are designated.~~ .

Box 1.1: The Mersey Estuary SPA qualifying features[1].

In accordance with the European Site Conservation Objectives for the Mersey Estuary SPA Site Code: UK 9005131 (v5, dated 21st February 2019), and the Mersey Estuary SPA Citation (v1.1, dated May 2004) the qualifying features of the SPA include:

- Common Shelduck *Tadorna tadorna* [Non-breeding]
- Eurasian Teal *Anas crecca* [Non-breeding]
- Northern Pintail *Anas acuta* [Non-breeding]
- European golden plover *Pluvialis apricaria* [Non-breeding]
- Dunlin *Calidris alpina alpina* [Non-breeding]
- Black-tailed godwit *Limosa limosa islandica* [Non-breeding]
- Common Redshank *Tringa totanus* [Non-breeding]
- Waterbird assemblage [non-breeding period]

Non-qualifying species of interest include Bewick's swan *Cygnus columbianus bewickii*, whooper swan *Cygnus cygnus*, merlin *Falco columbarius*, peregrine *Falco peregrinus*, ruff *Philomachus pugnax*, bar-tailed godwit *Limosa lapponica* and short-eared owl *Asio flammeus* which all occurred in non-breeding numbers of less than European importance (less than 1% of the GB population).

1.3.3 The Mersey Estuary Ramsar Information Sheet (RIS[2]) states 'The Mersey Estuary also regularly supports over 20,000 waterfowl in winter. The five year peak mean for the period 1987/88 to 1991/92 was 78,015 birds, comprising 47,714 waders and 30,301 wildfowl. These included internationally important numbers of the following species (figures are five year means for the period 1987/88 to 1991/92): *Tadorna tadorna* (4,510), *Anas crecca* (11,705), *A. acuta* (5,925), *Calidris alpina* (32,528), and *Tringa totanus* (4,080). The site also supports nationally important wintering numbers of *Anas penelope, Pluvialus squatarola*, *Limosa limosa*, and *Numenius arquata*. (Criteria 2c,3a,3c)'. As such the SPA and Ramsar features (wetland birds) are consistent and the two European designations are considered concurrently.

1.3.4 As part of the NBBMA falls within the Mersey Estuary SSSI, it is necessary to identify whether additional special features require consideration. To this end, the following bird features have been interpreted as SSSI Features, based on comments received from Natural England dated 10th November 2025:

- Wintering wildfowl and waders
- Migrating birds in spring and autumn
- Wintering Pintail *Anas acuta*
- Wintering Teal *Anas crecca*
- Wintering Shelduck *Tadorna tadorna*
- Wintering Wigeon *Anas penelope*

[1] Available online at: [redacted] [accessed May 2024]
[2] Available online at: [redacted]

- Wintering Dunlin *Calidris alpina*
- Wintering Curlew *Numenius arquata*
- Wintering Redshank *Tringa totanus*
- Wintering Golden Plover *Pluvialis apricaria*

1.3.5 Therefore, no additional bird species (or periods of presence) are named as SSSI features which do not already constitute an SPA or Ramsar feature (either qualifying or waterbird assemblage). For brevity, the term 'SPA species' is adopted throughout the ONBBMS; however, for the avoidance of doubt, this is considered to also include all wetland bird species for which the Ramsar and SSSI are designated.

1.4 ONBBMS Principles

1.4.1 The ONBBMS provides information on the proposed approach to mitigation for SPA species.

1.4.2 ~~Post-consent, the ONBBMA~~The ONBBMS will be developed into a full plan (the NBBMS) which must be in substantial accordance with the outline and will require approval by Cheshire West and Chester Council (CWACC) in consultation with Natural England and the RSPB. The Proposed Development must be undertaken in accordance with the approved plan. This is secured via a Requirement in Schedule 2 of the draft DCO [EN010153/DR/3.1].

1.4.3 The Proposed Development has the potential to impact on Functionally Linked Land ('FLL') to the Mersey Estuary SPA and Ramsar, through:

- Displacement of ~~Mersey Estuary~~ SPA ~~wetland bird~~ species due to the presence of solar panels and other infrastructure; and/or,
- Increased disturbance to ~~Mersey Estuary SPA wetland bird~~SPA species during construction, operation and decommissioning of the Proposed Development.

1.4.4 For the purposes of the ONBBMS, it is assumed that the entire Order Limits is FLL or has the potential to be FLL.

1.4.5 For the avoidance of doubt, non-breeding bird mitigation is proposed based on established bird-usage of the entire Order Limits, regardless of whether any or all parts of the Order Limits meet FLL criteria.

~~1.4.4~~1.4.6 The effects arising from the Proposed Development will be separate to, and in addition to, those already arising from the ~~Frodsham Wind Farm.~~FWF. Accordingly, the ONBBMS has been developed cognisant of this additional impact, and of the approved and functioning mitigation for FWF. The measures proposed within the ONBBMS are therefore provided in addition to those already implemented. This approach is subsequently termed 'additive mitigation', which is best summarised as a 'quality over quantity' approach.

~~1.4.5~~1.4.7 The additive mitigation approach is considered compliant with guidance from Natural England[3] regarding development mitigation and compensation measures for wild birds, which states:

'There should be a suitable amount of replacement habitat to compensate for the displacement. For example, there should be:

- *no net loss of habitat*
- *like-for-like replacement near to the original nest to provide a long-term home*

[3] https://www.gov.uk/guidance/wild-birds-advice-for-making-planning-decisions [accessed ~~April~~11th November 2025]

- *alternative habitat that is better in quality or area than the lost habitat*
- *maintained habitat connection to allow normal bird movement*

The development proposal should make sure compensation sites are established for wild birds to use before work starts'.

~~1.4.6 The ONBBMS provides a robust and ambitious mitigation / enhancement scheme, which:~~

~~(1) Ensures that existing within-site mitigation measures for FWF continue to be provided;~~

~~(2) Extends the lifetime of the FWF measures by an additional 27 years (required until 2042 only);~~

1.4.8 ~~Delivers the~~The Applicant also recognises the legal obligations on landowners with regards to Site of Special Scientific Interest (SSSI) set out in the Wildlife and Countryside Act 1981, specifically in Sections 28A – 28S. The measures set out in the ONBBMS will support the restoration of that part of the SSSI which is located within the NBBMA (see Section 1.3). This is in the context that it is considered that management of the SSSI to enable its restoration fully accords with and compliments the principles of the mitigation strategy presented herein. However, for the avoidance of doubt, mitigation for the Proposed Development is not proposed for, or derived from, enabling the restoration or management of the SSSI (see also Section 2.8).

1.5 Approach to Mitigation Through Delivery of the ONBBMS

~~1.4.7~~1.5.1 The ONBBMS will provide all additional mitigation required for the Proposed Development, ensuring that there will be no adverse effect on the integrity of the Mersey Estuary SPA and Ramsar (or the SSSI~~); and~~). Mitigation, including for and above that already in-place for FWF, will be delivered through:

~~(1) Delivers further benefits to Mersey Estuary SPA /Ramsar species and breeding wetland bird species.~~

(1) The provision of improved quality foraging and roosting habitats for SPA species through the complete re-engineering of Cell 3 and the Canal Pools area, leading to the creation of a mosaic of optimised habitats comprising grassland, wet grassland and additional scrapes with extensive wet edges and which is considerably higher quality than is currently delivered, or required to be delivered, by FWF. This will ensure that mitigation above that already in place for FWF is delivered, and therefore FWF mitigation measures continue to be provided.

(2) On-going dynamic conservation management of the NBBMA for at least the operational lifetime of the Proposed Development, and FWF which is above any management already in place under FWF. Management is intended be under the control of a suitably experienced conservation professional. Conservation management of the NBBMA will extend beyond that in place under FWF4 by an anticipated 28 years (assuming a 40-year period of operation of the Proposed Development from 2030, with the FWF decommissioning required in 2042);

(3) Extending the seasonal availability of existing FWF mitigation in the NBBMA to include the autumn passage and spring passage periods for waterfowl and waders. This will be achieved by reducing soil permeability and through on-going dynamic water management; and

[4] Where FWF mitigation falls within the Order Limits (i.e., excluding Cell 4 and Cell 6). For the avoidance of doubt, mitigation for the Proposed Development does not rely on the continued use of Cell 6 as a deposit ground for arisings from the Manchester Ship Canal.

(4) Reduced disturbance of SPA species across the NBBMA through the removal of uncontrolled recreational fishing of the Canal Pools.

1.5.2 Provision of habitat and management will ensure at least current levels of on-site resources are available for curlew, lapwing and golden plover and all other Mersey Estuary SPA species recorded within the Order Limits, through the delivery of higher quality foraging habitats (particularly wet grassland and scrapes).

1.5.3 It should be noted that additional mitigation and enhancement for SPA species will be provided within the Order Limits. The following areas are located within the Order Limits and are referred to as Biodiversity Enhancement Zones, as shown on Figure 2-3a illustrative Environmental Masterplan [EN010153/DR/6.3]:

(1) the Lum, an area of wetland retained and enhanced, within the Eastern SADA and is adjacent to the River Weaver. The Lum is marked on Appendix A, Figure A1.3, of the Outline Landscape and Ecology Management Plan (oLEMP) [EN010153/DR/7.13].

(2) A separate Biodiversity Enhancement zone, which form part of the Proposed Development design within the Western SADA and is designated for enhancement of wider ecology. This zone is located north-east of the NBBMA (at grid reference SJ 49955 79197) and shown as point 'C' on Appendix A, Figure A1.1, of the Outline Landscape and Ecology Management Plan (oLEMP) [EN010153/DR/7.13], This area is distinct from the NBBMA.

1.5.4 Note that the NBBMA does not form part of the Biodiversity Enhancement zone.

1.6 Additional Benefits of the ONBBMS

1.6.1 The proposals in this ONBBMS provide additional benefits (enhancements) for Mersey Estuary SPA, Ramsar and SSSI species through:

(1) Creation of a high quality, conservation managed, wetland in a strategic location, adjacent to the Mersey Estuary, and which will therefore support the conservation objectives of the Mersey Estuary SPA, Ramsar and SSSI.

(2) Provision of improved quality foraging habitats for SPA species through the re-engineering of Cell 3 and the Canal Pools area, leading to the creation of additional scrapes with extensive wet edges. This will increase the attractiveness of the NBBMA for other wader and waterfowl species which do not currently use the area regularly, or in significant numbers;

(3) The inclusion of island features to provide high-tide and safe roosting opportunities for waterbird species;

(4) Provision of improved foraging opportunities for winter and passage SPA species through control of water levels (i.e., ensuring grassland and scrapes remain wet under normal conditions);

(5) Preventing and/or managing encroachment of NZPW across the wider Frodsham Marsh Area (such as Cell 3 FWF mitigation scrapes and Cell 6);

(6) Re-engineering of soil, with re-seeding of grassland and subsequent control of grazing/mowing regime will remove the existing seedbed and therefore solve on-going issues of ruderal vegetation encroachment;

(7) Restoration of the corresponding area of the Mersey Estuary SSSI which falls within the NBBMA (namely Unit 1011753) to favourable status by:

(a) Eradication and/or on-going treatment of NZPW.

(b) Restoration of pools within the SSSI with features suitable for use as a high tide roost.

(c) Removal of a stand of semi-mature trees adjacent to the Canal Pools (within the SSSI), thereby increasing the attractiveness of the SSSI (and surrounding habitats) to wetland species waders through increasing open aspects adjacent to the SPA, and reducing predator opportunities.

(d) Reduced disturbance of the SSSI through the removal of uncontrolled recreational fishing of the Canal Pools.

(8) On-going dynamic management of all enhancement measures within the NBBMA. This will include conservation focussed grazing (or cutting) management across the NBBMA throughout the lifetime of the Proposed Development (with the cessation of the current grazing lease), i.e., grazing or cutting will be under the control of the managing nature conservation professional.

1.6.2 The proposals in this ONBBMS will provide beneficial measures for breeding waders of conservation concern through:

(1) Breeding season availability of wet grassland / scrapes, using water from a dedicated water source (as 1.6.1 above);

(2) The installation of predator exclusion measures around the perimeter of Cell 3 (e.g. fencing or ditches);

(3) Removal of the stand of semi-mature trees (as 1.6.1 above), which will reduce perching and nesting opportunities for avian predators; and

(4) Reduced disturbance of breeding species through the removal of uncontrolled recreational fishing of the Canal Pools (as 1.6.1 above).

1.6.3 Whilst not the primary focus of management of the NBBMA, the measures proposed will provide substantial enhancements for a wide range of other faunal species such as, but not limited to, water voles, European eels and amphibians.

~~1.5~~1.7 Stakeholder Engagement

~~1.5.1~~1.7.1 Measures proposed in the ONBBMS have been discussed extensively with key stakeholders, primarily ~~-~~Natural England and the RSPB. Both parties have accepted the additive mitigation principle and subsequently discussions primarily centred on the extent of mitigation required for SPA species.

~~1.5.2~~1.7.2 The measures included in the ONBBMS are agreed in principle with NE and RSPB. Further stakeholder engagement details are presented in the Environmental Statement: **ES Vol 1 Chapter 8: Ornithology [EN010153/DR/6.1] and the Statement of Common Ground with Natural England [EN010153/DR/8.4]**.

1.7.3 The **Design Approach Document [EN010153/DR/5.8]** also describes consultation undertaken with Cheshire Wildlife Trust, the BTO Wetland Bird Survey and the Cheshire and Wirral Ornithological Society during the pre-application stage.

~~1.6~~1.8 Baseline Bird Data

~~1.6.1~~1.8.1 This ONBBMS does not provide comprehensive details of field survey results and desk study; information is summarised for the purposes of the consultation. Comprehensive data is presented in

ES Vol 2 Appendix 8-1: Ornithology Survey Report [EN010153/DR/6.2~~].~~] and **Section 4.2 of** the revised **Information to Inform Habitats Regulations Assessment** report.

~~1.6.2 Summary tables of key data are provided throughout this document, where appropriate.~~

~~1.7~~1.9 Proposed Development and Site Context

~~1.7.1~~1.9.1 The Proposed Development comprises solar PV modules and related mounting structures, inverters, transformers, switch gear and control equipment, a substation, and underground on and off-site cabling, as well as an associated Battery Energy Storage System (BESS). A full description of the Proposed Development can be found in **ES Vol 1 Chapter 2: The Proposed Development [EN010153/DR/6.1]**.

~~1.7.2~~1.9.2 The Proposed Development is located between the M56 Motorway and the Manchester Ship Canal approximately 500m north of the town of Frodsham, in an area generally referred to as 'Frodsham Marsh'.

~~1.7.3~~1.9.3 **Figure 1** shows the ~~Site~~Order Limits (marked as a red line boundary), along with other key features in the wider Frodsham Marsh area, including the Mersey Estuary SPA / Ramsar, and the existing infrastructure of FWF.

~~1.7.4~~1.9.4 Broadly, the ~~Site~~Order Limits comprises a combination of low-lying arable farmland in the east (the 'Eastern SADA') and raised Cells in the west~~,~~ (the 'Western SADA' and NBBMA), which comprise former settling tanks used for management of dredgings from the Manchester Ship Canal (MSC). Part of the ~~low-lying arable farmland in the east (~~Eastern SADA (i.e., away from the Cells) is managed by wildfowlers for shooting purposes.

~~1.7.5~~1.9.5 Cells are numbered from 1 to 6 (**Figure 1**). Of these, Cells 1, 2, 3 and 5 are located within the ~~Site of the Proposed Development; these cells~~Order Limits. These Cells are no longer used for depositing of dredgings. Cell 6, outside the Order Limits, is still actively used for the management of dredgings.

~~1.7.6~~1.9.6 Cells 2, 3, 4 and 5 have existing ornithology-related management obligations under the planning conditions of the FWF planning consent.

1.9.7 The wider Frodsham Marsh is well established to be used by wetland birds from the Mersey Estuary (see Section ~~2~~1.3). Usage by most SPA species is primarily associated with operational Cell 6, which provides areas of open wetland habitat, and which change over time as they are used for the deposition of material dredged from the MSC. ~~In recent decades, the majority of waterbird interest has been associated with Cell 6, which includes a large wetland. Cell 6~~ Cell 6 is outside of the ~~Site~~Order Limits and remains operational~~.~~ and will do so until at least 2042 (see Section 2.2).

1.9.8 Cells 1, 2 and 5 (inside the Site) are no longer in operational use and are now managed as pasture for livestock grazing. Cells 1, 2 and 5 are largely unsuitable for most SPA species, but with some exceptions (principally curlew, lapwing and golden plover).

~~1.7.7~~1.9.9 Cell 3 is managed for SPA species pursuant to the planning conditions of the FWF, through the creation of wet areas ('scrapes') and grassland for foraging SPA birds.

2 BASIS FOR MITIGATION

2.1.1 Parts of the ~~Site~~Order Limits (Cells 1, 2, 3 and 5) are located within areas which NE defines as having 'High Potential' to constitute Functionally Linked Land (FLL) to the Mersey Estuary SPA in report 'NECR483 Edition 1 Identification of Functionally Linked Land in the North West of England – Phase 2

(NECR483)[5]'. **Plate 1** is reproduced from this NE report. The NE report subsequently establishes that all parts of the ~~Site~~Order Limits have potential to constitute FLL[6] ~~regardless of field survey results~~.

~~2.1.2 Determining~~For the ~~extent~~purposes of ~~use of these land parcels (and the remainder of the Site) by SPA species was, necessary in determining the extent of~~impact assessment, mitigation ~~required.~~

~~2.1.3 Parts of the Site, e.g., the arable farmland~~has been designed to ~~the east of Brook Furlong, fall outside those identified by NE as having 'High Potential to constitute FLL'; however, it is acknowledged that these areas may also support SPA species, and it was therefore necessary to determine levels of use by SPA species~~ account for all SPA bird use across the ~~entirety of the Site.~~

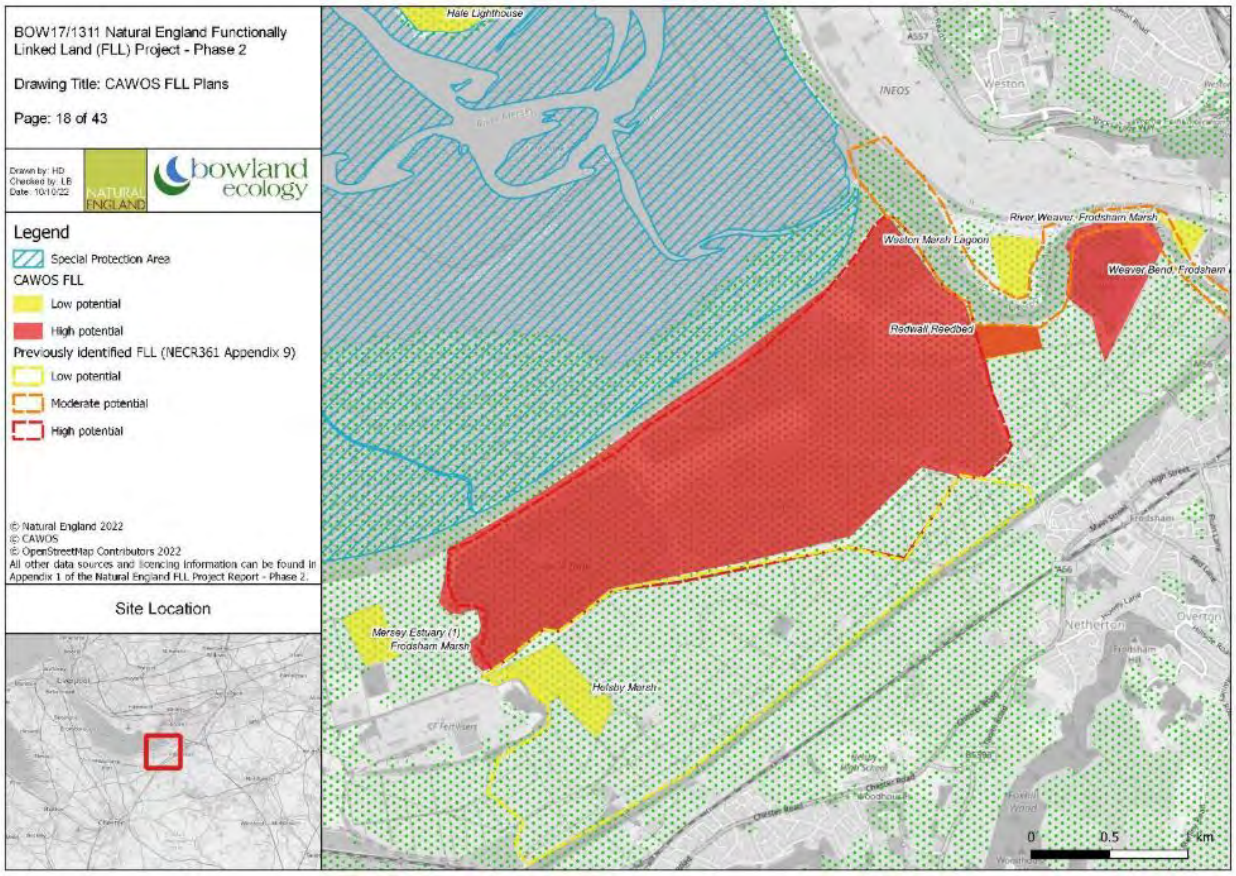
~~2.1.4 Based on survey results, desk study and habitat types, mitigation is considered primarily in relation to grassland wader species, namely golden plover, curlew and lapwing (i.e., the same species for which FWF delivers mitigation for). Other SPA species are only very rarely found on farmland (i.e., main areas affected by the Proposed Development) and therefore negative impacts on these species are considered likely to be nugatory; this is supported by extensive baseline data (see **ES Vol 2 Appendix 8-1: Ornithology Survey Report [EN010153/DR/6.2], Section 4 and Figures 6a to 86h for Year 1, Figure 8a to 8g for Year 2, and Figure 14a to 14f for Year 3)**.~~

~~2.1.5~~2.1.2 ~~It is acknowledged that Cell 3 is used by other species (primarily duck species); however, habitats within Cell 3 will be replaced. It is anticipated that most SPA qualifying species will benefit from the measures to be implemented in the NBBMA and therefore the proposed mitigation strategy also represents a substantial enhancement, both in terms of habitat quality and duration of availability~~entire Order Limits.

[5] Available online at: [redacted] [accessed May 2024]

[6] It should be noted that some areas marked as 'High Potential' on Plate 1 appear to be included on the basis of historical land use and are no longer suitable for SPA species due to scrub and reedbed encroachment. It should not therefore be assumed that all areas marked continue to have High Potential to be FLL.

Plate 1: Reproduced from NE report NECR483. Parts of the Site fall within the areas marked as having High Potential for FLL.



2.2 Frodsham Wind Farm Mitigation

2.2.1 FWF comprises 19 wind turbines (with a tip height of 125m). The wind farm consent included provision of mitigation habitat for non-breeding bird species associated with the Mersey Estuary SPA in Cells 2, 3 and 5 (**Figure 2**~~).~~), as required under Condition 33 and 34 of the FWF Section 36 Consent, dated 19th October 2012.

~~2.2.1~~2.2.2 These Cells are managed for Mersey Estuary SPA birds to mitigate impacts predicted to arise from the operation of the wind farm. The prescribed FWF management measures are detailed in the approved 'Outline Habitat Creation Management Plan: Frodsham Marshes Windfarm' (August 2014 report – pursuant to application 14/02525/DIS), hereafter the 'the HCMP'.

2.2.3 Construction of FWF began in March 2015, and it became fully operational in February 2017. The wind farm has a consented lifetime of 25 years. Current mitigation obligations, as detailed in the HCMP, are therefore due to cease in 2042.

~~2.2.2~~2.2.4 Cells 2, 3 and 5 are located within the Site (**Figure 1**). Existing wind farm mitigation measures for these Cells are summarised below.

- **Cell 2** and **Cell 5**. Both cells comprise grazed pasture with patches of extensive arable weed cover. Managed for Mersey Estuary SPA / Ramsar birds under the HCMP, prescribed as follows:

  'To maintain the fields, for the duration of the lifetime of the wind farm, in a condition that is favourable for wintering wader species, including golden plover, lapwing and curlew'.

~~2.2.3~~2.2.5 ~~—~~The entirety of Cell 2 and part of Cell 5 (**Figure 2**) are managed to provide short-sward grassland between October and March (inclusive), as a foraging habitat for the above species.

- **Cell 3.** Provides mitigation for the impacts of displacement on SPA birds as a consequence of the operational wind farm, and is prescribed in the HCMP as follows:

  'To create and maintain, across the whole area of Cell 3, a low sward grassland with shallow wader scrapes and areas of seasonally open water'.

~~2.2.4~~2.2.6 It should be noted that the Canal Pools are located outside of Cell 3 and are therefore not included in the FWF mitigation measures in respect of habitat management, aside from the restriction of fishing rights.

~~2.2.5 Construction of FWF began in March 2015, and it became fully operational in February 2017. The wind farm has a consented lifetime of 25 years. Current mitigation obligations, as detailed in the HCMP, are therefore due to cease in 2042.~~

2.3 Cell 3: Current Management ~~and Use by SPA Birds~~

~~2.3.1 To assist in determining the extent of mitigation required, it is first necessary to understand the levels of SPA species usage of the Cell under current FWF management prescriptions.~~

~~**FWF Mitigation: Current Management**~~

~~2.3.2~~2.3.1 Under the HCMP, the current mitigation objective for Cell 3 is: '*To create and maintain, across the whole area of Cell 3, a low sward grassland with shallow wader scrapes and areas of seasonally open water'*. These are set out in a report titled '*Cell 3 Scrape and Wetland Design'* for Frodsham Wind Farm (Atmos Consulting, 06 June 2014).

~~2.3.3~~2.3.2 The management and monitoring of Cell 3 mitigation is overseen by a Habitat Creation and Management Group (HCMG), with annual reports produced for Years 1 to 5 of operation. The most recently available report is '*Frodsham Wind Farm Post-Construction Ecological Monitoring Report: Year Five 2021'* (Atmos Consulting September 2022). A copy of this report is provided as **Annex 2**.

~~2.3.4~~2.3.3 According to the Year 5 (2021) monitoring report, scrapes have been successfully created in accordance with **Figure 2,** and these are satisfactorily used by waterfowl (SPA species) in the winter months. Management is limited to grazing and cutting ('topping'), undertaken by the tenant farmer on an ad-hoc basis and reviewed periodically by the HCMG. As such there is no dynamic management component to FWF mitigation, nor is the management under the direct control of a dedicated conservation professional.

~~2.3.5 Scrapes are understood to dry-out regularly, which can be expected to continue with increasingly dry conditions establishing in the UK, and are currently entirely rainwater fed. It is reasonable to assume that scrapes are typically available for use by SPA species over the winter (generally wetter) period and to some extent into the spring (conditions depending). Scrapes are most likely to dry-out over the summer and therefore be unavailable to autumn passage (and potentially breeding) birds. This drying-out is noted in the HCMG Year 5 wind farm monitoring report and has been observed on Site during surveys by Avian Ecology between 2022 and 2024. As such, the scrapes are not likely to be available over the entire period for which the Mersey Estuary SPA is designated as this includes the (spring and autumn) passage periods in addition to the winter months.~~

~~2.3.6 According to monitoring reports, creation and management of the surrounding grassland has been less successful, as is noted in the HCMG Year 5 monitoring report; extensive beds of nettles and thistles have established and therefore open grassland is not consistently present across most of the Cell during critical periods for dependent species. Some 'topping' of vegetation (i.e., active management) recently has reduced vegetation and further work is proposed; however, to date the grassland has not functioned as intended throughout the passage and non-breeding seasons, and vegetation will also preclude nesting waders from using the Cell. This is considered likely be a consequence of dry ground~~

conditions (see **Annex 3**) and high nutrient levels, and therefore there are limited opportunities to change this aside from continual vegetation cutting / topping. The grassland requires on going management to improve conditions for use by SPA species; active management (topping of ruderal species and potentially spraying with herbicides) is likely to be necessary for the lifetime of the wind farm (to 2042).

2.3.71.1.1 It has been agreed by members of the HCMG that Cell 3 management is compliant with corresponding FWF planning conditions as it provides a low sward grassland with shallow wader scrapes and areas of seasonally open water, and the area has been observed as having benefited the target SPA species.

2.3.8 As such, the Year 5 HCMG report establishes the Cell 3 habitat baseline, which will be taken as that on which the Proposed Development shall provide additive mitigation.

Current Use of Cell 3 FWF Mitigation Area by SPA Birds

2.3.9 Peak and mean counts of pertinent SPA bird species are presented in **Table 2.1** and **Table 2.2**, derived from bird surveys as summarised in Section 1.3.

Table 2.1 SPA Bird Species and those part of the waterbird assemblage Recorded on the Cell 3 Wind Farm Management Area during Year 2.

Year 2			
Species	Peak count	Average count	Frequency Recorded (%)
Lapwing	800	162.2	50
Pintail	5	0.8	16.7
Curlew	59	16.2	58.3
Golden plover	433	80.1	33.3
Teal	291	81.8	50
Black-tailed godwit	1,411	193.6	41.7
Redshank	48	4	8.3
Shelduck	11	1.7	41.7
Wigeon	25	5.3	33.3
Greylag goose	8	1.7	33.3
Snipe	28	4.9	41.7
Mallard	42	7.8	25
Oystercatcher	2	0.2	8.3
Ruff	10	1	16.7
Shoveler	38	4.3	33.3
Gadwall	6	1.1	25

Table 2.2 SPA Bird Species and those part of the waterbird assemblage recorded on the Cell 3 Wind Farm Management Area during Year 3.

Year 3

~~Target Species~~	~~Peak Count~~	~~Average Count~~	~~Frequency Recorded (%)~~
~~Lapwing~~	~~1,151~~	~~412.7~~	~~93.3~~
~~Pintail~~	~~13~~	~~1.1~~	~~20~~
~~Curlew~~	~~41~~	~~10.3~~	~~60~~
~~Golden plover~~	~~631~~	~~111.6~~	~~53.3~~
~~Teal~~	~~562~~	~~294.8~~	~~93.3~~
~~Black-tailed godwit~~	~~537~~	~~205.3~~	~~73.3~~
~~Redshank~~	~~6~~	~~0.5~~	~~13.3~~
~~Shelduck~~	~~7~~	~~0.7~~	~~20~~
~~Wigeon~~	~~169~~	~~33.5~~	~~40~~
~~Greylag goose~~	~~11~~	~~2.1~~	~~46.7~~
~~Pink-footed goose~~	~~131~~	~~8.7~~	~~13.3~~
~~Snipe~~	~~89~~	~~24.6~~	~~93.3~~
~~Jack snipe~~	~~1~~	~~0.1~~	~~6.7~~
~~Mallard~~	~~73~~	~~25.2~~	~~86.7~~
~~Oystercatcher~~	~~1~~	~~0.1~~	~~6.7~~
~~Ringed plover~~	~~1~~	~~0.1~~	~~6.7~~
~~Dunlin~~	~~9~~	~~0.6~~	~~6.7~~
~~Ruff~~	~~9~~	~~3.5~~	~~46.7~~
~~Mute swan~~	~~2~~	~~0.4~~	~~20~~
~~Shoveler~~	~~77~~	~~23.7~~	~~80~~
~~Gadwall~~	~~16~~	~~4.9~~	~~53.3~~
~~Tufted duck~~	~~8~~	~~1.5~~	~~26.7~~
~~Water rail~~	~~1~~	~~0.1~~	~~6.7~~
~~Marsh harrier~~	~~1~~	~~0.1~~	~~6.7~~

~~2.3.10 FWF HMCG reports include details of monitoring surveys undertaken for Years 1 to 5 (2021). However, the focus of surveys was on collision risk and therefore flight (vantage point) surveys only; detailed counts of bird usage of Cell 3 were not undertaken. It is relevant that the FWF HCMP did not include targets for bird numbers, nor was the mitigation area (ha) provided based on levels of usage at that time.~~

Efficacy of Cell 3 FWF Mitigation Area Management

~~2.3.11~~2.3.4 Whilst Cell 3 attracts waterbirds in the winter months (when thistles / ruderal vegetation dies-off), it is evidently not used by passage birds (which are also a SPA feature), particularly in the autumn months as scrapes dry-up and ruderal vegetation is at maximum height. As such there is a temporal discord between the qualifying periods for which the Mersey Estuary SPA is designated (i.e., passage) and availability. This is due, in part, to the absence of a mechanism for retaining and controlling water, which is not a requirement of the FWF HCMP and the nature of the ground conditions (although some of the created scrapes have been lined ~~in order~~ to assist with water retention).

2.3.5 Cell 3 is reported to be meeting standards required in the Year 5 HCMG report, which states: *'With the continued cutting of vegetation in the cells, the planning condition is met however, it has been agreed with the HCMG that management needs to be reviewed, including grazing levels. Continued monitoring will be carried out in years 6-9 to ensure compliance with planning conditions.* It is understood that there has been continued liaison between the operator of the wind farm and CWACC, and that ruderal vegetation management is on-going. It has been agreed by members of the HCMG that Cell 3 management is compliant with corresponding FWF planning conditions as it provides a low

sward grassland with shallow wader scrapes and areas of seasonally open water, and the area has been observed as having benefited the target SPA species.

~~2.3.12~~2.3.6 Visits to Site in summer 2024 and 2025 by Avian Ecology again confirmed the extensive presence of ruderal vegetation, albeit with some evidence of a reduction on previous years.

2.4 Canal Pools Area: Current Management ~~and Use by SPA Birds~~

2.4.1 The Cell 3 ~~Wind Farm~~FWF Management Area is separated from the Manchester Ship Canal by a raised bund, which contains a linear series of linked ponds formally used for recreational fishing and understood to still be used informally for this purpose. These are commonly referred to as the Canal Pools (see **Figure 3**). This area sits outside of, but immediately adjacent to, the FWF Cell 3 mitigation area.

2.4.2 Part of the Canal Pools complex falls within ~~the Mersey Estuary Site of Special Scientific Interest (SSSI) (**Plate 2**). The SSSI is designated for the same bird species as the SPA and therefore no additional consideration is afforded to the SSSI for the purposes of the ONBBMA~~a single Unit of the Mersey Estuary SSSI (Unit ID 1011753: Mersey Estuary SSSI – Frodsham Lagoons (012)), as shown on **Plate 2**.

~~2.4.3 However, as removal of the Canal Pools is proposed as part of the NBBMS (see Sections 3 and 4), consideration of current SPA bird use is necessary and therefore surveys in 2023 / 2024 and 2024 / 2025 included counts of the canal pools.~~

~~2.4.4 Surveys were undertaken concurrently with those of Cell 3. **Table 2.3** summarises the relevant results of bird surveys, as derived from bird surveys as summarised in Section 1.3.~~

~~**Table 2.3: SPA Bird Species Recorded on the Canal Pools 2023/25 (Year 2 and 3). Note surveys during year 1 were casual records but have been included.**~~

~~Area within the NBBMA~~	~~Year~~	~~SPA/Ramsar qualifying features and components of the waterbird assemblage~~									
		~~Curlew~~	~~Black-tailed godwit~~	~~Redshank~~	~~Wigeon~~	~~Teal~~	~~Gadwall~~	~~Mallard~~	~~Oystercatcher~~	~~Common snipe~~
~~Canal pools~~	~~1~~	~~9~~	~~-~~	~~-~~	~~-~~	~~-~~				
	~~2~~	~~-~~	~~1~~	~~1~~	~~-~~	~~56~~	~~12~~	~~43~~	~~4~~	~~34~~
			~~Present 1/12 surveys~~	~~Present 2/12 surveys~~		~~Present: 5/12 surveys~~	~~Present: 3/12 surveys~~	~~Present: 8/12 surveys~~	~~Present: 3/12 surveys~~	~~Present: 6/12 surveys~~
	~~3~~	~~-~~	~~-~~	~~-~~	~~80~~	~~64~~	~~30~~	~~8~~	~~1~~	~~10~~
					~~Present 5/30 surveys~~	~~Present 7/30 surveys~~	~~Present 2/30 surveys~~	~~Present 4/30 surveys~~	~~Present 1/30 surveys~~	~~Present 6/30 surveys~~

~~2.4.5~~2.4.3 Recreational access to the Canal Pools is not ~~currently~~ regulated. Regular presence of people using the Canal Pools has been noted during surveys but cannot be quantified. As the pools are largely elevated above Cell 3, and sit between Cell 3 and the Mersey Estuary, it is highly likely that ~~the fishing~~human presence causes disturbance not only to the Canal Pools but also to Cell 3 (and the FWF mitigation measures), as people ~~will be~~are highly visible 'above the skyline' to birds using the surrounding land. This is likely to limit the efficacy of FWF mitigation within Cell 3.

Plate 2: 'Canal Pools' area (within the marked blue line area) in relation to Mersey Estuary SSSI (green hatched).



~~2.4.6~~2.4.4 Some of the Canal Pools have been colonised by non-native New Zealand pigmy weed *Crassula helmsii* (NZPW~~).~~), including those within the SSSI. This is an invasive, non-native, largely aquatic injurious weed species is listed on Schedule 9 of the WCA (1981) and can easily and rapidly spread. It forms dense mats on water bodies that shade out other aquatic vegetation, consequently having a negative impact upon fish and invertebrate communities. These mats of vegetation can impede drainage and lead to flooding, and out-compete other aquatic vegetation. Severe oxygen depletion can also occur in the water under dense growths of NZPW.

2.4.5 The most recently available Natural England condition assessment of SSSI Unit 1011753, dated February 2020[7], identifies the unit as status 'Unfavourable – Recovering' and notes this is '*due to the presence of non-native New Zealand Pigmyweed (Crassula) within two of the pools*'. As such the presence of NZPW has been known at least since that time.

~~2.4.7~~2.4.6 The extent of NZPW within the Canal Pools and NBBMA was mapped by Avian Ecology in summer 2023, as presented in **Plate ~~4~~3**. It can reasonably be assumed that, without treatment and preferably eradication, there is a high risk that NZPW will in time be spread to other waterbodies, potentially including the scrapes created as part of the Frodsham Wind Farm mitigation strategy, as well as Cell 6 (i.e., the main wetland bird area of Frodsham Marsh) and the wider ditch network. As such the presence of NZPW represents a substantial threat to birds and wildlife using Frodsham Marsh.

~~2.4.8~~2.4.7 The Canal Pools are not currently under the ownership or control of the Applicant for the Proposed Development. Use of Cell 3 and the Canal Pools as part of the NBBMA is contingent on

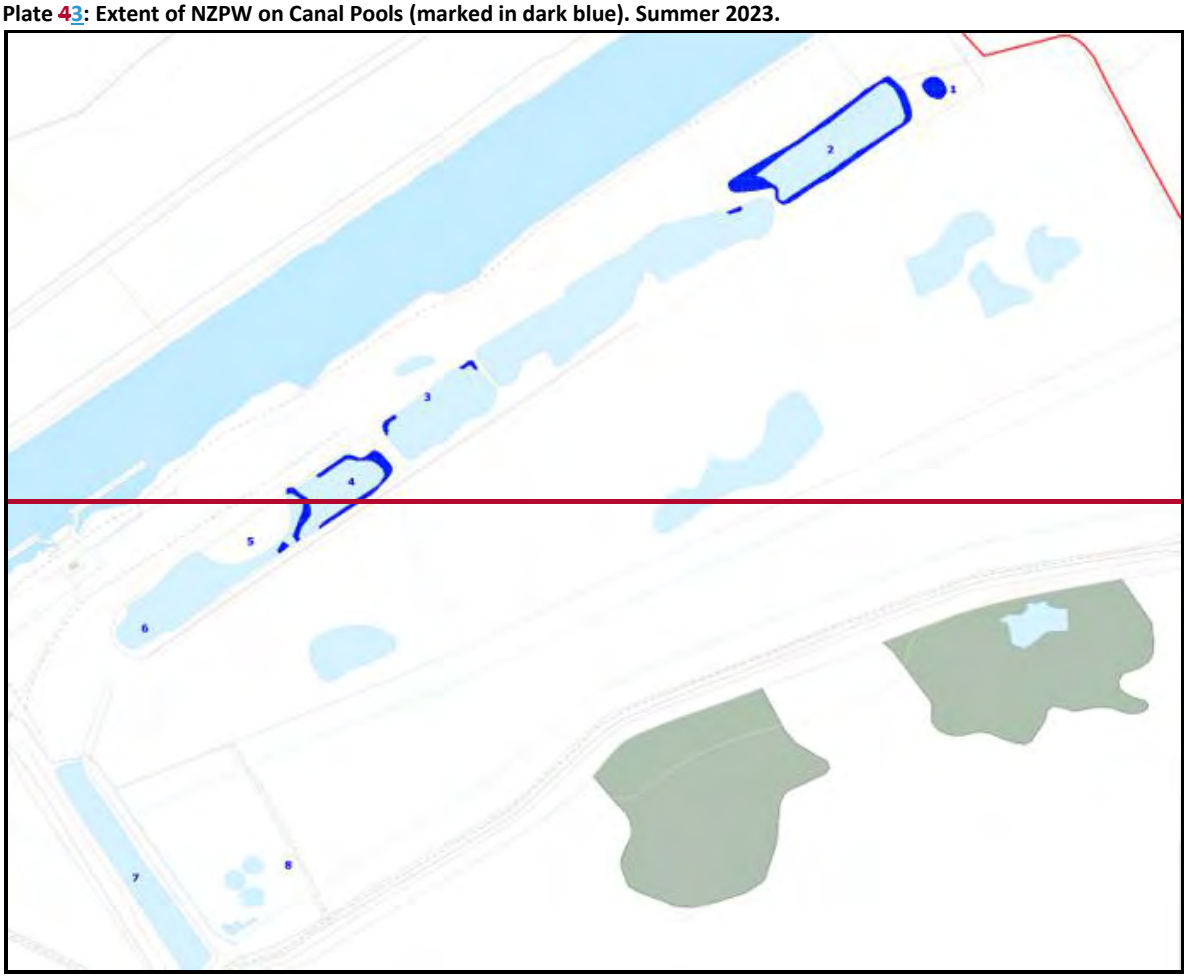
[7] Mersey Estuary SSSI - Frodsham Lagoons (012) Condition Assessment. Available online at: [redacted]

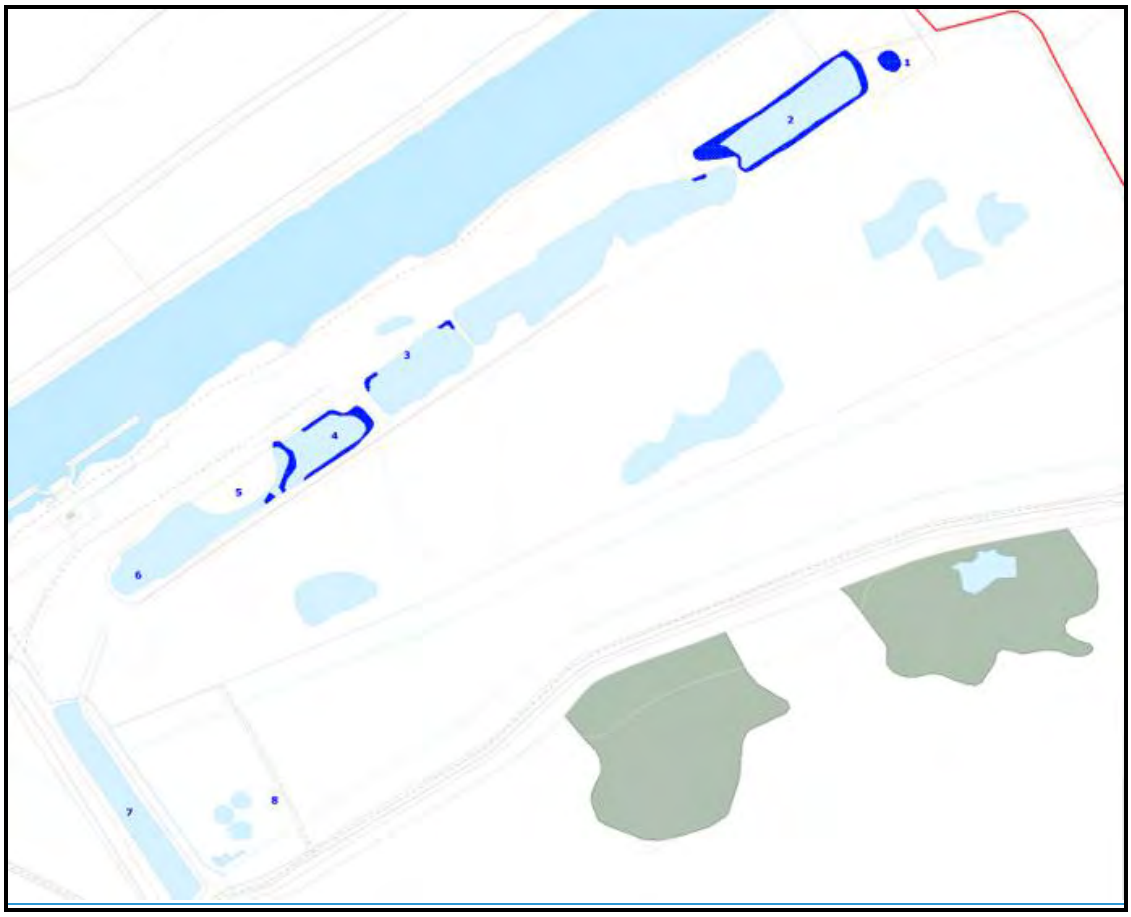
approval of the Development Consent Order. As such the Applicant cannot currently implement measures to treat NZPW.

~~2.4.9~~2.4.8 There is no legal requirement for the removal of injurious weeds by landowners, however The Weeds Act 1959 and the Wildlife and Countryside Act 1981 oblige landowners to prevent their spread.

~~2.4.10~~2.4.9 Measures to ensure the prevention of spread of NZPW will be implemented during the construction of the NBBMA (see Section 4.2), and which are included in the **Outline Construction Environmental Management Plan [EN010153/DR/7.5].**

Plate ~~4~~3: Extent of NZPW on Canal Pools (marked in dark blue). Summer 2023.





2.5 Cells 1, 2 and 5: Current Management ~~and Use by SPA Birds~~

2.5.1 Cells 2 and 5 comprise grazed pasture, with patches of extensive ruderal vegetation cover at times. These are managed specifically for grassland-associated species, namely golden plover, lapwing and curlew, in accordance with the FWF Habitat Creation and Management Plan (HCMP).

2.5.2 Cell 1 forms part of the wider Site not managed for mitigation of the Frodsham Wind Farm (FWF). ~~It is managed by wildfowlers for shooting purposes and, together with adjoining arable land, falls within the Solar Array Development Area (SADA).Peak and mean counts of pertinent SPA bird species recorded across Cells 1, 2 and 5 and the eastern extent of the SADA are presented in Table 2.4, as derived from bird surveys summarised in Section 1.3.~~

~~2.5.2~~2.5.3 The wider ~~Site~~Order Limits (including Cell 1 and ~~adjoining arable areas- eastern extent/array) is evidently~~the Eastern SADA) is used less by SPA species, which is consistent with Natural England mapping of FLL (~~FLL~~**Plate 1**). Nevertheless, usage levels of the entire Order Limits have informed the ~~design of the NBBMA, and bird numbers recorded in these areas are included in the Bird-day calculations presented in Annex 1.~~ONBBMS, which is based on both quantitative and qualitative assessment (see Section 1.4).

Table 2.4: SPA Bird Species Recorded on the Cells 1, 2 and 5 and the eastern extent/array (the SADA) from year 1 to year 3.

		Peak Count				Average Count				Frequency Recorded (%)			
	Species	SADA (includes Cells 1, 2 and 5 and the eastern extent)	Cell 1 (as part of the SADA western extent)	Cell 2 (as part of the SADA)	Cell 5 (as part of the SADA)	SADA (includes Cells 1, 2 and 5 and the eastern extent)	Cell 1 as part of the SADA)	Cell 2 as part of the SADA)	Cell 5 as part of the SADA)	SADA (includes Cells 1, 2 and 5 and the eastern extent)	Cell 1 as part of the SADA)	Cell 2 as part of the SADA)	Cell 5 as part of the SADA)
Year 1	Lapwing	159	159	-	-	12.1	11.1	-	-	21.1	15.8	-	-
	Curlew	27	9	27	22	5.3	0.8	2.6	1.7	26.3	15.8	21.1	15.8
	Golden plover	9	-	9	-	0.5	-	0.5	-	5.3	-	5.3	-
Year 2	Lapwing	450	280	450	5	114.2	40.5	73.3	0.4	41.7	33.3	33.3	8.3
	Curlew	90	70	90	-	27.8	6.7	21.1	-	75	25	58.3	-
	Golden plover	200	37	200	-	32.3	5.9	26.4	-	33.3	16.7	25	-
Year 3	Lapwing	67	244	200	13	8.4	22.3	32.7	1.2	46.7	40	53.3	20
	Curlew	-	45	37	-	-	6.9	15.3	-	-	33.3	60	-
	Golden plover	-	23	60	-	-	1.5	6.5	-	-	6.7	13.3	-

~~Other Data Sources~~

~~2.5.3 Data has also been acquired from the British Trust for Ornithology (BTO) and the Cheshire and Wirral Ornithological Society (CAWOS). A review of the baseline ornithology reports (and survey results therein undertaken between October 2021 and February 2022 and 2024) which supported the HyNet Carbon Dioxide Pipeline DCO (CWACC Planning Ref: 22/04113/NIP) was also undertaken; however, data from these surveys was not considered appropriate for use in bird-day calculations due to differing survey areas.~~

~~BTO Wetland Bird Survey (WeBS) data~~

~~2.5.4 Parts of the Site comprise a 'core count area' for the BTO's coordinated monthly counts. The count area includes parts of the Site (**Plate 3**).~~

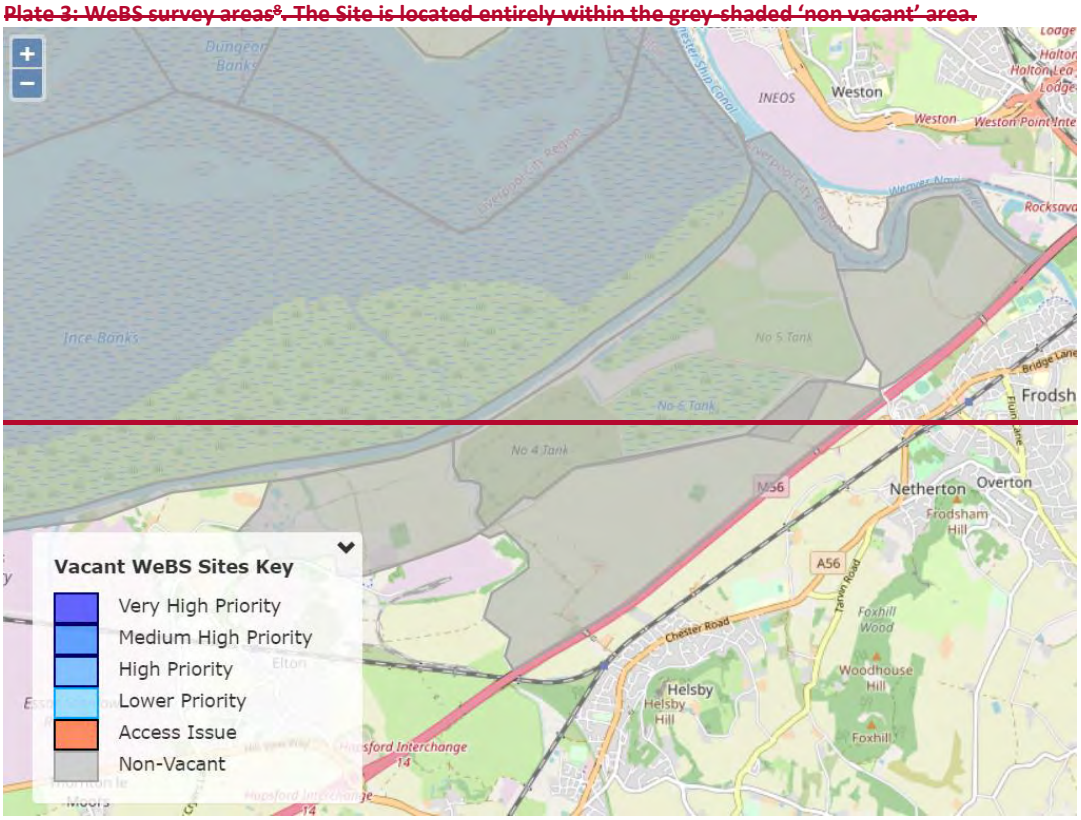
~~2.5.5 The BTO was contacted in July 2023 for data relating to the area referred to as 'Frodsham Sludge Lagoons' (Sector 45351) covering the most recently available 5-year period (up to June 2022).~~

~~2.5.6 BTO peak counts of golden plover, curlew and lapwing are presented in Table 2.5. However, it must be noted that the BTO count sector includes Cell 6, which is outside the Site and consistently supports large numbers of wetland birds as it is the only operational Cell. As such, it is not possible to distinguish Cell 6 records from those within the Site. BTO data does not therefore provide clarification on the extent of use of the Site by SPA species and therefore cannot be used as the basis for determining the extent (area in ha) of mitigation required for the Proposed Development.~~

~~Table 2.5: Key SPA Bird Species (BTO 5-year peak and average counts)~~

~~SPA Species~~	~~Peak Count across BTO WeBS Sector 45351 Frodsham Sludge Lagoons~~	~~Average across BTO WeBS Sector 45351 Frodsham Sludge Lagoons~~	~~Peak count across BTO WeBS Sector45424 Weston Marshes~~	~~Average count across BTO WeBS Sector45424 Weston Marshes~~
~~*Qualifying Species*~~				
~~Golden Plover~~	~~1,200~~	~~87.28~~	~~-~~	~~-~~
~~*Assemblage Species*~~				
~~Eurasian Curlew~~	~~340~~	~~41.04~~	~~-~~	~~-~~
~~Northern Lapwing~~	~~2,000~~	~~267.2~~	~~130~~	~~3.62~~

~~Plate 3: WeBS survey areas[8]. The Site is located entirely within the grey-shaded 'non vacant' area.~~



~~*CAWOS Data*~~

~~2.5.7 CAWOS were contacted in July 2023 to obtain records of SPA species at Frodsham Marsh. An extensive data set was supplied; however, many records could not be attributed to specific locations (and therefore the Site). It is relevant that CAWOS data presents casual observations, as submitted by local birdwatchers. It therefore excludes 'null' records where a species was not recorded which is an important component of formal bird counts used for ecological assessment purposes. As such, this data does not provide any detail on the frequency of occurrence relative to the number of visits made.~~

~~2.5.8 Subsequently CAWOS data does not provide clarification on the extent of use of the Site by SPA species and therefore cannot be used as the basis for determining the extent of mitigation required (area in~~

~~[8] From~~ [redacted]

~~ha). A summary of CAWOS peak count records of golden plover, curlew and lapwing are presented in Table 2.6.~~

~~**Table 2.6: SPA Bird Species (CAWOS peak counts)**~~

~~**SPA Species**~~	~~**Cell 1**~~	~~**Cell 2**~~	~~**Cell 3**~~	~~**Cell 5**~~
~~***Qualifying Species***~~				
~~Golden Plover~~	~~700~~	~~1,000~~	~~750~~	~~1,563~~
~~***Assemblage Species***~~				
~~Eurasian Curlew~~	~~80~~	~~275~~	~~40~~	~~100~~
~~Northern Lapwing~~	~~500~~	~~2,200~~	~~1,100~~	~~500~~

2.6 Determining the Extent of Mitigation Required

2.6.1 Additive mitigation requires the provision of mitigation for the Proposed Development in addition to those already and/or potentially implemented as part of the FWF mitigation strategy.

2.6.2 ~~The wider Site is evidently little used by SPA Species, in line with NE mapping of FLL. Regardless, levels of use for the entire Site are included in the Bird-day calculations presented in **Annex 1**.~~The ONBBMS is intended to deliver mitigation for all SPA birds using the Order Limits, i.e. a precautionary approach is adopted whereby it is assumed that the entire Order Limits is either FLL or has the potential to be FLL.

2.6.3 There is no set-formula to determine an area of land which provides adequate mitigation for effects on wetland birds. ~~Subsequently the approach must be agreed through a combination of quantitative and qualitative assessment and discussion with key stakeholders.~~ Smaller areas of high-quality and well-managed habitat are likely to achieve better outcomes than larger poor-quality habitats or fragmented locations, and so professional judgement is ~~inevitably~~ required. The Applicant has consequently engaged with Natural England, CWACC and RSPB regarding SPA bird mitigation throughout the pre-submission ~~phase~~and post-submission phases of the Proposed Development; details of these discussions are presented in **ES Vol 2 Appendix 8-2: Consultation and Engagement [EN010153/DR/6.2~~]~~.], the Statement of Common Ground with Natural England [EN010153/DR/8.4]** and **Response to Cheshire West and Chester Council (RR-037), Natural England (RR-12) and Environment Agency (RR-02) Relevant Representations [EN010153/DR/8.5].**

2.6.4 The Proposed Development includes the installation of solar panels and associated infrastructure on Cells 2 (partial cover) and Cell 5, which are both currently managed as grassland for curlew, lapwing and golden plover under FWF. It is therefore assumed that the Proposed Development will lead to the complete displacement of these species from Cells 5 and most of Cell 2. SPA species will also be displaced from the wider Site, including ~~Cell 1 and agricultural farmland away from the Cells~~the Eastern and Western SADA areas.

2.6.5 A key focus of NBBMS is in relation foraging habitats for curlew, lapwing and golden plover, i.e., those SPA species which regularly utilise grassland habitats and for which FWF provides mitigation. Cells 2 and 5 currently provide a combined total of 31.05ha of managed grassland for these species. The FWF management area of Cell 3 (i.e., excluding the Canal Pools) is approximately 39.7ha in extent. Accordingly, in relation to land managed specifically for these SPA species, FWF currently provides 71.2 ha of habitat. However, the mitigation will also deliver benefit to other SPA species present across the Order Limits by virtue of quality and management.

2.6.6 To ~~calculate~~inform the likely area of habitat required to support displaced SPA species from the entire ~~Site~~Order Limits as a result of the Proposed Development~~,~~ (not accounting for uplift in habitat quality),

the approach used for the consented Cleeve Hill NSIP Solar Park (termed 'Cleeve Hill approach') in Kent (May 2020) (and agreed by NE as appropriate) has been referenced. This quantifies current use of a Site by SPA species based on usage levels; numbers of birds and frequency of presence relative to physical area (ha). 'Bird-days' are therefore defined as the numbers of birds supported by each hectare of habitat over time; i.e., the theoretical area of habitat required to fully mitigate a loss of habitat for each relevant species. It should be noted, however, that the approach calculates physical area only and makes no provision for habitat quality. As such it provides ~~a precautionary guide and should~~an indication of 'like for like' requirement, but must not be taken as an absolute area requirement~~ where habitat improvements~~. Bird-day calculations to determine the number of SPA birds displaced by the Proposed Development are ~~implemented~~presented in **Annex 1**.

~~2.6.7 Calculations to determine the number of SPA birds displaced by the Proposed Development were based on survey data gathered by Avian Ecology Ltd, supplemented by historic data from the RSK surveys, the BTO and CAWOS, as presented in Section 1.2. Peak Counts per month have been combined using data from across the Site, as presented in **Annex 1**. Peak counts of each species across the entire Site / survey area were aggregated per survey to represent a worst-case scenario. For example, lapwings observed using adjacent fields or survey cells (within the Site boundary) were combined to produce the highest possible count for assessment purposes.~~

~~2.6.8 Following the Cleeve Hill approach, the amount of mitigation area that would be required to provide sufficient grassland habitat for golden plover, lapwing and curlew is calculated to be 63 ha. This is the results of the most complete survey data set covering the Site over the non-breeding period (September 2023 to March 2024) and thus represents a precautionary but realistic approach. Calculations are presented in **Annex 1**. This includes provision for numbers of birds using the entire Site of the Proposed Development; i.e., Cells 1, 2, 3, 5 and the wider farmland within the Order Limits.~~

2.6.7 ~~Optimal conditions to provide the highest quality foraging resource for golden plover, lapwing and curlew are damp grassland (generally known as grazing marsh) with appropriately managed sward; this approach was adopted at Cleeve Hill, where grazing marsh was provided as a key part of a programme to mitigate comparable effects as anticipated to occur under the Proposed Development, i.e., the loss of FLL used by qualifying species. Cleeve Hill is located adjacent to The Swale SPA, which supports a very similar assemblage of species to the Mersey Estuary SPA. Effects arising from the Cleeve Hill development and the Proposed Development, i.e. loss of FLL due to the development of a solar farm, are also the same. As such, the Proposed Development is directly comparable to Cleeve Hill.~~ The approach to, and extent of mitigation for the Proposed Development has therefore been determined by:

(a) A comprehensive review of existing bird usage of the entire Order Limits and, where relevant, the wider Frodsham Marsh Area (e.g. Cell 6). This data is presented in Section 4.2 the revised Information to **Inform Habitats Regulations Assessment** report.

(b) Understanding the efficacy and duration of existing obligations (FWF), both within the Order Limits and outside (again, Cell 6).

(c) Identification of opportunities to improve and extend existing habitats, both in extent and temporal availability, where these could not be implemented under the FWF mitigation.

(d) Recognition of the value of dynamic conservation focussed management of the NBBMA, and which is not currently possible under FWF.

2.7 Use of Cell 3 as a Mitigation Area for the Proposed Development

2.7.1 Existing mitigation measures within Cell 3 for FWF include a series of scrapes, a bund in the south-east and two excavated areas in the south-east and south, with grazed (unspecified) grassland being the main habitat type. These are illustrated in **Figure 2**. Current levels of usage have been established through extensive baseline data gathering, and it is considered that measures implemented for FWF mitigation are operating as required pursuant to ~~Condition~~Conditions 33 and 34 of the FWF ~~planning conditions~~Section 36 Consent. Subsequently consideration of the use of Cell 3 for mitigation is based on robust data and a clear understanding of existing measures, including any potential for improvement.

2.7.2 To fully understand the existing habitats on Cell 3 and establish the potential for the creation of optimum habitats, Ground Investigation (GI) works have been undertaken by the Applicant. Details of GI works are presented in **Annex 3**.

2.7.3 ~~Details of~~The GI ~~works are presented in~~ report (**Annex 3**~~. The GI~~) concludes that optimal wet grassland and scrapes could only be provided in Cell 3 if the cell is re-engineered to retain water, and that ~~a source of~~sufficient water is made available to manage water levels favourably. Current ground conditions and elevations preclude any additional water retention measures or wet grassland creation as the surface layers of the cell comprise sandy deposits which do not readily retain water. The GI has identified layers of low permeability material at depths of approximately 0.8m below ground level, where perched water has been recorded. As such it is evident that, with appropriate engineering and management, there are substantial opportunities to create higher quality habitat within Cell 3 than currently does or could exist, and for which there is no current mechanism of delivery.

2.7.4 In addition to the above the Applicant has undertaken a 'Water Balance' model, based on the proposed design of the NBBMA (**Figure 3**), as presented in **Annex 4** (Frodsham Solar: Cell 3 Water Balance Update report). The model calculated how much water the NBBMA will typically gather through rainfall, which is relevant to the viability of the mitigation proposed.

2.7.5 The water balance model was developed to represent the baseline case and the reprofiled NBBMA and was calibrated to observed data from the site. The model shows that the NBBMA is likely to remain generally wet throughout the year, with seasonal variations in water levels driven by rainfall and evaporation. There is sufficient water to maintain saturated conditions over the wet grassland area for up to 6 months of the year under average conditions. Even in a dry year, the wet grassland soils are expected to be near saturation for at least 2 months. The deeper scrapes will retain water year-round. Occasional overspill into the site drain is simulated during the wetter months, demonstrating surplus water that could be retained to maintain wetness. The model further considers the possible effects of climate change, concluding that it should be possible to mitigate some of the effects of drier summers by actively managing the site to retain more water during the autumn and spring, which should enable the mixture of ponds and wet grassland to be maintained.

2.7.6 The water balance model therefore provides confidence that the relatively dry conditions currently experienced on Cell 3 due to the prevailing geotechnical properties of the soils can, through the re-engineering of the soils, be modified to allow a large area of wetland habitats to be created on Cell 3.

2.8 Mersey Estuary Site of Special Scientific Interest (SSSI)

2.8.1 As previously noted, part of the NBBMA falls within a management unit of the Mersey Estuary SSSI (Unit ID 1011753: Mersey Estuary SSSI – Frodsham Lagoons (012)). The draft DCO [EN010153/DR/3.1] for the Proposed Development sets out that the detailed version of this NBBMS will become part of the 'management scheme' for the SSSI (for the purposes of section 28J of the Wildlife and Countryside Act 1981), meaning that the long term improved outcomes for the SSSI will be secured.

2.8.2 For the avoidance of doubt, the following actions are not considered to be mitigation for the Proposed Development but do constitute actions necessary to the successful delivery of the NBBMA and management of the SSSI .

(a) Eradication and/or on-going treatment of NZPW from within SSSI Unit 1011753.

(b) Restoration of pools within SSSI Unit 1011753 with features suitable for use as a high tide roost.

(c) Removal of the stand of semi-mature trees adjacent to the Canal Pools (within SSSI Unit 1011753).

2.8.3 The detailed NBBMS will set out the measures to achieve the above, and throughout the construction, operational and (if required) decommissioning phases of the Proposed Development, the conservation and enhancement of the special features of the Mersey Estuary SSSI (Unit 1011753) will be undertaken in line with the measures set out in the detailed NBBMS.

3 ONBMS OVERVIEW

3.1.1 Measures proposed under the ONBBMS are illustrated in **Figure ~~3a (Option A)~~** and ~~**Figure 3b (Option B)**~~.3.

3.1.2 To create the NBBMA ~~two options are being proposed. For both options~~, it ~~would~~will be necessary to re-engineer the soils within Cell 3, excavating soils within the central area of Cell 3 to lower the ground level and expose the low permeability soils buried beneath the existing sandy surface layer.

~~3.1.3 Option 1 (Figure 3a) would involve placing some of the excavated soils from Cell 3 into the ponds to the north of Cell 3, creating an additional area of grassland. Some of the soils would also be placed around the perimeter of Cell 3 and engineered to direct surface water towards the central area thereby helping to maintain a wet grassland habitat. A new water storage area / pond would be created within the bund to the north of Cell 3 that would act as a reservoir to help manage water levels within the NBBMA.~~

~~3.1.4 Option 2 (Figure 3b) would involve retaining all of the excavated soils within Cell 3, placing all of the material around the perimeter of Cell 3, and again directing surface water towards the central area of the cell. The existing ponds would act as a reservoir to help manage water levels within the NBBMA.~~

~~3.1.5 Both options would involve a New Zealand Pigmy Weed control strategy.~~

~~3.1.6 Two options are presented as there may need to be flexibility on where soils are moved within Cell 3 and how this is undertaken, which would be determined as part of permitting approach discussions with the Environment Agency. Both Options would deliver on the objectives of the NBBMS to mitigate the predicted impacts of the Proposed Development and be additive to measures in place for FWF.~~

3.1.3 Two options have been proposed by the Applicant to enable alternative potential environmental permitting approaches to be taken in relation to the management of the soils that would be re-engineered from Cell 3[9]. However, the Environment Agency has subsequently not raised concerns with either of the options from a waste management permitting perspective. As such the preferred approach is option 1 as it is considered the optimal approach in relation to control of NZPW. Option 1 includes drainage of the ponds, treatment of the base and sides of the ponds with herbicide, in-filling of the ponds and re-creation of those ponds within the boundary of the SSSI (in a similar location to the current eastern ponds). This approach will maximise the success outcome of NZPW eradication whilst also enabling restoration of SSSI features to be met. This is the approach included in this document, albeit either option is considered capable of delivering the long-term conservation and mitigation goals for the NBBMA.

3.1.4 Re-engineering will create the network of water features, including scrapes, swales, bunds and hollows (as shown on **Figure 3**). These will enable the dynamic conservation management of the NBBMA through water management, as water can be moved through the network and retained within (or discharged from) Cell 3 to keep habitats wetter and for longer periods throughout the calendar year.

3.1.5 Excavated soils from Cell 3 will be used to infill all the Canal Pools, with the aim of eradicating NZPW. An appropriately experienced specialist contractor will be contracted in order to determine the likely

[9] Option 1 involves infilling the existing ponds and then recreating waterbodies to the north of Cell 3 to provide a water source to aid the management of the created wetland areas. Option 2 would involve retaining all of the excavated soils within Cell 3, placing all excavated material around the perimeter of Cell 3. The existing ponds would be treated for NZPW and would act as a reservoir to help manage water levels within the NBBMA.

most effective approach to eradication during re-engineering of the Canal Pools (including managing contamination risk). Continual management of NZPW across the NBBMA, using best practice measures as identified at the time, will be undertaken for the entire 40-year management period.

3.1.6 Once infilling of the Canal Pools and NZPW treatment is completed, those Canal Pools which fall within Unit 1011753 of the Mersey Estuary SSSI will be re-instated to the same specification as previously present. Minor modifications, where these are to the benefit of SSSI features, may be adopted. A sluice system will also be included to enable water management between the restored Canal Pools for use as a back-up water source for Cell 3 (under exceptional circumstances, or where this it so the benefit of SSSI bird species). Decisions over water management will be made by the appointed nature conservation professional responsible for the management of the NBBMA.

3.1.7 Canal Pools which fall outside the Mersey Estuary SSSI will not be reinstated, with land turned to grassland and managed as such for SPA species, in accordance with the Aims and Objectives of the ONBBMS.

~~3.1.7~~3.1.8 The total area included in the ~~ONBBMS~~ONBBMA includes Cell 3, the Canal Pools area and additional fields to the northeast of Cell 3, which total 53.31 ha. **Table 3.1** presents the habitat types proposed within the ~~ONBBMS area based on Option 1~~NBBMA.

Table 3.1: NBBS Proposed Habitat Components ~~(assuming Option 1).~~ Text in italics identifies habitat features located within the minimum 16.2 ha area identified through ~~Site~~Ground Investigations as suitable for water storage and therefore could support scrapes and wet grassland (see paragraph 3.1.10).

Habitat	Area (ha)
Existing Scrape (FWF mitigation)	*2.71*
Proposed Additional Scrape	*3.31*
Proposed Island	*0.67*
~~Existing Drain~~	~~0.92~~
~~Proposed Water Storage Area~~	~~1.06~~
Proposed Wet Grassland Area	*9.52*
Proposed Grassland	28.44
Raised Bank with Grassland (Canal Pools area)	~~6.11~~4.79
Proposed Grassland (Trees to be Removed)	0.57
Existing Drain	0.92
Retained SSSI Canal Pool	2.38
Total NBBMS Area	**53.31**

~~3.1.8~~3.1.9 ~~In terms of mitigation, the~~The primary aim of the ONBBMS is to deliver mitigation for the loss of land within the entire ~~SADA~~Order Limits for SPA species, through the provision of higher quality and managed habitat in the NBBMA. This includes the displacement from Cells 2 (partial) and Cell 5 of foraging curlew, lapwing and golden plover (the FWF mitigation), but also includes mitigation and enhancement for all other SPA species recorded across the entire Order Limits. ~~Habitats within Cell 3 and which are regularly used by SPA qualifying species will be subject to temporary loss whilst capital works are undertaken (see Section 3.2).~~

~~3.1.9~~ Bird-day calculations demonstrate that 63 ha of grassland would be required to support existing levels of use by SPA species (**Annex 1**); however, this does not account for higher quality wet grassland (i.e. improved habitats[10]).

3.1.10 ~~Under Option 1,~~ The NBBMS provides for a total of ~~44.64~~43.32 ha of grassland overall, of which a minimum of 9.~~5~~52 ha will be actively managed as wet grassland. ~~Under Option 2, the overall areas are reduced to 38.53 ha of grassland but still includes 9.5 ha of wet grassland. Both Options are~~This is considered to provide at least a comparable foraging resource for ~~these~~SPA species, through improved quality and will also be available for the entirety of the non-breeding season (i.e., including passage periods) ~~as a result~~due to the re-engineering of ~~the creation of wet grassland areas~~Cell 3 and the ~~new measures to~~ Canal Pools, which will enable ~~active~~dynamic water management ~~within~~for the ~~cell.~~benefit of SPA birds.

3.1.11 It is anticipated that the NBBMA, with appropriate, large-scale re-engineering to enable control of water levels, and ~~appropriate continued~~continual dynamic management, will support a higher number and increased diversity of Mersey Estuary SPA species than under current management, and also over a longer time-period of time, than is possible from the mitigation measures provided by FWF mitigation.

3.1.12 Whilst Cell 3 will provide the primary focus of additive mitigation and management measures, areas of grassland across the NBBMA will be available for foraging waders, including (but not limited to) grassland species; Golden Plover, Lapwing and Curlew. The removal of the isolated clump of trees within the Mersey Estuary SSSI compartment of the NBBMA will improve the attractiveness of grassland foraging habitat for SPA birds across the NBBMA. Land on the raised Canal Pools 'embankment' (i.e., between Cell 3 and the Manchester Ship Canal), along with the area of land within the NBBMA which falls within Cell 2 (see **Figure 2**), are considered likely to be utilised by grassland waders given they provide an open aspect to the north (towards the estuary) and existing fences will be removed to increase openness.

~~3.1.11~~3.1.13 Wet pasture~~, in particular,~~ creates conditions what increase the abundance and accessibility of invertebrate species which form the primary food source for most wader species. Such conditions will enable the NBBMA to provide substantially higher resources than is currently the case, and noting that the current FWF mitigation is ~~also~~ due to cease in 2042. The modified management regime and improved design of this area will also provide additional benefits to an array of SPA species and likely to breeding waders and extend the management of the NBBMA by 28 years. Details are presented in Section 4.2 of the updated **Information to Inform Habitats Regulations Assessment** report.

~~3.1.12~~3.1.14 The SI, as provided in **Annex 3**, identified moderate to high levels of permeability within the upper metre of made ground, with ground water present at depths of 0.8 to 2.0 m below ground level. Groundwater was perched on a layer of black clay, thought to be deposited within the cells at depth due to the differentiated settlement of finer clay particles compared to the coarser silts and sands. This indicates that re-engineering the cells so the lower permeability clays are closer to the surface could deliver a wet soil at the surface, and therefore wet grassland could be created~~.~~ as demonstrated within the Water Balance report provided as **Annex 4.**

~~3.1.13~~3.1.15 This information has enabled the design to be capable of holding sufficient water such that it would be possible to provide substantial wet grassland areas, along with additional scrapes and associated muddy edge habitats.

~~3.1.14~~3.1.16 Based on the SI works, at least 16.2 ha of Cell 3 is anticipated to be available for use in the creation of wet grassland, existing scrapes and new scrapes with islands, as presented in Table 3.1 and shown on **Figure 3**.

[10] E.g., see https://defrafarming.blog.gov.uk/manage-lowland-wet-grassland-for-birds/

~~3.1.15~~3.1.17 This evidence-based approach is considered to provide the necessary confidence that the proposed works would deliver significant betterment to Cell 3 (as the main part of the NBBMA), and therefore additive mitigation will be achieved.

3.2 Duration and Timing of Works

~~3.2.1 For the purposes of this ONBBMS, the overall programme for works within the NBBMA is considered on the assumption that Option 1 (removal of the Canal Pools) is implemented. Option 2, should that be taken forward, would require an overall shorter works duration, albeit only marginally.~~

3.2.1 Works ~~for Option 1~~ are anticipated to require a maximum of nine months from commencement to completion and may be completed within 6 months.

3.2.2 To ensure that habitats within the Site are available for SPA species throughout the construction period, ~~the following approach will be adopted:~~there will be no other construction works within any part of the Order Limits until construction of the NBBMA within Cells 2 and 3 and the Canal Pools area are complete and functional.

3.2.3 ~~There will be no other construction~~For the purposes of the ONBBMS, 'functional' has been defined as follows and as agreed with Natural England as follows):

- All physical works within ~~Cells 1, 2 or 5 until construction of the~~ the NBBMA ~~within Cell 3 and the Canal Pools area~~ are ~~complete and functional.~~ completed.

  ~~(1) Works within Cell 3 and the Canal Pools will commence in early March (subject to ground conditions). This will minimise displacement over the construction period to no more than a few months, as work will predominantly be undertaken outside the winter season (i.e., the core non-breeding season for overwintering SPA qualifying species). Commencement in March will also ensure that breeding species are not subject to disturbance. An Ecological Clerk of Works (ECoW) will be engaged to ensure that breeding birds are protected in accordance with relevant legislation (see **Outline Construction Environmental Management Plan [EN010153/DR/7.5]**).~~

~~3.2.3 As a primary function of the NBBMA is to provide shallow wetland areas with muddy margins, which will be available for use by waterbirds immediately on completion of construction, it is considered that the NBBMA will be functional for SPA birds immediately on completion of earthworks and removal of any construction compounds etc., located within the NBBMA. As such mitigation would be available in advance of any construction on Cells.~~

~~3.3 Main Components of the ONBBMS~~

- The entire NBBMA area is available to support SPA bird species for which it is designed, and
- The entire NBBMA is free from construction-related disturbance

3.2.4 Details of each Aim are presented in Section 4.

4 ONBBMS ~~PROVIDES MITIGATION OF EFFECTS ARISING FROM THE PROPOSED DEVELOPMENT~~AIMS AND OBJECTIVES

~~3.3.1~~4.1.1 The ONBBMS will be delivered through the adoption and implementation of three main Aims and Objectives, as follows:

(1) Provision of habitat which ensures at least current levels of on-site resources are available for curlew, lapwing and golden plover and all other Mersey Estuary SPA species, through the delivery of higher quality foraging habitats (particularly wet grassland and scrapes);

(2) Extending the seasonal availability of existing mitigation in the NBBMA to include the autumn passage and spring passage periods for waterfowl and waders. This will be possible by reducing soil permeability and providing using water from a dedicated water source;

(3) Extending conservation management of the NBBMA by an anticipated 28 years (this assumes a 40 year period of operation of the Proposed Development from 2030, with the FWF decommissioning required in 2042); and

(4) On-going dynamic management of all mitigation for the Proposed Development and FWF.

3.3.2 The ONBBMS provides additional benefits (enhancements) for Mersey Estuary SPA species through:

(1) Provision of foraging habitats for SPA species through the creation of additional scrapes with extensive wet edges;

(2) The inclusion of island features to provide high tide and safe roosting opportunities for SPA species;

(1) Provide improved foraging opportunities for winter and passage SPA species through control of water levels (i.e., ensuring grassland and scrapes remain wet under normal conditions);

(2)(1) Preventing and/or managing encroachment of NZPW across the wider Frodsham Marsh Area (such as Cell 3 FWF mitigation scrapes and Cell 6);

(3)(1) Re-engineering of soil, with re-seeding of grassland and subsequent control of grazing/mowing regime will remove the existing seedbed and therefore solve on-going issues of ruderal vegetation encroachment;

(3) Removal of a small stand of semi-mature trees adjacent to the Canal Pools, thereby increasing the attractiveness of surrounding habitats to grassland waders (SPA species) and breeding waders through increasing open aspects adjacent to the SPA, and reducing predator opportunities;

(4) Reduced disturbance of SPA species through the removal of uncontrolled recreational fishing of the Canal Pools; and

(5) On-going dynamic management of all enhancement measures within the NBBMA. This will include conservation focussed grazing (or cutting) management across the NBBMA throughout the lifetime of the Proposed Development (with the cessation of the current grazing lease).

3.3.3 The ONBBMS provides beneficial measures for breeding waders of conservation concern through:

(1) Breeding season availability of wet grassland / scrapes, using water from a dedicated water source;

(2)(1) The installation of predator exclusion measures around the perimeter of Cell 3 (e.g. fencing or ditches);

(3) Removal of the stand of semi-mature trees (as above), which will reduce perching and nesting opportunities for avian predators; and

~~(4) Reduced disturbance of breeding species through the removal of uncontrolled recreational fishing of the Canal Pools (as above).~~

~~3.3.4~~1.1.1 ~~Whilst not the primary focus of management of the NBBMA, the measures proposed will provide substantial enhancements for a wide range of other faunal species such as, but not limited to, water voles, European eels and amphibians.~~

~~3.3.5 The NBBMS will be subject to dynamic conservation focussed management throughout the 40 year operational lifetime of the Proposed Development, and which will be funded accordingly by the Applicant or any subsequent operators.~~

~~3.3.6 The following sections detail the management prescriptions for achieving the objectives outlined above, which are summarised as:~~

Aim 1: Creation of Wetland Habitats, and Enhancement of Grazing Habitats

Aim 2: Removal or Treatment of NZPW and Creation of Additional Grassland

Aim 3: On-going Dynamic Habitat Management

4.1.2 Further detail for each of these is provided in the following sections.

~~3.3.7~~1.1.1 ~~Details of each Aim are presented in Section 4.~~

~~4 ONBBMS AIMS AND OBJECTIVES~~

~~4.1~~4.2 Aim 1: Creation of Wetland Habitats, and Enhancement of Grazing Habitats

~~4.1.1~~4.2.1 Cell 3 and the adjacent Canal Pools area will be entirely re-engineered to ensure water can be retained and managed, as follows:

(1) Existing scrapes (provided as part of the FWF mitigation) will be temporarily removed and ~~then~~those in the boundary of the SSSI will be re-instated as part of a wider, increased wetland network.

(2) Additional scrapes will be created, substantially increasing the amount of 'muddy edge' to provide foraging habitat for SPA species.

(3) Islands will be created to provide safe roosting locations for SPA species and nesting birds.

~~4.1.2~~4.2.2 The NBBMA will be managed as grassland, with ~~approximately~~a minimum of 9.5 ha of managed wet grassland (**Figure 3**). Note this area excludes those marked as scrapes and islands and is provided on an indicative basis; precise water ~~-~~levels (and therefore wet grassland extent) will vary depending on conditions and may be actively managed at different levels through the year to suit species.

~~(1) The Canal Pools area will be either:~~

~~(a) Option 1: removed entirely to provide additional grassland and create a raised water~~

~~storage area[11] which will be used to manage water levels on Cell 3, or~~

~~(b) Option 2: retained but re-engineered and used as a water source to manage water levels on Cell 3 (following the eradication or management of NZPW; see Section 4.2).~~

~~4.1.3~~4.2.3 The NBBMA will include predator exclusion measures with the aim of assisting breeding wader productivity. This will further prevent human access to the NBBMA.

~~4.1.4~~4.2.4 The above measures are illustrated on **Figure 3**.

~~Landscaping & Hydrological Management~~

4.2.5 It should be noted that the ultimate design will be informed through input from the appointed managing conservation body or professionals in order to maximise the ecological benefit of the NBBMA.

Re-engineering of the Canal Pools

4.2.6 The Canal Pools will be removed and partially reinstated, to eradicate and assist with future management of NZPW (See also Section 4.3). An appropriately experienced specialist contractor will be contracted in order to determine the likely most effective approach to eradication during re-engineering of the Canal Pools (including managing contamination risk).

4.2.7 Canal Pools which fall within the Mersey Estuary Site of Special Scientific Interest (SSSI) (see **Plate 1**) will be reinstated in their current footprint, which will enable the compartment of the SSSI to be restored to favourable condition. The re-instated pools will be include the installation of sluices and/or French Drain system to enable conservation management.

4.2.8 Those pools which fall outside of the SSSI will be permanently removed and replaced with grassland habitats which will contribute to the overall mitigation strategy.

Creation of Impermeable Substrate

~~4.1.5~~4.2.9 Details are presented in **Annex 3**; however, SI works have confirmed that a low permeability surface of ~~approximately~~at least 16.2 ha can be created within Cell 3. Of this, approximately 6.7 ha is proposed to be scrapes and islands (permanent / semi-permanent water features), with the remainder (9.5 ha) managed as wet grassland.

