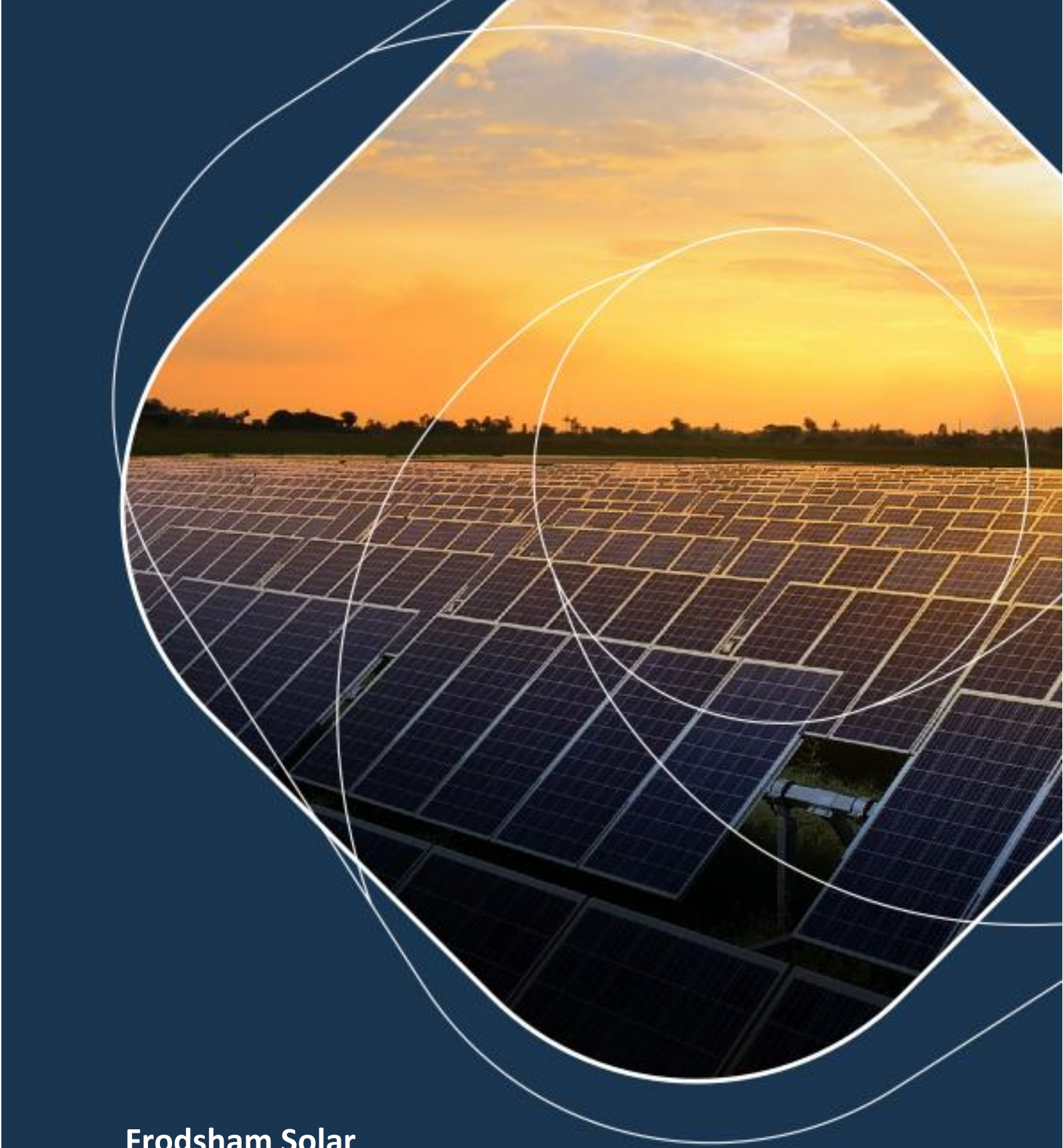


Frodsham Solar

Outline Non-Breeding Bird Mitigation Strategy

(Previously included as Appendix B of the outline Landscape and Ecology Management Plan - REP1-028)

March 2026

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Outline Landscape and Ecological Management Plan

Outline Non-Breeding Bird Mitigation Strategy (oNBBMS) [EN010153/DR/8.32]

Frodsham Solar, for Frodsham Solar Ltd



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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 by the Royal Society for the Protection of Birds (RSPB), or a suitably experienced and reputable nature conservation organisation.

1.1.4 It is the Applicant's intention that the NBBMA is managed by the RPSB, however should this not be possible, then a suitably experienced and reputable nature conservation organisation will be sought, which will be required to be agreed by Cheshire West and Chester Council and Natural England. References in this document to a nature conservation body should therefore be considered to mean RSPB or an approved alternative nature conservation body.

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 Order Limits: 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', 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 northwestern boundary of the Order Limits. The SPA and Ramsar designations are consistent; however, the SSSI extends to a wider area and includes the MSC and 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.

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: https://publications.naturalengland.org.uk/publication/5790848037945344 [accessed May 2024]
[2] Available online at: [redacted] [accessed 11th November 2025]

- 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 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.

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 SPA species due to the presence of solar panels and other infrastructure; and/or,
- Increased disturbance to 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.

1.4.6 The effects arising from the Proposed Development will be separate to, and in addition to, those already arising from the 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.

1.4.7 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*
- *alternative habitat that is better in quality or area than the lost habitat*

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

- *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'.

1.4.8 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

1.5.1 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). Mitigation, including for and above that already in-place for FWF, will be delivered through:

(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 adaptive 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 organisation. 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 adaptive water management; and

(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]:

[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.

(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 adaptive 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 organisation.

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.

1.7 Stakeholder Engagement

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.

1.7.2 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.

1.8 Baseline Bird Data

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.

1.9 Proposed Development and Site Context

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]**.

1.9.2 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'.

1.9.3 **Figure 1** shows the 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.

1.9.4 Broadly, the 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 Eastern SADA (i.e., away from the Cells) is managed by wildfowlers for shooting purposes.

1.9.5 Cells are numbered from 1 to 6 (**Figure 1**). Of these, Cells 1, 2, 3 and 5 are located within the 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.

1.9.6 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 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. Cell 6 is outside of the 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).

1.9.9 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.

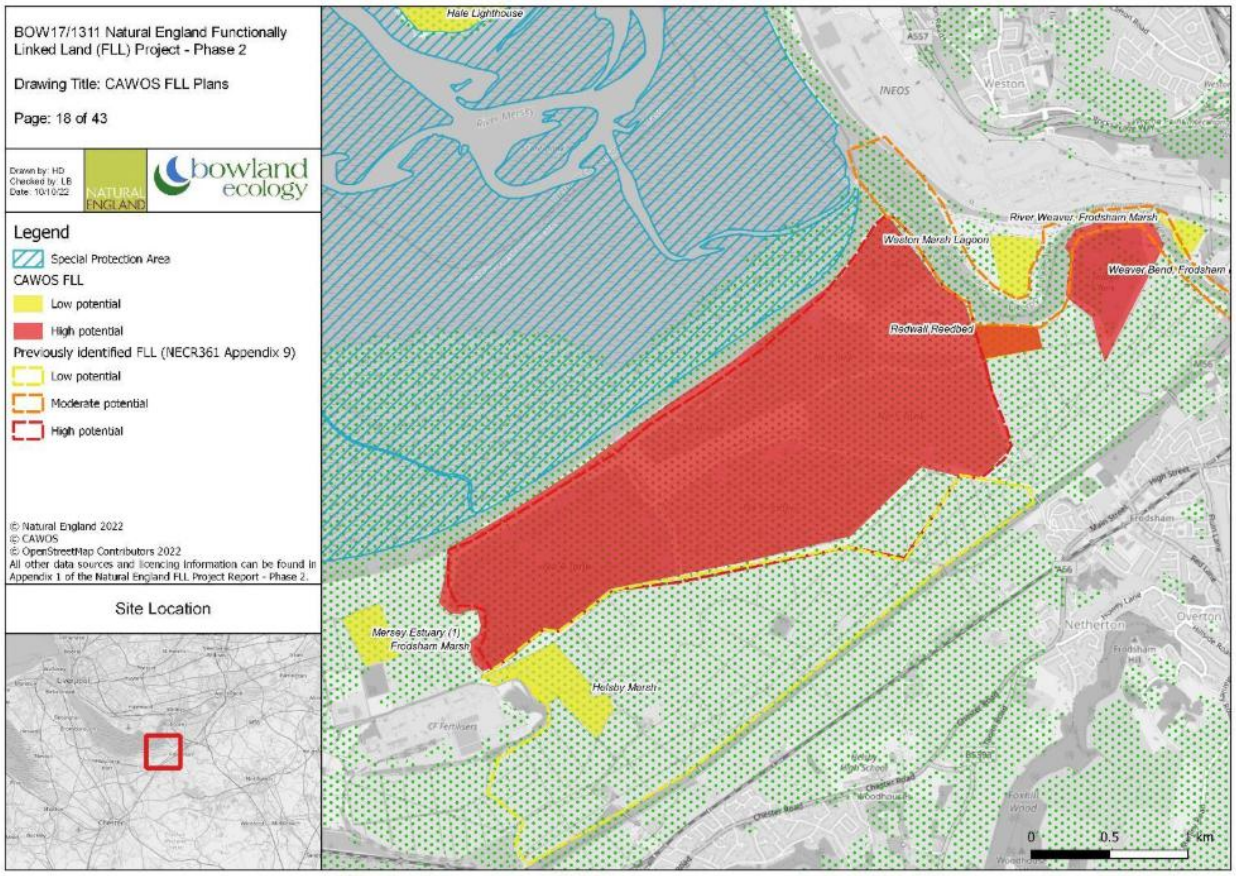
2 BASIS FOR MITIGATION

2.1.1 Parts of the 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 Northwest of England – Phase 2 (NECR483)[5]'. **Plate 1** is reproduced from this NE report. The NE report subsequently establishes that all parts of the Order Limits have potential to constitute FLL[6].

2.1.2 For the purposes of impact assessment, mitigation has been designed to account for all SPA bird use across the entire Order Limits.

[5] Available online at: https://publications.naturalengland.org.uk/publication/5359972901453824 [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.

2.2.2 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.

2.2.4 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'.

2.2.5 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'.

2.2.6 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.

2.3 Cell 3: Current Management

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).

2.3.2 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**.

2.3.3 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.

Efficacy of Cell 3 FWF Mitigation Area Management

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 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.

2.3.6 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

2.4.1 The Cell 3 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 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 Recreational access to the Canal Pools is not 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 human presence causes disturbance not only to the Canal Pools but also to Cell 3 (and the FWF mitigation measures), as people 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).



2.4.4 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.

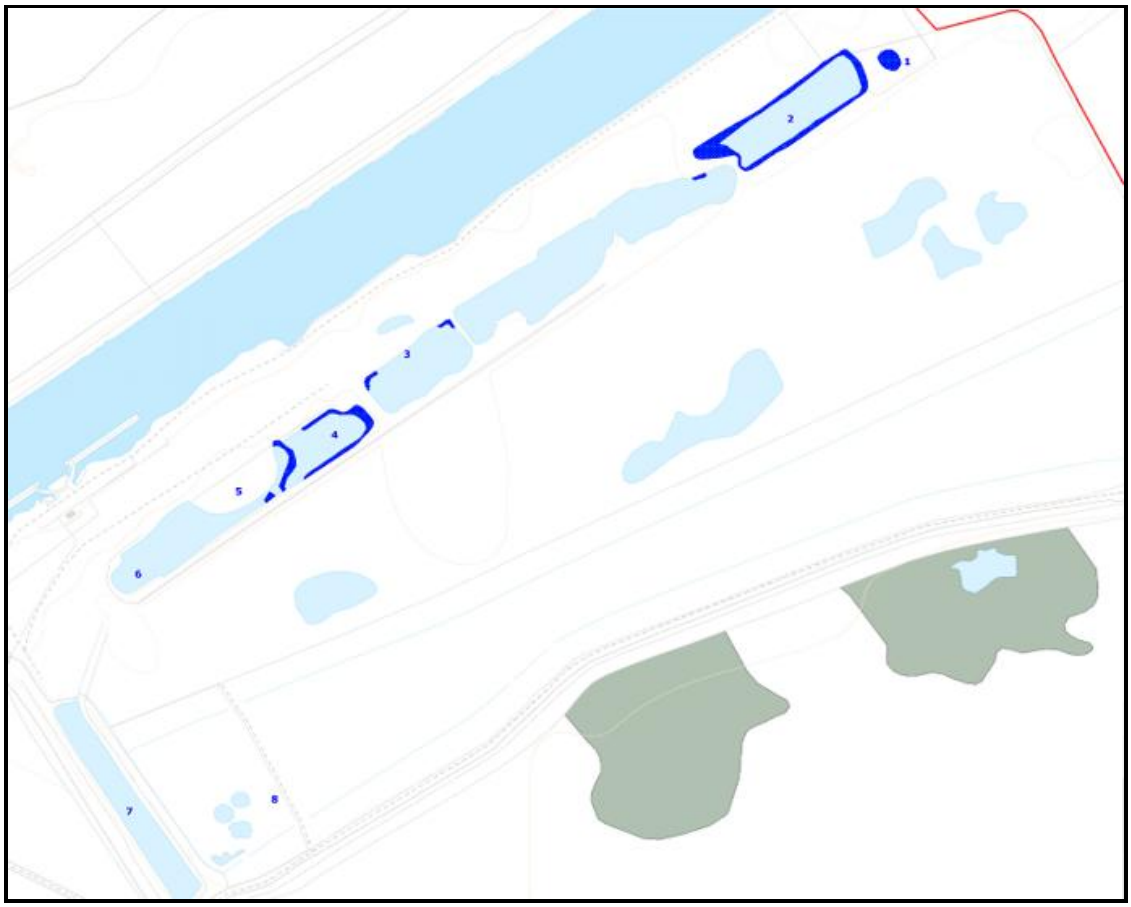
2.4.6 The extent of NZPW within the Canal Pools and NBBMA was mapped by Avian Ecology in summer 2023, as presented in **Plate 3**. It can reasonably be assumed that, without treatment and preferably eradication, there is a high risk that NZPW will in time be spread to other waterbodies, potentially including 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.