Creation of additional water feature habitats within Cell 3

~~4.1.6~~4.2.10 It is proposed to create the network of water features throughout Cell 3~~. Water will be diverted from a newly created water storage area on the Canal Pools area into the centre of Cell 3 and onwards to a created network of~~, including scrapes, swales~~,~~ bunds and hollows (as shown ~~in~~on **Figure 3**). ~~Water~~These will ~~move~~allow water to be moved through the network and ~~be allowed to be~~ retained within Cell 3 to keep ~~the~~ habitats wetter~~,~~ and for ~~a~~ longer ~~period~~periods throughout the calendar year.

~~4.1.7~~4.2.11 Scrape design criteria are set out in Section 2 of the '*Cell 3 Scrape and Wetland Design'* report (Atmos Consulting, 06 June 2014) and the same approach will be broadly applied for any additive

~~[11] This is currently anticipated the approximately 14,000m², but shallow (i.e.<1m). This equates to just under 10,000m³ volume, so below the 25,000m³ required by the Reservoir Act 1975.~~

water habitats. The key criteria being the creation of extensive 'edge' features and therefore variable depths ~~would~~will be ~~required~~provided.

~~4.1.8~~4.2.12 Existing scrapes, managed as part of the FWF mitigation, occupy an area of approximately 2.71 ha. These locations will be recreated (following re-engineering of the Cell), with an additional 3.31 ha of permanent / semi-permanent scrape. The new water features will also include three shallow domed islands, which will provide roosting and breeding opportunities for SPA and wetland species.

~~4.1.9 Further details are presented in **Annex 3**.~~

~~Creation of~~ Water Source for On-going Dynamic Management

~~4.1.10 Water source will depend on the required treatment of NZPW (see Section 4.2). Two options are under consideration:~~

~~(1) Removal of the Canal Pools; or~~

~~(2) Retention of the Canal Pools~~

~~4.1.11 Under Option 1, the Canal Pools will be removed to ensure NZPW is eradicated and will then be replaced by a newly created area of grassland and a water storage area. This will be used to ensure Cell 3 can be optimally managed for key species, through the installation of sluices between the raised Canal Pools area and the Cell bed. NZPW present in the ponds will be treated and buried in accordance with best practice guidance.~~

~~4.1.12 Option 2 – retention of the Canal Pools as a water source for Cell 3 following treatment of NZPW and provision for ongoing monitoring and management of NZPW.~~

4.2.13 Water balance calculations, presented in **Annex 4**, demonstrate that, in a typical year, rainfall catchment within the NBBMA will provide sufficient water to enable successful delivery of the ONBBMS through dynamic conservation management. As such, requirement for additional water supply is not anticipated in normal conditions.

4.2.14 Whilst not anticipated to be a regular occurrence, should conditions require water will be diverted from the re-created Canal Pools within the Mersey Estuary SSSI to ensure optimal management of the NBBMA is achieved. This is considered to complement management of the SSSI (see para 1.4.8 and Section 2.8).

Provide improved foraging opportunities for winter and passage SPA birds through control of water levels

~~4.1.13~~4.2.15 Control of water levels will optimize conditions for SPA species; ensuring water can be moved on to or around the ~~Cell (through water inundation from the created water storage area and sluice gates)~~cell in the drier months~~. This will extend~~ or periods and therefore extending the availability of existing resources over the passage period~~,~~ (as well as the winter months~~.~~). This will ~~require specific active conservation~~be achieved through the dynamic management of the ~~NBBMS area~~NBBMA.

Management of Grassland Areas for Golden Plover, Lapwing ~~and~~, Curlew (and other SPA species)

~~4.1.14~~4.2.16 Areas of conventional (dryer) grassland within Cell 3, on the Canal Pools and on land to the northeast of Cell ~~3~~2 (see **Figure 3**) will be managed in accordance with the current prescriptions of the FWF Cells 2 and 5 mitigation, i.e., by ensuring a favourable short sward is available in at least the period October to March (inclusive). Existing grazing management (under the current grazing lease) will be ceased and replaced by conservation ~~focussed~~ focused grazing (or cutting) management, which will be controlled by the appointed nature conservation professional responsible for management of the NBBMA.

~~4.1.15~~4.2.17 An isolated stand of semi mature trees (**Figure 3**) will be removed from the area to the east of the Canal Pools~~.~~ (within the SSSI). This will remove opportunities for predators and allow grassland wader species to utilise this area for foraging, which is not currently the case.

4.2.18 A series of fences in the north-eastern part of the NBBMA, within and adjacent to Cell 2, will be removed (or reduced where necessary for livestock management). This will increase the open aspect of the area and therefore, combined with the tree removal detailed above, ensure grassland in this part of the NBBMA is suitable for use by foraging grassland waders.

Provide opportunities for breeding waders through breeding season retention of wet grassland / scrapes

~~4.1.16~~4.2.19 The ability to release water around and onto the Cell ~~(through water inundation from the created water storage area)~~ and retain it through the spring and summer months would be highly beneficial to breeding waders, particularly when combined with predator fencing.

~~4.1.17~~4.2.20 Predator fences are known to provide good protection to nesting waders[12].The entire Cell 3 and the Canal Pools area will be surrounded by predator fencing, or other suitable predator exclusion method e.g. provision of perimeter ditches, to prevent predatory species like fox entering the Cell and potentially predating roosting, foraging and/or nesting birds (or eggs/chicks). The precise location of predator fencing / ditches will be determined through further detailed design and in consultation with key stakeholders; however, it is envisaged to encompass the entirely of Cell 3 ~~and the Canal Pools area.~~. Predator fencing / ditches will be subject to on-going checks to ensure integrity is maintained over the entire operational lifetime of the NBBMA~~.~~ as part of the on-going management (see Aim 3).

~~4.2~~4.3 Aim 2: Removal and/ On-going Treatment of NZPW and Creation of Additional Grassland

~~4.2.1~~4.3.1 NZPW is an invasive, non-native, largely aquatic Schedule 9 of the WCA (1981) species which has infested some of the Canal Pools (see **Plate 4**). Part of these pools are within the Mersey Estuary Site SSSI, as such, any works to control NZPW at the locality will be detailed in the full NBBMS produced post DCO consent (as the DCO will disapply the need for obtaining a separate SSSI consent under the Wildlife and Countryside Act ~~1091~~1980.

~~4.2.2~~4.3.2 NZPW is notoriously difficult to remove and filling-in of waterbodies is often the only option to facilitate eradication[13]. As such, in-filling is the preferred option. However, if this is not possible or NZPW re-appears then on-going management of NZPW will be undertaken over the lifetime of the Proposed Development ~~and measures implemented under the full NBBMS (40 years).~~.

~~Option 1: In-filling of the Canal Pools~~

~~4.2.3 As part of the ONBBMS, the Canal Ponds may be filled in with excavated materials from landscaping works in Cell 3. This will provide two benefits:~~

- ~~The eradication of NZPW, thereby preventing further spread to the existing habitats within Cell 3 and wider Frodsham Marsh (Cell 6 in particular), as well as those proposed as part of the NBBMP. Should these water features become infested with NZPW the ornithological value of the entire Frodsham marsh area will be substantially compromised.~~

[redacted] accessed May 2024]

- ~~Creation of 6.11ha of additional grassland (on land currently occupied by the Canal Pools), which will be managed for the benefit of golden plover, curlew and lapwing.~~

~~4.2.4 The removal of uncontrolled fishing activities from the Canal Pools will additionally serve to reduce or remove existing disturbance from Cell 3, which is considered a benefit of this ONBBMS. It is anticipated that that driven access to the Canal Pools by fisherman will be ceased (i.e., padlock change on the existing gate close to Marsh Farm). Signage and/or fencing may be installed to deter unauthorised access.~~

~~4.2.5 Once removed water storage area to be created. This will be used as a source of water for the main mitigation areas, within Cell 3.~~

~~Option 2: On-going NZPW Management~~

~~4.2.6 In the event that Option 1 cannot be pursued, for example due to permitting limitations, the Canal Pools will be retained and used as a source of water for the newly created wet grassland in Cell 3 once NZPW management is implemented and there is no risk of spread.~~

~~4.2.7~~4.3.3 ~~The preferred approach would be to eradicate NZPWM entirely.~~ An appropriately experienced specialist contractor would be engaged in order to determine the likely most effective approach to eradication during re-engineering of the Canal Pools and where required for on-going management. Continual management of NZPW across the NBBMA, using best practice measures as identified at the time, will be undertaken for the entire 40-year management period.

~~4.3~~4.4 Aim 3: On-going Dynamic Management

~~4.3.1~~4.4.1 On-going conservation management of ~~Cell 3 will be~~the NBBMA is secured through ~~an appropriate legally binding mechanism~~this management strategy and its implementation pursuant to a Requirement 9(j) of the draft DCO.

~~4.3.2~~4.4.2 Management measures will remain in place for the lifetime of the Proposed Development. All costs associated with on-going management will be borne by the Applicant, including the costs of CWaCC, Natural England and RSPB in engaging in the development of the NBBMS and involvement in on-going monitoring (including the steering group) discussed below.

~~4.3.3~~4.4.3 It is intended that the NBBMA will be managed by ~~an independent,~~a suitably experienced and reputable nature conservation ~~body and positive initial discussions have been held with RSPB in this regard, with discussions on-going.~~organisation, which will control management of the NBBMA. Management will be separated from that undertaken in the SADA or wider Site (i.e., all areas of the Site excluding the NBBMA). If agreement with a suitably experienced nature conservation ~~body~~organisation cannot be reached, suitably qualified and experienced personnel will be employed and / or contracted ~~to~~ by the Applicant.

~~4.3.4~~4.4.4 Management will require regular visits and dynamic action, based on conditions at the time. As such management will be on-going, requiring regular visits and (where necessary) actions throughout the year. Management actions will include, but not be limited to, control of water levels, livestock grazing (or cutting), island maintenance and the general upkeep of the NBBMA to ensure the Aims and Objectives of the NBBS are met.

~~4.3.5~~4.4.5 Measurable targets will be set to ensure the NBBMA is functioning effectively ~~and reaching the stated aims and objectives.~~. As bird populations fluctuate and are subject to numerous environmental factors which are outside of the control of the Applicant or nature conservation management organisation, it is envisaged that measurable targets will be based on extent of habitat area and hydrological function. The inclusion of measurable targets will ensure that the NBBMS Aims and Objectives are clearly met.

~~4.3.6~~4.4.6 Hydrological management of Cell 3 will be necessary to create and maintain a mosaic of dry and wet grassland with shallow areas of surface water, pools and scrapes, so as to ensure good nesting habitat and attractive foraging areas are present throughout the breeding and non-breeding season (including passage periods) for waders and wildfowl. This will be provided broadly as follows:

- Spring: A high-water table is proposed, to ensure the soil is soft enough for breeding wading birds to probe for earthworms and larvae during passage and breeding seasons;
- Early summer: The area of damp ground will be reduced, with some areas of high-water table remaining to provide feeding areas; and,
- Winter/Passage: damp fields with areas of surface flooding to support the desired grassland sward structure.

~~4.3.7~~4.4.7 The re-engineering of Cell 3 and Canal Pools (see **Figure 3**) will ensure that at least 16.2 ha of the Cell area is able to hold water and therefore a high water-table can be maintained ~~when there is sufficient water available. The use of water from the Canal Pools (Option 2) or creation of a water storage area (Option 1) will allow water levels in Cell 3 to be actively managed when sufficient rainfall is not available to achieve the desired seasonal water level~~using either rainfall or a water sluiced from the re-engineered Canal Pools.

Setting Measurable Targets

~~4.3.8~~4.4.8 Measurable Targets on which to determine the success of the NBBMS and on-going management to meet those Measurable Targets will be set in consultation with Natural England and RSPB and agreed with ~~key consultees~~CWaCC in the final NBBMS document.

~~4.3.9~~4.4.9 It is likely that targets will include:

- Annual survey of the extent and quality of grassland created, with key attributes for the quality of the grassland being sward height and absence of negative indicator plants. This could include measurement against the favourable condition information criteria set out in Natural England guidance 'Definition of Favourable Conservation Status for Lowland meadow (RP2971)'[14] and 'Common Standards Monitoring Guidance for Lowland Grassland Habitats' (Joint Nature Conservation Committee, 2004[15]); specifically pages 13-20 for MG4 and MG8 communities, which most identify to wet grassland.
- Hydrology will most likely be measured based on the extent to which scrapes hold water, both in terms of duration and depths at critical times of the year (see 4.~~3~~4.6).

Grassland Management

~~4.3.10~~4.4.10 It is anticipated that grassland within the NBBMA will be managed in accordance with RSPB guidance on wet grassland management (Benstead *et al.*, 1997)[16].

~~4.3.11~~4.4.11 The main principles of grassland management ~~within Cell 3~~ are likely to be:

- To maintain a short sward in spring, with grass height in April 3cm or less for 80% of Cell 3;
- To maintain taller grass tussocks for shelter: 10-15cm in April, covering no more than 20% of Cell

[redacted]

[15] https://data.jncc.gov.uk/data/15a03fed-f306-4f01-9139-4933e814b9ec/CSM-LowlandGrasslandHabitats-2004.pdf [accessed April 2025]

[16] Benstead, P., Drake, M., Jose, P.V., Mountford, O., Newbold, C. & Treweek, J. (1997) The Wet Grassland Guide: Managing floodplain and Coastal Wet Grasslands for Wildlife. RSPB, Sandy.

3;

- Reduce or remove stocking between April and July to lessen the risk of nest trampling by livestock; and,
- Management by grazing during late summer and autumn to create a short sward height between c.5-10cm from October until March to provide foraging grassland for non-breeding wildfowl and waders and the correct sward height for the following April.

~~4.3.12~~4.4.12 Grazing animals will be used to achieve the desired sward structure, supplemented by mechanical means as required. Cattle are considered the optimal grazing animal for ~~Cell 3~~conservation outcomes, and ~~they~~ are currently being used in Cell 3. The use of more sedate stock, such as suckler cows and their calves, is preferable to yearlings or dry cattle which are likely to cause greater nest losses due to trampling. Alternatively, sheep may be used in conjunction with cattle, if sufficient herd numbers are unavailable locally. Grazing measures implemented will be entirely under control of the ~~organisation~~nature conservation professional responsible for the management of the NBBMA.

~~4.3.13~~4.4.13 Provided weather conditions are appropriate for cattle welfare, grazing within Cell 3 during the period April to July should not exceed 0.5 Livestock Units (LSU)/Ha/Year based on **Table 4.1**. Stock shall be turned out onto other fields to settle before being moved into Cell 3 between April and July.

~~4.3.14~~4.4.14 In late summer (August - September) grazing will be increased to 2LSU/ha/year. This increased grazing will reduce the sward height necessary for breeding the following spring. During the non-breeding season swans require short, grazed grassland (5cm-15cm) and waders such as lapwing and golden plover prefer soils with high water tables and sward heights <10cm therefore the sward will be maintained between 5-10cm for wintering wildfowl. This will also encourage grass tussocks and assist with managing rush growth. Where livestock are not available, mechanical grazing would be utilised as an alternative to achieve the same sward height. Precise mechanical methods would be determined by the managing ~~organisation~~nature conservation professional.

Table 4.1: Recommended cattle stocking rates (Nix, 2003).

Animal/Breed	Livestock Units (LSU)/Year/ha
Dairy Cow	1.01
Beef Cow (excl. calf)	0.75
Heifer in calf (rearing)	0.80
Bull	0.65
Other cattle 0–1-year-old	0.34
Other cattle 1-2 years old	0.65
Other cattle 2 years old and over	0.80
Lowland ewes	0.11
Breeding ewe hogs 0.5 to 1 year	0.06
Other sheep, over 1 year	0.08
Store lambs, under 1 year	0.04
Rams	0.08

~~4.3.15~~4.4.15 A summary of the proposed grazing regime is presented in **Table 4.2**.

Table 4.2: Summary of proposed grazing regime in Cell 3.

Grazing Density	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2 LSU/ha/yr	~~✓~~✓	~~✓~~✓						~~✓~~✓	~~✓~~✓	~~✓~~✓	~~✓~~✓	~~✓~~✓
≤0.5 LSU/ha/yr			~~✓~~✓	~~✓~~✓	~~✓~~✓	~~✓~~✓	~~✓~~✓					

4.4.16 In the event that livestock grazing is not possible, a cutting regime to achieve the same objectives as sensitive grazing will be adopted.

Restricted Operations

~~4.3.16~~4.4.17 The following activities will only be ~~restricted~~allowed within the NBBMA ~~(as the Applicant will be in control of the land)~~where these are considered necessary to ~~minimise impacts on waterfowl and encourage habitat enhancement~~conservation management :

- Installation of any new drainage systems (other than prescribed herein);
- Application of insecticides, fungicides or molluscicides;
- Application of fertilisers;
- Application of lime or any other substance to alter the soil acidity;
- Supplementary feeding of livestock;
- Burning of vegetation or other materials;
- Ploughing, cultivation or re-seeding;
- Planting of trees;
- Earth movement; and,
- Storage of materials or machinery.

~~4.3.17~~4.4.18 Shooting within the NBBMA will be prohibited at any time of year for the entire operational period of the Proposed Development.

~~4.3.18~~1.1.1 ~~In the event that livestock grazing is not possible, a cutting regime to achieve the same objectives as sensitive grazing will be adopted.~~

5 MONITORING AND REVIEW

5.1.1 Monitoring of the effectiveness of the implementation of the NBBMS ~~would~~(including without limitations its grassland management, wetland creation and NPZW controls) and whether the agreed Measurable Targets are being met will commence at a time and in a form as agreed as part of a steering group which will comprise key stakeholders including, but not limited to, Natural England, CWACC, RSPB and the Applicant, and will be undertaken for the 40-year duration of the operational period of the Proposed Development~~. The purpose of monitoring will be to provide evidence of compliance with the corresponding planning condition~~, with the first meeting of that steering group to be held prior to the commencement of works on the NBBMA.

~~5.1.2 A separate dynamic management system will be implemented by the independent management body responsible for the NBBMS (see Section 4.3). This will allow the NBBMS to be adjusted so as to ensure the implementation of the agreed Aims of the NBBMS.~~

5.1.2 ~~Clear and measurable targets will be set to~~The steering group will also agree the time frames and form of on-going monitoring and shall be able to agree any remedial actions or amendments to the measures within the NBBMS required if the monitoring identifies any cause for concern.

5.1.3 This monitoring shall include regular measures being made of sward height (to assume effectiveness of grazing/cutting regimes), extent of water and time of year when the habitats (like scrapes) are wet, which will assess the effectiveness of the water inundation (sluice) system from the water storage area (see Section 4.~~3~~4).

~~5.1.4 Compliance monitoring, to demonstrate compliance with corresponding planning condition(s), will be undertaken annually for years 1 to 5 (following completion of the works on the NBBMA), then repeated at year 10 and each five-year period thereafter.~~

5.1.4 ~~The final~~Management of recreational pressure on the NBBMA will be overseen by the appointed conservation professionals, whom will undertake regular bird counts and behavioural monitoring to identify any disturbance responses associated with public access.

5.1.5 Above and beyond the aforementioned monitoring programme, the detailed NBBMS will ~~include~~ set out the process for agreed periodic reviews ~~and reporting to relevant bodies including Natural England and CWACC.~~with the steering group of the performance of the NBBMS , following which the ~~*Cleve Hill Solar Park Record of*~~ steering group shall be able to agree any variations being made to the ~~*Habitats Regulations Assessment undertaken under Regulation 63 of the Conservation of Habitats and Species Regulations 2017 (May 2020)*~~NBBMS that may be necessary following that review, thereby delivering a dynamic and measurable management regime.

Figure 1: Site Location and Cell Numbers

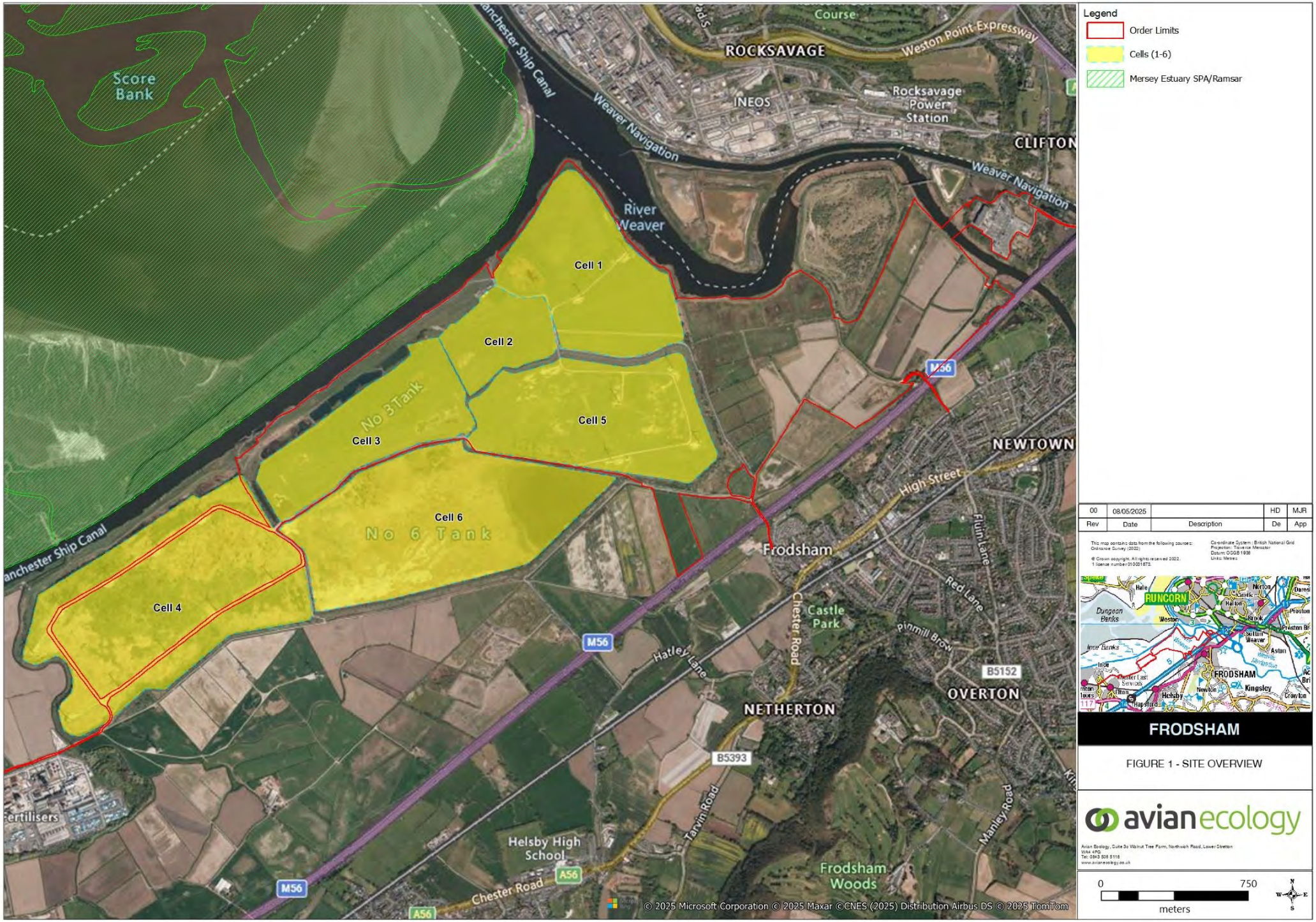
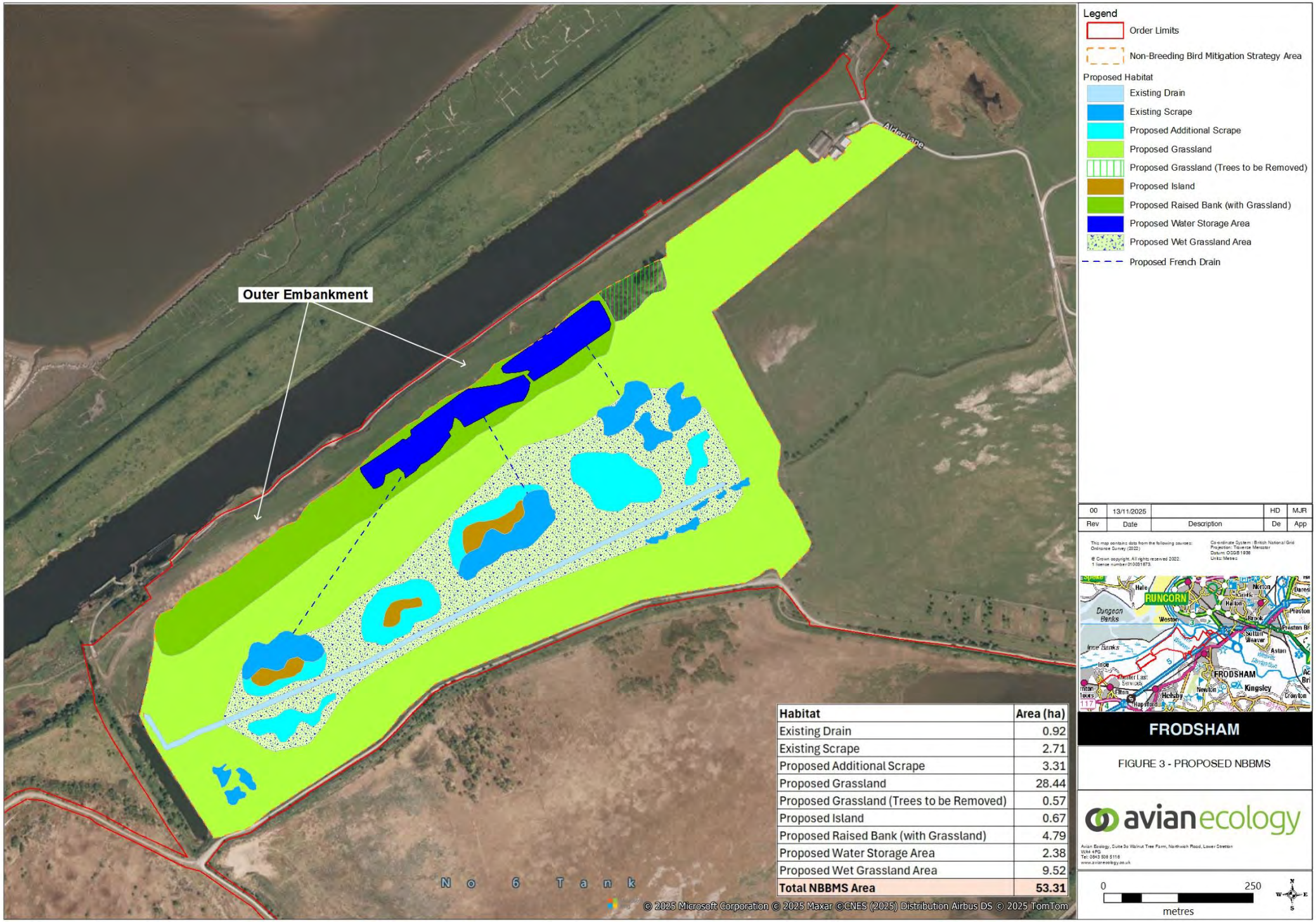


Figure 2: Existing Management Prescriptions



Figure 3: Proposed NBBMS Overview



Habitat	Area (ha)
Existing Drain	0.92
Existing Scrape	2.71
Proposed Additional Scrape	3.31
Proposed Grassland	28.44
Proposed Grassland (Trees to be Removed)	0.57
Proposed Island	0.67
Proposed Raised Bank (with Grassland)	4.79
Proposed Water Storage Area	2.38
Proposed Wet Grassland Area	9.52
Total NBBMS Area	**53.31**

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FRODSHAM

FIGURE 3 - PROPOSED NBBMS

avianecology

Avian Ecology, Suite 3a Walnut Tree Farm, Northwich Road, Lower Stretton
WA4 4PG
Tel: 0845 508 5116
www.avianecology.co.uk

REFERENCES

Benstead, P., Drake, M., Jose, P.V., Mountford, O., Newbold, C. & Treweek, J. (1997) The Wet Grassland Guide: Managing floodplain and Coastal Wet Grasslands for Wildlife. RSPB, Sandy.

~~BOWLAND ECOLOGY.~~ **Bowland Ecology** (2022~~.~~). Identification of Functionally Link Land in the North West of England – Phase 2. NECR483. Natural England

British Trust for Ornithology (BTO) (n.d.) *Vacant sites map*. Available at: [redacted] (Accessed: 27 May 2025).

Canal & River Trust (n.d.) *New Zealand pigmyweed*. Available at: [redacted] Accessed: 27 May 2025).

Department for Environment, Food & Rural Affairs (DEFRA) (n.d.) *Manage lowland wet grassland for birds*. DEFRA Farming blog. Available at: https://defrafarming.blog.gov.uk/manage-lowland-wet-grassland-for-birds/ (Accessed: 27 May 2025).

Joint Nature Conservation Committee (JNCC) (2004) *Common Standards Monitoring Guidance for Lowland Grassland Habitats*. Version February 2004. Available at: https://data.jncc.gov.uk/data/15a03fed-f306-4f01-9139-4933e814b9ec/CSM-LowlandGrasslandHabitats-2004.pdf (Accessed: 27 May 2025).

Natural England (2013) *A guide to assessing and managing anthropogenic impact on marine angiosperm habitat (NECR111)*. Natural England Commissioned Report NECR111. Available at: [redacted] (Accessed: 27 May 2025).

Natural England (2023) *Definition of Favourable Conservation Status for greater horseshoe bat (Rhinolophus ferrumequinum)*. Natural England. Available at: [redacted] (Accessed: 27 May 2025).

Natural England (2025) *Wild birds: advice for making planning decisions*. GOV.UK. Available at: https://www.gov.uk/guidance/wild-birds-advice-for-making-planning-decisions (Accessed: 27 May 2025).

Royal Society for the Protection of Birds (RSPB) (n.d.) *Fencing for safeguarding waders*. Available at: [redacted]

ANNEX 1 – SPA SPECIES REQUIRED MITIGATION HABITAT CALCULATIONS ('CLEEVE HILL APPROACH')

Bird-day calculations (BDCs) have been considered to gather baseline evidence for the scale of the NBBMA; however, they inherently under-predict the carrying capacity of purpose-built wetland habitat (i.e. more birds per hectare) because they are based on mean utilisation of predominantly dry agricultural land/dry grassland and they do not account for key habitat-quality multipliers such as water permanence, high invertebrate availability, soft soils, shallow wet features or security from disturbance. Furthermore, the majority of bird-days within the Order Limits are generated from Cell 3 rather than the wider SADA. Applying a uniform BDC across the whole SADA footprint therefore incorporates large areas that support negligible or zero use by multiple qualifying features (e.g., teal, lapwing and black-tailed godwit), inflating the area of land theoretically required. As such, scaling compensation to the entire SADA potentially overestimates the functional land requirement, whereas a like-for-like approach based on the actual functional area (predominantly Cell 3) provides a more realistic basis for mitigation scale.

Bird-day calculations for Years 2–3 indicate that compensating the entire Order Limits footprint, including the current levels of use of Cell 2 and Cell 3 (i.e., the NBBMA), and using average-quality grassland would require 59–63 ha without any habitat enhancement or modifications.

The NBBMA delivers 53 ha of optimised, hydrologically managed wetland, designed around the demonstrated preferences of golden plover, lapwing, teal, black-tailed godwit and other species (the 53 ha does not include other areas of enhancement i.e. the Lum and the Biodiversity Enhancement Area). One hectare of managed wetland provides disproportionately higher carrying capacity than one hectare of arable/improved grassland due to its non-linear ecological value. There is no agreed metric that exists to calculate what the non-linear habitat enhancements and additive mitigation being implemented as part of the NBBMA design.

Bird Day Calculations			
Year 2 Data			
–	Bird Days/winter. Current use of Order Limits	Bird days supported by each ha (taken from literature)	Area of Mitigation Needed (ha)
Golden plover	34,232.142	1,560	21.943
Lapwing	82,309.285	1,000	82.309
Combined – lapwing and golden plover	116,541.428	2,560	45.523
Curlew	13,571.142	1,000	13.571
All species combined	N/A	N/A	**59.095**
Year 3 Data			
–	Bird Days/winter. Current use of Order Limits	Bird days supported by each ha (taken from literature)	Area of Mitigation Needed (ha)
Golden plover	39,494	1,560	25.316
Lapwing	107,986.667	1,000	107.986
Combined – lapwing and golden plover	147,480.667	2,560	57.609
Curlew	5,460.000	1,000	5.460
All species combined	N/A	N/A	**63.069**

When peak counts for Year 2 and Year 3 are combined for golden plover across Cell 3 and compared to the entire SADA, 81% of all total counts sit within Cell 3 alone. Lapwing is 73% in Cell 3 and 95% of all counts of black-tailed godwit were with Cell 3 alone. The only species that this did not apply to was curlew, whereby the total counts across year 2 and 3, 64% existed within the SADA footprint and 36% of all counts combined were isolated to Cell 3. Curlew are primarily a coastal and intertidal wintering species, with the Mersey Estuary SPA forming their core supporting habitat.

Annex 2: Frodsham Wind Farm Year Five Monitoring Report (separate document)

atmos CONSULTING

8702-65/R01/Rev2

Technical Report

Frodsham Wind Farm

Post-Construction Ecological Monitoring Repo
Year Five 2021

Frodsham Wind Farm Limited

October 2022

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Version	Date	Reason
8702-65-R01-Rev1	02/09/2022	Draft for client review
8702-65-R01-Rev2	04/10/2022	Amendments following clients review

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1 Introduction

1.1 Background

Atmos Consulting Ltd (Atmos) were commissioned in 2016 to carry out post construction monitoring at Frodsham Wind Farm (FWF) to satisfy the following planning conditions amongst which is the condition to report on the results from year Five, April 2021 to October 2021 into an annual report:

Planning Condition 33(h) requires *'the establishment of a Habitat Creation a Management Group (HCMG), to advise on the detail of the HCMP, reviewing t findings of the post-construction ornithological monitoring programme and for refining the implementation of the HCMP'*.

Condition 31 requires '*post construction bird distribution monitoring in accordance with section 13.60 of the SEI; and bird collision mortality surveys following protocols to agreed in writing with the LPA in consultation with Natural England*'; and

Condition 33 (f) requires the '*monitoring of habitats and species during the ye preceding the commencement of the Development and at yearly intervals subsequent 5 years and at 5-yearly intervals thereafter, in order to inform an ongoing management programme*'.

1.2 Objectives

The principle objectives of the report are:

- to outline the survey methodologies used;
- to summarise the results of the surveys completed; and
- to discuss these results with broad reference to the pre-construction survey results

It should be noted that the results from the breeding season (April – August 2021) are included in this report along with the final two months of monitoring, September and October. With agreement from the HCMG and Chester West and Cheshire Council, ornithology reporting is produced such that the two main ornithology seasons are not split. Instead, survey work carried out during the bird breeding season is reported in the end of year report (this report), with non-breeding results reported in an updated report usually issued in the following June. However, due to the monitoring period ending in October 2021, the non-breeding results for Year 5 are also included within this report.

1.3 Site description

Frodsham Wind Farm is a nineteen-turbine wind farm located near the town Frodsham in Cheshire. Figure 1 shows the site layout and design. The wind fa divided into two areas; with six turbines present in the eastern section and thi present in the western section. Habitats found on the site include reed beds, areas open water, agricultural land, and areas of scrub. The site is made up of a number cells, which are separated by earth banks.

2 Methodology

2.1 HCMG

The HCMG's purpose is to monitor the effects, post construction, on the flora and fauna influenced by the windfarm. It is made up of representatives, who meet biannually as of 2017 (previously quarterly). With the final meeting taking place in October 2022. All aspects of the windfarms operation are discussed, and reports circulated detailing the surveys that have commenced and the results. At the end of each year the HCMG ar presented with an annual monitoring report, with an update report provic summary of the results of the non-breeding season ornithology work presented mid-year. These meetings will cease following the September 2022 meeting, with meetings organised as required to deal with specific topics.

The following representatives and their roles are as follows:

Frodsham Wind Farm Representative

[redacted] from Belltown Power. Responsible for formal liaison between FWF and the HCMG, via attendance at HCMG meetings.

Frodsham Wind Farm Ecologist

[redacted] rom Atmos Consulting Ltd. Responsible for: HCMG administration (organising meetings, providing meeting agendas, minutes ar action lists), reporting on the post-construction monitoring work to the HCM(contributing to HCMG discussions and providing input regarding site ecolog and management.

Frodsham Wind Farm Tenant Farmer

[redacted]. Responsible for: contributing to HCMG discussions, providing i regarding site management, and implementing grazing regimes as per the Habita Creation and Management Plan.

Cheshire West and Chester Council Representatives

[redacted] (Natural Environment Officer) and Paul Friston (Principal Planning Officer). Responsible for: review of HMCG activities in relation to planning condition requirements, contributing to HCMG discussions, and providing input regarding site ecology and management.

Natural Power Representative

[redacted] Responsible for: the provision of asset management services to Frodsham Wind Farm, supporting the delivery of off-site management services for Frodsham Wind Farm, including project management support, management of the OEM, stakehol liaison, daily client point of contact, assist with monthly reporting, host quarterly monthly operational meetings and prepare annual documentation for the wind farm.

Cheshire and Wirral Ornithological Society Representative

[redacted] Responsible for: contributing to HCMG discussions and providing input regarding site ornithology and management.

RSPB Representative

[redacted] (Conservation Officer, North West England). Responsible for: contributing to HCMG discussions and providing input regarding site ornithology and management.

Cheshire Wildlife Trust Representative

[redacted] Responsible for: contributing to HCMG discussions and providing input regarding site ecology and management.

Natural England Representative

[redacted] Lead Adviser, Coast and Marine, Cheshire, Greater Manchester Merseyside and Lancashire Area Team). Responsible for: contributing to discussions and providing input regarding site ecology and management.

2.2 Bats

2.2.1 Bat activity

Monitoring using remote bat detectors was carried out between the months of and September inclusive, with an Elekon Batlogger 'C' unit installed in the nacelle each of the 19 turbines and attached to exterior microphones. The detectors were programmed to record automatically between the 26th of March and the 25th of October 2021, with data being recorded from one hour before sunset until 45 minute after sunrise. Data was recorded onto removable SD memory cards before data was then uploaded securely to a backed up and dedicated drive.

In 2021, there has been some issues with the alert system regarding full SD cards, as well as limitations in accessing the detectors. This means that for some turbines, there was limited data or in some cases, data with no timestamps attached. Turbines 2, 3, 8, 10, 11, 15, 16, 17 and 18 did not collect any timestamped data. Records for turbines 4 and 6 are timestamped, but only contain data from July onwards.

Due to the volume of data gathered, which was too great to allow processing manually, the data was batch processed using the BatExplorer program. Advanced filters were created which filtered data based on a number of parameters; including peak frequency and call length. All data was then labelled as either *Pipistrellus* spp., *Pipistrellus nathusii*, *Nyctalus* spp or random noise. Each call was then linked with the met mast data gathered at the time of the call to be assessed. Met mast conditions are recorded at ten minute intervals so a bat call is tagged with data that is no more than five minutes old.

It was identified that a significant proportion of the data that was filtered out *Nyctalus* spp. could be attributed to random noise rather than a bat call. Estimates false positives were derived from this data so that an error rate could be obtained. For each of the turbines, 100 *Nyctalus* spp. labelled calls were re-analysed manually to assess whether they were produced by bats or were from a random noise source. Data was chosen at a random date and time, and then the next 100 positive calls analysed. Error rates per turbine were calculated based upon the number of calls per 100 which were erroneously tagged as bat calls. This gave a per turbine rate of error.

To calculate the false positive rate across the site, because the number of records per turbine varied, the site error rate was calculated by correcting the number of calls recorded at each turbine by the error rate for that turbine, and then summ

corrected number of calls and comparing with the sum of the uncorrected calls. This allowed the site error rate to be calculated.

2.2.2 Carcass monitoring

Bat carcass monitoring, using specially trained dogs, continued in 2021.

Trial searches

An initial searcher efficiency trial was carried out in March 2021 and a scavenger removal trial was undertaken across February and April 2021 to determine the likely carcass removal rate.

The searcher efficiency trial was carried out within a 50 m radius of three turbine bases, with the turbines chosen to represent the range of habitats found across the wind farm site. Two of the turbines were in the west (T10 and T13) and one was in the east (T19). One of the turbine search areas to the west of the wind farm was approximating to Cell 4 (T10) and the other was in the open farmland found around T11 to T13 (T13). In each plot, five trial bat carcasses were placed in random locations and the dog and handler were then asked to locate them within the time that would be taken to search the area around a turbine. The carcasses were deployed by an Atmos ecologist whilst out of sight of the dog and handler. The ecologist threw each carcass into position to ensure that the dog did not follow the ecologist's scent and diminished the chances of a false positive result. This trial survey enabled an estimate of searcher efficiency to be made. Once the searcher trials were complete, scavenger removal trials were undertaken by placing trial carcasses (dark coloured mice) around a further three turbines (T6, T12 and T17) and checking them at three-daily intervals for 30 days to see whether they were removed by scavengers.

Bat carcass surveys

The mitigation strategy requires up to one third of the monthly basis but provides no guidance as to how turbines should be allocated, except to say that groundcover should be taken into account.

As a result, the following factors were considered when determining turbines to be searched:

- Number of corrected bat calls at each turbine – turbines were grouped into 1 of three ranks, from most activity (rank 1) to least activity (rank 3) based on data from 2017.
- Cluster in which turbine is located.
- Ease of searching (gathered from figures produced for the bird carcass searching from July 2017).
- Likely location of rare breeding birds on the wind farm[1].

[1] It is an offence under the Wildlife and Countryside Act 1981 (as amended) to intentionally or recklessly disturb a Schedule 1 bird at or in the vicinity of the nest. With known Schedule 1 birds breeding on the site, turbines in the vicinity of their observed preferred breeding locations have therefore been excluded to avoid the possibility of disturbance as a result of taking dogs and humans into the area.

Table 1 shows the turbines that were included within the trial with the reason for inclusion.

Table 1: Turbines searched for bat carcasses

Turbine number	Cluster	Bat activity rank	Ground cover
5	West	Rank 3	Poor Cell 3 (but best accessibility in Cell 3)
10	West	Rank 2	Poor Cell 3
11	West	Rank 2	Good
13	West	Rank 1	Good
15	East	Rank 1	Good
16	East	Rank 1	Good
18	East	Rank 2	Good
19	East	Rank 1	Good

The turbines in the western cluster are split between th
farmland; as such, turbines from both areas were included, despite the f
ground conditions for searching were challenging within Cell 4.

There are no turbines in the eastern cluster ranked as Rank 3 for ba
Additionally the majority of turbines ranked in Rank 3 are found in Cell 4. To maintain the balance across the site, an additional Rank 2 turbine from the fields was included; this was among the lower ranked turbines of Rank 2.

The searches were carried out by a trained dog quartering the a
experienced handler, which alerted the handler whenever a bat was locate
following information was recorded when a bat was located:

- Species (if identifiable);
- Gender;
- Age;
- Condition; and
- Exact location (as well as a 10 figure GPS reference, a map was also produced for each searched turbine showing location of all carcasses found).

In addition photographs were taken of each carcass and the carcass removed and disposed of safely. Pipistrelle species had the wing venation photographed and th species separation was made firstly between nathusius and common/soprano pipistrelle and through additional analysis between soprano and common pipistrelle. This method was discovered by von Helversen & Holderied (2003)[2]. It must be noted that soprano and common pipistrelle species are estimated based on wing venati as there can be regional variations and therefore errors on this method of separating soprano/common pipistrelle.

Once the surveys had been completed, an estimate of the bat annual mortalit turbine and across the wind farm was calculated, along with an estima mortality per turbine per month.

2 http://www.nathusius.org.uk/ID_morphology.htm

Any bats located represent only a proportion of the actual or true number killed. As a result, a correction was applied taking account estimates of searcher efficiency predator removal rate to provide an estimate of the true number killed on the farm. There are a number of approaches which can be used to estimate the number of bats killed. Natural England[3] provided the following formula (SNH, 2019) and while it does not have the mathematical complexity that some other models have, tl can be considered both a benefit and a limitation, nevertheless it was adopted.

$$True\ n\ killed = \frac{number\ found}{observer\ efficiency\ x\ (1 - predator\ removal\ rate)\ x\ turbines\ search\ rate}$$

2.3 Ornithology

2.3.1 Vantage point surveys

Vantage point (VP) surveys commenced using four vantage points spread across tl site (see Figure 2):

VP1 - 350765, 378800

VP2 – 348863, 377458

VP3 – 347445, 377445

VP4 – 349957, 377700

VP surveys were carried out generally following Natural England's now lapsed guidance (NE 2010) and involved an average of six hours of observation per VP month, carried out in watches lasting no more than two hours. Table 2 shows the number of hours of observation carried out per VP per month.

Vantage point surveys came to an end in October 2021, which is the end of the year 5 monitoring. For the purposes of this report, data is presented from between April 2021 – October 2021, inclusive.

Table 2: Vantage point hours per VP per month

	VP1	VP2	VP3	VP4
April 2021	6	6	6.1	6
May 2021	6	6	6	6
June 2021	6	6	6	6
July 2021	6	6	6	6
August 2021	6	6	6	6
September 2021	6	6	6	6
October 2021	6	6	6	6
Total hours	42	42	42.1	42

3 SNH. (2019). *Bats and onshore wind turbines: Survey, assessment and mitigation.* Battleby: SNH.

2.3.2 Breeding birds

A modified Common Bird Census approach (Gilbert, 1998) was used, which involved four visits to the site, each comprising a site walkover by an experienced ornithologist in which all parts of the site were walked over to a minimum distance of 50 m (w accessible). Visits were carried out between the end of April and July and all birds seen or heard were recorded on site maps using British Trust for Ornitholog nomenclature.

Once all surveys were complete, analysis of territories was undertaken. This involved an assessment of bird records across all four survey visits. However due to the high density of species present, only species which are listed on Birds of Conservation Concern amber or red, English Priority species, Annex 1 or Schedule 1 species. Density of warblers across the site was extremely high; for example in some years there have been an estimated 60 Reed warbler *Acrocephalus scirpaceus* within cell 4 only. Four categories were recognised:

- Confirmed territory – nest was found or adults seen carrying food (unless raptors) or nesting materials or presence of juvenile birds on the site;
- Probable territory – bird(s) were seen in the same location on more than one location, breeding behaviour was observed on at least one occasion courtship, display or singing, pairs in suitable habitat, territorial disputes);
- Possible territory – birds observed only once in one location, but evidence breeding was observed, or birds recorded repeatedly (i.e. across several visits) in suitable habitat although no evidence of breeding observed; and
- Non-breeding – bird was recorded with no breeding behaviour observed and on no other visit was a bird observed in the same location.

Care had to be taken with territory analysis because this was a site where there we routinely high numbers of birds. Those included large numbers of birds feeding or loafing in the vicinity of the estuary or waterbodies within the survey area, some of which were in suitable breeding habitat (e.g. Lapwings would both feed and breed on pasture) bu which were actually formed birds passing through the site en route to breeding grounds, or which were non-breeding. More discretion had to be applied to son records, for example, flocks of birds in suitable habitat were considered no indicative of breeding even if they were present across all visits.

Limitations

Not all areas of the site were accessible down to a distance of 50 m (for example, attempt was made to walk through reed beds) and, as such, some t particularly of smaller species, may have been missed.

2.3.3 Winter bird walkovers

Winter walkovers were carried out in September and October 2021, with each survey taking two days. All birds seen or heard on the site were recorded with the exception of flyover gulls.

2.3.4 Marsh harrier

Although no dedicated raptor surveys were carried out, breeding Marsh harriers *Circus cyaneus* were recorded during the breeding bird surveys and flight data on M harriers was recorded during the vantage point surveys. The vantage point surveys were undertaken at four different locations around the wind farm, with one of the vant point locations chosen so as to provide thorough coverage of Cell 4, as Marsh harrie have used this area as breeding habitat in previous years. Since monitoring be birds have also begun breeding in Cell 6; this too is covered by VPs. This allowed for the continual monitoring of the species over the breeding season.

2.4 Habitat monitoring

The post-ecological monitoring program required that in the first year after construction an experienced ecologist visit the site to undertake an updated Phase I habitat surve of the whole Frodsham Wind Farm site, covering Cell 2 to 5. The results of this baseline survey, which was undertaken during August 2017, were then used to establish a new baseline against which future updated walkover surveys undertaken in Year 2-5 will be compared. This report details the results of the fourth Phase I habitat survey, which has been carried out in the fifth-year post-construction.

The Phase I habitat survey of the site, including all of the land within the rec boundary shown on Figure 1, was undertaken on 29th July 2021. A Phase I habitat survey is a standardised method of recording habitat types and the characteristic vegetat of a site as set out in the Handbook for Phase I Habitat Survey – A Technique for Environmental Audit (JNCC, 2010). During the survey habitats greater than 0.1 ha were mapped, whereas smaller habitats and features of ecological interest were describ in target notes. The DAFOR scale was used to record the relative abundance of plan species within a given area. This involved ranking the species in terms of the 'DAFOR' (Dominant, Abundant, Frequent, Occasional or Rare) scale of abundance.

The survey was undertaken during the optimal period for Phase I habitat su (typically considered to be April to September), in favourable weather and wi access. No significant limitations were therefore identified.

3 Results

3.1 Bats

3.1.1 Bat activity

The static detectors recorded the presence of *Pipistrellus* species (common pipistrelle *Pipistrellus pipistrellus* and soprano pipistrelle *Pipistrellus pygmaeus*), nathusius' pipistrelle *Pipistrellus nathusii* and *Nyctalus* species, along with small numbers of brown long-eared *Plecotus auritus* and *Myotis* species.

The *Nyctalus* spp. data in the following tables has been adjusted to account for err (as per the methodology). An error rating was obtained and applied for each c turbines, which was then averaged out to give an estimated error rate of 0.24 (i.e. 24% of records tagged as *Nyctalus* were likely to be erroneous). This is lower than 2020, where the error rate was 0.35.

A total of 44198 bat passes were recorded during the months of April, May, June, July, August, September and October. As shown in the table below (Table 3), *Nyctalus* were the most frequently recorded species, with 25245 recorded across all months (corrected). *Pipistrellus* were the second most frequently recorded (18341). Low numbers of *Pipistrellus nathusii* (611 passes) were also recorded, along with low numbers of *Myotis* species and brown long-eared *Plecotus auritus* (not shown in the table). As previously mentioned, not all the turbines provided time stamped data, so their resu are omitted from the above analysis and below table. Across the 18 turbine provided data, there were 38899 total corrected calls for the months of April-September.

Overall, bat activity was generally lower in 2021 than in 2020. This could be reflective of the weather conditions this year, which were generally less favourable for bat foraging than in 2020, which was the most active year over the past 3.

The highest level of bat activity was recorded at Turbine 14, which was the same in and 2020. This was followed by Turbine 19, and Turbine 5. Turbines 14 and 19 are both in the eastern cluster, which was the area that exhibited the highest levels of activity during the first year of monitoring. The lowest levels of activity (for turbines that had data from the whole monitoring period) were recorded at Turbine 6, followed by Turbine 1. *Pipistrellus* and *Nyctalus* species were recorded at all turbine locations, whilst Nathusius' pipistrelle was not recorded at Turbine 6, likely down to the lack of full season data for this turbine.

Table 3: Number of bat passes recorded at each turbine location

Static detector location	Species			Total
	Pipistrellus spp.	*Nyctalus* spp.	*Nathusius' pipistrelle*	
Turbine 1	310	947	10	1267
Turbine 2				
Turbine 3				

Turbine 4	791	1483	13	2287
Turbine 5	1169	2456	76	3701
Turbine 6	50	706	0	756
Turbine 7				
Turbine 8				
Turbine 9	1473	1768	45	3286
Turbine 10				
Turbine 11				
Turbine 12	1353	1208	47	2608
Turbine 13	1621	1748	50	3419
Turbine 14	5135	12143	254	17532
Turbine 15				
Turbine 16				
Turbine 17				
Turbine 18				
Turbine 19	3154	809	80	4043
Total	**15056**	**23268**	**575**	**38899**

Bat activity recorded on the static detectors was greatest during the month of August, followed by July, June, September, May and April (Table 4). These results are only from nine turbines in total, and one of these nine only had data available from July, which may have skewed the overall values, and explains the lower numbers in 2021.

Table 4: Average bat passes per turbine per night per month (data is uncorrected)

Recording month	Average bat passes for all species			
	2018	2019	2020	2021
April	13.53	102.07	120.95	7.04
May	26.07	91.04	177.80	22.68
June	56.51	181.56	330.92	28.91
July	77.10	271.96	190.76	33.40
August	31.53	194.78	295.93	40.65
September	35.65	169.87	76.91	11.39
Average	40.07	168.55	198.88	24.01

An analysis of timing of bat activity was also carried out for *Nyctalus* spp and pipistrelle spp. Data was quantified across all turbines relative to the time of sunrise or sunset t establish when bat activity levels were highest across the site. These are shown in Charts 1, 2 and 3. It should be noted that due to the nature of the data it is not possible to correct it in relation to noise which has been filtered in, so it will be an overestimate bat activity.

Chart 1: Sunrise timing of bat activity (data is uncorrected)

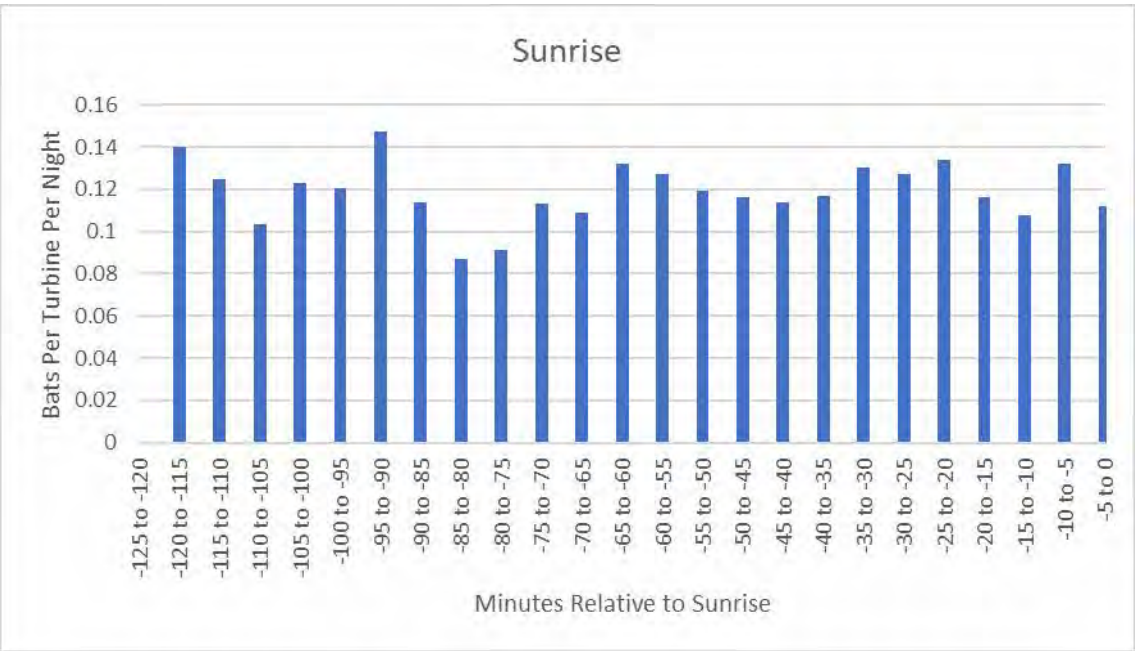


Chart 2: Sunset timing of bat activity (data is uncorrected)

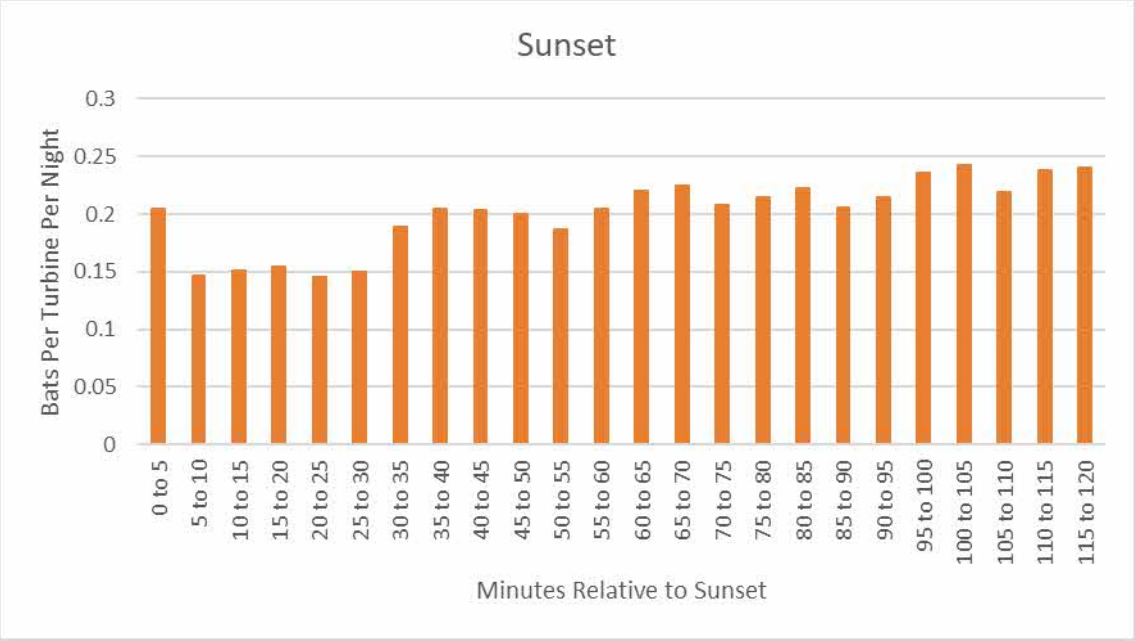
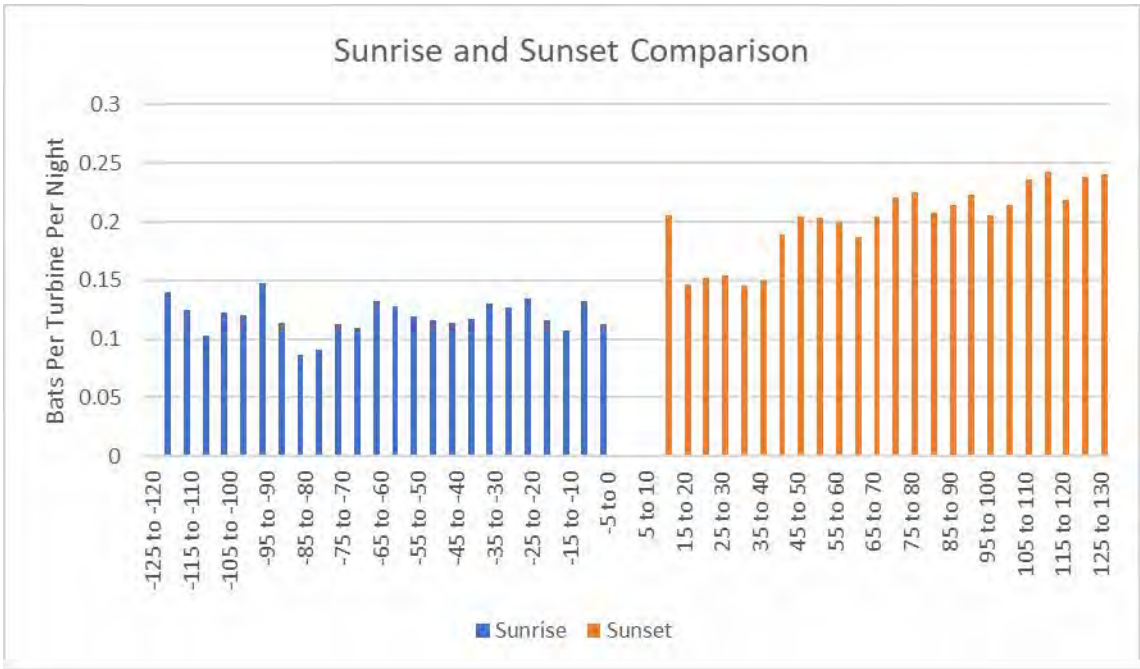


Chart 3: Comparison of the sunset and sunrise bat activity (data is uncorrected)



The highest level of bat activity occurs around 100 minutes after sunset, which is different to previous years, where the highest activity was witnessed in the p immediately after sunset. During all years of monitoring, the levels of bat activity at sunrise were visibly lower.

Throughout all years of monitoring, there was relatively little activity in the perio immediately around sunset or sunrise and this is the same in 2021, except for between 5 and 10 minutes after sunset. In 2021, activity periods are similar to previous years, with there being prolonged activity at sunrise and sunset. Sunrise experienced larger amounts of activity, whereas sunrise remains below 0.15 throughout the entire 120 minute period.

3.1.2 Carcass monitoring

Carcass trials

The observer efficiency trials showed the overall efficiency of th 100% as a result of all 15 of the bat carcasses being located. All carcasses were found at all turbines.

Carcasses put down for the predator trials varied on their removal rate. At turbine 12 the first carcass was removed by day 3 and 100% of carcasses had been removed by day 18. At turbine 6 the first two carcasses had been removed by day 6 and the rest of the carcasses had been removed by day 15. At turbine 17 the first three carcasses were removed by day 6, with 80% being removed by day 21, with just on carcass remaining at the end of the trial. Overall the predator removal rate was calculated as 93.34% as 6.66% of carcasses remained at the end of the trial.

Carcass searches

No bat carcasses were found during the carcass searches over the 6 months.

Table 5: Results of the bat carcass search

	Bat carcasses found at each of the turbines surveyed							
Search Date	T5	T10	T11	T13	T15	T16	T18	T19
26/04/2021	0	0	0	0	0	0	0	0
14/05/2021	0	0	0	0	0	0	0	0
16/06/2021	0	0	0	0	0	0	0	0
15/07/2021	0	0	0	0	0	0	0	0
16/08/2021	0	0	0	0	0	0	0	0
15/09/2021	0	0	0	0	0	0	0	0

$$True\ n\ killed = \frac{number\ found}{observer\ efficiency\ x\ (1 - predator\ removal\ rate)\ x\ turbines\ search\ rate}$$

The above formula was populated on a monthly basis with the 0 for all months); the observer efficiency 1.0; the estimated predator removal rate between searches of 93% and the turbine search rate of 0.42 (eight out of 19 turbines).

Due to the fact that there were no bat casualties reported this season, the casualty rate for both *Pipistrellus spp.* and *nyctalus spp.* is 0.

3.2 Ornithology

3.2.1 Vantage point surveys

A total of 23 target species were recorded during VPs between April – October 2021 (Table 6). These are shown in the following supporting figures. Where possible they are arranged by species group, but for some species, activity was such that they had to be included separately.

Figure 3a Waders (Oystercatcher, Curlew, Dunlin, Golden plover, Snipe, Redshank and Ruff) – Sept 2020 – March 2021

Figure 3b – Geese and swans (Greylag goose, Mute swan and Whooper swan) – Sept 2020 – March 2021

Figure 3c – Duck (Pintail, Mallard, Shoveler, Teal, Gadwall, Tufted duck and Wigeon) – Sept 2020 – March 2021

Figure 3d – Raptors and others (Merlin, Peregrine, Coot, Little grebe, Common gull and Herring gull) – Sept 2020 – March 2021

Figure 3e – Marsh harrier – Sept 2020 – March 2021

Figure 3f – Lapwing – Sept 2020 – March 2021

Figure 3g– Canada goose – Sept 2020 – March 2021

Figure 3h – Waders (Oystercatcher, Curlew, Dunlin, Golden plover, Snipe, Redshank and Ruff) - April 2021 – October 2021

Figure 3i – Geese and swans (Greylag goose, Mute swan and Whooper swan) – April 2021 – October 2021

Figure 3j – Duck (Pintail, Mallard, Shoveler, Teal, Gadwall, Tufted duck and Wigeon) – April 2021 – October 2021

Figure 3k – Raptors and others (Merlin, Peregrine, Coot, Little grebe, Common gull and Herring gull) – April 2021 – October 2021

Figure 3l – Marsh harrier – April 2021 – October 2021

Figure 3m – Lapwing – April 2021 – October 2021

Figure 3n– Canada goose – April 2021 – October 2021

Figure 3o– Shelduck – April 2021 – October 2021

Figure 3p– Black tailed godwit – April 2021 – October 2021

Table 6: Vantage point results April – October 2021

Species	Scientific Name	Min No. of Birds	Max No. of Birds	Mean No. of Birds	No. of Flights	Total Bird Seconds	At Risk Bird Seconds
Black-tailed godwit	*Limosa limosa*	1	1500	113.81	59	261,574	121,246
Canada goose	*Branta canadensis*	1	1000	51.98	52	157,508	1,728
Curlew	*Numenius arquata*	1	25	5.71	14	4,384	716
Dunlin	*Calidris alpina*	15	300	111.67	3	11,050	0
Gadwall	*Anas strepera*	1	12	5	7	899	325
Golden plover	*Pluvialis apricaria*	30	200	72.50	4	26,360	10,900
Greylag goose	*Anser anser*	2	19	7.60	5	8,877	8,861
Lapwing	*Vanellus vanellus*	1	500	50.67	55	165,150	76,673
Marsh harrier	*Circus aeruginosus*	1	2	1.05	75	6,335	510
Merlin	*Falco columbarius*	1	1	1	1	20	0
Mute swan	*Cygnus olor*	3	4	3.50	2	272	0
Oystercatcher	*Haematopus ostralegus*	1	1	1	2	33	0
Peregrine	*Falco peregrinus*	1	1	1	1	404	60
Pintail	*Anas acuta*	5	30	13.20	5	2,260	1,053
Redshank	*Tringa tota*	2	400	69.15	13	34,829	5,660
Ruff	*Philomachus pugnax*	1	1	1	1	3	0
Shelduck	*Tadorna tad*	1	8	2.20	90	8,221	2,798
Shoveler	*Spatula clypeata*	1	100	19.25	8	5,258	296
Snipe	*Gallinago gallinago*	1	3	1.60	5	173	5
Teal	*Anas crecca*	1	100	23.20	5	4,274	0
Tufted duck	*Aythya fuligula*	1	25	9.33	3	785	0
Whooper swan	*Cygnus cygnus*	6	6	6	2	930	300
Wigeon	*Anas penelope*	5	50	35	3	3,050	0

The most commonly recorded species were Shelduck – in terms of flights recorded – and Black-tailed godwit – in terms of flight seconds recorded, due to the large flocks of Black-tailed godwit observed.

Table 7 shows a comparison between the April – August period in 2021 with the April – August period in 2017 – 2019. Data will differ from that shown in Table 6, as September and October 2021 have been excluded to allow an equal comparison.

Table 7: Comparison of results between the 2021, 2020, 2019, 2018 and 2017 breeding season.

	2021			2020			2019			2018			2017		
Species	Mean No. of Birds	No. of Flights	Total Bird Seconds	Mean No. of Birds	No. of Flights	Total Bird Seconds	Mean No. of Birds	No. of Flights	Total Bird Seconds	Mean No. of Birds	No. of Flights	Total Bird Seconds	Mean No. of Birds	No. of Flights	Total Bird Seconds
Avocet	0	0	0	2	1	26	1	1	18	1.75	4	475	1	1	25
Black-tailed godwit	119.8	40	175,682	124.55	20	142,031	78.95	21	124,754	94.67	27	266,263	112.48	21	158,232
Canada goose	16.9	29	28,698	9.52	21	9,203	17.29	24	30,822	53.82	11	49,185	16.05	19	13,412
Common sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	2	1	30
Curlew	2	1	72	1	1	32	2.13	8	507	9.86	7	4,530	11.33	3	1,540
Dunlin	157.5	2	10,650	4	1	228	0	0	0	4	1	240	97	5	16,955
Gadwall	5	7	899	2.33	6	931	4	2	450	1.75	12	579	3	1	249
Golden Plover	30	1	660	0	0	0	0	0	0	0	0	0	20.33	3	1,840
Green sandpiper	0	0	0	0	0	0	0	0	0	1	1	15	2	3	180
Grey heron	0	0	0	0	0	0	1.33	9	423	0	0	0	0	0	0
Greylag goose	10.33	3	8,478	0	0	0	0	0	0	5.67	3	870	6.33	3	1,025
Hobby	0	0	0	0	0	0	0	0	0	1.25	4	930	1	3	402
Hen harrier	0	0	0	1	1	39	0	0	0	0	0	0	0	0	0
Lapwing	6.53	36	8,110	27.82	22	41,825	63.39	38	228.947	2.55	42	6,450	3.38	53	10,742
Little egret	0	0	0	2	1	308	0	0	0	0	0	0	0	0	0
Little ringed plover	0	0	0	0	0	0	0	0	0	1.5	4	245	0	0	0

			2021			2020			2019			2018			2017
Mallard	33.40	5	7,847	0	0	0	0	0	0	2.5	2	180	7.22	9	1,932
Marsh harrier	1.06	70	6,044	1.13	71	8,474	1.07	30	2,589	1.19	111	19,714	1.12	49	7,403
Merlin	1	1	20	0	0	0	0	0	0	0	0	0	0	0	0
Mute swan	3.50	2	272	3.33	6	986	1	1	40	3.5	4	645	2.25	4	634
Osprey	0	0	0	0	0	0	0	0	0	0	0	0	1	1	64
Oystercatcher	1	2	33	0	0	0	0	0	0	0	0	0	1.33	3	112
Peregrine	1	1	404	2	1	64	1.5	2	249	1.33	6	1,205	1	4	990
Pink-footed goose	0	0	0	0	0	0	0	0	0	47	1	8,460	18.5	4	4,940
Red kite	0	0	0	0	0	0	0	0	0	1	1	300	0	0	0
Redshank	88	8	30,085	4	1	320	0	0	0	0	0	0	90	3	22,825
Ringed plover	0	0	0	3	1	42	2	1	114	9	1	225	25	1	3,250
Ruff	1	1	3	0	0	0	0	0	0	2	2	90	0	0	0
Sanderling	0	0	0	6	1	252	0	0	0	0	0	0	0	0	0
Shelduck	2.20	90	8,221	3.55	56	13,658	4.16	56	14,901	4.13	38	6,372	2.64	50	6,272
Short-eared owl	0	0	0	0	0	0	2.5	2	480	0	0	0	0	0	0
Shoveler	6.25	4	682	0	0	0	0	0	0	0	0	0	19	1	570
Snipe	1.50	2	50	0	0	0	0	0	0	3	1	60	0	0	0
Teal	6	2	86	65	1	5,200	2	1	90	6	1	240	30	1	1,200
Tufted duck	13.50	2	770	11.75	4	2,252	2	1	50	2.75	4	260	4	2	130
Whimbrel	0	0	0	0	0	0	0	0	0	0	0	0	14.5	2	585
Whooper swan	0	0	0	0	0	0	3.5	2	550	0	0	0	0	0	0

Table 8 shows the overall levels of activity in comparison across the five years. Species which were only recorded in one year have been omitted from this comparison. Levels of activity were high in 2021, with the second highest mean number of birds, the highest number individual flights, although the total bird seconds was ranked fourth.

Table 8: Summary of flight activity over five years.

	Mean No. of Birds	No. of Flights	Total Bird Seconds
2017	345	236	229513
2018	255	284	367083
2019	180	186	172227
2020	265	213	225272
2021	342	309	225139

3.2.2 Breeding birds

Table 9 shows the results of the breeding bird surveys for 2021 which are also shown on Figure 4. In total, 21 species with conservation sensitivity were thought to be breeding on the site.

Marsh harrier was the only Annex I, Schedule 1 species. Two species listed on Annex I of the Birds Directive were recorded breeding within the survey area – Kingfisher *Alcedo atthis*, although no nest was identified, and Marsh harrier (see 3.2.3). A juvenile Avocet *Recurvirostra avosetta* was observed on the shore of the River Weaver; it is not known where the nest was.

The other Annex I species present for which no evidence of breeding was observed was Peregrine *Falco peregrinus*.

Table 9: 2021 breeding bird results

Species	Scientific names	Conservation Status*	Confirmed	Probable	Possible	Total
Cetti's Warbler	*Cettia cetti*	Sch1		1	9	10
Dunnock	*Prunella modularis*	EPL Amber	1		2	3
Gadwall	*Anas strepera*	Amber			2	2
Grasshopper warbler	*Locustella naevia*	EPL Red			1	1
Lapwing	*Vanellus vanellus*	EPL Red	2		4	6
Linnet	*Linaria cannabina*	EPL Red			4	4
Mallard	*Anas platyrhynchos*	Amb	1		1	2
Marsh Harrier	*Circus aeroginosus*	Ann1 Sch1 Amber		1	1	2
Meadow Pipit	*Anthus pratensis*	Amb			2	2
Reed Bunting	*Emberiza schoeniclus*	EPL Amb		6	5	11
Skylark	*Alauda arvensis*	EPL Red		4	22	26
Song Thrush	*Turdus philomelos*	EPL Red			3	3
Willow warbler	*Phylloscopus trochilus*	Amb		1	2	3
Yellow wagtail	*Motacilla flava*	EPL Red	1			1

* An1- Listed on Annex 1 of the Birds Directive

Sch1 – Listed on Schedule 1 of the Wildlife and Countryside Act

EPL – English Priority Species

Red/Amb – red or amber classification under the Birds of Conservation Concern

The only non-Annex I, Schedule 1 species breeding was Cetti's warbler (2 probable and 7 possible territories). There was no evidence of Little ringed plover *Charadrius dubius* breeding in Cell 6 this year.

Unlike last year, only one Lapwing territory was tentatively identified and no nests were identified. However, there were several observations of single birds or two birds together

High densities of breeding warblers were recorded as noted in 3.2.2; warblers recorded (in order of frequency) were Reed warbler, Sedge warbler *Acrocephalus schoenobaenus*; Whitethroat *Sylvia communis,* Chiffchaff *Phylloscopus collybita* Blackcap *Sylvia atricapilla*, and Garden warbler *Sylvia borin*.

3.2.3 Marsh harrier

Harriers were monitored during VPs and breeding bird surveys, but no additional effor was employed during the last two years (e.g. ringing or additional monitoring surveys). As a result, there is greater uncertainty over the outcomes for Marsh harrier, althou activity levels and behaviour observed suggested there were territory holding present again in Cell 6, but breeding was not confirmed, although the pair was present together in early spring. One territory was also defined in Cell 4 as birds were recorded over this area; activity recorded during VPs suggested at least one territory in this area, with either a roost/rest point or potentially a third nest location in Cell 4.

3.3 Habitat monitoring

The habitats on site are shown on Figure 5, which also shows target note locations. Target notes are described in Appendix A.

The western side of the site comprises an area of *Phragmites australis* reed bed to its north (Cell 4), which also contains within it stands of tall ruderal vegetation, an area semi-improved neutral grassland, and there had previously been large areas of willow *Salix* spp dominated scrub, however, clearance of this started in 2020 but was not completed due to the nesting bird season. It is due to recommence in Autumn 2022. To the south of this area are improved grassland and arable fields, which are divided by species-poor hedges dominated by hawthorn *Crataegus monogyna* and elder *Sambucus nigra*. Cell 3, located towards the centre of the site, is a mitigation a containing standing water in the form of five artificial scrapes. The vegetation within thi area is species-poor improved grassland which is currently dominated by nettle *Urtica dioica* and creeping thistle *Cirsium arvense* over much of the area with stands of common reed *Phragmites australis* also present. During the 2021 survey, it appeared this area had been topped several times which had restricted the growth of the nettles and thistle. The habitat to the east of the site (Cell 1, 2 and 5) is predominantly comprised of poor semi-improved grassland, with improved fields also present. Detailed descriptions of the habitats, and how they have changed since Year 1 of monitoring (201 provided below.

3.3.1 Woodland and scrub

Scrub

As recorded in the previous years of monitoring, there are areas of scattered wi scrub, which include goat willow *Salix caprea* and grey willow *Salix cinerea*, located amongst the reed bed habitat within Cell 4 (TN1). This scrub habitat is partic

dominant towards the centre of the cell and to the north. It appears that the v encroachment within the reed beds has got worse over the years. In early spring 2020, work started to cut back the scrub encroachment. Around half of the sc removed and used for animal fodder. The works took longer than anticipated and had to be postponed due to the nesting bird season.

There are further areas of scrub scattered around the wind farm, with the earth b that extends around site being vegetated by hawthorn and bramble *Rubus fruticosus agg* in many places. Again, the extent of scrub on the site is not considered to ha undergone a notable change since the previous years of monitoring and the sl species present remain largely unchanged.

Scattered trees

There are few trees around the wind farm site and are pathway to the south of Cell 5 (TN2). There are a number of scattered trees and large shrubs lining the track here including elder *Sambucus nigra*, grey poplar *Populus × canescens* and spindle *Euonymus europaea.* There have been no notable ch the scattered trees on the site since the previous years of monitoring.

3.3.2 Grassland

Semi-improved neutral grassland

There is an area of semi-improved neutral grassland to the northeast of Cell 4 around Turbine 5 (TN3). The habitat in this area had not changed significantly in its spe composition since the previous years of monitoring. During the second year c vegetation in this area appeared to be dead due to the hot and dry conditions over the summer. It appeared to have visibly recovered during year three and suppor species such as common bent *Agrostis capillaris*, cocksfoot *Dactylis glomerata*, yorkshire fog H*olcus lanatus, creeping thistle Cirsium arvense,* common centaury *Centaurium erythraea* and ragwort *Senecio jacobaea* with stands of rosebay willowherb *Chamaenerion angustifolium* and bramble *Rubus fruticosus* also present. This area has become more dominate with tall ruderal species in the last couple of years of monitoring.

Poor semi-improved grassland

The site supports fields of poor semi-improved grassland habitat within Cell 1, 2 and 5, which lie to the east of the wind farm site, and Cell 3 (TN4, TN5, TN6 and TN7). These habitats have remained relatively unchanged since the first year of monitoring and support species such as perennial ryegrass *Lolium perenne*, cock's-foot, creeping bent *Agrostis stolonifera*, white clover and common nettle *Urtica dioica.* Over the last three years of monitoring, it was noted that creeping thistle, spear thistle *Cirsium vulgare* and nettles *Urtica dioica* dominate the area during the summer. An increase in management over the last 18 months of monitoring, meant these species becoming slightly less dominant. However, for this effort to succeed, this increase in management needs to be maintained.

Improved grassland

There is an improved grassland field to the southwest of the site dominated by perennial ryegrass and white clover.

3.3.3 Tall herb and fern

Tall ruderal

There are areas of tall ruderal vegetation across the site, with the most notable being the large swatches of tall ruderal vegetation within the reed bed in Cell 4 (TN9). T species present here include stands dominated by rosebay willowherb *Chamaenerion angustifolium,* great willowherb *Epilobium hirsutum,* creeping thistle and common fleabane *Pulicaria dysenterica.* There are also large stands of tall ruder predominantly thistle and nettle species, within the mitigation cell (Cell 3) (TN8). During the survey It was noted that these areas in Cell 3 had been recently topped and wer not as tall as previously had been. The tall ruderal cover in the reed bed remains similar to previous years in extent and in the species present. Broad leaved dock has remained not an issue this year, but creeping thistle and nettle are becoming increa dominant.

3.3.4 Swamp, marginal and inundation

Swamp

Cell 4 supports an extensive area of dry reed bed, dominated by comm *Phragmites australis* (TN 10) which dominated the west of the cell. The willow scrub encroachment located towards the centre and the east has started a to be remo to enhance the reed beds functioning. The extent of the reed bed habitat had no undergone a visible significant change since the first year of monitoring, although it was difficult to get an accurate idea of reed bed coverage from ground level.

There are smaller areas of reed bed habitat found other parts of the wind farm sit There is dry reed bed, interspersed with tall ruderal and semi-improved grassland, within the mitigation cell (Cell 3) and there are also large stands of common reed four the south of Cell 2 and Cell 5.

3.3.5 Open water

Standing water

In Cell 3, artificial scrapes were excavated to provide habit for wading birds. In ye one and two many of the scrapes were dry due to the particularly hot and dry summ conditions. In the last two surveys, the scrapes were holding water and appeared to be showing signs of being colonised by aquatic marginal vegetation with yellow and a number of rush species recorded (TN11). Some of the smaller scrapes did not hold water during the summer months, however, the larger ones did and supported many wetland birds including good numbers of Black tailed godwit and several species of ducks.

The pond located on the western edge of Cell 3 was holding water during the sur and appeared to be relatively unchanged since the previous years of monitoring, with common reed growing around the margins of the pond and banks vegetated with ruderal species, including bramble, common nettle and scattered scrub of willow a elder.

There are a number of drainage ditches lying at the foot of the species-poor hedges in the southwest of the site, some of which contained shallow areas of standing v

during the survey. Several of these ditches were dredged in 2020 and now hold more water.

3.3.6 Cultivated/disturbed land

Arable

The southwest of the site comprises arable fields and at the time of the survey the supported young maize (TN12).

The fields within this area of the site have remained in a similar condition to the previous years of monitoring as they are still under arable management, with similar crops being grown.

Ephemeral/short perennial

The compacted gravel substrate at the base of each turbine supports an ephemeral/short perennial vegetation (TN13). As noted during the previous years monitoring, the abundance and density of the vegetation differs between each of the turbine bases and some are only very sparsely vegetated. There are a number of low-growing species found here, such as bent Agrostis spp, ragwort, common knotgr *Polygonum aviculare*, chickweed *Stellaria media*, annual meadow-grass *Poa annua* and greater plantain *Plantago major*.

There have been no obvious changes to the vegetation assem
turbines since the previous years of monitoring and the density and cover of the vegetation in these areas has not significantly increased in this time.

3.3.7 Boundaries

Hedgerows

There are both intact and defunct hedgerows found in the ar
fields to the southwest of the survey area. These hedgerows are all considered to be species-poor, with hawthorn dominating and occasional elder. Many of these hedges run parallel alongside artificial drainage ditches, which are dominated by cor reed in some areas and tall ruderal species, such as nettle, in others. The hedgero have remained largely the same since the first and second years of monito however it was noted that a stretch of hedgerow directly to the east of Turbine 12 ha been removed during the third year. But there were no further changes to the he rows during year four and five.

3.3.8 Miscellaneous

Bare ground

As recorded during the first year of monitoring, areas of hardstanding occur at the base of each of the turbines. These are areas of compacted stone which are in the proce of being colonised by ephemeral/short perennial vegetation (see above). An area of hardstanding is also located to the south west corner of the site within the field in which Turbine 11 is located and a substation is located next to Turbine 19 to the east of t site, with an area of hardstanding surrounding it.

Dry ditch

There are dry drainage ditches found across the site. The ditch semi-improved grassland and tall ruderal habitat in Cell 3 was dry at the time of survey, as it was during the previous years of habitat monitoring. This ditch remains relatively unchanged since the first year of monitoring and is still largely dominated by comm reed, with some areas dominated by common nettle and thistle species. A number dry ditches are also found at the foot of the species-poor hedges in the southwest of the site.

4 Discussion

4.1 Bats

4.1.1 Bat activity

As with last year, the species group most commonly recorded in this secon monitoring period was *Nyctalus* spp. There were also large numbers of soprano pipistrelle recorded and small numbers of nathusius' pipistrelle, *Myotis* spp, and brown-long eared bat. Overall, activity for all species was lower in 2021 than in 2020.

A large amount of random noise was recorded by the bat detectors and was ofte automatically allocated to the *Nyctalus* spp. filter. This was because much of the recorded noise shared similar parameters with this type of bat call. An error margin was calculated and applied to the *Nyctalus* spp. results and so it is considered that these results are largely accurate but there may still inevitably be some error present in the reported results.