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

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.

2.4.9 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 3: Extent of NZPW on Canal Pools (marked in dark blue). Summer 2023.



[7] Mersey Estuary SSSI - Frodsham Lagoons (012) Condition Assessment. Available online at: https://designatedsites.naturalengland.org.uk/UnitDetail.aspx?UnitId=1011753 [accessed 11th November 2025].

2.5 Cells 1, 2 and 5: Current Management

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).

2.5.3 The wider Order Limits (including Cell 1 and the Eastern SADA) is used less by SPA species, which is consistent with Natural England mapping of FLL (**Plate 1**). Nevertheless, usage levels of the entire Order Limits have informed the ONBBMS, which is based on both quantitative and qualitative assessment (see Section 1.4).

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 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. 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 required. The Applicant has consequently engaged with Natural England, CWACC and RSPB regarding SPA bird mitigation throughout the pre-submission 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** and **the Applicant's Responses to Cheshire West and Chester Council, Natural England and Environment Agency's Relevant Representations and Examination submissions. .**

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 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 inform the likely area of habitat required to support displaced SPA species from the entire 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, duration (seasonal) availability or of the benefits of

adaptive management measures included within the oNBBMS. As such, whilst bird-day calculations provide a broad indication of scale (ha), they must not be taken as an absolute area needed to deliver mitigation. Bird-day calculations are presented in **Annex 1**.

2.6.7 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 adaptive 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 Conditions 33 and 34 of the FWF 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 The GI report (**Annex 3**) 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 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 The Wildlife and Countryside Act 1981, specifically in Sections 28A – 28S, imposes legal obligations on landowners with regards to SSSIs to ensure they manage the SSSI to favourable condition. The measures set out in the ONBBMS will support the restoration of that part of the SSSI to favourable condition through the re-creation and management of the Canal Pools area.

2.8.3 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 for waders and waterfowl (as features of the SSSI, SPA and Ramsar).

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

2.8.4 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.

2.8.5 For those areas of the NBBMA which form part of the SSSI, the draft DCO provides that their management in accordance with the NBBMS will form part of the management scheme of the SSSI under the Wildlife and Countryside Act 1981, securing management of that area by the landowners in line with SSSI requirements post-decommissioning of the Proposed Development.

3 ONBMS OVERVIEW

3.1.1 Measures proposed under the ONBBMS are illustrated in **Figure 3**.

3.1.2 To create the NBBMA, it 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 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[8]. 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 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 organisation 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.

[8] 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.

3.1.8 The total area included in the 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 NBBMA.

Table 3.1: NBBS Proposed Habitat Components. Text in italics identifies habitat features located within the minimum 16.2 ha area identified through 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*
Proposed Wet Grassland Area	*9.52*
Proposed Grassland	28.44
Raised Bank with Grassland (Canal Pools area)	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**

3.1.9 The primary aim of the ONBBMS is to deliver mitigation for the loss of land within the entire 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.

3.1.10 It is acknowledged that not all areas of habitat within the NBBMA will provide optimal habitat, particularly the eastern 'panhandle' between Cell 3 and Marsh Farm (see **Figure 3**). This area is still considered suitable as foraging habitat for grassland waders (curlew, golden plover and lapwing) as it provides a raised, flat area of grassland which is open in aspect towards the estuary. Removal of trees between this area and the Canal Pools (**Figure 3**), which will be replaced with grassland will also increase this open-aspect.

3.1.11 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[9]). The NBBMS provides for a total of 43.32 ha of grassland overall, of which a minimum of 9.52 ha will be actively managed as wet grassland. This is considered to provide at least a comparable foraging resource for SPA species, through improved quality and will also be available for the entirety of the non-breeding season (i.e., including passage periods) due to the re-engineering of Cell 3 and the Canal Pools, which will enable adaptive water management for the benefit of SPA birds.

3.1.12 It is anticipated that the NBBMA, with appropriate, large-scale re-engineering to enable control of water levels, and continual adaptive management, will support a higher number and increased

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

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.

3.1.13 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.

3.1.14 Wet pasture 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 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.

3.1.15 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.**

3.1.16 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.

3.1.17 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**.

3.1.18 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 Works 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, 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 For the purposes of the ONBBMS, 'functional' has been defined as follows and as agreed with Natural England as follows):

- All physical works within the NBBMA are completed.

- 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 AIMS AND OBJECTIVES

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

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 Adaptive Habitat Management

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

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

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 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.

4.2.2 The NBBMA will be managed as grassland, with 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.

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.

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

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

<u>Re-engineering of the Canal Pools</u>

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

4.2.9 Details are presented in **Annex 3**; however, SI works have confirmed that a low permeability surface of 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

4.2.10 It is proposed to create the network of water features throughout Cell 3, including scrapes, swales bunds and hollows (as shown on **Figure 3**). These will allow water to be moved through the network and retained within Cell 3 to keep habitats wetter and for longer periods throughout the calendar year.

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

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.

Water Source for On-going Adaptive Management

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 adaptive 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

4.2.15 Control of water levels will optimize conditions for SPA species; ensuring water can be moved on to or around the cell in the drier months or periods and therefore extending the availability of existing resources over the passage period (as well as the winter months). This will be achieved through the dynamic and adaptive management of the NBBMA.

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

4.2.16 Areas of conventional (dryer) grassland within Cell 3, on the Canal Pools and on land to the northeast of Cell 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-focused grazing (or cutting) management, which will be controlled by the appointed nature conservation organisation responsible for management of the NBBMA.

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

4.2.19 The ability to release water around and onto the Cell and retain it through the spring and summer months would be highly beneficial to breeding waders, particularly when combined with predator fencing.

4.2.20 Predator fences are known to provide good protection to nesting waders[10].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 . 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).

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

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 1980.

4.3.2 NZPW is notoriously difficult to remove and filling-in of waterbodies is often the only option to facilitate eradication[11]. 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.

4.3.3 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.

[10] [redacted] [accessed May 2024]

4.4 Aim 3: On-going Adaptive Management

4.4.1 On-going conservation management of the NBBMA is secured through this management strategy and its implementation pursuant to a Requirement 9(j) of the draft DCO.

4.4.2 The final NBBMS will include an Adaptive Management Plan (AMP), to be agreed with consultees. It is anticipated that the content of the AMP will be led by the appointed nature conservation organisation responsible for the management of the NBBMA.

4.4.3 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 the suitably experienced and reputable nature conservation organisation appointed to manage the NBBMA, in engaging in the development of the NBBMS and involvement in on-going monitoring (including the steering group) discussed below.

4.4.4 It is intended that the NBBMA will be managed by a suitably experienced and reputable nature conservation 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).

4.4.5 Management will require regular visits and adaptive actions, based on conditions at the time. Actions will be undertaken where appropriate and will include, but are not limited to:

- Adjustment, modification and control of hydrological levels and regimes;
- Island creation, extension, reduction, maintenance and reprofiling;
- Vegetation management and control (i.e. clearing vegetation around scrapes and maintenance of open vistas);
- Adjustment and adapting livestock-grazing management and regimes;
- Localised ground works or reprofiling; and,
- Implementation of reasonable design or layout refinements within the Order Limits, where necessary and considered proportionate.

4.4.6 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.

4.4.7 Measurable performance targets will be set to ensure the NBBMA is functioning effectively. 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.

4.4.8 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.

4.4.9 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 using either rainfall or a water sluiced from the re-engineered Canal Pools.

Setting Measurable Performance Targets

4.4.10 Measurable performance 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 CWaCC in the final NBBMS document. These Measurable Targets will form the basis of the monitoring framework set out within the AMP and will define both performance indicators and trigger thresholds for intervention.

4.4.11 It is likely that targets will include, but not be limited to:

- Annual survey of the extent and quality of grassland created, with key attributes for the quality of the grassland being sward height, percentage of bare ground, scrub thresholds and the absence of negative indicator plant species. 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)'[12] and 'Common Standards Monitoring Guidance for Lowland Grassland Habitats' (Joint Nature Conservation Committee, 2004[13]); 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 relative to defined target ranges (see 4.4.5). Metrics are likely to include the proportion of scrapes holding water during critical periods including wintering and passage periods and maintenance of target water levels, including evidence that the implementation of measures support the intended mosaic of wet grassland and shallow surface water; and

- Verification and (or) confirmation that the distribution of wet features, islands and open grassland continues to mirror the agreed habitat design necessary to support waterbird assemblages. Including minimum extent (hectares) of each habitat component (wet grassland, scrapes, islands etc.)

4.4.12 The precise thresholds and methodology, including the monitoring frequency and reporting will be defined within the final version of the NBBMS and associated AMP. These will be created to provide a proportionate and robust evidence base to inform the AMP interventions where performance potentially falls outside of the agreed parameters.

4.4.13 Bird usage of the NBBMA will also be regularly monitored; see Section 5.

[12] https://publications.naturalengland.org.uk/publication/5879561481617408 [accessed April 2025]

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

Grassland Management

4.4.14 It is anticipated that grassland within the NBBMA will be managed in accordance with RSPB guidance on wet grassland management (Benstead *et al*., 1997)[14].

4.4.15 The main principles of grassland management are likely to be:

- To maintain a sward of 5cm or less over the autumn passage and winter period for SPA species across 80% of the NBBMA grassland;
- That 20% of the NBBMA grassland is maintained as taller grass tussocks and clumps for shelter, at approximately 10-15cm in height;
- 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 3;
- Ideally stock will be removed between mid-March and May to avoid trampling and damage. Grazing will be reduced or stock removed between April and July to lessen the risk of nest trampling by livestock; and,
- Management by hard grazing during late summer and autumn to create a short sward height of less than 5cm from October until March to provide foraging grassland for non-breeding wildfowl and waders and the correct sward height for the following April. Grazing may be required throughout the winter to ensure this sward height is maintained, depending on climatic and ground conditions.

4.4.16 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 conservation outcomes, and 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 nature conservation professional responsible for the management of the NBBMA.

4.4.17 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.

4.4.18 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 nature conservation organisation.

[14]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.

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

4.4.19 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			✓	✓	✓	✓	✓					

4.4.20 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

4.4.21 The following activities will only be allowed within the NBBMA where these are considered necessary to 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.

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

5 MONITORING AND REVIEW

5.1.1 Monitoring of the effectiveness of the implementation of the NBBMS (including without limitations its grassland management, wetland creation and NPZW controls) and whether the agreed measurable performance 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, the appointed nature conservation organisation and the Applicant, and will be undertaken for the 40-year duration of the operational period of the Proposed Development, with the first meeting of that steering group to be held prior to the commencement of works on the NBBMA.

5.1.2 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, but not be limited to, 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 Aim 3, Section 4.4).

5.1.4 Monitoring will include regular monitoring of bird use, including counts of SPA and waterbird species. The timing and frequency of such counts will be agreed though consultation and provided in the final NBBMS. It is anticipated that the counts will be undertaken by the appointed nature conservation organisation.

5.1.5 Management of recreational pressure on the NBBMA will be overseen by the appointed nature conservation organisation, whom will undertake regular bird counts and behavioural monitoring to identify any disturbance responses associated with public access.

5.1.6 Above and beyond the aforementioned monitoring programme, the detailed NBBMS will set out the process for agreed periodic reviews with the steering group of the performance of the NBBMS , following which the steering group shall be able to agree any variations being made to the NBBMS that may be necessary following that review, thereby delivering an adaptive and measurable management regime.

Figure 1: Site Location and Cell Numbers

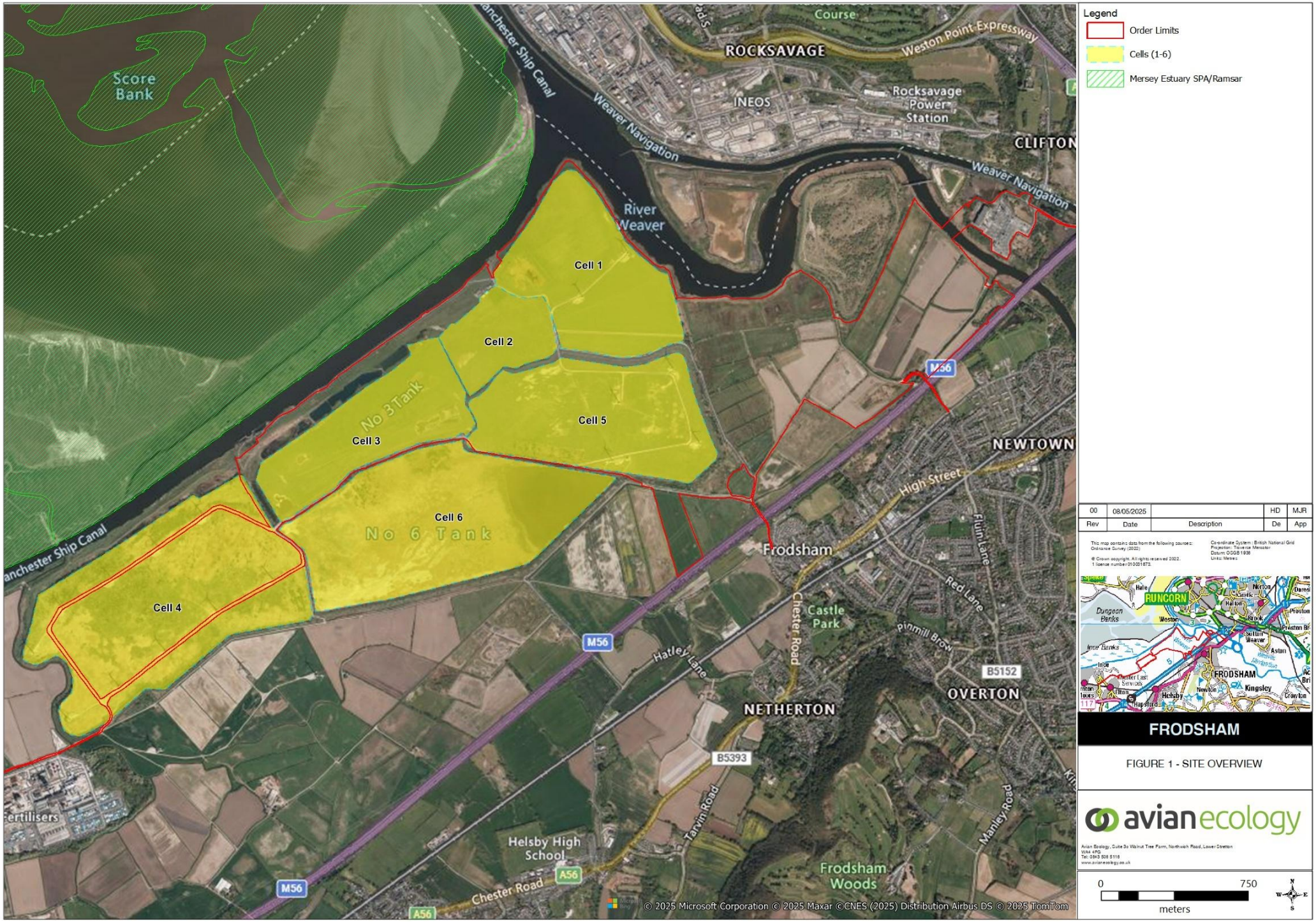
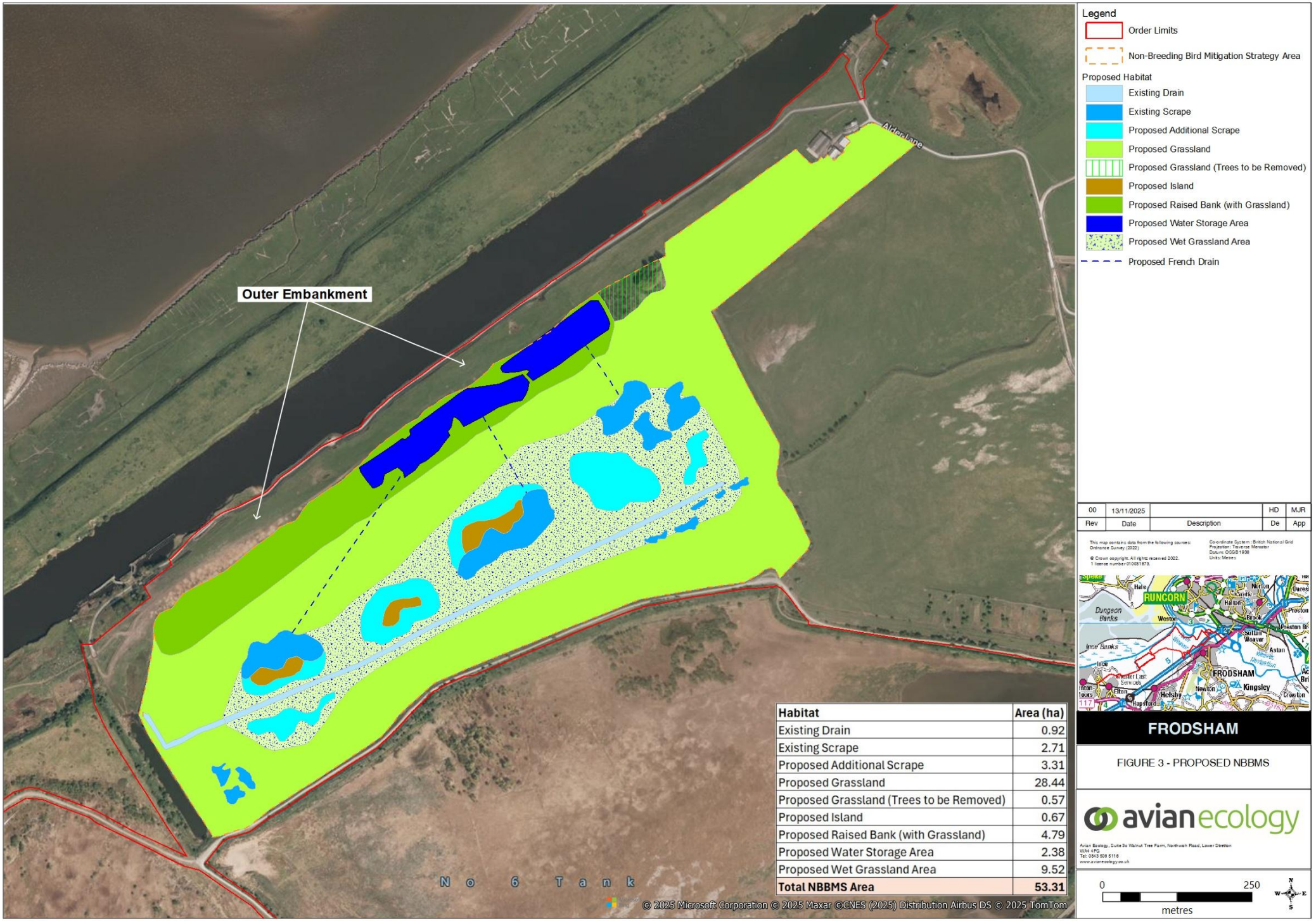


Figure 2: Existing Management Prescriptions



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**

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 (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]

Canal & River Trust (n.d.) *New Zealand pigmyweed*. Available at: [redacted]

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: https://publications.naturalengland.org.uk/publication/5879561481617408 (Accessed: 27 May 2025).

Natural England (2023) *Definition of Favourable Conservation Status for greater horseshoe bat (Rhinolophus ferrumequinum)*. Natural England. Available at: https://publications.naturalengland.org.uk/publication/5790848037945344 (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 [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 [1]			
Year 2 Data			
	Bird Days/winter. Current use of Order Limits	Bird days supported by each ha[1]	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**

[1]Bird days supported by each hectare is adopted from Gillings, S., Fuller, R.J. and Sutherland, W. (2007). Winter field use and habitat selection by Eurasian Golden Plovers *Pluvialis apricaria* and Northern Lapwings *Vanellus vanellus* on arable farmland. *Ibis* 149: 509-520. This states that 'on average the area [of study] supported 2000-2000 Golden Plovers and c.1000 Lapwings, which, after accounting for aggregation in only a fraction of fields, gave mean usage densities of 1,560 Golden Plover bird-days/ha and 1000 Lapwing bird-days/ha per winter. There is no clear equivalent for Curlew and so the 1,000 days figure is used as a proxy for this species.

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 Report: Year Five 2021

Frodsham Wind Farm Limited

October 2022

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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 and Management Group (HCMG), to advise on the detail of the HCMP, reviewing the 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 be agreed in writing with the LPA in consultation with Natural England*'; and

Condition 33 (f) requires the '*monitoring of habitats and species during the year preceding the commencement of the Development and at yearly intervals for the 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 of Frodsham in Cheshire. Figure 1 shows the site layout and design. The wind farm is divided into two areas; with six turbines present in the eastern section and thirteen present in the western section. Habitats found on the site include reed beds, areas of open water, agricultural land, and areas of scrub. The site is made up of a number of 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 are presented with an annual monitoring report, with an update report providing the summary of the results of the non-breeding season ornithology work presented mid-year. These meetings will cease following the September 2022 meeting, with sub meetings organised as required to deal with specific topics.

The following representatives and their roles are as follows:

Frodsham Wind Farm Representative

William Primarolo from Belltown Power. Responsible for formal liaison between FWF and the HCMG, via attendance at HCMG meetings.

Frodsham Wind Farm Ecologist

Alex Hatton and Frances MacCormack from Atmos Consulting Ltd. Responsible for: HCMG administration (organising meetings, providing meeting agendas, minutes and action lists), reporting on the post-construction monitoring work to the HCMG, contributing to HCMG discussions and providing input regarding site ecology and management.

Frodsham Wind Farm Tenant Farmer

Chris Faulkner. Responsible for: contributing to HCMG discussions, providing input regarding site management, and implementing grazing regimes as per the Habitat Creation and Management Plan.

Cheshire West and Chester Council Representatives

Ami Weir (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

Jonny Bouker. 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, stakeholder liaison, daily client point of contact, assist with monthly reporting, host quarterly and monthly operational meetings and prepare annual documentation for the wind farm.

Cheshire and Wirral Ornithological Society Representative

Professor David Norman. Responsible for: contributing to HCMG discussions and providing input regarding site ornithology and management.

RSPB Representative

Jeremy Sutton (Conservation Officer, North West England). Responsible for: contributing to HCMG discussions and providing input regarding site ornithology and management.

Cheshire Wildlife Trust Representative

Chris Meredith. Responsible for: contributing to HCMG discussions and providing input regarding site ecology and management.

Natural England Representative

Katie Finkill-Coombs (Lead Adviser, Coast and Marine, Cheshire, Greater Manchester, Merseyside and Lancashire Area Team). Responsible for: contributing to HCMG 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 April and September inclusive, with an Elekon Batlogger 'C' unit installed in the nacelle of 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 minutes 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 as *Nyctalus* spp. could be attributed to random noise rather than a bat call. Estimates of 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 were 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 summing the

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 in habitat 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, which 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 turbines be searched on a 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 those in Cell 4 and those on farmland; as such, turbines from both areas were included, despite the fact that ground conditions for searching were challenging within Cell 4.

There are no turbines in the eastern cluster ranked as Rank 3 for bat activity. 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 area with an experienced handler, which alerted the handler whenever a bat was located. The 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 then 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 venation, 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 mortality per turbine and across the wind farm was calculated, along with an estimate of bat 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 and predator removal rate to provide an estimate of the true number killed on the wind farm. There are a number of approaches which can be used to estimate the true 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, this 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 the 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 per 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 (where 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 Ornithology survey 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 as 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 (e.g. courtship, display or singing, pairs in suitable habitat, territorial disputes);
- Possible territory – birds observed only once in one location, but evidence of 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 were 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) but 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 some records, for example, flocks of birds in suitable habitat were considered not to be 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, no attempt was made to walk through reed beds) and, as such, some territories, 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 Marsh 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 vantage point locations chosen so as to provide thorough coverage of Cell 4, as Marsh harriers have used this area as breeding habitat in previous years. Since monitoring began, 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 survey 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 red line 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 vegetation 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 described in target notes. The DAFOR scale was used to record the relative abundance of plant 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 survey (typically considered to be April to September), in favourable weather and with full 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 error (as per the methodology). An error rating was obtained and applied for each of the 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 results are omitted from the above analysis and below table. Across the 18 turbines that 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 to 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 of bat activity.