Bat activity was generally higher in the eastern portion of the wind farm tl western section, as it was during the previous years of monitoring. The pre-construction bat activity levels also showed a strong bias towards to eastern side of the wind far The habitats in this area are largely open agricultural land, which is considered to sub optimal habitat for foraging bats, however there are some linear features within thi area such as the earth bunds bordering the site and the bank that drops down to Manchester Ship Canal, along with a line of trees and ditches towards the south eas The level of activity on this side of the site indicate that bats may use these features t commute to a foraging ground.

The gaps in the bat data this year resulted in a lower number of overall calls, but da from turbines with full season data seems to follow similar trends from 2020.

4.1.2 Bat trials

The bat carcass search team regularly deliver a 100% find rate during ol efficiency trials, and this was the case at Frodsham in 2021.

The predator removal rates varied across the three trial areas. At T17 there were fallen stock and therefore a noticeable large population of scavengers, particularly corvi in the cell. This, coupled with the short sward height would account for a h predator removal rate.

4.1.3 Carcass monitoring

In 2021 no bat carcases were found; therefore the mortality rate is likely too low to be detectable. This is a decrease on the levels of mortality estimated in 2020.

Ornithology

4.1.4 Vantage point surveys

After five years of observation, an understanding of the variability in activity is bei gained; this year continued the same pattern as last year similar levels of activity as the

previous year, which was considered intermediate, lying between the maximum and minimum activity levels. This is positive as it suggests there is no overall decline in activity and numbers are stable.

From the figures, flight activity remains the highest in Cell 6 by birds moving to and from that area. Large numbers of waders were present – the largest flock was a flock of 1500 Black-tailed godwits, but there were also persistently other waders and v observed on and around it. Despite the reduction in breeding Lapwing observed, flocks of Lapwing were still present on Cell 6 and Cell 3.

The flight activity continues to show the most common flight routes using either access across Cell 3 or generally avoiding turbines to enter the Weaver estuary. Shel particularly show a strong flight corridor through the western corridor.

Table 10: Comparison of pre and post construction monitoring

	2014-15		2020-2021		Difference	
	Bird secs/ hour	bird secs at risk/ hour	Bird secs/ hour	bird secs at risk/ hour	Bird secs/ hour	bird secs at risk/ hour
Avocet	2.1	0.2	0	0	-2.1	-0.2
Black-tailed godwit	94.1	45.4	3845.3	857.9	3751.2	812.5
Curlew	2977.2	1639.5	2343.1	2304.1	-634.1	664.6
Dunlin	2572.1	1761.6	148.2	0	-2423.9	-1761.6
Golden plover	9379	6411	290.4	250.7	-9088.6	-6160.3
Green sandpiper	2.8	0	0	0	-2.8	0
Lapwing	153324.4	109610.5	140586.1	69370.7	-12738.3	-40239.8
Marsh Harrier	198.2	46.2	136.7	16.4	-61.5	-29.8
Oystercatcher	6.1	4.2	0.5	0	-5.6	-4.2
Redshank	31.3	10.9	415.9	77.5	384.6	66.6
Ruff	12.3	9.8	0	0	-12.3	-9.8
Shelduck	117.8	31.2	113.5	39.7	-4.3	8.5
Snipe	27.5	19.6	2.7	1.3	-24.8	-18.3
Whimbrel	3.6	0	0	0	-3.6	0
Total	168432.5	119512.7	147882.4	72918.3	-20865.9	-119590.1

The comparison shows that the number of bird seconds for Black-tailed godwit has seen the most significant increase which is not representative to what is happening in wider area. This increase could be attributed to additional shelter during poor weather. Golden plover and Lapwing numbers have seen the most significant dec line. Although, lapwing remain to have large wintering flocks, with a peak count of 6,000 bird season, their breeding numbers have declined significantly. Shelduck at risk seconds have increased, this is possibly due to the fact that the species have changed their flightline to avoid the turbines to reduce risk of collision and can therefore fly within the at-risk height band. Following lockdown, the wind farm saw a big increase ir general public using the footpaths on Site. This could be a contributing factor to the decline in nesting Lapwing, in addition to external factors such as change in land use and general population decline. Shelduck, Black-tailed godwit and Redshank, which are all listed within the Mersey Estuary SPA, saw an increase in bird seconds. Whilst bird

activity for a number of species appears to have declined on the consideration across the region suggests that this is not linked solely to the wind farm but appears to be reflective of what is happening across the estuary, illustrated in the table below[4].

Table 11: WebS – Annual Peaks Mersey Estuary

Species	2014-2015	2019-2020	Difference
Avocet	7	83	76
Black-tailed Godwit	2777	1170	-1607
Curlew	2411	1097	-1314
Dunlin	44271	40966	-3305
Golden Plover	2318	613	-1705
Green Sandpiper	1	3	2
Lapwing	11553	3775	-7778
Oystercatcher	1339	741	-598
Redshank	2684	5140	2456
Ruff	32	12	-20
Shelduck	8999	3590	-5409
Snipe	50	43	-7
Whimbrel	27	7	-20

4.1.5 Breeding birds

The site continues to hold a high density of breeding spe , in 2019, a decline in some species was noticed; it was considered this could be d artefact of analysis, but for some species this decline has continued into 2021. No Avocet were recorded during 2021 surveys, however, Lapwing numbers increa There was also no evidence of Little ringed plover in Cell 6 in two consecutive years.

Lapwing have traditionally been found in the highest numbers in the fields to the sout of the cells; potentially recreational use of some of those fields or changes in management have reduced their suitability – the fields were planted with maize in 2020 which may have had reduced suitability for breeding Lapwing and resulted in no confirmed breeding for that species. Additionally in 2020, the unusual conditions created by Covid also meant recreational use of the site was also greatly increased. In 2021, in the fields south of the cells, there was a Lapwing confirmed nest, although no returning to their previous numbers.

Species which did not continue to show a decline were Cetti's warbler, Gadwall, Lapwing, Linnet and Yellow Wagtail.

Table 12: Comparison of breeding territory estimates 2018-2021

Species	2018	2019	2020	2021
Avocet	1	3	1	0
Bullfinch	0	1	0	0
Cetti'sWarbler	4	7	9	10

[4] https://app.bto.org/webs-reporting/numbers.jsp?locid=LOC656735

Species	2018	2019	2020	2021
Curlew	1	1	1	0
Dunnock	41	9	11	3
Gadwall	12	3	1	2
Grasshopper warbler	3	2	1	1
House Sparrow	1	1	1	0
Kestrel	2	1	0	0
Kingfisher	0	0	1	0
Lapwing	32	10	1	6
Linnet	24	6	3	4
Little Ringed Plover	2	1	0	0
Mallard	16	6	3	2
Meadow Pipit	15	7	3	2
Reed Bunting	47	22	19	11
Ringed Plover	4	1	0	0
Shelduck	16	4	1	0
Shoveler	0	1	0	0
Skylark	58	30	38	26
Song Thrush	13	5	3	3
Starling	1	1	1	0
Stock Dove	2	4	0	0
Yellow Wagtail	1	4	0	1
Yellowhammer	7	1	1	0

4.1.6 Marsh harrier

Marsh harrier continued to be present and presumed to be breeding from the activ observed, but there was much less certainty as to outcomes in 2020 and 2021 due to the reduction in additional monitoring. However, in 2020, there were presumed to be at least two territories present, using the preferred cell locations of 4 and 6 and even some indirect evidence for a second nest in Cell 4. The same was true for 2021 breeding season, both Cell 4 and 6 had marsh harrier territories, with activity recorded during VPs suggested potentially a third nest location in Cell 4.

4.2 Habitat monitoring

The habitats on the Frodsham Wind Farm site are not cor
significantly between the previous years and this fifth year of post-construction monitoring. Last year there were visible changes between some of the habitats during the fourth year of monitoring compared to the previous year which was considered to be due to the variations in climatic conditions between the spring/summer months of each year. The second year of post-construction monitoring was carried out during a year where temperatures were consistently high and rainfall was low. This h obvious visible impact on some of the habitats as a number of mitigation scrapes dried out and many areas of vegetation had died back or were in a visibly poor condi The third year of habitat monitoring was carried out during a summer of comparative higher rainfall and so the mitigation scrapes that were dry during the previous year were holding water and the habitats were in a visibly improved condition with no larg

areas of dead vegetation as during the previous year. Year three saw the colonisation of a number of the mitigation scrapes with a low density of marginal/aquatic plant species and the reduction in the dominance of broad-leaved dock in the mitigation area.

Conditions were mixed during year four, with a heat wave spring/early summer then periods of heavy rainfall mixed with hot weather causing thunderstorms. The mixed conditions meant vegetation grew well. Unfortunately, with creeping thistle and nettles dominating in some areas. Due to an increase in management, the creeping thistle in Cell 3 had not overgrown and remained short throughout the summer as it was regularly cut.

The majority of Cell 2 is generally considered to be favourable condition. The condition of Cell 5 became increasingly unfavourable in year four, with nettles dominating the Cell, the worst areas being at the north and eastern margins of the Cell. The Habitat Creation Management Plan (HCMP) for this area is 'short sward grassland', efforts were increased during year five by regular cutting of these areas have helped to reduce the encroachment of these species. A short sward grassland habitat is favourable for wintering wader species, including golden plover, lapwing and curlew. The a grazed by sheep and cattle all year round and the grassland between these stands nettles would be considered a short sward. During the winter walkover surveys it was noted that the nettles and thistles die back and what is left is a grassland of favourable condition.

Cell 3 saw an improvement on the condition with thistles becoming less dominant. For the condition of this area to continue to improve, this increase in management has to continue indefinitely. In year four the southern side of the cell was dominated by stands of nettle. The northern side of the cell had areas of relatively open poor semi-improved grassland but also supports numerous stands of creeping thistle and occasional stands of spear thistle. The expected outcome for this area, as shown in the HCMP, was to be grazed wet grassland, areas of dry grassland, and a number of shallow pools, scrub bordering the southern edge of the cell. This habitat was designed to provide a high quality roosting, loafing, and feeding areas for wintering wildfowl, however during the previous years of monitoring, management requirements were not being met and so the area is currently considered sub-optimal for the target wildfowl species. However, as previously mentioned, conditions change during the winter months. The thistle die back and leaves suitable roosting and feeding areas. Nonetheless, it would be beneficial to the mitigation area if the encroachment of this species were correctly managed to provide suitable feeding and roosting areas in the summer months. As part of the ecological mitigation measures this habitat should be managed as such grassland and management carried out in previous years has not been successful. Topping of these species has improved this year and has been more regular, however, no spraying has taken place. The increase in topping and the addition of spray would see the area improve for the summer months. With the continued cutting of vegetation in the cells, the planning condition is met however, it has been agreed with the HCMG that management needs to be reviewed, including grazing. Continued monitoring will be carried out in years 6-9 to ensure compliance with planning conditions.

In Cell 4 the HCMP proposed that the reed bed habitat be kept as such for the lifetime of the development and that dry scrub should be prevented from encroaching into the area. During the baseline previous years of post-construction monitoring, it was

apparent that the reed bed habitat was being encroached by tall ruderal species suc as nettle and great willow herb, which dominated the habitat in some areas. It had also been noted that the centre and the northern end of the cell held abundant scrub. During a walkover with the HCMP it was agreed that the reed bed within Cell needed further management. Methods included reedbed cutting and baili phased manner, rewetting areas that have become less wet and scrub removal. The removal of scrub encroachment started, however, due to the nesting bird season, it has been delayed. Plans are to continue scrub management and possibly cut and bail the reed bed to minimise leaf litter.

5 Summary

The habitats on the Frodsham Wind Farm site are not cons o have changed significantly from the previous years of post-construction monitoring. The most notable changes recorded during the survey are thought likely to be attributable to variations i the climatic conditions during the spring and summer months of each year. This year has seen an increase in the management of the thistles and nettles in Cell 3 and 5. This has improved the areas slightly, but for it to be effective, it needs to continue e year. The addition of spraying of these areas would speed up the process. Scrub management in Cell 4 has started and is planned to continue. Management is required to ensure that objectives are being met.

As with last year, the species group most commonly recorded over this fifth-year monitoring period was *Nyctalus* spp. There were also large numbers of soprano pipistrelle recorded and small numbers of Nathusius' pipistrelle, *Myotis* spp, and brown-long eared bat. The level of bat activity was generally higher in the ea portion of the wind farm than the western section, as it was during previous years of monitoring.

The bat collision monitoring continued with trials of both scavenger rates and searcher efficiency. The searches this year returned 0 dead bats. When comparing this data with wider studies of bat deaths in UK wind farms this number appears to be extremely low.

The site continued to hold sensitive breeding species, with Marsh harrier appearing to continue to breed in Cells 6 and 4. The number of Lapwing breeding in the fields to the south of the site appear to have declined, but given the occurrence of non-breeding Lapwing, this does not appear to be linked to the wind farm but could be due to land management practices/changes.

The total number of flights recorded, and the total bird seconds remained stable this year. 2020 saw flight activity between the previously recorded minimum and maximum – this was an increase on the minimum recorded in 2019.

This year saw an increase in Shelduck flight activity, meaning Marsh harrier was the second most recorded species. Flight activity for Shelduck concentrated from the Weaver River to Cell 6. Black-tailed godwit recorded the largest flock with 1,500. Most flights were observed in and around Cells 6 and 3; the wind farm design is therefore working in allowing birds to access Cell 6 safely. While there are ongoing habitat issues in Cell 3, there was still some use of it through the breeding season, although fe breeding records were recorded this year and last.

The comparison table set out in section 4.1.4 shows a change in bird second numbers, with a large rise in Black-tailed godwit and Redshank. Although the comparison table showed a decline in most species, it is unlikely this is due to windfarm activities as records show numbers declining in the wider area also.

6 References

Duffy, K., & Steward, M. (2008). *Turbine search methods and carcass re*
the Braes of Doune windfarm. Natural Research Information Note 4. Banc hory: Natural Research Ltd.

Gilbert, G. G. (1998). *Bird Monitoring Methods.* RSPB: Sandy.

JNCC. (2010). *Handbook for Phase 1 habitat survey - a technique for environmental a ud it.* Peterborough: JNCC.

Matthews, F., Richardson, S., Lintott, P., & Hosken, D. (2016). *Understanding the risk to European protected species (bats) at onshore wind turbine sites to inform ri management. A report by the University of Exeter.*

NE. (2010). *TIN069 Assessing the effects of onshore wind farms on birds.* Natural England.

SNH. (2019). *Bats and onshore wind turbines: Survey, assessment and mitigat* Battleby: SNH.

Young, D., Erickson, W., & Good, R. (2003). *Avian and bat mortality associated with the initial phase of the Foote Creek Rim Wind Power Project, Carbon Coun Wyoming.* Report prepared for: Pacificorp, Inc., Portland, Oregon; SeaWe Windpower Inc., San Diego, California; and Bureau of Land Manage Rawlins District Office, Rawlins, Wyoming.

7 Figures

Figure 1. Site layout and design

Frodsham Wind Farm

Figure 1
Site Location

Key

- Site boundary
- Turbine location

0 200 400 800

Metres

Scale @ A3:
1:15,000

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21/12/2017 TL01a 8702/SL/068a

Drawn by: AA Checked by: JB Approved by: JB

Figure 2. Vantage point viewsheds

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Frodsham Wind Farm

Figure 2
Vantage Point Viewsheds

Key

- Site boundary
- Turbine location
- Woodland
- Vantage Point

VP Viewshed

- VP1
- VP2
- VP3
- VP4

Generated using Ordnance Survey's Terrain 50 dataset that does not take into account the screening effects of buildings.

Observer height 1.5m above ground.
Viewshed height modelled 20m above ground.

Forestry has been used to screen visibility at a height of 10m using the Ordnance Survey OpenMap Local Woodland dataset.

0 200 400 800

Metres

Scale @ A3:
1:15,000

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21/12/2017 TL01c 8702/OR/034a

Drawn by: AA Checked by: TH Approved by: ES

Figure 3. Vantage point flightlines

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Frodsham Wind Farm

Figure 3a
Wader Flightlines
September 2020 - March 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Black-tailed godwit
- Curlew
- Dunlin
- Golden plover
- Snipe
- Redshank

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

0 150 300 600

Metres

Scale @ A3:
1:12,000

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03/06/2021 8702/OR/121a

Drawn by: KM Checked by: TH Approved by: JB

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Frodsham Wind Farm

Figure 3b
Geese and Swan Flightlines
September 2020 - March 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Pink-footed goose
- Mute swan
- Whooper swan
- Greylag goose

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

atmos CONSULTING

0 200 400 800

Metres

Scale @ A3:
1:18,000

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03/ 06/ 2021 8702/ OR/ 122a

Drawn by: KM Checked by: TH Approved by: JB

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Frodsham Wind Farm

Figure 3c
Duck Flightlines
September 2020 - March 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Pintail
- Shelduck
- Shoveler
- Teal
- Gadwall
- Tufted duck

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

atmos CONSULTING

0 150 300 600

Metres

Scale @ A3:
1:12,000

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03/ 06/ 2021 8702/ OR/ 123a

Drawn by: KM Checked by: TH Approved by: JB

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Frodsham Wind Farm

Figure 3d
Raptors and Other Flightlines
September 2020 - March 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Merlin
- Peregrine
- Sparrowhawk
- Little egret

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

0 150 300 600

Metres

Scale @ A3:
1:12,000

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Frodsham Wind Farm

Figure 3e
Marsh Harrier Flightlines
September 2020 - March 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Marsh harrier

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

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Frodsham Wind Farm

0 150 300 600

Metres

Scale @ A3:
1:12,000

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03/ 06/ 2021 8702/ OR/ 125a

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Frodsham Wind Farm

Figure 3f
Lapwing Flightlines
September 2020 - March 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Lapwing

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

0 200 400 800

Metres

Scale @ A3:
1:16,000

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Frodsham Wind Farm

Figure 3g
Canada Goose Flightlines
September 2020 - March 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Canada goose

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

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Frodsham Wind Farm

Hoopoo Gutter

0 150 300 600

Metres

Scale @ A3:
1:12,000

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Drawn by: KM Checked by: TH Approved by: JB

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Frodsham Wind Farm

Figure 3h
Wader Flightlines
April 2021 - October 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Oystercatcher
- Curlew
- Dunlin
- Golden plover
- Snipe
- Redshank
- Ruff

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

0 150 300 600

Metres

Scale @ A3:
1:12,000

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05/ 10/ 2022 8702/ OR/ 128a

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Frodsham Wind Farm

Figure 3i
Geese and Swan Flightlines
April 2021 - October 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Greylag goose
- Mute swan
- Whooper swan

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

0 200 400 800

Metres

Scale @ A3:
1:18,000

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Frodsham Wind Farm

Figure 3j
Duck Flightlines
April 2021 - October 2021

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Frodsham Wind Farm

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Pintail
- Mallard
- Shoveler
- Teal
- Gadwall
- Tufted duck
- Wigeon
- Species 8

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

atmos CONSULTING

0 150 300 600

Metres

Scale @ A3:
1:12,000

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05/10/2022 8702/OR/130a

Drawn by: AF Checked by: TH Approved by: JB

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Frodsham Wind Farm

Figure 3k
Raptors and Other Flightlines
April 2021 - October 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Merlin
- Peregrine
- Coot
- Little grebe
- Common gull
- Herring gull

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

atmos CONSULTING

0 150 300 600

Metres

Scale @ A3:
1:12,000

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Frodsham Wind Farm

Figure 3l
Marsh Harrier Flightlines
April 2021 - October 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Marsh harrier

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

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Frodsham Wind Farm

0 150 300 600

Metres

Scale @ A3:
1:12,000

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Frodsham Wind Farm

Figure 3m
Lapwing Flightlines
April 2021 - October 2021

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Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Lapwing

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

0 200 400 800

Metres

Scale @ A3:
1:16,000

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Frodsham Wind Farm

Figure 3n
Canada Goose Flightlines
April 2021 - October 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Canada goose

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

0 150 300 600

Metres

Scale @ A3:
1:12,000

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Frodsham Wind Farm

Figure 3o
Shelduck Flightlines
April 2021 - October 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Shelduck

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

0 150 300 600
Metres

Scale @ A3:
1:17,000

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Frodsham Wind Farm

Figure 3p
Black-tailed godwit Flightlines
April 2021 - October 2021

Key

- Site boundary
- Turbines
- Vantage Point

Target species registrations

- Black-tailed godwit

Height Band

- Below 20m height
- 20 - 125m height
- Above 125m height
- On ground
- Heard only

0 150 300 600

Metres

Scale @ A3:
1:12,000

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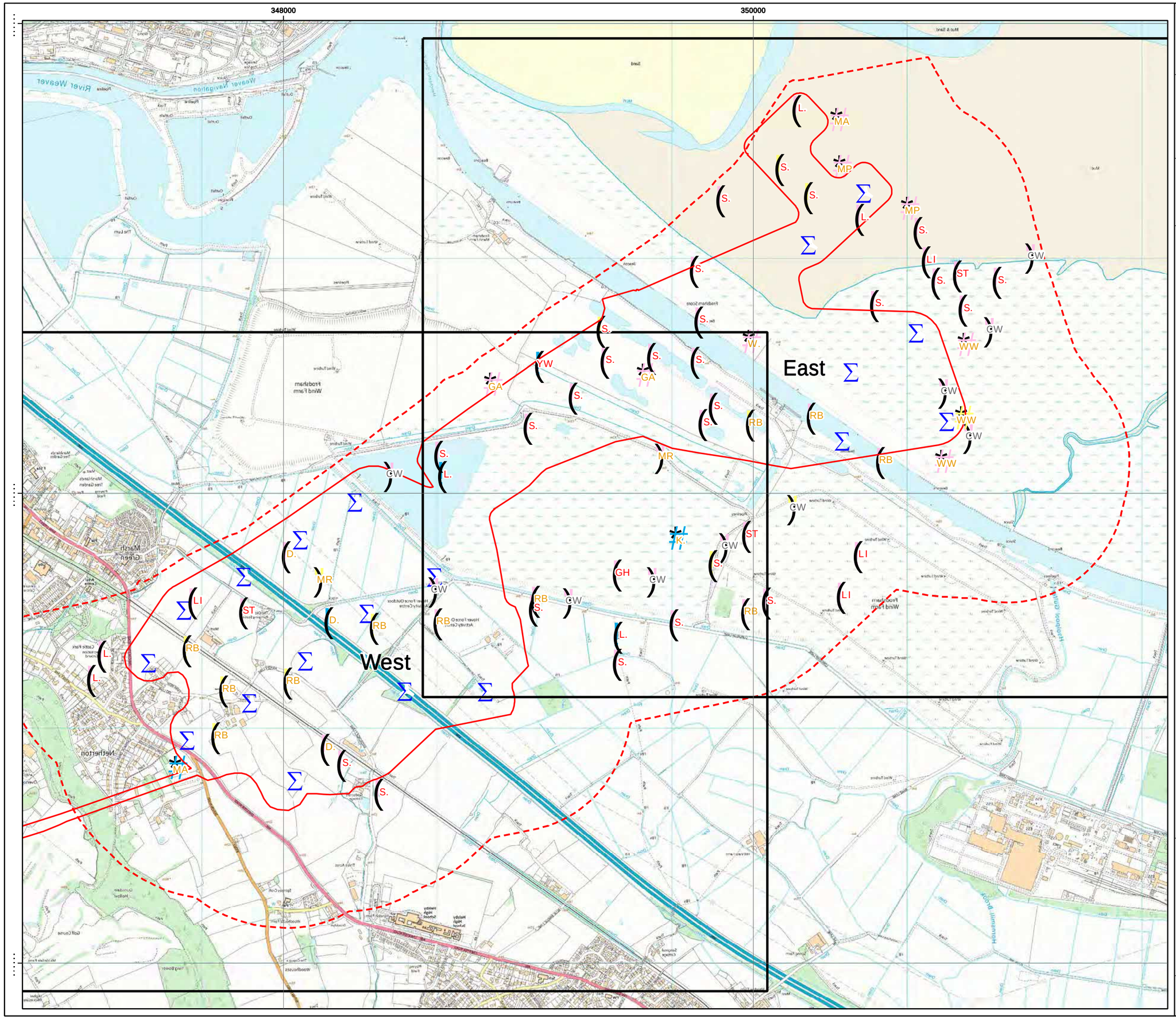
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Drawn by: AF Checked by: TH Approved by: JB

Figure 4. Breeding bird territories 2021

Frodsham Wind Farm

Figure 4
2021 Breeding Bird
Survey Results



Key

- Site boundary
- Turbines
- Survey area

Ca tegory

- Schedule 1/Annex 1
- English Priority Species
- Not designated

Breeding Status

- Confirmed
- Prob ab le
- Possib le

Red listed species - BOCC
Amber listed species - BOCC

0 187.5 375 750
Metres

Scale @ A3:
1:15,000

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Drawn by: AF Checked by: KM Approved by: JB

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Frodsham Wind Farm

Figure 4
2021 Breeding Bird
Survey Results

Key

- Site boundary
- Turbines
- Survey area

Ca tegory

- Schedule 1/Annex 1
- English Priority Species
- Not designated

Breeding Status

- Confirmed
- Prob ab le
- Possib le

Red listed species - BOCC
Amber listed species - BOCC

atmos CONSULTING

0 125 250 500

Me tres

Scale @ A3:
1:10,000

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02/ 09/ 2022 8702/ OR/ 137a

Drawn by: AF Checked by: KM Approved by: JB

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Frodsham Wind Farm

Figure 4
2021 Breeding Bird
Survey Results

Key

- Site boundary
- Turbines
- Survey area

Ca tegory

- Schedule 1/Annex 1
- English Priority Species
- Not designated

Breeding Status

- Confirmed
- Prob ab le
- Possib le

Red listed species - BOCC
Amber listed species - BOCC

0 125 250 500
Me tres

Scale @ A3:
1:10,000

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Drawn by: AF Checked by: KM Approved by: JB

Figure 5. Phase I habitat survey results

Frodsham Wind Farm

Figure 5
Phase 1 Habitat Survey Results

Key

- Survey area
- Target Note
- ! Broadleaf tree
- Intact hedge - species-poor
- Defunct hedge - species-poor
- D Scrub - scattered
- SI Neutral grassland - semi-improved
- I Improved grassland
- SI Poor semi-improved grassland
- Other tall herb and fern - ruderal
- Swamp
- Standing water
- A Cultivated/disturbed land - arable
- Bare ground

0 125 250 500
Metres

Scale @ A3:
1:12,500

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12/08/2022 8702/HB/080b
Drawn by: JT Checked by: TH Approved by: FM

Figure 6. Habitat Management

Appendices

Appendix A. Phase I habitat survey target notes

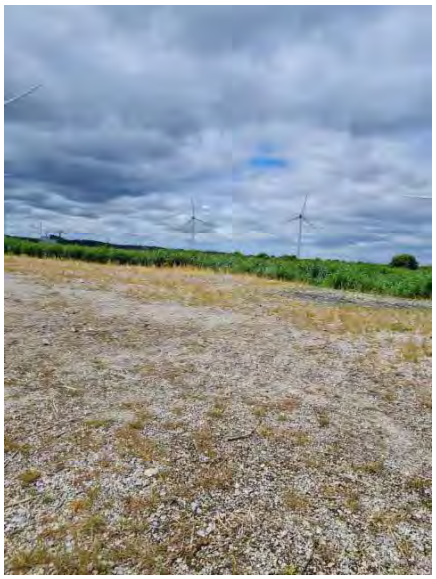
Target note description	Plate
Target note 1. Area of reed bed with encroaching willow scrub. Grey willow *Salix cinerea* and goat willow *Salix caprea* are dominant species here.	
Target note 2. Scattered trees along track. Prominent species include elder *Sambucus nigra*, willow *Salix* spp, grey poplar *Populus x canescens* and spindle *Euonymus europaea*. The vegetatic the edge of the track is comprised of tall ruderal vegetation, including common nettle *Urtica dioica*, mugwort *Artemisia vulgaris*, sow thistle *Sonchus* spp and spear thistle *Cirsium vulgare*, interspersed with common reed *Phragmites australis*	

Target note description	Plate
Target note 3. Area of semi-improved neutral grassland with species including common bent *Agrostis capillaris*; Yorkshire fog H*olcus lanatus*; red bartsia *Odontites vernus*; creeping thistle *Cirsium arvense*, false oat-grass *Arrehenatherum elatius*; white clover *Trifolium repens*; common centaury *Centaurium erythraea,* cock's-foot *Dactylis glomerata*, creeping bent *Agrostis stolonifera*, red fescue *Festuca rubra* and silverweed *Potentilla anserina* with small areas of hard rush *Juncus inflexus*. Patches of rosebay willowherb *Chamaenerion angustifolium* and bramble *Rubus fruticosus*were also present.	
Target note 4. Poor semi-improved grassland habita surrounding turbine 15. Perennial ryegrass *Lolium perenne* dominates with timothy *Phleum pratense* and cock's-foot *Dactylis glomerata* also present.	

Target note description	Plate
Target note 5. Abundant creeping thistle *Cirsium arvense* and frequent common nettle stands in p semi-improved grassland forming a tall ruderal-grassland mosaic habitat. The area had been topped at the time of the survey. Other species present include cock's-foot *Dactylis glomerata*, perennial ryegrass *Lolium perenne*, bent *Agrostis* spp, couch *Elymus repens*, white clover *Trifolium repens* and crested dog's-tail *Cynosurus cristatus.*	
Target note 6. Improved grassland habitat with perennial ryegrass *Lolium perenne* and white clover *Trifolium repens* dominating. Mugwort *Artemisia vulgaris* dominates around the field perimeter.	
Target note 7. Some fields had been cut for hay.	

Target note description	Plate
Target note 8. Thistle had reduced in Cell 3 due to increased management.	
Target note 9. Common reed *Phragmites australis* bed in the area surrounding turbine 6. The short ephemeral/perennial community becomes more diverse as it moves away from the turbine base with the following species present: Canadian fleabane *Conyza canadensis*; bird's-foot trefoil *Lotus corniculatus*; white campion *Silene latifolia*, scarlet pimpernel *Anagallis arvensis*; broad-leaved dock *Rumex obtusifolius*; common toadflax *Linaria vulgaris*; marsh foxtail *Alopecurus geniculatus*, scentless mayweed *Tripleurospermum inodorum*, black horehound *Ballota nigra* and white clover *Trifolium repens.*	

Target note description	Plate
Target note 10. Area of *Phragmites australis* reedbed with scattered trees and stands of tall ruderal.	
Target note 11. Mitigation scrape within Cell 3. With only a small amount of aquatic vegetation or marginal vegetation present in these scrapes.	

Target note description	Plate
Target note 12. Arable fields containing maize crop to the south west of the site. The fields are divided by species-poor hedgerows that vary in condition from intact to defunct and are dominated by hawthorn *Crataegus monogyna*. Artificial ditches are located at the foot of the hedgerows and are dominated by common reed *Phragmites australis*, with tall ruderal vegetation also occurring.	
Target note 13. Short ephemeral/perennial vegetation growing around the base of turbine 6. Species include dominant orache *Atriplex* spp and abundant common knotgrass *Polygonum aviculare*, with frequent creeping bent *Agrostis stolonifera* and annual meadow grass *Poa annua*, and occasional weld *Reseda luteola*, spear thistle *Cirsium vulgare* and common nettle, with perennial ryegrass dominating directly below the turbine base.	

Appendix B. Vantage Point Visit details

Table 13: Vantage Point Visit Records for Frodsham between 06/04/2021 and 19/10/2021

Survey Date	Start Time	Finish Time	Duration	Surveyor	VP Type	VP Number
06/04/2021	09:15	11:25	02:10:00	C. Collingwood	Diurnal	3
06/04/2021	11:45	13:45	02:00:00	C. Collingwood	Diurnal	4
06/04/2021	14:22	16:22	02:00:00	C. Collingwood	Diurnal	2
07/04/2021	10:45	12:45	02:00:00	C. Collingwood	Diurnal	2
07/04/2021	13:00	15:00	02:00:00	C. Collingwood	Diurnal	3
08/04/2021	09:45	11:45	02:00:00	C. Collingwood	Diurnal	3
08/04/2021	12:15	14:15	02:00:00	C. Collingwood	Diurnal	1
08/04/2021	14:35	16:35	02:00:00	C. Collingwood	Diurnal	4
09/04/2021	10:20	12:20	02:00:00	C. Collingwood	Diurnal	2
09/04/2021	13:00	15:00	02:00:00	C. Collingwood	Diurnal	1
29/04/2021	10:55	12:55	02:00:00	N. Robinson	Diurnal	4
29/04/2021	13:26	15:26	02:00:00	N. Robinson	Diurnal	1
05/05/2021	09:45	11:45	02:00:00	C. Collingwood	Diurnal	3
05/05/2021	11:57	13:57	02:00:00	C. Collingwood	Diurnal	2
05/05/2021	14:20	16:20	02:00:00	C. Collingwood	Diurnal	4
07/05/2021	09:20	11:20	02:00:00	N. Robinson	Diurnal	4
07/05/2021	12:00	14:00	02:00:00	N. Robinson	Diurnal	1
13/05/2021	12:40	14:40	02:00:00	N. Robinson	Diurnal	3
13/05/2021	15:20	17:20	02:00:00	N. Robinson	Diurnal	4
17/05/2021	09:00	11:00	02:00:00	N. Robinson	Diurnal	1
17/05/2021	11:40	13:40	02:00:00	N. Robinson	Diurnal	3
17/05/2021	14:20	16:20	02:00:00	N. Robinson	Diurnal	2
28/05/2021	10:10	12:10	02:00:00	C. Collingwood	Diurnal	2
28/05/2021	12:40	14:40	02:00:00	C. Collingwood	Diurnal	1
02/06/2021	16:25	18:25	02:00:00	N. Robinson	Diurnal	1
02/06/2021	18:45	20:45	02:00:00	N. Robinson	Diurnal	4
03/06/2021	10:40	12:40	02:00:00	C. Collingwood	Diurnal	3
03/06/2021	12:50	14:50	02:00:00	C. Collingwood	Diurnal	2
03/06/2021	15:35	17:35	02:00:00	C. Collingwood	Diurnal	4
11/06/2021	10:00	12:00	02:00:00	N. Robinson	Diurnal	2
11/06/2021	12:30	14:30	02:00:00	N. Robinson	Diurnal	3
11/06/2021	15:00	17:00	02:00:00	N. Robinson	Diurnal	1
16/06/2021	09:50	11:50	02:00:00	N. Robinson	Diurnal	1
21/06/2021	08:27	10:27	02:00:00	N. Robinson	Diurnal	4
21/06/2021	11:05	13:05	02:00:00	N. Robinson	Diurnal	2
21/06/2021	14:15	16:15	02:00:00	N. Robinson	Diurnal	3
07/07/2021	08:30	10:30	02:00:00	C. Collingwood	Diurnal	3

Survey Date	Start Time	Finish Time	Duration	Surveyor	VP Type	VP Number
07/07/2021	10:40	12:40	02:00:00	C. Collingwood	Diurnal	2
22/07/2021	18:15	20:15	02:00:00	N. Robinson	Dusk	1
23/07/2021	09:30	11:30	02:00:00	C. Collingwood	Diurnal	3
23/07/2021	11:37	13:37	02:00:00	C. Collingwood	Diurnal	2
23/07/2021	14:00	16:00	02:00:00	C. Collingwood	Diurnal	1
26/07/2021	07:30	09:30	02:00:00	N. Robinson	Diurnal	4
26/07/2021	10:15	12:15	02:00:00	N. Robinson	Diurnal	3
27/07/2021	11:00	13:00	02:00:00	N. Robinson	Diurnal	4
28/07/2021	10:00	12:00	02:00:00	N. Robinson	Diurnal	1
28/07/2021	12:30	14:30	02:00:00	N. Robinson	Diurnal	4
28/07/2021	15:25	17:25	02:00:00	N. Robinson	Diurnal	2
02/08/2021	15:15	17:15	02:00:00	N. Robinson	Diurnal	1
03/08/2021	12:45	14:45	02:00:00	N. Robinson	Diurnal	4
03/08/2021	15:05	17:05	02:00:00	N. Robinson	Diurnal	2
06/08/2021	08:45	10:45	02:00:00	C. Collingwood	Diurnal	3
06/08/2021	10:50	12:50	02:00:00	C. Collingwood	Diurnal	2
09/08/2021	15:15	17:15	02:00:00	N. Robinson	Diurnal	4
09/08/2021	17:45	19:45	02:00:00	N. Robinson	Diurnal	1
12/08/2021	14:30	16:30	02:00:00	C. Collingwood	Diurnal	2
12/08/2021	16:38	17:38	01:00:00	C. Collingwood	Diurnal	3
13/08/2021	13:15	15:15	02:00:00	C. Collingwood	Diurnal	1
16/08/2021	14:55	15:55	01:00:00	C. Collingwood	Diurnal	3
18/08/2021	08:56	10:56	02:00:00	C. Collingwood	Diurnal	4
24/08/2021	16:15	18:15	02:00:00	C. Collingwood	Diurnal	3
03/09/2021	09:20	11:20	02:00:00	N. Robinson	Diurnal	3
03/09/2021	11:50	13:50	02:00:00	N. Robinson	Diurnal	2
03/09/2021	14:20	16:20	02:00:00	N. Robinson	Diurnal	1
06/09/2021	09:30	11:30	02:00:00	N. Robinson	Diurnal	1
06/09/2021	12:00	14:00	02:00:00	N. Robinson	Diurnal	4
06/09/2021	14:30	16:30	02:00:00	N. Robinson	Diurnal	2
09/09/2021	08:45	10:45	02:00:00	C. Collingwood	Diurnal	4
09/09/2021	11:15	13:15	02:00:00	C. Collingwood	Diurnal	3
13/09/2021	10:15	12:15	02:00:00	N. Robinson	Diurnal	3
13/09/2021	13:30	15:30	02:00:00	N. Robinson	Diurnal	4
13/09/2021	16:00	18:00	02:00:00	N. Robinson	Diurnal	1
23/09/2021	13:00	15:00	02:00:00	N. Robinson	Diurnal	2
04/10/2021	10:15	12:15	02:00:00	N. Robinson	Diurnal	2
04/10/2021	12:45	14:45	02:00:00	N. Robinson	Diurnal	3
04/10/2021	15:15	17:15	02:00:00	N. Robinson	Diurnal	1
06/10/2021	11:49	13:49	02:00:00	N. Robinson	Diurnal	4
06/10/2021	14:20	16:20	02:00:00	N. Robinson	Diurnal	1
13/10/2021	13:30	15:30	02:00:00	N. Robinson	Diurnal	4
13/10/2021	15:50	17:50	02:00:00	N. Robinson	Diurnal	1

Survey Date	Start Time	Finish Time	Duration	Surveyor	VP Type	VP Number
15/10/2021	08:15	10:15	02:00:00	N. Robinson	Diurnal	3
15/10/2021	10:45	12:45	02:00:00	N. Robinson	Diurnal	2
15/10/2021	13:30	15:30	02:00:00	N. Robinson	Diurnal	4
19/10/2021	09:15	11:15	02:00:00	C. Collingwood	Diurnal	3
19/10/2021	11:25	13:25	02:00:00	C. Collingwood	Diurnal	2

Weather details for Vantage Point Surveys

Table 14: Vantage Point Weather Summary for Frodsham between 06/04/2021 and 19/10/2021

Survey Date	VP Number	VP Type	Mean Cloud Cover (eights)	Modal Visibility	Modal Precipitation	Mean Temperature (°C)	Mean Wind Speed (Beaufort Scale)	Modal Wind Direction
06/04/2021	2	Diurnal	3	> 2km	None	5	4	NNW
			3	> 2km	None	5	4	NW
	3	Diurnal	3	> 2km	None	3	3	NNW
	4	Diurnal	3	> 2km	None	5	4	NW
07/04/2021	2	Diurnal	8	> 2km	None	4	2	NNW
	3	Diurnal	7	> 2km	None	5	2	NW
08/04/2021	1	Diurnal	7	> 2km	None	10	3	WSW
	3	Diurnal	7	> 2km	None	8	2	SW
09/04/2021	1	Diurnal	4	> 2km	None	9	2	NW
	2	Diurnal	6	> 2km	None	7	2	WNW
29/04/2021	1	Diurnal	7	1km - 2km	Light Intermittent	10	2	NW
	4	Diurnal	5	> 2km	None	13	1	N
05/05/2021	2	Diurnal	6	> 2km	Light Persistent	6	1	NNW
			6	> 2km	Light Persistent	6	1	NW
			6	> 2km	Light Persistent	6	1	WNW
	3	Diurnal	6	> 2km	Light Intermittent	6	1	W
	4	Diurnal	5	> 2km	None	6	2	WNW
07/05/2021	1	Diurnal	4	> 2km	None	9	2	W
	4	Diurnal	5	1km - 2km	None	10	2	W
13/05/2021	3	Diurnal	6	> 2km	None	11	3	WNW
	4	Diurnal	7	1km - 2km	Light Intermittent	12	3	NNW
17/05/2021	1	Diurnal	6	> 2km	None	14	3	WNW
	2	Diurnal	3	> 2km	None	14	2	WNW

	3	Diurnal	3	> 2km	None	11	4	ESE
28/05/2021	1	Diurnal	8	> 2km	Light Intermittent	15	1	ENE
	2	Diurnal	8	> 2km	None	14	1	N
			8	> 2km	None	14	1	NNE
02/06/2021	1	Diurnal	7	> 2km	None	22	1	N
	4	Diurnal	8	1km - 2km	Light Intermittent	18	1	N
03/06/2021	2	Diurnal	7	> 2km	None	17	1	NNW
			7	> 2km	None	17	1	NW
	3	Diurnal	8	> 2km	None	17	1	NNW
			8	> 2km	None	17	1	SSW
	4	Diurnal	7	> 2km	None	18	1	N
11/06/2021	1	Diurnal	4	> 2km	None	19	2	NW
	2	Diurnal	5	> 2km	None	17	2	WSW
	3	Diurnal	4	> 2km	None	19	3	WSW
16/06/2021	1	Diurnal	5	> 2km	None	19	2	WSW
21/06/2021	2	Diurnal	7	> 2km	None	16	2	ENE
	3	Diurnal	8	> 2km	None	15	2	NE
	4	Diurnal	7	> 2km	None	15	1	ENE
07/07/2021	2	Diurnal	6	> 2km	None	17	2	WSW
	3	Diurnal	7	> 2km	Light Intermittent	16	1	W
			7	> 2km	Light Intermittent	16	1	WNW
22/07/2021	1	Dusk	4	> 2km	None	26	1	N
23/07/2021	1	Diurnal	7	> 2km	None	25	2	E
	2	Diurnal	2	> 2km	None	25	3	ESE
	3	Diurnal	3	> 2km	None	23	3	SE
26/07/2021	3	Diurnal	4	> 2km	None	26	2	SE
	4	Diurnal	5	> 2km	None	16	1	SSW
27/07/2021	4	Diurnal	7	1km - 2km	Light Intermittent	22	1	WSW
28/07/2021	1	Diurnal	5	> 2km	None	19	3	NE
	2	Diurnal	6	> 2km	None	16	3	NE
	4	Diurnal	6	> 2km	Light Intermittent	18	2	NE

02/08/2021	1	Diurnal	5	> 2km	None	17	2	SE
03/08/2021	2	Diurnal	4	> 2km	None	24	2	SW
	4	Diurnal	4	> 2km	None	24	1	S
06/08/2021	2	Diurnal	6	> 2km	None	17	3	WSW
	3	Diurnal	8	1km - 2km	Light Persistent	16	3	SW
09/08/2021	1	Diurnal	4	> 2km	None	18	3	NE
	4	Diurnal	4	> 2km	None	21	2	NE
12/08/2021	2	Diurnal	6	> 2km	None	20	3	WSW
	3	Diurnal	7	> 2km	None	20	3	WSW
13/08/2021	1	Diurnal	4	> 2km	None	20	5	W
16/08/2021	3	Diurnal	4	> 2km	None	20	5	W
18/08/2021	4	Diurnal	8	> 2km	None	14	2	WNW
24/08/2021	3	Diurnal	8	> 2km	None	20	1	E
03/09/2021	1	Diurnal	8	> 2km	None	21	2	E
	2	Diurnal	8	> 2km	None	20	2	E
	3	Diurnal	7	> 2km	None	14	1	E
06/09/2021	1	Diurnal	7	> 2km	Light Intermittent	20	1	W
	2	Diurnal	3	> 2km	None	26	2	NW
	4	Diurnal	4	> 2km	None	21	2	WNW
09/09/2021	4	Diurnal	8	1km - 2km	None	18	1	SSW
13/09/2021	1	Diurnal	8	> 2km	None	17	3	SE
	3	Diurnal	8	> 2km	None	14	3	ESE
	4	Diurnal	7	> 2km	None	16	1	ESE
23/09/2021	2	Diurnal	6	> 2km	None	17	3	WNW
04/10/2021	1	Diurnal	5	> 2km	None	12	3	NNE
	2	Diurnal	5	> 2km	None	12	3	NE

	3	Diurnal	7	> 2km	Light Intermittent	13	2	NNE
06/10/2021	1	Diurnal	5	> 2km	None	15	1	WNW
	4	Diurnal	3	> 2km	None	15	1	E
13/10/2021	1	Diurnal	7	> 2km	None	12	2	NE
	4	Diurnal	7	> 2km	None	15	2	ENE
15/10/2021	2	Diurnal	2	> 2km	None	12	1	ENE
	3	Diurnal	0	> 2km	None	9	1	ENE
	4	Diurnal	4	> 2km	None	12	1	E
19/10/2021	2	Diurnal	8	> 2km	None	17	3	SSW
	3	Diurnal	8	> 2km	Light Persistent	16	3	SSW

Appendix C. Target bird flight record details

Table 15: Target Bird Flight Records for Frodsham between 06/04/2021 and 19/10/2019.

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
06/04/2021	Lapwing	4	12:09	1	B	30	30	30	Standard
06/04/2021	Lapwing	4	12:10	1	B	30	30	30	Standard
06/04/2021	Lapwing	4	12:43	1	A	16	0	14	Standard
06/04/2021	Marsh harrier	3	10:57	1	A	63	0	10	Standard
06/04/2021	Marsh harrier	3	11:03	2	A	205	0	10	Standard
06/04/2021	Marsh harrier	3	11:03	2	A	130	0	10	Standard
06/04/2021	Marsh harrier	4	12:09	1	A	188	0	10	Standard
06/04/2021	Marsh harrier	4	12:18	1	A	16	0	5	Standard
06/04/2021	Marsh harrier	4	12:27	1	A	203	0	5	Standard
07/04/2021	Marsh harrier	2	12:02	1	A	69	0	5	Standard
07/04/2021	Marsh harrier	3	13:28	1	A	133	0	5	Standard
07/04/2021	Marsh harrier	3	13:43	1	A	70	0	5	Standard
07/04/2021	Marsh harrier	3	14:39	1	A	148	0	10	Standard
08/04/2021	Black-tailed godwit	4	13:58	1	B	93	93	50	Standard
08/04/2021	Canada goose	1	12:20	1	B	87	87	20	Standard
08/04/2021	Canada goose	1	12:48	7	A	10	0	5	Standard
08/04/2021	Canada goose	1	13:01	2	A	10	0	5	Standard
08/04/2021	Canada goose	1	13:06	2	A	16	0	10	Standard

08/04/2021	Canada goose	1	13:21	2	A	8	0	5	Standard
08/04/2021	Canada goose	1	13:24	2	B	91	182	60	Standard
08/04/2021	Canada goose	1	13:58	2	A	29	0	15	Standard
08/04/2021	Canada goose	1	14:08	4	A	10	0	5	Standard
08/04/2021	Canada goose	4	15:44	2	A	19	0	10	Standard
08/04/2021	Golden plover	1	13:37	30	A	22	0	10	Standard
08/04/2021	Greylag goose	4	15:08	10	B	308	3080	50	Standard
08/04/2021	Greylag goose	4	16:06	19	B	276	5244	60	Standard
08/04/2021	Marsh harrier	3	11:00	1	A	101	0	10	Standard
08/04/2021	Peregrine	3	10:39	1	A	14	0	125	Standard
08/04/2021	Peregrine	3	10:39	1	B	60	60	125	Standard
08/04/2021	Peregrine	3	10:39	1	C	330	0	125	Standard
08/04/2021	Shelduck	1	12:53	2	B	96	192	60	Standard
08/04/2021	Shelduck	1	12:54	2	B	83	166	60	Standard
08/04/2021	Shelduck	1	13:04	2	B	75	150	60	Standard
08/04/2021	Shelduck	4	15:05	2	A	31	0	15	Standard
08/04/2021	Shelduck	4	15:20	2	B	47	94	20	Standard
08/04/2021	Shelduck	4	15:50	2	B	124	248	60	Standard
08/04/2021	Shoveler	1	13:42	1	B	96	96	60	Standard
08/04/2021	Snipe	4	15:28	1	A	10	0	15	Standard
09/04/2021	Canada goose	1	13:49	1	A	8	0	5	Standard
09/04/2021	Canada goose	1	14:04	2	A	16	0	15	Standard
09/04/2021	Canada goose	1	14:11	1	A	8	0	5	Standard
09/04/2021	Canada goose	1	14:28	2	A	32	0	15	Standard

09/04/2021	Canada goose	1	14:45	2	A	6	0	5	Standard
09/04/2021	Canada goose	1	14:58	3	A	21	0	5	Standard
09/04/2021	Lapwing	1	14:37	30	A	58	0	5	Standard
09/04/2021	Lapwing	1	14:53	18	A	27	0	15	Standard
09/04/2021	Marsh harrier	2	10:40	1	B	96	96	30	Standard
09/04/2021	Marsh harrier	2	11:28	1	A	59	0	10	Standard
09/04/2021	Marsh harrier	2	11:28	1	A	99	0	10	Standard
29/04/2021	Black-tailed godwit	1	13:30	7	B	22	154	20	Standard
29/04/2021	Black-tailed godwit	4	11:40	40	A	3	0	2	Standard
29/04/2021	Black-tailed godwit	4	12:02	25	A	5	0	4	Standard
29/04/2021	Canada goose	1	13:59	4	B	12	48	20	Standard
29/04/2021	Herring gull	1	14:25	1	A	24	0	13	Standard
29/04/2021	Herring gull	4	12:07	2	B	35	70	25	Standard
29/04/2021	Lapwing	4	11:36	2	A	3	0	3	Standard
29/04/2021	Lapwing	4	11:55	2	A	15	0	2	Standard
29/04/2021	Lapwing	4	12:00	3	B	53	159	25	Standard
29/04/2021	Mallard	1	13:58	3	A	43	0	10	Standard
29/04/2021	Marsh harrier	4	11:08	2	A	80	0	10	Standard
29/04/2021	Marsh harrier	4	11:08	2	B	31	62	22	Standard
29/04/2021	Merlin	4	10:53	1	A	8	0	3	Incidental
29/04/2021	Mute swan	4	12:55	4	A	14	0	18	Standard
29/04/2021	Shelduck	1	14:12	2	B	17	34	25	Standard
29/04/2021	Shelduck	1	14:21	2	A	15	0	8	Standard

29/04/2021	Shelduck	1	15:03	2	A	22	0	16	Standard
29/04/2021	Shelduck	1	15:25	2	A	16	0	17	Standard
29/04/2021	Shelduck	4	11:54	1	A	32	0	7	Standard
29/04/2021	Shelduck	4	12:27	2	A	39	0	12	Standard
29/04/2021	Shelduck	4	12:35	2	A	18	0	16	Standard
29/04/2021	Shoveler	4	11:30	2	A	5	0	2	Standard
05/05/2021	Lapwing	4	14:28	1	A	23	0	3	Standard
05/05/2021	Lapwing	4	14:36	1	A	101	0	10	Standard
05/05/2021	Lapwing	4	15:11	3	A	61	0	18	Standard
05/05/2021	Marsh harrier	3	10:19	1	A	26	0	10	Standard
05/05/2021	Marsh harrier	3	10:56	1	A	118	0	10	Standard
05/05/2021	Marsh harrier	3	10:58	1	A	3	0	5	Standard
07/05/2021	Black-tailed godwit	4	10:56	350	A	9	0	5	Standard
07/05/2021	Common gull	1	12:23	1	B	57	57	35	Standard
07/05/2021	Herring gull	4	10:00	1	A	11	0	17	Standard
07/05/2021	Herring gull	4	10:02	2	A	9	0	19	Standard
07/05/2021	Herring gull	4	11:04	3	A	30	0	18	Standard
07/05/2021	Herring gull	4	11:04	3	B	9	27	28	Standard
07/05/2021	Lapwing	4	09:23	1	A	20	0	7	Standard
07/05/2021	Lapwing	4	09:28	2	A	35	0	13	Standard
07/05/2021	Lapwing	4	10:04	1	A	12	0	10	Standard
07/05/2021	Lapwing	4	10:08	1	A	43	0	5	Standard
07/05/2021	Lapwing	4	10:08	1	B	18	18	25	Standard

07/05/2021	Marsh harrier	1	13:17	1	A	101	0	8	Standard
07/05/2021	Marsh harrier	1	13:17	1	B	55	55	25	Standard
07/05/2021	Marsh harrier	4	10:54	1	A	67	0	4	Standard
07/05/2021	Mute swan	1	12:32	3	A	72	0	18	Standard
07/05/2021	Shelduck	1	12:29	1	A	53	0	15	Standard
07/05/2021	Shelduck	1	12:52	2	A	62	0	9	Standard
07/05/2021	Shelduck	1	13:25	2	A	31	0	10	Standard
07/05/2021	Shelduck	4	09:21	2	A	7	0	2	Standard
07/05/2021	Shelduck	4	09:32	6	A	6	0	4	Standard
07/05/2021	Shelduck	4	10:27	4	A	76	0	10	Standard
07/05/2021	Shelduck	4	10:27	4	B	100	400	80	Standard
07/05/2021	Shelduck	4	10:40	8	A	60	0	15	Standard
07/05/2021	Shelduck	4	10:40	8	B	62	496	65	Standard
07/05/2021	Shelduck	4	10:46	7	A	27	0	15	Standard
07/05/2021	Shelduck	4	10:46	7	B	15	105	30	Standard
07/05/2021	Shelduck	4	11:06	4	A	11	0	10	Standard
07/05/2021	Shelduck	4	11:06	4	B	27	108	32	Standard
07/05/2021	Teal	4	09:32	10	A	5	0	4	Standard
13/05/2021	Black-tailed godwit	4	16:23	70	A	53	0	3	Standard
13/05/2021	Black-tailed godwit	4	17:00	70	A	14	0	10	Standard
13/05/2021	Black-tailed godwit	4	17:00	70	B	6	420	25	Standard
13/05/2021	Common gull	4	17:10	1	A	13	0	15	Standard
13/05/2021	Herring gull	3	14:17	1	A	22	0	8	Standard

13/05/2021	Herring gull	4	16:11	1	A	41	0	19	Standard
13/05/2021	Lapwing	4	15:40	1	A	9	0	18	Standard
13/05/2021	Lapwing	4	16:02	1	A	21	0	8	Standard
13/05/2021	Lapwing	4	16:16	1	A	3	0	1	Standard
13/05/2021	Marsh harrier	3	13:10	1	A	45	0	4	Standard
13/05/2021	Marsh harrier	4	15:28	1	A	115	0	2	Standard
13/05/2021	Marsh harrier	4	16:01	1	A	276	0	3	Standard
13/05/2021	Ruff	4	16:16	1	A	3	0	1	Standard
13/05/2021	Shelduck	3	12:54	2	A	39	0	5	Standard
13/05/2021	Shelduck	3	14:26	4	A	10	0	18	Standard
13/05/2021	Shelduck	3	14:26	4	B	51	204	22	Standard
13/05/2021	Shelduck	4	15:29	1	A	52	0	15	Standard
13/05/2021	Shelduck	4	15:48	2	A	16	0	7	Standard
13/05/2021	Shelduck	4	16:57	2	A	24	0	8	Standard
13/05/2021	Teal	4	15:30	2	A	18	0	4	Standard
17/05/2021	Common gull	2	15:01	1	A	6	0	15	Standard
17/05/2021	Common gull	3	13:00	1	A	11	0	10	Standard
17/05/2021	Lapwing	1	10:02	1	A	23	0	7	Standard
17/05/2021	Lapwing	2	14:26	1	A	7	0	6	Standard
17/05/2021	Marsh harrier	2	15:40	1	A	48	0	4	Standard
17/05/2021	Marsh harrier	2	16:00	1	A	121	0	4	Standard
17/05/2021	Marsh harrier	2	16:12	1	A	10	0	6	Standard
17/05/2021	Marsh harrier	3	12:19	1	A	208	0	4	Standard
17/05/2021	Shelduck	1	09:27	2	A	27	0	7	Standard

17/05/2021	Shelduck	1	09:29	3	A	63	0	13	Standard
17/05/2021	Shelduck	1	09:29	3	B	75	225	22	Standard
17/05/2021	Shelduck	1	09:34	1	A	8	0	10	Standard
17/05/2021	Shelduck	1	09:34	1	B	37	37	20	Standard
17/05/2021	Shelduck	1	10:04	2	A	29	0	15	Standard
17/05/2021	Shelduck	1	10:08	1	A	28	0	12	Standard
17/05/2021	Shelduck	1	10:08	1	A	31	0	15	Standard
17/05/2021	Shelduck	1	10:10	2	A	9	0	4	Standard
17/05/2021	Shelduck	1	10:27	2	A	12	0	10	Standard
17/05/2021	Shelduck	1	10:52	2	A	33	0	16	Standard
17/05/2021	Shelduck	1	10:52	4	A	23	0	18	Standard
28/05/2021	Canada goose	1	13:11	4	A	16	0	5	Standard
28/05/2021	Canada goose	1	14:12	2	A	12	0	5	Standard
28/05/2021	Lapwing	1	14:35	2	B	30	60	40	Standard
28/05/2021	Marsh harrier	2	11:06	1	A	10	0	10	Standard
28/05/2021	Shelduck	1	13:30	2	B	48	96	40	Standard
28/05/2021	Shelduck	1	13:31	1	B	59	59	40	Standard
28/05/2021	Shelduck	1	14:39	1	B	20	20	20	Standard
02/06/2021	Black-tailed godwit	4	18:58	130	A	54	0	8	Standard
02/06/2021	Black-tailed godwit	4	19:35	90	A	38	0	10	Standard
02/06/2021	Black-tailed godwit	4	19:42	40	A	24	0	14	Standard
02/06/2021	Gadwall	1	17:34	1	A	5	0	5	Standard
02/06/2021	Gadwall	4	19:45	2	A	6	0	2	Standard

02/06/2021	Lapwing	1	17:41	1	A	23	0	4	Standard
02/06/2021	Lapwing	4	20:15	1	A	12	0	10	Standard
02/06/2021	Lapwing	4	20:15	1	B	38	38	25	Standard
02/06/2021	Shelduck	1	16:46	1	A	26	0	8	Standard
02/06/2021	Shelduck	1	17:03	2	A	38	0	6	Standard
02/06/2021	Shelduck	1	17:05	3	A	27	0	6	Standard
02/06/2021	Shelduck	1	17:10	1	A	55	0	5	Standard
02/06/2021	Shelduck	1	17:11	1	A	51	0	8	Standard
02/06/2021	Shelduck	1	17:23	2	A	33	0	10	Standard
02/06/2021	Shelduck	1	17:27	2	A	40	0	5	Standard
02/06/2021	Shelduck	1	17:29	2	A	15	0	4	Standard
02/06/2021	Shelduck	1	17:30	1	A	51	0	2	Standard
02/06/2021	Shelduck	1	17:34	2	A	9	0	4	Standard
02/06/2021	Shelduck	1	17:44	1	A	32	0	7	Standard
02/06/2021	Shelduck	1	17:44	2	A	24	0	6	Standard
02/06/2021	Shelduck	1	17:51	2	A	40	0	10	Standard
02/06/2021	Shelduck	1	17:54	2	A	34	0	4	Standard
02/06/2021	Shelduck	1	18:07	2	A	27	0	6	Standard
02/06/2021	Shelduck	1	18:07	2	A	49	0	10	Standard
02/06/2021	Shelduck	1	18:19	5	A	30	0	10	Standard
02/06/2021	Shelduck	1	18:21	1	A	36	0	3	Standard
02/06/2021	Shelduck	4	18:57	8	A	33	0	12	Standard
02/06/2021	Shelduck	4	19:02	2	A	25	0	12	Standard
02/06/2021	Shelduck	4	19:15	1	A	10	0	10	Standard

02/06/2021	Shelduck	4	19:15	1	B	28	28	22	Standard
02/06/2021	Shelduck	4	19:21	2	A	50	0	10	Standard
02/06/2021	Shelduck	4	19:23	6	A	31	0	7	Standard
02/06/2021	Tufted duck	4	19:43	2	A	10	0	5	Standard
03/06/2021	Canada goose	3	11:15	2	B	30	60	40	Standard
03/06/2021	Lapwing	4	16:57	2	A	215	0	5	Standard
03/06/2021	Marsh harrier	3	11:53	1	A	68	0	7	Standard
03/06/2021	Shelduck	4	16:57	2	B	68	136	20	Standard
03/06/2021	Snipe	3	11:40	2	A	20	0	10	Standard
11/06/2021	Gadwall	3	13:34	1	A	5	0	4	Standard
11/06/2021	Lapwing	2	11:26	1	A	15	0	6	Standard
11/06/2021	Lapwing	2	11:34	1	B	13	13	22	Standard
11/06/2021	Lapwing	2	11:40	1	A	10	0	14	Standard
11/06/2021	Marsh harrier	2	10:03	1	A	61	0	5	Standard
11/06/2021	Marsh harrier	2	10:03	1	B	78	78	23	Standard
11/06/2021	Marsh harrier	2	10:22	1	A	9	0	4	Standard
11/06/2021	Marsh harrier	2	10:24	1	A	20	0	4	Standard
11/06/2021	Marsh harrier	2	10:26	2	A	7	0	5	Standard
11/06/2021	Marsh harrier	2	10:58	1	A	9	0	3	Standard
11/06/2021	Marsh harrier	2	11:14	1	A	22	0	5	Standard
11/06/2021	Marsh harrier	2	11:15	1	A	8	0	4	Standard
11/06/2021	Marsh harrier	2	11:19	1	A	6	0	3	Standard
11/06/2021	Marsh harrier	3	12:30	1	A	129	0	10	Standard
11/06/2021	Marsh harrier	3	13:31	1	A	8	0	3	Standard

11/06/2021	Marsh harrier	3	13:33	1	A	15	0	10	Standard
11/06/2021	Marsh harrier	3	13:33	1	A	13	0	8	Standard
11/06/2021	Marsh harrier	3	13:34	1	A	95	0	10	Standard
11/06/2021	Marsh harrier	3	13:34	1	B	19	19	22	Standard
11/06/2021	Marsh harrier	3	14:27	1	A	21	0	10	Standard
11/06/2021	Oystercatcher	2	10:24	1	A	16	0	18	Standard
11/06/2021	Shelduck	1	15:08	2	A	28	0	7	Standard
11/06/2021	Shelduck	1	15:13	2	A	37	0	6	Standard
11/06/2021	Shelduck	1	16:09	1	A	44	0	10	Standard
11/06/2021	Shelduck	1	16:17	1	A	33	0	2	Standard
11/06/2021	Shelduck	1	16:24	2	A	41	0	6	Standard
11/06/2021	Shelduck	1	16:35	2	A	24	0	5	Standard
11/06/2021	Shelduck	1	16:51	2	A	50	0	7	Standard
11/06/2021	Shelduck	1	16:52	2	A	45	0	7	Standard
11/06/2021	Tufted duck	3	12:21	2	A	19	0	18	Incidental
16/06/2021	Greylag goose	1	10:15	2	A	8	0	15	Standard
16/06/2021	Greylag goose	1	10:15	2	B	69	138	25	Standard
16/06/2021	Marsh harrier	1	10:33	1	A	134	0	10	Standard
16/06/2021	Shelduck	1	09:56	1	A	40	0	5	Standard
16/06/2021	Shelduck	1	10:30	2	A	38	0	2	Standard
16/06/2021	Shelduck	1	10:34	1	A	5	0	6	Standard
16/06/2021	Shelduck	1	10:39	2	A	30	0	17	Standard
16/06/2021	Shelduck	1	11:00	2	A	26	0	8	Standard
16/06/2021	Shelduck	1	11:13	1	A	39	0	6	Standard

16/06/2021	Shelduck	1	11:20	2	A	41	0	10	Standard
16/06/2021	Shelduck	1	11:20	1	A	35	0	8	Standard
16/06/2021	Shelduck	1	11:27	2	A	37	0	12	Standard
16/06/2021	Shelduck	1	11:46	1	A	33	0	3	Standard
21/06/2021	Black-tailed godwit	4	09:01	100	A	18	0	5	Standard
21/06/2021	Black-tailed godwit	4	09:57	250	A	27	0	7	Standard
21/06/2021	Coot	4	08:56	1	A	15	0	2	Standard
21/06/2021	Curlew	3	15:45	2	B	36	72	40	Standard
21/06/2021	Herring gull	2	12:49	2	B	26	52	20	Standard
21/06/2021	Lapwing	2	12:44	1	B	45	45	35	Standard
21/06/2021	Lapwing	4	08:55	3	A	34	0	4	Standard
21/06/2021	Lapwing	4	09:57	2	A	28	0	8	Standard
21/06/2021	Marsh harrier	2	11:44	1	A	28	0	3	Standard
21/06/2021	Marsh harrier	2	11:58	1	A	5	0	4	Standard
21/06/2021	Marsh harrier	2	12:19	1	A	69	0	6	Standard
21/06/2021	Marsh harrier	4	09:22	1	A	50	0	7	Standard
21/06/2021	Marsh harrier	4	09:48	1	A	45	0	2	Standard
21/06/2021	Oystercatcher	2	12:35	1	A	17	0	8	Standard
21/06/2021	Shelduck	4	08:32	1	A	20	0	1	Standard
21/06/2021	Shelduck	4	09:29	2	A	25	0	10	Standard
21/06/2021	Shelduck	4	09:31	2	A	17	0	1	Standard
21/06/2021	Shelduck	4	09:51	2	A	19	0	1	Standard
21/06/2021	Shelduck	4	10:07	2	A	11	0	2	Standard

07/07/2021	Marsh harrier	2	12:16	1	A	12	0	10	Standard
07/07/2021	Marsh harrier	3	09:10	1	A	63	0	5	Standard
07/07/2021	Marsh harrier	3	10:21	1	A	106	0	7	Standard
22/07/2021	Shelduck	1	18:39	1	A	38	0	10	Standard
23/07/2021	Marsh harrier	3	10:12	1	A	75	0	5	Standard
23/07/2021	Marsh harrier	3	10:28	1	A	199	0	5	Standard
23/07/2021	Marsh harrier	3	10:36	1	A	45	0	5	Standard
26/07/2021	Black-tailed godwit	4	09:00	20	A	60	0	18	Standard
26/07/2021	Black-tailed godwit	4	09:00	20	B	60	1200	50	Standard
26/07/2021	Black-tailed godwit	4	09:29	14	A	20	0	10	Standard
26/07/2021	Black-tailed godwit	4	09:29	14	B	25	350	30	Standard
26/07/2021	Gadwall	3	11:38	5	B	65	325	25	Standard
26/07/2021	Lapwing	4	08:23	3	A	30	0	5	Standard
26/07/2021	Little grebe	4	08:05	1	A	11	0	6	Standard
26/07/2021	Mallard	4	08:25	30	A	100	0	10	Standard
26/07/2021	Mallard	4	08:25	30	B	20	600	20	Standard
26/07/2021	Marsh harrier	3	11:58	1	A	30	0	6	Standard
26/07/2021	Marsh harrier	3	12:05	1	A	25	0	10	Standard
26/07/2021	Marsh harrier	4	08:20	1	A	8	0	3	Standard
26/07/2021	Marsh harrier	4	08:21	1	A	80	0	7	Standard
26/07/2021	Marsh harrier	4	09:29	2	A	40	0	35	Standard
26/07/2021	Marsh harrier	4	09:29	2	A	20	0	7	Standard

26/07/2021	Redshank	4	07:58	12	A	25	0	4	Standard
26/07/2021	Redshank	4	08:36	15	A	70	0	3	Standard
27/07/2021	Black-tailed godwit	4	11:17	4	A	16	0	1	Standard
27/07/2021	Black-tailed godwit	4	11:31	250	A	20	0	10	Standard
27/07/2021	Black-tailed godwit	4	11:31	250	B	24	6000	20	Standard
27/07/2021	Black-tailed godwit	4	12:12	100	A	15	0	10	Standard
27/07/2021	Black-tailed godwit	4	12:12	100	B	15	1500	20	Standard
27/07/2021	Black-tailed godwit	4	12:15	150	A	10	0	10	Standard
27/07/2021	Black-tailed godwit	4	12:15	150	B	5	750	20	Standard
27/07/2021	Black-tailed godwit	4	12:20	80	A	20	0	10	Standard
27/07/2021	Black-tailed godwit	4	12:34	100	A	25	0	10	Standard
27/07/2021	Common gull	4	11:26	1	A	22	0	12	Standard
27/07/2021	Dunlin	4	12:25	15	A	10	0	1	Standard
27/07/2021	Gadwall	4	12:25	10	A	10	0	4	Standard
27/07/2021	Lapwing	4	11:31	2	A	8	0	2	Standard
27/07/2021	Marsh harrier	4	11:07	1	A	89	0	2	Standard
27/07/2021	Marsh harrier	4	11:27	1	A	10	0	1	Standard
27/07/2021	Marsh harrier	4	12:01	1	A	52	0	3	Standard
27/07/2021	Marsh harrier	4	12:28	1	A	80	0	5	Standard
27/07/2021	Redshank	4	12:13	40	A	15	0	8	Standard

27/07/2021	Redshank	4	12:31	7	A	25	0	3	Standard
27/07/2021	Shelduck	4	12:28	5	A	10	0	2	Standard
28/07/2021	Black-tailed godwit	1	11:15	150	A	20	0	6	Standard
28/07/2021	Black-tailed godwit	1	11:15	150	B	10	1500	20	Standard
28/07/2021	Black-tailed godwit	1	11:20	50	A	20	0	6	Standard
28/07/2021	Black-tailed godwit	1	11:20	50	B	10	500	20	Standard
28/07/2021	Black-tailed godwit	4	12:50	40	A	35	0	5	Standard
28/07/2021	Black-tailed godwit	4	12:52	300	A	35	0	8	Standard
28/07/2021	Black-tailed godwit	4	14:53	8	A	15	0	5	Standard
28/07/2021	Dunlin	4	12:52	300	A	35	0	8	Standard
28/07/2021	Gadwall	4	13:11	4	A	14	0	1	Standard
28/07/2021	Gadwall	4	13:51	12	A	33	0	11	Standard
28/07/2021	Lapwing	4	12:52	12	A	35	0	8	Standard
28/07/2021	Mallard	4	12:52	70	A	35	0	5	Standard
28/07/2021	Marsh harrier	2	15:27	1	A	17	0	4	Standard
28/07/2021	Merlin	4	12:40	1	A	20	0	5	Standard
28/07/2021	Redshank	4	12:52	400	A	35	0	8	Standard
02/08/2021	Mallard	1	16:08	14	A	12	0	15	Standard
03/08/2021	Black-tailed godwit	4	12:52	100	A	38	0	10	Standard
03/08/2021	Black-tailed godwit	4	12:52	100	B	49	4900	60	Standard

03/08/2021	Black-tailed godwit	4	13:09	40	A	40	0	10	Standard
03/08/2021	Black-tailed godwit	4	13:09	40	B	50	2000	60	Standard
03/08/2021	Black-tailed godwit	4	13:15	1500	A	30	0	10	Standard
03/08/2021	Lapwing	4	13:36	50	A	15	0	3	Standard
03/08/2021	Mallard	4	13:15	50	A	30	0	10	Standard
03/08/2021	Marsh harrier	2	15:55	1	A	210	0	5	Standard
03/08/2021	Marsh harrier	2	16:35	1	A	95	0	3	Standard
03/08/2021	Marsh harrier	4	13:15	1	A	50	0	5	Standard
03/08/2021	Marsh harrier	4	13:15	1	B	200	200	100	Standard
03/08/2021	Marsh harrier	4	13:15	1	C	50	0	140	Standard
03/08/2021	Redshank	4	13:15	120	A	60	0	6	Standard
03/08/2021	Shoveler	4	13:15	10	A	30	0	10	Standard
03/08/2021	Tufted duck	4	13:15	25	A	30	0	10	Standard
09/08/2021	Black-tailed godwit	1	18:58	80	B	45	3600	40	Standard
09/08/2021	Black-tailed godwit	1	19:15	50	B	38	1900	40	Standard
09/08/2021	Black-tailed godwit	4	15:28	4	A	10	0	10	Standard
09/08/2021	Black-tailed godwit	4	15:28	4	B	10	40	25	Standard
09/08/2021	Black-tailed godwit	4	15:32	8	A	9	0	10	Standard
09/08/2021	Black-tailed godwit	4	15:32	8	B	17	136	25	Standard
09/08/2021	Black-tailed godwit	4	16:04	120	A	30	0	10	Standard

09/08/2021	Black-tailed godwit	4	16:04	120	B	60	7200	30	Standard
09/08/2021	Black-tailed godwit	4	16:12	150	A	15	0	10	Standard
09/08/2021	Black-tailed godwit	4	16:12	150	B	55	8250	40	Standard
09/08/2021	Black-tailed godwit	4	16:15	60	A	15	0	10	Standard
09/08/2021	Black-tailed godwit	4	16:15	60	B	45	2700	50	Standard
09/08/2021	Black-tailed godwit	4	16:20	30	A	15	0	10	Standard
09/08/2021	Black-tailed godwit	4	16:20	30	B	45	1350	50	Standard
09/08/2021	Black-tailed godwit	4	16:23	80	A	10	0	10	Standard
09/08/2021	Black-tailed godwit	4	16:23	80	B	55	4400	40	Standard
09/08/2021	Black-tailed godwit	4	16:25	50	A	10	0	10	Standard
09/08/2021	Black-tailed godwit	4	16:25	50	B	45	2250	40	Standard
09/08/2021	Canada goose	1	18:45	100	A	10	0	4	Standard
09/08/2021	Lapwing	1	19:06	60	B	30	1800	50	Standard
09/08/2021	Lapwing	4	16:45	20	A	60	0	2	Standard
09/08/2021	Redshank	4	15:51	80	A	10	0	10	Standard
09/08/2021	Redshank	4	15:51	80	B	52	4160	25	Standard
09/08/2021	Redshank	4	15:56	30	A	10	0	10	Standard
09/08/2021	Redshank	4	15:56	30	B	50	1500	25	Standard
09/08/2021	Shoveler	4	15:39	12	A	8	0	10	Standard
09/08/2021	Shoveler	4	15:39	12	B	15	180	20	Standard

13/08/2021	Canada goose	1	13:01	5	A	5	0	5	Standard
13/08/2021	Canada goose	1	14:47	25	A	61	0	10	Standard
16/08/2021	Canada goose	3	15:36	4	A	74	0	10	Standard
16/08/2021	Marsh harrier	3	15:02	1	A	77	0	5	Standard
16/08/2021	Marsh harrier	3	15:48	1	A	22	0	5	Standard
18/08/2021	Black-tailed godwit	4	09:27	1	B	18	18	20	Standard
18/08/2021	Black-tailed godwit	4	10:54	80	B	97	7760	60	Standard
18/08/2021	Canada goose	4	10:05	12	A	20	0	10	Standard
18/08/2021	Canada goose	4	10:09	2	A	29	0	10	Standard
18/08/2021	Canada goose	4	10:19	62	A	29	0	10	Standard
18/08/2021	Canada goose	4	10:34	70	A	78	0	10	Standard
18/08/2021	Canada goose	4	10:42	50	A	100	0	15	Standard
18/08/2021	Canada goose	4	10:42	40	A	100	0	10	Standard
18/08/2021	Canada goose	4	10:51	90	A	93	0	15	Standard
24/08/2021	Marsh harrier	3	17:16	1	A	63	0	5	Standard
03/09/2021	Black-tailed godwit	1	16:10	15	A	10	0	10	Standard
03/09/2021	Black-tailed godwit	1	16:10	15	B	7	105	20	Standard
03/09/2021	Black-tailed godwit	1	16:12	40	A	12	0	10	Standard
03/09/2021	Black-tailed godwit	1	16:12	40	B	9	360	30	Standard
03/09/2021	Canada goose	1	15:14	20	A	45	0	6	Standard
03/09/2021	Canada goose	2	12:48	50	A	20	0	12	Standard
03/09/2021	Canada goose	2	12:48	50	B	20	1000	35	Standard

03/09/2021	Canada goose	3	10:07	8	A	37	0	17	Standard
03/09/2021	Common gull	2	12:36	1	A	14	0	12	Standard
03/09/2021	Herring gull	3	10:16	1	A	50	0	15	Standard
06/09/2021	Black-tailed godwit	4	12:21	100	A	40	0	8	Standard
06/09/2021	Curlew	2	16:03	1	A	24	0	18	Standard
06/09/2021	Lapwing	4	13:33	200	A	30	0	10	Standard
06/09/2021	Lapwing	4	13:33	200	B	30	6000	22	Standard
06/09/2021	Marsh harrier	1	10:29	1	A	15	0	4	Standard
06/09/2021	Redshank	4	12:30	60	A	15	0	3	Standard
06/09/2021	Snipe	4	12:21	3	A	30	0	10	Standard
06/09/2021	Snipe	4	13:34	1	A	18	0	15	Standard
06/09/2021	Snipe	4	13:34	1	B	2	2	20	Standard
09/09/2021	Canada goose	3	11:31	2	A	35	0	20	Standard
09/09/2021	Canada goose	4	09:32	200	A	55	0	5	Standard
09/09/2021	Lapwing	4	10:08	300	A	66	0	10	Standard
13/09/2021	Black-tailed godwit	1	17:46	500	B	50	25000	20	Standard
13/09/2021	Black-tailed godwit	1	17:50	250	B	51	12750	20	Standard
13/09/2021	Black-tailed godwit	1	17:55	250	B	46	11500	20	Standard
13/09/2021	Black-tailed godwit	4	13:33	1	A	17	0	5	Standard
13/09/2021	Black-tailed godwit	4	13:50	2	A	10	0	7	Standard
13/09/2021	Black-tailed godwit	4	14:05	40	A	25	0	5	Standard

13/09/2021	Black-tailed godwit	4	14:25	300	A	40	0	8	Standard
13/09/2021	Canada goose	1	16:05	50	A	150	0	10	Standard
13/09/2021	Canada goose	1	16:08	150	A	170	0	18	Standard
13/09/2021	Canada goose	1	16:22	80	A	140	0	12	Standard
13/09/2021	Canada goose	1	16:26	70	A	160	0	18	Standard
13/09/2021	Canada goose	3	10:19	2	A	24	0	4	Standard
13/09/2021	Canada goose	3	10:26	2	A	19	0	5	Standard
13/09/2021	Canada goose	3	10:30	400	A	20	0	7	Standard
13/09/2021	Canada goose	3	10:33	7	A	45	0	6	Standard
13/09/2021	Canada goose	3	10:44	50	A	17	0	6	Standard
13/09/2021	Canada goose	3	10:46	50	A	23	0	7	Standard
13/09/2021	Canada goose	3	10:50	1000	A	45	0	7	Standard
13/09/2021	Canada goose	3	11:10	10	B	30	300	40	Standard
13/09/2021	Canada goose	4	13:31	3	A	12	0	3	Standard
13/09/2021	Canada goose	4	15:26	30	A	43	0	18	Standard
13/09/2021	Common gull	4	13:33	1	A	8	0	5	Standard
13/09/2021	Common gull	4	13:46	1	A	10	0	6	Standard
13/09/2021	Greylag goose	3	11:22	5	B	65	325	40	Standard
13/09/2021	Greylag goose	3	11:28	2	B	37	74	55	Standard
13/09/2021	Lapwing	4	13:48	1	A	40	0	6	Standard
13/09/2021	Lapwing	4	13:57	3	A	60	0	6	Standard
13/09/2021	Lapwing	4	13:59	200	A	38	0	3	Standard
13/09/2021	Lapwing	4	14:05	200	A	40	0	12	Standard

13/09/2021	Lapwing	4	14:25	200	A	60	0	10	Standard
13/09/2021	Lapwing	4	14:25	6	B	30	180	20	Standard
13/09/2021	Marsh harrier	4	14:54	1	A	113	0	6	Standard
13/09/2021	Marsh harrier	4	14:57	1	A	36	0	6	Standard
13/09/2021	Redshank	4	13:50	2	A	7	0	1	Standard
13/09/2021	Redshank	4	14:25	50	A	20	0	5	Standard
13/09/2021	Shoveler	4	14:40	2	A	10	0	10	Standard
13/09/2021	Shoveler	4	14:40	2	B	10	20	25	Standard
13/09/2021	Shoveler	4	15:19	7	A	48	0	4	Standard
13/09/2021	Teal	4	13:38	1	A	8	0	4	Standard
23/09/2021	Canada goose	2	14:38	20	A	25	0	8	Standard
23/09/2021	Canada goose	2	14:54	20	A	30	0	10	Standard
23/09/2021	Curlew	2	14:59	4	A	25	0	12	Standard
23/09/2021	Curlew	2	14:59	2	A	20	0	15	Standard
23/09/2021	Curlew	2	14:59	4	B	20	80	25	Standard
23/09/2021	Curlew	2	14:59	2	B	25	50	23	Standard
04/10/2021	Black-tailed godwit	3	13:07	1	A	45	0	15	Standard
04/10/2021	Canada goose	2	10:38	23	A	42	0	8	Standard
04/10/2021	Curlew	2	11:05	12	A	200	0	12	Standard
04/10/2021	Curlew	2	11:06	2	B	35	70	25	Standard
04/10/2021	Curlew	2	11:08	16	A	48	0	10	Standard
04/10/2021	Herring gull	2	11:37	1	A	38	0	10	Standard
04/10/2021	Mallard	2	10:48	1	B	11	11	21	Standard

04/10/2021	Mallard	3	13:26	4	B	49	196	25	Standard
04/10/2021	Pintail	2	11:19	15	B	60	900	50	Standard
06/10/2021	Dunlin	4	12:21	20	A	20	0	5	Standard
06/10/2021	Golden plover	4	12:21	200	A	30	0	10	Standard
06/10/2021	Golden plover	4	12:21	200	A	20	0	10	Standard
06/10/2021	Golden plover	4	12:21	200	B	50	10000	30	Standard
06/10/2021	Lapwing	1	14:36	300	B	30	9000	30	Standard
06/10/2021	Lapwing	1	14:58	80	B	30	2400	35	Standard
06/10/2021	Lapwing	4	11:56	8	A	25	0	6	Standard
06/10/2021	Lapwing	4	12:21	500	A	30	0	8	Standard
06/10/2021	Lapwing	4	12:21	500	A	15	0	10	Standard
06/10/2021	Lapwing	4	12:21	500	B	70	35000	30	Standard
06/10/2021	Redshank	4	12:21	80	A	35	0	10	Standard
06/10/2021	Wigeon	4	12:21	50	A	30	0	15	Standard
13/10/2021	Black-tailed godwit	1	17:28	200	B	50	10000	60	Standard
13/10/2021	Black-tailed godwit	1	17:30	50	B	50	2500	60	Standard
13/10/2021	Black-tailed godwit	4	14:00	16	A	8	0	5	Standard
13/10/2021	Black-tailed godwit	4	14:00	3	A	7	0	5	Standard
13/10/2021	Black-tailed godwit	4	14:00	3	B	20	60	30	Standard
13/10/2021	Golden plover	1	17:32	30	C	160	0	140	Standard
13/10/2021	Golden plover	1	17:48	30	B	30	900	100	Standard
13/10/2021	Herring gull	4	14:11	5	A	12	0	5	Standard

13/10/2021	Herring gull	4	14:11	5	B	3	15	25	Standard
13/10/2021	Herring gull	4	14:31	1	A	5	0	2	Standard
13/10/2021	Lapwing	1	16:19	30	B	50	1500	40	Standard
13/10/2021	Lapwing	1	17:28	40	B	50	2000	70	Standard
13/10/2021	Lapwing	4	13:30	2	A	60	0	6	Standard
13/10/2021	Lapwing	4	14:46	200	A	20	0	10	Standard
13/10/2021	Lapwing	4	14:46	200	B	60	12000	25	Standard
13/10/2021	Marsh harrier	4	14:46	1	A	52	0	5	Standard
13/10/2021	Pintail	4	13:43	9	A	20	0	5	Standard
13/10/2021	Pintail	4	13:43	9	B	17	153	35	Standard
13/10/2021	Pintail	4	14:19	7	A	11	0	3	Standard
13/10/2021	Pintail	4	15:03	5	A	10	0	4	Standard
13/10/2021	Shoveler	4	14:46	20	A	10	0	3	Standard
13/10/2021	Snipe	4	14:04	1	A	10	0	5	Standard
13/10/2021	Snipe	4	14:04	1	B	3	3	20	Standard
13/10/2021	Tufted duck	4	13:33	1	A	15	0	4	Standard
13/10/2021	Whooper swan	4	14:50	6	A	15	0	4	Standard
13/10/2021	Whooper swan	4	15:33	6	A	20	0	10	Incidental
13/10/2021	Whooper swan	4	15:33	6	B	10	60	20	Incidental
13/10/2021	Wigeon	4	14:46	5	A	10	0	2	Standard
15/10/2021	Black-tailed godwit	2	11:45	6	A	8	0	8	Standard
15/10/2021	Black-tailed godwit	2	12:32	9	A	12	0	8	Standard
15/10/2021	Black-tailed godwit	4	13:43	40	A	40	0	12	Standard

15/10/2021	Black-tailed godwit	4	14:44	100	A	40	0	15	Standard
15/10/2021	Common gull	4	13:45	1	A	45	0	6	Standard
15/10/2021	Curlew	2	11:08	5	A	5	0	12	Standard
15/10/2021	Curlew	2	11:08	5	B	17	85	30	Standard
15/10/2021	Curlew	2	11:13	25	A	8	0	10	Standard
15/10/2021	Curlew	2	11:13	25	B	10	250	25	Standard
15/10/2021	Curlew	2	11:14	3	A	15	0	18	Standard
15/10/2021	Curlew	2	11:28	4	A	10	0	10	Standard
15/10/2021	Lapwing	4	13:50	2	A	60	0	3	Standard
15/10/2021	Lapwing	4	14:45	80	A	5	0	5	Standard
15/10/2021	Lapwing	4	14:45	80	A	20	0	5	Standard
15/10/2021	Lapwing	4	14:45	80	B	80	6400	20	Standard
15/10/2021	Marsh harrier	4	14:44	1	A	75	0	10	Standard
15/10/2021	Pintail	4	14:45	30	A	30	0	3	Standard
15/10/2021	Redshank	4	13:59	3	A	10	0	18	Standard
15/10/2021	Shoveler	4	14:45	100	A	40	0	3	Standard
15/10/2021	Teal	4	13:44	3	A	60	0	3	Standard
15/10/2021	Teal	4	14:45	100	A	40	0	3	Standard
15/10/2021	Whooper swan	3	10:05	6	A	90	0	15	Standard
15/10/2021	Whooper swan	3	10:05	6	B	50	300	30	Standard
15/10/2021	Wigeon	4	14:45	50	A	30	0	3	Standard
19/10/2021	Canada goose	3	10:08	1	B	51	51	30	Standard
19/10/2021	Curlew	2	11:36	2	B	38	76	60	Standard

19/10/2021	Curlew	2	13:12	1	B	33	33	60	Standard
19/10/2021	Curlew	3	11:10	1	A	26	0	15	Standard

Annex 3: Frodsham Solar: Ground Investigations Report (separate document)

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CUBICO INVEST

FRODSHAM SOLAR

CELL 3 GROUND INVESTIGATION REPORT

FEBRUARY 2025

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DATE ISSUED:	**FEBRUARY 2025**
JOB NUMBER:	**GM12793**
REPORT NUMBER:	**011**
VERSION:	**V1.0**
STATUS:	**FINAL**

CUBICO INVEST

FRODSHAM SOLAR

CELL 3 GROUND INVESTIGATION REPORT

FEBRUARY 2025

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Appendix A Wardell Armstrong LLP Borehole Logs
Appendix B Laboratory Geotechnical Testing Results
Appendix C Laboratory Geochemical Testing Results
Appendix D Groundwater Monitoring Results
Appendix E Variable Head Test Results
Appendix F Permeability Analyses

DRAWINGS

DRAWING NO.	TITLE	SCALE
GM12793-004	Cell 3 Site Location Plan	1:10,000 at A3
GM12793-010	Cell 3 Ground Investigation Location Plan	1:5,000 at A3

1 INTRODUCTION

1.1 Instruction and Background

1.1.1 Wardell Armstrong LLP (WA) were commissioned by Cubico Invest (herein referred to as the 'Client') to undertake a ground investigation (Task 1b in WA letter dated 3 May 2024) at Cell 3 of Frodsham Wind Farm, located off Lordship Lane, Frodsham, WA6 7SN. The Client is currently undertaking an Environmental Impact Assessment (EIA) to support the application for a Development Consent Order (DCO) for the development of the site into a wetland mitigation area as part of the wider Frodsham Solar Farm development.