Chart 1: Sunrise timing of bat activity (data is uncorrected)

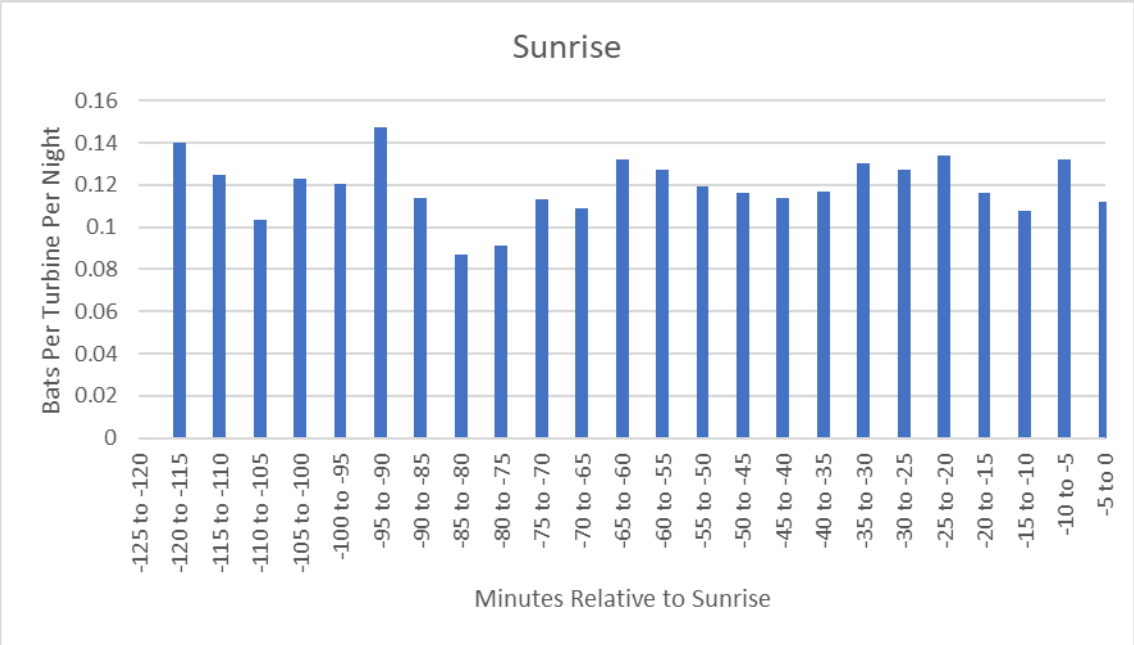


Chart 2: Sunset timing of bat activity (data is uncorrected)

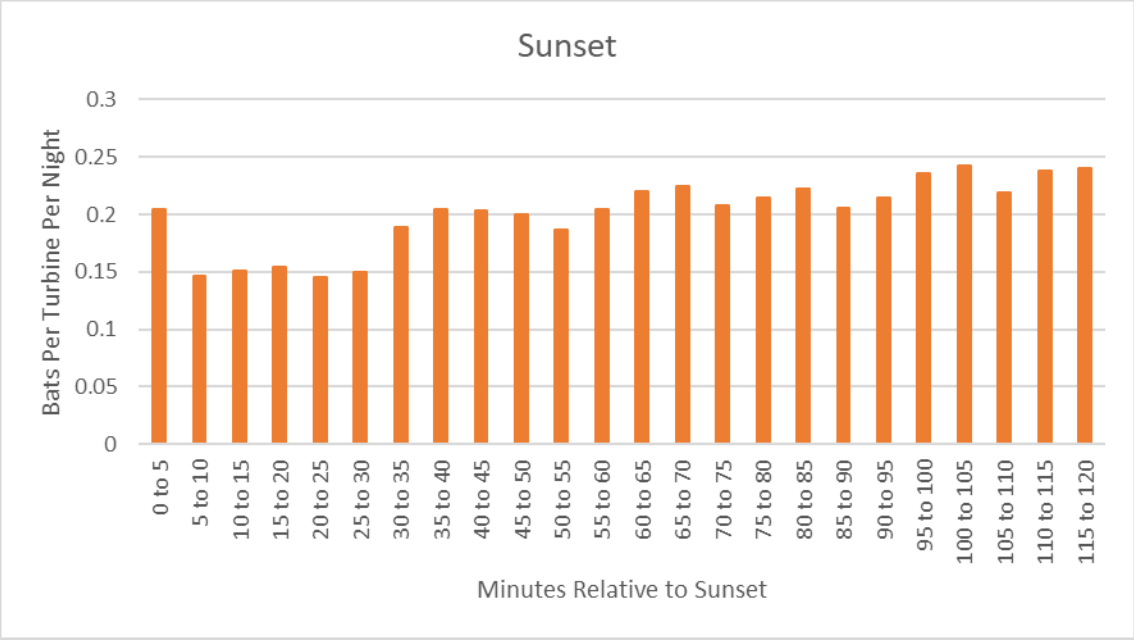
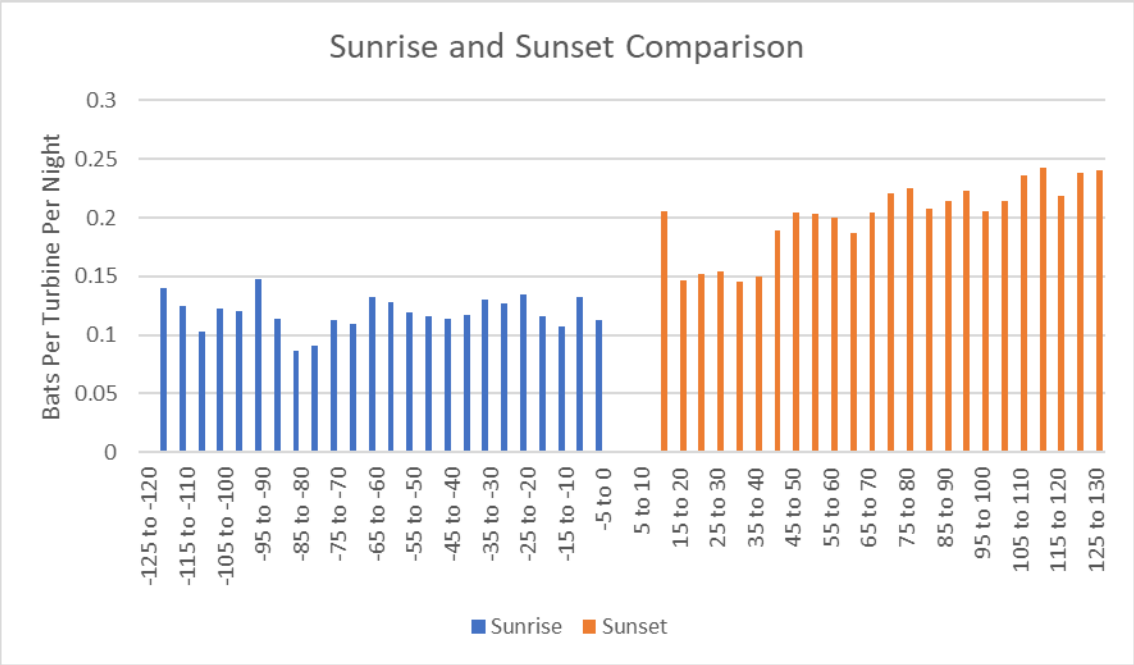


Chart 3: Comparison of the sunset and sunrise bat activity (data is uncorrected)



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 period 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 period 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 the dogs to be 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 number of bats found (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 totanus*	2	400	69.15	13	34,829	5,660
Ruff	*Philomachus pugnax*	1	1	1	1	3	0
Shelduck	*Tadorna tadorna*	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.

Species	2021			2020			2019			2018			2017		
	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 of 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 effort 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, although activity levels and behaviour observed suggested there were territory holding birds 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 of 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 area containing standing water in the form of five artificial scrapes. The vegetation within this 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 (2017) are provided below.

3.3.1 Woodland and scrub

Scrub

As recorded in the previous years of monitoring, there are areas of scattered willow 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 particularly

dominant towards the centre of the cell and to the north. It appears that the willow 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 scrub was 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 bank 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 have undergone a notable change since the previous years of monitoring and the shrub species present remain largely unchanged.

Scattered trees

There are few trees around the wind farm site and are generally restricted to the 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 changes to 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 species composition since the previous years of monitoring. During the second year of the 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 supported 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 were 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). The 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 ruderal vegetation, 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 were 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 increasingly dominant.

3.3.4 Swamp, marginal and inundation

Swamp

Cell 4 supports an extensive area of dry reed bed, dominated by common reed *Phragmites australis* (TN10) which dominated the west of the cell. The willow scrub encroachment located towards the centre and the east has started a to be removed to enhance the reed beds functioning. The extent of the reed bed habitat had not 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 site. 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 found to 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 years one and two many of the scrapes were dry due to the particularly hot and dry summer 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 flag 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 survey 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 tall ruderal species, including bramble, common nettle and scattered scrub of willow and 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 water

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 these 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 of 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 knotgrass *Polygonum aviculare*, chickweed *Stellaria media*, annual meadow-grass *Poa annua* and greater plantain *Plantago major*.

There have been no obvious changes to the vegetation assemblage at the base of the 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 arable/improved grassland 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 common reed in some areas and tall ruderal species, such as nettle, in others. The hedgerows have remained largely the same since the first and second years of monitoring, however it was noted that a stretch of hedgerow directly to the east of Turbine 12 had been removed during the third year. But there were no further changes to the hedge 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 process 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 the site, with an area of hardstanding surrounding it.

Dry ditch

There are dry drainage ditches found across the site. The ditch that intersects the poor 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 common reed, with some areas dominated by common nettle and thistle species. A number of 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 second year monitoring period was *Nyctalus* spp. There were also large numbers of common and 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 often 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 than the 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 farm. The habitats in this area are largely open agricultural land, which is considered to be suboptimal habitat for foraging bats, however there are some linear features within this area such as the earth bunds bordering the site and the bank that drops down to the Manchester Ship Canal, along with a line of trees and ditches towards the south east. The level of activity on this side of the site indicate that bats may use these features to commute to a foraging ground.

The gaps in the bat data this year resulted in a lower number of overall calls, but data 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 observer 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 corvids, in the cell. This, coupled with the short sward height would account for a higher 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 being 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 wildfowl 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. Shelduck 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 the wider area. This increase could be attributed to additional shelter during poor weather. Golden plover and Lapwing numbers have seen the most significant decline. Although, lapwing remain to have large wintering flocks, with a peak count of 6,000 birds this 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 in the 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 wind farm, 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 species. However, in 2019, a decline in some species was noticed; it was considered this could be due to an artefact of analysis, but for some species this decline has continued into 2021. No Avocet were recorded during 2021 surveys, however, Lapwing numbers increased. 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 south 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 not 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's Warbler	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 activity 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 considered to have changed 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 had an 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 condition. The third year of habitat monitoring was carried out during a summer of comparatively 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 large

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 and 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 area is grazed by sheep and cattle all year round and the grassland between these stands of 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, with 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 dies 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 short 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 spraying 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 levels. 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 upon 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 such 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 willow scrub. During a walkover with the HCMP it was agreed that the reed bed within Cell 3 needed further management. Methods included reedbed cutting and bailing in a 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 considered to 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 in 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 every 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 common and 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 eastern 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 fewer 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 removal trials at the Braes of Doune windfarm. Natural Research Information Note 4.* Banchory: Natural Research Ltd.

Gilbert, G. G. (1998). *Bird Monitoring Methods.* RSPB: Sandy.

JNCC. (2010). *Handbook for Phase 1 habitat survey - a technique for environmental audit.* 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 risk 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 mitigation.* 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 County, Wyoming.* Report prepared for: Pacificorp, Inc., Portland, Oregon; SeaWest Windpower Inc., San Diego, California; and Bureau of Land Management, Rawlins District Office, Rawlins, Wyoming.

7 Figures

Figure 1. Site layout and design

Frodsham Wind Farm

Energy

Figure 1
Site Location

Key

- Site boundary
- Turbine location

atmos CONSULTING

0 200 400 800

Metres

N

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

Frodsham Wind Farm

Energy

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.

atmos CONSULTING

0 200 400 800
Metres

N

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

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

atmos CONSULTING

0 150 300 600
Metres

N

Scale @ A3:
1:12,000

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03/06/2021 8702/OR/121a
Drawn by: KM Checked by: TH Approved by: JB

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

N

Scale @ A3:
1:18,000

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03/06/2021 8702/OR/122a
Drawn by: KM Checked by: TH Approved by: JB

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

N

Scale @ A3:
1:12,000

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03/06/2021 8702/OR/123a
Drawn by: KM Checked by: TH Approved by: JB

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

atmos CONSULTING

0 150 300 600
Metres

N

Scale @ A3:
1:12,000

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03/06/2021 8702/OR/124a

Drawn by: KM Checked by: TH Approved by: JB

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

atmos CONSULTING

0 150 300 600
Metres

N

Scale @ A3:
1:12,000

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03/06/2021 8702/OR/125a

Drawn by: KM Checked by: TH Approved by: JB

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

N

Scale @ A3:
1:16,000

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03/06/2021 8702/OR/126a

Drawn by: KM Checked by: TH Approved by: JB

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

atmos CONSULTING

0 150 300 600
Metres

N

Scale @ A3:
1:12,000

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03/06/2021 8702/OR/127a
Drawn by: KM Checked by: TH Approved by: JB

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

atmos CONSULTING

0 150 300 600
Metres

N

Scale @ A3:
1:12,000

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05/10/2022 8702/OR/128a

Drawn by: AF Checked by: TH Approved by: JB

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

atmos CONSULTING

0 200 400 800
Metres

N

Scale @ A3:
1:18,000

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05/10/2022 8702/OR/129a
Drawn by: AF Checked by: TH Approved by: JB

Frodsham Wind Farm

Figure 3j
Duck Flightlines
April 2021 - October 2021

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

N

Scale @ A3:
1:12,000

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05/10/2022 8702/OR/130a
Drawn by: AF Checked by: TH Approved by: JB

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

N

Scale @ A3:
1:12,000

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05/10/2022 8702/OR/131a
Drawn by: AF Checked by: TH Approved by: JB

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

atmos CONSULTING

0 150 300 600
Metres

N

Scale @ A3:
1:12,000

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05/10/2022 8702/OR/132a

Drawn by: AF Checked by: TH Approved by: JB

Frodsham Wind Farm

Figure 3m
Lapwing Flightlines
April 2021 - October 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

atmos CONSULTING

0 200 400 800
Metres

N

Scale @ A3:
1:16,000

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05/10/2022 8702/OR/133a
Drawn by: AF Checked by: TH Approved by: JB

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

atmos CONSULTING

0 150 300 600
Metres

N

Scale @ A3:
1:12,000

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Drawn by: AF Checked by: TH Approved by: JB

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

atmos CONSULTING

0 150 300 600
Metres

N

Scale @ A3:
1:17,000

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Drawn by: AF Checked by: TH Approved by: JB

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

atmos CONSULTING

0 150 300 600
Metres

N

Scale @ A3:
1:12,000

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05/10/2022 8702/OR/136a
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

East

West

Key

- Site boundary
- Turbines
- Survey area

Category

- Schedule 1/Annex 1
- English Priority Species
- Not designated

Breeding Status

- Confirmed
- Probable
- Possible

Red listed species - BOCC
Amber listed species - BOCC

0 187.5 375 750
Metres

N

Scale @ A3:
1:15,000

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02/09/2022 8702/OR/137a

Drawn by: AF Checked by: KM Approved by: JB

Frodsham Wind Farm

Figure 4
2021 Breeding Bird
Survey Results

348000
350000
378000
376000

Frodsham
Wind Farm

Hoolpool Gutter

Hornsmill Brook

Hover Force Outdoor
Activity Centre

Helsby
High
School

Hill View Farm

Spring Farm

Sangreal
Cottage

Meadow Farm

MARSH LANE

BRAKE LANE

LORDSHIP LANE

BLUE BRIDGE LANE

CHESTER ROAD

A56

M56

Key

- Site boundary
- Turbines
- Survey area

Category

- Schedule 1/Annex 1
- English Priority Species
- Not designated

Breeding Status

- Confirmed
- Probable
- Possible

Red listed species - BOCC
Amber listed species - BOCC

atmos CONSULTING

0 125 250 500
Metres

N

Scale @ A3:
1:10,000

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02/09/2022 8702/OR/137a
Drawn by: AF Checked by: KM Approved by: JB

350000

378000

Frodsham Wind Farm

Figure 4
2021 Breeding Bird
Survey Results

Key

- Site boundary
- Turbines
- Survey area

Category

- Schedule 1/Annex 1
- English Priority Species
- Not designated

Breeding Status

- Confirmed
- Probable
- Possible

Red listed species - BOCC
Amber listed species - BOCC

atmos CONSULTING

0 125 250 500
Metres

N

Scale @ A3:
1:10,000

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02/09/2022 8702/OR/137a
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

348000

350000

378000

Frodsham Wind Farm

Frodsham Marsh Farm

Frodsham Score

Hoolpool Gutter

Hover Force Outdoor Activity Centre

Weaver Navigation

Manchester Ship Canal

Godscroft Cottage

Hadley House

Hill View Farm

The Old Pumping Station

Key

- Survey area
- Target Note
- Broadleaf tree
- Intact hedge - species-poor
- Defunct hedge - species-poor
- 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

N

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

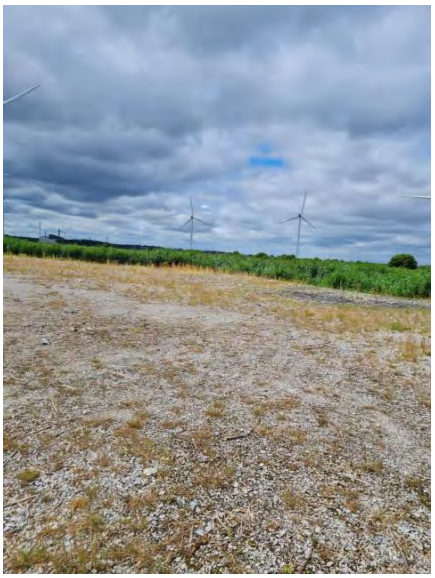
Target note description	Plate
Target note 1. Area of reed bed with encroaching willow scrub. Grey willow *Salix cinerea* and goat willow *Salix caprea* are dominant species here.	
Target note 2. Scattered trees along track. Prominent species include elder *Sambucus nigra*, willow *Salix* spp, grey poplar *Populus x canescens* and spindle *Euonymus europaea*. The vegetation to 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 habitat 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 poor 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 this year 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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CUBICO INVEST

FRODSHAM SOLAR

CELL 3 GROUND INVESTIGATION REPORT

FEBRUARY 2025

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ENERGY AND CLIMATE CHANGE
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APPENDICES

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

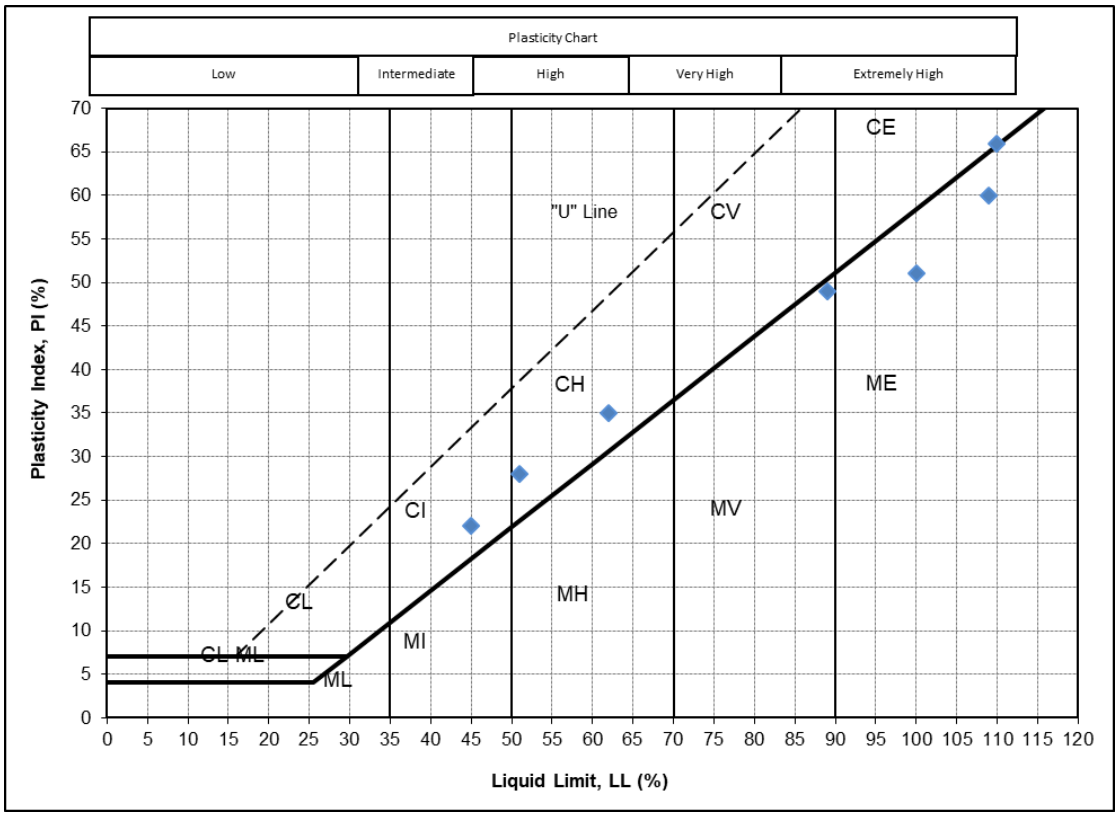


Figure 2: A-Line Chart

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
Unit 5, Newton Business Centre
Thorncliffe Park
Chapeltown
Sheffield
S35 2PH

t: 0845 111 7777

[redacted]

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
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]

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.

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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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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				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.
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

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]

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.

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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]

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

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soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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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					
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.

Wardell Armstrong
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Glasgow
G2 1RW

[redacted]

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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]

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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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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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

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

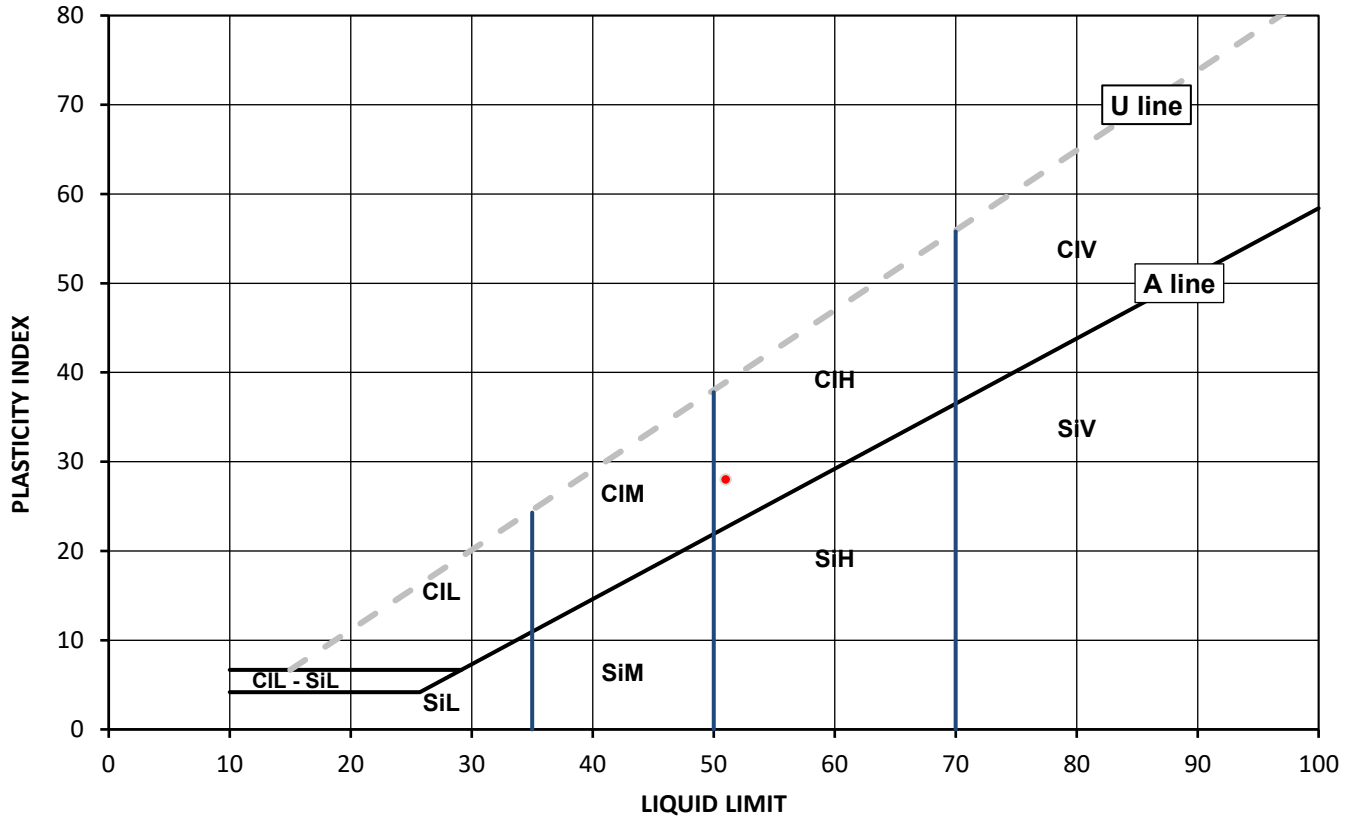
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	10/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site 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]