1.1.2 This report provides the factual results of the investigation in terms of the shallow subsurface geology beneath the site. The results of the investigation and geotechnical testing should be read in conjunction with the Cell 3 Ground Investigation Report, dated April 2024, prepared by WA. The interpretation of the results of the chemical testing, and the risk assessment in terms of the potential pollution of Controlled Water and Human Health, is excluded from the WA scope of work and will be carried out by the Project Environmental Consultant, Smith Grant.

1.2 Site Location and Description

1.2.1 The site is located north of Frodsham, Cheshire as shown on Drawing GM12793-004 and is bound to the north by the Manchester Ship Canal (MSC), with the wider Frodsham Wind Farm site surrounding the site to the east, south and west. The Frodsham Wind Farm site has been divided into cells/lagoons where MSC dredgings have been deposited. Frodsham Deposit Ground No. 6 is to the south of the site, with agricultural land with an operational windfarm located on former deposit grounds to the northeast and southwest of the site.

1.2.2 There are a series of fishing ponds along the site's northern and western borders. At the time of the investigations, the site comprised agricultural land used for grazing cattle, with a series of ecological 'surface scrapes' and ponds, and an east-west orientated drainage ditch traversing through the site.

1.3 Limitations

1.3.1 This report has been prepared for the exclusive benefit of the Client, for the purpose of providing information on the ground conditions at the site. The report contents shall only be used in that context. Furthermore, new information, changes in practice or new legislation may necessitate revised interpretation of the report after the date of its preparation.

1.3.2 It should be noted that ground investigation relies upon the determination of information from 'point sources' such as the boreholes, and the interpretation of data between investigation points. It should be recognised that the actual conditions at and between investigation points can differ spatially and temporally. The assessments and recommendations given in this report are based upon the interpretation of the results from the ground investigation at a specific point and time and therefore any conclusions drawn would need to be reviewed prior to their use for further development of the site.

1.3.3 The ground investigation was preliminary and restricted in places for various reasons including the presence of underground utilities and restricted access. Exploratory locations were positioned at locations to avoid these constraints and minimise disruption to the current land uses.

1.3.4 Four boreholes across the east of the site were inaccessible at the time of the initial investigation due to the presence of cattle. These positions were drilled and investigated, along with an additional five boreholes along the northern site boundary, over a two day-period in October 2024.

1.3.5 This report does not consider broader development constraints such as services, land drainage, flood risk, ecology, invasive weeds, archaeology, acoustics or air quality.

1.3.6 WA has used reasonable skill and care in the design of the ground investigation work to comply with currently available industry guidance and to meet the requirements of the commission.

1.3.7 The variable head tests conducted, only tested a small volume of soil; therefore, the results are only representative of the permeability around the borehole. Additionally, these tests only provide results for the horizontal permeability of the deposits and may not be representative of vertical permeability.

2 BACKGROUND INFORMATION

2.1 Current Site Use

2.1.1 The site is currently undeveloped grazing land, previously used to store MSC dredging deposits. Access to the site is off an unnamed road which runs east-west to the south of the site, through the Natural Power Windfarm west of the site. There are a series of fishing ponds along the site's northern and western borders and the MSC trends northeast-southwest to the north of the site. Frodsham Windfarm is located east, south and west of the site. Deposit Ground 6 is located south of the site.

2.1.2 The site topography lies at around 9m above Ordnance Datum (AOD) and is relatively flat, sloping up slightly to the north at the fishing ponds.

2.2 Physical Setting of Site

2.2.1 The British Geological Survey (BGS) do not record any artificial ground beneath the site. However, it is known from previous records and previous intrusive investigations carried out by WA at the site that there is made ground across the site in the form of MSC dredging deposits.

2.2.2 The BGS indicates the site is underlain by Tidal Flat superficial deposits, and solid deposits of the Chester Formation comprising pebbly sandstone. The Tidal Flat deposits are classified as a Secondary (undifferentiated) aquifer. The Chester Formation is classified as a Principal aquifer. The site is not within a Source Protection Zone (SPZ).

2.2.3 A series of fishing ponds are located along the site's northern and western borders, and a series of surface water 'scrapes' are present across the site, constructed for ecological purposes. The nearest surface watercourse is the MSC recorded approximately 130m away from the site trending north east-south west.

3 GROUND INVESTIGATION

3.1 Intrusive Work

3.1.1 The ground investigation was designed to provide a general classification of the ground conditions at Cell 3. Ground investigation works were designed in general accordance with current UK guidance.

3.1.2 The ground investigation comprised the following:

- 14 No. window sample (WS) boreholes drilled across the site under the full-time supervision of a WA Geologist between 10 and 13 June 2024, with an additional 8 No. WS boreholes drilled in the north and east of the site between 24 and 25 October 2024 (borehole logs are attached at Appendix A). The boreholes were excavated to a maximum depth of 6.0 metres below ground level (mbgl) in order to:
    - Investigate the nature, distribution and thickness of the near surface strata;
    - Obtain samples for laboratory geotechnical and geochemical testing; and,
    - Carry out in-situ Standard Penetration Tests (SPTs) to provide information on the density of the near surface deposits.
- 20 No. Groundwater (GW) monitoring standpipes were installed in the boreholes apart from WS15, WS18 and WS21 in order to:
    - Provide a representative monitoring grid across the site; and,
    - Determine the depth of groundwater beneath the site.

3.1.3 The ground investigation was designed to target the area of the proposed wetland and the area surrounding the fishing ponds to the north of the site.

3.1.4 The ground investigation was undertaken by PM Sampling Ltd under the direct supervision of a WA Geologist. Ground investigation positions are shown on Drawing GM12793-010.

3.1.5 Exploratory arisings were logged on site by the WA Geologist in general accordance with the requirements of BS5930, including recorded observed visual and olfactory indications of contamination.

3.1.6 Selected samples of soils from the window sample boreholes were analysed to determine their geochemical and geotechnical characteristics to assess, as far as possible, the likely contamination status of the site and to enable preliminary characterisation of the soils beneath the site.

3.1 Groundwater Monitoring

3.1.1 Standpipes were installed within 20 of the 23 window sample boreholes for subsequent groundwater monitoring.

3.1.2 Six rounds of groundwater monitoring will be carried out across the site over the following 12 months. Since 30 August 2024, two monitoring visits have taken place; this report will be updated following the completion of all monitoring visits.

3.2 Laboratory Analysis

3.2.1 Representative soil samples were selected for laboratory geochemical and geotechnical testing to inform on the ground conditions at the site. The laboratory selected by WA for the geotechnical and chemical analysis was i2 (UKAS and MCERTS accredited). Smith Grant LLP were consulted to determine the chemical testing suites required and in regard of the samples to be selected for testing.

3.2.2 Further to this, water sampling was conducted in June 2024 to determine chemical composition of the water on site. Groundwater samples were obtained from WS03, WS06, WS07, WS08 and WS10. Surface water samples were obtained on-site from the drainage ditch, surface scrapes, and a fishing pond, as shown on Figure 1 below. A sample was also collected from the Hoolpool Gutter, which runs 1.5km west of the site adjacent to the Natural Power Windfarm.

Figure 1: Surface Water Sampling Locations



Source: Bing Aerial Imagery

3.2.3 A summary of the laboratory testing scheduled is provided in Table 3.1. The chemical testing results are attached as Appendix B.

Table 3.1: Laboratory Testing

Laboratory Test	Test Methodology	No. Samples Tested
Geotechnical testing		
Particle Size Distribution with Sedimentation	BS1377-2-2022 Clause 10	9
Moisture Content	BS1377-2-2022 Clause 4.1	11
Atterberg 4-Point	BS1377-2-2022 Clause 5.2	11
Geochemical testing		
Asbestos ID	A001	5
Asbestos Quantification	A006B	2
Sulphate as SO4	L038	3
TPH CWG	L088/L076	2
pH	L099-PL	4
Ammoniacal Nitrogen	L082B	2
TOC	L009B	1
Speciated PAH	L064B	2
Metals	L038B	3
Volatile Organic Compounds (VOCs)	L073B	5

Table 3.1: Laboratory Testing		
Laboratory Test	**Test Methodology**	**No. Samples Tested**
Leachable Metals	L039B	5
Leachable PAH	L102B	4
Leachable ammoniacal Nitrogen	L082B	1
Groundwater Testing		
BTEX / MTBE	L073B	13
Dissolved heavy metals	L012B	13
Chromium VI	L080	13
Calcium	L039	13
Salinity	L031B	13
Sulphate as SO4	L039B	13
Chloride	L082B	13
Ammoniacal nitrogen	L082B	13
pH	L099	13
DOC	L037B	13
BOD	L086B	13
PAHs	L088B	13
TPH CWG	L070B/L088B	13

4 RESULTS OF GROUND INVESTIGATION - STRATIGRAPHY

4.1 Ground Conditions – Strata Profile

4.1.1 Details of the ground conditions encountered are provided in the WA borehole logs attached at Appendix A, and the individual strata are summarised in Table 4.1, 4.2 and 4.3.

Topsoil

4.1.2 Topsoil was encountered at four positions along the Site's northern boundary, interpreted to be outside of the dredging deposit ground. The topsoil was encountered to a maximum depth of 0.40mbgl. The topsoil is summarised in Table 4.1.

Table 4.1: Summary of Topsoil

Description	Positions	Thickness Range (m)	Depth Range (mbgl)	
			Top	Base
TOPSOIL: Dark brown clayey fine to coarse SAND with occasional rootlets.	WS02, WS15, WS17, WS18	0.30 – 0.40	Ground Level	0.30 – 0.40

Made Ground

4.1.3 Made ground interpreted to represent dredging deposits was encountered across the majority of the site to a maximum observed depth of 5.7mbgl. The made ground consisted generally of dark brown sandy clay, dark grey silty clay or dark brown to yellowish brown clayey sand, underlain by black silty clay. The made ground is summarised in Table 4.2.

Table 4.2: Summary of Made Ground

Description	Positions	Thickness Range (m)	Depth Range (mbgl)	
			Top	Base
MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	WS01, WS03 to WS14, WS16, WS19 to WS23	0.30 – 0.50	Ground Level	0.30 – 0.50
MADE GROUND: Dark grey silty CLAY.	WS01, WS03, WS05, WS07, WS08, WS11 to WS14, WS16, WS19 to WS21, WS23	0.30 – 2.50	0.30 – 1.50	0.90 – 2.90

Table 4.2: Summary of Made Ground				
Description	**Positions**	**Thickness Range (m)**	**Depth Range (mbgl)**	
			Top	**Base**
MADE GROUND: Reddish brown fine to coarse SAND.	WS09, WS23	0.60 – 1.00	0.40 – 0.50	1.00 – 1.50
MADE GROUND: Reddish brown fine to coarse gravelly SAND. Gravel is fine to coarse, subangular mixed lithologies.	WS04	0.40	0.30	0.70
MADE GROUND: Dark grey sandy CLAY.	WS04, WS09, WS22	0.70 – 2.30	0.70 – 2.00	2.70 – 3.00
MADE GROUND: Dark brown to yellowish brown clayey fine to coarse SAND.	WS06, WS10, WS11	0.70 – 1.30	0.30	1.00 – 1.60
MADE GROUND: Black silty CLAY with abundant rootlets and occasional silt pockets.	WS01, WS03, WS05 to WS08, WS10 to WS14, WS16, WS19, WS22	1.10 – 4.50	0.90 – 3.00	2.50 – 5.70*
MADE GROUND: Black sandy CLAY with abundant rootlets and occasional sand pockets. Sand is fine to coarse.	WS04, WS09, WS20, WS21, WS23	2.00 – 3.30	1.70 – 3.00	5.00*

*Base not proven in WS04 and WS09

Natural Superficial Deposits

4.1.4 Natural superficial deposits were encountered across the site to a maximum recorded depth of 6.0mbgl and surrounding the fishing ponds. The natural superficial deposits are summarised in Table 4.3.

Table 4.3: Summary of Natural Superficial Deposits				
Description	**Positions**	**Thickness Range (m)**	**Depth Range (mbgl)**	
			Top	**Base**
Loose yellowish brown fine to coarse clayey gravelly SAND with a low cobble content. Gravel is fine to coarse, subrounded mixed lithologies. Cobbles are	WS02, WS15, WS17, WS18	0.50 – 1.70	0.30 – 1.50	1.50 – 2.00

Table 4.3: Summary of Natural Superficial Deposits				
Description	**Positions**	**Thickness Range (m)**	**Depth Range (mbgl)**	
			Top	**Base**
subrounded mixed lithologies (TIDAL FLAT DEPOSITS).				
Loose dark grey silty fine to coarse SAND (TIDAL FLAT DEPOSITS).	WS02, WS15, WS18	3.00 – 3.20	1.50 – 2.00	4.70 – 5.00*
Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	WS01, WS03 to WS08, WS10 to WS14, WS19	0.30 – 1.80	3.20 – 5.70	4.70 – 6.00*

*Base not proven

5 RESULTS OF GEOTECHNICAL INVESTIGATION - GEOTECHNICAL TESTING

5.1 General

5.1.1 A suite of in-situ and laboratory geotechnical testing was undertaken on selected samples obtained from the windowless sample boreholes, in order to characterise the geotechnical parameters of the soils.

5.1.2 The in-situ geotechnical test results are recorded on the window sample logs contained within Appendix A. The laboratory geotechnical testing carried out is outlined in Section 3.2 and the results are contained within Appendix C.

5.2 In-situ Geotechnical Testing

5.2.1 SPTs have been carried out in all boreholes. Uncorrected SPT "N Values" range from 0 to 20 with a summary of the SPT results provided in Table 5.1.

Table 5.1: Summary of SPT Results

Depth (mbgl)	N Value (uncorrected)		Classification based on average uncorrected SPT N values
	Range	Average	
1.20	0-12	1	Very soft / Very loose
2.00	0-20	2	Very soft / Very loose
3.00	0-5	0	Very soft / Very loose
4.00	0-12	1	Very soft / Very loose
5.00	0-17	7	Soft / Loose

5.2.2 The superficial Tidal flat deposits are generally classed as very soft to soft / very loose to loose, based on the average uncorrected SPT N values.

5.1 Laboratory Geotechnical Testing

5.1.1 The laboratory geotechnical testing was in accordance with BS 1377:1990 and BS EN 17892-1:2014.

Moisture Content & Atterberg Limits

5.1.2 Eleven samples from site were scheduled for natural moisture content and Atterberg limit testing. A summary of the natural moisture content and Atterberg limit testing results is presented in Table 5.2 and the A Line Chart is presented in Figure 2. The results indicate the clays are generally of intermediate to extremely high plasticity clays with a medium to high volume change potential.

Table 5.2 Natural Moisture Content & Atterberg limit Results Summary				
Depth (mbgl)	**Moisture content (%)**	**Liquid limit (%)**	**Plastic Limit (%)**	**Plasticity Index**
0.50	70.3	62	27	35
1.00	79.3	30	NP	NP
1.20 – 1.30	35.0 – 98.2	45 – 89	23 – 40	22 – 49
1.50	95.5	110	44	66
2.00	17.9	75	32	43
3.00	79.8	109	49	60
4.00	24.7 – 36.8	NP – 51	NP – 23	NP – 28
5.00	26.4 – 94.9	29 – 100	NP – 49	NP – 51

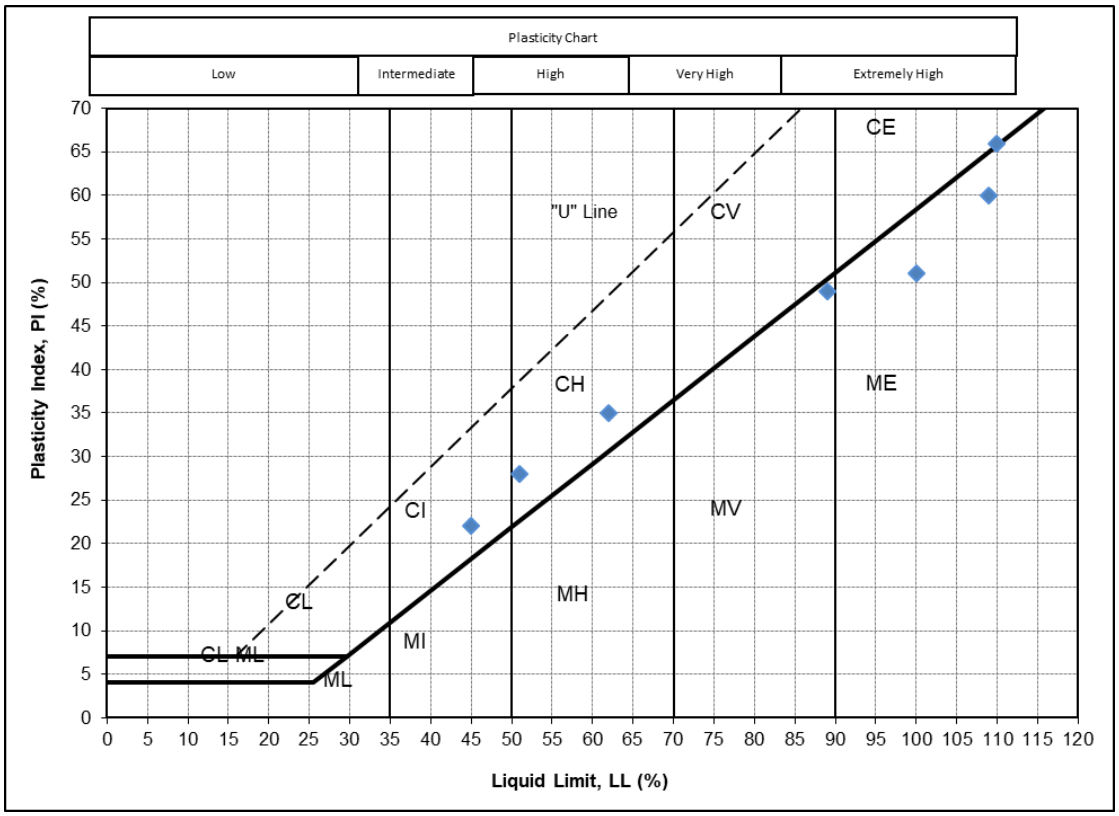


Figure 2: A-Line Chart

Particle Size Distribution (PSD)

5.1.3 Nine samples were scheduled for PSD testing (coarse sieving with fines by sedimentation); the results of these tests are included in Appendix C. A summary of the PSD testing results, and preliminary earthworks classification is presented in Table 5.3.

Table 5.3: Summary of PSD testing results and preliminary earthworks classification								
Location	**Depth (mbgl)**	**Strata**	**Grading (%)**					**Earthworks Class (Table 6/2)**
			Cobble	**Gravel**	**Sand**	**Silt**	**Clay**	
WS07	5.50	Clay	0	0	7	54	39	2A & 2B
WS08	4.00	Sand	0	0	62	32	6	2A & 2B
WS14	4.00	Silt	0	1	5	67	27	2A & 2B
WS15	4.00	Silt	0	0	23	45	32	2A & 2B
WS17	4.00	Sand	0	3	87	-	10	1B
WS18	2.00	Sand	0	0	93	-	7	1B
WS20	1.00	Silt	0	0	14	54	32	2A & 2B
WS21	1.00	Silt	0	2	36	36	26	2A & 2B
WS23	3.00	Silt	0	1	45	34	20	2A & 2B

Natural Moisture Content (NMC)

5.1.4 Eight samples of superficial deposits from the site were scheduled for NMC testing. The NMC for the silt samples was recorded between 17.9 – 36.8% whilst for the sand samples it was between 26.4 – 79.3%. The NMC for the clay samples ranged from 24.7 – 98.2%, with an average result of 71.2%.

5.2 Groundwater

Groundwater Strikes & Monitoring

5.2.1 Water quality data was taken from five positions across the site during a groundwater monitoring visit. The water quality data is summarised below in Table 5.4.

Table 5.4: Water quality data					
Location	**WS07**	**WS10**	**WS06**	**WS08**	**WS03**
Temperature (°C)	14.6	17.03	18.15	18.1	17.8
Oxidation Reduction Potential (mV)	-41.0	0.77	28.1	-31.63	-30.7
pH	7.36	7.63	7.22	7.44	7.49
Dissolved Oxygen % Salinity	34.4	66.7	27.47	47.4	57.1
Dissolved Oxygen (mg/l)	3.50	6.17	2.55	4.38	0.53
Electrical Conductivity (mS/cm)	1,989	14.41	4,055	7,267	7,406
Total Organic Sulphate (mg/l)	1,292	10.01	2,635	4,723	4,813

Seawater Specific Gravity (σT)	0	6.6	0.1	2	2.1
Salinity (psu)	1.11	10.01	2.37	4.45	4.53

5.2.2 Groundwater strikes were encountered at all investigation locations during the investigation and ranged between 0.4 – 2.2mbgl. Details of groundwater strikes are recorded on the borehole logs attached as Appendix A.

5.2.3 The groundwater levels recorded across the site during three monitoring visits between 30 August 2024 and 13 February 2025 are presented on Table 5.5. A further three visits are yet to take place. Table 5.5 will be updated upon the completion of all monitoring visits. Groundwater monitoring results can be found attached at Appendix D.

Table 5.5: Groundwater monitoring

Location	Response Zone (mbgl)	GW Monitoring (mbgl)		GW fluctuation (m)	Additional comments
		Minimum depth	Maximum depth		
WS01	1.00 – 4.05	0.20	0.51	0.31	
WS02	0.50 – 2.61	1.80	2.63	0.83	
WS03	1.00 – 5.00	0.30	0.60	0.30	
WS04	1.00 – 3.94	0.85	2.21	0.514	
WS05	1.00 – 3.97	1.10	1.62	0.52	
WS06	1.00 – 2.19	0.70	1.33	0.63	
WS07	1.00 – 5.00	0.53	-	-	Only sampled in February due to Flooding.
WS08	1.00 – 4.03	0.90	1.40	0.50	
WS09	1.00 – 3.14	0.70	1.00	0.30	
WS10	1.00 – 5.00	0.90	0.90	-	
WS11	1.00 – 2.27	0.75	1.27	0.52	
WS12	1.00 – 4.86	0.30	1.54	1.24	
WS13	1.00 – 3.13	1.20	1.57	0.37	
WS14	1.00 – 3.13	1.10	1.57	0.47	
WS16	1.00 – 5.00	0.30	0.90	0.60	
WS17	1.00 – 5.00	0.60	0.80	0.20	
WS19	1.00 – 5.00	0.50	-	-	Only sampled in February due to flooding.
WS20	1.00 – 5.00	0.30	0.90	0.60	

Table 5.5: Groundwater monitoring					
Location	Response Zone (mbgl)	GW Monitoring (mbgl)		GW fluctuation (m)	Additional comments
		Minimum depth	Maximum depth		
WS22	1.00 – 5.00	0.86	-	-	Only sampled in February due to flooding.
WS23	1.00 – 5.00	0.30	0.62	0.32	

Variable Head Tests

5.2.4 Boreholes WS03, WS07, WS08 and WS10 were selected for undertaking variable head tests within the made ground deposits. Variable head tests were undertaken at these locations to provide an estimate of the permeability of these deposits in the vicinity of the proposed wetland.

5.2.5 The boreholes were first purged and then allowed to recharge, with data loggers installed within the boreholes to monitor changes in groundwater levels as well as temperature changes. A barometric logger was used to allow compensation for atmospheric pressure variations.

5.2.6 All tests were conducted within deposits of made ground which have a general lithological description of very soft to soft black silty CLAY, with occasional rootlets, silt pockets, and a very strong organic odour.

5.2.7 Graphs displaying the changes in groundwater level and temperature in each of the four boreholes throughout the variable head tests are attached as Appendix E. Calculations were completed to estimate the permeability of the made ground deposits tested within each borehole using the information produced by the data loggers; the permeabilities are given as a permeability coefficient (k) in m/s and m/d. The analyses are attached at Appendix F.

WS03

5.2.8 At WS03, groundwater was recorded at the start of the test at a level of 14.86m AOD, before being purged to a level of 10.48m AOD. WS03 did not recharge throughout the test. A k value of 1.66E-07 m/s was calculated which suggests that the deposits tested at WS03 are of low permeability.

WS07

5.2.9 At WS07, groundwater was recorded at the start of the test at a level of 14.86m AOD, before being purged to a level of 11.73m AOD. WS07 recharged to 14.24m AOD over a duration of 8 minutes 32 seconds. A permeability coefficient of 2.33E-05 m/s was calculated for WS07, suggesting that some of the deposits tested within this borehole (presumably sand lenses) are of moderate permeability.

WS08

5.2.10 At WS08, groundwater was recorded at the start of the test at a level of 13.21m AOD, before being purged to a level of 11.13m AOD. WS08 did not recharge to the starting groundwater level throughout the test and the results from the data loggers were similar to those seen within WS03, suggesting that the deposits tested at WS08 are of low permeability.

WS10

5.2.11 At WS10, groundwater was recorded at the start of the test at a level of 14.05m AOD, before being purged to a level of 10.52m AOD. WS10 did not recharge to the starting groundwater level throughout the test and data logger results were again similar to WS03, suggesting that the deposits tested at WS10 are of low permeability.

5.2.12 Despite the deposits within WS07 being recorded to have moderate permeability, the data from the other boreholes suggests that it's more common for the dredging deposits across the site to have very low permeability.

6 CONCLUSIONS

6.1 Ground Conditions

6.1.1 The soils encountered during the Cell 3 ground investigation consisted of made ground likely derived from historical deposits of dredging material from the Manchester Ship Canal. The made ground was variable in composition and proven to a maximum depth of 5.70mbgl.

6.1.2 Topsoil was encountered at four positions (WS02, WS15, WS17, WS18) outside of the dredging deposit ground, to a maximum depth of 0.40mbgl. Natural superficial Tidal Flat deposits were encountered across the site underlying the made ground to a maximum observed depth of 6.0mbgl. The Tidal Flats comprised sands and silty clays.

6.1.3 Groundwater strikes were encountered during the investigation between 0.4 – 2.2mbgl and were likely to be representative of higher permeability silt or sand lenses or perched on the clay deposits.

6.1.4 The results of the variable head tests show a moderate permeability of the dredging deposits within WS07, likely due to the presence of sand lenses, and a low permeability of the dredging deposits within WS03, WS08, and WS10. This data suggests that it is more common for the dredging deposits to have a low permeability across the site. This should be further investigated to confirm low permeability material is present, and continuous across the proposed wetland area.

6.1.5 **Additional Comments**

6.1.6 As with any GI involving discrete sampling, test results will only be representative of the points sampled. If suspect material is encountered during either the enabling works or construction works, then this material should be isolated and further investigation undertaken to determine the risk posed by these materials and appropriate methods of management etc.

6.1.7 A programme of groundwater level monitoring to determine seasonal and/or tidal effect on groundwater levels at the site has commenced and this report will be updated following completion of the monitoring visits.

6.1.8 It is recommended that that further site investigation is undertaken to confirm the findings of this report are consistent across the wider areas of cell 3 and to inform the detailed design of the wetland.

APPENDICES

Appendix A

Wardell Armstrong LLP Borehole Logs

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS01/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 10/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E348658.70 N378088.57
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 8.27m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
								MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
		0.50	ES		0.40	7.87		MADE GROUND: Dark grey silty CLAY.	
	▽				0.90	7.37		MADE GROUND: Very soft to firm black silty CLAY with abundant rootlets and occasional silt pockets. *0.90m - 4.60m : Very strong organic odour*	1
		1.20 1.20	D SPT(S)	N=0 (0,0/0,0,0,0)					
		1.50 – 2.00	B						
		2.00 2.00 2.00	D ES SPT(S)	N=0 (0,0/0,0,0,0)					2
		3.00 3.00	D SPT(S)	N=5 (1,1/1,2,1,1)					3
		4.00 4.00	D SPT(S)	N=12 (1,2/2,3,3,4)					4
					4.60	3.67		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	
		5.00 5.00	D SPT(S)	N=15 (3,3/3,4,4,4)	5.00	3.27		End of Borehole at 5.00m	5
									6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 4.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.7m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS02/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 10/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E348600.00 N378255.07
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 10.28m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
					0.30	9.98		TOPSOIL: Dark brown clayey fine to coarse SAND.	
		0.50 0.50 – 1.00	ES B					Loose yellowish brown fine to coarse clayey gravelly SAND with a low cobble content. Gravel is fine to coarse, subrounded mixed lithologies. Cobbles are subrounded mixed lithologies (TIDAL FLAT DEPOSITS).	1
		1.20 1.20	D SPT(S)	N=12 (2,3/2,3,3,4)					
	▽	2.00 2.00	D SPT(S)	N=0 (0,0/0,0,0,0)	2.00	8.28		Loose dark grey silty fine to coarse SAND (TIDAL FLAT DEPOSITS).	2
		2.50	ES						
		3.00	SPT(S)	N=0 (0,0/0,0,0,0)					3
		4.00	SPT(S)	N=0 (0,0/0,0,0,0)					4
		5.00	SPT(S)	N=0 (0,0/0,0,0,0)	5.00	5.28		End of Borehole at 5.00m	5
									6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 0.50m	0.50m 2.50m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 0.5 m bgl and slotted to 2.5 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 2.2m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS03/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 10/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E348776.06 N378228.53
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 9.52m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	6.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.20	ES		0.30	9.22		MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
	▽	0.50 – 1.00	B					MADE GROUND: Dark grey silty CLAY (TIDAL FLAT DEPOSITS).	1
		1.20 1.20	D SPT(S)	N=0 (0,0/0,0,0,0)	1.10	8.42		MADE GROUND: Very soft to soft black silty CLAY with abundant rootlets and occasional silt pockets. *1.10m - 5.30m : Very strong organic odour*	
		2.00 2.00	D SPT(S)	N=0 (0,0/0,0,0,0)					2
		3.00 3.00 3.00	D ES SPT(S)	N=0 (0,0/0,0,0,0)					3
		4.00 4.00	D SPT(S)	N=0 (0,0/0,0,0,0)					4
		5.00 5.00	D SPT(S)	N=11 (2,2/2,3,3,3)					5
					5.30	4.22		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	
					6.00	3.52		End of Borehole at 6.00m	6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 5.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 5.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.5m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS04/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 10/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E348846.62 N378399.14
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 11.04m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
								MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
					0.30	10.74		MADE GROUND: Reddish brown fine to coarse gravelly SAND. Gravel is fine to coarse, subangular mixed lithologies.	
					0.70	10.34		MADE GROUND: Dark grey sandy CLAY.	
		1.00	ES						1
	▽	1.20 1.20	D SPT(S)	N=2 (1,1/0,0,1,1)					
		2.00 2.00	D SPT(S)	N=20 (3,4/5,4,5,6)					2
		3.00 3.00	D SPT(S)	N=0 (0,0/0,0,0,0)	3.00	8.04		MADE GROUND: Very soft to soft black sandy CLAY with abundant rootlets and occasional sand pockets. Sand is fine to coarse. *3.00m - 5.00m : Very strong organic odour*	3
		4.00 4.00	ES SPT(S)	N=0 (0,0/0,0,0,0)					4
		5.00	SPT(S)	N=0 (0,0/0,0,0,0)	5.00	6.04		End of Borehole at 5.00m	5
									6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 4.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 1.3m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS05/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 13/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E349001.72 N378321.64
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 9.50m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	6.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		0.20	ES		0.30	9.20		MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
								MADE GROUND: Soft dark grey silty CLAY.	1
		1.20 1.20	D SPT(S)	N=0 (0,0/0,0,0,0)					
	▽				1.40	8.10		MADE GROUND: Very soft to soft black mottled light grey silty CLAY with abundant rootlets and occasional silt pockets. Sand is fine to coarse. *1.40m - 5.70m : Very strong organic odour*	
		2.00 2.00	D SPT(S)	N=0 (0,0/0,0,0,0)					2
		3.00 – 3.50 3.00	B SPT(S)	N=0 (0,0/0,0,0,0)					3
		3.50	ES						
		4.00 4.00	D SPT(S)	N=0 (0,0/0,0,0,0)					4
		5.00	SPT(S)	N=0 (0,0/0,0,0,0)					5
					5.70	3.80		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	
		6.00	ES		6.00	3.50		End of Borehole at 6.00m	6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 4.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 1.5m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS06/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 12/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E349001.72 N378321.64
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 9.73m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	6.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
								MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
					0.30	9.43		MADE GROUND: Dark brown to yellowish brown clayey fine to coarse SAND.	
	▽	1.00 1.00 – 1.50 1.20 1.20	ES B D SPT(S)	N=0 (0,0/0,0,0,0)	1.10	8.63		MADE GROUND: Soft black silty CLAY with abundant rootlets and occasional silt pockets. Sand is fine to coarse. *1.10m - 5.50m : Very strong organic odour*	1
		2.00 2.00	D SPT(S)	N=0 (0,0/0,0,0,0)					2
		3.00 3.00 3.00	D ES SPT(S)	N=0 (0,0/0,0,0,0)					3
		4.00 4.00	D SPT(S)	N=0 (0,0/0,0,0,0)					4
		5.00 5.00 5.00	D ES SPT(S)	N=0 (0,0/0,0,0,0)					5
					5.50	4.23		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	
					6.00	3.73		End of Borehole at 6.00m	6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 2.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 2.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 1.2m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS07/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 11/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E349127.76 N378487.03
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 9.85m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	6.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
								MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
					0.30	9.55		MADE GROUND: Soft dark grey silty CLAY.	
	▽	1.00 1.00 – 1.50 1.20 1.20	ES B D SPT(S)	N=0 (0,0/0,0,0,0)					1
					1.50	8.35		MADE GROUND: Soft black silty CLAY with abundant rootlets and occasional silt pockets. Sand is fine to coarse. *1.50m - 5.50m : Very strong organic odour*	
		2.00 2.00 2.00	D ES SPT(S)	N=0 (0,0/0,0,0,0)					2
		3.00 3.00	D SPT(S)	N=0 (0,0/0,0,0,0)					3
		4.00 4.00	D SPT(S)	N=0 (0,0/0,0,0,0)					4
		5.00 5.00	D SPT(S)	N=7 (1,1/1,2,2,2)					5
		5.50 – 6.00	B		5.50	4.35		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	
					6.00	3.85		End of Borehole at 6.00m	6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 5.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 5.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 1.2m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS08/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 12/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E349157.40 N378380.13
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 9.34m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	6.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		0.20	ES		0.30	9.04		MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
								MADE GROUND: Soft dark grey silty CLAY.	
	▽				1.00	8.34		MADE GROUND: Very soft to soft black silty CLAY with abundant rootlets and occasional silt pockets. Sand is fine to coarse.	1
		1.20	D					*1.00m - 5.50m : Very strong organic odour*	
		1.20	SPT(S)	N=0 (0,0/0,0,0,0)					
		1.50	ES						
		2.00	D						2
		2.00 – 2.50	B						
		2.00	SPT(S)	N=0 (0,0/0,0,0,0)					
		3.00	D						3
		3.00	SPT(S)	N=0 (0,0/0,0,0,0)					
		4.00	D						4
		4.00	SPT(S)	N=0 (0,0/0,0,0,0)					
		5.00	D						5
		5.00	SPT(S)	N=14 (2,2/3,3,3,5)					
					5.50	3.84		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	
					6.00	3.34		End of Borehole at 6.00m	6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 4.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.9m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS09/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 11/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E349206.34 N378646.20
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 10.46m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
								MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
	▽	0.50	ES		0.40	10.06		MADE GROUND: Reddish brown fine to coarse SAND.	
		1.20	D		1.00	9.46		MADE GROUND: Dark grey sandy CLAY.	1
		1.20	SPT(S)	N=1 (1,0/0,1,0,0)					
		2.00	SPT(S)	N=2 (1,0/1,0,1,0)					2
		3.00	SPT(S)	N=0 (0,0/0,0,0,0)	3.00	7.46		Made Ground: Very soft to soft black sandy CLAY with abundant rootlets and occasional sand pockets. Sand is fine to coarse.	3
								3.00m - 4.00m : Very strong organic odour	
		4.00	D						4
		4.00	SPT(S)	N=0 (0,0/0,0,0,0)					
		5.00	SPT(S)	N=0 (0,0/0,0,0,0)	5.00	5.46		End of Borehole at 5.00m	5
									6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 3.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 3.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.5m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS10/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 12/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E348921.00 N378309.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 9.44m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	6.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.10	ES		0.30	9.14		MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
								MADE GROUND: Dark brown to yellowish brown clayey fine to coarse SAND.	1
		1.20 1.20	D SPT(S)	N=0 (0,0/0,0,0,0)	1.60	7.84		Made Ground: Very soft to soft black mottled light grey silty CLAY with abundant rootlets and occasional silt pockets. Sand is fine to coarse. *1.60m - 4.50m : Very strong organic odour*	
		2.00 2.00 2.00	D ES SPT(S)	N=0 (0,0/0,0,0,0)					2
		3.00 3.00	D SPT(S)	N=0 (0,0/0,0,0,0)					3
		4.00 4.00	D SPT(S)	N=0 (0,0/0,0,0,0)					4
		5.00 5.00	D SPT(S)	N=14 (2,2/3,3,4,4)	4.50	4.94		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	5
					6.00	3.44		End of Borehole at 6.00m	6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 5.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 5.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS11/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 12/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E348809.00 N378111.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 8.93m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	6.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.50	ES		0.30	8.63		MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
					1.00	7.93		MADE GROUND: Dark brown to yellowish brown clayey fine to coarse SAND.	1
		1.20 1.20	D SPT(S)	N=0 (0,0/0,0,0,0)	1.30	7.63		MADE GROUND: Soft dark grey silty CLAY.	
		2.00 2.00 2.00	D ES SPT(S)	N=0 (0,0/0,0,0,0)				MADE GROUND: Very soft to soft black mottled light grey silty CLAY with abundant rootlets and occasional silt pockets. Sand is fine to coarse. *1.30m - 4.80m : Very strong organic odour*	2
		3.00 3.00	D SPT(S)	N=0 (0,0/0,0,0,0)					3
		4.00	SPT(S)	N=0 (0,0/0,0,0,0)					4
		5.00	SPT(S)	N=0 (0,0/0,0,0,0)	4.80	4.13		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	5
					6.00	2.93		End of Borehole at 6.00m	6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 2.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 2.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS12/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 13/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E348924.00 N378208.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 9.35m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	6.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
								MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
					0.30	9.05		MADE GROUND: Soft dark grey silty CLAY.	
	▽	1.00 1.00 – 1.50 1.20 1.20	ES B D SPT(S)	 N=0 (0,0/0,0,0,0)	1.20	8.15		MADE GROUND: Very soft to soft black mottled light grey silty CLAY with abundant rootlets and occasional silt pockets. Sand is fine to coarse. *1.20m - 5.50m : Very strong organic odour*	1
		2.00 2.00	D SPT(S)	 N=0 (0,0/0,0,0,0)					2
		3.00 3.00 3.00	D ES SPT(S)	 N=0 (0,0/0,0,0,0)					3
		4.00 4.00	D SPT(S)	 N=0 (0,0/0,0,0,0)					4
		5.00 5.00	D SPT(S)	 N=16 (3,3/3,4,4,5)					5
					5.50	3.85		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	
					6.00	3.35		End of Borehole at 6.00m	6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 5.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 5.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 1.1m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS13/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 13/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E349135.00 N378289.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 9.42m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	6.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
					0.30	9.12		MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
								MADE GROUND: Soft dark grey silty CLAY.	
		1.00	ES						1
		1.20	SPT(S)	N=0 (0,0/0,0,0,0)					
	▽				1.40	8.02		MADE GROUND: Very soft to soft black mottled light grey silty CLAY with abundant rootlets and occasional silt pockets. Sand is fine to coarse. *1.40m - 5.50m : Very strong organic odour*	
		2.00	D						2
		2.00	SPT(S)	N=0 (0,0/0,0,0,0)					
		3.00	SPT(S)	N=0 (0,0/0,0,0,0)					3
		4.00	SPT(S)	N=0 (0,0/0,0,0,0)					4
		5.00	D						5
		5.00	SPT(S)	N=0 (0,0/0,0,0,0)					
					5.50	3.92		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	
					6.00	3.42		End of Borehole at 6.00m	6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 5.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 5.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 1.5m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS14/CELL3
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 13/06/2024
Location: Frodsham Wind Farm, Cheshire	Contractor: PM Sampling	Co-ords: E349249.00 N378344.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level : 9.25m AoD

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
FL	SS	SS	66%	6.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
								MADE GROUND: Dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
					0.30	8.95		MADE GROUND: Soft dark grey silty CLAY.	
	▽	0.50 0.50 – 1.00	ES B						1
		1.20 1.20	D SPT(S)	N=0 (0,0/0,0,0,0)					
					1.80	7.45		MADE GROUND: Very soft to soft black mottled light grey silty CLAY with abundant rootlets and occasional silt pockets. Sand is fine to coarse. *1.80m - 4.50m : Very strong organic odour*	
		2.00	SPT(S)	N=0 (0,0/0,0,0,0)					2
		3.00 3.00	D SPT(S)	N=0 (0,0/0,0,0,0)					3
		4.00 4.00	D SPT(S)	N=0 (0,0/0,0,0,0)					4
					4.50	4.75		Firm to stiff light grey mottled light brown silty CLAY (TIDAL FLAT DEPOSITS).	
		5.00 5.00 5.00	D ES SPT(S)	N=17 (2,2/3,4,5,5)					5
					6.00	3.25		End of Borehole at 6.00m	6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 3.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 m bgl for service clearance and GPR scanned prior to the drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 m bgl and slotted to 3.0 m bgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.9m.

Log printed on 25/07/2024 at 10:07

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS15
Sheet 1 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 25/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E348755.00 N378337.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
								TOPSOIL: Loose dark brown clayey fine to coarse SAND with occasional rootlets.	
					0.40			Very soft light grey mottled reddish brown silty sandy CLAY. Sand is fine to coarse.	
	▽	1.00 – 1.40 1.00	ES SPT(S)	N=1 (0,0/0,0,0,1)					1
		1.50 – 2.00	ES		1.50			Very loose light brown clayey fine to coarse SAND.	
		2.00	SPT(S)	N=1 (0,0/0,1,0,0)	2.00			Very soft light grey very sandy CLAY. Sand is fine to coarse.	2
		3.00	SPT(S)	N=1 (1,1/0,1,0,0)					3
		4.00 – 5.00 4.00	B SPT(S)	N=0 (0,0/0,0,0,0)					4

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
BACKFILL: Pit backfilled with arisings, no install in place.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.8 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS15
Sheet 2 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 25/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E348755.00 N378337.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT(S)	N=2 (1,0/0,1,1,1,0)	5.00			Very soft light grey very sandy CLAY. Sand is fine to coarse.	5
								End of Borehole at 5.00m	6
									7
									8
									9

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
BACKFILL: Pit backfilled with arisings, no install in place.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.8 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS16
Sheet 1 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 25/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E348999.00 N378512.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
								MADE GROUND: Dark brown clayey fine to coarse SAND with occasional rootlets (TOPSOIL).	
					0.50			MADE GROUND: Very soft light grey silty very sandy CLAY. Sand is fine to coarse.	
		1.00	SPT(S)	N=1 (1,0/0,0,1,0)					1
		1.30 – 1.60	B					*1.30m - 1.40m : Light brown clayey fine to coarse SAND.*	
					1.40			MADE GROUND: Very soft black silty CLAY with a very strong organic smell.	
	▽	1.60 – 2.00	ES					*1.60m - 1.70m : Dark grey silty very sandy CLAY. Sand is fine to coarse.*	
		2.00	SPT(S)	N=2 (1,1/0,1,1,0)					2
					2.50			Very loose light brownish grey clayey silty fine to coarse SAND.	
		3.00	SPT(S)	N=1 (0,0/0,0,1,0)					3
								3.80m - 3.90m : Dark brownish grey sandy CLAY. Sand is fine to coarse.	
		4.00	SPT(S)	N=0 (1,1/0,0,0,0)					4
		4.70 – 5.00	ES		4.70			Very loose reddish brown clayey silty fine to coarse SAND.	

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 3.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 3.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 1.6 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS16
Sheet 2 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 25/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E348999.00 N378512.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT(S)	N=1 (1,0/0,1,0,0)	5.00			Very loose reddish brown clayey silty fine to coarse SAND.	5
								End of Borehole at 5.00m	6
									7
									8
									9

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 3.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 3.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 1.6 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS17
Sheet 1 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 25/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349124.00 N378617.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		0.00 – 0.30	ES					TOPSOIL: Soft dark brown very clayey fine to coarse SAND with occasional rootlets.	
					0.30				
		0.40 – 1.00	ES					Very loose light brown clayey silty fine to coarse SAND.	
	▽								
		1.00	SPT(S)	N=0 (1,1/0,0,0,0)					1
					1.80				
		2.00 – 4.00	B					Very loose to loose brownish red very clayey silty fine to coarse SAND with a low cobble content.	
		2.00	SPT(S)	N=1 (0,0/0,0,1,0)					2
		3.00	SPT(S)	N=2 (1,0/1,0,0,1)					3
		4.00	SPT(S)	N=6 (2,2/1,2,2,1)					4
					4.80				
								Very soft dark grey silty CLAY.	

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 4.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.7 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS17
Sheet 2 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 25/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349124.00 N378617.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT(S)	N=0 (1,1/0,0,0,0)	5.00			Very soft dark grey silty CLAY.	
								End of Borehole at 5.00m	5
									6
									7
									8
									9

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 4.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.7 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS18
Sheet 1 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 25/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349365.00 N378786.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		0.30 – 1.00	ES		0.30			TOPSOIL: Loose dark brown clayey fine to coarse SAND.	
	▽	1.00 – 2.00 1.00	B SPT(S)	N=1 (0,0/1,0,0,0)				Very loose light brown clayey silty fine to coarse SAND with a low cobble content.	1
					1.50			Very loose light grey very clayey silty fine to coarse SAND.	
		2.00	SPT(S)	N=0 (1,0/0,0,0,0)					2
		3.00	SPT(S)	N=3 (0,0/0,1,1,1)					3
		4.00 – 4.50 4.00	ES SPT(S)	N=1 (0,0/0,0,0,1)					4
					4.70			Very soft dark grey silty sandy CLAY. Sand is fine to coarse.	

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
BACKFILL: Pit backfilled with arisings, no install in place.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.8 m.

Log printed on 14/11/2024 at 11:11

Draft

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS18
Sheet 2 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 25/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349365.00 N378786.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT(S)	N=1 (1,1/0,1,0,0)	5.00			Very soft dark grey silty sandy CLAY. Sand is fine to coarse.	5
								End of Borehole at 5.00m	6
									7
									8
									9

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
BACKFILL: Pit backfilled with arisings, no install in place.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.8 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS19
Sheet 1 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 24/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349454.00 N378776.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
	▽	0.50 – 1.00	B		0.50			MADE GROUND: Soft dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
					0.90			MADE GROUND: Soft dark greyish brown slightly sandy silty CLAY. Sand is fine to coarse.	
		1.00 – 2.00 1.00	ES SPT(S)	N=0 (0,0/0,0,0,0)				MADE GROUND: Very soft black silty CLAY.	1
		2.00 – 3.00 2.00	ES SPT(S)	N=0 (0,0/0,0,0,0)					2
		3.00	SPT(S)	N=1 (0,0/1,0,0,0)					3
					3.20			Very soft light grey mottled reddish brown silty CLAY.	
		4.00	SPT(S)	N=0 (1,0/0,0,0,0)					4

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 4.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.4 m.

Log printed on 14/11/2024 at 11:11

Draft

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS19
Sheet 2 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 24/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349454.00 N378776.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT(S)	N=2 (0,0/1,0,1,0)	5.00			Very soft light grey mottled reddish brown silty CLAY.	
								End of Borehole at 5.00m	

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 4.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.4 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS20
Sheet 1 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 24/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349433.00 N378646.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		0.00 – 1.00	B					MADE GROUND: Soft dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
	▽				0.40			MADE GROUND: Very soft dark grey silty CLAY.	
		1.00	SPT(S)	N=0 (0,0/0,0,0,0)					1
		2.00 – 3.00	ES						
		2.00	SPT(S)	N=0 (0,0/0,0,0,0)					2
					2.90			MADE GROUND: Very soft black slightly sandy silty CLAY. Sand is fine to coarse.	
		3.00	SPT(S)	N=1 (0,1/0,0,0,1)					3
		3.50 – 4.00	ES						
		4.00	SPT(S)	N=2 (0,0/1,1,0,0)					4

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 4.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.4 m.

Log printed on 14/11/2024 at 11:11

Draft

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS20
Sheet 2 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 24/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349433.00 N378646.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT(S)	N=2 (1,0/0,1,1,1,0)	5.00			MADE GROUND: Very soft black slightly sandy silty CLAY. Sand is fine to coarse.	5
								End of Borehole at 5.00m	6
									7
									8
									9

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 4.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.4 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS21
Sheet 1 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 24/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349347.00 N378539.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.00 – 1.00	B					MADE GROUND: Soft dark brown sandy CLAY with occasional rootlets. Sand is fine to coarse (TOPSOIL).	
	▽				0.40			MADE GROUND: Very soft dark grey silty CLAY.	
		1.00 – 1.50 1.00	ES SPT(S)	N=0 (0,0/0,0,0,0)					1
					1.70			MADE GROUND: Very soft black silty sandy CLAY. Sand is fine to coarse.	
		2.00 – 3.00 2.00	ES SPT(S)	N=0 (0,0/0,0,0,0)					2
		3.00	SPT(S)	N=1 (0,0/0,0,0,1)					3
		4.00	SPT(S)	N=3 (0,0/1,0,1,1)					4

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
BACKFILL: Pit backfilled with arisings, no install in place.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.5 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS21
Sheet 2 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 24/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349347.00 N378539.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT(S)	N=1 (1,1/0,0,1,0)	5.00			MADE GROUND: Very soft black silty sandy CLAY. Sand is fine to coarse.	5
								End of Borehole at 5.00m	6
									7
									8
									9

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
BACKFILL: Pit backfilled with arisings, no install in place.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.5 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS22
Sheet 1 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 24/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349567.00 N378628.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
								MADE GROUND: Soft dark brown sandy CLAY with occasional rootlets. Sand is fine to coarse (TOPSOIL).	
					0.50			MADE GROUND: Very soft light grey mottled reddish brown silty sandy CLAY. Sand is fine to coarse.	
	▽	1.00 – 1.30 1.00	ES SPT(S)	N=0 (0,0/0,0,0,0)					1
		1.50 – 2.00	B		1.50			MADE GROUND: Very soft to soft black silty CLAY with a very strong organic odour.	
		2.00 – 2.50 2.00	ES SPT(S)	N=7 (1,1/2,2,2,1)	2.00			Very soft to soft light grey very sandy CLAY. Sand is fine to coarse.	2
		3.00	SPT(S)	N=1 (0,0/1,0,0,0)	2.70			Very soft black silty CLAY.	3
		4.00	SPT(S)	N=3 (0,0/1,1,1,0)					4

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 4.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.7 m.

Log printed on 14/11/2024 at 11:11

Draft

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS22
Sheet 2 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 24/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349567.00 N378628.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT(S)	N=1 (0,1/0,0,0,1)	5.00			Very soft black silty CLAY.	
								End of Borehole at 5.00m	

5
6
7
8
9

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 4.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.7 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS23
Sheet 1 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 24/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349502.00 N378402.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
	▽							MADE GROUND: Soft dark brown sandy CLAY. Sand is fine to coarse (TOPSOIL).	
					0.50			MADE GROUND: Very soft dark reddish brown very sandy CLAY. Sand is fine to coarse.	
		1.00 – 1.50 1.00	ES SPT(S)	N=0 (0,0/0,0,0,0)					1
		1.50 – 2.00	ES		1.50			MADE GROUND: Very soft dark grey silty CLAY.	
					1.80			MADE GROUND: Very soft to firm black silty CLAY with a very strong organic odour.	
		2.00 – 3.00 2.00	B SPT(S)	N=2 (1,1/1,1,0,0)				*2.20m - 2.30m : Light grey fine to coarse SAND.*	2
		3.00	SPT(S)	N=2 (0,1/0,0,1,1)					3
		4.00	SPT(S)	N=4 (0,0/1,1,1,1)					4

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 4.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.5 m.

Log printed on 14/11/2024 at 11:11

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS23
Sheet 2 of 2

Project Name: Frodsham Cell 3 Additional Works	Client: Cubico Invest	Date: 24/10/2024
Location: Frodsham, Cheshire	Contractor: PM Sampling Ltd	Co-ords: E349502.00 N378402.00
Project No. : GM12793	Drilling Equipment: WS Dart Rig	Level :

Logged By	Checked By	Approved By	SPT Energy Ratio	Final Depth
SC			%	5.00

Install. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT(S)	N=10 (2,2/3,2,2,3)	5.00			MADE GROUND: Very soft to firm black silty CLAY with a very strong organic odour.	
								End of Borehole at 5.00m	

Draft

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
												0.00m 1.00m	1.00m 4.00m	PLAIN SLOTTED	

Remarks

SERVICES: Inspection pit excavated to 1.2 mbgl for service clearance and GPR scanned prior to drilling.
INSTALL: Raised cover. Plain pipe installed to 1.0 mbgl and slotted to 4.0 mbgl.
TERMINATION REASON: Borehole terminated at proposed depth.
WATER: Water strike at 0.5 m.

Log printed on 14/11/2024 at 11:11

Appendix B

Laboratory Geotechnical Testing Results

Wardell Armstrong
Wardell Armstrong LLP
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Chapeltown
Sheffield
S35 2PH

t: 0845 111 7777

e: [redacted]

i2 Analytical Ltd.
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Herts,
WD18 8YS

t: 01923 225404
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e: reception@i2analytical.com

Analytical Report Number : 24-025611

Project / Site name:	Cell 3	Samples received on:	14/06/2024
Your job number:	GM12793	Samples instructed on/ Analysis started on:	18/06/2024
Your order number:	GM5963	Analysis completed by:	21/06/2024
Report Issue Number:	1	Report issued on:	26/06/2024
Samples Analysed:	8 soil samples - 4 leachate samples		

[redacted]

Key Account Executive
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 24-025611
Project / Site name: Cell 3
Your Order No: GM5963

Lab Sample Number				230605	230606	230608	230610	230611
Sample Reference				WS02	WS02	WS07	WS06	WS06
Sample Number				Cell 3	Cell 3	Cell 3	Cell 3	Cell 3
Depth (m)				0.50	2.50	2.50	1.00	3.00
Date Sampled				10/06/2024	10/06/2024	10/06/2024	10/06/2024	10/06/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	-	< 0.1
Moisture Content	%	0.01	NONE	5.9	20	43	-	40
Total mass of sample received	kg	0.1	NONE	0.9	0.8	0.9	-	0.8
Asbestos								
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Detected	Not-detected	-	Detected	-
Asbestos Analyst ID	N/A	N/A	N/A	MMI	MMI	-	MMI	-
Actinolite detected	Type	N/A	ISO 17025	Not-detected	-	-	Not-detected	-
Amosite detected	Type	N/A	ISO 17025	Not-detected	-	-	Not-detected	-
Anthophyllite detected	Type	N/A	ISO 17025	Not-detected	-	-	Not-detected	-
Chrysotile detected	Type	N/A	ISO 17025	Detected	-	-	Detected	-
Crocidolite detected	Type	N/A	ISO 17025	Not-detected	-	-	Not-detected	-
Tremolite detected	Type	N/A	ISO 17025	Not-detected	-	-	Not-detected	-
Asbestos % by hand picking/weighing	%	0.001	ISO 17025	< 0.001	-	-	< 0.001	-
Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	Loose Fibres	-	-	Loose Fibres	-
General Inorganics								
Total Sulphate as SO_4	mg/kg	50	MCERTS	130	-	1500	-	-
Petroleum Hydrocarbons								
TPHCWG - Aliphatic >EC5 - EC6 $_{HS_1D_AL}$	mg/kg	0.02	NONE	-	< 0.020	-	-	< 0.020
TPHCWG - Aliphatic >EC6 - EC8 $_{HS_1D_AL}$	mg/kg	0.02	NONE	-	< 0.020	-	-	0.097
TPHCWG - Aliphatic >EC8 - EC10 $_{HS_1D_AL}$	mg/kg	0.05	NONE	-	< 0.050	-	-	0.071
TPHCWG - Aliphatic >EC10 - EC12 $_{EH_CU_1D_AL}$	mg/kg	1	MCERTS	-	< 1.0	-	-	220
TPHCWG - Aliphatic >EC12 - EC16 $_{EH_CU_1D_AL}$	mg/kg	2	MCERTS	-	< 2.0	-	-	250
TPHCWG - Aliphatic >EC16 - EC21 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	-	< 8.0	-	-	600
TPHCWG - Aliphatic >EC21 - EC35 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	-	< 8.0	-	-	1200
TPHCWG - Aliphatic >EC35 - EC40 $_{EH_CU_1D_AL}$	mg/kg	10	NONE	-	< 10	-	-	160
TPHCWG - Aliphatic >EC5 - EC40 $_{EH_CU+HS_1D_AL}$	mg/kg	10	NONE	-	< 10	-	-	2500
TPHCWG - Aromatic >EC5 - EC7 $_{HS_1D_AR}$	mg/kg	0.01	NONE	-	< 0.010	-	-	< 0.010
TPHCWG - Aromatic >EC7 - EC8 $_{HS_1D_AR}$	mg/kg	0.01	NONE	-	< 0.010	-	-	< 0.010
TPHCWG - Aromatic >EC8 - EC10 $_{HS_1D_AR}$	mg/kg	0.05	NONE	-	< 0.050	-	-	< 0.050
TPHCWG - Aromatic >EC10 - EC12 $_{EH_CU_1D_AR}$	mg/kg	1	MCERTS	-	< 1.0	-	-	16
TPHCWG - Aromatic >EC12 - EC16 $_{EH_CU_1D_AR}$	mg/kg	2	MCERTS	-	< 2.0	-	-	200
TPHCWG - Aromatic >EC16 - EC21 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	-	< 10	-	-	310
TPHCWG - Aromatic >EC21 - EC35 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	-	< 10	-	-	830
TPHCWG - Aromatic >EC35 - EC40 $_{EH_CU_1D_AR}$	mg/kg	10	NONE	-	< 10	-	-	54
TPHCWG - Aromatic >EC5 - EC40 $_{EH_CU+HS_1D_AR}$	mg/kg	10	NONE	-	< 10	-	-	1400
TPH Total >EC5 - EC40 $_{EH_CU+HS_1D_TOTAL}$	mg/kg	10	NONE	-	< 10	-	-	3900
VOCs								
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	< 5.0	-	-	< 5.0
Benzene	µg/kg	5	MCERTS	-	< 5.0	-	-	< 5.0
Toluene	µg/kg	5	MCERTS	-	< 5.0	-	-	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	-	< 5.0	-	-	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	-	< 5.0	-	-	< 5.0

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 24-025611
Project / Site name: Cell 3
Your Order No: GM5963

Lab Sample Number				230605	230606	230608	230610	230611
Sample Reference				WS02	WS02	WS07	WS06	WS06
Sample Number				Cell 3	Cell 3	Cell 3	Cell 3	Cell 3
Depth (m)				0.50	2.50	2.50	1.00	3.00
Date Sampled				10/06/2024	10/06/2024	10/06/2024	10/06/2024	10/06/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
o-Xylene	µg/kg	5	MCERTS	-	< 5.0	-	-	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 24-025611
Project / Site name: Cell 3
Your Order No: GM5963

Lab Sample Number				230612	230613	230614
Sample Reference				SPARE 2	WS05	WS05
Sample Number				None Supplied	Cell 3	Cell 3
Depth (m)				0.50	0.20	3.50
Date Sampled				10/06/2024	10/06/2024	10/06/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
Stone Content	%	0.1	NONE	< 0.1	-	-
Moisture Content	%	0.01	NONE	15	-	-
Total mass of sample received	kg	0.1	NONE	0.4	-	-
Asbestos						
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	-	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	-	MMI	MMI
Actinolite detected	Type	N/A	ISO 17025	-	-	-
Amosite detected	Type	N/A	ISO 17025	-	-	-
Anthophyllite detected	Type	N/A	ISO 17025	-	-	-
Chrysotile detected	Type	N/A	ISO 17025	-	-	-
Crocidolite detected	Type	N/A	ISO 17025	-	-	-
Tremolite detected	Type	N/A	ISO 17025	-	-	-
Asbestos % by hand picking/weighing	%	0.001	ISO 17025	-	-	-
Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	-	-	-
General Inorganics						
Total Sulphate as SO_4	mg/kg	50	MCERTS	1000	-	-
Petroleum Hydrocarbons						
TPHCWG - Aliphatic >EC5 - EC6 $_{HS_1D_AL}$	mg/kg	0.02	NONE	-	-	-
TPHCWG - Aliphatic >EC6 - EC8 $_{HS_1D_AL}$	mg/kg	0.02	NONE	-	-	-
TPHCWG - Aliphatic >EC8 - EC10 $_{HS_1D_AL}$	mg/kg	0.05	NONE	-	-	-
TPHCWG - Aliphatic >EC10 - EC12 $_{EH_CU_1D_AL}$	mg/kg	1	MCERTS	-	-	-
TPHCWG - Aliphatic >EC12 - EC16 $_{EH_CU_1D_AL}$	mg/kg	2	MCERTS	-	-	-
TPHCWG - Aliphatic >EC16 - EC21 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	-	-	-
TPHCWG - Aliphatic >EC21 - EC35 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	-	-	-
TPHCWG - Aliphatic >EC35 - EC40 $_{EH_CU_1D_AL}$	mg/kg	10	NONE	-	-	-
TPHCWG - Aliphatic >EC5 - EC40 $_{EH_CU+HS_1D_AL}$	mg/kg	10	NONE	-	-	-
TPHCWG - Aromatic >EC5 - EC7 $_{HS_1D_AR}$	mg/kg	0.01	NONE	-	-	-
TPHCWG - Aromatic >EC7 - EC8 $_{HS_1D_AR}$	mg/kg	0.01	NONE	-	-	-
TPHCWG - Aromatic >EC8 - EC10 $_{HS_1D_AR}$	mg/kg	0.05	NONE	-	-	-
TPHCWG - Aromatic >EC10 - EC12 $_{EH_CU_1D_AR}$	mg/kg	1	MCERTS	-	-	-
TPHCWG - Aromatic >EC12 - EC16 $_{EH_CU_1D_AR}$	mg/kg	2	MCERTS	-	-	-
TPHCWG - Aromatic >EC16 - EC21 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	-	-	-
TPHCWG - Aromatic >EC21 - EC35 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	-	-	-
TPHCWG - Aromatic >EC35 - EC40 $_{EH_CU_1D_AR}$	mg/kg	10	NONE	-	-	-
TPHCWG - Aromatic >EC5 - EC40 $_{EH_CU+HS_1D_AR}$	mg/kg	10	NONE	-	-	-
TPH Total >EC5 - EC40 $_{EH_CU+HS_1D_TOTAL}$	mg/kg	10	NONE	-	-	-
VOCs						
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-	-
Benzene	µg/kg	5	MCERTS	-	-	-
Toluene	µg/kg	5	MCERTS	-	-	-
Ethylbenzene	µg/kg	5	MCERTS	-	-	-
p & m-Xylene	µg/kg	5	MCERTS	-	-	-

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Analytical Report Number: 24-025611
Project / Site name: Cell 3
Your Order No: GM5963

Lab Sample Number				230612	230613	230614
Sample Reference				SPARE 2	WS05	WS05
Sample Number				None Supplied	Cell 3	Cell 3
Depth (m)				0.50	0.20	3.50
Date Sampled				10/06/2024	10/06/2024	10/06/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
o-Xylene	µg/kg	5	MCERTS	-	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
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Analytical Report Number: 24-025611
Project / Site name: Cell 3
Your Order No: GM5963

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006 based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
230605	WS02	0.50	162	Loose Fibres	Chrysotile	< 0.001	< 0.001
230610	WS06	1.00	127	Loose Fibres	Chrysotile	< 0.001	< 0.001

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 24-025611
Project / Site name: Cell 3

Your Order No: GM5963

Lab Sample Number				230606	230607	230609	230615
Sample Reference				WS02	WS03	WS08	WS05
Sample Number				Cell 3	Cell 3	Cell 3	Cell 3
Depth (m)				2.50	3.00	1.50	6.00
Date Sampled				10/06/2024	10/06/2024	10/06/2024	10/06/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status				
Speciated PAHs							
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	0.98	0.61	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	0.51	0.57	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	0.27	0.32	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	0.48	0.36	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	0.14	0.12	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	0.24	0.11	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	0.14	0.07	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01
Total PAH							
Total EPA-16 PAHs	µg/l	0.16	NONE	< 0.16	2.76	2.16	< 0.16
Heavy Metals / Metalloids							
Arsenic (dissolved)	µg/l	1	ISO 17025	1.4	15	19	2.9
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	0.11	< 0.08	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	1.4	1.9	1.8	3.8
Copper (dissolved)	µg/l	0.7	ISO 17025	12	16	18	22
Lead (dissolved)	µg/l	1	ISO 17025	1.3	2.7	2.7	1.1
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	< 0.3	3.4	3.7	4.9
Zinc (dissolved)	µg/l	0.4	ISO 17025	7.5	15	12	7.6

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number : 24-025611
Project / Site name: Cell 3

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
230605	WS02	Cell 3	0.5	Brown sand with gravel and vegetation
230606	WS02	Cell 3	2.5	Brown sand with vegetation
230608	WS07	Cell 3	2.5	Brown clay
230611	WS06	Cell 3	3	Brown clay with vegetation
230612	SPARE 2	None Supplied	0.5	Brown sand with vegetation

Analytical Report Number : 24-025611
Project / Site name: Cell 3

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references	HSE Report No: 83/1996, HSG 248 (2021), HSG 264 (2012) & SCA Blue Book (draft)	A006B	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L038B	D	MCERTS
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088	D/W	MCERTS
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080	W	ISO 17025
Speciated PAHs and/or Semi-volatile organic compounds in leachate	SVOCs and PAHs in leachate	In-house method	L102B		ISO 17025
Asbestos Quant if Screen/ID positive	In-house method	In-house method		D	NONE
Asbestos types if id possitive	In-house method	In-house method		D	NONE

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis

Analytical Report Number : 24-025611
Project / Site name: Cell 3

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
MS	Mass spectrometry				
FID	Flame Ionisation Detector				
GC	Gas Chromatography				
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))				
CU	Clean-up - e.g. by Florisil®, silica gel				
1D	GC - Single coil/column gas chromatography				
2D	GC-GC - Double coil/column gas chromatography				
Total	Aliphatics & Aromatics				
AL	Aliphatics				
AR	Aromatics				
#1	EH_2D_Total but with humics mathematically subtracted				
#2	EH_2D_Total but with fatty acids mathematically subtracted				
_	Operator - underscore to separate acronyms (exception for +)				
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total				

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution

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Analytical Report Number : 24-026512

Project / Site name:	Delsol, Frodsham	Samples received on:	21/06/2024
Your job number:	GM12793	Samples instructed on / Analysis started on:	21/06/2024
Your order number:		Analysis completed by:	01/07/2024
Report Issue Number:	1	Report issued on:	01/07/2024
Samples Analysed:	5 water samples		

[redacted]
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 24-026512
Project / Site name: Delsol, Frodsham

Lab Sample Number				235130	235131	235132	235133	235134
Sample Reference				WS03	WS06	WS07	WS08	WS10
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				20/06/2024	20/06/2024	20/06/2024	20/06/2024	20/06/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					
General Inorganics								
pH (L099)	pH Units	N/A	ISO 17025	7.3	7.4	7.9	7.6	7.3
Salinity	ppt	2	NONE	5.6	< 2.0	< 2.0	3.9	6
Sulphate as SO_4	mg/l	0.045	ISO 17025	119	47.4	224	219	158
Chloride	mg/l	0.15	ISO 17025	2300 $^{\$\$}$	1100 $^{\$\$}$	280	2300 $^{\$\$}$	4300 $^{\$\$}$
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	82000	34000	4500	91000	150000 $^{\$\$}$
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	60.5	42.6	26.5	84	78.4
BOD (Biochemical Oxygen Demand) (Total) - PL (L086B)	mg/l	1	ISO 17025	17	29	2.8	320	70
Speciated PAHs								
Naphthalene	µg/l	0.01	ISO 17025	2	0.69	< 0.01	0.58	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	0.03	0.09	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	0.36	0.65	< 0.01	0.21	0.21
Fluorene	µg/l	0.01	ISO 17025	0.2	0.4	< 0.01	0.12	0.1
Phenanthrene	µg/l	0.01	ISO 17025	0.32	0.34	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	0.13	0.31	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	0.17	0.53	< 0.01	< 0.01	0.14
Pyrene	µg/l	0.01	ISO 17025	0.12	0.46	< 0.01	< 0.01	0.13
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	0.21	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	0.2	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	0.24	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	0.1	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	0.18	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total PAH								
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	3.33	4.4	< 0.16	0.91	0.58
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	0.15	ISO 17025	9.58	22.9	12.2	14.6	14.7
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.04	< 0.02	1.4	< 0.02	0.03
Chromium (dissolved)	µg/l	0.2	ISO 17025	3.3	2.4	0.5	3.8	4.3
Copper (dissolved)	µg/l	0.5	ISO 17025	7.5	< 0.5	25	1.6	7.6
Lead (dissolved)	µg/l	0.2	ISO 17025	2	1.1	0.4	0.6	1.5
Mercury (dissolved)	µg/l	0.05	ISO 17025	0.19	0.06	< 0.05	0.24	0.08
Nickel (dissolved)	µg/l	0.5	ISO 17025	16	8.5	15	18	16
Zinc (dissolved)	µg/l	0.5	ISO 17025	25	3.1	89	2.3	12
Calcium (dissolved)	mg/l	0.012	ISO 17025	460	320	310	470	530
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0 ^{*h}

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Analytical Report Number: 24-026512
Project / Site name: Delsol, Frodsham

Lab Sample Number				235130	235131	235132	235133	235134
Sample Reference				WS03	WS06	WS07	WS08	WS10
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				20/06/2024	20/06/2024	20/06/2024	20/06/2024	20/06/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					
Petroleum Hydrocarbons								
TPH - Aliphatic >EC5 - EC6 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aliphatic >EC6 - EC8 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aliphatic >EC8 - EC10 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aliphatic >EC10 - EC12 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	110	< 10	< 10	< 10
TPH - Aliphatic >EC12 - EC16 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	330	36	80	96
TPH - Aliphatic >EC16 - EC21 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	400	47	93	84
TPH - Aliphatic >EC21 - EC35 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	290	84	70	80
TPH - Aliphatic >EC5 - EC35 $_{HS+EH_1D_AL_MS}$	µg/l	10	NONE	< 10	1100	170	240	260
TPH - Aromatic >EC5 - EC7 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aromatic >EC7 - EC8 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aromatic >EC8 - EC10 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aromatic >EC10 - EC12 $_{EH_1D_AR_MS}$	µg/l	10	NONE	37	48	10	20	34
TPH - Aromatic >EC12 - EC16 $_{EH_1D_AR_MS}$	µg/l	10	NONE	80	120	32	90	100
TPH - Aromatic >EC16 - EC21 $_{EH_1D_AR_MS}$	µg/l	10	NONE	86	130	36	50	90
TPH - Aromatic >EC21 - EC35 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	160	50	< 10	80
TPH - Aromatic >EC5 - EC35 $_{HS+EH_1D_AR_MS}$	µg/l	10	NONE	200	460	130	160	300
VOCs								
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 24-026512
Project / Site name: Delsol, Frodsham

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW	In-house method based on USEPA Method 6020 & 200.8 for the determination of trace elements in water by ICP-MS	L012B	W	ISO 17025
Salinity in water	Determination of salinity of water by electrometric measurement	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L031B	W	NONE
Dissolved Organic Carbon in water	Determination of dissolved organic carbon in water by TOC/DOC NDIR Analyser	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037B	W	ISO 17025
Total petroleum hydrocarbons with carbon banding by GC-MS in water	Determination of total petroleum hydrocarbons in water by GC-MS/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L070B	W	NONE
BTEX and/or Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA 8260	L073B	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW	L080	W	ISO 17025
Chloride in water	Determination of Chloride colorimetrically by discrete analyser	In-house based on MEWAM Method ISBN 0117516260. Accredited matrices: SW,PW, GW,FSE,LL	L082B	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW	In-house method based on standard method 5210B	L086B	W	ISO 17025
Total petroleum hydrocarbons by GC-MS HS in water	Determination of total petroleum hydrocarbons in water by GC-MS HS	In-house method	L088B	W	ISO 17025
pH at 20°C in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method	L099	W	ISO 17025
Speciated PAHs and/or Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds (including PAH) in leachate by extraction in dichloromethane followed by GC-MS	In-house method based on USEPA 8270	L102B	W	ISO 17025
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	ISO 17025
Sulphate in water	Determination of sulphate in water after filtration by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW, LL	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025

Analytical Report Number : 24-026512
Project / Site name: Delsol, Frodsham

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices: SW, GW, PW, PrW (Al, Cu, Fe,Zn)	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution

$$ - Result was reported from high dilution. The result should be interpreted with caution.

*h - Due to methods difference, results for Hexavalent Chromium and Total Chromium do not agree, results should be interpreted with caution.

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Analytical Report Number : 24-027809

Project / Site name:	Frodsham Cell 3	Samples received on:	28/06/2024
Your job number:	GM12793	Samples instructed on/ Analysis started on:	28/06/2024
Your order number:	GM5987	Analysis completed by:	08/07/2024
Report Issue Number:	1	Report issued on:	08/07/2024
Samples Analysed:	8 water samples		

[redacted]
Senior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 24-027809
Project / Site name: Frodsham Cell 3

Your Order No: GM5987

Lab Sample Number				241578	241579	241580	241581	241582
Sample Reference				Drain 1	Drain 2	Pond	Gutter	Scrape1
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				27/06/2024	27/06/2024	27/06/2024	27/06/2024	27/06/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					
General Inorganics								
pH (L099)	pH Units	N/A	ISO 17025	8.1	7.9	8.2	7.1	7.7
Salinity	ppt	2	NONE	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Sulphate as SO_4	mg/l	0.045	ISO 17025	36.8	12.1	2.73	105	35.3
Chloride	mg/l	0.15	ISO 17025	210	210	28	160	190
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	91	150	35	1000	1200
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	41.3	47.5	14.4	18.5	49.7
BOD (Biochemical Oxygen Demand) (Total) - PL (L086B)	mg/l	1	ISO 17025	9.3	6.4	4.8	32	24
Speciated PAHs								
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total PAH								
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	0.15	ISO 17025	17.5	39.3	8.29	7.02	129
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.06	< 0.02	0.02	< 0.02	< 0.02
Chromium (total)	µg/l	0.2	ISO 17025	7.4	2.7	3.8	6.8	36.4
Copper (dissolved)	µg/l	0.5	ISO 17025	5.2	5	3.8	0.9	1.8
Lead (dissolved)	µg/l	0.2	ISO 17025	3.6	< 0.2	0.8	0.4	0.6
Mercury (dissolved)	µg/l	0.05	ISO 17025	0.08	< 0.05	< 0.05	< 0.05	0.16
Nickel (dissolved)	µg/l	0.5	ISO 17025	5	5.3	1.3	5	7.2
Zinc (dissolved)	µg/l	0.5	ISO 17025	5.9	2	1.6	8.8	1.3
Calcium (dissolved)	mg/l	0.012	ISO 17025	120	210	21	94	90
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0	U/S *U/S j	< 5.0

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Analytical Report Number: 24-027809
Project / Site name: Frodsham Cell 3

Your Order No: GM5987

Lab Sample Number				241578	241579	241580	241581	241582
Sample Reference				Drain 1	Drain 2	Pond	Gutter	Scrape1
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				27/06/2024	27/06/2024	27/06/2024	27/06/2024	27/06/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					
Petroleum Hydrocarbons								
TPH - Aliphatic >EC5 - EC6 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aliphatic >EC6 - EC8 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aliphatic >EC8 - EC10 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aliphatic >EC10 - EC12 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aliphatic >EC12 - EC16 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aliphatic >EC16 - EC21 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aliphatic >EC21 - EC35 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aliphatic >EC5 - EC35 $_{HS+EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aromatic >EC5 - EC7 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aromatic >EC7 - EC8 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aromatic >EC8 - EC10 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH - Aromatic >EC10 - EC12 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aromatic >EC12 - EC16 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aromatic >EC16 - EC21 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aromatic >EC21 - EC35 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aromatic >EC5 - EC35 $_{HS+EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
VOCs								
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 24-027809
Project / Site name: Frodsham Cell 3

Your Order No: GM5987

Lab Sample Number				241583	241584	241585
Sample Reference				Scrape2	Scrape3	Scrape4
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				27/06/2024	27/06/2024	27/06/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			
General Inorganics						
pH (L099)	pH Units	N/A	ISO 17025	8.1	8.1	8.1
Salinity	ppt	2	NONE	< 2.0	< 2.0	< 2.0
Sulphate as SO_4	mg/l	0.045	ISO 17025	9.76	27.7	8.62
Chloride	mg/l	0.15	ISO 17025	100	250	69
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	190	3500	130
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	47.7	87.5	47.7
BOD (Biochemical Oxygen Demand) (Total) - PL (L086B)	mg/l	1	ISO 17025	68	83	18
Speciated PAHs						
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Total PAH						
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16
Heavy Metals / Metalloids						
Arsenic (dissolved)	µg/l	0.15	ISO 17025	230	120	213
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.02	< 0.02	0.28
Chromium (total)	µg/l	0.2	ISO 17025	78	53.4	36.8
Copper (dissolved)	µg/l	0.5	ISO 17025	4	1.7	20
Lead (dissolved)	µg/l	0.2	ISO 17025	3.9	0.9	2.1
Mercury (dissolved)	µg/l	0.05	ISO 17025	0.28	0.09	0.15
Nickel (dissolved)	µg/l	0.5	ISO 17025	18	9.8	14
Zinc (dissolved)	µg/l	0.5	ISO 17025	3.5	2.6	8.7
Calcium (dissolved)	mg/l	0.012	ISO 17025	110	150	130
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0

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Analytical Report Number: 24-027809
Project / Site name: Frodsham Cell 3

Your Order No: GM5987

Lab Sample Number				241583	241584	241585
Sample Reference				Scrape2	Scrape3	Scrape4
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				27/06/2024	27/06/2024	27/06/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			
Petroleum Hydrocarbons						
TPH - Aliphatic >EC5 - EC6 HS_1D_AL	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH - Aliphatic >EC6 - EC8 HS_1D_AL	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH - Aliphatic >EC8 - EC10 HS_1D_AL	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH - Aliphatic >EC10 - EC12 EH_1D_AL_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH - Aliphatic >EC12 - EC16 EH_1D_AL_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH - Aliphatic >EC16 - EC21 EH_1D_AL_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH - Aliphatic >EC21 - EC35 EH_1D_AL_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH - Aliphatic >EC5 - EC35 HS+EH_1D_AL_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH - Aromatic >EC5 - EC7 HS_1D_AR	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH - Aromatic >EC7 - EC8 HS_1D_AR	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH - Aromatic >EC8 - EC10 HS_1D_AR	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH - Aromatic >EC10 - EC12 EH_1D_AR_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH - Aromatic >EC12 - EC16 EH_1D_AR_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH - Aromatic >EC16 - EC21 EH_1D_AR_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH - Aromatic >EC21 - EC35 EH_1D_AR_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH - Aromatic >EC5 - EC35 HS+EH_1D_AR_MS	µg/l	10	NONE	< 10	< 10	< 10
VOCs						
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0
Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 24-027809
Project / Site name: Frodsham Cell 3

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW	In-house method based on USEPA Method 6020 & 200.8 for the determination of trace elements in water by ICP-MS	L012B	W	ISO 17025
Metals in water by ICP-MS (total)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW	In-house method based on USEPA Method 6020 & 200.8 for the determination of trace elements in water by ICP-MS	L012B	W	ISO 17025
Salinity in water	Determination of salinity of water by electrometric measurement	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L031B	W	NONE
Dissolved Organic Carbon in water	Determination of dissolved organic carbon in water by TOC/DOC NDIR Analyser	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037B	W	ISO 17025
Total petroleum hydrocarbons with carbon banding by GC-MS in water	Determination of total petroleum hydrocarbons in water by GC-MS/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L070B	W	NONE
BTEX and/or Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA 8260	L073B	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW	L080	W	ISO 17025
Chloride in water	Determination of Chloride colorimetrically by discrete analyser	In-house based on MEWAM Method ISBN 0117516260. Accredited matrices: SW,PW, GW,FSE,LL	L082B	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW	In-house method based on standard method 5210B	L086B	W	ISO 17025
Total petroleum hydrocarbons by GC-MS HS in water	Determination of total petroleum hydrocarbons in water by GC-MS HS	In-house method	L088B	W	ISO 17025
pH at 20°C in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method	L099	W	ISO 17025
Speciated PAHs and/or Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds (including PAH) in leachate by extraction in dichloromethane followed by GC-MS	In-house method based on USEPA 8270	L102B	W	ISO 17025
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	ISO 17025
Sulphate in water	Determination of sulphate in water after filtration by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW, LL	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025

Analytical Report Number : 24-027809
Project / Site name: Frodsham Cell 3

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices: SW, GW, PW, PrW (Al, Cu, Fe,Zn)	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution

*U/S j - Unsuitable for analysis due to high discrepancy between Hexavalent Chromium and dissolved Chromium results caused by methods difference.