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Opinions and interpretations expressed herein are outside of the scope of the UKAS Accred
report may not be reproduced other than in full without the prior written approval of the issui
laboratory. The results included within the report relate only to the sample(s) submitted for te

or 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

i2 Analytical Ltd
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UKAS TESTING 4041

Environmental Science

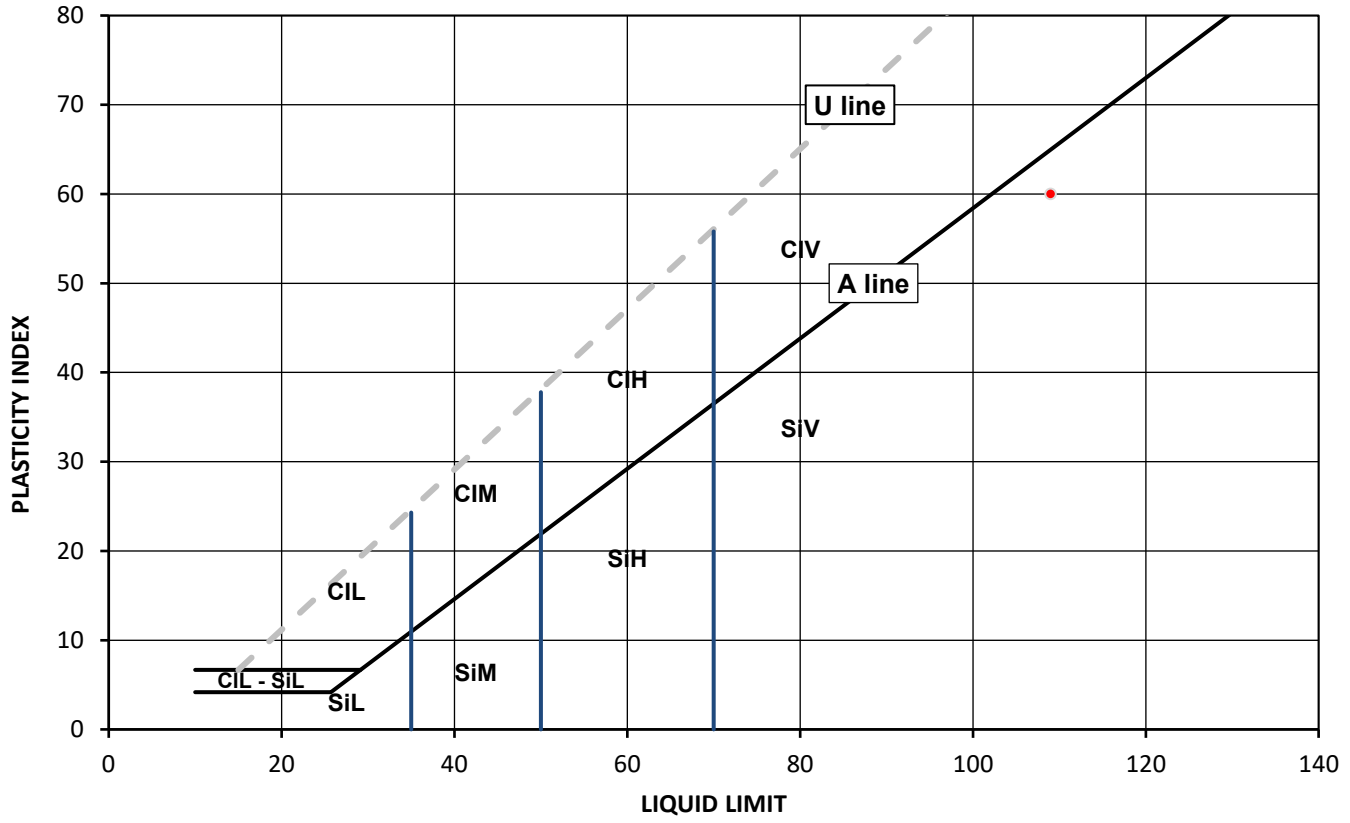
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	10/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site 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:

[redacted]

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3/07/2024

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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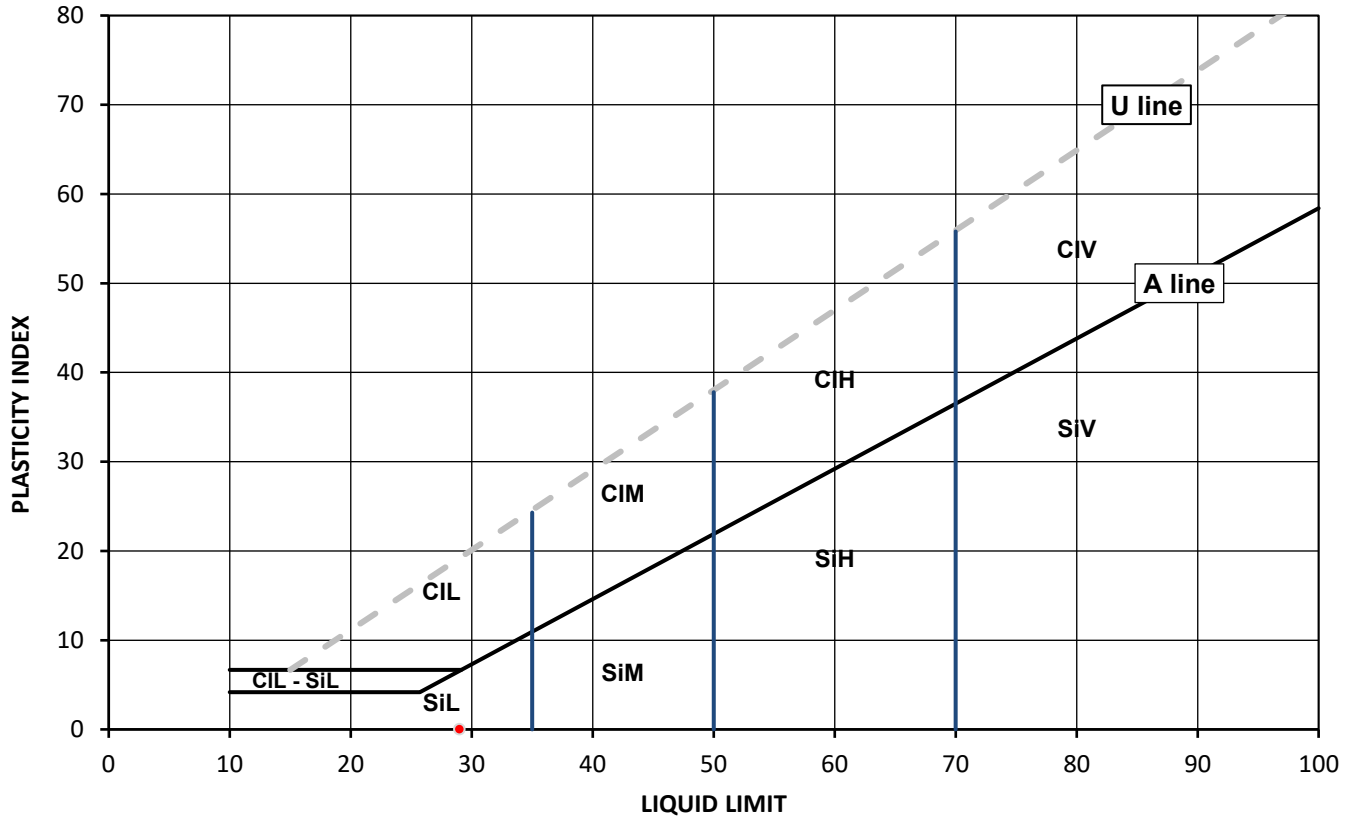
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	11/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site 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:

[redacted]

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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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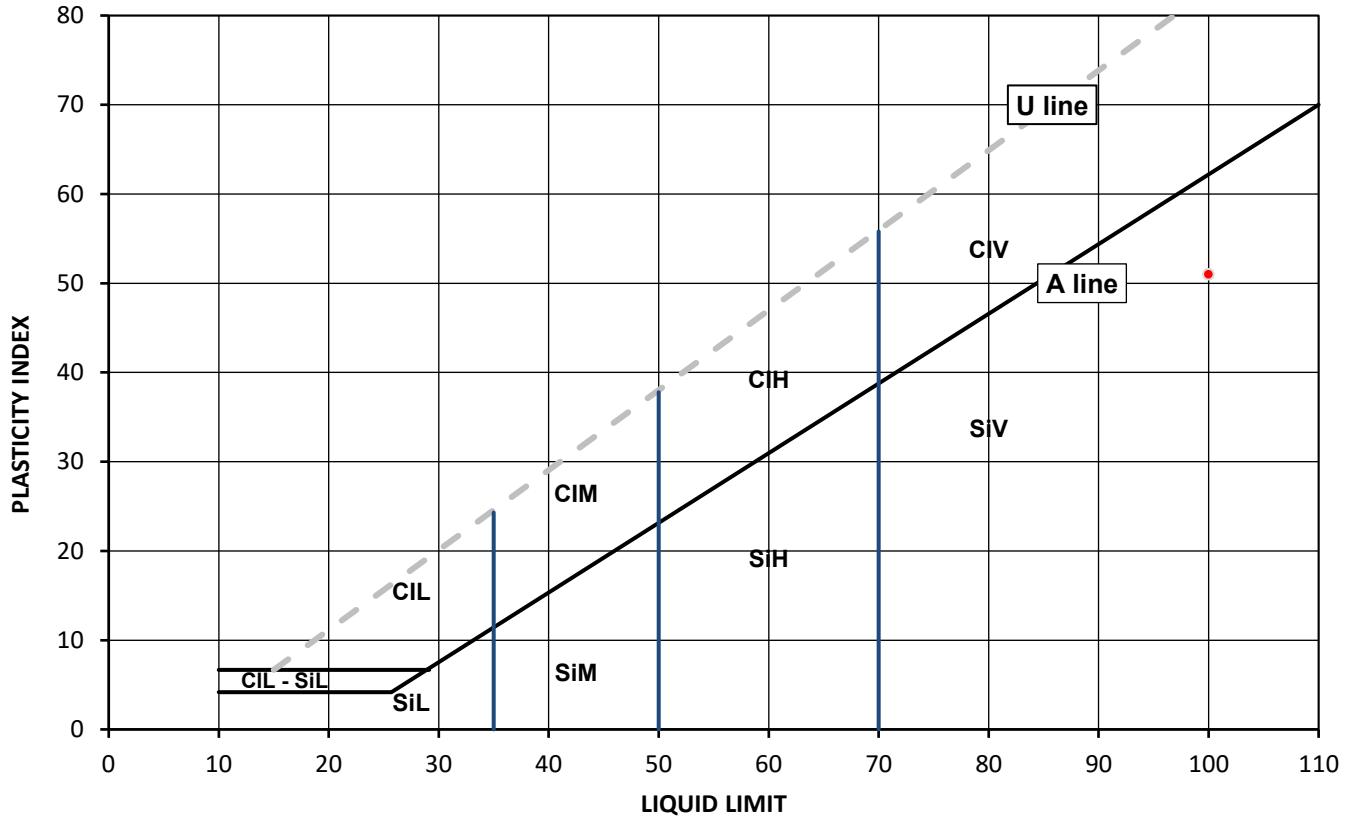
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	12/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site 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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ate Reported: 23/07/2024 **GF 337.13**

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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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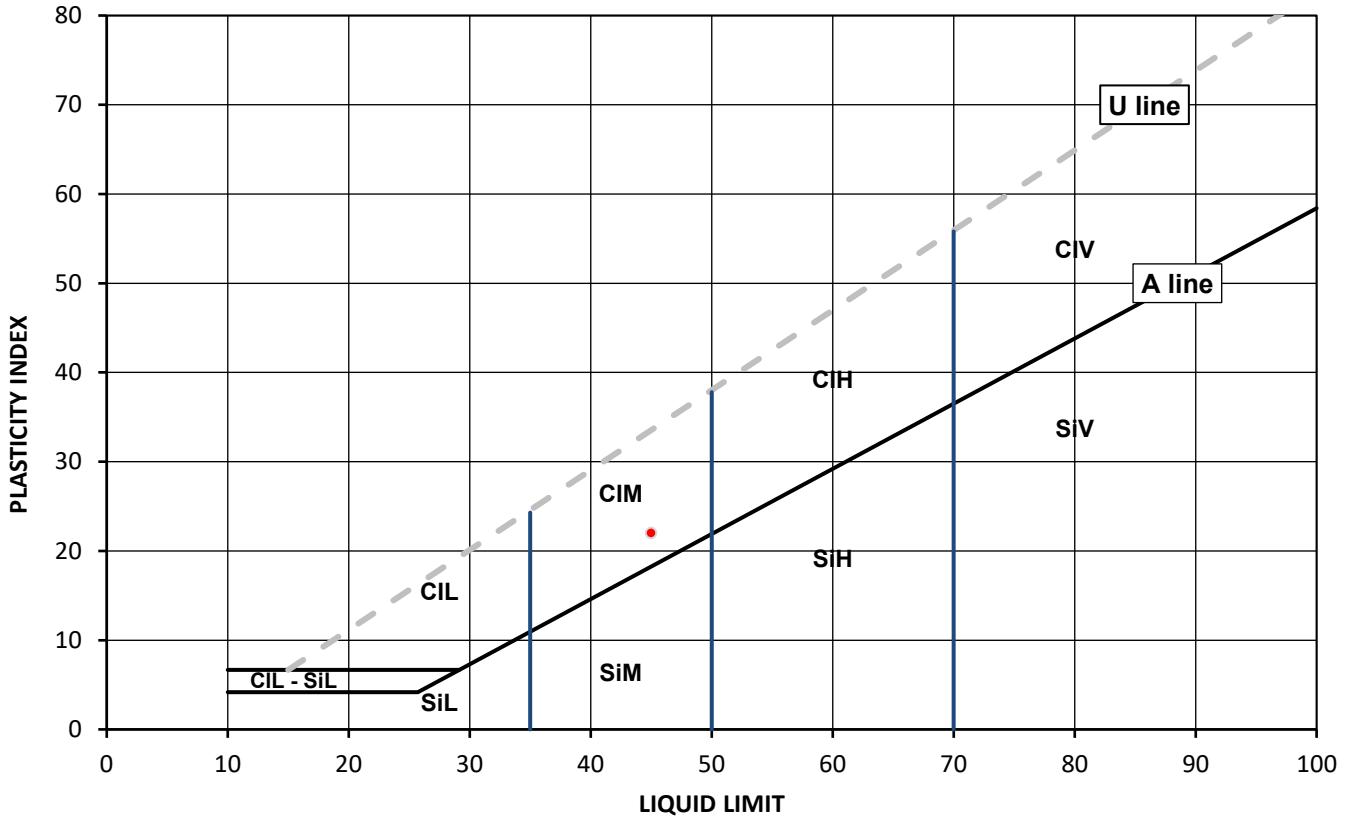
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	13/06/2024
		Date Received:	10/06/2024
Contact:	Fay Lawrence	Date Tested:	03/07/2024
Site 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:

[redacted]

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ate 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.

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: 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)

[redacted]pecialist

for and on behalf of i2 Analytical Ltd

Date Reported: 23/07/2024 **GF 362.15**

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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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Brackmills Industrial Estate
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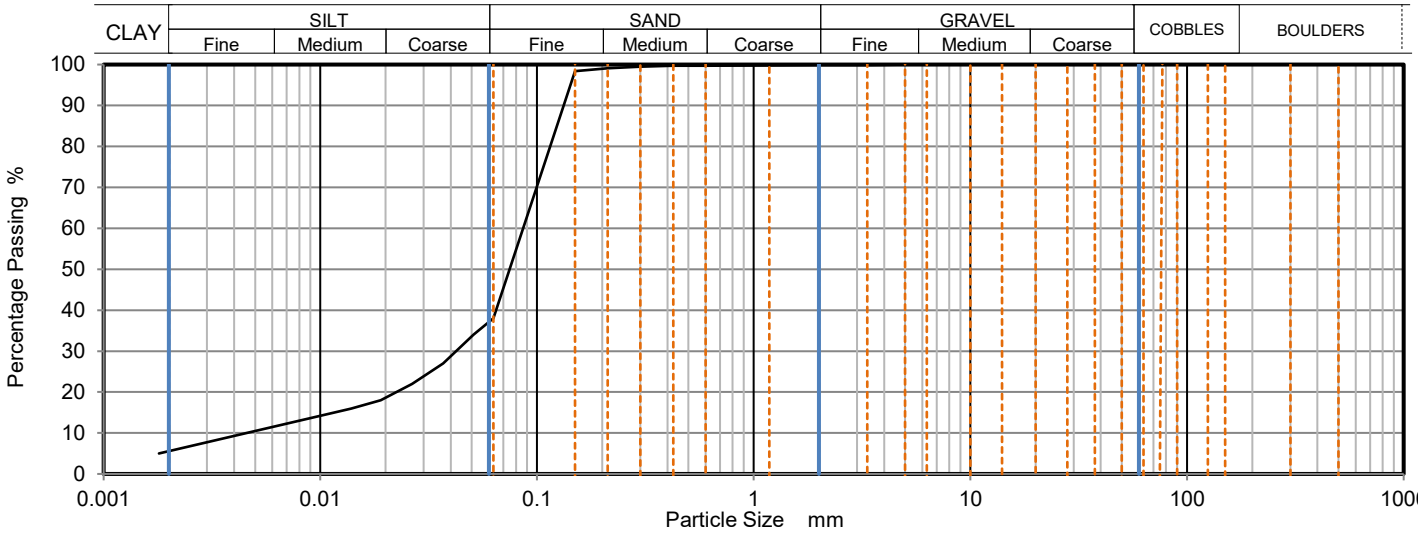
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Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	12/06/2024
		Date Received:	10/06/2024
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:

[redacted]pecialist

r and on behalf of i2 Analytical Ltd

ate Reported: 23/07/2024 **GF 366.11**

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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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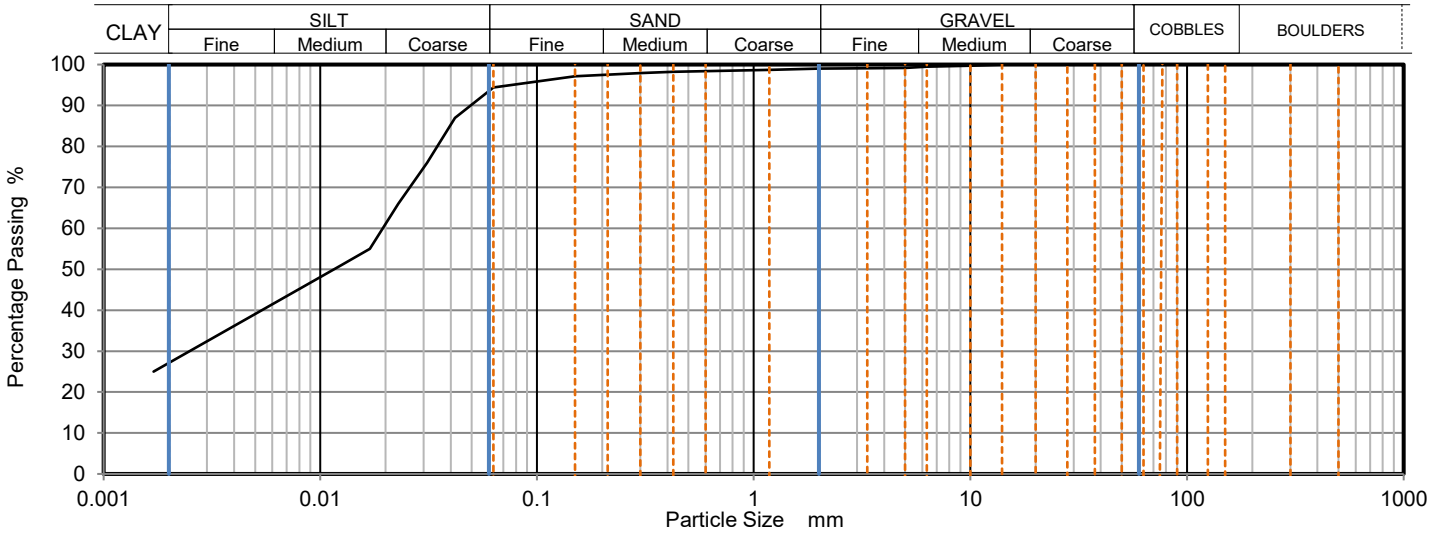
Environmental Science

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

[redacted] pecialist

r and on behalf of i2 Analytical Ltd

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ate 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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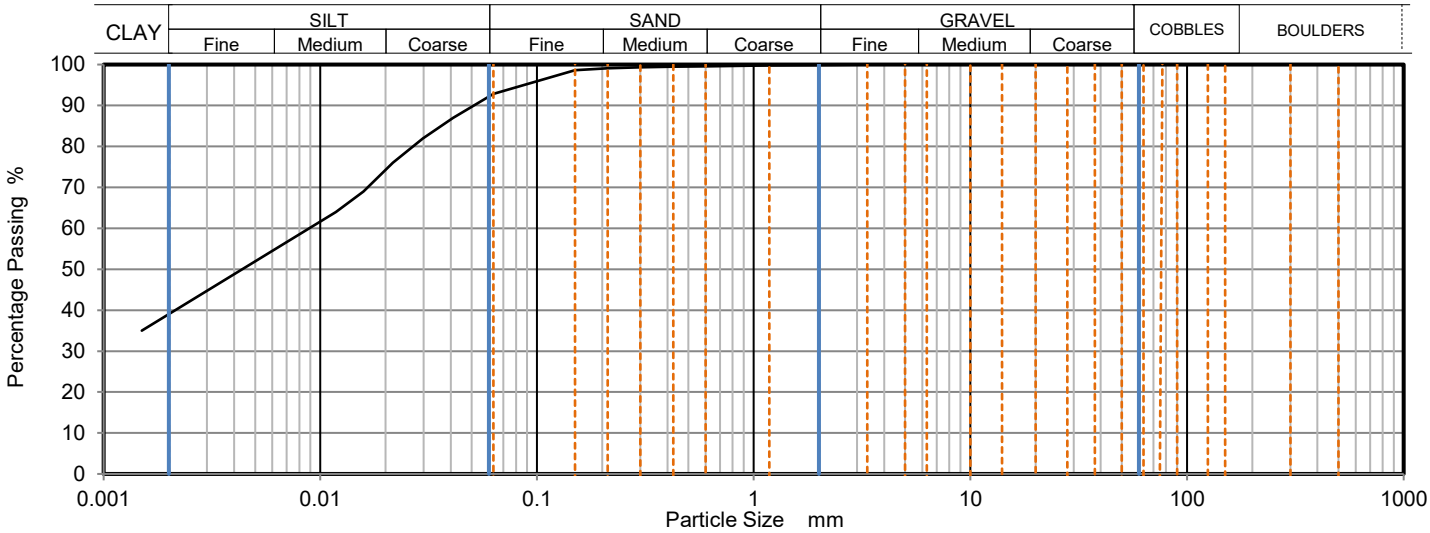
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Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-027034-2
		Date Sampled:	11/06/2024
		Date Received:	10/06/2024
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:

[redacted]

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ate 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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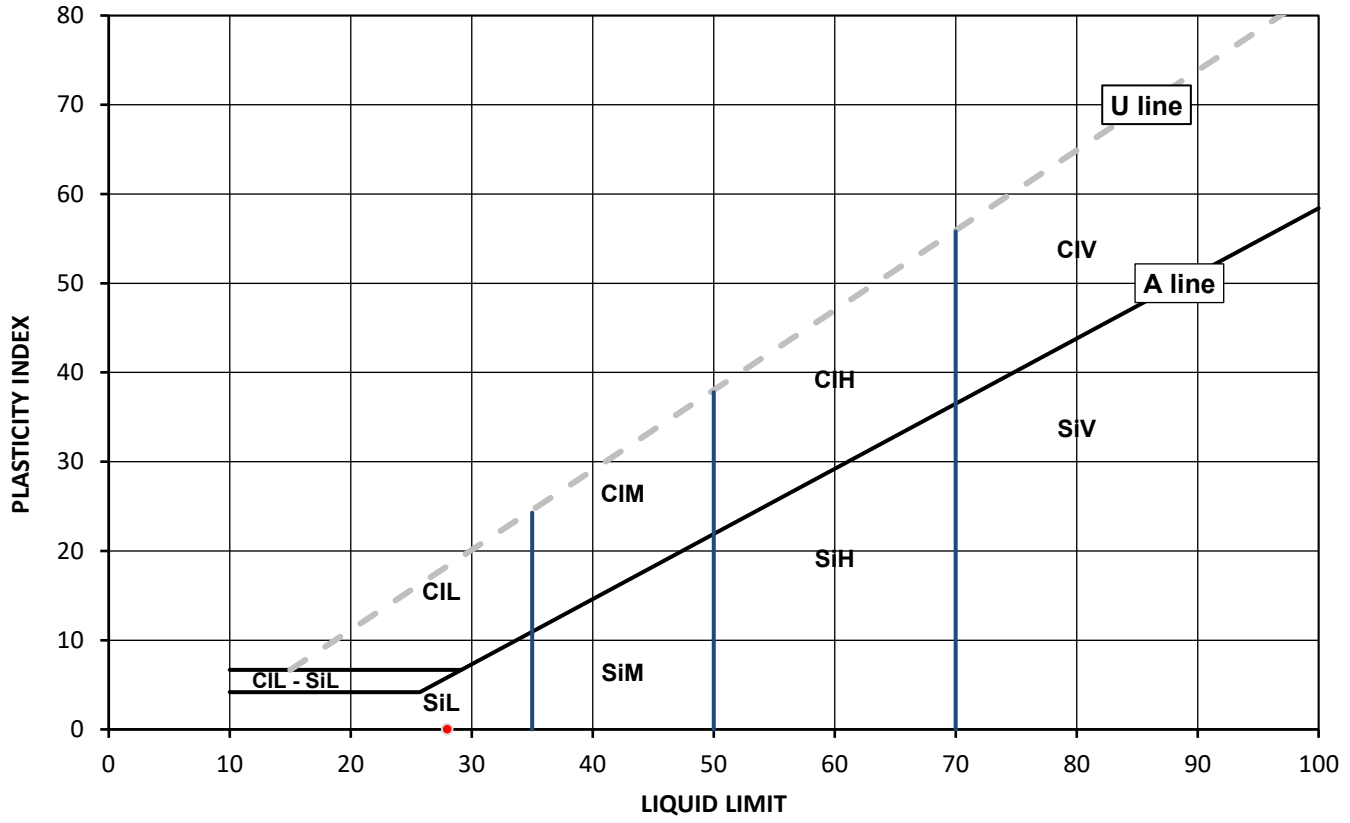
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site 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.