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Analytical Report Number : 24-051843

Project / Site name:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Samples received on:	28/10/2024
Your job number:	GM12793	Samples instructed on / Analysis started on:	05/11/2024
Your order number:	GM6426	Analysis completed by:	13/11/2024
Report Issue Number:	1	Report issued on:	13/11/2024
Samples Analysed:	7 soil samples - 1 leachate sample		

[redacted]

PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 24-051843
Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire
Your Order No: GM6426

Lab Sample Number				369025	369026	369027	369028	369029
Sample Reference				WS17	WS18	WS19	WS21	WS22
Sample Number				ES2	ES1	ES1	ES1	ES1
Depth (m)				0.00-0.30	0.30-1.00	1.00-2.00	1.00-1.50	1.00-1.30
Date Sampled				25/10/2024	25/10/2024	25/10/2024	25/10/2024	25/10/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	28	22	43	42	37
Total mass of sample received	kg	0.1	NONE	1.1	1.1	1.7	1.7	1.1
General Inorganics								
pH (L099)	pH Units	N/A	MCERTS	8	8	-	-	7.6
Ammoniacal Nitrogen as N	mg/kg	0.5	MCERTS	-	-	-	-	< 0.5
Ammoniacal Nitrogen as NH_4^+	mg/kg	0.5	MCERTS	-	-	-	-	< 0.5
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	3.7	-	-	-	-
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	0.18	< 0.05	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	0.1	< 0.05	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	0.15	< 0.05	-	-	-
Fluorene	mg/kg	0.05	MCERTS	0.2	< 0.05	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	1.4	< 0.05	-	-	-
Anthracene	mg/kg	0.05	MCERTS	0.3	< 0.05	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	1.2	< 0.05	-	-	-
Pyrene	mg/kg	0.05	MCERTS	1.3	< 0.05	-	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.57	< 0.05	-	-	-
Chrysene	mg/kg	0.05	MCERTS	0.59	< 0.05	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.56	< 0.05	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.23	< 0.05	-	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.52	< 0.05	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.18	< 0.05	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.05	< 0.05	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.23	< 0.05	-	-	-
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	7.69	< 0.80	-	-	-
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	28	5	-	-	48
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.9	< 0.2	-	-	3
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	20	7.5	-	-	100
Copper (aqua regia extractable)	mg/kg	1	MCERTS	25	4.3	-	-	130
Lead (aqua regia extractable)	mg/kg	1	MCERTS	59	6.3	-	-	190
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	1.3	< 0.3	-	-	23
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	9.3	6.3	-	-	33
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	190	22	-	-	560

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Analytical Report Number: 24-051843
Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire
Your Order No: GM6426

Lab Sample Number				369025	369026	369027	369028	369029
Sample Reference				WS17	WS18	WS19	WS21	WS22
Sample Number				ES2	ES1	ES1	ES1	ES1
Depth (m)				0.00-0.30	0.30-1.00	1.00-2.00	1.00-1.50	1.00-1.30
Date Sampled				25/10/2024	25/10/2024	25/10/2024	25/10/2024	25/10/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status					
VOCs								
Chloromethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Chloroethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Bromomethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Vinyl Chloride	µg/kg	5	NONE	-	-	< 5.0	< 5.0	< 5.0
Trichlorofluoromethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,1-Dichloroethene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Trans 1,2-dichloroethylene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,1-Dichloroethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
2,2-Dichloropropane	µg/kg	5	NONE	-	-	< 5.0	< 5.0	< 5.0
Chloroform	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,1,1-Trichloroethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,2-Dichloroethane	µg/kg	7	MCERTS	-	-	< 7.0	< 7.0	< 7.0
1,1-Dichloropropene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Cis-1,2-dichloroethene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Carbontetrachloride	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,2-Dichloropropane	µg/kg	6	MCERTS	-	-	< 6.0	< 6.0	< 6.0
Trichloroethene	µg/kg	10	MCERTS	-	-	< 10	< 10	< 10
Dibromomethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Bromodichloromethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Cis-1,3-dichloropropene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Trans-1,3-dichloropropene	µg/kg	10	MCERTS	-	-	< 10	< 10	< 10
Toluene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,1,2-Trichloroethane	µg/kg	6	MCERTS	-	-	< 6.0	< 6.0	< 6.0
1,3-Dichloropropane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Dibromochloromethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Tetrachloroethene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,2-Dibromoethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Chlorobenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,1,1,2-Tetrachloroethane	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	8	MCERTS	-	-	< 8.0	< 8.0	< 8.0
Styrene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Bromoform	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Isopropylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,1,2,2-Tetrachloroethane	µg/kg	5	NONE	-	-	< 5.0	< 5.0	< 5.0
Bromobenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
n-Propylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
2-Chlorotoluene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
4-Chlorotoluene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,3,5-Trimethylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
tert-Butylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,2,4-Trimethylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
sec-Butylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,3-Dichlorobenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
p-Isopropyltoluene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,4-Dichlorobenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,2-Dichlorobenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0

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Analytical Report Number: 24-051843
Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire
Your Order No: GM6426

Lab Sample Number				369025	369026	369027	369028	369029
Sample Reference				WS17	WS18	WS19	WS21	WS22
Sample Number				ES2	ES1	ES1	ES1	ES1
Depth (m)				0.00-0.30	0.30-1.00	1.00-2.00	1.00-1.50	1.00-1.30
Date Sampled				25/10/2024	25/10/2024	25/10/2024	25/10/2024	25/10/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status					
Butylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,2-Dibromo-3-chloropropane	µg/kg	8	MCERTS	-	-	< 8.0	< 8.0	< 8.0
1,2,4-Trichlorobenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
Hexachlorobutadiene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0
1,2,3-Trichlorobenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0	< 5.0

VOCs TICs

VOCs TICs Compound Name	N/A	N/A	NONE	-	-	ND	ND	ND

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 24-051843
Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire
Your Order No: GM6426

Lab Sample Number				369030	369031
Sample Reference				WS23	WS23
Sample Number				ES1	ES2
Depth (m)				1.00-1.50	1.50-2.00
Date Sampled				25/10/2024	25/10/2024
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	34	39
Total mass of sample received	kg	0.1	NONE	1.1	1.4
General Inorganics					
pH (L099)	pH Units	N/A	MCERTS	7.6	-
Ammoniacal Nitrogen as N	mg/kg	0.5	MCERTS	1.2	-
Ammoniacal Nitrogen as NH_4^+	mg/kg	0.5	MCERTS	1.6	-
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	-	-
Speciated PAHs					
Naphthalene	mg/kg	0.05	MCERTS	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-
Total PAH					
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	-	-
Heavy Metals / Metalloids					
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	62	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	4.2	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	120	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	180	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	240	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	18	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	39	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	720	-

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Analytical Report Number: 24-051843
Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire
Your Order No: GM6426

Lab Sample Number				369030	369031
Sample Reference				WS23	WS23
Sample Number				ES1	ES2
Depth (m)				1.00-1.50	1.50-2.00
Date Sampled				25/10/2024	25/10/2024
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status		
VOCs					
Chloromethane	µg/kg	5	MCERTS	< 5.0	< 5.0
Chloroethane	µg/kg	5	MCERTS	< 5.0	< 5.0
Bromomethane	µg/kg	5	MCERTS	< 5.0	< 5.0
Vinyl Chloride	µg/kg	5	NONE	< 5.0	< 5.0
Trichlorofluoromethane	µg/kg	5	MCERTS	< 5.0	< 5.0
1,1-Dichloroethene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	5	MCERTS	< 5.0	< 5.0
Trans 1,2-dichloroethylene	µg/kg	5	MCERTS	< 5.0	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	MCERTS	< 5.0	< 5.0
1,1-Dichloroethane	µg/kg	5	MCERTS	< 5.0	< 5.0
2,2-Dichloropropane	µg/kg	5	NONE	< 5.0	< 5.0
Chloroform	µg/kg	5	MCERTS	< 5.0	< 5.0
1,1,1-Trichloroethane	µg/kg	5	MCERTS	< 5.0	< 5.0
1,2-Dichloroethane	µg/kg	7	MCERTS	< 7.0	< 7.0
1,1-Dichloropropene	µg/kg	5	MCERTS	< 5.0	< 5.0
Cis-1,2-dichloroethene	µg/kg	5	MCERTS	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0
Carbontetrachloride	µg/kg	5	MCERTS	< 5.0	< 5.0
1,2-Dichloropropane	µg/kg	6	MCERTS	< 6.0	< 6.0
Trichloroethene	µg/kg	10	MCERTS	< 10	< 10
Dibromomethane	µg/kg	5	MCERTS	< 5.0	< 5.0
Bromodichloromethane	µg/kg	5	MCERTS	< 5.0	< 5.0
Cis-1,3-dichloropropene	µg/kg	5	MCERTS	< 5.0	< 5.0
Trans-1,3-dichloropropene	µg/kg	10	MCERTS	< 10	< 10
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,1,2-Trichloroethane	µg/kg	6	MCERTS	< 6.0	< 6.0
1,3-Dichloropropane	µg/kg	5	MCERTS	< 5.0	< 5.0
Dibromochloromethane	µg/kg	5	MCERTS	< 5.0	< 5.0
Tetrachloroethene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,2-Dibromoethane	µg/kg	5	MCERTS	< 5.0	< 5.0
Chlorobenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,1,1,2-Tetrachloroethane	µg/kg	5	MCERTS	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
p & m-Xylene	µg/kg	8	MCERTS	< 8.0	< 8.0
Styrene	µg/kg	5	MCERTS	< 5.0	< 5.0
Bromoform	µg/kg	5	MCERTS	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0
Isopropylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,1,2,2-Tetrachloroethane	µg/kg	5	NONE	< 5.0	< 5.0
Bromobenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
n-Propylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
2-Chlorotoluene	µg/kg	5	MCERTS	< 5.0	< 5.0
4-Chlorotoluene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,3,5-Trimethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
tert-Butylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,2,4-Trimethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
sec-Butylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,3-Dichlorobenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
p-Isopropyltoluene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,4-Dichlorobenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,2-Dichlorobenzene	µg/kg	5	MCERTS	< 5.0	< 5.0

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Analytical Report Number: 24-051843
Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire
Your Order No: GM6426

Lab Sample Number				369030	369031
Sample Reference				WS23	WS23
Sample Number				ES1	ES2
Depth (m)				1.00-1.50	1.50-2.00
Date Sampled				25/10/2024	25/10/2024
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status		
Butylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,2-Dibromo-3-chloropropane	µg/kg	8	MCERTS	< 8.0	< 8.0
1,2,4-Trichlorobenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
Hexachlorobutadiene	µg/kg	5	MCERTS	< 5.0	< 5.0
1,2,3-Trichlorobenzene	µg/kg	5	MCERTS	< 5.0	< 5.0

VOCs TICs

VOCs TICs Compound Name	N/A	N/A	NONE	ND	ND

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 24-051843
Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire

Your Order No: GM6426

Lab Sample Number				369030
Sample Reference				WS23
Sample Number				ES1
Depth (m)				1.00-1.50
Date Sampled				25/10/2024
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	Units	Test Limit of detection	Test Accreditation Status	
General Inorganics				
Ammoniacal Nitrogen as N	µg/l	15	NONE	120
Ammoniacal Nitrogen as NH_4^+	µg/l	15	NONE	150
Heavy Metals / Metalloids				
Arsenic (dissolved)	µg/l	1	ISO 17025	6.6
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08
Chromium (dissolved)	µg/l	0.4	ISO 17025	6.3
Copper (dissolved)	µg/l	0.7	ISO 17025	57
Lead (dissolved)	µg/l	1	ISO 17025	2.8
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	6.3
Zinc (dissolved)	µg/l	0.4	ISO 17025	31

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 24-051843

Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
369025	WS17	ES2	0.00-0.30	Brown loam and clay with gravel and vegetation
369026	WS18	ES1	0.30-1.00	Brown clay and sand with gravel and vegetation
369027	WS19	ES1	1.00-2.00	Brown clay and loam with gravel
369028	WS21	ES1	1.00-1.50	Brown clay and sand with gravel and vegetation
369029	WS22	ES1	1.00-1.30	Brown clay and sand with gravel
369030	WS23	ES1	1.00-1.50	Brown clay and sand with gravel and vegetation
369031	WS23	ES2	1.50-2.00	Brown clay and sand with gravel

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Analytical Report Number : 24-051843
Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025
Speciated PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Tentatively identified compounds (VOC) in soil	Determination of volatile organic compounds total ion count in soil by headspace GC-MS followed by a full library scan	In-house method based on USEPA 8260	L073B	W	NONE
Ammonium as NH4 in leachate	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	NONE
Ammoniacal Nitrogen as N in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method,10:1 water extraction.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	MCERTS
Ammonium as NH4 in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099-PL	D	MCERTS
NRA Leachate 10:1		In-house method based on interim NRA guidance (1994)	L020B	W	NONE

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number : 24-051843
Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in leachate	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	NONE

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution

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The results included within the report relate only to the sample(s) submitted for testing.

Sample Deviation Report

Analytical Report Number : 24-051843

Project / Site name: Cell 3, Frodsham Marshes, Frodsham, Cheshire

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis.Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
WS17	ES2	S	369025	c	Speciated PAHs and/or Semi-volatile organic compounds in soil	L064B	c
WS18	ES1	S	369026	c	Speciated PAHs and/or Semi-volatile organic compounds in soil	L064B	c
WS19	ES1	S	369027	c	BTEX and/or Volatile organic compounds in soil	L073B	c
WS19	ES1	S	369027	c	Tentatively identified compounds (VOC) in soil	L073B	c
WS21	ES1	S	369028	c	BTEX and/or Volatile organic compounds in soil	L073B	c
WS21	ES1	S	369028	c	Tentatively identified compounds (VOC) in soil	L073B	c
WS22	ES1	S	369029	c	BTEX and/or Volatile organic compounds in soil	L073B	c
WS22	ES1	S	369029	c	Tentatively identified compounds (VOC) in soil	L073B	c
WS23	ES1	S	369030	c	BTEX and/or Volatile organic compounds in soil	L073B	c
WS23	ES1	S	369030	c	Tentatively identified compounds (VOC) in soil	L073B	c
WS23	ES2	S	369031	c	BTEX and/or Volatile organic compounds in soil	L073B	c
WS23	ES2	S	369031	c	Tentatively identified compounds (VOC) in soil	L073B	c

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Appendix C

Laboratory Soil Geochemical Testing Results

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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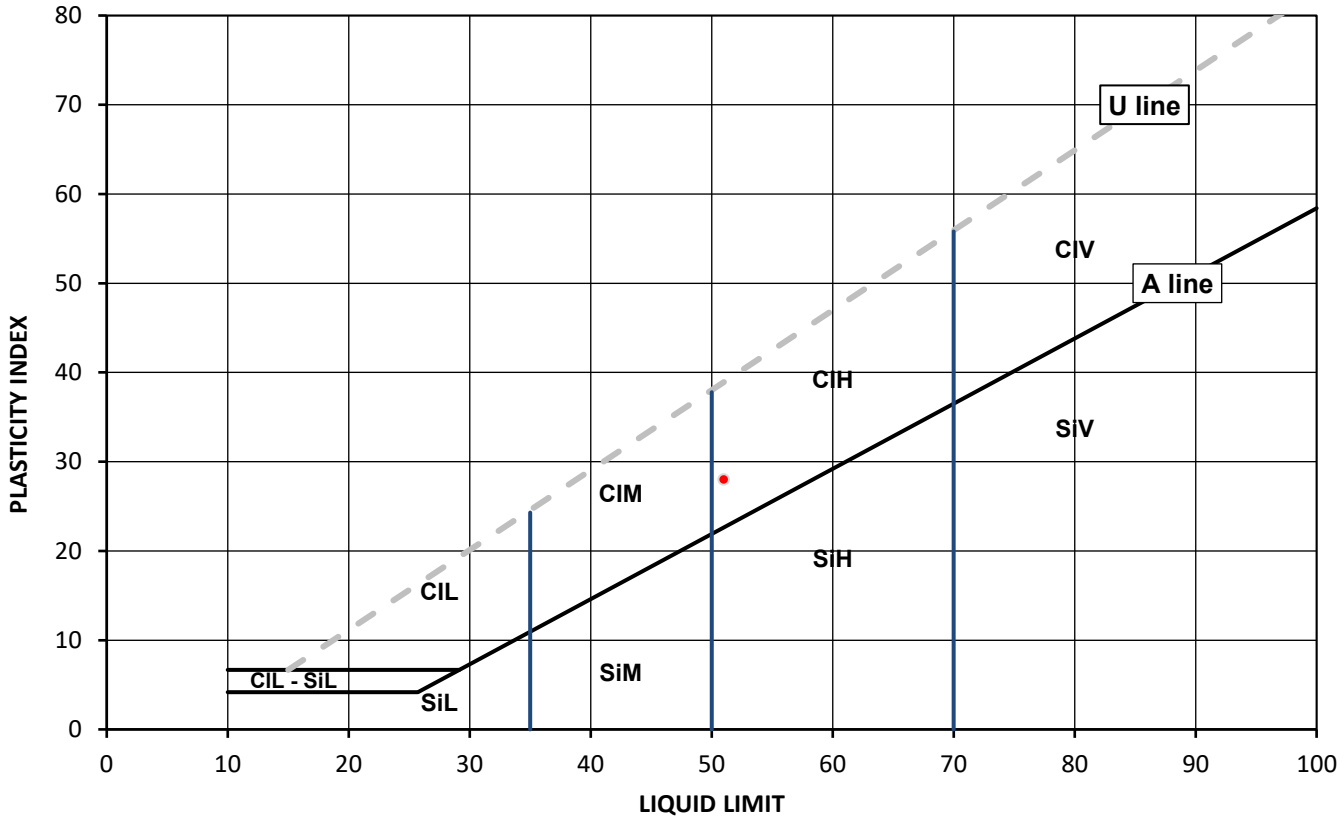
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	10/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site Address:	Cell 3	Sampled By:	Client - Fay Lawrence

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	237821	Depth Top [m]:	4.00
Hole No.:	WS03/Cell3	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Greyish brown slightly sandy CLAY		
Sample Preparation:	Tested in natural condition; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
24.7	51	23	28	0.07	0.93	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks:

[redacted]

Senior Reporting Specialist
or and on behalf of i2 Analytical Ltd

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laboratory. The results included within the report relate only to the sample(s) submitted for testi

Date Reported: 23/07/2024

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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Environmental Science

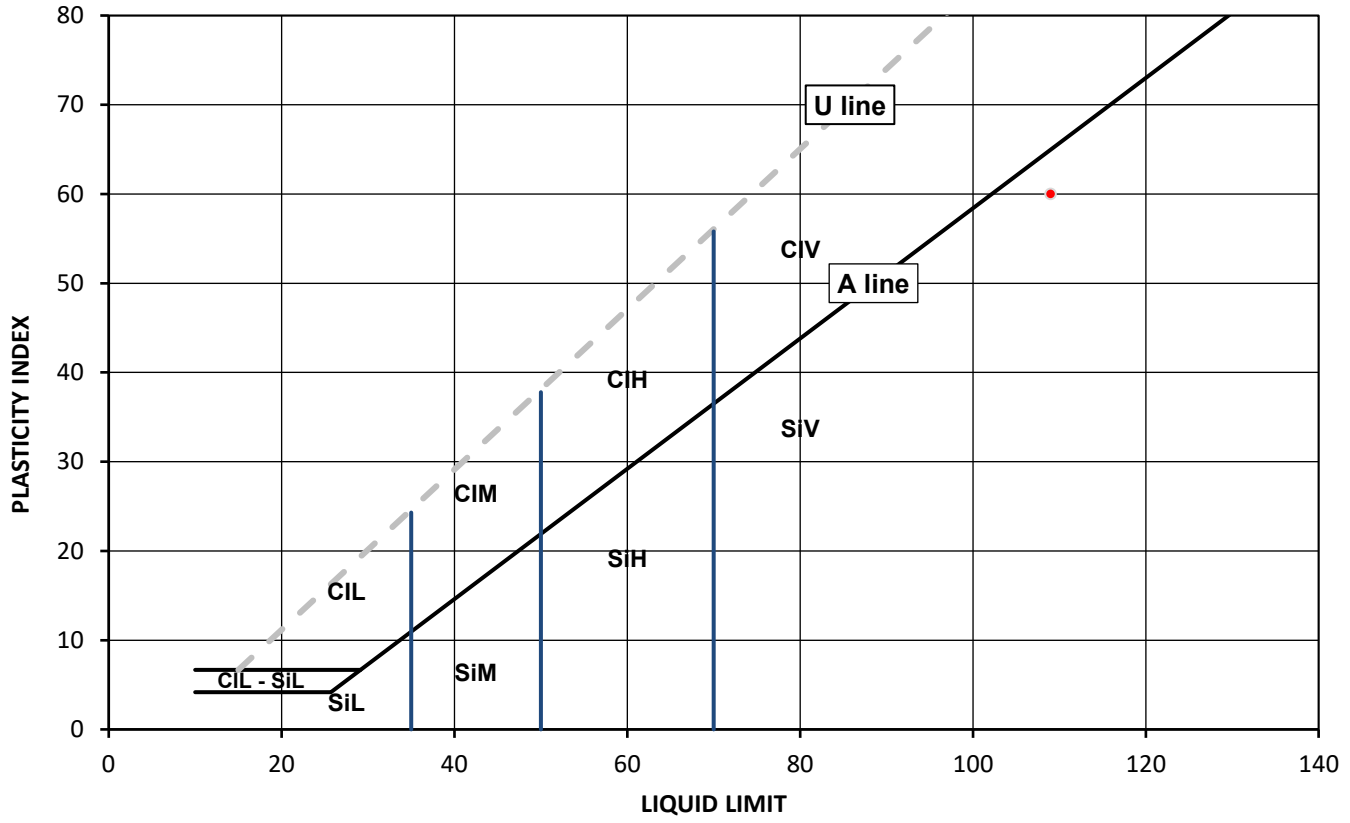
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	10/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site Address:	Cell 3	Sampled By:	Client - Fay Lawrence

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	237822	Depth Top [m]:	3.00
Hole No.:	WS04/Cell3	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Dark brown organic CLAY		
Sample Preparation:	Tested in natural condition; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
79.8	109	49	60	0.52	0.48	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks:

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[redacted]

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TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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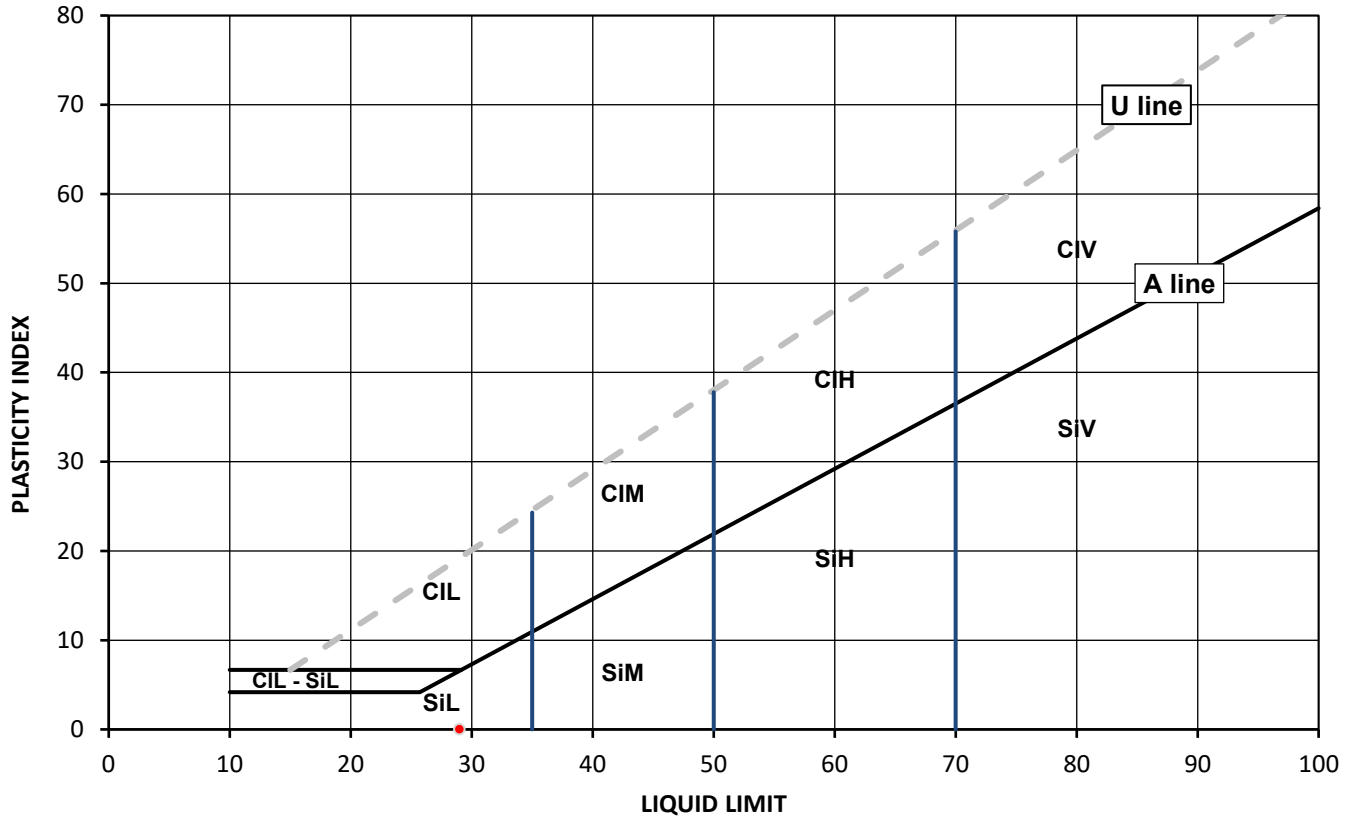
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	11/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site Address:	Cell 3	Sampled By:	Client - Fay Lawrence

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	237823	Depth Top [m]:	5.00
Hole No.:	WS07/Cell3	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Greyish brown slightly silty SAND		
Sample Preparation:	Tested in natural condition; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
26.4	29	NP	NP	N/A	N/A	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks:

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Date Reported: 23/07/2024

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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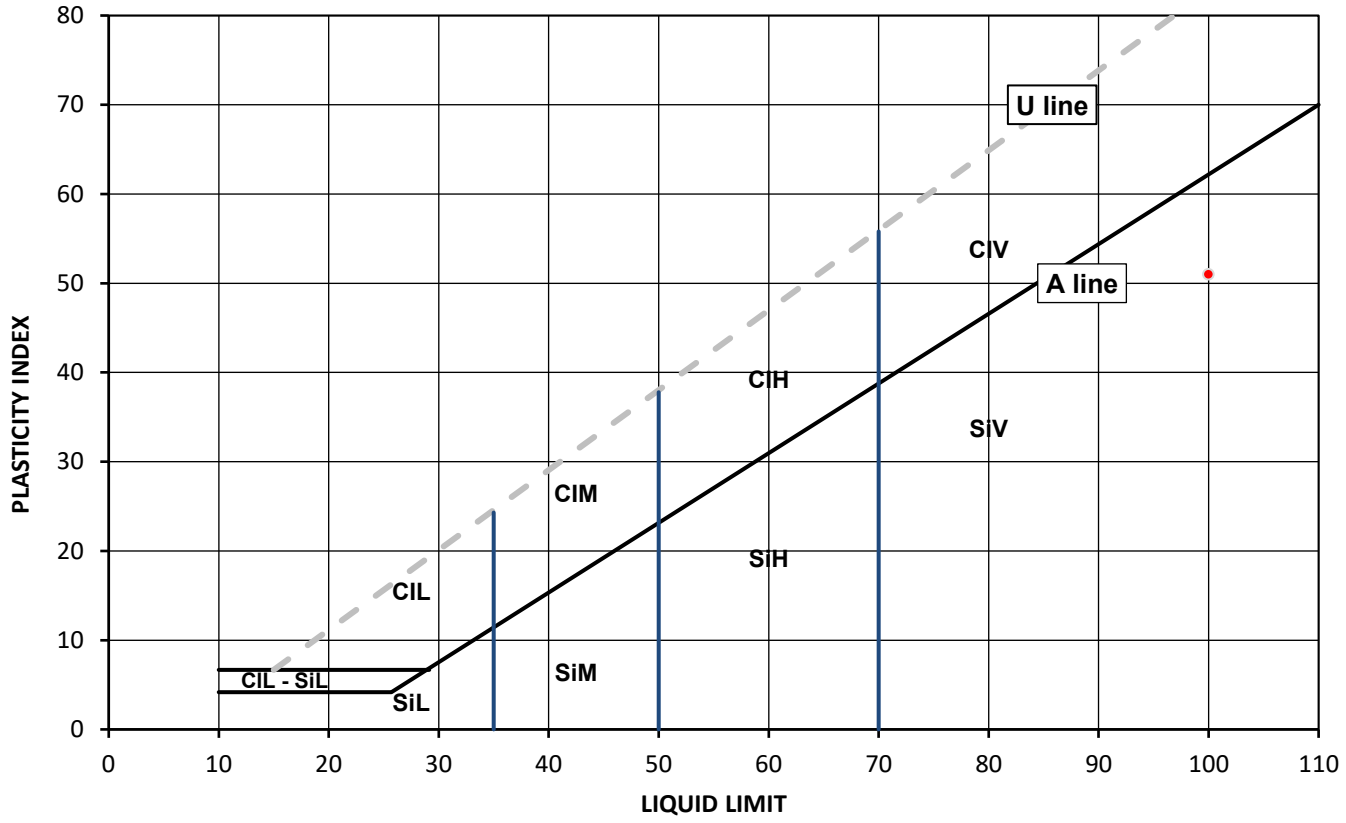
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	12/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site Address:	Cell 3	Sampled By:	Client - Fay Lawrence

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	237825	Depth Top [m]:	5.00
Hole No.:	WS10/Cell3	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Dark grey organic CLAY		
Sample Preparation:	Tested in natural condition; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
94.9	100	49	51	0.90	0.10	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks: Replaces Analytical Report Number 24-027034, issue no 1; Hole No. amended

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for and on behalf of i2 Analytical Ltd

Date Reported: 23/07/2024

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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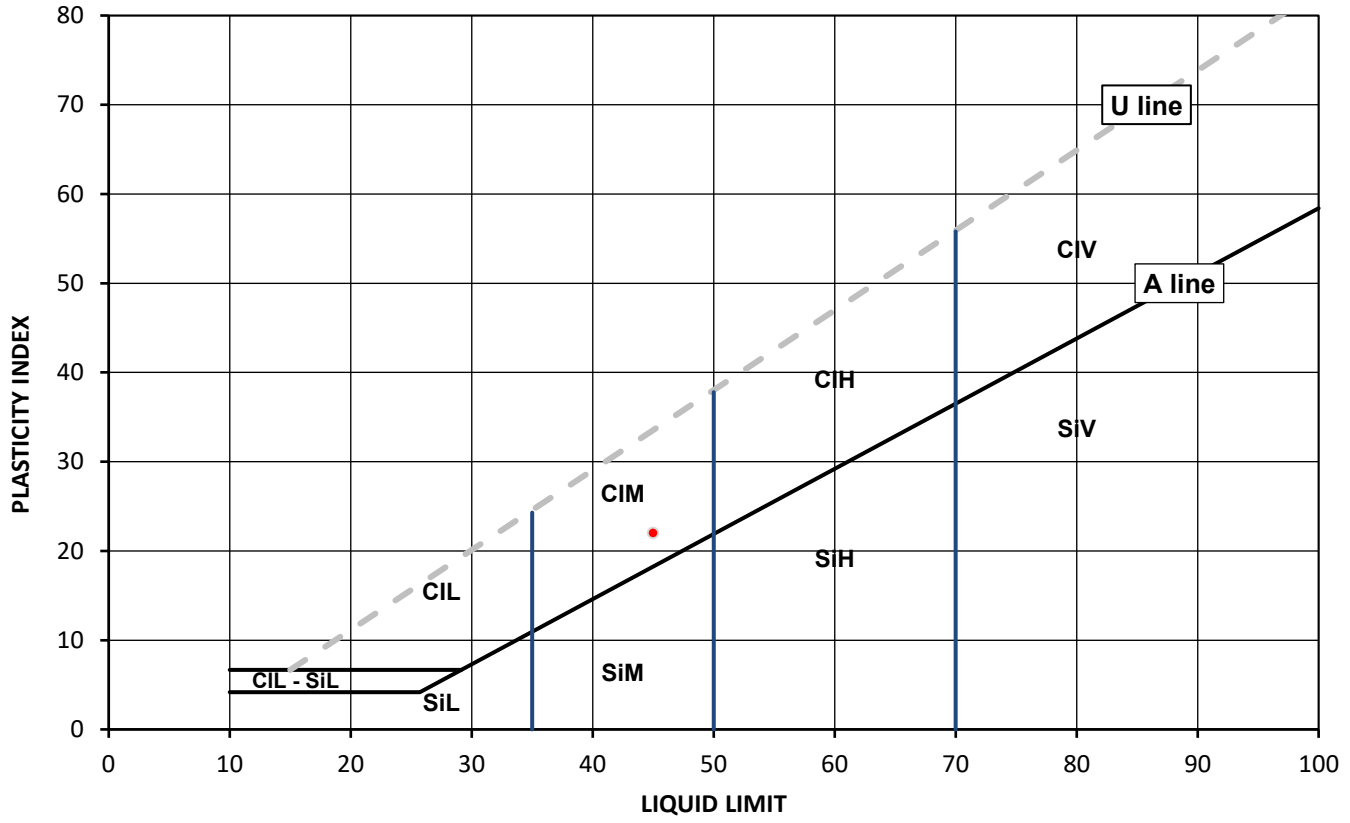
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	13/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site Address:	Cell 3	Sampled By:	Client - Fay Lawrence

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	237827	Depth Top [m]:	1.20
Hole No.:	WS05/Cell3	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Brown slightly sandy silty CLAY		
Sample Preparation:	Tested in natural condition; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
35.0	45	23	22	0.55	0.45	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks:

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[redacted]

[redacted]
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 23/07/2024

SUMMARY REPORT

SUMMARY OF CLASSIFICATION TEST RESULTS

Tested in Accordance with:

BS EN ISO 17892-12:2018+A2:2022 cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6. W by BS EN ISO 17892-1:2014+A1:2022.

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Brackmills Industrial Estate
Northampton NN4 7EB

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Client: Wardell Armstrong

Client Address: Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH

Contact: Fay Lawrence

Site Address: Cell 3

Client Reference: GM12793
Job Number: 24-027034-2
Date Sampled: 10/06 - 13/06/2024
Date Received: 10/06/2024
Date Tested: 03/07/2024
Sampled By: Client - Fay Lawrence

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	W	Liquid & Plastic Limit							Density		
		Reference	Depth Top m	Depth Base m	Type			%	% Passing 425um %	WL* %	Correlation Factor	Wp %	Ip %	Cone type	Sample Preparation	bulk Mg/m3	dry Mg/m3	PD Mg/m3
237821	WS03/Cell3	Not Given	4.00	Not Given	D	Greyish brown slightly sandy CLAY	Atterberg 4 Point	24.7	100	51	-	23	28	80g/30 deg	N / I			
237822	WS04/Cell3	Not Given	3.00	Not Given	D	Dark brown organic CLAY	Atterberg 4 Point	79.8	100	109	-	49	60	80g/30 deg	N / I			
237823	WS07/Cell3	Not Given	5.00	Not Given	D	Greyish brown slightly silty SAND	Atterberg 4 Point	26.4	100	29	-	NP	NP	80g/30 deg	N / I			
237825	WS10/Cell3	Not Given	5.00	Not Given	D	Dark grey organic CLAY	Atterberg 4 Point	94.9	100	100	-	49	51	80g/30 deg	N / I			
237827	WS05/Cell3	Not Given	1.20	Not Given	D	Brown slightly sandy silty CLAY	Atterberg 4 Point	35.0	100	45	-	23	22	80g/30 deg	N / I			

Note: # Non accredited; NP - Non plastic; N - Tested in natural condition, R - Tested after >0,425mm removed by hand, W - Tested after washing to remove >425mm; I - The water content in the sample was increased , D - The water content in the sample was decreased; * - One point liquid limit corrected as per the report Correlation Factor by Clayton C.R.I and Jukes A.W (1978)

Comments: Replaces Analytical Report Number 24-027034, issue no 1; Hole No. Amended (sample 237825)

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for and on behalf of i2 Analytical Ltd

Date Reported: 23/07/2024 **GF 362.15**

TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS EN ISO 17892-4:2016, BS 1377-2:2022 cl. 10

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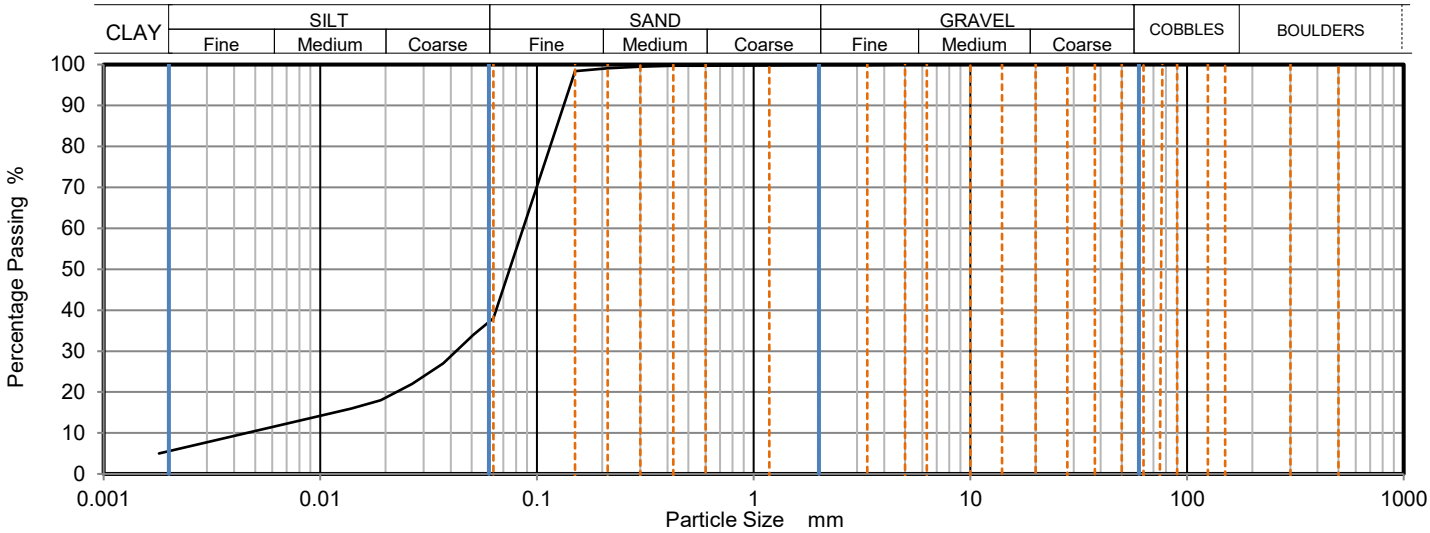
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Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	12/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site Address:	Cell 3	Sampled By:	Client - Fay Lawrence

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	237824	Depth Top [m]:	4.00
Hole No.:	WS08/Cell3	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Brownish grey very silty SAND		
Sample Preparation:	Sample was quartered, oven dried at 108.9 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0509	34
300	100	0.0369	27
150	100	0.0265	22
125	100	0.0190	18
90	100	0.0139	16
75	100	0.0018	5
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	2.65	Mg/m3
0.3	100		
0.212	99		
0.15	98		
0.063	38		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	0.00
Sand	62.00
Silt	32.00
Clay	6.00

Grading Analysis		
D100	mm	5
D60	mm	0.0864
D30	mm	0.0419
D10	mm	0.00426
Uniformity Coefficient		20
Curvature Coefficient		4.8

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving and hydrometer sedimentation

Remarks:

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[redacted]
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 23/07/2024

TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS EN ISO 17892-4:2016, BS 1377-2:2022 cl. 10

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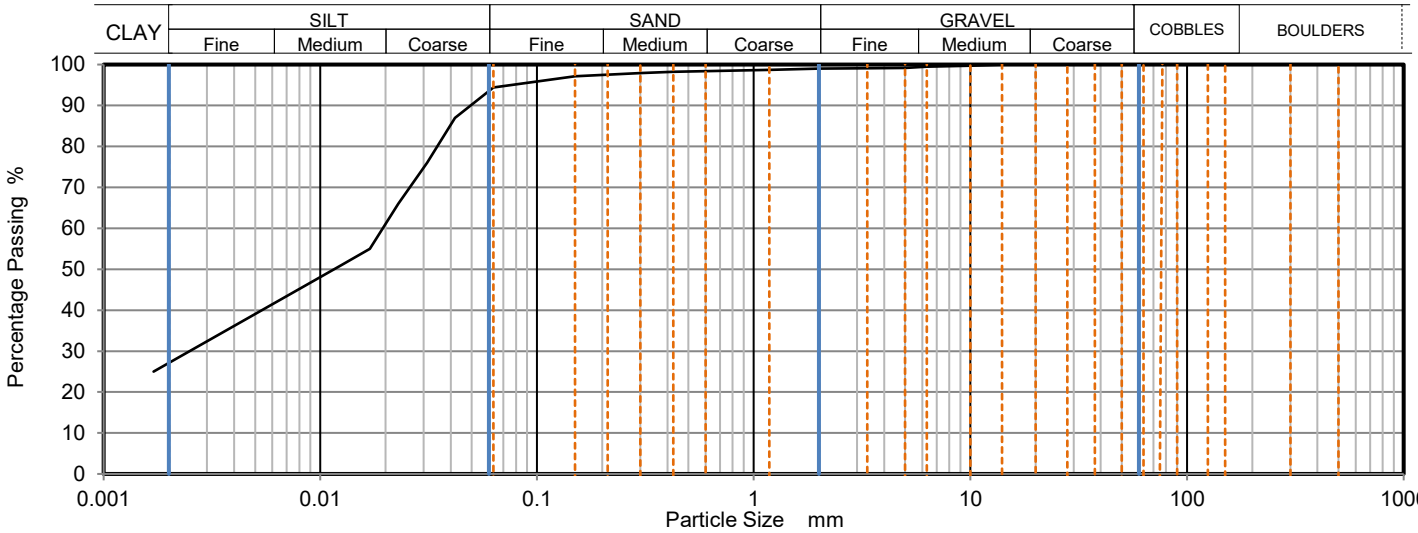
Environmental Science

Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	13/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site Address:	Cell 3	Sampled By:	Client - Fay Lawrence

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	237826	Depth Top [m]:	4.00
Hole No.:	WS14/Cell3	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Brown slightly sandy clayey SILT with fragments of grass		
Sample Preparation:	Sample was whole tested, oven dried at 108.8 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0418	87
300	100	0.0311	76
150	100	0.0229	66
125	100	0.0169	55
90	100	0.0125	51
75	100	0.0017	25
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	99		
3.35	99		
2	99		
1.18	99		
0.6	98	Particle density	(assumed)
0.425	98	2.65	Mg/m3
0.3	98		
0.212	98		
0.15	97		
0.063	94		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	1.00
Sand	5.00
Silt	67.00
Clay	27.00

Grading Analysis		
D100	mm	14
D60	mm	0.0195
D30	mm	0.00257
D10	mm	
Uniformity Coefficient		0.31
Curvature Coefficient		

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving and hydrometer sedimentation

Remarks: Replaces Analytical Report Number 24-027034, issue no 1; Hole No. Amended

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

[redacted]
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 23/07/2024

GF 366.11

TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS EN ISO 17892-4:2016, BS 1377-2:2022 cl. 10

i2 Analytical Ltd
Unit 8 Harrowden Road
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Northampton NN4 7EB

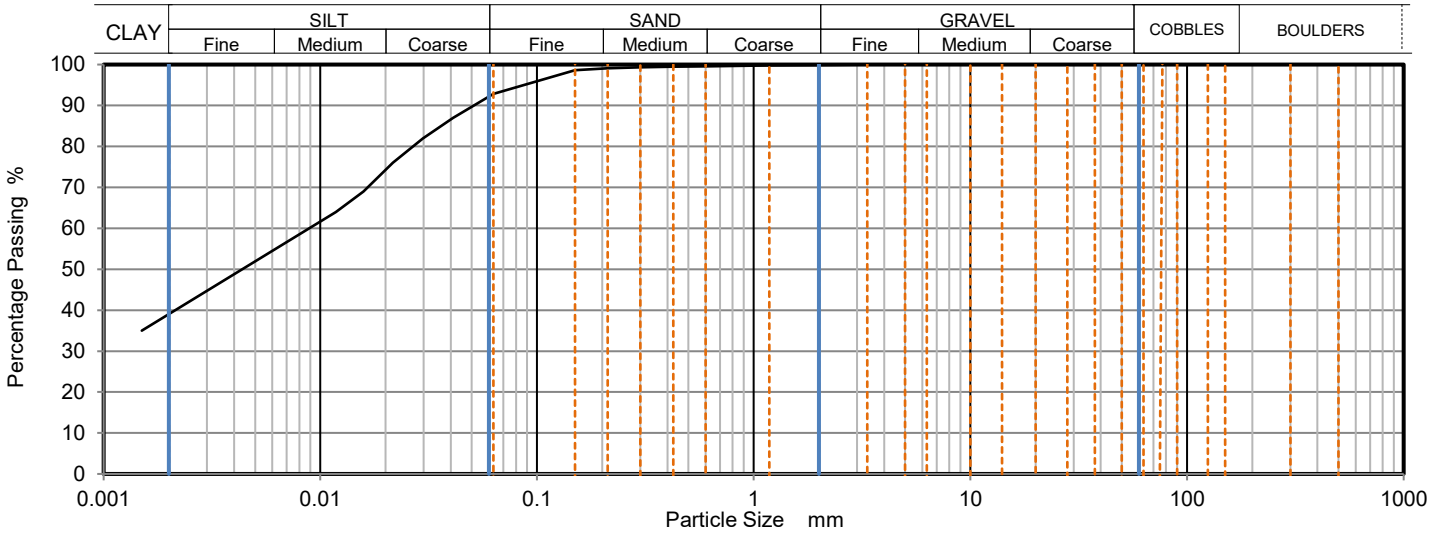
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Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	11/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	05/07/2024
Site Address:	Cell 3	Sampled By:	Client - Fay Lawrence

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	237828	Depth Top [m]:	5.50
Hole No.:	WS07/Cell3	Depth Base [m]:	6.00
Sample Reference:	Not Given	Sample Type:	B
Sample Description:	Greyish brown slightly sandy slightly organic silty CLAY		
Sample Preparation:	Sample was quartered, oven dried at 108.4 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0410	87
300	100	0.0298	82
150	100	0.0216	76
125	100	0.0158	69
90	100	0.0118	64
75	100	0.0015	35
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	2.65	Mg/m3
0.3	99		
0.212	99		
0.15	99		
0.063	93		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	0.00
Sand	7.00
Silt	54.00
Clay	39.00

Grading Analysis		
D100	mm	3.35
D60	mm	0.00909
D30	mm	
D10	mm	
Uniformity Coefficient		0.14
Curvature Coefficient		

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving and hydrometer sedimentation

Remarks:

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[redacted]

Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 23/07/2024

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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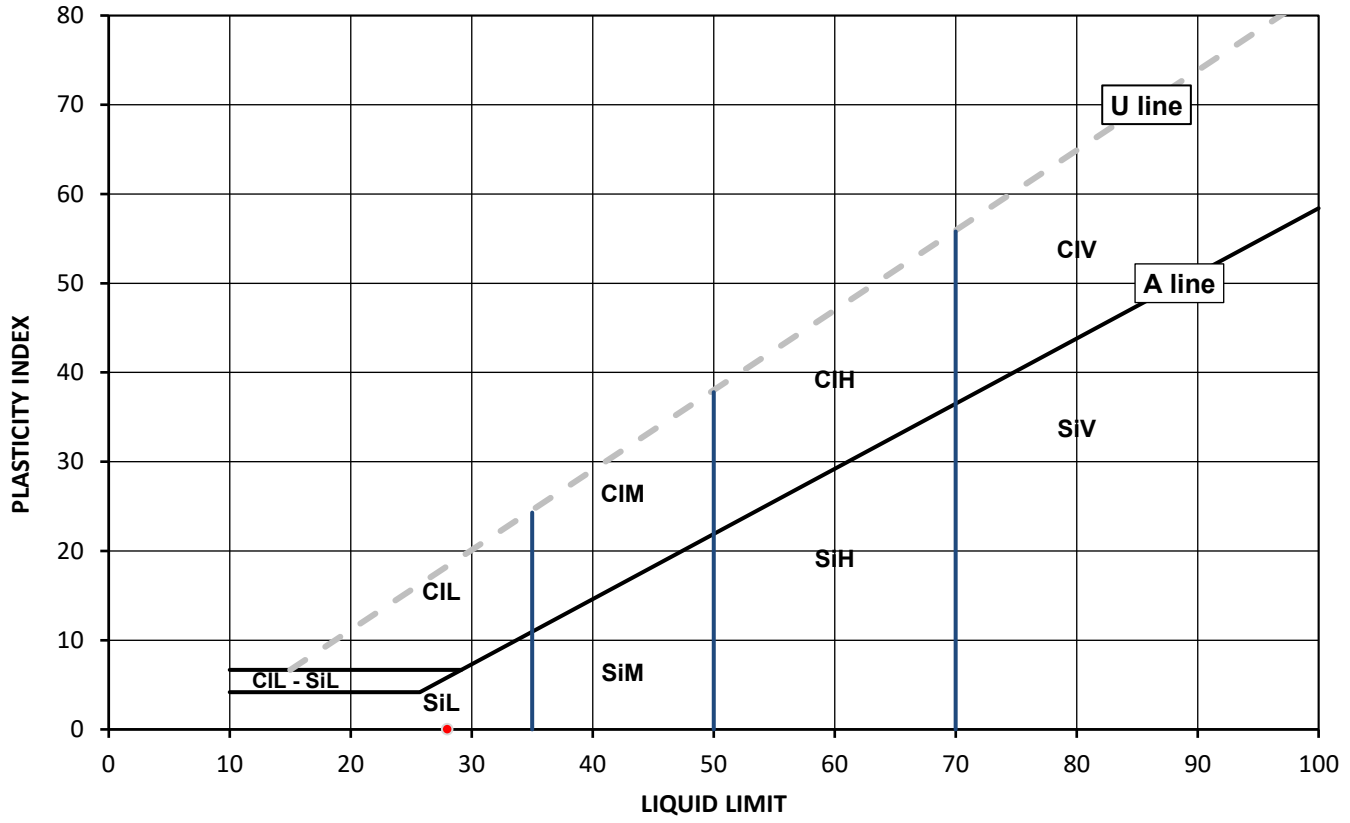
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367546	Depth Top [m]:	4.00
Hole No.:	WS15	Depth Base [m]:	5.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Grey slightly sandy clayey SILT		
Sample Preparation:	Tested in natural condition; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
36.8	28	NP	NP	N/A	N/A	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks: NP - non plastic.

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. T report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

[redacted]

Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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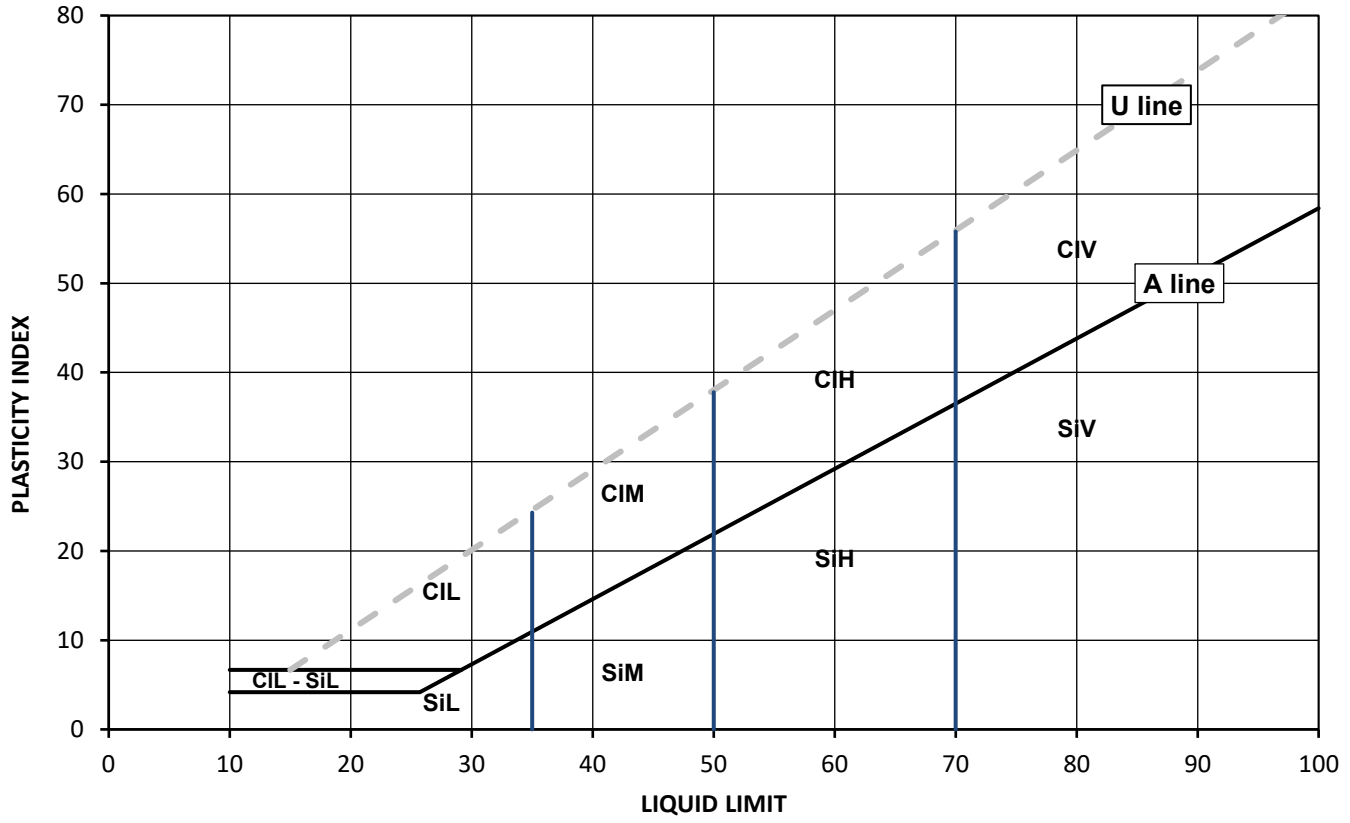
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	15/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367547	Depth Top [m]:	1.30
Hole No.:	WS16	Depth Base [m]:	1.60
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Dark grey slightly organic CLAY		
Sample Preparation:	Tested in natural condition; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
98.2	89	40	49	1.18	-0.18	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

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[redacted]

Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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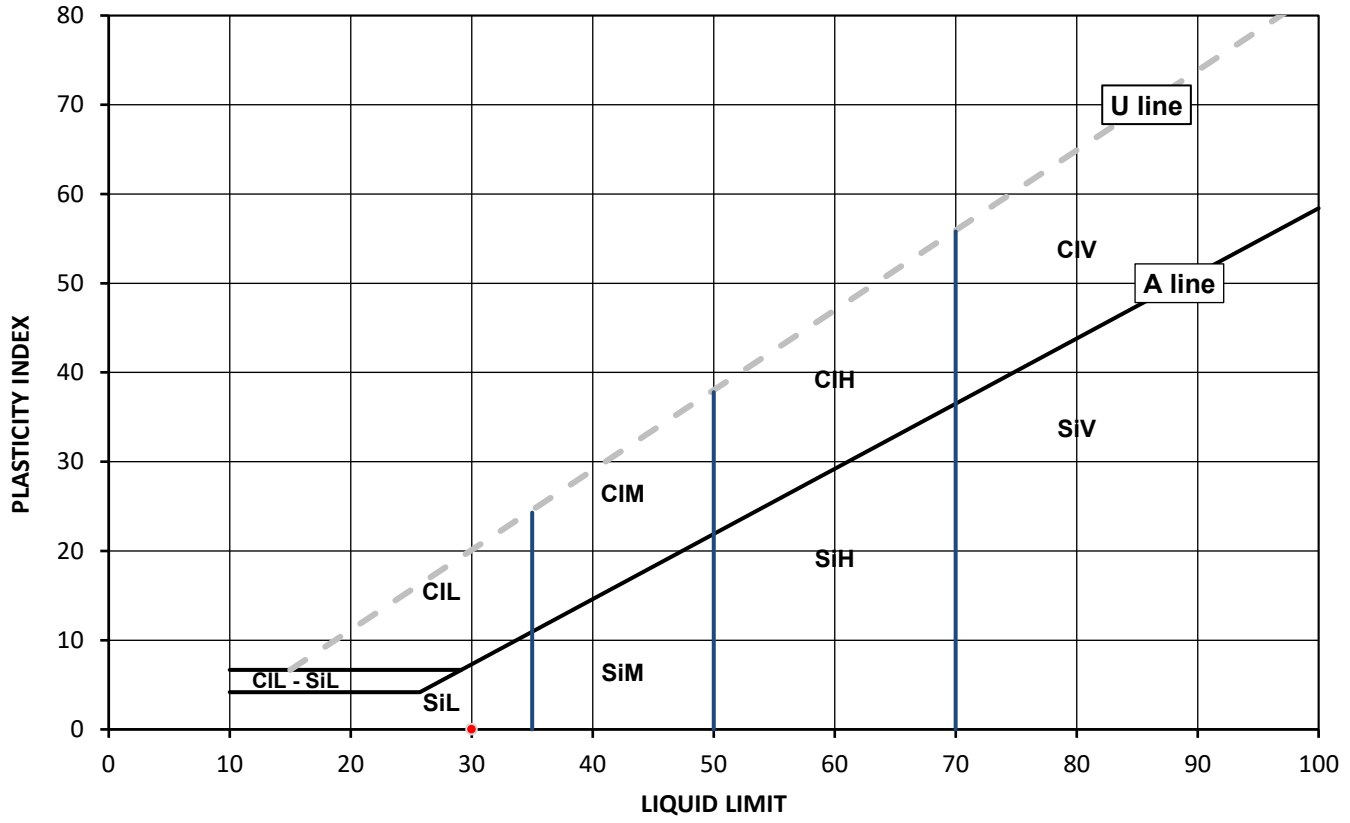
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367549	Depth Top [m]:	1.00
Hole No.:	WS18	Depth Base [m]:	2.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Yellowish brown clayey organic SAND		
Sample Preparation:	Tested in natural condition; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
79.3	30	NP	NP	N/A	N/A	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks: NP - non plastic.

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[redacted]
Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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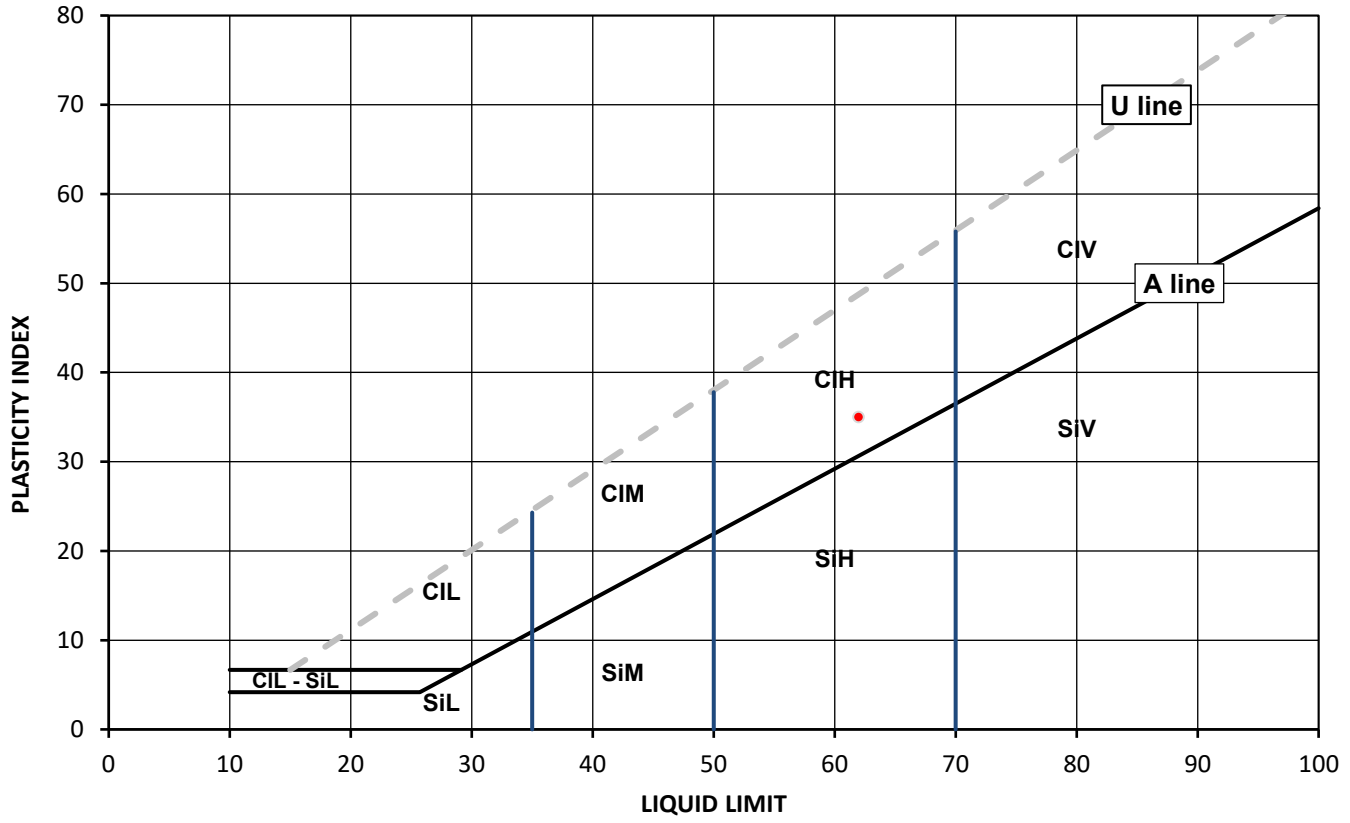
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	15/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367550	Depth Top [m]:	0.50
Hole No.:	WS19	Depth Base [m]:	1.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Greyish brown slightly gravelly slightly organic CLAY		
Sample Preparation:	Tested after washing to remove >0.425mm; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
70.3	62	27	35	1.23	-0.23	97



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

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[redacted]

Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

GF 337.14

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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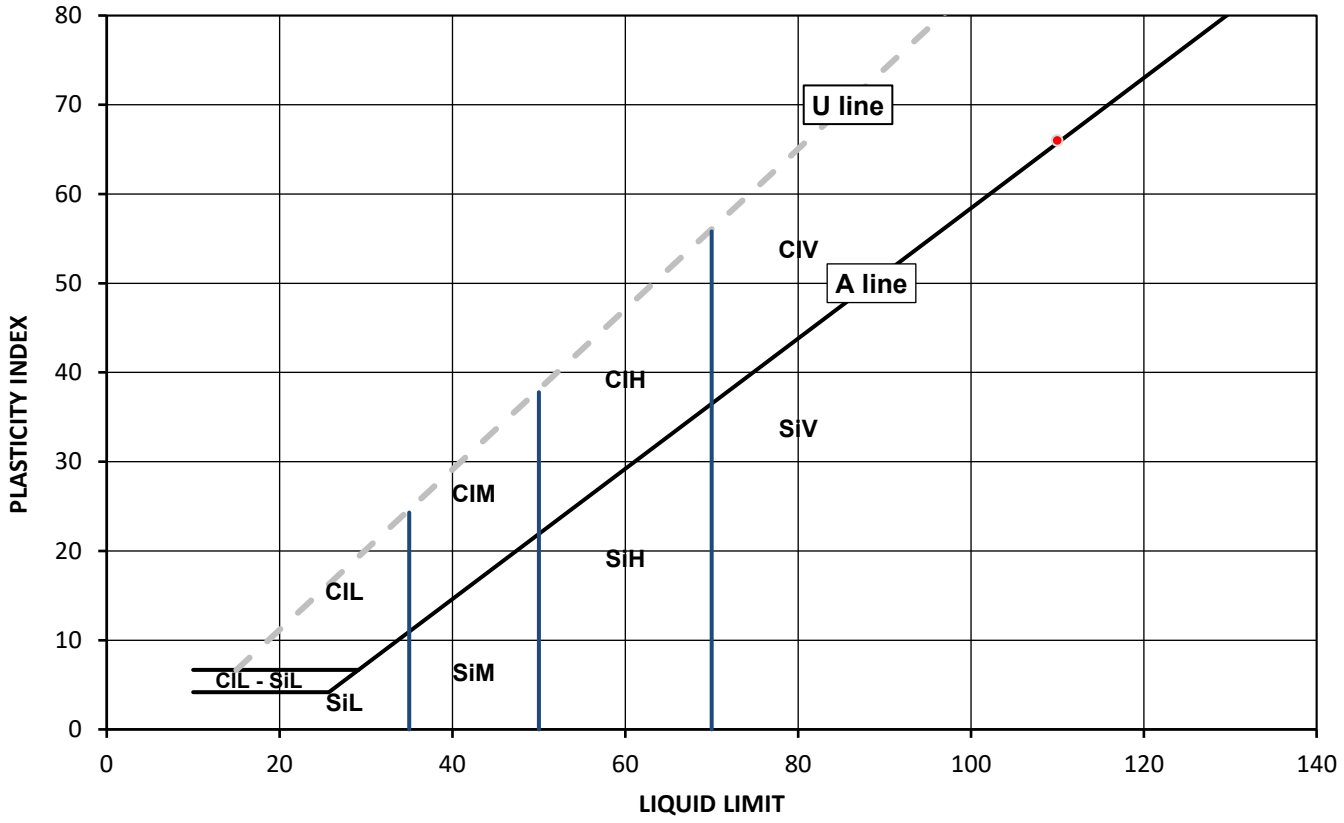
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367553	Depth Top [m]:	1.50
Hole No.:	WS22	Depth Base [m]:	2.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Dark grey slightly gravelly organic CLAY		
Sample Preparation:	Tested after washing to remove >0.425mm; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
95.5	110	44	66	0.79	0.21	99



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

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report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing

[redacted] eotechnical Reporting Team Leader
or and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

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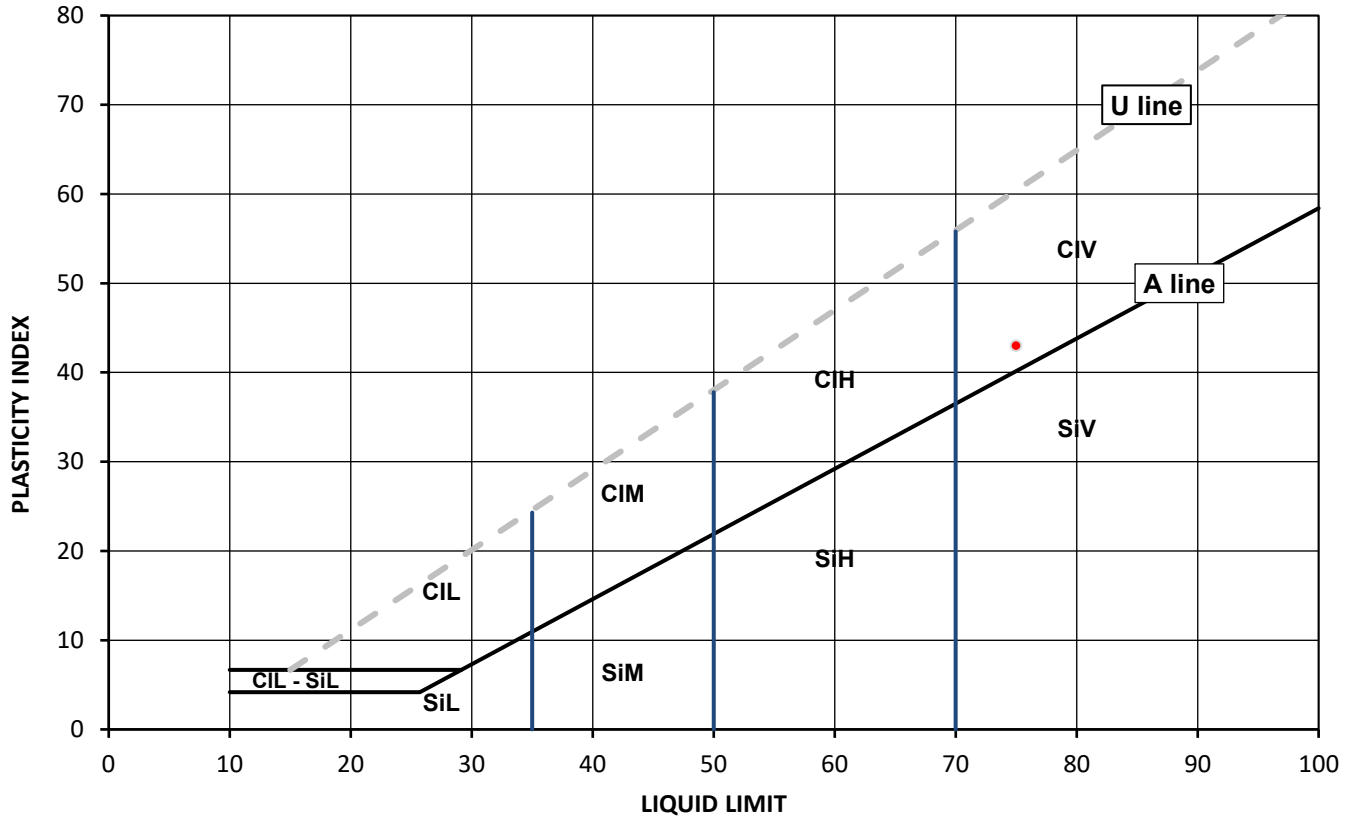
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367554	Depth Top [m]:	2.00
Hole No.:	WS23	Depth Base [m]:	3.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Dark grey sandy clayey SILT		
Sample Preparation:	Tested after >0.425mm removed by hand; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
17.9	75	32	43	-0.33	1.33	85



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditatio report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing

[redacted]

Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

SUMMARY REPORT

SUMMARY OF CLASSIFICATION TEST RESULTS

Tested in Accordance with:

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Client: Wardell Armstrong

Client Address: Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH

Contact: Shannon Connell

Site Address: Cell 3, Frodsham Marshes, Frodsham, Cheshire

BS EN ISO 17892-12:2018+A2:2022 cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6. W by BS EN ISO 17892-1:2014+A1:2022.

Client Reference: GM12793
Job Number: 24-051554-1
Date Sampled: 25/10/2024
Date Received: 28/10/2024
Date Tested: 15/11/2024
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	W	Liquid & Plastic Limit							Density		
		Reference	Depth Top m	Depth Base m	Type			%	% Passing 425um %	WL* %	Correlation Factor	Wp %	Ip %	Cone type	Sample Preparation	bulk Mg/m3	dry Mg/m3	PD Mg/m3
367546	WS15	Not Given	4.00	5.00	D	Grey slightly sandy clayey SILT	Atterberg 4 Point	36.8	100	28	-	NP	NP	80g/30 deg	N / I			
367547	WS16	Not Given	1.30	1.60	D	Dark grey slightly organic CLAY	Atterberg 4 Point	98.2	100	89	-	40	49	80g/30 deg	N / I			
367549	WS18	Not Given	1.00	2.00	D	Yellowish brown clayey organic SAND	Atterberg 4 Point	79.3	100	30	-	NP	NP	80g/30 deg	N / I			
367550	WS19	Not Given	0.50	1.00	D	Greyish brown slightly gravelly slightly organic CLAY	Atterberg 4 Point	70.3	97	62	-	27	35	80g/30 deg	WR / I			
367553	WS22	Not Given	1.50	2.00	D	Dark grey slightly gravelly organic CLAY	Atterberg 4 Point	95.5	99	110	-	44	66	80g/30 deg	WR / I			
367554	WS23	Not Given	2.00	3.00	D	Dark grey sandy clayey SILT	Atterberg 4 Point	17.9	85	75	-	32	43	80g/30 deg	R / I			

Note: # Non accredited; NP - Non plastic; N - Tested in natural condition, R - Tested after >0,425mm removed by hand, WR - Tested after washing to remove >425mm; I - The water content in the sample was increased , D - The water content in the sample was decreased; * - One point liquid limit corrected as per the report Correlation Factor by Clayton C.R.I and Jukes A.W (1978)

Comments:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

[redacted]

Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024 **GF 362.16**

SUMMARY REPORT

DETERMINATION OF WATER CONTENT

Tested in Accordance with: BS EN ISO 17892-1:2014+A1:2022, BS 1377-2: 2022, clause 4.1

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Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

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Client: Wardell Armstrong

Client Address: Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH

Contact: Shannon Connell

Site Address: Cell 3, Frodsham Marshes, Frodsham, Cheshire

Client Reference: GM12793

Job Number: 24-051554-1

Date Sampled: 25/10/2024

Date Received: 28/10/2024

Date Tested: 14/11 - 15/11/2024

Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	WC											
		Reference	Depth Top m	Depth Base m	Type			%											
367546	WS15	Not Given	4.00	5.00	D	Grey slightly sandy clayey SILT		36.8											
367547	WS16	Not Given	1.30	1.60	D	Dark grey slightly organic CLAY		98.2											
367549	WS18	Not Given	1.00	2.00	D	Yellowish brown clayey organic SAND		79.3											
367550	WS19	Not Given	0.50	1.00	D	Greyish brown slightly gravelly slightly organic CLAY		70.3											
367553	WS22	Not Given	1.50	2.00	D	Dark grey slightly gravelly organic CLAY		95.5											
367554	WS23	Not Given	2.00	3.00	D	Dark grey sandy clayey SILT		17.9											

Comments:

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[redacted]

[redacted]
Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS EN ISO 17892-4:2016, BS 1377-2:2022 cl. 10

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

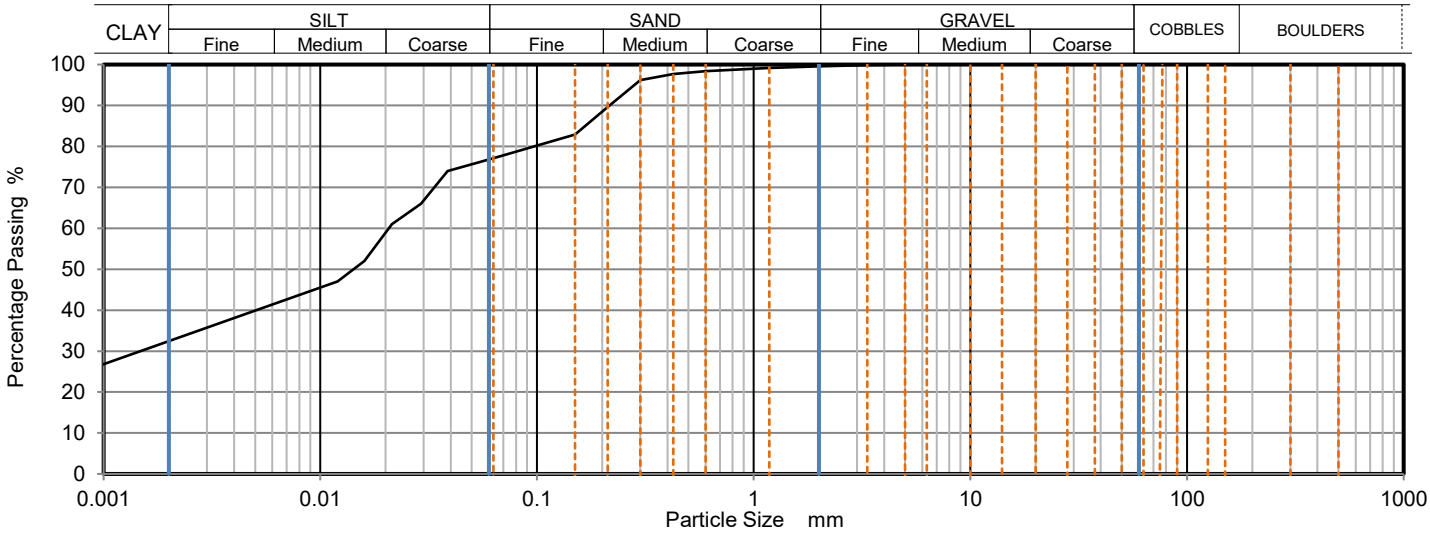
4041

Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367546	Depth Top [m]:	4.00
Hole No.:	WS15	Depth Base [m]:	5.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Grey slightly sandy clayey SILT		
Sample Preparation:	Sample was quartered, oven dried at 107.9 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0387	74
300	100	0.0292	66
150	100	0.0214	61
125	100	0.0160	52
90	100	0.0120	47
75	100	0.0008	25
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	98	Particle density	(assumed)
0.425	98	2.65	Mg/m3
0.3	96		
0.212	90		
0.15	83		
0.063	77		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	0.00
Sand	23.00
Silt	45.00
Clay	32.00

Grading Analysis		
D100	mm	5
D60	mm	0.021
D30	mm	0.00152
D10	mm	
Uniformity Coefficient		0.33
Curvature Coefficient		

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving and hydrometer sedimentation

Remarks:

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Geotechnical Reporting Team Leader
or and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS EN ISO 17892-4:2016, BS 1377-2:2022 cl. 10

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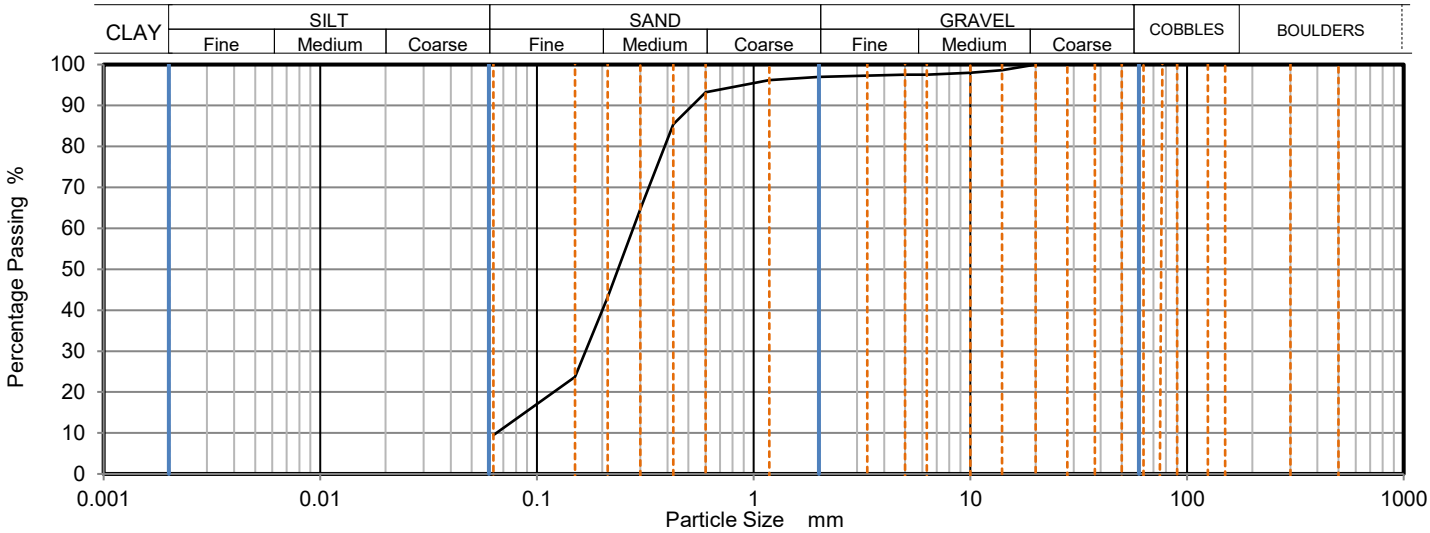
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Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367548	Depth Top [m]:	2.00
Hole No.:	WS17	Depth Base [m]:	4.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Brown slightly gravelly clayey SAND		
Sample Preparation:	Sample was quartered, oven dried at 107.9 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	99		
10	98		
6.3	98		
5	98		
3.35	97		
2	97		
1.18	96		
0.6	93		
0.425	85		
0.3	65		
0.212	43		
0.15	24		
0.063	10		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	3.00
Sand	87.00
Fines <0.063 mm	10.00

Grading Analysis		
D100	mm	20
D60	mm	0.278
D30	mm	0.168
D10	mm	0.0648
Uniformity Coefficient		4.3
Curvature Coefficient		1.6

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving on as received or wet sample

Remarks:

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Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

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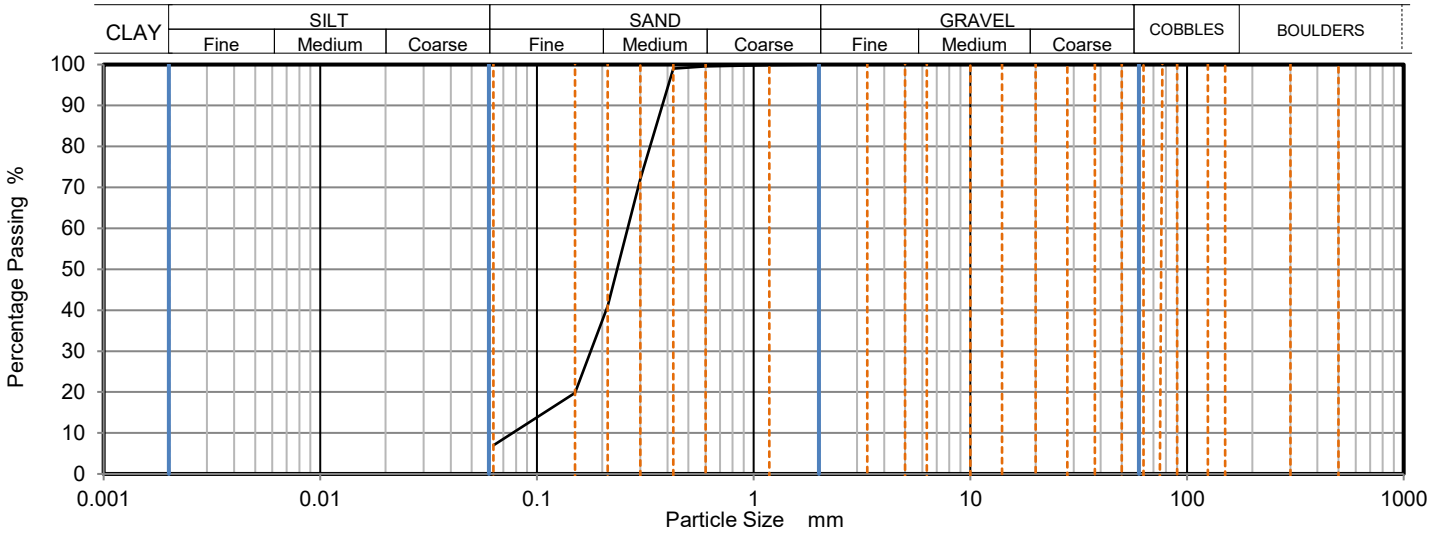
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Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367549	Depth Top [m]:	1.00
Hole No.:	WS18	Depth Base [m]:	2.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Yellowish brown clayey organic SAND		
Sample Preparation:	Sample was quartered, oven dried at 107.9 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	99		
0.3	72		
0.212	41		
0.15	20		
0.063	7		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	0.00
Sand	93.00
Fines <0.063 mm	7.00

Grading Analysis		
D100	mm	3.35
D60	mm	0.262
D30	mm	0.177
D10	mm	0.077
Uniformity Coefficient		3.4
Curvature Coefficient		1.6

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving on as received or wet sample

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Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

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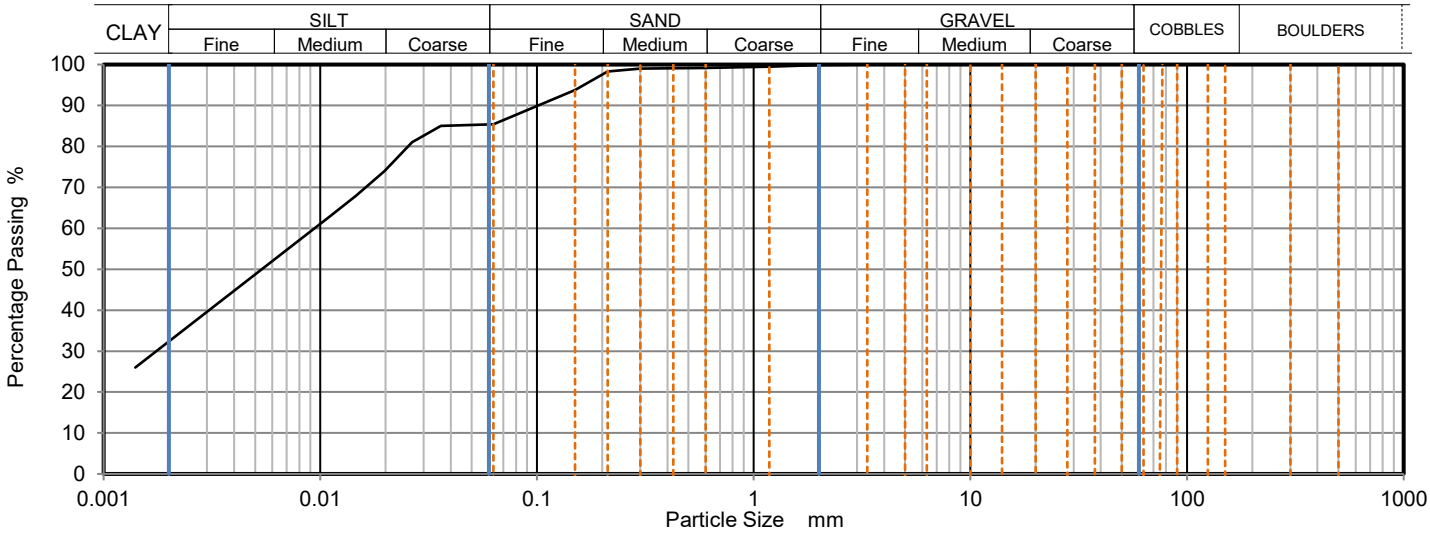
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Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367551	Depth Top [m]:	0.00
Hole No.:	WS20	Depth Base [m]:	1.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Brown slightly sandy clayey SILT		
Sample Preparation:	Sample was quartered, oven dried at 107.9 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0360	85
300	100	0.0265	81
150	100	0.0198	74
125	100	0.0146	68
90	100	0.0111	63
75	100	0.0014	26
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99	Particle density	(assumed)
0.425	99	2.65	Mg/m3
0.3	99		
0.212	98		
0.15	94		
0.063	85		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	0.00
Sand	14.00
Silt	54.00
Clay	32.00

Grading Analysis		
D100	mm	3.35
D60	mm	0.00958
D30	mm	0.00179
D10	mm	
Uniformity Coefficient		0.15
Curvature Coefficient		

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving and hydrometer sedimentation

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Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

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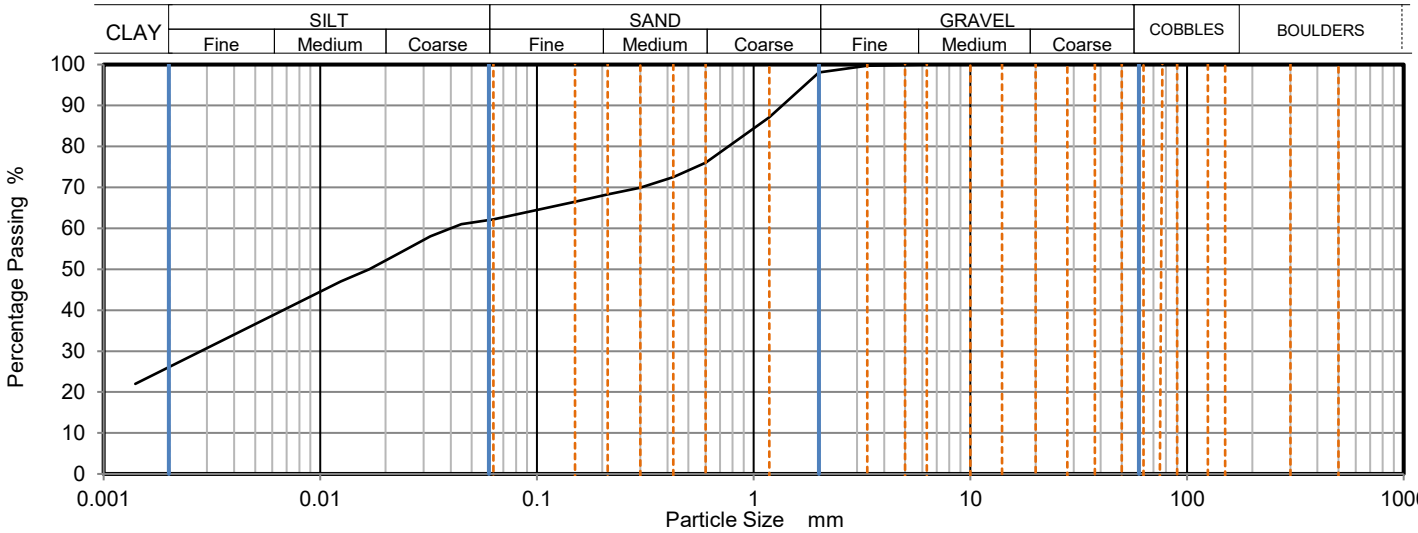
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		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367552	Depth Top [m]:	0.00
Hole No.:	WS21	Depth Base [m]:	1.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Dark grey slightly gravelly slightly sandy clayey SILT		
Sample Preparation:	Sample was quartered, oven dried at 107.9 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0448	61
300	100	0.0322	58
150	100	0.0232	54
125	100	0.0168	50
90	100	0.0124	47
75	100	0.0014	22
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	98		
1.18	87		
0.6	76	Particle density	(assumed)
0.425	73	2.65	Mg/m3
0.3	70		
0.212	68		
0.15	67		
0.063	62		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	2.00
Sand	36.00
Silt	36.00
Clay	26.00

Grading Analysis		
D100	mm	6.3
D60	mm	0.0418
D30	mm	0.00288
D10	mm	
Uniformity Coefficient		0.66
Curvature Coefficient		

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving and hydrometer sedimentation

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Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

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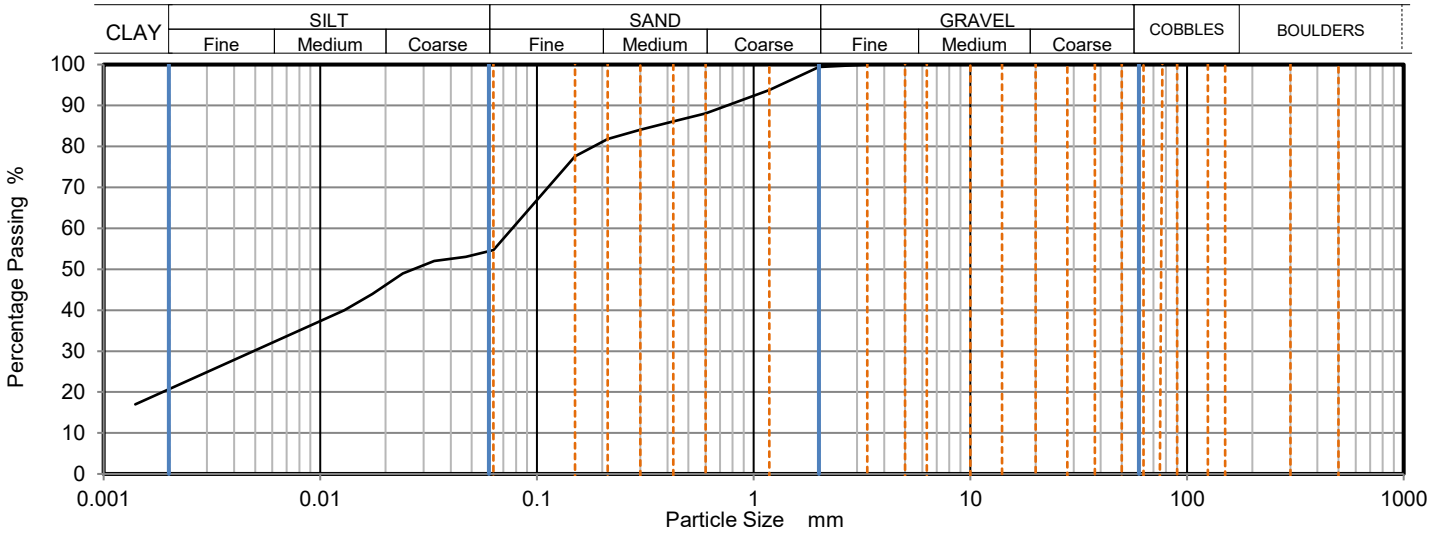
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		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	367554	Depth Top [m]:	2.00
Hole No.:	WS23	Depth Base [m]:	3.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Dark grey sandy clayey SILT		
Sample Preparation:	Sample was quartered, oven dried at 107.9 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0470	53
300	100	0.0335	52
150	100	0.0240	49
125	100	0.0174	44
90	100	0.0129	40
75	100	0.0014	17
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	94		
0.6	88	Particle density	(assumed)
0.425	86	2.65	Mg/m3
0.3	84		
0.212	82		
0.15	78		
0.063	55		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	1.00
Sand	45.00
Silt	34.00
Clay	20.00

Grading Analysis		
D100	mm	3.35
D60	mm	0.0771
D30	mm	0.00511
D10	mm	
Uniformity Coefficient		1.2
Curvature Coefficient		

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving and hydrometer sedimentation

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Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Date Reported: 25/11/2024

Appendix D

Groundwater Monitoring Results

Job No:	GM12793
Site Name:	Frodsham Solar Farm
Client:	Frodsham Solar Limited

Visit No:	1	of	6
Date:	30/08/2024		
Time:	10:00	to	14:00

Operator:	Shannon Connell

		WELL AND WATER DATA			ADDITIONAL COMMENTS
Monitoring Point	Order	Product thickness (mm)	Water level (m bgl)	Depth of well (mbgl)	
WS01	4		0.51	4.05	
WS02	8		2.36	2.61	
WS03	-		-	-	Cows blocking position.
WS04	7		2.21	3.94	
WS05	2		1.62	3.97	
WS06	9		1.33	2.19	
WS07	-		-	-	Cows blocking position.
WS08	5		1.40	4.03	
WS09	6		1.00	3.14	
WS10 (spare 1)	-		-	-	Cows blocking position.
WS11 (spare 2)	1		1.27	2.27	
WS12 (spare 3)	11		1.54	4.86	
WS13 (spare 4)	3		1.57	3.13	
WS14 (spare 5)	10		1.57	3.13	
Max			**2.36**	**4.86**	
Min			**0.51**	**2.19**	

SITE INFORMATION:

Nature of ground:	X	Soft-landscaping		Hardstanding		
State of ground:	X	Dry		Wet		
		Frozen		Snow		
Wind:	X	Calm		Moderate		Strong
Cloud cover:	X	None		Cloudy		Overcast
Preciptation:	X	None		Moderate		Heavy

Additional Comments:

Job No:	GM12793
Site Name:	Frodsham Solar Farm
Client:	Frodsham Solar Limited

Visit No:	2	of	6
Date:	28/11/2024		
Time:	-	to	-

Operator:	Mollie Heal

		WELL AND WATER DATA			ADDITIONAL COMMENTS
Monitoring Point	Order	Product thickness (mm)	Water level (m bgl)	Depth of well (mbgl)	
WS01			0.20	3.90	
WS02			1.80	2.40	
WS03			0.60	4.70	
WS04			1.70	3.70	
WS05			1.10	3.70	
WS06			0.70	1.90	
WS07			-	-	Could not locate position.
WS08			0.90	3.80	
WS09			0.70	3.00	
WS10			0.90	4.70	
WS11			0.75	2.00	
WS12			0.30	4.80	
WS13			1.20	4.70	
WS14			1.10	2.80	
WS15			-	-	
WS16			0.90	3.80	
WS17			0.60	4.20	
WS18			-	-	
WS19			-	-	
WS20			0.30	4.80	
WS21			-	-	
WS22			-	-	Inaccessible.
WS23			0.30	4.70	
Max			**1.80**	**4.80**	
Min			**0.20**	**1.90**	

SITE INFORMATION:

Nature of ground:	X	Soft-landscaping		Hardstanding		
State of ground:		Dry	X	Wet		
		Frozen		Snow		
Wind:		Calm		Moderate		Strong
Cloud cover:		None		Cloudy		Overcast
Preciptation:		None		Moderate		Heavy

Additional Comments:

Job No:	GM12793
Site Name:	Frodsham Solar Farm
Client:	Frodsham Solar Limited

Visit No:	3	of	6
Date:	01/12/2025		
Time:	-	to	-

Operator:	Mollie Heal

		WELL AND WATER DATA			ADDITIONAL COMMENTS
Monitoring Point	Order	Product thickness (mm)	Water level (m bgl)	Depth of well (mbgl)	
WS01			0.32	3.86	
WS02			2.24	2.24	
WS03			0.30	4.40	
WS04			0.85	4.70	
WS05			1.15	4.71	
WS06			0.75	1.84	
WS07			0.53	4.84	
WS08			1.12	3.82	
WS09			0.60	2.90	
WS10			0.90	4.50	
WS11			1.93	0.90	
WS12			1.25	4.63	
WS13			1.34	3.81	
WS14			2.34	3.10	
WS15			-	-	
WS16			0.30	3.80	
WS17			0.80	4.60	
WS18			-	-	
WS19			0.50	4.10	
WS20			0.90	4.80	
WS21			-	-	
WS22			0.86	4.47	
WS23			0.62	4.83	
Max			**2.34**	**4.84**	
Min			**0.30**	**0.90**	

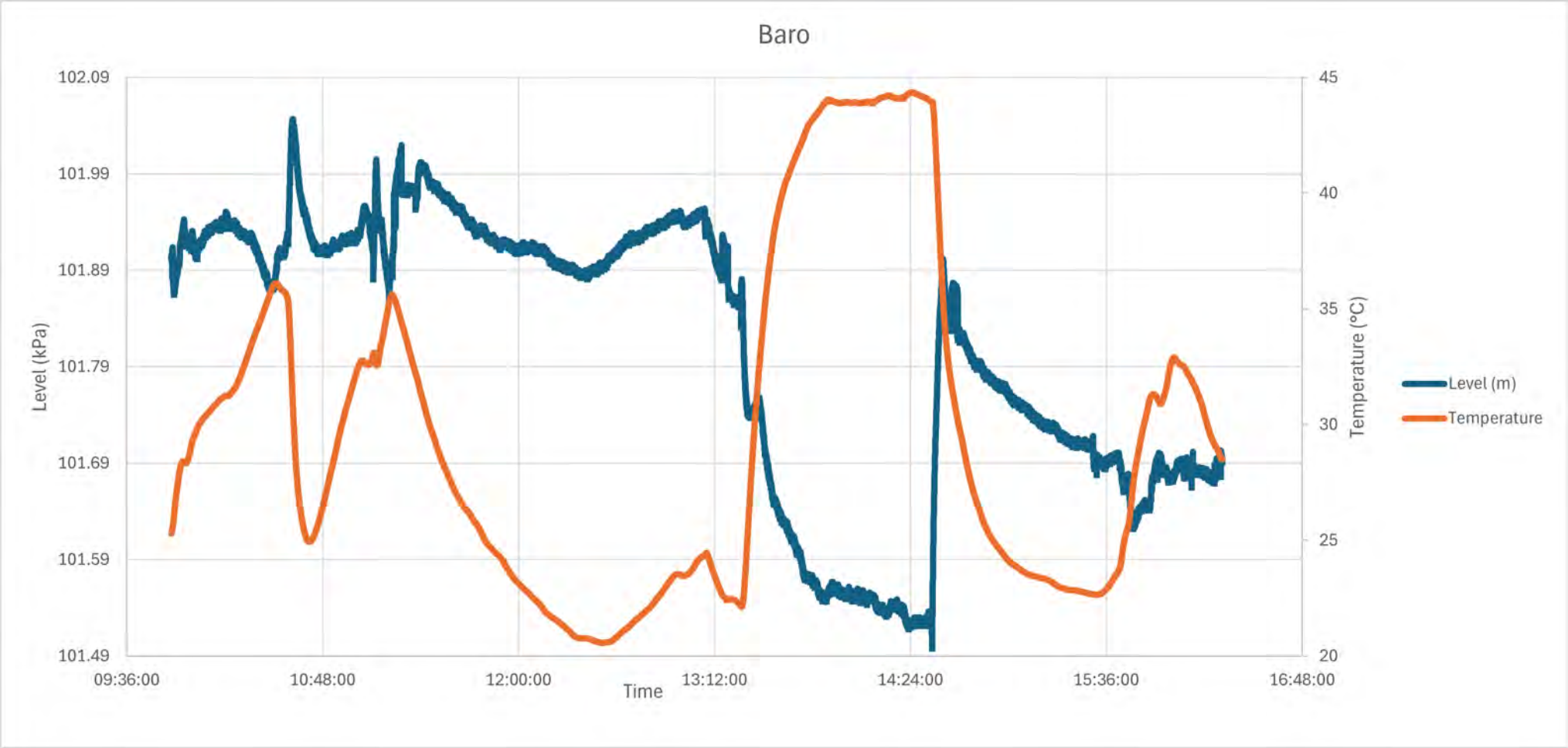
SITE INFORMATION:

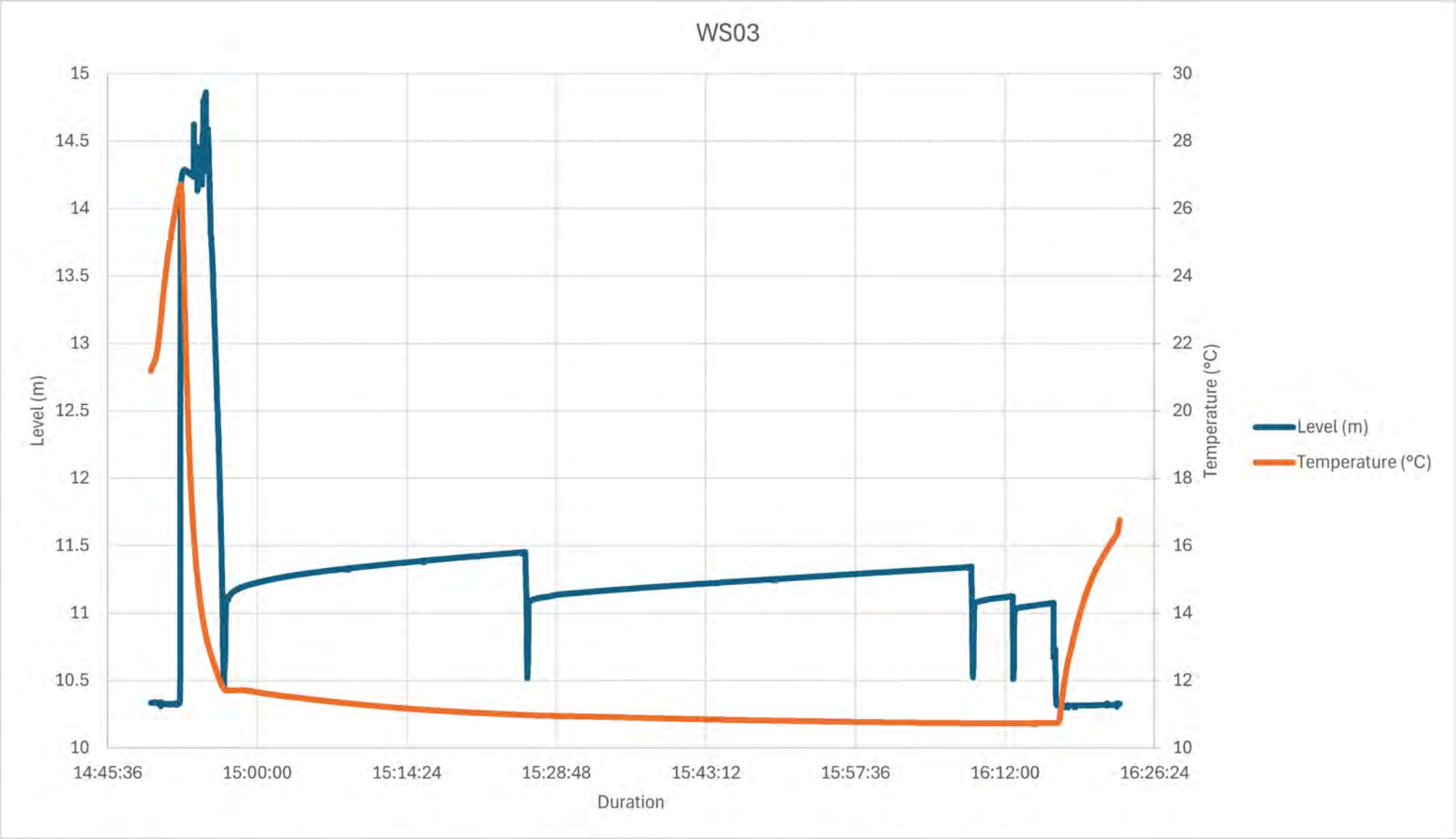
Nature of ground:	X	Soft-landscaping		Hardstanding	
State of ground:		Dry	X	Wet	
		Frozen		Snow	
Wind:		Calm		Moderate	Strong
Cloud cover:		None		Cloudy	Overcast
Preciptation:		None		Moderate	Heavy

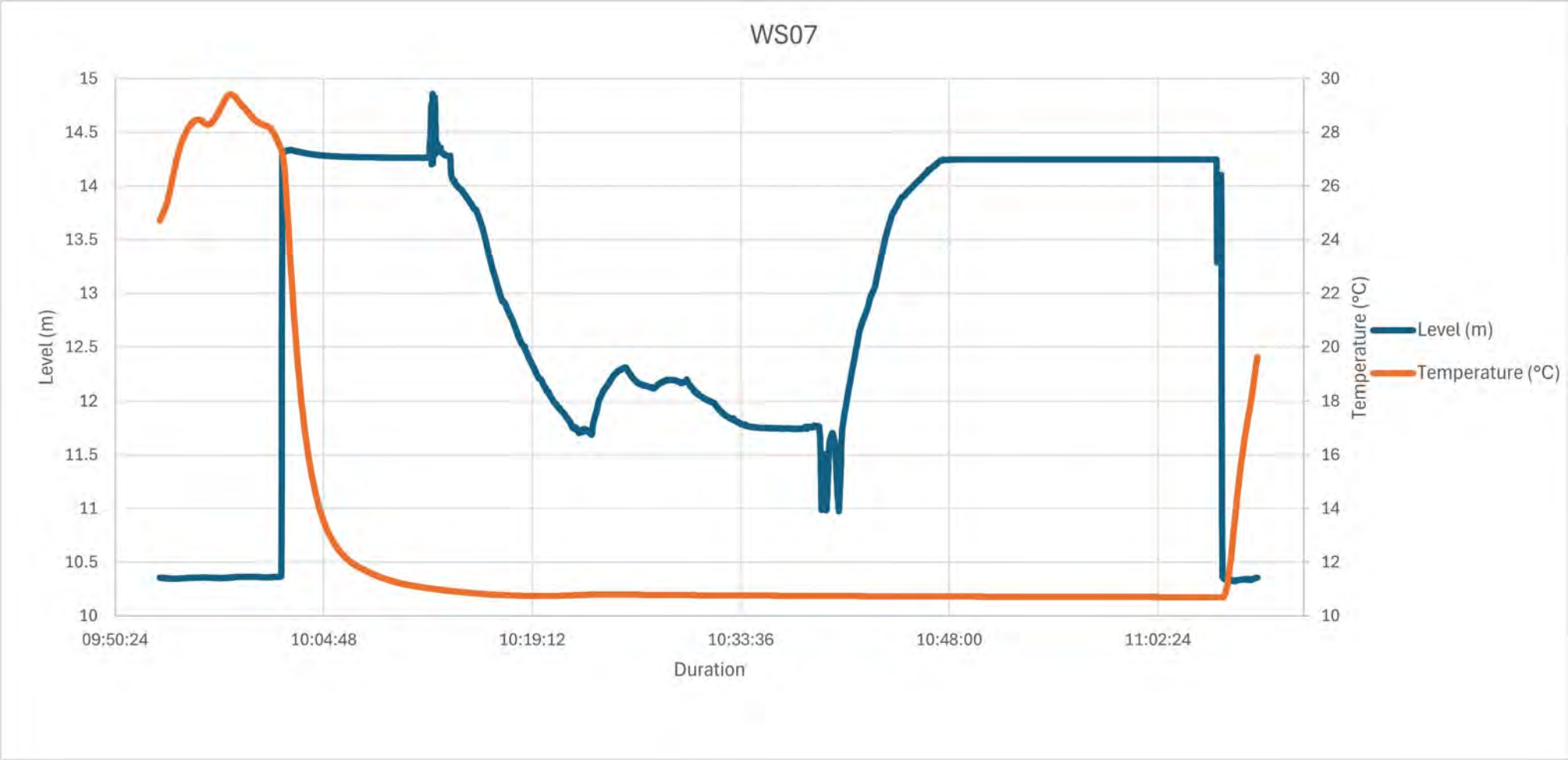
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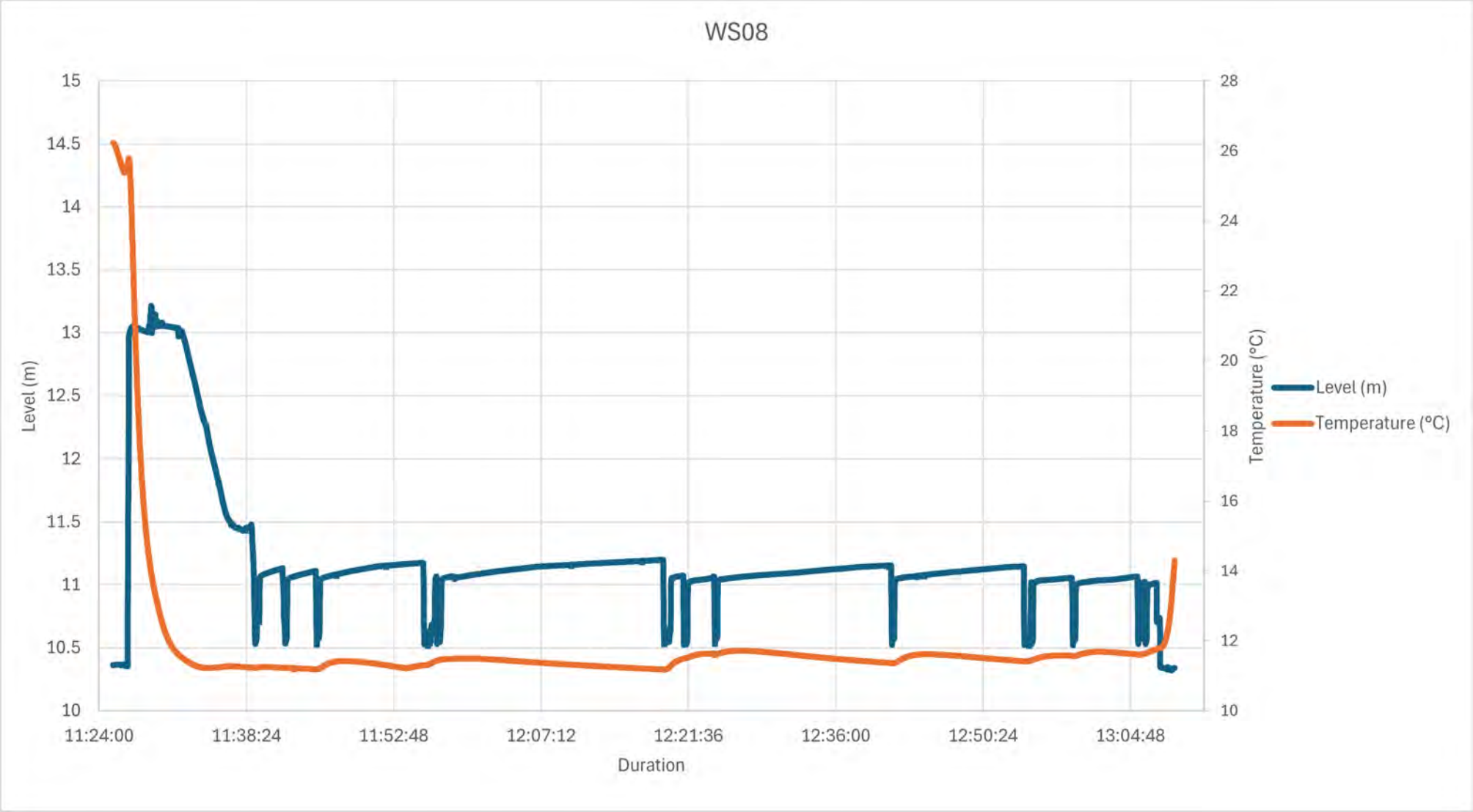
Appendix E

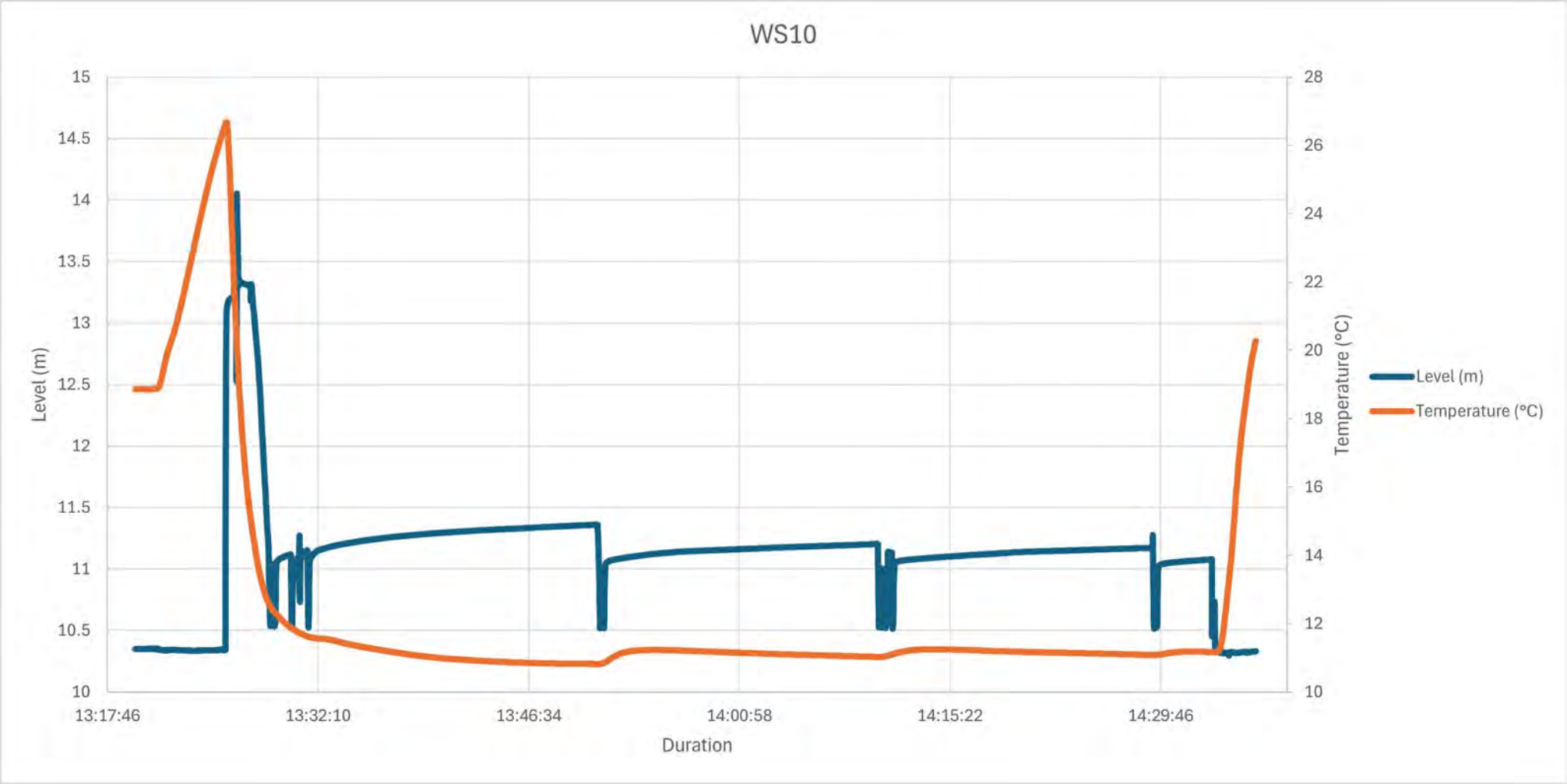
Variable Head Test Graphs


Baro
102.09
101.99
101.89
101.79
101.69
101.59
101.49
Level (kPa)
45
40
35
30
25
20
Temperature (°C)
09:36:00
10:48:00
12:00:00
13:12:00
14:24:00
15:36:00
16:48:00
Time
Level (m)
Temperature


WS03
15
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
Level (m)
30
28
26
24
22
20
18
16
14
12
10
Temperature (°C)
14:45:36
15:00:00
15:14:24
15:28:48
15:43:12
15:57:36
16:12:00
16:26:24
Duration
Level (m)
Temperature (°C)


WS07
15
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
Level (m)
30
28
26
24
22
20
18
16
14
12
10
Temperature (°C)
09:50:24
10:04:48
10:19:12
10:33:36
10:48:00
11:02:24
Duration
Level (m)
Temperature (°C)


WS08
15
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
Level (m)
28
26
24
22
20
18
16
14
12
10
Temperature (°C)
11:24:00
11:38:24
11:52:48
12:07:12
12:21:36
12:36:00
12:50:24
13:04:48
Duration
Level (m)
Temperature (°C)


WS10
Level (m)
Temperature (°C)
Duration
15
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
28
26
24
22
20
18
16
14
12
10
13:17:46
13:32:10
13:46:34
14:00:58
14:15:22
14:29:46
Level (m)
Temperature (°C)

Appendix F

Permeability Analyses

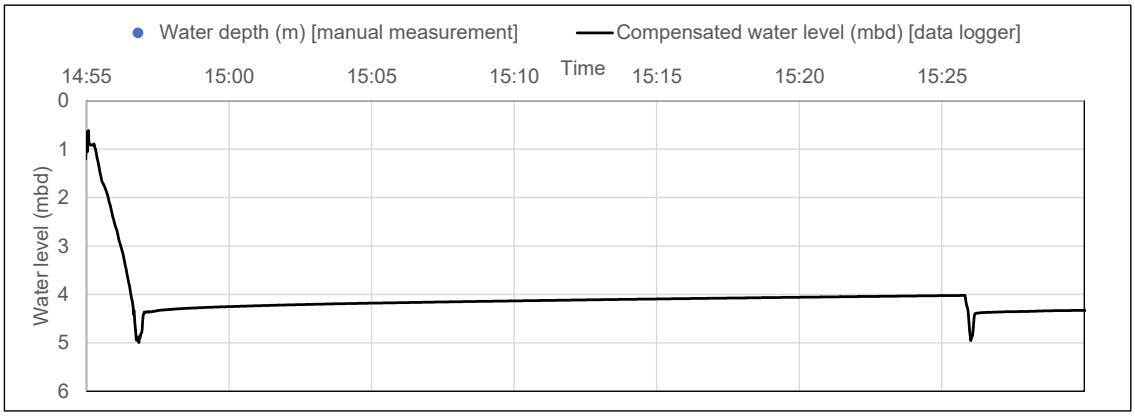
Analysis of open system hydraulic test

Project no.	GM12793	**Project name:**	Frodsham Solar
Task/Workstage:	Water monitoring	**Site name:**	Frodsham Marsh
Installation ref.	WS03	**NGR:**	SJ 48771 78229 (approx.)
Datum point:	Top of casing (0.09 magl)	**Datum elevation:**	Not known
Depth to base from datum:	5.04 m	**Depth to top of test section:**	Not known (assumed 1 m)
Diameter of pipe:	0.1 m	**Diameter of test section:**	0.1 m
Test method:	Rising head test	**Date of test:**	20/06/2024
Rest water level:	0.99 mbd	**Date/time of rest water level:**	20/06/2024 14:55
Test supervisor name:	Amelia Ebanks	**Date/time of test start:**	

Notes: Logger installed @14:50. Borehole purged dry after 9 litres extracted. Recovery could not be measured manually but some recovery recorded on data logger.

Test data

Time from start of test (min)	Water depth (m)	Time from start of test (min)	Water depth (m)
00:00		00:05	
00:00		00:06	
00:00		00:07	
00:00		00:08	
00:00		00:09	
00:01		00:10	
00:01	No manual data collected	00:12	No manual data collected
00:02		00:14	
00:02		00:16	
00:03		00:18	
00:03		00:20	
00:04		00:25	
00:04		00:30	

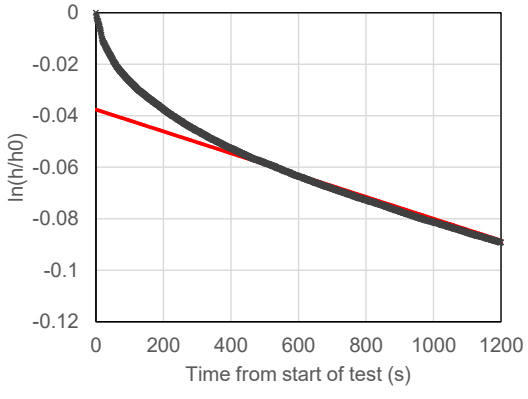


Test analysis

Velocity graph method

NOT USED

Hvorslev method



Shape factor (F) (m)		Gradient	-4.24E-05
Cross section (S) (m2)		t0 (s) [Hvorslev time]	2.26E+04
Alpha (/t)		k (m/s)	1.66E-07
k (m/s)		k (m/d)	1.43E-02
k (m/d)			

Notes: Analysis based on recovery obseved between 14:57 and 15:25 (between attempts to collect water samples). Analysis results are indicative and fitted to later time data.

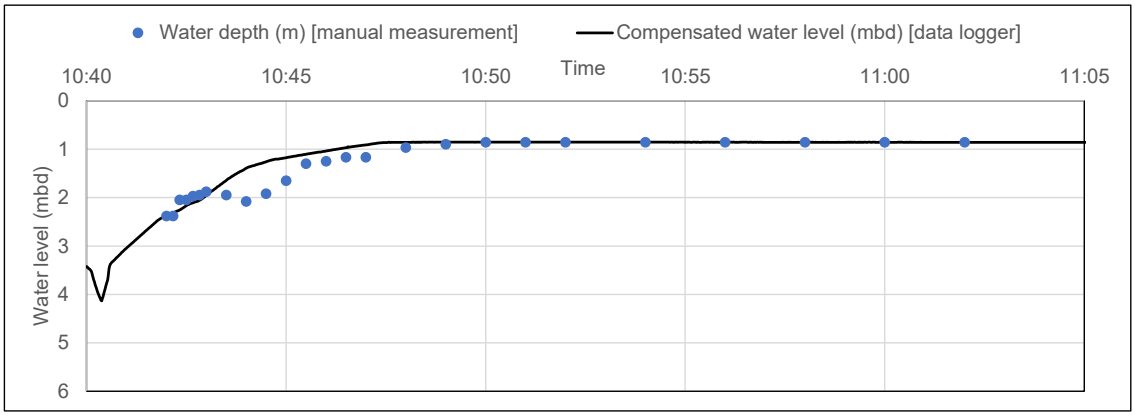
Analysis of open system hydraulic test

Project no.	GM12793	**Project name:**	Frodsham Solar
Task/Workstage:	Water monitoring	**Site name:**	Frodsham Marsh
Installation ref.	WS07	**NGR:**	SJ 49141 78483 (approx.)
Datum point:	Top of casing (0.1 magl)	**Datum elevation:**	Not known
Depth to base from datum:	5 m	**Depth to top of test section:**	Not known (assumed 1 m)
Diameter of pipe:	0.1 m	**Diameter of test section:**	0.1 m
Test method:	Rising head test	**Date of test:**	20/06/2024
Rest water level:	0.85 mbd	**Date/time of rest water level:**	20/06/2024 08:30
Test supervisor name:	Amelia Ebanks	**Date/time of test start:**	20/06/2024 10:42

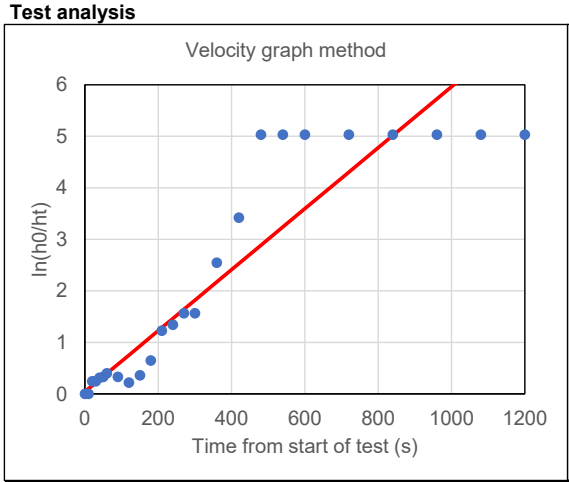
Notes: Water sampling completed before start of hydraulic test. Logger installed in borehole at 10:00. Wasp pump used to lower water level before start of test. Pump on at 10:15. Monitoring of level recovery started 10:42.

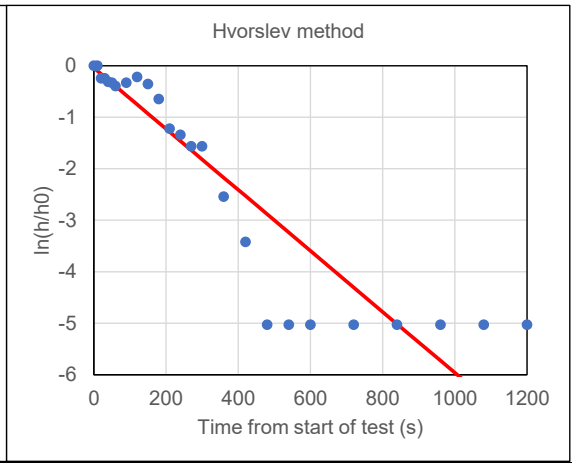
Test data

Time from start of test (min)	Water depth (m)	Time from start of test (min)	Water depth (m)
00:00	2.38	00:05	1.17
00:00	2.58	00:06	1.17
00:00	2.05	00:07	0.97
00:00	2.05	00:08	0.9
00:00	1.97	00:09	0.86
00:01	1.95	00:10	0.86
00:01	1.88	00:12	0.86
00:02	1.95	00:14	0.86
00:02	2.08	00:16	0.86
00:03	1.92	00:18	0.86
00:03	1.65	00:20	0.86
00:04	1.3	00:25	0.86
00:04	1.25	00:30	EoT



Test analysis

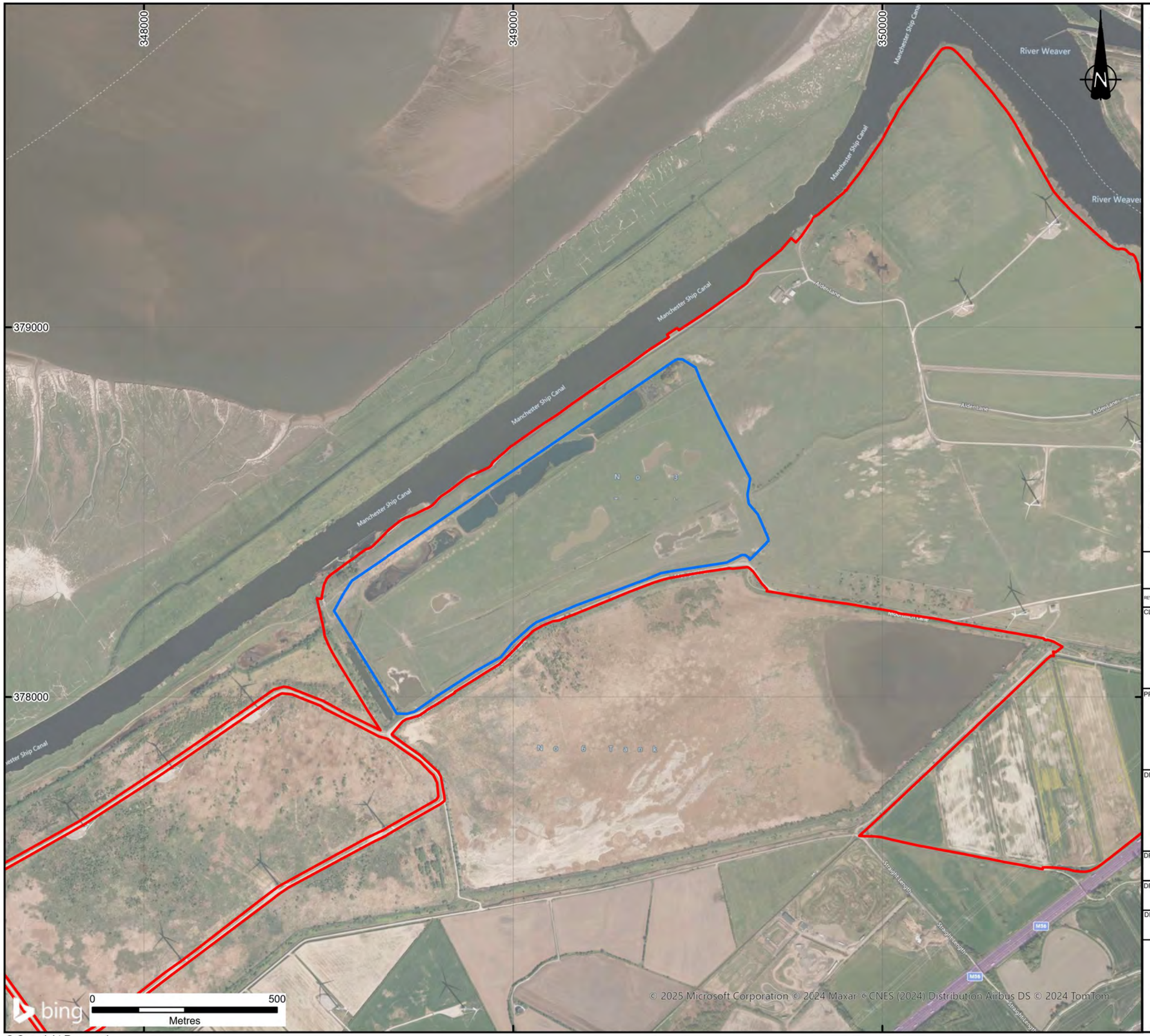




Shape factor (F) (m)	2.10E+00	Gradient	-5.92E-03
Cross section (S) (m2)	7.85E-03	t0 (s) [Hvorslev time]	1.61E+02
Alpha (/t)	5.92E-03	k (m/s)	2.33E-05
k (m/s)	2.22E-05	k (m/d)	2.01E+00
k (m/d)	1.92E+00		

Notes: Water level measurements between 90 and 180 seconds excluded from fitting.

DRAWINGS



KEY

Site Boundary

Cell 3 Location



Notes:

Boundaries are indicative. Aerial imagery shown for context purposes only.

REVISION	DETAILS	DATE	DRAWN	CHK'D	APP'D

CLIENT

CUBICO INVEST

PROJECT

FRODSHAM SOLAR

DRAWING TITLE

CELL 3 SITE LOCATION PLAN

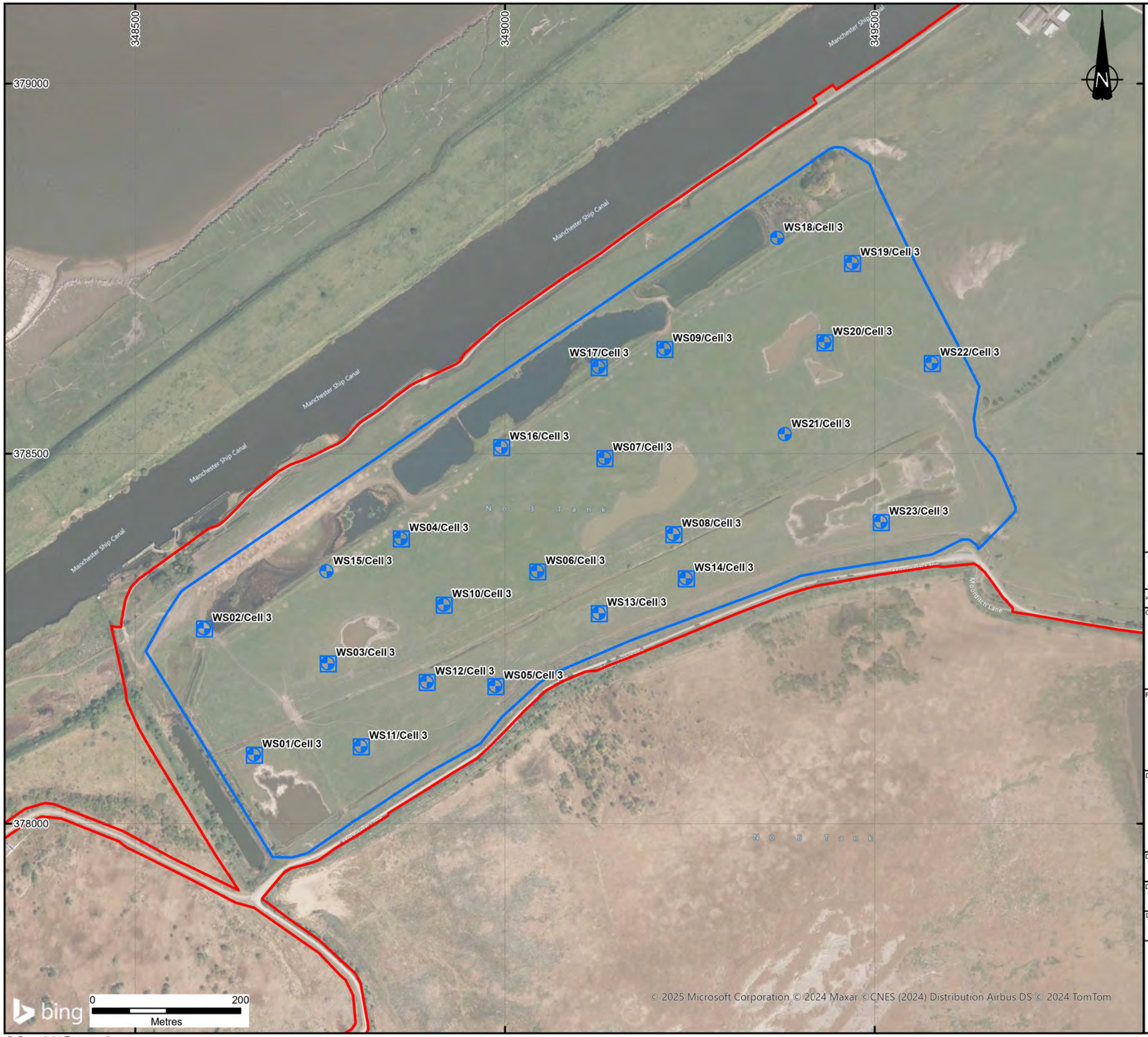
DRG No.	REV	SUIT. CODE
GM12793-004	C	--

DRG SIZE	SCALE	DATE
A3	1:10,000	14/01/2025

DRAWN BY	CHECKED BY	APPROVED BY
EK	SS	GC

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KEY

- Site Boundary
- Cell 3 Location
- Windowless Sample Borehole
- Windowless Sample Borehole with Standpipe

Notes:

Boundaries are indicative. Aerial imagery shown for context purposes only.

REVISION	DETAILS	DATE	DRAWN	CHK'D	APP'D

CLIENT

CUBICO INVEST

PROJECT

FRODSHAM SOLAR

DRAWING TITLE

CELL 3
GROUND INVESTIGATION LOCATION PLAN

DRG No.	REV	SUIT. CODE
GM12793-010	A	--

DRG SIZE	SCALE	DATE
A3	1:5,000	14/01/2025

DRAWN BY	CHECKED BY	APPROVED BY
EK	SS	GC

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LAND AND PROPERTY
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MINERAL ESTATES
WASTE RESOURCE MANAGEMENT



CUBICO INVEST

FRODSHAM SOLAR

CELL 3 GROUND INVESTIGATION REPORT

APRIL 2024

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DATE ISSUED: **APRIL 2024**
JOB NUMBER: **GM12793**
REPORT NUMBER: **006**
VERSION STATUS: **V2.0/FINAL**

CUBICO INVEST

FRODSHAM SOLAR

CELL 3 GROUND INVESTIGATION REPORT

APRIL 2024

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Fay Lawrence Geologist

REVIEWED BY:

Sabine Sargeant Associate Director

APPROVED BY:

Gavin Campbell Service Director



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ENERGY AND CLIMATE CHANGE
ENVIRONMENT AND SUSTAINABILITY
INFRASTRUCTURE AND UTILITIES
LAND AND PROPERTY
MINING AND MINERAL PROCESSING
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WASTE RESOURCE MANAGEMENT

CONTENTS

1 INTRODUCTION....1
2 SCOPE OF GROUND INVESTIGATION WORKS....3
3 GROUND CONDITIONS....4
4 SOAKAWAY TESTING....8
5 DISCUSSION....9
6 CONCLUSIONS....12

APPENDICES

Appendix A Wardell Armstrong LLP Trial Pit and Soakaway Pit Logs
Appendix B Wardell Armstrong LLP Soakaway Test Data Sheets
Appendix C Laboratory Geotechnical Testing Results
Appendix D Laboratory Geochemical Testing Results

DRAWINGS

DRAWING NO.	TITLE	SCALE
GM12793-001	Site Location Plan	1:10,000 at A3
GM12793-002	Site Investigation Location Plan	1:5,000 at A3

1 INTRODUCTION

1.1 Instruction and Background

1.1.1 Wardell Armstrong LLP (WA) were commissioned by Cubico Invest (herein referred to as the 'Client') to undertake a ground investigation at Cell 3 of Frodsham Wind Farm located off Lordship Lane, Frodsham, WA6 7SN. The Client is currently undertaking an Environmental Impact Assessment (EIA) to support the application for a Development Consent Order (DCO), including developing the site for a wetland mitigation area as part of the wider Frodsham Solar Farm development.

1.2 Site Location and Description

1.2.1 The site is located north of Frodsham, Cheshire as shown on Drawing GM12793-001. The site is bound to the north by the Manchester Ship Canal (MSC), with the wider Frodsham Wind Farm site surrounding the site to the east, south and west. The Frodsham Wind Farm site has been divided into cells/lagoons where MSC dredgings have been deposited. Frodsham Deposit Ground No. 6 is to the south of the site, with agricultural land with an operational windfarm located on former deposit grounds to the east and west of the site.

1.2.2 There are a series of lakes and fishing ponds along the site's northern and western borders. At the time of the investigations, the site comprises agricultural land used for grazing cattle, with a series of ecological 'surface scrapes' and ponds, and an east-west orientated drainage ditch traversing through the site.

1.3 Limitations

1.3.1 This report has been prepared for the exclusive benefit of the Client, for the purpose of providing information on the ground conditions at the site. The report contents shall only be used in that context. Furthermore, new information, changes in practice or new legislation may necessitate revised interpretation of the report after the date of its production.

1.3.2 It should be noted that ground investigation relies upon the determination of information from 'point sources' such as the trial pits and the interpretation of data between investigation points. It should be recognised that the actual conditions at and between investigation points can differ spatially and temporally. The assessments and recommendations given in this report are based upon the interpretation of the results from the ground investigation at a specific point and time and therefore any

conclusions drawn would need to be reviewed prior to their use for further development of the site.

1.3.3 The ground investigation was preliminary and restricted in places due to the presence of ponds and 'surface scrapes'. Exploratory locations were positioned at locations to avoid these constraints and minimise disruption to the current land uses.

1.3.4 This report does not consider broader development constraints such as services, land drainage, flood risk, ecology, invasive weeds, archaeology, acoustics or air quality.

1.3.5 WA has used reasonable skill and care in the design of the ground investigation work to comply with currently available industry guidance and to meet the requirements of the commission.

2 SCOPE OF GROUND INVESTIGATION WORKS

2.1 Description of Works

2.1.1 The ground investigation was designed to provide a general classification of the ground conditions at Cell 3 of the Frodsham Wind Farm deposit ground. Ground investigation works were designed in general accordance with current UK guidance.

2.1.2 The ground investigation work comprised the following:

- Eight Trial Pits were excavated between the 14th and 15 February 2024 under the full-time supervision of a WA Geologist (Trial pit logs are attached at Appendix A). The Trial Pits were excavated to a maximum depth of 3.20 metres below ground level (mbgl) in order to:
    - Investigate the nature, distribution and thickness of made ground dredging deposits and near surface strata; and
    - Obtain samples for contamination and geotechnical analysis.
- Three Soakaway Tests were conducted within trial pits excavated on the 16th February 2024 under the full-time supervision of a WA Geologist (Soakaway Pit logs are attached at Appendix A and Soakaway test sheets are attached at Appendix B). The Soakaway pits were excavated to a maximum depth of 1.0mbgl to determine a soil infiltration rate for the soils within 1m of ground level.

2.1.3 The ground investigation works were undertaken by Cheetham Hill Construction Ltd under the direct supervision of an experienced WA Geologist. Ground investigation positions are shown on Drawing GM12793-002.

2.1.4 Exploratory arisings were logged on site by the WA Geologist in general accordance with the requirements of BS5930, including recorded observed visual and olfactory indications of contamination.

3 GROUND CONDITIONS

3.1 Introduction

3.1.1 Details of the ground conditions encountered are provided in the WA trial pit and soakaway pit logs attached at Appendix A, and the individual strata are summarised in Table 3.1.

3.2 Made Ground

3.2.1 Made ground interpreted to represent dredging deposits were encountered across the whole site to a maximum recorded depth of 3.2mbgl. The made ground deposits are summarised in Table 3.1. The base of the made ground was not proven within the trial pits excavated across the site.

Table 3.1: Summary of ground conditions

Description	Thickness Range (m)	Depth Range (mbgl)	
		Top	Base
Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	0.20 (TP04, TP06) – 0.30 (TP01-TP03, TP05, TP07-TP08)	0.00 (All positions)	0.20 (TP04, TP06) – 0.30 (TP01-TP03, TP05, TP07-TP08)
Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	0.20 (TP03) – 0.90 (TP05-TP06, TP08)	0.20 (TP04, TP06) – 0.30 (TP01-TP03, TP05, TP07-TP08)	0.50 (TP03) – 1.20 (TP05, TP08)
Made Ground: Very soft black silty CLAY with abundant rootlets and occasional pockets of fine to coarse black sand.	0.90 (TP06-TP07) – 2.50* (TP03)	0.50 (TP03) – 1.20 (TP05, TP08)	2.00 (TP06-TP07) – 3.20* (TP02)

*Base of made ground not proven.

3.2.2 A very strong organic odour was reported within the black clay encountered from 0.50 – 1.20mbgl across the site. No other visual or olfactory signs of contamination were noted during the ground investigation.

3.3 Groundwater

3.3.1 Groundwater was encountered in each trial pit between 0.8 – 2.0mbgl, perched on the very soft black silty clay. Details on groundwater strikes are included in the trial pit logs attached at Appendix A and summarised in Table 3.2.

Table 3.2: Summary of groundwater strikes

Location	Strata	Groundwater Strike (m)
TP01	Made ground: Light brown and yellowish brown slightly silty very sandy CLAY.	0.8
TP02	Made ground: Very soft black silty CLAY with abundant rootlets.	2.0
TP03		1.2
TP04	Made ground: Light brown and yellowish brown slightly silty very sandy CLAY.	0.5
TP05		1.1
TP06		1.0
TP07		0.8
	Made ground: Very soft black silty CLAY with abundant rootlets.	1.1
		1.8
TP08	Made ground: Light brown and yellowish brown slightly silty very sandy CLAY.	1.0

3.4 Laboratory Analysis

3.4.1 Representative soil samples were selected for laboratory geochemical and geotechnical testing to inform on the ground conditions at the site. The laboratory selected by WA for chemical analysis was Envirolab (UKAS and MCERTS accredited) and Murray Rix (UKAS accredited) for geotechnical testing. Smith Grant LLP were consulted to determine the chemical testing suites and samples selected for testing.

Geotechnical Testing

3.4.2 The following geotechnical testing suite was undertaken:

- Six Particle Size Distributions and Sedimentation;
- Two 2.5kg Compaction;
- Six Natural Moisture Content;
- Four Atterberg Classification;
- Three BRE Suites;
- Six Organic Content; and

- One Falling Head Permeability (on a recompacted sample).

3.4.3 The laboratory geotechnical test results are attached at Appendix C. A summary of the results of the geotechnical testing scheduled is provided in Table 3.3.

Chemical Testing

3.4.4 Seven samples of made ground were scheduled for the following chemical testing suite provided by Smith Grant LLP:

- Metals (As, B, Ba, Be, Fe, Cd, Cr, Cu, Hg, Ni, Pb, Se, Mn, V and Zn);
- Phenol;
- pH;
- Asbestos ID and quantification;
- USEPA 16 Polycyclic Aromatic Hydrocarbons (PAHs);
- Total Petroleum Hydrocarbons (TPHs); and
- Speciated PCBs.

3.4.5 Three samples of made ground were scheduled for the following leachate suite provided by Smith Grant LLP:

- Metals (As, B, Ba, Br, Fe, Cd, Cu, Cr, Pb, Mn, Hg, Ni, Se, V, Zn, Ca).
- Ammoniacal nitrogen as N;
- Chloride;
- Nitrite;
- Nitrate;
- Sulphate; and
- Sulphide.

3.4.6 Laboratory chemical testing results are attached at Appendix D.

Table 3.3: Summary of geotechnical testing results								
Strata	Particle Size Distribution Classification*	2.5kg compaction		Moisture Content (%)	Atterberg Classification		Organic Content	Falling Head Permeability (m/s)
		Optimum Water Content (%)	Maximum Dry Density (Mg/m^3)		Plasticity Index	Modified Plasticity Index		
Made Ground: Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	SHW Class 2A & 2B/7A	-	-	63.4	52	50.44	8.2	-
Made Ground: Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	SHW Class 2A & 2B/7A	-	-	39.8 – 47.7	43 - 49	41.71 – 46.55	2.4 – 5.2	-
Made Ground: Very soft black silty CLAY with abundant rootlets and occasional pockets of fine to coarse black sand.	SHW Class 2A & 2B/7A	39 – 40	0.76 – 1.21	92.0	71	66.74	5.4 – 6.4	5.4×10^{-10}

* Classification in accordance with Specification of Highway Works (Series 600)

4 SOAKAWAY TESTING

4.1 Introduction

4.1.1 Three soakaway pits were excavated to 0.8 – 1.0mbgl within the sandy clay deposits across the site to determine a soil infiltration rate to help inform on the proposed development.

4.1.2 Soakaway pits were excavated in general accordance with BRE DG 365. The pits were terminated above groundwater with the edges trimmed square and gravel infill used to aid in the stability of the pits. Soakaway pits were filled as quickly as possible with clean water, and the time taken for the water to drain away was recorded at suitable intervals, in accordance with the requirements of BRE DG 365. Soakaway testing sheets are attached at Appendix B.

4.1.3 Soakaway pit SW01 was not completed as the pit could not be filled with water due to significant outflow through permeable made ground deposits.

4.2 Testing Results

4.2.1 The infiltration rate within the top metre of made ground at the soakaway test positions has been estimated as 7.83 x10-4 m/s in SW02 and 1.88 x10-4 m/s in SW03, suggesting the top metre of made ground at the site is of moderate to high permeability.

5 DISCUSSION

5.1 Summary of Ground Conditions

5.1.1 The trial pitting has indicated that the ground conditions across the site area are relatively consistent with three distinct strata encountered comprising a topsoil to depths of 0.2 – 0.3 m bgl underlain by a light yellowish-brown sandy clay which extended to depths of between 0.5 m and 1.2 m bgl, which in turn is underlain by a very soft black organic-rich clay. The depth of the black clay was unproven during this investigation. It is considered that all the deposits encountered are historical dredging deposits from the adjacent Manchester Ship Canal.

5.1.2 Groundwater was recorded in all the trial pit locations at depths between 0.8 and 2.0 m bgl. The groundwater appeared to be perched on the black clay.

5.2 Proposed wetland feasibility

5.2.1 The purpose of the preliminary ground investigation was to obtain some initial information on the ground conditions to assist in determining the feasibility of the site for the construction of a wetland. The information would also be used to inform the initial conceptual designs.

5.2.2 It is understood that most of the shallow soils across the site area would need to remain saturated for most of the year to constitute a wetland. The preference is to utilise site-won materials to construct the wetland if feasible.

5.2.3 Based on the preliminary observations, it appears that groundwater was recorded at or near the boundary between the sandy clay and the black clay indicating that groundwater was perched on the black clay. A laboratory falling head permeability test was undertaken on a recompacted sample of the black clay and the coefficient of permeability (k) was recorded at 5.4 x 10-10 m/s indicating the material is practically impermeable. Further assessment is required, but initial information appears to suggest that the black clay may form a suitable lining to the wetland area to maintain saturation of the above soils.

5.2.4 Soakaway testing on the yellowish-brown sandy clay layer, which extended to depth of between 0.5 m and 1.2 m bgl indicated that this material had a moderate to high permeability. Therefore, it is considered that some of this material will require removing to create the wetland area. It has been proposed that this material will be used to backfill the existing ponds located along the northern boundary.

5.3 Earthworks

5.3.1 Earthworks of the site soils will be required to create the wetland; however, at the time of writing final levels are unclear. At this stage, it is assumed that the topsoil and a proportion of the sandy clay is likely to be cut from the proposed wetland area and re-used as fill in the pond area.

5.3.2 The results of the initial classification testing suggest that the topsoil and sandy clay generally fall into Class 2A & 2B (general cohesive material) in accordance with the Specification of Highway Works (SHW) Series 600 Earthworks of the Manual of Contract Documents for Highway Works.

5.3.3 Materials used as fill will need to be placed to a suitable engineering specification with the degree of compaction required dependent upon the end use and serviceability criteria.

5.3.4 Because of the low frequency of investigation points at this preliminary investigation stage, the materials encountered during the earthworks to construct the wetland may vary from those proved in the investigation. Furthermore, winter working or inclement weather may result in materials being unsuitable for incorporation in the works without modification. Cohesive soils are particularly susceptible to wet weather working. Unprotected stockpiled materials may deteriorate due to water infiltration and may become unsuitable for re-use in the works.

5.3.5 Earthwork modelling will be undertaken to determine if a mass balance could be achieved re-using all site-won materials on-site to create the wetland.

5.3.6 Further ground investigation and earthworks testing, particularly compaction testing, will be required prior to the completion of a design and earthworks specification for the wetland.

5.4 Excavations

5.4.1 Conventional mechanical excavators will readily excavate the made ground across the site. The trafficability of plant across the site during construction of the wetland will require careful consideration to ensure the most effective selection of mechanical plant and materials movement.

5.4.2 Trench excavations at the site should be considered unstable and consideration should be given for temporary support requirements by the Contractor. Where shallow sub-surface clay barriers are required to be constructed (potentially around the perimeter

of the wetland), appropriate methods of clay compaction should be adopted to remove the requirement for personnel entry into trenches e.g. use of a vibrating plate on the end of a back actor.

5.4.3 Should any perched groundwater be encountered, local dewatering via sump and pump should be suitable. Subject to the results of groundwater analysis, the pumped groundwater may require, treatment prior to disposal under permit to watercourse or to sewer.

6 CONCLUSIONS

6.1 Ground Conditions

6.1.1 The ground conditions encountered during the ground investigation across Cell 3 consisted of made ground derived from the historical use of the site to store dredging deposits from the Manchester Ship Canal.

6.1.2 The made ground was proven to a depth of 3.20mbgl and described as loose dark brown sandy clay topsoil underlain by loose light brown and yellowish brown slightly silty very sandy clay, and very soft black silty clay.

6.1.3 Groundwater was recorded in all the trial pit locations at depths between 0.8 and 2.0 m bgl. The groundwater appeared to be perched on the black clay.

6.1.4 Soakaway tests in general accordance with BRE DG 365 undertaken in the sandy clay indicated a moderate to high permeability.

6.1.5 A laboratory falling head test on the black clay indicated that the material was practically impermeable.

6.2 Wetland Feasibility

6.2.1 The initial assessment appears to suggest that the black clay encountered at depths between 0.5 m and 1.2 m bgl may form a suitable lining to the wetland area to maintain saturation of the above soils.

6.2.2 Soakaway testing of the sandy clay, which is overlying the black clay indicates a moderate to high permeability and therefore a proportion of this material will require removing from the wetland area.

6.2.3 Earthworks of existing site materials will be required to create the wetland and the next stage is to undertake earthworks modelling to develop initial concept designs.

6.3 Recommendations

6.3.1 Further site investigation is recommended to provide more data/information on the ground conditions between the existing trial pit locations.

6.3.2 A programme of groundwater level monitoring to determine seasonal and/or tidal effect on groundwater levels at the site.

6.3.3 Further assessment of the permeability of the black clay which could include laboratory testing or field tests such as falling/rising head tests.

6.3.4 The results of the further site investigation works will be used to refine the initial earthwork modelling and conceptual designs.

APPENDICES

Appendix A

Wardell Armstrong LLP Trial Pit and Soakaway Pit Logs

Trial Pit Log

TRIAL PIT REFERENCE
SW01
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 16/02/2024
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E349336.15 N378443.71
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 1.00m x 1.00m / Final Depth: 1.00m
Logged By: FL	Checked By: SS	Approved By: GC
Level: 9.46m AoD	Orientation: 50°	

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.20	ES		0.30	9.16		Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
		1.00	ES		1.00	8.46		Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	
								Base of Excavation at 1.00m	1
									2
									3
									4

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Soakaway pit utilised gravel infill to prevent instability.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Infiltration testing undertaken according to BRE 365.
BACKFILL: Trial pit backfilled with arisings.

Log printed on 12/03/2024 at 08:03

Trial Pit Log

TRIAL PIT REFERENCE
SW02
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 16/02/2024	
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E349143.20 N378350.02	
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 1.00m x 1.00m	Final Depth: 0.80m
Logged By: FL	Checked By: SS	Approved By: GC	Level: 9.50m AoD	Orientation: 50°

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.20	ES		0.30	9.20		Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
		0.80	ES		0.80	8.70		Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	
								Base of Excavation at 0.80m	1 2 3 4

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Soakaway pit utilised gravel infill to prevent instability.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Infiltration testing undertaken according to BRE 365.
BACKFILL: Trial pit backfilled with arisings.

Log printed on 12/03/2024 at 08:03

Trial Pit Log

TRIAL PIT REFERENCE
SW03
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 16/02/2024	
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E348890.70 N378229.72	
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 1.00m x 1.00m	Final Depth: 0.80m
Logged By: FL	Checked By: SS	Approved By: GC	Level: 9.32m AoD
			Orientation: 50°

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.20	ES		0.30	9.02		Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
		0.80	ES		0.80	8.52		Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	
								Base of Excavation at 0.80m	1 2 3 4

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Soakaway pit utilised gravel infill to prevent instability.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Infiltration testing undertaken according to BRE 365.
BACKFILL: Trial pit backfilled with arisings.

Log printed on 12/03/2024 at 08:03

Trial Pit Log

TRIAL PIT REFERENCE
TP01
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 15/02/2024
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E348713.34 N378217.38
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 2.00m x 0.60m / Final Depth: 2.80m
Logged By: FL	Checked By: SS	Approved By: GC
Level: 9.53m AoD	Orientation: 50°	

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
					0.30	9.23		Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
		0.50 0.50	B ES					Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	
	▽				0.90	8.63		Made Ground: Very soft black silty CLAY with abundant rootlets and occasional pockets of fine to coarse black sand. *0.90m - 2.80m : Very strong organic odour*	1 2
		1.50	ES						
		2.80	HSV	0kPa	2.80	6.73		Base of Excavation at 2.80m	3 4

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Sides of pit collapsing beneath water strike. Trial pit terminated at 2.8m depth due to collapsing.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Hand Shear Vane testing of the black clay returned values of 0-2kPa.
BACKFILL: Trial pit backfilled with arisings. Difficulty backfilling due to swelling of black clay with water strike.
GROUNDWATER: Fast water ingress at 0.8m depth from sand pockets, with water collecting at base of trial pit.

Log printed on 12/03/2024 at 08:03

Trial Pit Log

TRIAL PIT REFERENCE
TP02
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 14/02/2024
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E348805.09 N378113.66
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 2.00m x 0.60m / Final Depth: 3.20m
Logged By: FL	Checked By: SS	Approved By: GC
Level: 8.84m AoD		Orientation: 50°

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.10	ES					Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
					0.30	8.54		Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	
								0.90m - 1.00m : Lense of orangish brown fine to medium silty SAND.	
					1.00	7.84		Made Ground: Very soft black silty CLAY with abundant rootlets and occasional pockets of fine to coarse black sand.	1
								1.00m - 3.20m : Very strong organic odour	
		1.50	ES						
	▽								2
									3
					3.20	5.64		Base of Excavation at 3.20m	
									4

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Sides of pit collapsing beneath water strike. Trial pit terminated at 3.2m depth due to collapsing.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Hand Shear Vane testing of the black clay returned values of 0-2kPa.
BACKFILL: Trial pit backfilled with arisings. Difficulty backfilling due to swelling of black clay with water strike.
GROUNDWATER: Fast water ingress at 2.0m depth from sand pockets, with water collecting at base of trial pit.

Log printed on 12/03/2024 at 08:03

Trial Pit Log

TRIAL PIT REFERENCE
TP03
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 15/02/2024
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E349007.23 N378399.56
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 2.00m x 0.60m / Final Depth: 3.00m
Logged By: FL	Checked By: SS	Approved By: GC
Level: 9.40m AoD	Orientation: 50°	

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.20	ES		0.30	9.10		Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
		0.40	B		0.50	8.90		Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse. *0.40m - 0.50m : Lense of orangish brown fine to medium silty SAND.*	
	▽	2.00 2.00	ES HSV	2kPa	3.00	6.40		Made Ground: Very soft black silty CLAY with abundant rootlets and occasional pockets of fine to coarse black sand. *0.50m - 3.00m : Very strong organic odour*	1 2 3 4
								Base of Excavation at 3.00m	

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Sides of pit collapsing beneath water strike. Trial pit terminated at 3.0m depth due to collapsing.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Hand Shear Vane testing of the black clay returned values of 0-2kPa.
BACKFILL: Trial pit backfilled with arisings. Difficulty backfilling due to swelling of black clay with water strike.
GROUNDWATER: Fast water ingress at 1.2m depth from sand pockets, with water collecting at base of trial pit.

Log printed on 12/03/2024 at 08:03

Trial Pit Log

TRIAL PIT REFERENCE
TP04
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 14/02/2024
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E349071.06 N378262.59
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 2.00m x 0.60m / Final Depth: 3.10m
Logged By: FL	Checked By: SS	Approved By: GC
Level: 9.55m AoD		Orientation: 50°

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
					0.20	9.35		Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
	▽	0.50	ES					Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	
					0.80	8.75		Made Ground: Very soft black silty CLAY with abundant rootlets and occasional pockets of fine to coarse black sand.	
		1.00 1.00	B ES					*0.80m - 3.10m : Very strong organic odour*	1
									2
									3
					3.10	6.45		Base of Excavation at 3.10m	
									4

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Sides of pit collapsing beneath water strike. Trial pit terminated at 3.1m depth due to collapsing.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Hand Shear Vane testing of the black clay returned values of 0-2kPa.
BACKFILL: Trial pit backfilled with arisings. Difficulty backfilling due to swelling of black clay with water strike.
GROUNDWATER: Fast water ingress at 0.5m depth from sand pockets, with water collecting at base of trial pit.

Log printed on 12/03/2024 at 08:03

Trial Pit Log

TRIAL PIT REFERENCE
TP05
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 15/02/2024
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E349281.17 N378553.82
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 2.00m x 0.60m / Final Depth: 3.00m
Logged By: FL	Checked By: SS	Approved By: GC
Level: 9.60m AoD		Orientation: 10°

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.10	ES					Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
					0.30	9.30		Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	
	▽	1.00	ES						1
					1.20	8.40		Made Ground: Very soft black silty CLAY with abundant rootlets and occasional pockets of fine to coarse black sand. *1.20m - 3.00m : Very strong organic odour*	
									2
		3.00	HSV	0kPa	3.00	6.60		Base of Excavation at 3.00m	3
									4

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Sides of pit collapsing beneath water strike. Trial pit terminated at 3.0m depth due to collapsing.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Hand Shear Vane testing of the black clay returned values of 0-2kPa.
BACKFILL: Trial pit backfilled with arisings. Difficulty backfilling due to swelling of black clay with water strike.
GROUNDWATER: Fast water ingress at 1.1m depth from sand pockets, with water collecting at base of trial pit.

Log printed on 12/03/2024 at 08:03

Trial Pit Log

TRIAL PIT REFERENCE
TP06
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 14/02/2024
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E349337.02 N378382.28
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 2.00m x 0.60m / Final Depth: 2.00m
Logged By: FL	Checked By: SS	Approved By: GC
Level: 9.53m AoD		Orientation: 130°

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.10	ES		0.20	9.33		Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
	▽	1.00	B		1.10	8.43		Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	1
		2.00	ES		2.00	7.53		Made Ground: Very soft black silty CLAY with abundant rootlets and occasional pockets of fine to coarse black sand. *1.10m - 2.00m : Very strong organic odour*	2
								Base of Excavation at 2.00m	3
									4

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Sides of pit collapsing beneath water strike. Trial pit terminated at 2.0m depth due to collapsing.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Hand Shear Vane testing of the black clay returned values of 0-2kPa.
BACKFILL: Trial pit backfilled with arisings. Difficulty backfilling due to swelling of black clay with water strike.
GROUNDWATER: Fast water ingress at 1.0m depth from sand pockets, with water collecting at base of trial pit.

Log printed on 12/03/2024 at 08:03

Trial Pit Log

TRIAL PIT REFERENCE
TP07
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 15/02/2024
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E349462.02 N378746.64
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 2.00m x 0.60m / Final Depth: 2.00m
Logged By: FL	Checked By: SS	Approved By: GC
Level: 9.41m AoD		Orientation: 130°

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
					0.00	9.41		Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
					0.30	9.11		Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	
	▽	0.50	ES						1
	▽				1.10	8.31		Made Ground: Very soft black silty CLAY with abundant rootlets and occasional pockets of fine to coarse black sand. *1.10m - 2.00m : Very strong organic odour*	
	▽	2.00 2.00	B ES		2.00	7.41		Base of Excavation at 2.00m	2
									3
									4

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Sides of pit collapsing beneath water strike. Trial pit terminated at 2.0m depth due to collapsing.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Hand Shear Vane testing of the black clay returned values of 0-2kPa.
BACKFILL: Trial pit backfilled with arisings. Difficulty backfilling due to swelling of black clay with water strike.
GROUNDWATER: Fast water ingress at 0.8m, 1.1m and 1.8m depth from sand pockets, with water collecting at base of trial pit.

Log printed on 12/03/2024 at 08:03

Trial Pit Log

TRIAL PIT REFERENCE
TP08
Sheet 1 of 1

Project Name: Frodsham Cell 3	Client: Cubico Invest	Date: 15/02/2024
Location: Frodsham Cell 3, Frodsham Wind Farm, Cheshire	Contractor: Cheetham Hill Construction Ltd	Co-ords: E349572.39 N378584.41
Project No. : GM12793	Excavator: Volvo ECR58D	Dimensions : 2.00m x 0.60m / Final Depth: 2.80m
Logged By: FL	Checked By: SS	Approved By: GC
Level: 9.40m AoD		Orientation: 240°

Backfill	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description	Scale
		0.10	B					Made Ground: (Loose) Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).	
		0.20	ES						
					0.30	9.10		Made Ground: (Loose) Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.	
		0.75	ES						1
	▽								
					1.20	8.20		Made Ground: Very soft black silty CLAY with abundant rootlets and occasional pockets of fine to coarse black sand.	
								1.20m - 2.80m : Very strong organic odour	2
					2.80	6.60		Base of Excavation at 2.80m	3
									4

Trench Support and Comment			Pumping Data		
Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
Sides of pit collapsing beneath water strike. Trial pit terminated at 2.8m depth due to collapsing.					

General Remarks

SERVICES: Location service cleared using a CAT and Genny prior to excavation.
TESTING: Hand Shear Vane testing of the black clay returned values of 0-2kPa.
BACKFILL: Trial pit backfilled with arisings. Difficulty backfilling due to swelling of black clay with water strike.
GROUNDWATER: Fast water ingress at 1.0m depth from sand pockets, with water collecting at base of trial pit.

Log printed on 12/03/2024 at 08:03

Appendix B

Wardell Armstrong LLP Soakaway Test Data Sheets

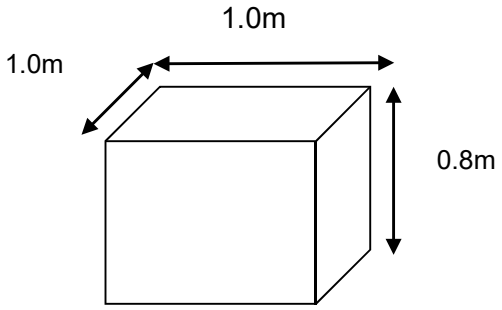
In-situ Soakaway Test Record – Test No: SA02

SITE	Frodsham Cell 3	DATE	16/02/2024
CLIENT	Cubico Invest	JOB NO.	GM12793

Type of Test:	Pit
Width of pit:	1.0
Length of pit:	1.0
Depth of pit:	0.80
Standing Water Level Prior to Test:	N/A
Depth of Water at T = 0 (below ground level):	0.62m
Infilled with gravel? (Y/N):	Y
Calculated Soil Infiltration Rate (m/s):	7.826×10^{-4}

NOTES:
Gravel infill to 0.20mbgl
Difficulty filling with water to 75% full

Depth (mbgl)	Strata
0.0 – 0.30	Made Ground: Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).
0.30 – 0.80	Made Ground: Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.



Water Level Records

Test 1	
Time (secs)	Depth to Water (mbgl)
10	0.68
20	0.70
30	0.72
40	0.76
50	0.78
60	0.80
70	0.80

Test 2	
Time (secs)	Depth to Water (mbgl)
10	0.65
20	0.70
30	0.74
40	0.77
50	0.79
60	0.80

Test 3	
Time (secs)	Depth to Water (mbgl)
10	0.60
20	0.63
30	0.67
40	0.70
50	0.73
60	0.76
70	0.80

Undertaken in general accordance with the methodology set out within BRE 365.

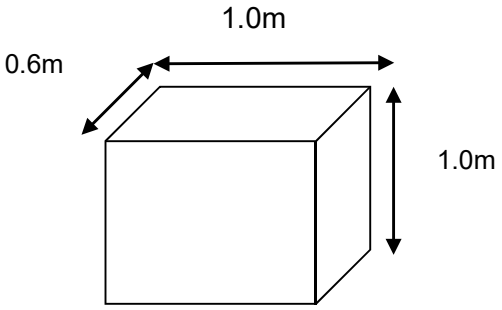
In-situ Soakaway Test Record – Test No: SA03

SITE	Frodsham Cell 3	DATE	16/02/2024
CLIENT	Cubico Invest	JOB NO.	GM12793

Type of Test:	Pit
Width of pit:	0.6m
Length of pit:	1.0m
Depth of pit:	1.0m
Standing Water Level Prior to Test:	N/A
Depth of Water at T = 0 (below ground level):	0.20m
Infilled with gravel? (Y/N):	Y
Calculated Soil Infiltration Rate (m/s):	1.883×10^{-4}

NOTES:

Depth (mbgl)	Strata
0.0 – 0.30	Made Ground: Dark brown sandy CLAY. Sand is fine to coarse (Topsoil).
0.30 – 0.80	Made Ground: Light brown and yellowish brown slightly silty very sandy CLAY. Sand is fine to coarse.



Water Level Records

Test 1	
Time (secs)	Depth to Water (mbgl)
1	0.55
2	0.50
3	0.69
4	0.77
5	0.83
6	0.90
7	1.00

Test 2	
Time (secs)	Depth to Water (mbgl)
1	0.25
2	0.52
3	0.64
4	0.69
5	0.83
6	0.85
7	1.00

Test 3	
Time (secs)	Depth to Water (mbgl)
30	0.41
60	0.51
90	0.57
120	0.64
150	0.72
180	0.77
210	0.79
240	0.83
270	0.90
300	1.00

Undertaken in general accordance with the methodology set out within BRE 365.

Appendix C

Laboratory Geotechnical Testing Results

envirolab
Hattersley Science & Technology Park
Stockport Road, Hattersley, SK14 3QU

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 24/01712
Issue Number: 1 **Date:** 29 February, 2024

Client:
Wardell Armstrong (Bolton)
41-50 Futura Park
Aspinall Way
Middlebrook
Bolton
Lancashire
UK
BL6 6SU

Project Manager: Fay Lawrence/Sabine Sargeant
Project Name: Frodsham Cell 3
Project Ref: GM12793
Order No: GM5591
Date Samples Received: 19/02/24
Date Instructions Received: 20/02/24
Date Analysis Completed: 29/02/24

[redacted]

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/1	24/01712/2	24/01712/6	24/01712/10	24/01712/11	24/01712/12	24/01712/16	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP02	TP02	TP06	TP03	TP05	TP05	TP07			
Depth to Top	0.10	1.50	2.00	2.00	0.10	1.00	2.00			
Depth To Bottom										
Date Sampled	14-Feb-24	14-Feb-24	14-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	5E	6E	3E	3E	6E	3E	3			
% Stones >10mm$_A$	<0.1	<0.1	3.4	<0.1	<0.1	<0.1	4.7	% w/w	0.1	A-T-044
pH$_D$$^{M\#}$	-	-	7.88	7.77	7.90	7.84	8.02	pH	0.01	A-T-031s
Phenol$_A$	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	0.2	A-T-050s
Total Organic Carbon$_D$$^{M\#}$	-	-	3.71	2.60	2.39	2.45	3.44	% w/w	0.03	A-T-032s
Arsenic$_D$$^{M\#}$	-	-	63	26	30	21	38	mg/kg	1	A-T-024s
Barium$_D$	-	-	403	262	366	261	413	mg/kg	1	A-T-024s
Beryllium$_D$	-	-	1.2	0.6	0.8	0.6	1.0	mg/kg	0.5	A-T-024s
Boron (water soluble)$_D$$^{M\#}$	-	-	10.4	6.5	1.5	5.4	10.1	mg/kg	1	A-T-027s
Cadmium$_D$$^{M\#}$	-	-	3.2	1.7	2.7	1.8	2.7	mg/kg	0.5	A-T-024s
Copper$_D$$^{M\#}$	-	-	177	85	104	77	134	mg/kg	1	A-T-024s
Chromium$_D$$^{M\#}$	-	-	123	59	80	57	101	mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	-	-	<1	<1	<1	<1	<1	mg/kg	1	A-T-040s
Iron$_D$	-	-	28900	14100	18500	11900	25400	mg/kg	50	A-T-024s
Lead$_D$$^{M\#}$	-	-	223	164	328	165	241	mg/kg	1	A-T-024s
Manganese$_D$	-	-	1300	704	850	560	1050	mg/kg	1	A-T-024s
Mercury$_D$	-	-	7.14	8.91	22.8	29.9	15.2	mg/kg	0.17	A-T-024s
Nickel$_D$$^{M\#}$	-	-	35	20	26	20	34	mg/kg	1	A-T-024s
Selenium$_D$$^{M\#}$	-	-	2	<1	<1	<1	<1	mg/kg	1	A-T-024s
Vanadium$_D$$^{M\#}$	-	-	51	31	39	28	49	mg/kg	1	A-T-024s
Zinc$_D$$^{M\#}$	-	-	682	390	486	363	572	mg/kg	5	A-T-024s
Leachate Prep BS EN 12457-2 (10:1)$_A$	*	*	-	-	-	*	-			A-T-001
Ammoniacal nitrogen as N (leachable)$_A$	<0.05	18.04	-	-	-	6.08	-	mg/l	0.05	A-T-033w
Chloride (leachable)$_A$	<1.00	374	-	-	-	120	-	mg/l	1	A-T-026w
Nitrite (leachable)$_A$	<0.1	<0.1	-	-	-	<0.1	-	mg/l	0.1	A-T-026w (N)
Nitrate (leachable)$_A$	1.8	0.4	-	-	-	0.3	-	mg/l	0.1	A-T-026w (N)
Sulphate (leachable)$_A$	1.44	22.73	-	-	-	20.52	-	mg/l	1	A-T-026w
Sulphide (leachable)$_A$	<0.1	<0.1	-	-	-	<0.1	-	mg/l	0.1	A-T-043-w
Arsenic (leachable)$_A$	29	37	-	-	-	27	-	µg/l	1	A-T-025w
Boron (leachable)$_A$	<10	582	-	-	-	402	-	µg/l	10	A-T-025w
Barium (leachable)$_A$	31	150	-	-	-	95	-	µg/l	1	A-T-025w
Beryllium (leachable)$_A$	<1	<1	-	-	-	<1	-	µg/l	1	A-T-025w
Cadmium (leachable)$_A$	<1	<1	-	-	-	<1	-	µg/l	1	A-T-025w
Copper (leachable)$_A$	21	<4	-	-	-	7	-	µg/l	4	A-T-025w

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/1	24/01712/2	24/01712/6	24/01712/10	24/01712/11	24/01712/12	24/01712/16	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP02	TP02	TP06	TP03	TP05	TP05	TP07			
Depth to Top	0.10	1.50	2.00	2.00	0.10	1.00	2.00			
Depth To Bottom										
Date Sampled	14-Feb-24	14-Feb-24	14-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	5E	6E	3E	3E	6E	3E	3			
Chromium (leachable)$_A$	2	2	-	-	-	2	-	µg/l	1	A-T-025w
Chromium (hexavalent) (leachable)$_A$	<0.05	<0.05	-	-	-	<0.05	-	mg/l	0.05	A-T-040w
Iron (leachable)$_A$	399	26	-	-	-	194	-	µg/l	10	A-T-025w
Lead (leachable)$_A$	27	2	-	-	-	18	-	µg/l	1	A-T-025w
Manganese (leachable)$_A$	16	89	-	-	-	90	-	µg/l	1	A-T-025w
Mercury (leachable)$_A$	0.2	<0.1	-	-	-	0.3	-	µg/l	0.1	A-T-025w
Nickel (leachable)$_A$	2	5	-	-	-	4	-	µg/l	2	A-T-025w
Selenium (leachable)$_A$	<1	<1	-	-	-	<1	-	µg/l	1	A-T-025w
Vanadium (leachable)$_A$	9	6	-	-	-	7	-	µg/l	1	A-T-025w
Zinc (leachable)$_A$	52	17	-	-	-	26	-	µg/l	2	A-T-025w
Calcium (leachable)$_A$	7	21	-	-	-	8	-	mg/l	1	A-T-049w

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/1	24/01712/2	24/01712/6	24/01712/10	24/01712/11	24/01712/12	24/01712/16	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP02	TP02	TP06	TP03	TP05	TP05	TP07			
Depth to Top	0.10	1.50	2.00	2.00	0.10	1.00	2.00			
Depth To Bottom										
Date Sampled	14-Feb-24	14-Feb-24	14-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	5E	6E	3E	3E	6E	3E	3			
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{D}^{\#}$	-	-	NAD	Chrysotile	Chrysotile	Chrysotile	NAD			A-T-045
Asbestos Matrix (visual)$_{D}$	-	-	-	-	-	-	-			A-T-045
Asbestos Matrix (microscope)$_{D}$	-	-	-	Loose Fibres	Loose Fibres	Loose Fibres	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_{D}$	-	-	N/A	N/A	N/A	N/A	N/A			A-T-045
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	-	-	-	<0.001	<0.001	<0.001	-	% w/w	0.001	A-T-054

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/1	24/01712/2	24/01712/6	24/01712/10	24/01712/11	24/01712/12	24/01712/16	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP02	TP02	TP06	TP03	TP05	TP05	TP07			
Depth to Top	0.10	1.50	2.00	2.00	0.10	1.00	2.00			
Depth To Bottom										
Date Sampled	14-Feb-24	14-Feb-24	14-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	5E	6E	3E	3E	6E	3E	3			
PAH-16MS										
Acenaphthene$_A^{M\#}$	-	-	0.61	0.98	0.04	0.38	0.54	mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	-	-	0.06	0.08	0.11	0.04	0.11	mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	-	-	0.39	1.41	0.13	0.46	0.76	mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	-	-	0.43	1.50	0.26	0.24	0.56	mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	-	-	0.51	1.19	0.43	0.22	0.63	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	-	-	0.53	1.25	0.64	0.28	0.74	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	-	-	0.20	0.37	0.47	<0.05	0.24	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	-	-	0.20	0.51	0.19	<0.07	0.26	mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	-	-	0.59	1.50	0.37	0.32	0.69	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A$	-	-	<0.04	0.10	0.09	<0.04	<0.04	mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	-	-	1.45	4.02	0.40	0.88	1.69	mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	-	-	0.39	0.84	0.03	0.30	0.52	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	-	-	0.24	0.47	0.63	0.10	0.30	mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	-	-	0.82	2.11	0.07	1.26	0.78	mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	-	-	1.18	2.93	0.29	0.92	1.41	mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	-	-	1.00	3.30	0.39	0.68	1.41	mg/kg	0.07	A-T-019s
Total PAH-16MS$_A$	-	-	8.60	22.6	4.54	6.08	10.6	mg/kg	0.01	A-T-019s

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/1	24/01712/2	24/01712/6	24/01712/10	24/01712/11	24/01712/12	24/01712/16	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP02	TP02	TP06	TP03	TP05	TP05	TP07			
Depth to Top	0.10	1.50	2.00	2.00	0.10	1.00	2.00			
Depth To Bottom										
Date Sampled	14-Feb-24	14-Feb-24	14-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	5E	6E	3E	3E	6E	3E	3			
Speciated PCB-EC7										
PCB BZ $28_A^{M\#}$	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	mg/kg	0.003	A-T-004s
PCB BZ $52_A^{M\#}$	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	mg/kg	0.002	A-T-004s
PCB BZ $101_A^{M\#}$	-	-	<0.004	<0.004	<0.004	<0.004	<0.004	mg/kg	0.004	A-T-004s
PCB BZ $118_A^{M\#}$	-	-	<0.007	<0.007	<0.007	<0.007	<0.007	mg/kg	0.007	A-T-004s
PCB BZ $138_A^{M\#}$	-	-	<0.006	<0.006	<0.006	<0.006	<0.006	mg/kg	0.006	A-T-004s
PCB BZ $153_A^{M\#}$	-	-	<0.004	<0.004	<0.004	<0.004	<0.004	mg/kg	0.004	A-T-004s
PCB BZ $180_A^{M\#}$	-	-	<0.004	<0.004	0.007	<0.004	<0.004	mg/kg	0.004	A-T-004s
Total Speciated PCB-$EC7_A^{M\#}$	-	-	<0.007	<0.007	0.007	<0.007	<0.007	mg/kg	0.003	A-T-004s

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/1	24/01712/2	24/01712/6	24/01712/10	24/01712/11	24/01712/12	24/01712/16	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP02	TP02	TP06	TP03	TP05	TP05	TP07			
Depth to Top	0.10	1.50	2.00	2.00	0.10	1.00	2.00			
Depth To Bottom										
Date Sampled	14-Feb-24	14-Feb-24	14-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24	15-Feb-24			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	5E	6E	3E	3E	6E	3E	3			
TPH CWG with Clean Up										
Ali >C5-C6$_A$	-	-	<0.01	0.06	<0.01	0.06	<0.01	mg/kg	0.01	A-T-022s
Ali >C6-C8$_A$	-	-	0.79	1.52	<0.01	2.34	0.69	mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	-	-	92	125	<1	152	132	mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	-	-	69	98	<1	106	108	mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	-	-	79	162	<1	186	179	mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	-	-	86	125	3	158	175	mg/kg	1	A-T-055s
Ali >C21-C35$_A^{M\#}$	-	-	218	234	61	285	324	mg/kg	1	A-T-055s
Total Aliphatics$_A$	-	-	544	746	64	888	918	mg/kg	1	Calc-As Recd
Aro >C5-C7$_A^{\#}$	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	-	-	<0.01	0.04	<0.01	0.02	<0.01	mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	-	-	35	51	1	56	48	mg/kg	1	A-T-055s
Aro >C10-C12$_A$	-	-	59	94	1	98	101	mg/kg	1	A-T-055s
Aro >C12-C16$_A$	-	-	132	250	4	257	264	mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	-	-	137	150	9	158	188	mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	-	-	122	115	27	98	114	mg/kg	1	A-T-055s
Total Aromatics$_A$	-	-	485	660	43	667	715	mg/kg	1	Calc-As Recd
TPH (Ali & Aro >C5-C35)$_A$	-	-	1030	1410	107	1560	1630	mg/kg	1	Calc-As Recd
BTEX - Benzene$_A^{\#}$	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	-	-	<0.01	0.04	<0.01	0.02	<0.01	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	-	-	<0.01	0.02	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	-	-	<0.01	0.06	<0.01	0.04	<0.01	mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	-	-	<0.01	0.06	<0.01	0.06	<0.01	mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/21	24/01712/22						Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	SW03	SW03								
Depth to Top	0.20	1.00								
Depth To Bottom										
Date Sampled	16-Feb-24	16-Feb-24								
Sample Type	SOIL - ES	SOIL - ES								
Sample Matrix Code	3	6E								
% Stones >10mm$_A$	<0.1	<0.1						% w/w	0.1	A-T-044
pH$_D$$^{M\#}$	7.87	8.14						pH	0.01	A-T-031s
Phenol$_A$	<0.2	<0.2						mg/kg	0.2	A-T-050s
Total Organic Carbon$_D$$^{M\#}$	2.99	2.30						% w/w	0.03	A-T-032s
Arsenic$_D$$^{M\#}$	23	39						mg/kg	1	A-T-024s
Barium$_D$	279	333						mg/kg	1	A-T-024s
Beryllium$_D$	0.7	0.6						mg/kg	0.5	A-T-024s
Boron (water soluble)$_D$$^{M\#}$	1.5	2.2						mg/kg	1	A-T-027s
Cadmium$_D$$^{M\#}$	2.2	2.4						mg/kg	0.5	A-T-024s
Copper$_D$$^{M\#}$	80	93						mg/kg	1	A-T-024s
Chromium$_D$$^{M\#}$	65	63						mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1						mg/kg	1	A-T-040s
Iron$_D$	15000	16500						mg/kg	50	A-T-024s
Lead$_D$$^{M\#}$	232	274						mg/kg	1	A-T-024s
Manganese$_D$	642	593						mg/kg	1	A-T-024s
Mercury$_D$	21.4	8.61						mg/kg	0.17	A-T-024s
Nickel$_D$$^{M\#}$	23	21						mg/kg	1	A-T-024s
Selenium$_D$$^{M\#}$	<1	<1						mg/kg	1	A-T-024s
Vanadium$_D$$^{M\#}$	33	38						mg/kg	1	A-T-024s
Zinc$_D$$^{M\#}$	371	437						mg/kg	5	A-T-024s

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/21	24/01712/22						Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	SW03	SW03								
Depth to Top	0.20	1.00								
Depth To Bottom										
Date Sampled	16-Feb-24	16-Feb-24								
Sample Type	SOIL - ES	SOIL - ES								
Sample Matrix Code	3	6E								
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{D}^{\#}$	Chrysotile	Chrysotile								A-T-045
Asbestos Matrix (visual)$_{D}$	-	-								A-T-045
Asbestos Matrix (microscope)$_{D}$	Loose Fibres	Loose Fibres								A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_{D}$	N/A	N/A								A-T-045
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	<0.001	<0.001						% w/w	0.001	A-T-054

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/21	24/01712/22						Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	SW03	SW03								
Depth to Top	0.20	1.00								
Depth To Bottom										
Date Sampled	16-Feb-24	16-Feb-24								
Sample Type	SOIL - ES	SOIL - ES								
Sample Matrix Code	3	6E								
PAH-16MS										
Acenaphthene$_A^{M\#}$	<0.01	<0.01						mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	0.02	0.08						mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	<0.02	0.09						mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.08	0.09						mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.13	0.18						mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.14	0.43						mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.08	0.27						mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	0.12						mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	0.11	0.23						mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A$	<0.04	<0.04						mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	0.14						mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01						mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.11	0.32						mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	<0.03	0.06						mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	0.06	0.11						mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	<0.07	0.15						mg/kg	0.07	A-T-019s
Total PAH-16MS$_A$	0.73	2.27						mg/kg	0.01	A-T-019s

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/21	24/01712/22						Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	SW03	SW03								
Depth to Top	0.20	1.00								
Depth To Bottom										
Date Sampled	16-Feb-24	16-Feb-24								
Sample Type	SOIL - ES	SOIL - ES								
Sample Matrix Code	3	6E								
Speciated PCB-EC7										
PCB BZ $28_A^{M\#}$	<0.003	<0.003						mg/kg	0.003	A-T-004s
PCB BZ $52_A^{M\#}$	<0.002	<0.002						mg/kg	0.002	A-T-004s
PCB BZ $101_A^{M\#}$	<0.004	<0.004						mg/kg	0.004	A-T-004s
PCB BZ $118_A^{M\#}$	<0.007	<0.007						mg/kg	0.007	A-T-004s
PCB BZ $138_A^{M\#}$	<0.006	<0.006						mg/kg	0.006	A-T-004s
PCB BZ $153_A^{M\#}$	<0.004	<0.004						mg/kg	0.004	A-T-004s
PCB BZ $180_A^{M\#}$	<0.004	<0.004						mg/kg	0.004	A-T-004s
Total Speciated PCB-$EC7_A^{M\#}$	<0.007	<0.007						mg/kg	0.003	A-T-004s

Envirolab Job Number: 24/01712

Client Project Name: Frodsham Cell 3

Client Project Ref: GM12793

Lab Sample ID	24/01712/21	24/01712/22						Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	SW03	SW03								
Depth to Top	0.20	1.00								
Depth To Bottom										
Date Sampled	16-Feb-24	16-Feb-24								
Sample Type	SOIL - ES	SOIL - ES								
Sample Matrix Code	3	6E								
TPH CWG with Clean Up										
Ali >C5-C6$_A$	<0.01	<0.01						mg/kg	0.01	A-T-022s
Ali >C6-C8$_A$	<0.01	<0.01						mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	<1	2						mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	5						mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	24						mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	3	53						mg/kg	1	A-T-055s
Ali >C21-C35$_A^{M\#}$	59	264						mg/kg	1	A-T-055s
Total Aliphatics$_A$	62	348						mg/kg	1	Calc-As Recd
Aro >C5-C7$_A^{\#}$	<0.01	<0.01						mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01						mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	<1	<1						mg/kg	1	A-T-055s
Aro >C10-C12$_A$	<1	5						mg/kg	1	A-T-055s
Aro >C12-C16$_A$	3	52						mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	6	113						mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	18	44						mg/kg	1	A-T-055s
Total Aromatics$_A$	27	213						mg/kg	1	Calc-As Recd
TPH (Ali & Aro >C5-C35)$_A$	90	561						mg/kg	1	Calc-As Recd
BTEX - Benzene$_A^{\#}$	<0.01	<0.01						mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01						mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01						mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01						mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01						mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01						mg/kg	0.01	A-T-022s

Report Notes

General
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received within the same delivery, will be disposed of **four weeks** after the initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of **six months** after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and Interpretations expressed are outside our scope of accreditation.
The client Sample No, Client Sample ID, Depth to top, Depth to Bottom and Date Sampled are all provided by the client.
A deviating sample report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Key

Superscript "#"	Accredited to ISO 17025
Superscript "M"	Accredited to MCertS
Superscript "U"	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript "A"	Analysis performed on as-received Sample
Subscript "D"	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript "^"	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
N/A	Not applicable

Asbestos
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing, and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Assigned Matrix Codes

1	SAND	6	CLAY/LOAM	A	Contains Stones
2	LOAM	7	OTHER	B	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	C	Contains visible hydrocarbons
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal
5	SAND/CLAY			E	Contains roots / twigs
Note: 7,8,9 matrices are not covered by our ISO 17025 or MCertS accreditation, unless stated above.					

Soil Chemical Analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH by method A-T-007:
For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase only.
Results "with Clean up" indicates samples cleaned up with Silica during extraction.

EPH CWG (method A-T-055) from TPH CWG:
EPH CWG results have humics mathematically subtracted through instrument calculation.
Where these humic substances have been identified in any IDs from "TPH CWG with clean up" please note that the concentration is **NOT** included in the quantified results but present in the ID for information.

Electrical Conductivity of water by method A-T-037:
Results greater than 12900µS/cm @ 25^{o}C / 11550µS/cm @ 20^{o}C fall outside the accreditation range and as such are unaccredited.

Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Hattersley Science & Technology Park, Stockport Road, Hattersley, SK14 3QU
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Wardell Armstrong (Bolton), 41-50 Futura Park, Aspinall Way, Middlebrook, Bolton, Lancashire, UK, BL6 6SU

Project: Frodsham Cell 3

Clients Project No: GM12793

Project No: 24/01712

Date Received: 20/02/2024 (am)

Cool Box Temperatures (°C): 13.8, 13.4, 12.6, 15.2

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	24/01712/1	24/01712/2	24/01712/6	24/01712/10	24/01712/11	24/01712/12	24/01712/16	24/01712/21	24/01712/22
Client Sample No									
Client Sample ID/Depth	TP02 0.10m	TP02 1.50m	TP06 2.00m	TP03 2.00m	TP05 0.10m	TP05 1.00m	TP07 2.00m	SW03 0.20m	SW03 1.00m
Date Sampled	14/02/24	14/02/24	14/02/24	15/02/24	15/02/24	15/02/24	15/02/24	16/02/24	16/02/24
A-T-004s			28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024
A-T-019s			28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024
A-T-022s			27/02/2024	27/02/2024	27/02/2024	27/02/2024	27/02/2024	27/02/2024	27/02/2024
A-T-024s			28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024
A-T-025w	29/02/2024	28/02/2024				29/02/2024			
A-T-026w	27/02/2024	27/02/2024				27/02/2024			
A-T-026w (N)	27/02/2024	27/02/2024				27/02/2024			
A-T-027s			28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024
A-T-031s			27/02/2024	27/02/2024	27/02/2024	27/02/2024	27/02/2024	27/02/2024	27/02/2024
A-T-032s			28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024
A-T-033w	28/02/2024	28/02/2024				28/02/2024			
A-T-040s			27/02/2024	27/02/2024	27/02/2024	27/02/2024	27/02/2024	27/02/2024	27/02/2024
A-T-040w	27/02/2024	27/02/2024				27/02/2024			
A-T-043-w	27/02/2024	27/02/2024				27/02/2024			
A-T-044	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
A-T-045			22/02/2024	22/02/2024	22/02/2024	22/02/2024	22/02/2024	22/02/2024	22/02/2024
A-T-049w	26/02/2024	26/02/2024				26/02/2024			
A-T-050s			28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024
A-T-054				28/02/2024	28/02/2024	28/02/2024		28/02/2024	28/02/2024
A-T-055s			28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024
Calc-As Recd			28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024	28/02/2024

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

Appendix D

Laboratory Chemical Testing Results

envirolab
Hattersley Science & Technology Park
Stockport Road, Hattersley, SK14 3QU

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 24/02064
Issue Number: 1 **Date:** 06 March, 2024

Client:
Murray Rix (Northern) Ltd
Andrew House
Hadfield Street
Dukinfield
Dukinfield
SK16 4QX

Project Manager: Enquires/Owain Davies
Project Name: GM12793
Project Ref: No
Order No: 24/081
Date Samples Received: 27/02/24
Date Instructions Received: 29/02/24
Date Analysis Completed: 06/03/24

Approved by:

[redacted]

Client Manager

Envirolab Job Number: 24/02064

Client Project Name: GM12793

Client Project Ref: No

Lab Sample ID	24/02064/1	24/02064/2	24/02064/3	24/02064/4	24/02064/5	24/02064/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP01	TP04	TP08	TP03	TP06	TP07				
Depth to Top	0.50	1.00	0.10	0.40	1.00	2.00				
Depth To Bottom										
Date Sampled										
Sample Type	SOIL - B	SOIL - B	SOIL - B	SOIL - B	SOIL - B	SOIL - B				
Sample Matrix Code	6E	6	6E	6E	6E	6				
% Stones >10mm$_A$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		% w/w	0.1	A-T-044
pH BRE$_D^{M\#}$	7.72	7.66	7.61	-	-	-		pH	0.01	A-T-031s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	19	956	56	-	-	-		mg/l	10	A-T-026s
Sulphate BRE (acid sol)$_D^{M\#}$	0.20	0.36	0.17	-	-	-		% w/w	0.02	A-T-028s
Sulphur BRE (total)$_D$	0.12	0.48	0.12	-	-	-		% w/w	0.01	A-T-024s
Organic Matter$_D^{M\#}$	5.2	6.2	8.2	2.4	5.4	6.4		% w/w	0.1	A-T-032s

Report Notes

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The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received within the same delivery, will be disposed of **four weeks** after the initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of **six months** after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and Interpretations expressed are outside our scope of accreditation.
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Key

Superscript "#"	Accredited to ISO 17025
Superscript "M"	Accredited to MCertS
Superscript "U"	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript "A"	Analysis performed on as-received Sample
Subscript "D"	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript "^"	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
N/A	Not applicable

Asbestos
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing, and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Assigned Matrix Codes

1	SAND	6	CLAY/LOAM	A	Contains Stones
2	LOAM	7	OTHER	B	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	C	Contains visible hydrocarbons
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5	SAND/CLAY			E	Contains roots / twigs
Note: 7,8,9 matrices are not covered by our ISO 17025 or MCertS accreditation, unless stated above.					

Soil Chemical Analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
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TPH by method A-T-007:
For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase only.
Results "with Clean up" indicates samples cleaned up with Silica during extraction.

EPH CWG (method A-T-055) from TPH CWG:
EPH CWG results have humics mathematically subtracted through instrument calculation.
Where these humic substances have been identified in any IDs from "TPH CWG with clean up" please note that the concentration is **NOT** included in the quantified results but present in the ID for information.

Electrical Conductivity of water by method A-T-037:
Results greater than 12900µS/cm @ 25^{o}C / 11550µS/cm @ 20^{o}C fall outside the accreditation range and as such are unaccredited.

Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Hattersley Science & Technology Park, Stockport Road, Hattersley, SK14 3QU
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Murray Rix (Northern) Ltd, Andrew House , Hadfield Street, Dukinfield , Dukinfield, SK16 4QX

Project: GM12793

Clients Project No: No

Project No: 24/02064

Date Received: 29/02/2024 (am)

Cool Box Temperatures (°C): 7.3

Lab Sample ID	24/02064/1	24/02064/2	24/02064/3	24/02064/4	24/02064/5	24/02064/6
Client Sample No						
Client Sample ID/Depth	TP01 0.50m	TP04 1.00m	TP08 0.10m	TP03 0.40m	TP06 1.00m	TP07 2.00m
Date Sampled						
Deviation Code						
E (no date)	✓	✓	✓	✓	✓	✓

Key
E (no date) *No sampling date provided (all results affected if not provided)*

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	24/02064/1	24/02064/2	24/02064/3	24/02064/4	24/02064/5	24/02064/6
Client Sample No						
Client Sample ID/Depth	TP01 0.50m	TP04 1.00m	TP08 0.10m	TP03 0.40m	TP06 1.00m	TP07 2.00m
Date Sampled						
A-T-024s	06/03/2024	06/03/2024	06/03/2024			
A-T-026s	06/03/2024	06/03/2024	06/03/2024			
A-T-028s	06/03/2024	06/03/2024	06/03/2024			
A-T-031s	06/03/2024	06/03/2024	06/03/2024			
A-T-032s	05/03/2024	05/03/2024	05/03/2024	05/03/2024	05/03/2024	05/03/2024
A-T-044	06/03/2024	06/03/2024	06/03/2024	06/03/2024	06/03/2024	06/03/2024

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

MURRAY RIX
CONSULTANCY, SITE INVESTIGATION
CONSTRUCTION MATERIALS TESTING

TEST REPORT

Client Wardell Armstrong LLP

Address Sir Henry Doulton House
Forge Lane
Etruria
Stoke on Trent
ST1 5BD

Contract GM12793

Job Number MRN 24066/6
Date of Issue 08 March 2024

Approved Signatories

S J Hutchings, O P Davies

Notes

1 All remaining samples and remnants from this contract will be disposed 28 days from the date of this report unless you notify us to the contrary.

2 Result certificates, in this report, not bearing a UKAS mark, are not included in our UKAS accreditation schedule.

3 Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

4 Certified that the samples have been examined and tested in accordance with the terms of the contract/order and unless otherwise stated conform to the standards/specifications quoted.

5 The results included within the report are representative of the samples submitted for analysis.

6 This certificate should not be reproduced, except in full, without the express permission of the laboratory.

M U R R A Y R I X

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

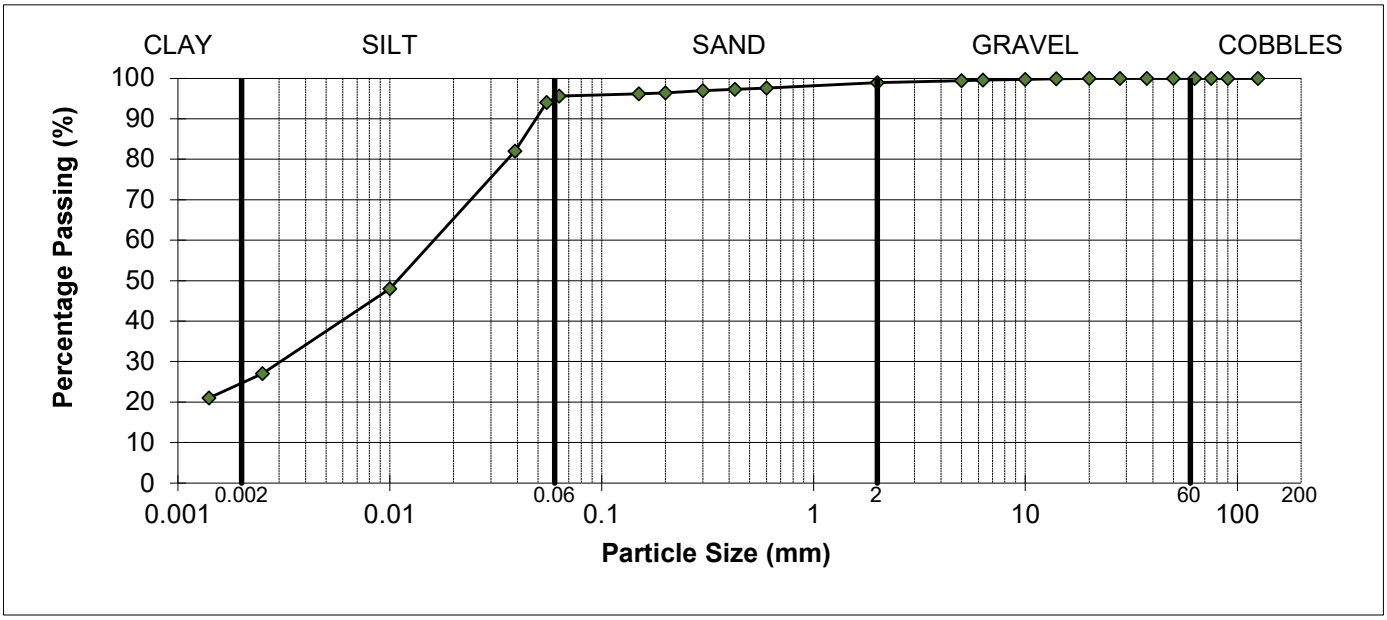
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	TP01 B 0.5	DATE SAMPLED	Not advised
LAB SAMPLE No	426701	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Dark brown organic CLAY
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		2	99	
90	100		0.6	98	
75	100		0.425	97	
63	100		0.3	97	
50	100		0.2	96	
37.5	100		0.15	96	
28	100		0.063	96	
20	100		0.055	94	
14	100		0.039	82	
10	100		0.01	48	
6.3	100		0.0025	27	
5	99		0.0014	21	



REMARKS
As received water content = 47.7%

SIGNED [redacted]

NAME (Laboratory Manager) DATE 08-Mar-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD
PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

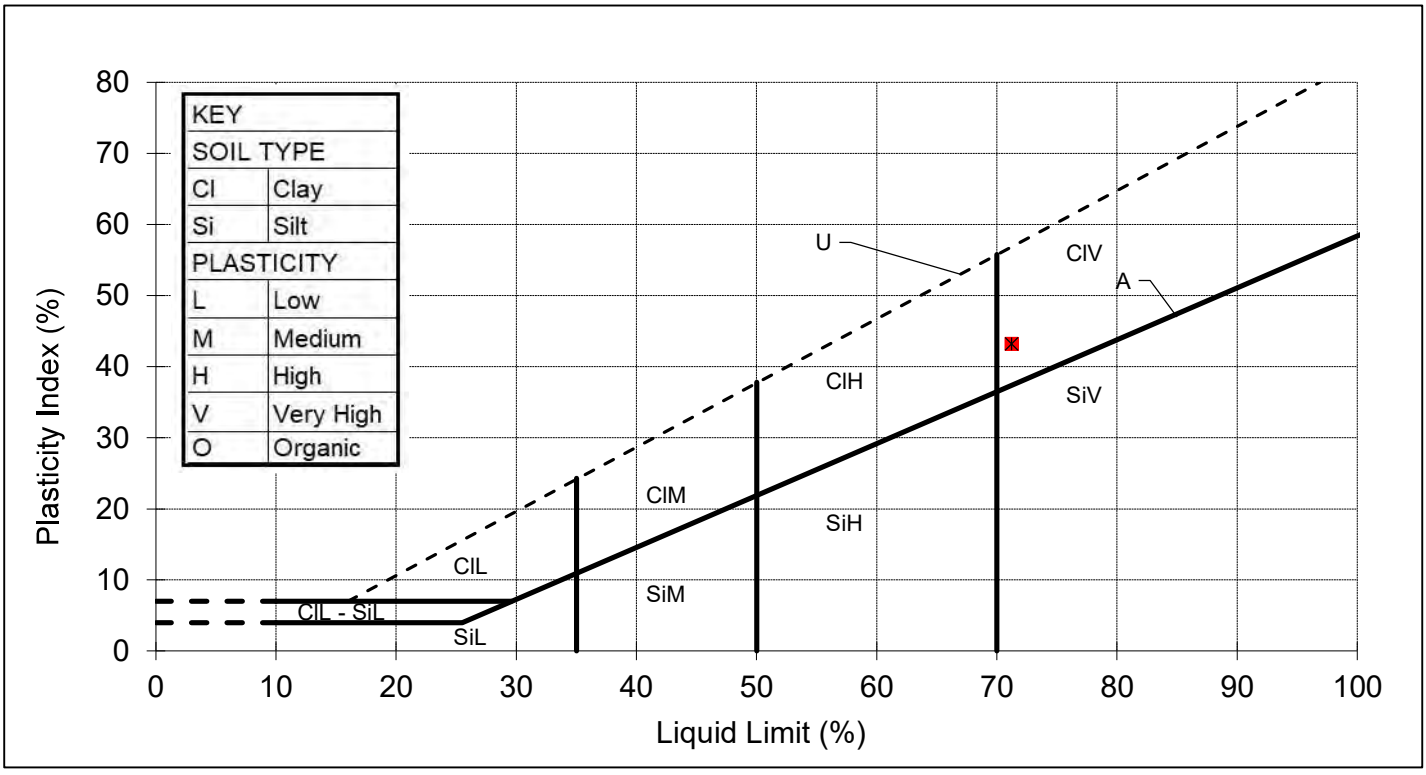
CLIENT	Wardell Armstrong LLP
SITE	GM13229 - Roseachre
JOB NUMBER	MRN 24066/3

SAMPLE LABEL	TP01 B 0.5	DATE SAMPLED	Not advised
SAMPLE No.	426701	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Dark brown organic CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	23.1	75.3	0.948	
Determination 2 (avg)	23.0	75.0		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
47.7	71	28	43	97



REMARKS

SIGNED [redacted]

NAME (Laboratory Manager) DATE 08-Mar-24

M U R R A Y R I X

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

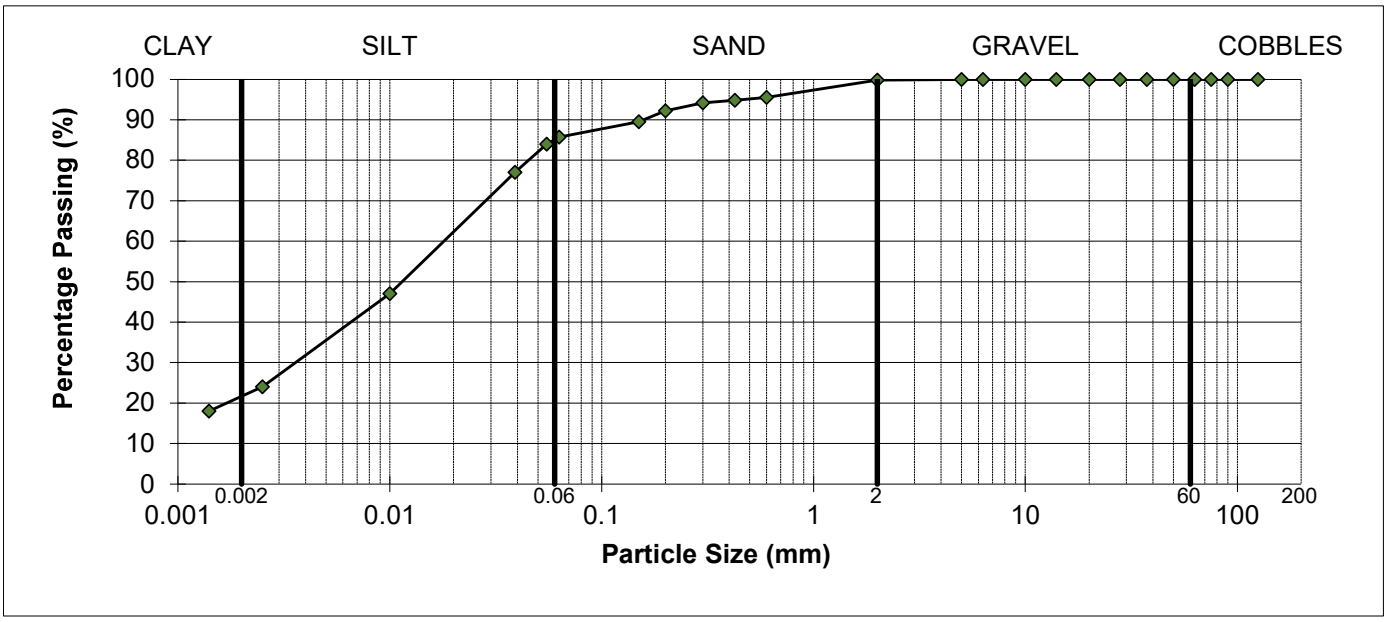
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	TP03 B 0.4	DATE SAMPLED	Not advised
LAB SAMPLE No	426702	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Dark brown organic CLAY
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		2	100	
90	100		0.6	96	
75	100		0.425	95	
63	100		0.3	94	
50	100		0.2	92	
37.5	100		0.15	90	
28	100		0.063	86	
20	100		0.055	84	
14	100		0.039	77	
10	100		0.01	47	
6.3	100		0.0025	24	
5	100		0.0014	18	



REMARKS
As received water content = 39.8%

SIGNED [redacted]

NAME (Laboratory Manager) DATE 08-Mar-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD
PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

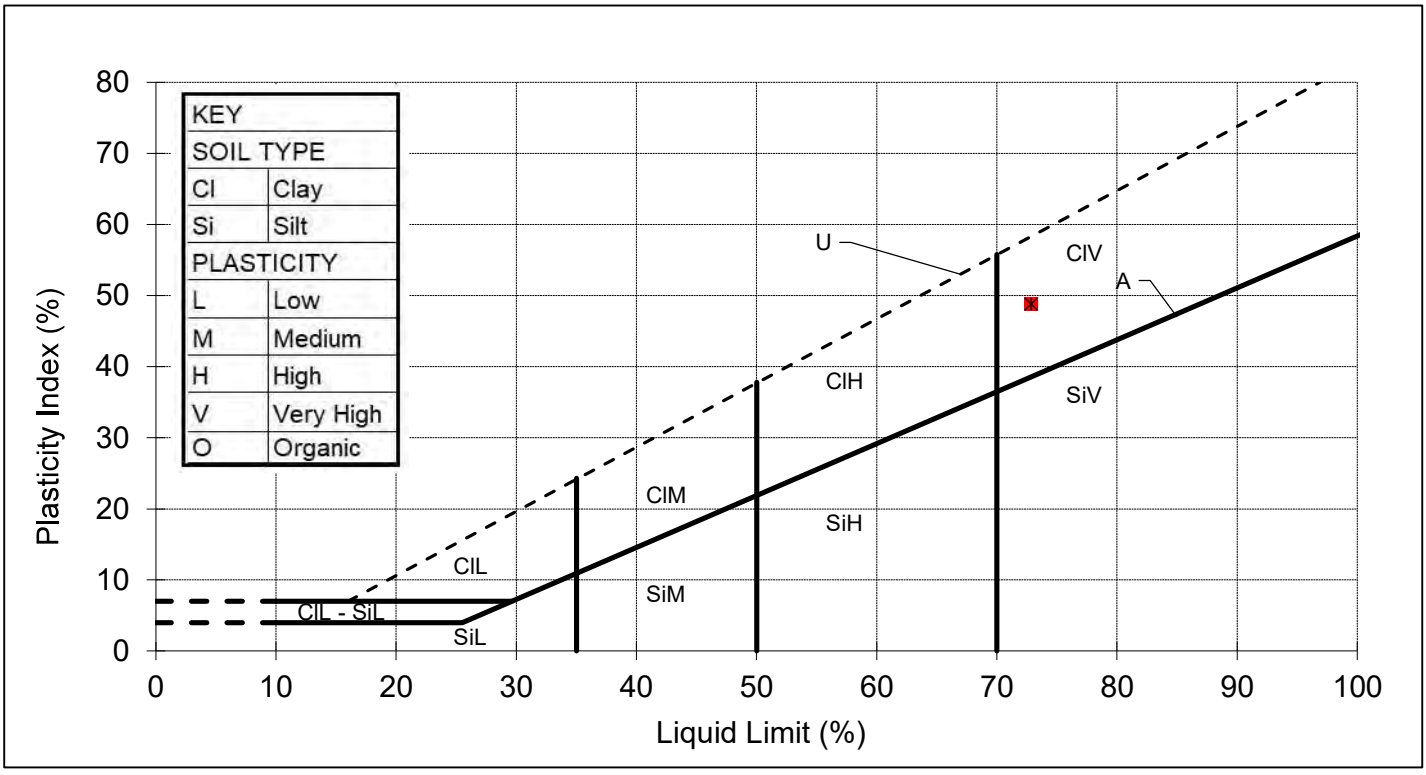
CLIENT	Wardell Armstrong LLP
SITE	GM13229 - Roseachre
JOB NUMBER	MRN 24066/3

SAMPLE LABEL	TP03 B 0.4	DATE SAMPLED	Not advised
SAMPLE No.	426702	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Dark brown organic CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	16.8	70.0	1.041	
Determination 2 (avg)	18.7	70.0		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
39.8	73	24	49	95



REMARKS

SIGNED [redacted]

NAME (Laboratory Manager) DATE 08-Mar-24

M U R R A Y R I X

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

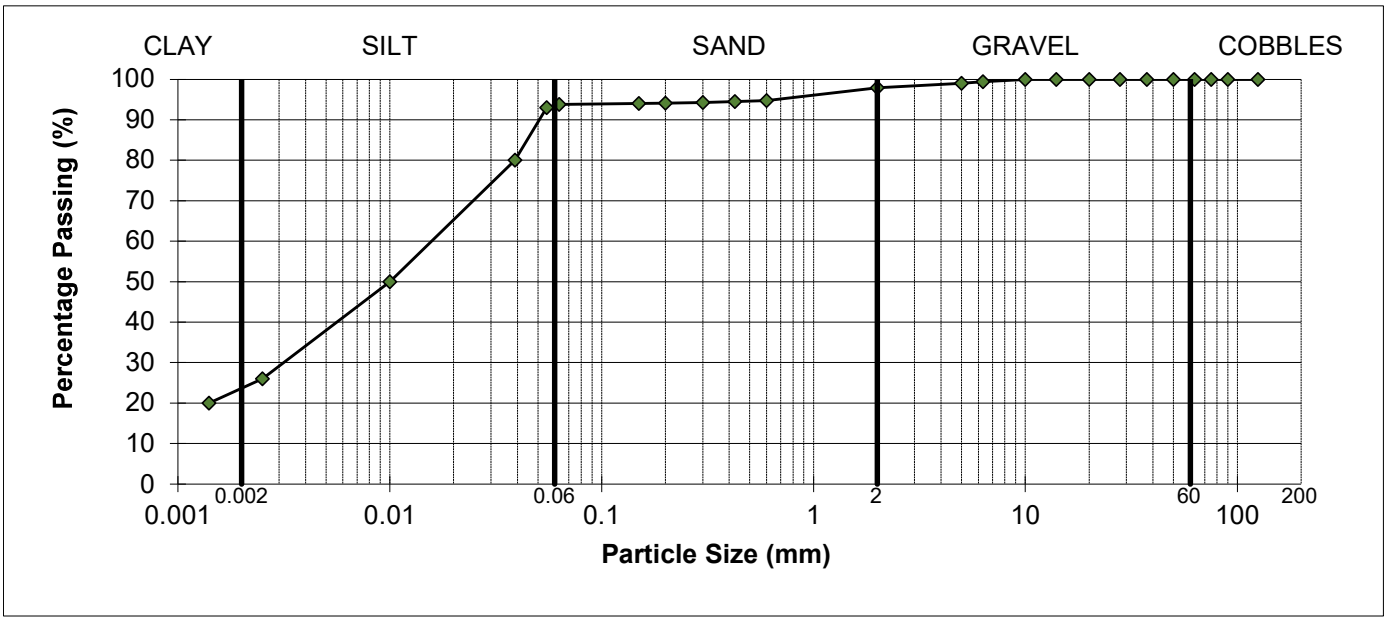
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	TP04 B 1.0	DATE SAMPLED	Not advised
LAB SAMPLE No	426703	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Grey brown organic CLAY
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		2	98	
90	100		0.6	95	
75	100		0.425	94	
63	100		0.3	94	
50	100		0.2	94	
37.5	100		0.15	94	
28	100		0.063	94	
20	100		0.055	93	
14	100		0.039	80	
10	100		0.01	50	
6.3	99		0.0025	26	
5	99		0.0014	20	



REMARKS
As received water content = 92.0%

SIGNED [redacted]

NAME (Laboratory Manager) DATE 08-Mar-24

MURRAY RIX

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DUKINFIELD, CHESHIRE SK16 4QX
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UKAS TESTING 1580

TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD
PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

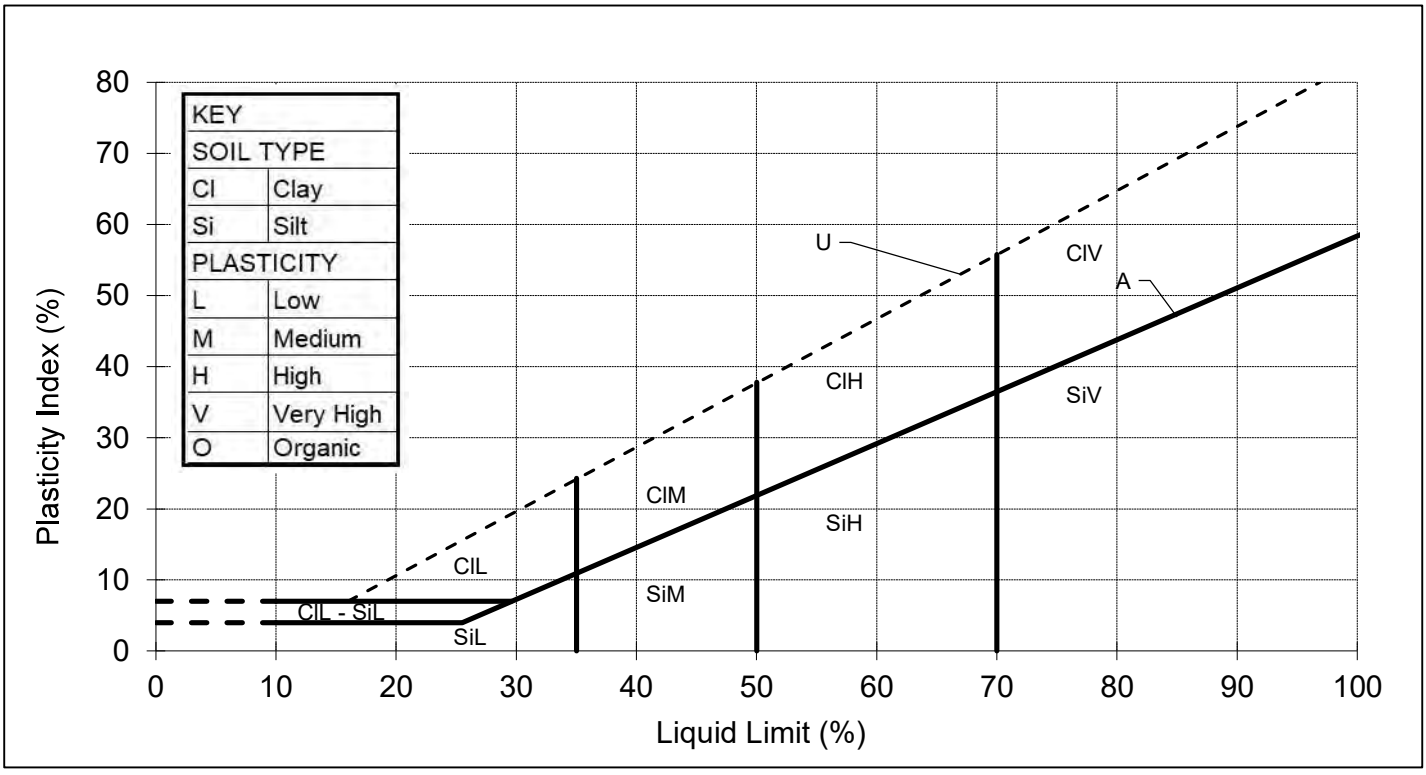
CLIENT	Wardell Armstrong LLP
SITE	GM13229 - Roseachre
JOB NUMBER	MRN 24066/3

SAMPLE LABEL	TP04 B 1.0	DATE SAMPLED	Not advised
SAMPLE No.	426703	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Grey brown organic CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	16.5	99.9	1.065	
Determination 2 (avg)	16.5	99.7		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
92.0	106	35	71	94



REMARKS

SIGNED [redacted]

NAME (Laboratory Manager) DATE 08-Mar-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

DRY DENSITY/WATER CONTENT RELATIONSHIP 2.5kg RAMMER
BS 1377-2:2022 Cl.11
PARTICLE DENSITY METHOD BS 1377-2:2022 Cl.9.2

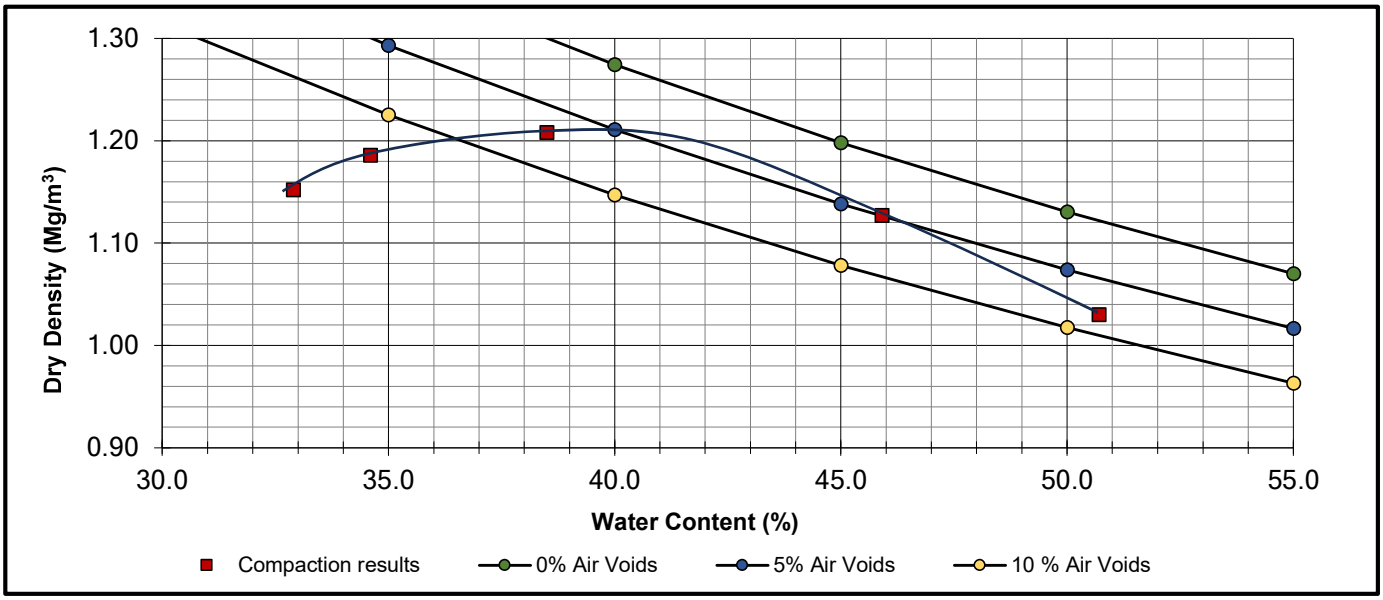
CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	TP04 B 1.0	DATE SAMPLED	Not advised
SAMPLE NUMBER	426703	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Grey brown organic CLAY
ADVISED SOURCE	Site Investigation Sample
PRE TREATMENT	Air Dried / Separate Batches

RETAINED 37.5mm	0 %	GRADING ZONE	Zone 1
RETAINED 20mm	0 %	PARTICLE DENSITY	2.60 Mg/m3 (Assumed)

POINT NUMBER	WATER CONTENT (%)	DRY DENSITY (Mg/m^3)
1	32.9	1.152
2	34.6	1.186
3	38.5	1.208
4	45.9	1.127
5	50.7	1.030



OPTIMUM WATER CONTENT	**40**	(%)
MAXIMUM DRY DENSITY	**1.21**	(Mg/m^3)

REMARKS

NAME [redacted] SIGNE [redacted] DATE 08-Mar-24

(Laboratory Manager)

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

TEST CERTIFICATE

FALLING HEAD PERMEABILITY
IN-HOUSE METHOD No. 7:1997 BASED ON
HEAD, KH: MANUAL OF SOIL ALBORATORY TESTING VOL. 2 SECTION 10.7.2

CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	TP04 B 1.0	DATE SAMPLED	Not advised
SAMPLE NUMBER	426703	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Grey brown organic CLAY
ADVISED SOURCE	Site Investigation Sample

PREPARATION	Remoulded, using 2.5kg rammer	SPECIMEN DIAMETER	105.00 mm
SPECIMEN LENGTH	115.00 mm	SPECIMEN AREA	8659 mm^2

ORIENTATION OF SAMPLE	Vertical	
BULK DENSITY AT TEST	1.461	Mg/m^3
DRY DENSITY AT TEST	0.76	Mg/m^3
MOISTURE CONTENT	92	%
VOLUME	996	cm^3
PARTICLE DENSITY (assumed)	2.60	Mg/m^3
VOIDS RATIO	2.42	
TEST TEMPERATURE	20	°C
PERMEABILITY (uncorrected for temperature) k	5.4×10^{-10}	m/s
COEFFICIENT OF PERMEABILITY k	5.4×10^{-10}	m/s

COMMENT / ANOMALIES

NAME [redacted]) SIGNED [redacted] DATE 08-Mar-24
(Laboratory Manager)

M U R R A Y R I X

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

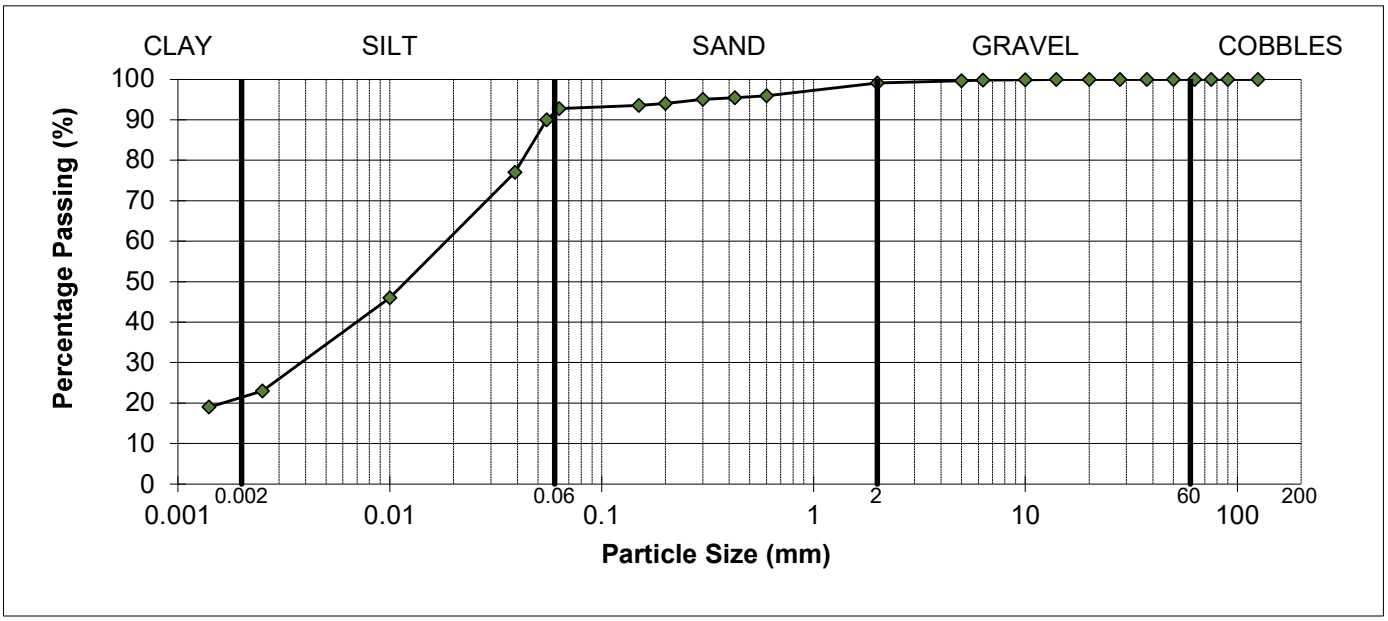
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	TP06 B 1.0	DATE SAMPLED	Not advised
LAB SAMPLE No	426704	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Dark brown organic CLAY
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		2	99	
90	100		0.6	96	
75	100		0.425	95	
63	100		0.3	95	
50	100		0.2	94	
37.5	100		0.15	94	
28	100		0.063	93	
20	100		0.055	90	
14	100		0.039	77	
10	100		0.01	46	
6.3	100		0.0025	23	
5	100		0.0014	19	



REMARKS
As received water content = 43.1%

SIGNED [redacted]

NAME DATE 08-Mar-24

M U R R A Y R I X

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

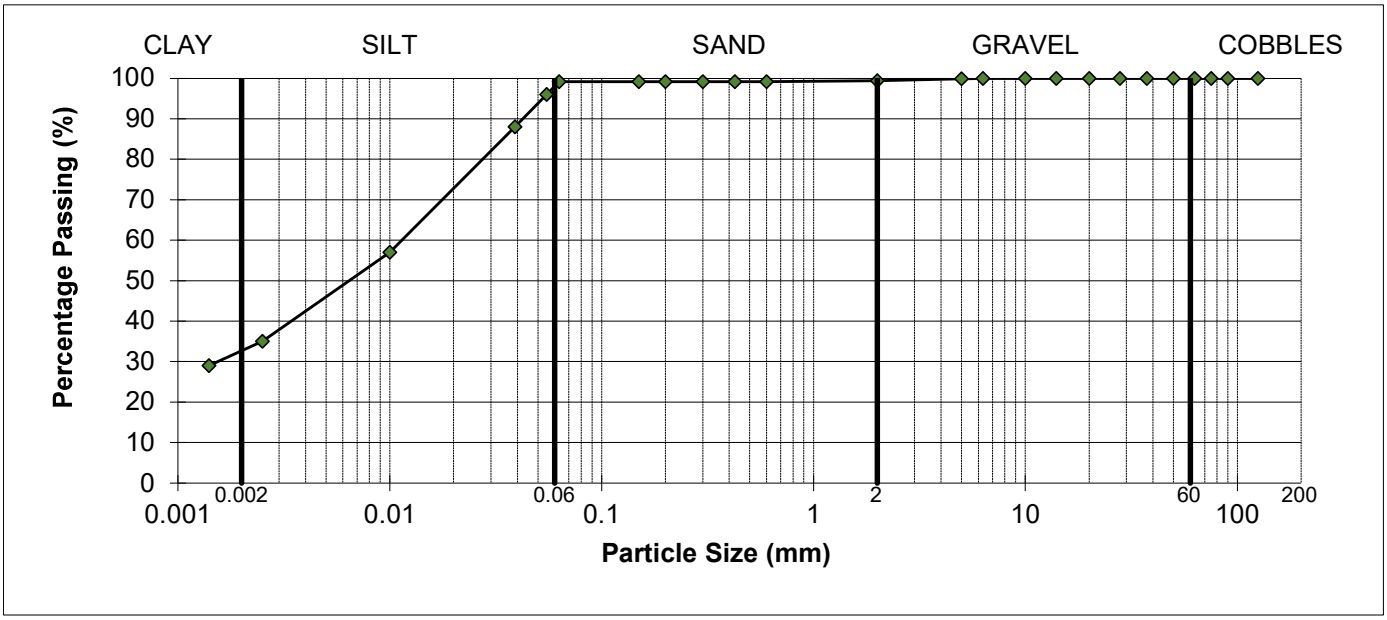
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	TP07 B 2.0	DATE SAMPLED	Not advised
LAB SAMPLE No	426705	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Grey brown organic CLAY
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		2	99	
90	100		0.6	99	
75	100		0.425	99	
63	100		0.3	99	
50	100		0.2	99	
37.5	100		0.15	99	
28	100		0.063	99	
20	100		0.055	96	
14	100		0.039	88	
10	100		0.01	57	
6.3	100		0.0025	35	
5	100		0.0014	29	



REMARKS
As received water content = 75.4%

SIGNED [redacted]

NAME (Laboratory Manager) DATE 08-Mar-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

DRY DENSITY/WATER CONTENT RELATIONSHIP 2.5kg RAMMER
BS 1377-2:2022 Cl.11
PARTICLE DENSITY METHOD BS 1377-2:2022 Cl.9.2

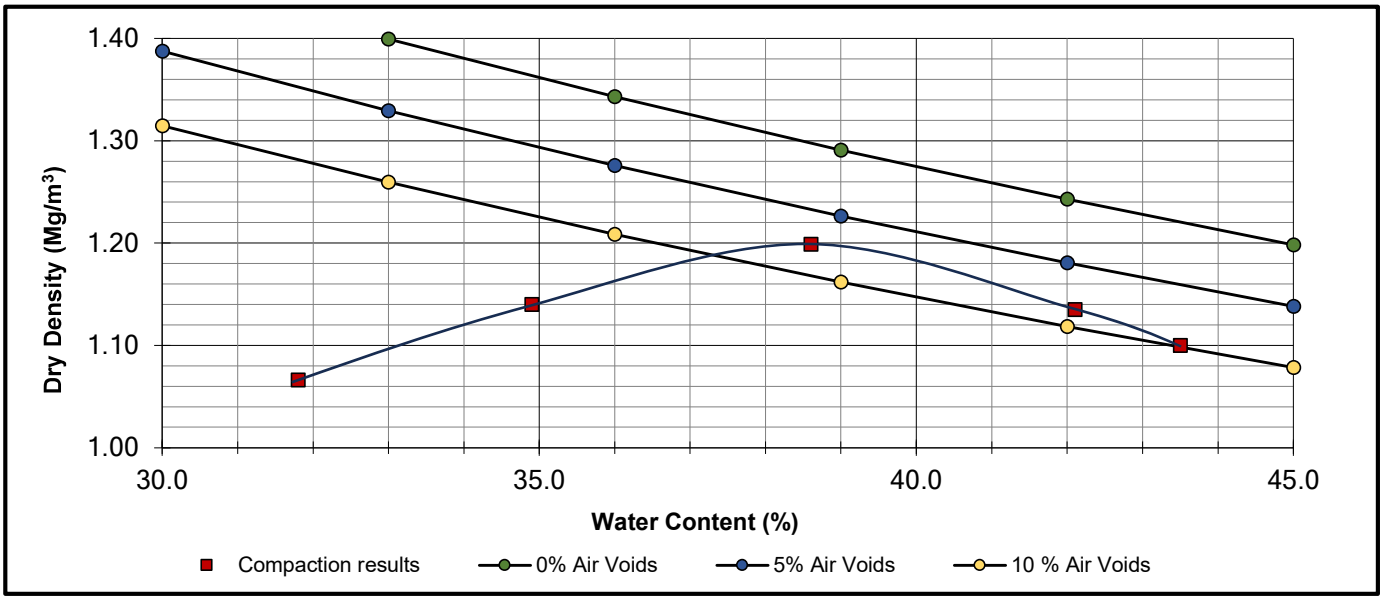
CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	TP07 B 2.0	DATE SAMPLED	Not advised
SAMPLE NUMBER	426705	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Grey brown organic CLAY
ADVISED SOURCE	Site Investigation Sample
PRE TREATMENT	Air Dried / Separate Batches

RETAINED 37.5mm	0 %	GRADING ZONE	Zone 1
RETAINED 20mm	0 %	PARTICLE DENSITY	2.60 Mg/m3 (Assumed)

POINT NUMBER	WATER CONTENT (%)	DRY DENSITY (Mg/m^3)
1	31.8	1.066
2	34.9	1.140
3	38.6	1.199
4	42.1	1.135
5	43.5	1.100



OPTIMUM WATER CONTENT	**39**	(%)
MAXIMUM DRY DENSITY	**1.20**	(Mg/m^3)

REMARKS

NAME [redacted]) SIGNED [redacted] DATE 08-Mar-24

(Laboratory Manager)

M U R R A Y R I X

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

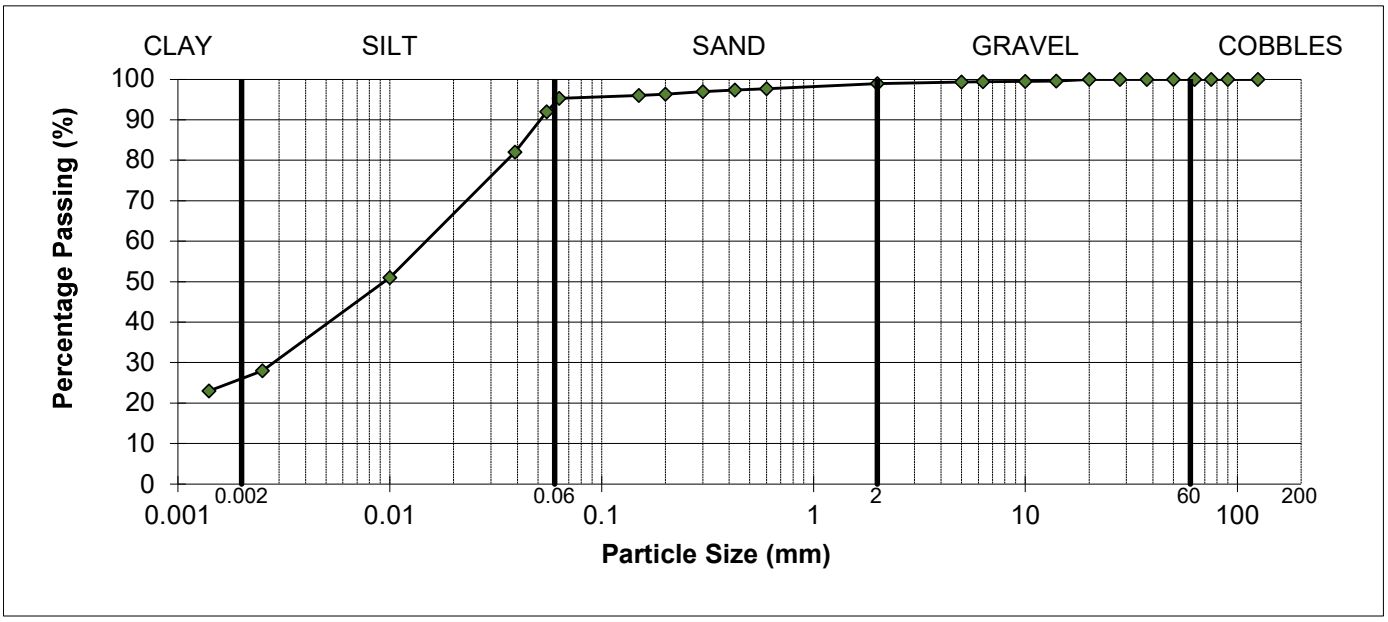
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	TP08 B 0.1	DATE SAMPLED	Not advised
LAB SAMPLE No	426706	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Brown organic CLAY
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		2	99	
90	100		0.6	98	
75	100		0.425	97	
63	100		0.3	97	
50	100		0.2	96	
37.5	100		0.15	96	
28	100		0.063	95	
20	100		0.055	92	
14	100		0.039	82	
10	99		0.01	51	
6.3	99		0.0025	28	
5	99		0.0014	23	



REMARKS
As received water content = 63.4%

SIGNED [redacted]

NAME (Laboratory Manager) DATE 08-Mar-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD
PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

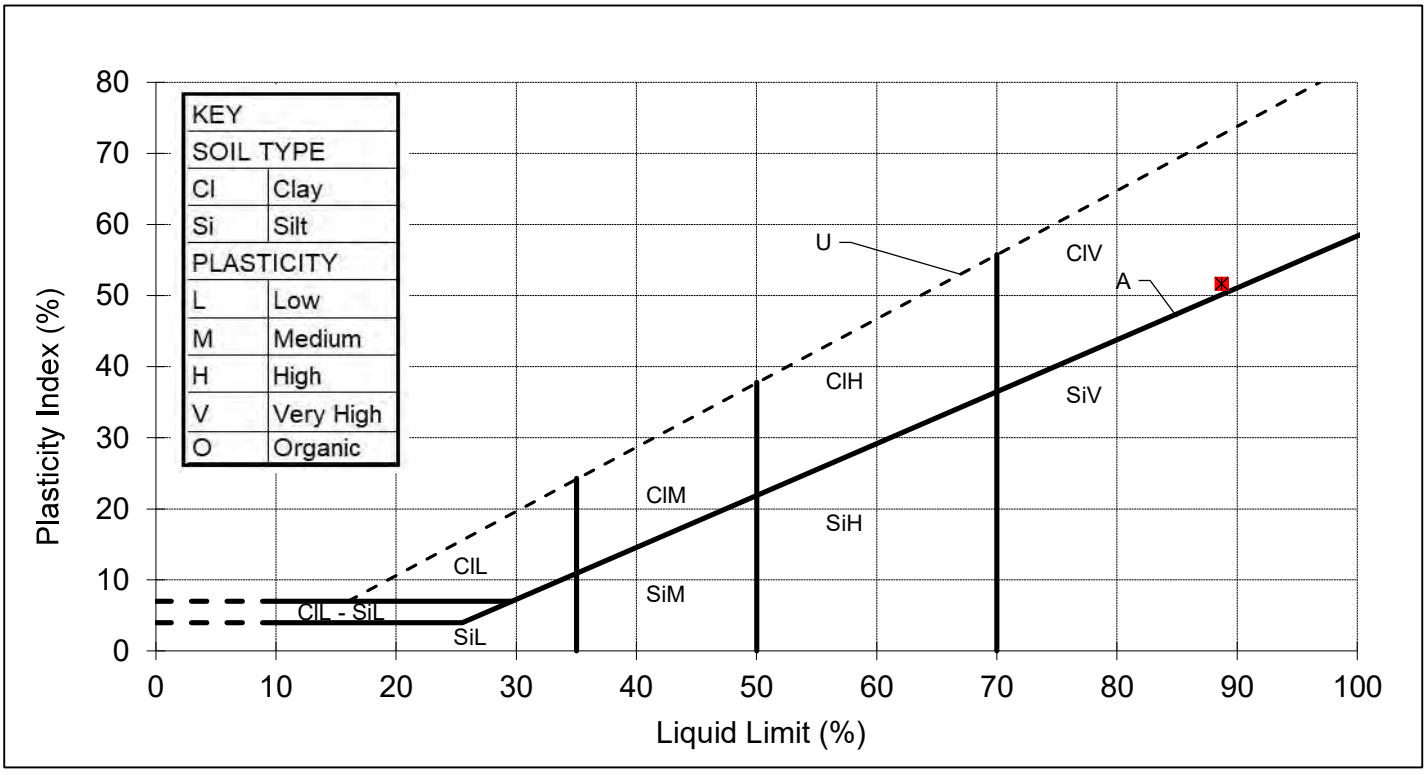
CLIENT	Wardell Armstrong LLP
SITE	GM13229 - Roseachre
JOB NUMBER	MRN 24066/3

SAMPLE LABEL	TP08 B 0.1	DATE SAMPLED	Not advised
SAMPLE No.	426706	DATE RECEIVED	19-Feb-24
DATE TESTED	26-Feb-24	SAMPLED BY	Client

MATERIAL	Brown organic CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	18.5	86.2	1.024	
Determination 2 (avg)	18.8	87.0		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
63.4	89	37	52	97



REMARKS

SIGNED [redacted]

NAME (Laboratory Manager) DATE 08-Mar-24

DRAWINGS



KEY

Cell 3 Site Boundary



Notes:

Boundaries are indicative. Aerial imagery shown for context purposes only.

Issuing	Issue	Date	Drawn	Chkd	Appd

CLIENT

FRODSHAM SOLAR LIMITED

PROJECT

FRODSHAM SOLAR

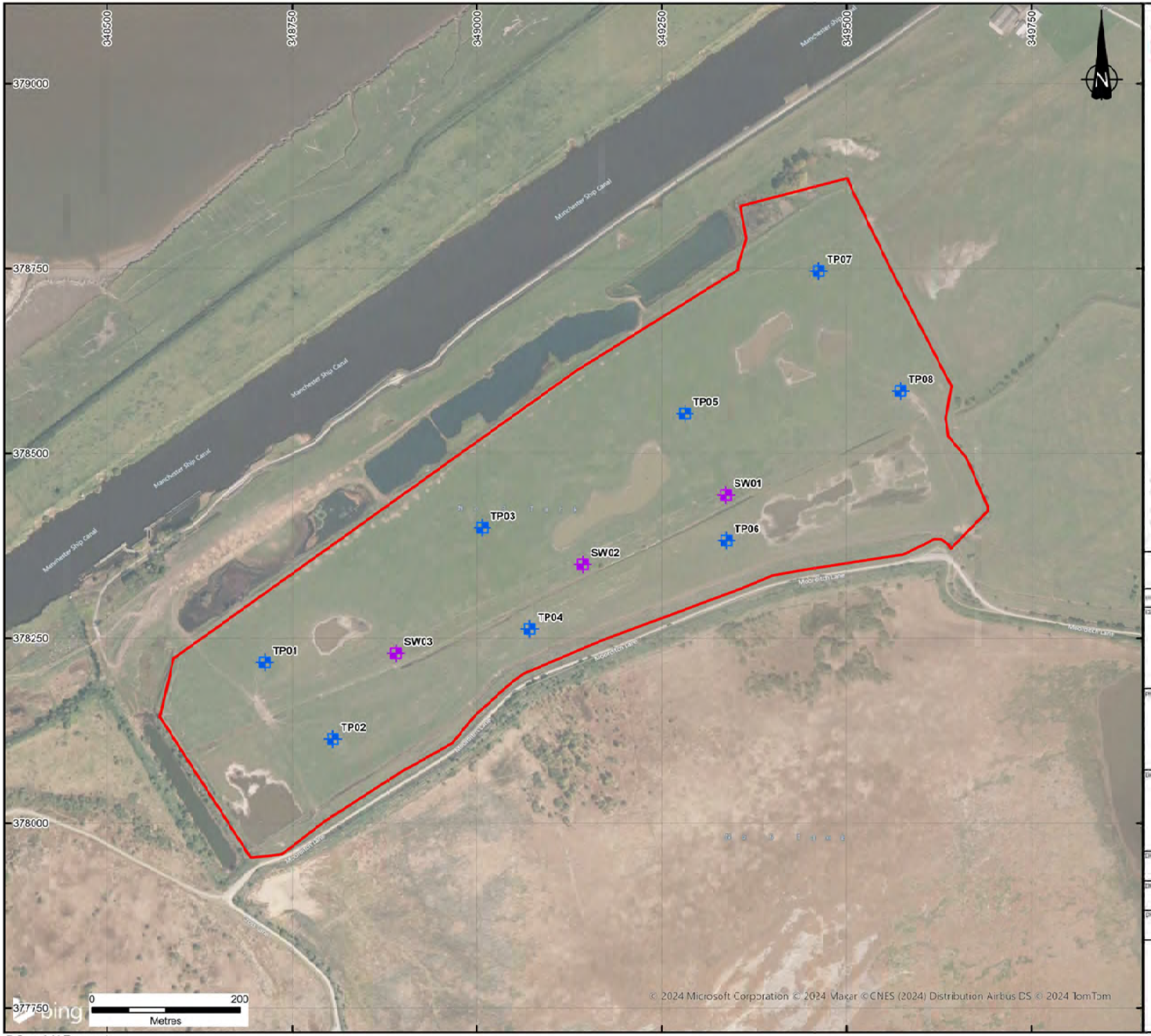
DRAWING TITLE

CELL 3 SITE LOCATION PLAN

DRG No: GM/12793-004		REV: A	SUIT. CODE: --
DRG SIZE: A3	SCALE: 1:10,000	DATE: 12/03/2024	
DRAWN BY: EK	CHECKED BY: SS	APPROVED BY: GC	

wardell armstrong

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KEY

- Cell 3 Site Boundary
- Soakaway Test Pits
- Trial Pit

Notes:

Boundaries are indicative. Aerial imagery shown for context purposes only.

CLIENT	FRODSHAM SOLAR LIMITED		
PROJECT	FRODSHAM SOLAR		
DRAWING TITLE	CELL 3 GROUND INVESTIGATION LOCATION PLAN		
DRG. No	GM12793-005	REV.	A
DRG. SIZE	A3	SCALE	1:5,000
DATE	12/03/2024		
DRAWN BY	EK	CHECKED BY	SS
APPROVED BY	GC		

wardell armstrong

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Analytical Report Number : 25-007148

Project / Site name:	Fordsham	Samples received on:	13/02/2025
Your job number:	GM12793	Samples instructed on/ Analysis started on:	14/02/2025
Your order number:	GM6688	Analysis completed by:	24/02/2025
Report Issue Number:	1	Report issued on:	27/02/2025
Samples Analysed:	2 water samples		

[redacted]
Customer Service Advisor
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting
air	- once the analysis is complete

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Retention period for records and reports is minimum 6 years from the date of issue of the final report.
Some records may be kept for longer according to other legal/best practice requirements.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 25-007148
Project / Site name: Fordsham

Your Order No: GM6688

Lab Sample Number				453590	453591
Sample Reference				WS17	WS02
Sample Number				None Supplied	None Supplied
Water Matrix				Other water	Other water
Depth (m)				None Supplied	None Supplied
Date Sampled				12/02/2025	12/02/2025
Time Taken				None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Test Limit of detection	Test Accreditation Status		
General Inorganics					
pH (L099)	pH Units	N/A	NONE	7.3	7.2
Chloride	mg/l	0.15	NONE	40	28
Ammoniacal Nitrogen as N	µg/l	15	NONE	84	21
Ammoniacal Nitrogen as NH_4^+	µg/l	15	NONE	110	28
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	7.24	5.35
Heavy Metals / Metalloids					
Arsenic (dissolved)	µg/l	0.15	NONE	1.13	0.52
Cadmium (dissolved)	µg/l	0.02	NONE	< 0.02	0.03
Chromium (dissolved)	µg/l	0.2	NONE	0.3	0.6
Copper (dissolved)	µg/l	0.5	NONE	8.1	5
Lead (dissolved)	µg/l	0.2	NONE	< 0.2	< 0.2
Mercury (dissolved)	µg/l	0.05	NONE	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	NONE	5.7	1.8
Zinc (dissolved)	µg/l	0.5	NONE	4.9	8.3
Calcium (dissolved)	mg/l	0.012	NONE	120	170
Petroleum Hydrocarbons					
TPH - Aliphatic >EC5 - EC6 $_{HS_1D_AL}$	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aliphatic >EC6 - EC8 $_{HS_1D_AL}$	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aliphatic >EC8 - EC10 $_{HS_1D_AL}$	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aliphatic >EC10 - EC12 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >EC12 - EC16 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >EC16 - EC21 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >EC21 - EC35 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >EC5 - EC35 $_{HS+EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >EC35 - EC40 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >EC5 - EC40 $_{HS+EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC5 - EC7 $_{HS_1D_AR}$	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aromatic >EC7 - EC8 $_{HS_1D_AR}$	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aromatic >EC8 - EC10 $_{HS_1D_AR}$	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aromatic >EC10 - EC12 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC12 - EC16 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC16 - EC21 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC21 - EC35 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC5 - EC35 $_{HS+EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC35 - EC40 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC5 - EC40 $_{HS+EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH Total (>EC5 - EC40) $_{HS+EH_1D_TOTAL_MS}$	µg/l	10	NONE	< 10	< 10

Analytical Report Number: 25-007148
Project / Site name: Fordsham

Your Order No: GM6688

Lab Sample Number				453590	453591
Sample Reference				WS17	WS02
Sample Number				None Supplied	None Supplied
Water Matrix				Other water	Other water
Depth (m)				None Supplied	None Supplied
Date Sampled				12/02/2025	12/02/2025
Time Taken				None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Test Limit of detection	Test Accreditation Status		
VOCs					
Chloromethane	µg/l	3	NONE	< 3.0	< 3.0
Chloroethane	µg/l	3	NONE	< 3.0	< 3.0
Bromomethane	µg/l	3	NONE	< 3.0	< 3.0
Vinyl Chloride	µg/l	3	NONE	< 3.0	< 3.0
Trichlorofluoromethane	µg/l	3	NONE	< 3.0	< 3.0
1,1-Dichloroethene	µg/l	3	NONE	< 3.0	< 3.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	3	NONE	< 3.0	< 3.0
Trans 1,2-dichloroethylene	µg/l	3	NONE	< 3.0	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	NONE	< 3.0	< 3.0
1,1-Dichloroethane	µg/l	3	NONE	< 3.0	< 3.0
2,2-Dichloropropane	µg/l	3	NONE	< 3.0	< 3.0
Chloroform	µg/l	3	NONE	< 3.0	< 3.0
1,1,1-Trichloroethane	µg/l	3	NONE	< 3.0	< 3.0
1,2-Dichloroethane	µg/l	3	NONE	< 3.0	< 3.0
1,1-Dichloropropene	µg/l	3	NONE	< 3.0	< 3.0
Cis-1,2-dichloroethene	µg/l	3	NONE	< 3.0	< 3.0
Benzene	µg/l	3	NONE	< 3.0	< 3.0
Carbontetrachloride	µg/l	3	NONE	< 3.0	< 3.0
1,2-Dichloropropane	µg/l	3	NONE	< 3.0	< 3.0
Trichloroethene	µg/l	3	NONE	< 3.0	< 3.0
Dibromomethane	µg/l	3	NONE	< 3.0	< 3.0
Bromodichloromethane	µg/l	3	NONE	< 3.0	< 3.0
Cis-1,3-dichloropropene	µg/l	3	NONE	< 3.0	< 3.0
Trans-1,3-dichloropropene	µg/l	3	NONE	< 3.0	< 3.0
Toluene	µg/l	3	NONE	< 3.0	< 3.0
1,1,2-Trichloroethane	µg/l	3	NONE	< 3.0	< 3.0
1,3-Dichloropropane	µg/l	3	NONE	< 3.0	< 3.0
Dibromochloromethane	µg/l	3	NONE	< 3.0	< 3.0
Tetrachloroethene	µg/l	3	NONE	< 3.0	< 3.0
1,2-Dibromoethane	µg/l	3	NONE	< 3.0	< 3.0
Chlorobenzene	µg/l	3	NONE	< 3.0	< 3.0
1,1,1,2-Tetrachloroethane	µg/l	3	NONE	< 3.0	< 3.0
Ethylbenzene	µg/l	3	NONE	< 3.0	< 3.0
p & m-xylene	µg/l	3	NONE	< 3.0	< 3.0
Styrene	µg/l	3	NONE	< 3.0	< 3.0
Bromoform	µg/l	3	NONE	< 3.0	< 3.0
o-xylene	µg/l	3	NONE	< 3.0	< 3.0
Isopropylbenzene	µg/l	3	NONE	< 3.0	< 3.0
1,1,2,2-Tetrachloroethane	µg/l	3	NONE	< 3.0	< 3.0
Bromobenzene	µg/l	3	NONE	< 3.0	< 3.0

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Analytical Report Number: 25-007148
Project / Site name: Fordsham

Your Order No: GM6688

Lab Sample Number				453590	453591
Sample Reference				WS17	WS02
Sample Number				None Supplied	None Supplied
Water Matrix				Other water	Other water
Depth (m)				None Supplied	None Supplied
Date Sampled				12/02/2025	12/02/2025
Time Taken				None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Test Limit of detection	Test Accreditation Status		
n-Propylbenzene	µg/l	3	NONE	< 3.0	< 3.0
2-Chlorotoluene	µg/l	3	NONE	< 3.0	< 3.0
4-Chlorotoluene	µg/l	3	NONE	< 3.0	< 3.0
1,3,5-Trimethylbenzene	µg/l	3	NONE	< 3.0	< 3.0
tert-Butylbenzene	µg/l	3	NONE	< 3.0	< 3.0
1,2,4-Trimethylbenzene	µg/l	3	NONE	< 3.0	< 3.0
sec-Butylbenzene	µg/l	3	NONE	< 3.0	< 3.0
1,3-Dichlorobenzene	µg/l	3	NONE	< 3.0	< 3.0
p-Isopropyltoluene	µg/l	3	NONE	< 3.0	< 3.0
1,4-Dichlorobenzene	µg/l	3	NONE	< 3.0	< 3.0
1,2-Dichlorobenzene	µg/l	3	NONE	< 3.0	< 3.0
Butylbenzene	µg/l	3	NONE	< 3.0	< 3.0
1,2-Dibromo-3-chloropropane	µg/l	3	NONE	< 3.0	< 3.0
1,2,4-Trichlorobenzene	µg/l	3	NONE	< 3.0	< 3.0
Hexachlorobutadiene	µg/l	3	NONE	< 3.0	< 3.0
1,2,3-Trichlorobenzene	µg/l	3	NONE	< 3.0	< 3.0

PCBs by GC-MS

PCB Congener 28	µg/l	0.02	NONE	< 0.02	< 0.02
PCB Congener 52	µg/l	0.02	NONE	< 0.02	< 0.02
PCB Congener 101	µg/l	0.02	NONE	< 0.02	< 0.02
PCB Congener 118	µg/l	0.02	NONE	< 0.02	< 0.02
PCB Congener 138	µg/l	0.02	NONE	< 0.02	< 0.02
PCB Congener 153	µg/l	0.02	NONE	< 0.02	< 0.02
PCB Congener 180	µg/l	0.02	NONE	< 0.02	< 0.02

Total ICES-7 PCBs	µg/l	0.14	NONE	< 0.14	< 0.14

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 25-007148
Project / Site name: Fordsham

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)
Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited matrices: SW, PW, GW, except B - SW,GW, Hg - SW,PW, Al - SW,PW	In-house method based on USEPA Method 6020 & 200.8 for the determination of trace elements in water by ICP-MS	L012B	W	NONE
PCB's By GC-MS in water	Determination of PCB by extraction with hexane followed by GC-MS	In-house method based on USEPA 8082	L028B	W	NONE
Dissolved Organic Carbon in water	Determination of dissolved organic carbon in water by TOC/DOC NDIR Analyser. Accredited matrices: SW, PW, GW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037B	W	NONE
Total Petroleum Hydrocarbons with carbon banding in water by GC-MS	Determination of total petroleum hydrocarbons in water by GC-MS with carbon banding aliphatic and aromatic	In-house method	L070B	W	NONE
BTEX and/or Volatile Organic Compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW, PW, GW	In-house method based on USEPA 8260	L073B	W	NONE
Chloride in water	Determination of chloride in water by colorimetry using discrete analyser. Accredited matrices: SW, PW, GW, FSE, LL	In-house based on MEWAM Method ISBN 0117516260	L082B	W	NONE
Ammonium as NH4 in water	Determination of ammonium/ammonia/ammoniacal nitrogen by the colorimetric salicylate/nitroprusside method using discrete analyser. Accredited matrices: SW, PW, GW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	NONE
Total Petroleum Hydrocarbons in water by HS-GC-MS	Determination of total petroleum hydrocarbons in water by headspace GC-MS. Accredited matrices: SW, PW, GW	In-house method	L088-PL	W	NONE
pH of water at 20°C (automated)	Determination of pH of water by electrochemical measurement. Accredited matrices: SW, PW, GW, FSE, LL	In-house method	L099-PL	W	NONE
Ammoniacal Nitrogen as N in water	Determination of ammonium/ammonia/ammoniacal nitrogen by the colorimetric salicylate/nitroprusside method using discrete analyser. Accredited matrices: SW, PW, GW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	NONE
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited matrices: SW, PW, GW, FSE, LL; PrW, DI PrW (Al, Cu, Fe,Zn)	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	NONE

Analytical Report Number : 25-007148
Project / Site name: Fordsham

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)
Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution

Annex 4: Frodsham Solar: Cell 3 Water Balance Update Report (separate document).

Technical Memorandum

To:	Andrew Russel – Director, Axis	**Prepared by:**	Ayça Türker, Rik Ingram
Client:	Frodsham Solar	**SLR Consulting Limited**	
cc:	Howard Fearn – Managing Director, Avian Ecology	**Date:**	14 November 2025
		Project No.	440.V12793.00WA1 / GM12793
		Document:	GM12793-0013 R1

RE: Frodsham Solar: Cell 3 water balance update

Non-Technical Summary

This technical memorandum presents an updated water balance assessment for Frodsham Solar. It is proposed that Cell 3 of the former Manchester Ship Canal Dredging Deposit Grounds would be reprofiled to construct a Non-Breeding Bird Mitigation Area (NBBMA) that comprises scrapes that would retain water year-round and wet grassland that would provide marginal wetland habitat. A water balance model has been used to demonstrate that there will be sufficient water to support the required habitats.

An initial water balance assessment was completed at an early stage of the project and identified some uncertainties in the proposals. The initial assessment was based on limited data. Following the completion of the initial assessment site investigations, including additional permeability testing, window sample boreholes, and groundwater level monitoring, were carried out. The amount and quality of available information has now improved significantly since the completion of the initial assessment. These new data have been used to refine both the baseline conceptual model and scenario-based water balance model, providing a more realistic representation of the site's hydrological behaviour.

The conceptual hydrological model for Cell 3 under current conditions shows that groundwater levels are shallow (1 m depth on average). The depth of the groundwater table puts it within made-ground deposits comprising material dredged from the Manchester Ship Canal and River Weaver. The permeability of these deposits is generally low and the permeability declines further below the water table. Lenses of higher permeability material are present, but are discontinuous and do not have a major effect on the hydrology of the site. The made ground deposits sit on glacial till, which also has a low permeability. The till isolates shallow groundwater in the made ground from deeper groundwater in the Permo-Triassic sandstone Principal aquifer that is present at depth beneath the site.

A new water balance model was developed to represent the baseline case and the reprofiled NBBMA scenario. The baseline model was calibrated to observed data from the site. The scenario model shows that the site is likely to remain generally wet throughout the year, with seasonal variations in water levels driven by rainfall and evaporation. There is sufficient water to maintain saturated conditions over the wet grassland area for up to 6 months of the year under average conditions. Even in a dry year, the wet grassland soils are expected to be near saturation for at least 2 months. The deeper scrapes will retain water year-round. Occasional overspill into the site drain is simulated during the wetter months, demonstrating surplus water that could be retained on site to maintain wetness.

A qualitative evaluation of possible effects of climate change on the site hydrology identified that the site is likely to become wetter in the winter and drier in the summer. It should be possible to mitigate some of the effects of drier summers by actively managing the site to

retain more water during the autumn and spring. This should enable the mixture of ponds and wet grassland to be maintained.

1.0 Introduction

This technical memorandum describes the development of a new water balance assessment for Frodsham Solar in relation to the proposal to re-engineer Cell 3 of former Manchester Ship Canal Dredging Deposit Grounds into a Non Breeding Bird Mitigation Area as part of the project.. The memorandum contains the following sections:

- Description of the proposed development
- Summary of the first water balance study
- Summary of new information gathered since the first water balance study
- Revised conceptual hydrological model understanding
- Updated water balance
- Discussion

2.0 Proposed development

The proposed development comprises a 147 MW solar energy generating station and 100 MW Battery Energy Storage System on land at Frodsham Marsh, Frodsham, within the borough of Cheshire West and Chester (the Site). The Site is located next to the River Weaver and the Manchester Ship Canal (MSC) and is to be developed on land previously used for landfilling of dredgings from these watercourses. The landfill operations were organised into discrete “cells” and Cells 1, 2, 3 and 5 form part of the Site.

In addition to the solar array and BESS, part of the Site has been identified as a Non-Breeding Bird Mitigation Area (NBBMA). The NBBMA is being created to benefit several non-breeding bird species, particularly Golden Plover, Curlew, and Lapwing. The area proposed for the NBBMA currently comprises the land on Cell 3, a section of land between Cell 3 and the MSC, and land immediately surrounding Marsh Farm; the latter two areas are part of the Mersey Estuary Site of Special Scientific Interest (SSSI) and Cell 3 forms part of the mitigation for Frodsham Windfarm. Cell 3 currently comprises areas of grassland with some manmade scrapes (shallow areas of water). Ponds are located in the land between Cell 3 and the MSC, which have been used in the past for recreational fishing.

The proposed NBBMA would include approximately 53.51 ha suitable for new and enhanced habitats (wetland and other neutral grassland) to benefit wetland birds and 13.19 ha of additional grassland habitat. Earthworks would be carried out within the NBBMA to reprofile the ground surface and create larger areas of wet and marginal habitat. This would involve temporarily removing and then reinstating the scrapes created for Frodsham Windfarm, construction of additional scrapes and making areas of raised ground. Soils produced from the reprofiling would either be placed within the ponds to the north of Cell 3, infilling the ponds and creating an additional area of grassland, or the soils would be reprofiled across the remaining area of Cell 3, directing surface water towards the central area and thereby increasing the contributing hydrological catchment area, which would help to maintain a wet grassland habitat. Detailed design considerations and Environmental Permitting requirements would determine the approach taken.

3.0 Initial water balance study

An initial water balance study was completed by Wardell Armstrong in 2023[1] to evaluate whether re-wetting Cell 3 would be feasible.

The conceptual model presented in the initial water balance study was based on limited data. Data from three boreholes were used to interpret the stratigraphy, which was as follows: topsoil (c. 0.4 m), Made Ground (dredged, clay-silt rich), alluvial clay and peat, a transitional layer, fluvio-glacial sand, and finally glacial till overlying the Sherwood Sandstone aquifer. Surface water features were thought to dry out in summer and refill in winter. Shallow groundwater was assumed to be perched within the Made Ground, with weak hydraulic connection to the ponds and ditches. This weak connection was attributed to the fine grained nature of the Made Ground (low hydraulic conductivity assumed). Although small gravel lenses might enable some faster flow, they were considered isolated. The little groundwater monitoring data available at the time of the initial water balance study seemed to show a deep water table (c. 6 mbgl) in the made ground and a shallow water table in the soil perched on the lower permeability made ground deposits.

The model also assumed no vertical connection between shallow and deep layers. The thick, low permeability glacial till was believed to act as an aquitard i.e. a lower permeability geological horizon restricting water flow, separating the fluvio-glacial deposit from the Sherwood Sandstone aquifer.

That study concluded that raising groundwater levels to ground surface would not be possible within an acceptable period of time, but that sufficient water would be available if the proposed wetland areas were lined with low permeability material. These conclusions were tentative and recommendations for further site investigation were made. Specific uncertainties, related to the permeability of the surficial deposits and the groundwater levels at the Site, were noted.

4.0 New information gathered since the initial water balance study

4.1 Site investigation

Two phases of site investigation have been completed since the initial water balance study was completed. The following data are relevant to the water balance study.

February 2024 (Wardell Armstrong, 2024[2]). This included:

8 trial pits excavated to depths up to 3.2 metres below ground level (mbgl). Trial pits indicated the presence of loose sandy CLAY (to depths of 0.5 to 0.9 mbgl) overlying soft black silty CLAY with rootlets (to depths of 2.0 to 3.2 mbgl). Groundwater was encountered at depths between 0.5 and 2.0 mbgl. Based upon the results of laboratory falling head permeability testing on the silty CLAY material, the coefficient of permeability of that material was estimated to be 5×10^{-10} m/s.

BRE365 soakaway tests were carried out in 3 additional pits excavated to between 0.8 and 1 mbgl (within the uppermost sandy CLAY). Two tests yielded infiltration rates between 2 and 8×10^{-4} m/s. Infiltration was very rapid in the other test and the rate could not be determined.

June 2024 to February 2025 (Wardell Armstrong, 2025[3]). This included:

[1] Wardell Armstrong, 2023. Phase 1 Water Balance at Cell 3. Technical note ref GM12793-004, November 2023.
[2] Wardell Armstrong, 2024. Cell 3 Ground Investigation Report. Report ref. GM12793-006, April 2024.
[3] Wardell Armstrong, 2025. Cell 3 Ground Investigation Report. Report ref. GM12793-011, February 2025.

23 window sample boreholes each drilled to a depth of 6 m with 20 of them installed with standpipes for groundwater monitoring. Window sampling indicated the following geological sequence: Topsoil (to 0.4 m); Made Ground comprising sandy and silty CLAY with subordinate SAND (dredging deposits – absent at installations outside the cell boundary) to depths of 2.5 to 5.7 mbgl; and Superficial deposits comprising clayey gravelly SAND, silty SAND and silty CLAY (from base of topsoil, or base of made ground where present, to base of installations).

Six rounds of groundwater level monitoring were completed between August 2024 and October 2025. Groundwater levels were found to be typically 0.8 to 1.3 mbgl (range 0.2 to 2.6 mbgl) with variation between maximum and minimum levels of 0.7 m on average (range 0.2 to 1.5 m).

Permeability (rising head tests) in four stand pipes. Two tests could not be completed because the rate of inflow to the standpipes was too low, one test recorded a permeability of 1.7×10^{-7} m/s and one recorded a permeability of 2.3×10^{-5} m/s. Overall, it was concluded that the saturated permeability of the made ground is very low, but discontinuous lenses may be present resulting in locally higher permeabilities. This conclusion was consistent with the lithological observations.

Wellhead parameters were measures on groundwater abstracted from the standpipes when preparing the rising head tests. Water quality results varied between locations. One well contained fresher more oxygenated water, probably influenced by nearby surface water. In contrast, other wells showed more saline, oxygen depleted water indicating stagnant groundwater.

4.2 Pond water levels

The ponds on the existing site that were created in the scrapes constructed as part of Frodsham Windfarm development provide a useful analogue for the proposed wet habitats in the NBBMA. To limit water losses into the ground by infiltration, these scrapes were either lined or excavated to the groundwater table[4].

Although there are no water level data available for these ponds, it is possible to estimate the water levels in these ponds over time using a combination of topographic data for the site (Drawing GM12793-SK-002) and aerial photographs (Google Earth).

Ground surface levels within Cell 3 to the north of the drain that runs across the Site are between 9.5 and 10.5 mAOD. Levels within the scrapes are slightly lower than this, down to c. 9.0 mAOD. Bank full levels within the scrapes appear to be around 9.5 mAOD. Levels are lower than this on the land to the south of the drain (c. 8.5 mAOD). The level of the drain also appears to be around 8.5 mAOD.

Aerial imagery shows that the ponds that formed in these scrapes are bank full for much of the time. The area of open water in these ponds was notably low in imagery from June 2020 and similarly in October 2025, but otherwise the water limit shown in the aerial imagery corresponds with the area of the scrapes. None of the imagery indicates that the ponds to the north of the drain completely dried out over the period although images were only available for 10 periods in that time. In contrast, the scrapes to the south of the drain were completely dry in June 2020 and showed much lower water levels in other summers than the scrapes to the north of the drain.

[4] Wardell Armstrong, 2024. Cell 3 earthwork feasibility Cell 3. Technical note GM12793-003, May 2024.

5.0 Revised conceptual model

5.1 Baseline conceptual model

Geological data from the site investigation shows that the made ground (dredgings) at the site are heterogeneous, having higher permeability near the surface, but lower permeability (due to more clayey lithology) at depths greater than about 1 m below ground surface. The water table is shown to be at shallow depth (around 1 m bgl) within the made ground i.e. not perched within the topsoil as considered in the initial water balance. Groundwater levels vary throughout the year by around 0.5 m.

The chemical data indicate that water quality varies and show local differences in redox conditions and flow behaviour. This suggests the presence of small scale preferential pathways within the shallow deposits, rather than a single uniform low permeability layer. However, this pattern does not imply the existence of a new major flow system. Instead, it supports interpretation of a mainly stagnant and reducing shallow aquifer, with more oxygenated conditions occurring only near local recharge or seepage zones e.g. where ponded surface water may 'spill' over into groundwater.

The site appears to contain a shallow perched groundwater system within low permeability Made Ground and tidal flat deposits. Recharge is likely to occur mainly from rainfall and some surface water seepage, but flow seems to be slow and locally variable due to fine grained materials.

It is accepted that there would be no connection between the deep Sherwood Sandstone aquifer and groundwater in the made ground due to the presence of low permeability glacial till at depth beneath the tidal flat deposits.

The water level responses of the ponds in the scrapes, shown by analysis of aerial photographs, suggest that the main input of water is from rainfall and that groundwater inflow appears to be limited. The aerial imagery shows that ponds at higher levels (those to the north of the drain, presumed to be lined) retain water better than those at the south east corner of the Site (lower level, presumed unlined and excavated down to groundwater table). This finding contrasts with anecdotal reports that suggest the ponds regularly dry out, limiting their use by birds[1 and 4].

Evaporation would be the primary output of water from the ponds, but it also seems likely that lateral seepage occurs when pond water levels get higher, explaining why the maximum area of open water in each scrape is similar from year to year. This model is consistent with the hydrogeological data from site investigations that showed a thin, sandy clay present near to the surface that is relatively permeable and would be able to infiltrate pond water into the ground.

5.2 Conceptual model for the NBBMA

The design of the NBBMA aims to produce a habitat that is wetter than the current site, comprising a range of wetland habitats that are present year-round. The two proposed means of achieving this are:

- deepening the existing scrapes pond features and digging new scrapes; and
- reprofiling the land around the scrapes to produce a more gradual topographic gradient, increasing the wetted area and creating a larger catchment area

The main area of reprofiling would be in the part of Cell 3 north of the drain. The drain would be the main outfall from the system. The reprofiled landform would be unlined. Conceptual design details are given in Table 1 below.

The ponds located between Cell 3 and the MSC are not part of the proposed scheme considered in this assessment. There is no hydraulic connection between these ponds and the Cell 3 area under baseline conditions and it is assumed this will continue to be the case after reprofiling of Cell 3 to create the NBBMA. The data presented in Table 1 exclude these ponds and the ponds have not been included in the water balance modelling presented in Section 6.

Table 1: NBBMA conceptual design details

Parameter	Value (Drawing ref. GM12793-007)
Total catchment area	33.4 Ha
Wetland area	17.0 Ha, ca. 9.12 mAOD (ground surface reduction by ca. 0.6 m)
Scrapes	5.8 Ha, 7.62 to 9.12 mAOD (ground surface reduction by 1.4-1.9 m)
Islands	0.7 Ha, 9.52 mAOD
Outfall elevation	8.27 mAOD

6.0 Updated water balance

6.1 Water balance model

A spreadsheet water balance model was developed in MS Excel. The model considers a simple system comprising an impermeable basin that receives inputs from rainfall and from which water is lost by evaporation and overflow at the top of the basin. A schematic diagram of the model concepts is presented in Figure 1.

The dimensions of the basin at different elevations (water depths) can be specified so that different basin shapes can be represented. Rainfall inputs are based upon the area of open water in the basin or the catchment area of the basin, whichever is bigger. Evaporation outputs are based on the area of open water plus a wetted perimeter, which is the extent over which evaporation may occur from shallow groundwater around the basin. Groundwater is not explicitly represented in the model, but the influence of groundwater storage, inflows and outflows can be accounted for by adjusting the basin depth/area input parameters and changing the thickness of the wetter perimeter.

The model is designed to run on a daily time step. The user inputs daily time series of rainfall and evaporation.

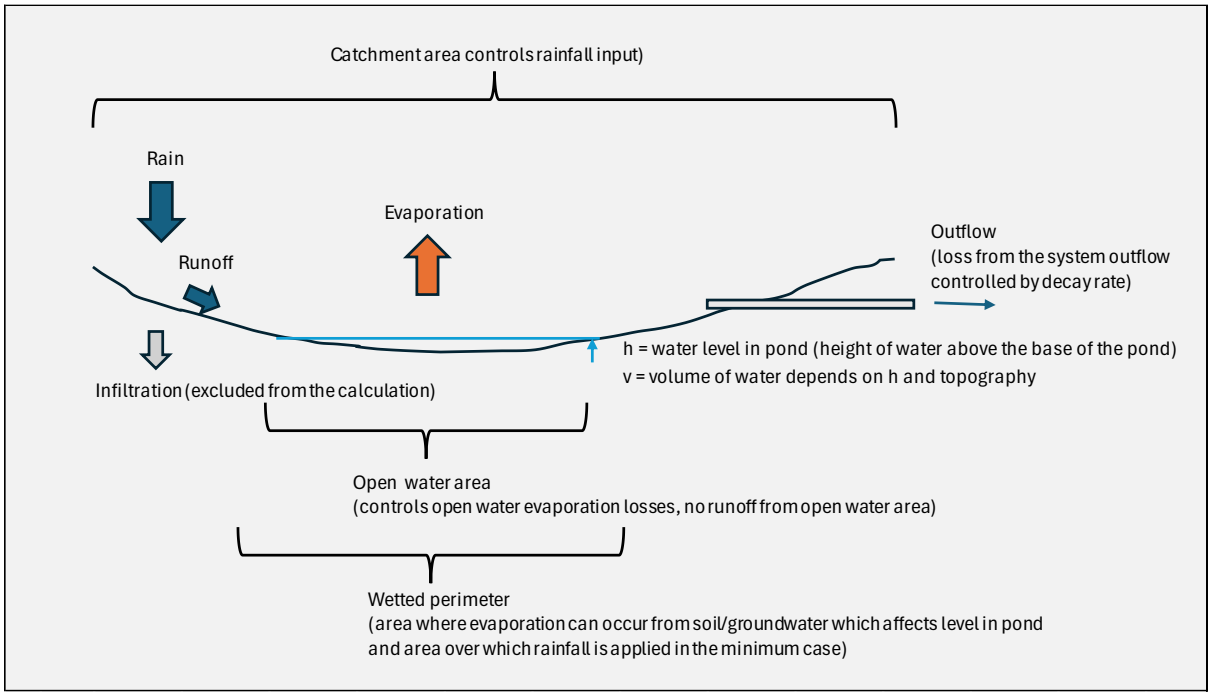


Figure 1. Schematic diagram showing inputs and outputs for the simple water balance model.

6.2 Baseline model

A baseline model was developed to test the spreadsheet methodology and determine site specific factors for some parameters. The baseline model was built to simulate water levels and storage within one of the scrapes.

Input data were daily rainfall from the Environment Agency's Folly Gates rain gauge, monthly long-term average grass potential evapotranspiration for MORECS square 105[1] (which was converted to equivalent open water evaporation rates using factors published by the Environment Agency[5]) and water depth – area data measured from site plans.

The baseline model was calibrated against observed open water areas shown on aerial imagery on Google Earth. The calibration is presented in Figure 2. Ignoring the data point from 2015, which most probably reflects a dry condition soon after the scrape was formed, there is reasonable agreement between the observations and the model simulation. The model also agrees with the anecdotal evidence that the ponds dry substantially in most years, even though most of the aerial imagery shows the ponds to be full.

Figure 3 presents water balance data for the pond. Of note is the relatively small amounts of overspill from the pond compared with the larger and more constant evaporative losses. This is consistent with the conceptual model in that large amounts of overspill would not be expected given that the aquifer has poor permeability – groundwater levels would soon mound to be close to ground level if overspill rates were particularly high.

The results from the baseline model support the use of this model for simulating the scenarios.

[5] Environment Agency, 2001. Estimation of Open Water Evaporation A Review of Methods R&D Technical Report W6-043/TR.

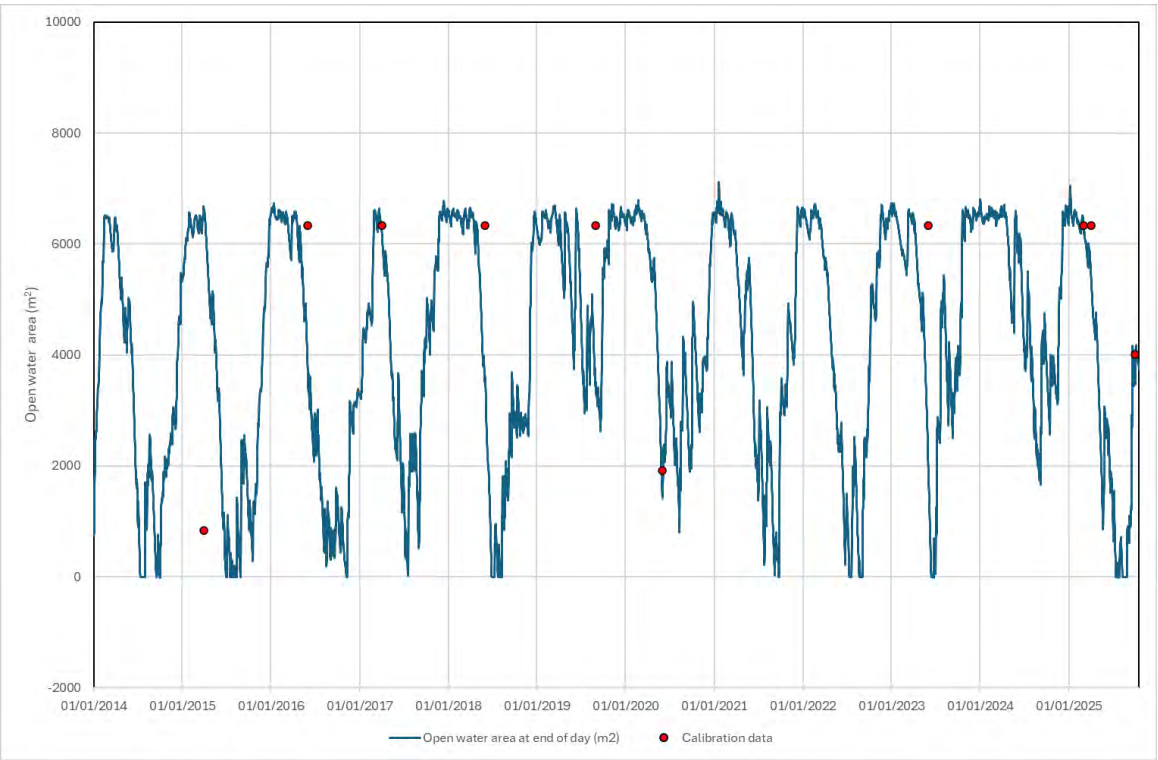


Figure 2. Calibration of the baseline model

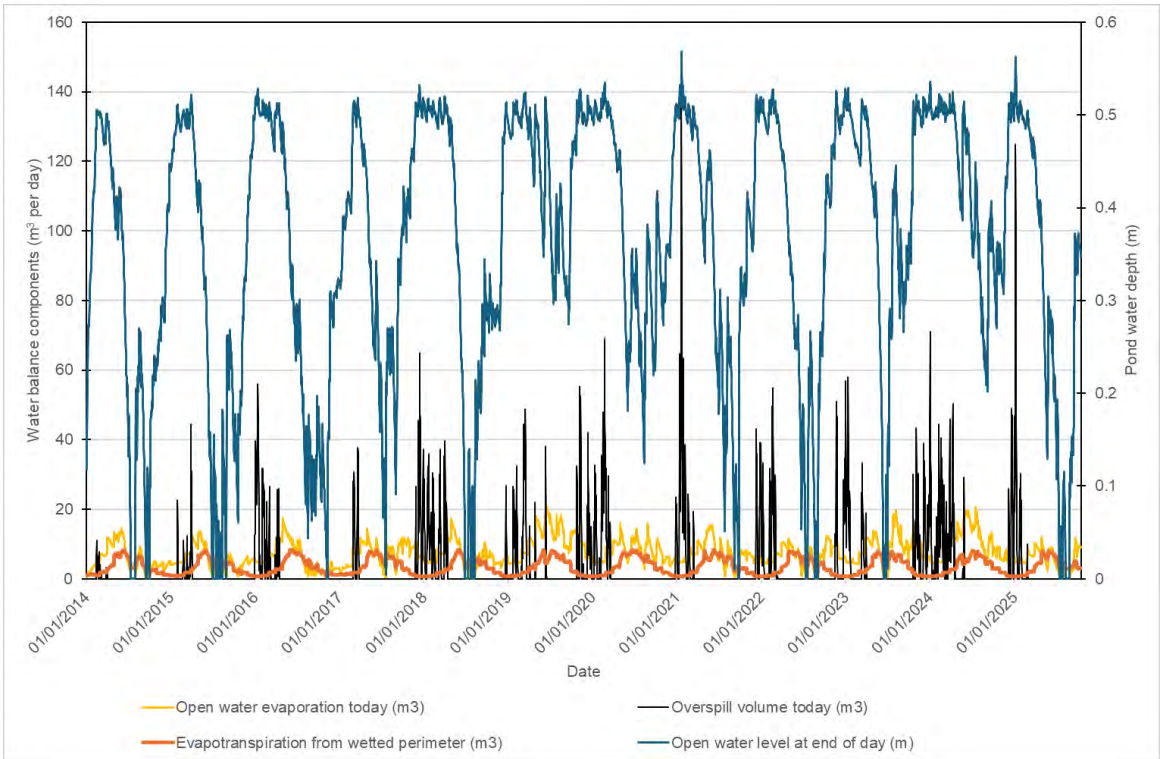


Figure 3. Baseline model: Simulated water levels and outflows

6.3 Scenario model

A scenario model was developed, as presented in Table 1. Input parameters were as in the baseline model with the following differences:

- The shape of the basin was changed to match the conceptual design.
- Overspill level was set to the level corresponding to the top of the wetland area (Table 1).
- The thickness of the wetted perimeter in the model was increased compared with the baseline, representing the greater importance that groundwater inflow/outflow would be expected to play in the water balance.
- Runoff rate was decreased compared with the baseline because the landforms will not be lined in this scenario.
- The same historic rainfall and potential evapotranspiration series were used for the scenario model.

The results from the simulation is presented in Figures 4.

The scenario model demonstrates seasonal fluctuations in water levels, with increases during wetter periods and decreases during drier periods. After an initial 2-year period where water levels may need to increase in response to the reprofiled landform (change in hydrological catchment) these annual cycles remain consistent throughout the simulated periods. The model assumes very low starting water levels, so the estimate of time to reach typical conditions is considered representative of a worst case. Water levels are at or above ground surface over the wet grassland area 41% of the time and the scrapes are bank full 46% of the time. This shows that there is sufficient water to maintain saturated soils within the wet grassland during winter periods. Overspill events occur each year during winter, providing further evidence of water surplus although magnitude and frequency differ from year to year in response to rainfall. Dry conditions with less than 1 m depth of water within the scrapes occur less than 7% of the time.

To assess hydrogeological persistence during the dry season, simulated monthly water levels were analysed. The initial two years of the simulation were excluded to allow the system to reach equilibrium, and the analysis was therefore conducted for the period 2016–2025. The average and minimum monthly water levels are presented in Figure 5.

The results indicate that minimum simulated water levels ranged from 1.1 to 1.9 metres, with annual minima occurring from late summer to early autumn. During the dry season, water levels in the ponds is shown to fall but open water is still expected to be present in the deeper parts of the scrapes. This indicates that the scapes are likely to retain moisture even under the most severe dry conditions, effectively preventing desiccation of the substrate.

Minimum water levels are simulated to be highest in March and April. In these months the levels were just below the elevation of the wet grassland. This shows that, even in a dry year, soils in the wet grassland are likely to reach near-saturation at the end of the winter season such that wetness is likely to be maintained. During average conditions, water levels in the winter are simulated to be above ground level in the wet grassland area for 5 to 6 months. It will be possible to manage this surplus – so that soils remain saturated but not inundated – through water level control at the outflow point from the drain.

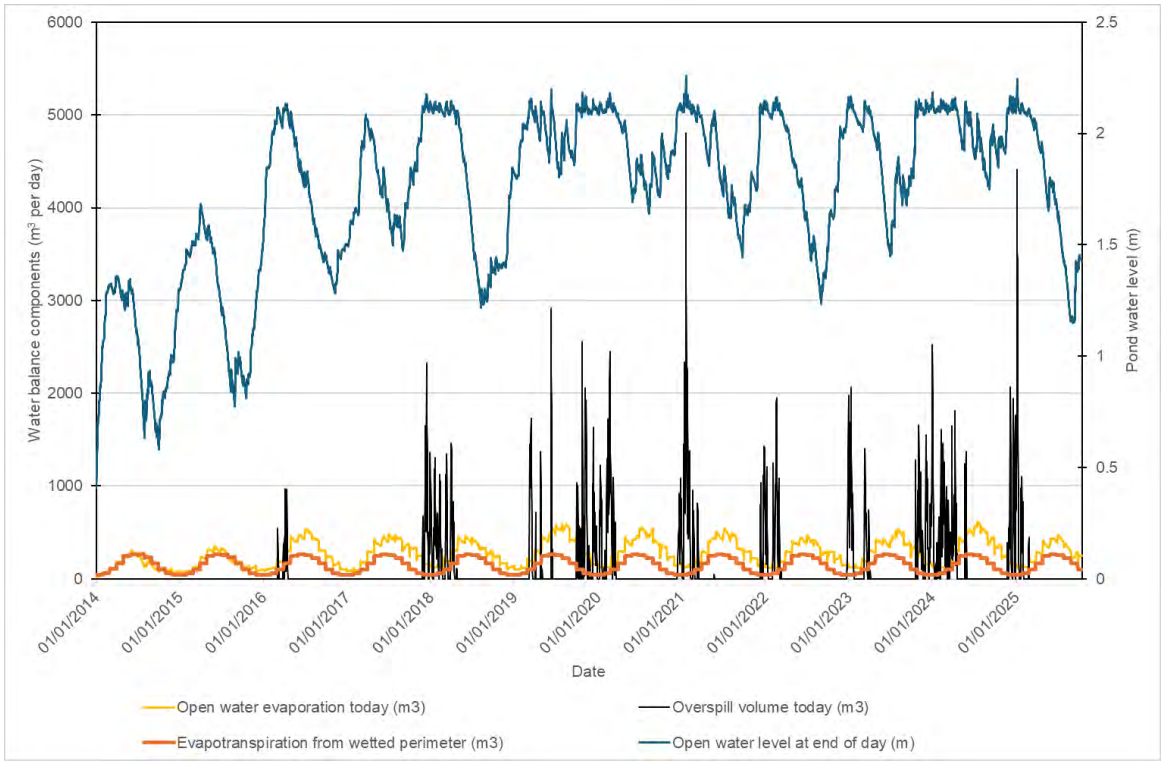


Figure 4. Scenario Model: Simulated water levels and outflows

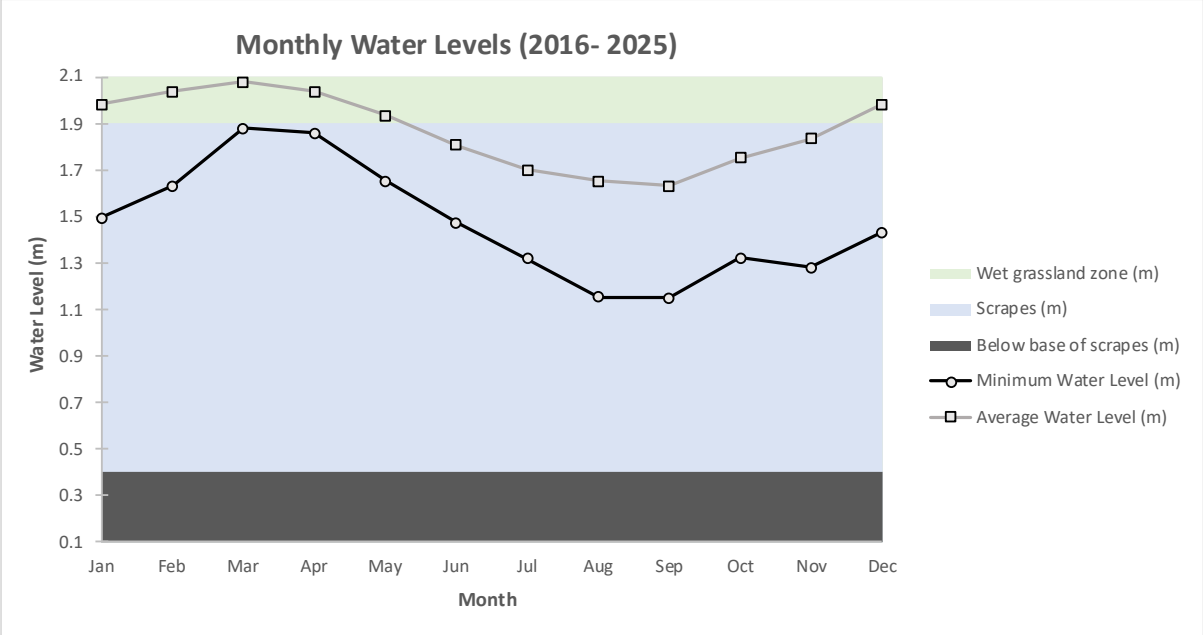


Figure 5. Simulated minimum and average monthly water levels

6.4 Future Climate Considerations

Regional near and far-future flow projections were examined to evaluate the potential impacts of climate change on water availability.

Near-future projections (2020-2049) suggest that winter conditions will remain broadly similar to current patterns, while spring and autumn are anticipated to experience reduced water availability. The most notable changes are expected during the summer months, when lower flows and extended dry periods are projected to become more common.[6]

Under far future climate projections (2050-2079), more pronounced seasonal variations in hydrological conditions are expected. Winter months are projected to experience increased flow, indicating wetter conditions compared to the baseline. Early spring shows a slight increase, whereas mid spring and late autumn are projected to remain close to current levels. From late spring to autumn, water availability progressively declines, with substantial reductions projected for summer and early autumn. The lowest levels are expected during the late summer months, reflecting extended dry periods and markedly reduced water inputs[7].

The projected seasonal changes in flow in the region across both scenarios reflect shifting regional hydrological conditions under a changing climate. These changes indicate that water levels may become increasingly variable through time. In the near future, moderate reductions in spring and summer flow indicate drier conditions and increased evaporative demand, likely resulting in lower summer water levels at the site. However, with winter rainfall being maintained at comparable levels to present, it is expected that water levels will recover to fill the ponds and saturated the wet grassland soils in most winters.

In the far future, projections show stronger seasonal contrasts: higher winter flows suggest wetter conditions in winter, followed by longer low-flow periods in summer, implying more pronounced seasonal drying. This implies greater surplus of water at the site during the wetter winter season and lower levels in the summer. Therefore it is likely that the site will continue to function as indicated by the modelling for the current climate and wetness in the winter is likely to be maintained. However, it may be necessary to change management practices so that water is retained to a greater degree during the spring and autumn to slow the rate of drying into the summer and speed the rate of re-wetting after the summer. Managing conveyance of excess water during the winter to prevent excessive water logging may be needed.

[6]UK Centre for Ecology& Hydrology (n.d), Climate model-driven simulations, Accessed (2025), Available at: https://hydroprojections.ceh.ac.uk/ddh/climate-change.
[7] UK Centre for Ecology& Hydrology (n.d), Climate model-driven simulations, Accessed (2025), Available at: https://hydroprojections.ceh.ac.uk/ddh/climate-change.

7.0 Discussion

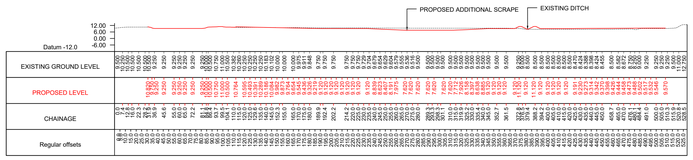
The results of the updated water balance assessment show that the indicative landform changes are likely to be successful at retaining water and ensuring that the wetness of the habitat is increased compared with the current situation.

The water balance results for the scenario model indicate the continuation of generally wet conditions, with clear seasonal fluctuations in water levels driven by rainfall and evaporative processes. The model also suggests that water would be lost to overspill into the site drain under this scenario, which provides resilience to the scheme and would enable more water to be retained on site if actual conditions differ from those modelled.

Variable water level control on the drain discharging from the Site would be critical to the success of the proposed scheme along with reprofiling of the drain to be consistent with the desired minimum water levels within the scrapes.

Overall, the results indicate a hydrologically balanced and generally adaptive system with a clear capacity to adjust to varying rainfall and evaporation over time, though its behaviour may vary under future climate influences.

Drawing



EXISTING GROUND LEVEL	11.250 11.500 11.750 12.000 12.250 12.500 12.750 13.000 13.250 13.500 13.750 14.000 14.250 14.500 14.750 15.000 15.250 15.500 15.750 16.000 16.250 16.500 16.750 17.000 17.250 17.500 17.750 18.000 18.250 18.500 18.750 19.000 19.250 19.500 19.750 20.000 20.250 20.500 20.750 21.000

Appendix C – Condition Assessment Sheets

Condition Sheet: DITCH Habitat Type			
Habitat Type			
Watercourses - Ditches			
Habitat Description			
See the Statutory Biodiversity Metric User Guide.			
On-site or off-site, site name and location		**Survey date and Surveyor name**	
Limitations (if applicable)		**Survey reference (if relating to a wider survey)**	
Grid reference		**Habitat parcel reference**	

	Condition Assessment Criteria	Criterion passed (Yes or No)	Notes (such as justification)
A	The ditch is of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.		
B	A range of emergent, submerged and floating-leaved plants are present. As a guide >10 species of emergent, floating or submerged plants present in a 20 m ditch length.		
C	There is less than 10% cover of filamentous algae and or duckweed *Lemna* spp. (these are signs of eutrophication).		
D	A fringe of aquatic marginal vegetation is present along more than 75% of the ditch.		
E	Physical damage is evident along less than 5% of the ditch, with examples of damage including: excessive poaching, damage from machinery use or storage, or any other damaging management activities.		
F	Sufficient water levels are maintained - as a guide a minimum summer depth of approximately 50 cm in minor ditches and 1 m in main drains.		
G	Less than 10% of the ditch is heavily shaded.		
H	There is an absence of non-native plant and animal species[1].		
	Number of criteria passed		

Condition Assessment Result (out of 8 criteria)	Condition Assessment Score	Score Achieved ×/✓
Passes 8 criteria	Good (3)	
Passes 6 or 7 criteria	Moderate (2)	
Passes 5 or fewer criteria	Poor (1)	

Suggested enhancement interventions to improve condition score

Footnotes

Footnote 1 – This includes any species listed on the Water Framework Directive UKTAG GB High Impact Species List: Water Framework Directive (WFD) UKTAG (2021) *Classification of aquatic alien species according to their level of impact* [online]. Available from:
UKTAG classification of alien species working paper v8.pdf (wfduk.org)

• Frequently occurring non-native plant species include water fern *Azolla filiculoides* , Australian swamp stonecrop *Crassula helmsii* , parrot's feather *Myriophyllum aquaticum* , floating pennywort *Hydrocotyle ranunculoides* , Japanese knotweed *Reynoutria japonica* and giant hogweed *Heracleum mantegazzianum* (on the bank).

• Frequently occurring non-native animals include signal crayfish *Pacifastacus leniusculus* , zebra mussel *Dreissena polymorpha* , killer shrimp *Dikerogammarus villosus* , demon shrimp *Dikerogammarus haemobaphes* , and carp *Cyprinus carpio* .

Condition Sheet: GRASSLAND Habitat Type (low distinctiveness)			
UK Habitat Classification (UKHab) Habitat Type			
Grassland - Modified grassland			
On-site or off-site, site name and location		**Survey date and Surveyor name**	
Limitations (if applicable)		**Survey reference (if relating to a wider survey)**	
Grid reference		**Habitat parcel reference**	
Habitat Description			
ukhab – UK Habitat Classification			

	Condition Assessment Criteria	Criterion passed (Yes or No)	Notes (such as justification)
A	There are 6-8 vascular plant species per m^2 present, including at least 2 forbs (these may include those listed in Footnote 1). **Note - this criterion is essential for achieving Moderate or Good condition.** Where the vascular plant species present are characteristic of medium, high or very high distinctiveness grassland, or there are 9 or more of these characteristic species per m^2 (excluding those listed in Footnote 1), please review the full UKHab description to assess whether the grassland should instead be classified as a higher distinctiveness grassland. Where a grassland is classed as medium, high, or very high distinctiveness, please use the relevant condition sheet.		
B	Sward height is varied (at least 20% of the sward is less than 7 cm and at least 20% is more than 7 cm) creating microclimates which provide opportunities for vertebrates and invertebrates to live and breed.		
C	Any scrub present accounts for less than 20% of the total grassland area. (Some scattered scrub such as bramble *Rubus fruticosus* agg. may be present). Note - patches of scrub with continuous (more than 90%) cover should be classified as the relevant scrub habitat type.		
D	Physical damage is evident in less than 5% of total grassland area. Examples of physical damage include excessive poaching, damage from machinery use or storage, erosion caused by high levels of access, or any other damaging management activities.		
E	Cover of bare ground is between 1% and 10%, including localised areas (for example, a concentration of rabbit warrens)[2].		
F	Cover of bracken *Pteridium aquilinum* is less than 20%.		
G	There is an absence of invasive non-native plant species[3] (as listed on Schedule 9 of WCA[4]).		
		Essential criterion achieved (Yes or No)	
		Number of criteria passed	

Condition Assessment Result (out of 7 criteria)	Condition Assessment Score	Score Achieved ×/✓
Passes 6 or 7 criteria including passing essential criterion A	Good (3)	
Passes 4 or 5 criteria including passing essential criterion A	Moderate (2)	
Passes 3 or fewer criteria; OR Passes 4 - 6 criteria (excluding criterion A)	Poor (1)	

Suggested enhancement interventions to improve condition score

Footnotes

Footnote 1 – Creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, curled dock *Rumex crispus*, broad-leaved dock *Rumex obtusifolius*, common nettle *Urtica dioica*, creeping buttercup *Ranunculus repens*, greater plantain *Plantago major*, white clover *Trifolium repens* and cow parsley *Anthriscus sylvestris*.

Footnote 2 – For example, this could include small, scattered areas of bare ground allowing establishment of new species, or localised patches where not exceeding 10% cover.

Footnote 3 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.

Footnote 4 – Wildlife and Countryside Act 1981 (as amended).

Condition Sheet: GRASSLAND Habitat Type (medium, high and very high distinctiveness)

UK Habitat Classification (UKHab) Habitat Types

Grassland - Lowland calcareous grassland
Grassland - Lowland dry acid grassland
Grassland - Lowland meadows
Grassland - Other lowland acid grassland
Grassland - Other neutral grassland
Grassland - Tall herb communities (H6430) [Not to be confused with the Tall forbs secondary code – see UKHab guidance for details.]
Grassland - Upland acid grassland
Grassland - Upland calcareous grassland
Grassland - Upland hay meadows
Sparsely vegetated land - Calaminarian grassland

On-site or off-site, site name and location		**Survey date and Surveyor name**	
Limitations (if applicable)		**Survey reference (if relating to a wider survey)**	
Grid reference		**Habitat parcel reference**	

Habitat Description

ukhab – UK Habitat Classification			

	Condition Assessment Criteria	Criterion passed (Yes or No)	Notes (such as justification)
A	The parcel represents a good example of its habitat type, with a consistently high proportion of characteristic indicator species present relevant to the specific habitat type (and relative to Footnote 3 suboptimal species which may be listed in the UKHab description).[1] **Note - this criterion is essential for achieving Moderate or Good condition for non-acid grassland types only.**		
B	Sward height is varied (at least 20% of the sward is less than 7 cm and at least 20% is more than 7 cm) creating microclimates which provide opportunities for insects, birds and small mammals to live and breed.		
C	Cover of bare ground is between 1% and 5%, including localised areas, for example, rabbit warrens[2].		
D	Cover of bracken *Pteridium aquilinum* is less than 20% and cover of scrub (including bramble *Rubus fruticosus* agg.) is less than 5%.		
E	Combined cover of species indicative of suboptimal condition[3] and physical damage (such as excessive poaching, damage from machinery use or storage, damaging levels of access, or any other damaging management activities) accounts for less than 5% of total area. If any invasive non-native plant species[4] (as listed on Schedule 9 of WCA[5]) are present, this criterion is automatically failed.		
	Additional Criterion - must be assessed for all non-acid grassland types		
F	There are 10 or more vascular plant species per m^2 present, including forbs that are characteristic of the habitat type (species referenced in Footnote 3 and 5 cannot contribute towards this count). **Note - this criterion is essential for achieving Good condition for non-acid grassland types only.**		
	Essential criterion for Good condition achieved (for non-acid grassland) (Yes or No)		
	Number of criteria passed		

Condition Assessment Result	Condition Assessment Score	Score Achieved ×/✓
Acid grassland types (Result out of 5 criteria)		
Passes 5 criteria	Good (3)	
Passes 3 or 4 criteria	Moderate (2)	
Passes 2 or fewer criteria	Poor (1)	
Non-acid grassland types (Result out of 6 criteria)		
Passes 5 or 6 criteria, including essential criterion A and additional criterion F.	Good (3)	
Passes 3 - 5 criteria, including essential criterion A.	Moderate (2)	
Passes 2 or fewer criteria; OR Passes 3 or 4 criteria excluding criterion A and F.	Poor (1)	

Suggested enhancement interventions to improve condition score

Notes

Footnote 1 - Professional judgement should be used alongside the UKHab description.

Footnote 2 – For example, this could include small, scattered areas of bare ground allowing for plant colonisation, or localised patches not exceeding 5% cover.

Footnote 3 - Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, curled dock *Rumex crispus*, broad-leaved dock *Rumex obtusifolius*, common nettle *Urtica dioica*, creeping buttercup *Ranunculus repens*, greater plantain *Plantago major*, white clover *Trifolium repens* and cow parsley *Anthriscus sylvestris*. There may be additional relevant species local to the region and or site.

Footnote 4 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, by applying professional judgement.

Footnote 5 – Wildlife and Countryside Act 1981 (as amended).

Condition sheet: HEDGEROW Habitat Types

Habitat Type

Native hedgerow
Native hedgerow - associated with bank or ditch
Native hedgerow with trees
Native hedgerow with trees - associated with bank or ditch
Species-rich native hedgerow
Species-rich native hedgerow - associated with bank or ditch
Species-rich native hedgerow with trees
Species-rich native hedgerow with trees - associated with bank or ditch

Habitat Description

ukhab – UK Habitat Classification

On-site or off-site, site name and location		**Survey date and Surveyor name**	
Limitations (if applicable)		**Survey reference (if relating to a wider survey)**	
Grid reference		**Habitat parcel reference**	

Condition Assessment Details

A series of ten attributes, representing key physical characteristics are used for this assessment. Each attribute is assigned to one of five functional groups (A – E) and the condition of a hedgerow is assessed according to the number of attributes from these functional groups which pass or fail the 'favourable condition' criteria.

This assessment is based on the Hedgerow Survey Handbook[1] and Favourable Conservation Status document[2]. For further clarification please refer to the Hedgerow Survey Handbook.

Best practice would be to record the species, age, spacing and other key information about all trees present along a hedgerow within the 'Habitat Description' box, as well as other key features of the hedgerow.

Hedgerow favourable condition attributes

Attributes and functional groupings (A, B, C, D and E)		Criteria - the minimum requirements for 'favourable condition'	Criteria description	Criterion passed (Yes or No)	Notes (such as justification)
Core groups - applicable to all hedgerow types					
A1.	Height	>1.5 m average along length	The average height of woody growth estimated from base of stem to the top of the shoots, excluding any bank beneath the hedgerow, any gaps or isolated trees. Newly laid or coppiced hedgerows are indicative of good management and pass this criterion for up to a maximum of four years (if undertaken according to good practice). A newly planted hedgerow does not pass this criterion (unless it is >1.5 m height).		
A2.	Width	>1.5 m average along length	The average width of woody growth estimated at the widest point of the canopy, excluding gaps and isolated trees. Outgrowths (such as blackthorn *Prunus spinosa* suckers) are only included in the width estimate when they are >0.5 m in height. Laid, coppiced, cut and newly planted hedgerows are indicative of good management and pass this criterion for up to a maximum of four years (if undertaken according to good practice).		
B1.	Gap - hedge base	Gap between ground and base of canopy <0.5 m for >90% of length	This is the vertical 'gappiness' of the woody component of the hedgerow, and its distance from the ground to the lowest leafy growth. Certain exceptions to this criterion are acceptable (see page 65 of the Hedgerow Survey Handbook).		
B2.	Gap - hedge canopy continuity	Gaps make up <10% of total length; and No canopy gaps >5 m	This is the horizontal 'gappiness' of the woody component of the hedgerow. Gaps are complete breaks in the woody canopy (no matter how small). Access points and gates contribute to the overall 'gappiness' but are not subject to the >5 m criterion (as this is the typical size of a gate).		
C1.	Undisturbed ground and perennial vegetation	>1 m width of undisturbed ground with perennial herbaceous vegetation for >90% of length: · Measured from outer edge of hedgerow; and · Is present on one side of the hedgerow (at least).	This is the level of disturbance (excluding wildlife disturbance) at the base of the hedgerow. Undisturbed ground is present for at least 90% of the hedgerow length, greater than 1 m in width and must be present along at least one side of the hedgerow. This criterion recognises the value of the hedgerow base as a boundary habitat with the capacity to support a wide range of species. Cultivation, heavily trodden footpaths, poached ground etc. can limit available habitat niches.		
C2.	Nutrient-enriched perennial vegetation	Plant species indicative of nutrient enrichment of soils dominate <20% cover of the area of undisturbed ground.	The indicator species used are nettles *Urtica* spp., cleavers *Galium aparine* and docks *Rumex* spp. Their presence, either singly or together, does not exceed the 20% cover threshold.		
D1.	Invasive and neophyte species	>90% of the hedgerow and undisturbed ground is free of invasive non-native plant species (including those listed on Schedule 9 of WCA[3]) and recently introduced species.	Recently introduced species refer to plants that have naturalised in the UK since AD 1500 (neophytes). Archaeophytes count as natives. For information on archaeophytes and neophytes see the JNCC website[4], as well as the BSBI website[5] where the 'Online Atlas of the British and Irish Flora'[6] contains an up-to-date list of the status of species. For information on invasive non-native species see the GB Non-Native Secretariat website[7].		
D2.	Current damage	>90% of the hedgerow or undisturbed ground is free of damage caused by human activities.	This criterion addresses damaging activities that may have led to or lead to deterioration in other attributes. This could include evidence of pollution, piles of manure or rubble, or inappropriate management practices (for example, excessive hedgerow cutting).		
Additional group - applicable to hedgerows with trees only					
E1.	Tree class	There is more than one age-class (or morphology) of tree present (for example: young, mature, veteran and or ancient[8]), and there is on average at least one mature, ancient or veteran tree present per 20 - 50m of hedgerow.	This criterion addresses if there are a range of age-classes or morphologies which allow for replacement of trees and provide opportunities for different species.		
E2.	Tree health	At least 95% of hedgerow trees are in a healthy condition (excluding veteran features valuable for wildlife). There is little or no evidence of an adverse impact on tree health by damage from livestock or wild animals, pests or diseases, or human activity.	This criterion identifies if the trees are subject to damage which compromises the survival and health of the individual specimens.		

The hedgerow condition assessment generates a weighting (score) ranging from 1 - 3, which is used within the Statutory Biodiversity Metric. The scores for each are set out in the tables below.

Condition categories for hedgerows without trees

Category	Category Requirements	Metric Score
Good	No more than 2 failures in total; **AND** No more than 1 failure in any functional group.	3
Moderate	No more than 4 failures in total; **AND** Does not fail both attributes in more than one functional group (for example, fails attributes A1, A2, B1 and C2 = Moderate condition).	2
Poor	Fails a total of more than 4 attributes; **OR** Fails both attributes in more than one functional group (for example, fails attributes A1, A2, B1 and B2 = Poor condition).	1
	Score achieved:	

Condition categories for hedgerows with trees

Category	Category Requirements	Metric score
Good	No more than 2 failures in total; **AND** No more than 1 failure in any functional group.	3
Moderate	No more than 5 failures in total; **AND** Does not fail both attributes in more than one functional group (for example, fails attributes A1, A2, B1, C2 and E1 = Moderate condition).	2
Poor	Fails a total of more than 5 attributes; **OR** Fails both attributes in more than one functional group (for example, fails attributes A1, A2, B1 and B2 = Poor condition).	1
	Score achieved:	

Suggested enhancement interventions to improve condition score

Footnotes

Footnote 1 – DEFRA (2007) *Hedgerow Survey Handbook. A standard procedure for local surveys in the UK.* [online] Available on:
layout (hedgelink.org.uk)
Footnote 2 – STALEY, J.T. ET AL. (2020) *Definition of Favourable Conservation Status for Hedgerows.* [online] Available on:
Definition of Favourable Conservation Status for Hedgerows - RP2943 (naturalengland.org.uk)
Footnote 3 – Wildlife and Countryside Act 1981 (as amended).
Footnote 4 – CHEFFINGS, C. M. et al. (2005) *The Vascular Plant Red Data List for Great Britain.* Species Status 7: 1-116. [online] Available on:
The Vascular Plant Red Data List for Great Britain (Species Status No. 7) | JNCC Resource Hub
Footnote 5 – BOTANICAL SOCIETY OF BRITAIN AND IRELAND (BSBI). *Definitions: wild, native or alien?* [online] Available on:
Definitions: wild, native or alien? – Botanical Society of Britain & Ireland (bsbi.org)
Footnote 6 – BSBI and Biological Records Centre (BRC) (2022) *Online Atlas of the British and Irish Flora.* [online] Available on:
Acknowledgements | Online Atlas of the British and Irish Flora (brc.ac.uk)
Footnote 7 – GB NON-NATIVE SPECIES SECRETARIAT (GBNNSS) (2022) Available on:
Home » NNSS (nonnativespecies.org)
Footnote 8 – See gov.uk standing advice on ancient and veteran trees. Available from:
Keepers of time: ancient and native woodland and trees policy in England (publishing.service.gov.uk)
and
Ancient woodland, ancient trees and veteran trees: advice for making planning decisions - GOV.UK (www.gov.uk)

Condition Sheet: POND Habitat Type			
Habitat Type			
Lakes - Ponds (priority habitat) **Lakes - Ponds (non-priority habitat)** **Lakes - Temporary lakes ponds and pools (H3170)** [Use this condition sheet for Temporary ponds and pools, use Lake condition sheet for Temporary lakes] **Lakes - Ornamental lake or pond** [Use this condition sheet for Ornamental ponds, use Lake condition sheet for Ornamental lakes]			
Habitat Description			
ukhab – UK Habitat Classification			
On-site or off-site, site name and location		**Survey date and Surveyor name**	
Limitations (if applicable)		**Survey reference (if relating to a wider survey)**	
Grid reference		**Habitat parcel reference**	

	Condition Assessment Criteria	Criterion passed (Yes or No)	Notes (such as justification)
Core Criteria - applicable to all ponds (woodland[1] and non-woodland):			
A	The pond is of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution. Turbidity is acceptable if the pond is grazed by livestock.		
B	There is semi-natural habitat (moderate distinctiveness or above) completely surrounding the pond, for at least 10 m from the pond edge for its entire perimeter.		
C	Less than 10% of the water surface is covered with duckweed *Lemna* spp. or filamentous algae.		
D	The pond is not artificially connected to other waterbodies, such as agricultural ditches or artificial pipework.		
E	Pond water levels can fluctuate naturally throughout the year. No obvious artificial dams[2], pumps or pipework.		
F	There is an absence of listed non-native plant and animal species[3].		
G	The pond is not artificially stocked with fish. If the pond naturally contains fish, it is a native fish assemblage at low densities.		
Additional Criteria - must be assessed for all non-woodland ponds:			
H	Emergent, submerged or floating plants (excluding duckweed)[4] cover at least 50% of the pond area which is less than 3 m deep.		
I	The pond surface is no more than 50% shaded by adjacent trees and scrub.		
	Number of criteria passed		

Condition Assessment Result	Condition Assessment Score	Score Achieved ×/✓
Results for woodland ponds which require assessment of 7 core criteria		
Passes 7 criteria	Good (3)	
Passes 5 or 6 criteria	Moderate (2)	
Passes 4 or fewer criteria	Poor (1)	
Results for non-woodland ponds which require assessment of 9 criteria		
Passes 9 criteria	Good (3)	
Passes 6 to 8 criteria	Moderate (2)	
Passes 5 or fewer criteria	Poor (1)	

Suggested enhancement interventions to improve condition score

Footnote 1 - A woodland pond will be surrounded on all sides by woodland habitat.

Footnote 2 – This excludes natural dams such as those created by Eurasian beaver *Castor fiber*.

Footnote 3 - Any species included on the Water Framework Directive (WFD) UKTAG GB High Impact Species List should be absent: WFD UKTAG (2021) *Classification of aquatic alien species according to their level of impact* [online]. Available from:

UKTAG classification of alien species working paper v8.pdf (wfduk.org)

• Frequently occurring non-native plant species include water fern *Azolla filiculoides*, Australian swamp stonecrop *Crassula helmsii*, parrot's feather *Myriophyllum aquaticum*, floating pennywort *Hydrocotyle ranunculoides* and Japanese knotweed *Reynoutria japonica*, giant hogweed *Heracleum mantegazzianum* (on the bank).
• Frequently occurring non-native animals include signal crayfish *Pacifastacus leniusculus*, zebra mussels *Dreissena polymorpha*, killer shrimp *Dikerogammarus villosus*, demon shrimp *Dikerogammarus haemobaphes*, carp *Cyprinus carpio*.

Footnote 4 - If the pond is seasonal (as in, it dries out in most summers) then emergent species alone are likely to be found.

Condition Sheet: SCRUB Habitat Type

Habitat Types

Heathland and shrub - Blackthorn scrub
Heathland and shrub - Gorse scrub
Heathland and shrub - Hawthorn scrub
Heathland and shrub - Hazel scrub
Heathland and shrub - Mixed scrub
Heathland and shrub - Dunes with sea buckthorn (H2160)
Heathland and shrub - Willow scrub

Habitat Description

For Dunes with sea buckthorn see:	Dunes with sea-buckthorn (Dunes with Hippophae rhamnoides) - Special Areas of Conservation (jncc.gov.uk)		
For other scrub types see:	ukhab – UK Habitat Classification		
On-site or off-site, site name and location		**Survey date and Surveyor name**	
Limitations (if applicable)		**Survey reference (if relating to a wider survey)**	
Grid reference		**Habitat parcel reference**	

	Condition Assessment Criteria	**Criterion passed (Yes or No)**	**Notes (such as justification)**
A	The parcel represents a good example of its habitat type - the appearance and composition of the vegetation closely matches its UKHab description (where in its natural range).[1] - At least 80% of scrub is native, - There are at least three native woody species[2], - No single species comprises more than 75% of the cover (except hazel *Corylus avellana*, common juniper *Juniperus communis*, sea buckthorn *Hippophae rhamnoides* (only in its restricted native range), or box *Buxus sempervirens*, which can be up to 100% cover).		
B	Seedlings, saplings, young shrubs and mature (or ancient or veteran[3]) shrubs are all present.		
C	There is an absence of invasive non-native plant species[4] (as listed on Schedule 9 of WCA[5]) and species indicative of suboptimal condition[6] make up less than 5% of ground cover.		
D	The scrub has a well-developed edge with scattered scrub and tall grassland and or forbs present between the scrub and adjacent habitat.		
E	There are clearings, glades or rides present within the scrub, providing sheltered edges.		
		Number of criteria passed	

Condition Assessment Result (out of 5 criteria)	**Condition Assessment Score**	**Score Achieved ×/✓**
Passes 5 criteria	Good (3)	
Passes 3 or 4 criteria	Moderate (2)	
Passes 2 or fewer criteria	Poor (1)	

Suggested enhancement interventions to improve condition score

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.

Footnote 2 – Native woody species as defined and listed in the Hedgerow Survey Handbook: DEFRA (2007) *Hedgerow Survey Handbook: A standard procedure for local surveys in the UK.* 2nd ed. [online]. Defra, London. PB1195. Available from: Hedgerow Survey Handbook (publishing.service.gov.uk).

Footnote 3 – See gov.uk standing advice on ancient and veteran species. Available from:

Keepers of time: ancient and native woodland and trees policy in England (publishing.service.gov.uk)	and
Ancient woodland, ancient trees and veteran trees: advice for making planning decisions - GOV.UK (www.gov.uk)	

Footnote 4 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.

Footnote 5 – Wildlife and Countryside Act 1981 (as amended).

Footnote 6 – Species indicative of suboptimal condition for this habitat type may include: non-native conifers, tree-of-heaven *Alianthus altissima*, holm oak *Quercus ilex*, European turkey oak *Quercus cerris*, cherry laurel *Prunus laurocerasus*, snowberry *Symphoricarpos* spp., shallon *Gaultheria shallon*, American skunk cabbage *Lysichiton americanus*, buddleia *Buddleja* spp., cotoneaster *Cotoneaster* spp., Spanish bluebell *Hyacinthoides hispanica* and hybrid bluebells *Hyacinthoides x massartiana*. There may be additional relevant species local to the region and or site.

Condition Sheet: WETLAND Habitat Type

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

For Oceanic valley mires - see EUNIS

See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:

Coastal and floodplain grazing marsh UK BAP Priority Habitat description

Priority Habitat Inventory (England) - data.gov.uk

All other wetland habitats - see UK Habitat Classification (UKHab):

UKHab

On-site or off-site, site name and location		**Survey date and Surveyor name**	
Limitations (if applicable)		**Survey reference (if relating to a wider survey)**	
Grid reference		**Habitat parcel reference**	

	Condition Assessment Criteria	**Criterion passed (Yes or No)**	**Notes (such as justification)**
Core Criteria - must be assessed for **all wetland habitat types**:			
A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**		
B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]		
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.		
D	Cover of scrub and scattered trees are less than 10%.		
E	Cover of bare ground is less than 5%.		
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.		
Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:			
G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.		
Additional Criterion - must be assessed for **Bog** habitats only:			
H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.		
Additional Criterion - must be assessed for **Reedbed** habitats only:			
I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.		
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:			
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.		
	Essential criterion achieved (required for Good condition) Yes or No:		
	Number of criteria passed		

Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):		
•Passes 5 or 6 core criteria, including criterion A.	Good (3)	
•Passes 3 or 4 core criteria; OR •Passes 5 core criteria but fails criterion A.	Moderate (2)	
•Passes 2 or fewer core criteria.	Poor (1)	
Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):		
•Passes 5 or 6 core criteria including criterion A; AND •Passes additional criterion G, H, I or J (choose the one specified for the habitat type).	Good (3)	
•Passes 4 or 5 of 7 criteria; OR •Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).	Moderate (2)	
•Passes 3 or fewer criteria.	Poor (1)	

Suggested enhancement interventions to improve condition score

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.

Footnote 2 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.

Footnote 3 – Wildlife and Countryside Act 1981 (as amended).

Footnote 4 – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site.

Footnote 5 – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare.

Footnote 6 – Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site.

Footnote 7 – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.

Condition Sheet: WOODLAND Habitat Type

UK Habitat Classification (UKHab) Habitat Types

Woodland and forest - Lowland beech and yew woodland
Woodland and forest - Lowland mixed deciduous woodland
Woodland and forest - Native pine woodlands
Woodland and forest - Other coniferous woodland
Woodland and forest - Other Scot's pine woodland
Woodland and forest - Other woodland; broadleaved
Woodland and forest - Other woodland; mixed
Woodland and forest - Upland birchwoods
Woodland and forest - Upland mixed ashwoods
Woodland and forest - Upland oakwood
Woodland and forest - Wet woodland

Habitat Description

ukhab – UK Habitat Classification

This condition sheet is based on the England Woodland Biodiversity Group (EWBG) Woodland Condition Survey Method, available here:
Woodland Wildlife Toolkit (sylva.org.uk)

IMPORTANT: This biodiversity metric woodland condition assessment must be used to assess woodland being input into the biodiversity metric. The outputs of this condition assessment are not equivalent to, nor are they comparable with the scores from the EWBG condition assessment, because the EWBG assessment has been adapted for the biodiversity metric, including the removal of EWBG Indicator 7 (Proportion of favourable land cover around woodland) and Indicator 14 (Size of woodland), and minor changes to other indicators.

On-site or off-site, site name and location		**Survey date and Surveyor name**	
Limitations (if applicable)		**Survey reference (if relating to a wider survey)**	
Grid reference		**Habitat parcel reference**	

Condition Assessment Criteria

	Indicator	Good (3 points)	Moderate (2 points)	Poor (1 point)	Score per indicator	Notes (such as justification)
A	**Age distribution of trees**	Three age-classes[1] present.	Two age-classes[1] present.	One age-class[1] present.		
B	**Wild, domestic and feral herbivore damage**	No significant browsing damage evident in woodland[2].	Evidence of significant browsing pressure is present in less than 40% of whole woodland[2].	Evidence of significant browsing pressure is present in 40% or more of whole woodland[2].		
C	**Invasive plant species**	No invasive species[3] present in woodland.	Rhododendron *Rhododendron ponticum* or cherry laurel *Prunus laurocerasus* not present, and other invasive species[3] <10% cover.	Rhododendron or cherry laurel present, or other invasive species[3] ≥10% cover.		
D	**Number of native tree species**	Five or more native tree or shrub species[4] found across woodland parcel.	Three to four native tree or shrub species[4] found across woodland parcel.	Two or less native tree or shrub species[4] across woodland parcel.		
E	**Cover of native tree and shrub species**	>80% of canopy trees and >80% of understory shrubs are native[5].	50 - 80% of canopy trees and 50 - 80% of understory shrubs are native[5].	<50% of canopy trees and <50% of understory shrubs are native[5].		
F	**Open space within woodland**	10 - 20% of woodland has areas of temporary open space[6]. Unless woodland is <10ha, in which case 0 - 20% temporary open space is permitted[7].	21 - 40% of woodland has areas of temporary open space[6].	<10% or >40% of woodland has areas of temporary open space[6]. But if woodland <10ha has <10% temporary open space, please see Good category[7].		
G	**Woodland regeneration**	All three classes present in woodland[8]; trees 4 - 7 cm Diameter at Breast Height (DBH), saplings and seedlings or advanced coppice regrowth.	One or two classes only present in woodland[8].	No classes or coppice regrowth present in woodland[8].		
H	**Tree health**	Tree mortality 10% or less, no pests or diseases and no crown dieback[9].	11% to 25% tree mortality and or crown dieback or low-risk pest or disease present[9].	Greater than 25% tree mortality and or any high-risk pest or disease present[9].		
I	**Vegetation and ground flora**	Recognisable NVC plant community[10] at ground layer present, strongly characterised by ancient woodland flora specialists.	Recognisable woodland NVC plant community[10] at ground layer present.	No recognisable woodland NVC plant community[10] at ground layer present.		
J	**Woodland vertical structure**	Three or more storeys across all survey plots, or a complex woodland[11].	Two storeys across all survey plots[11].	One or less storey across all survey plots[11].		
K	**Veteran trees**	Two or more veteran trees[12] per hectare.	One veteran tree[12] per hectare.	No veteran trees[12] present in woodland.		
L	**Amount of deadwood**	50% of all survey plots within the woodland parcel have deadwood, such as standing and fallen deadwood, large dead branches and or stems, branch stubs and stumps, or an abundance of small cavities[13].	Between 25% and 50% of all survey plots within the woodland parcel have deadwood, such as standing and fallen deadwood, large dead branches and or stems, stubs and stumps, or an abundance of small cavities[13].	Less than 25% of all survey plots within the woodland parcel have deadwood, such as standing and fallen deadwood, large dead branches and or stems, stubs and stumps, or an abundance of small cavities[13].		
M	**Woodland disturbance**	No nutrient enrichment or damaged ground evident[14].	Less than 1 hectare in total of nutrient enrichment across woodland area, and or less than 20% of woodland area has damaged ground[14].	1 hectare or more of nutrient enrichment, and or 20% or more of woodland area has damaged ground[14].		
				Total Score (out of a possible 39)		

Condition Assessment Result	Condition Assessment Score	Result Achieved
Total score >32 (33 to 39)	Good (3)	
Total score 26 to 32	Moderate (2)	
Total score <26 (13 to 25)	Poor (1)	

Suggested enhancement interventions to improve condition score

Footnotes

Footnotes below refer to the EWBG woodland condition assessment details: EWBG (No date). *Assessing your Woodland's Condition* [online]. Available from:
Woodland Wildlife Toolkit (sylva.org.uk)

The woodland condition assessment survey methodology is outlined in the EWBG toolkit. However the criteria on this sheet are those specific to the Statutory Biodiversity Metric and must be used when assessing woodland condition.

Footnote 1 - See EWBG method INDICATOR 1 for more information. If tree species is not a birch *Betula* sp., cherry *Prunus* sp. or *Sorbus* sp.: 0 – 20 years (Young); 21 - 150 years (Intermediate); and >150 years (Old). For birch, cherry or *Sorbus* species; 0 - 20 years = Young; 21 - 60 years =Intermediate; >60 years = Old. A recognisable age-class should be a consistent recognisable layer across the woodland or stand being assessed. Presence of a few saplings would not indicate that the woodland has an 'age-class' of young trees.

Footnote 2 - See EWBG method INDICATOR 2 for more information. Browsing pressure is considered to be significant where >20% of vegetation visible within each survey plot shows damage from any type of browsing pressure listed.

Footnote 3 - See EWBG method INDICATOR 3 for more information. Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly.

Check for the presence of all plant species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended), particularly the following invasive non-native species: American skunk cabbage *Lysichiton americanus* ; Himalayan balsam *Impatiens glandulifera* ; Japanese knotweed *Reynoutria japonica* ; cherry laurel *Prunus laurocerasus* ; shallon *Gaultheria shallon* ; snowberry *Symphoricarpos albus* ; variegated yellow archangel *Lamiastrum galeobdolon subsp. argentatum* ; rhododendron *Rhododendron ponticum* ; and tree-of-heaven *Alianthus altissima* .

Footnote 4 - See EWBG method INDICATOR 4 and Table 2 for more information. The number of different native tree or shrub species including young trees and shrubs. A list of commonly found native tree and shrub species is provided in Table 2. Not all species listed are native to all parts of the UK. Note a list of commonly found non-native tree species are also included and should be recorded if present.

Footnote 5 - See EWBG method INDICATOR 5 and for more information. The abundance of native tree species in upper (>5 m) and understorey (up to 5 m) layers including young trees and shrubs.

Footnote 6 - See EWBG method INDICATOR 6 for more information. Open space within woodland in this context is temporary open space in which trees can be expected to regenerate (for example, glades, rides, footpaths, areas of clear-fell). This differs from permanent open space where tree regeneration is not possible or desirable (for example, tarmac, buildings, rivers). Area is at least 10 m wide with less than 20% covered by shrubs or trees.

Footnote 7 – Given the increased ratio of edge habitat to woodland where the woodland is <10ha.

Footnote 8 - See EWBG method INDICATOR 8 for more information. This indicator measures regeneration potential of the woodland by considering three classes: seedlings; saplings; and young trees of 4-7 cm DBH. All three classes would fall in the 'young' category of the 'age distribution of trees' indicator, but the regeneration indicator gathers additional information by considering regeneration potential - if seedlings, saplings and young trees are all present that means natural regeneration processes are happening.

Footnote 9 - See EWBG method INDICATOR 9 for more information and Table 3 for a list of diseases and pests and their risk level.

Footnote 10 - See EWBG method INDICATOR 10 directing to NVC key for more information. The 'UKHab to NVC translation table' in the UK Habitat Classification resources may also be useful to assess this.

Footnote 11 – This criterion looks at structural diversity and is useful to understand in conjunction with the age of trees in a woodland. Vertical structure is defined as the number of canopy storeys present. Possible storey values are: 1) Upper; 2) Complex: recorded when the stand is composed of multiple tree heights that cannot easily be stratified into broad height bands (such as upper, middle or lower); 3) Middle; 4) Lower; and 5) Shrub layer. There might be no storeys where the woodland has been felled. See EWBG INDICATOR 11 for more information.

Footnote 12 - See EWBG method INDICATOR 12 for more information. See gov.uk standing advice on ancient and veteran trees. Available from:

Keepers of time: ancient and native woodland and trees policy in England (publishing.service.gov.uk)
and:
Ancient woodland, ancient trees and veteran trees: advice for making planning decisions - GOV.UK (www.gov.uk)

EWBG INDICATOR 12 is the relevant indicator.

Footnote 13 – See EWBG method INDICATOR 13 for more information. This includes logs, large dead branches on the forest floor and stumps (<1 m tall) >20 cm diameter at narrowest point and >50 cm long. Also includes standing dead trees (>1 m tall) and also deadwood on standing live trees. Diameter is measured at the narrowest point on the stem. Minimum diameter of 20 cm.

Footnote 14 - See EWBG method INDICATOR 15 for more information. Examples of disturbance are: significant nutrient enrichment; soil compaction from trampling, machinery, animal poaching or litter.