[redacted]

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[redacted]ting Team Leader
[redacted]r and on behalf of i2 Analytical Ltd

[redacted]ate 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

i2 Analytical Ltd
Unit 8 Harrowden Road
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4041

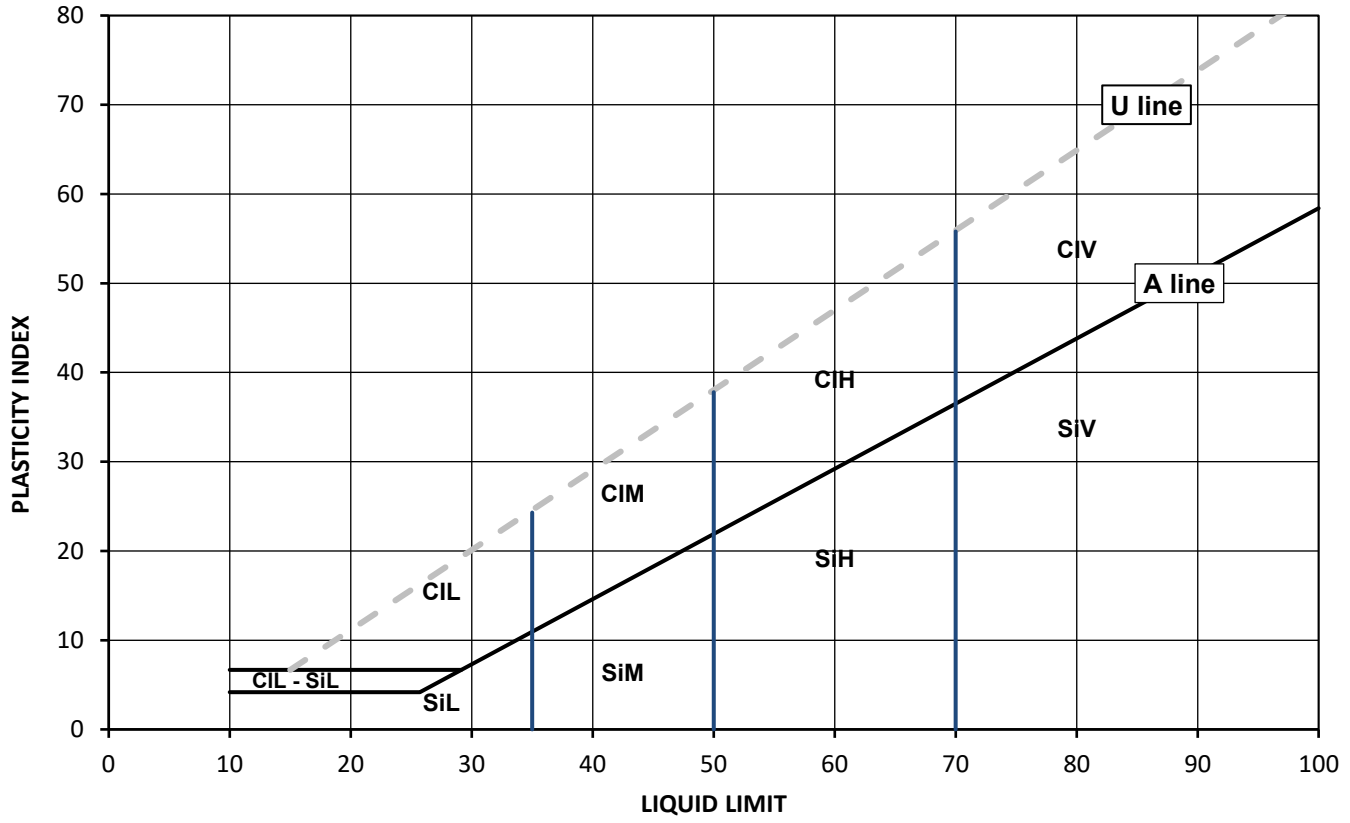
Client:	Wardell Armstrong	Client Reference:	GM12793
Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	15/11/2024
Site 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:

[redacted]

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[redacted]rting Team Leader
r and on behalf of i2 Analytical Ltd

ate 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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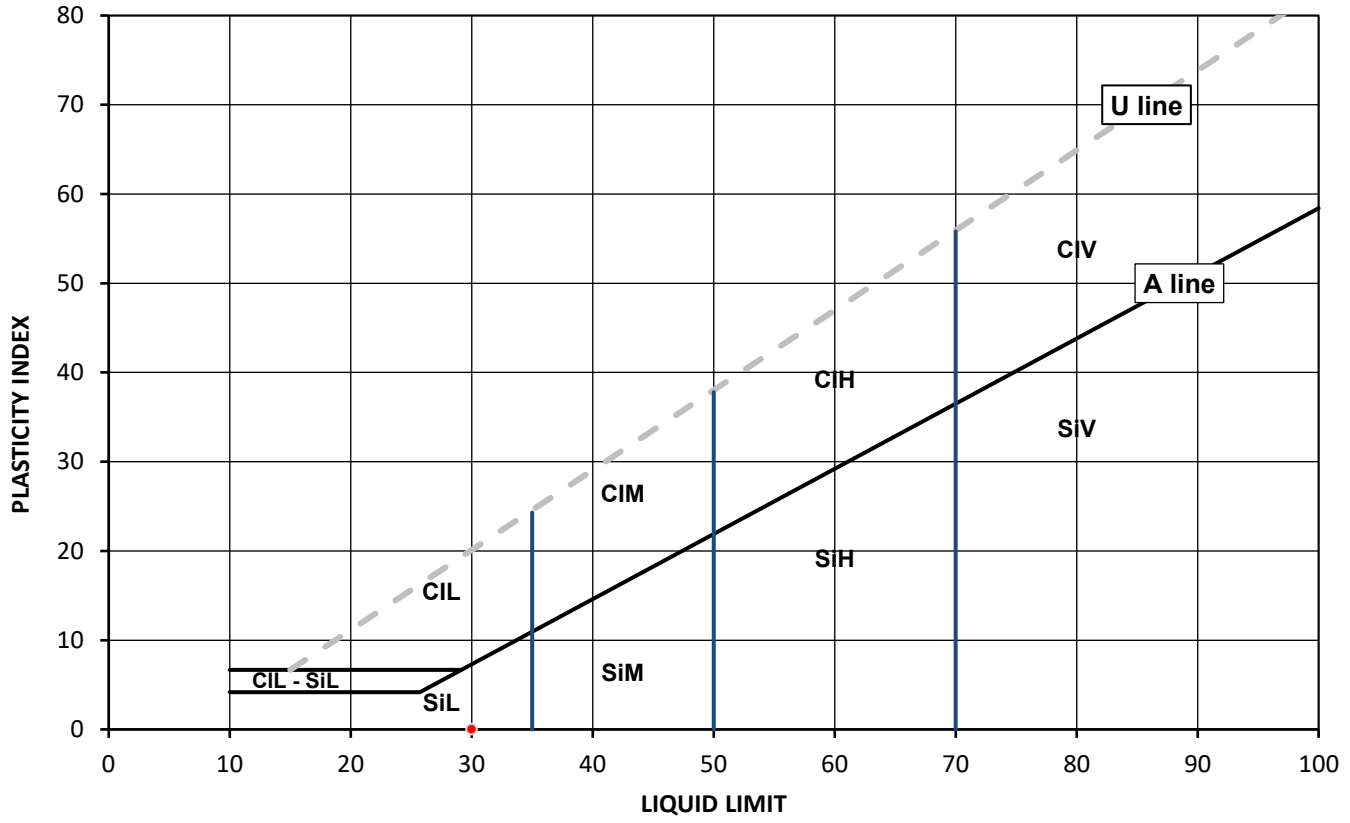
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		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	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.

[redacted]

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Date Reported: 25/11/2024

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

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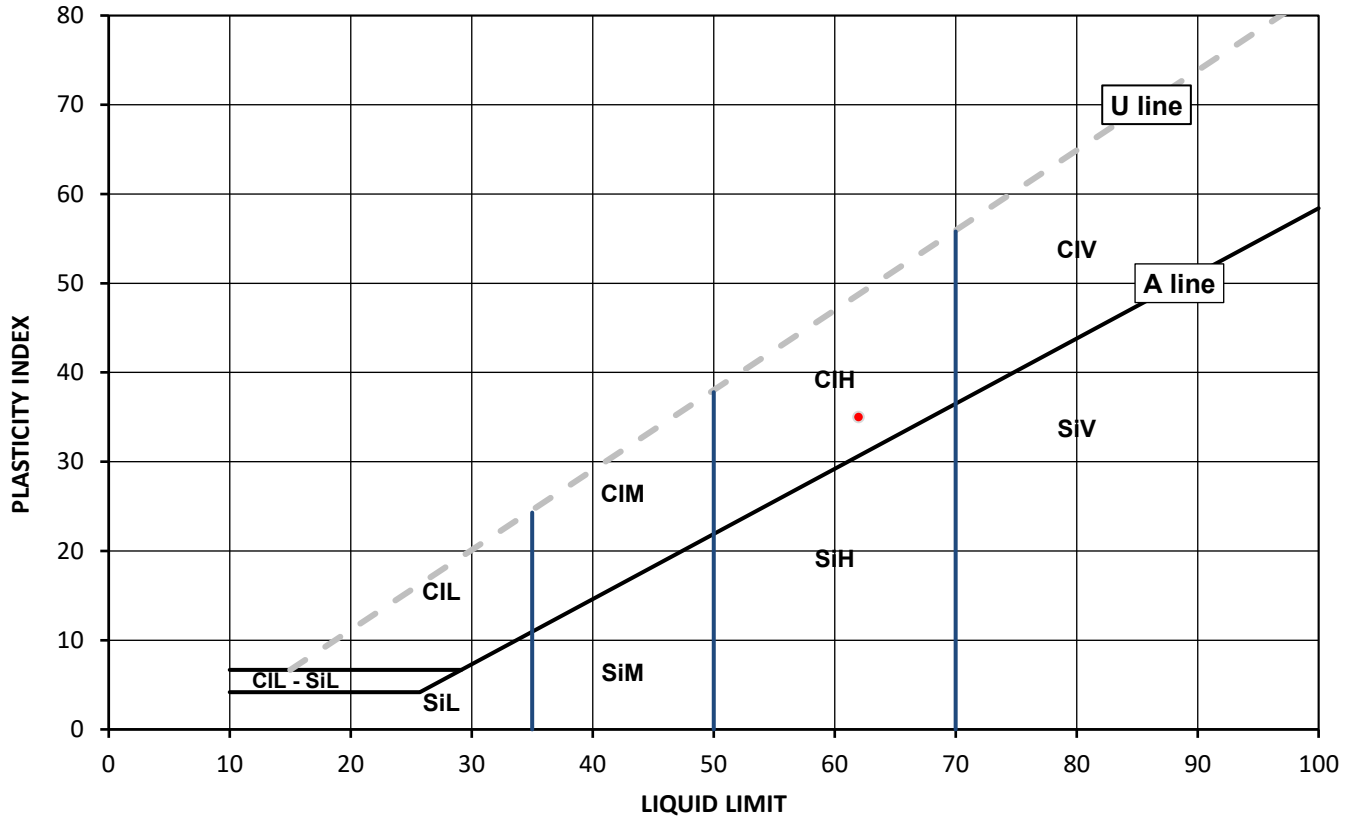
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		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	15/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

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:

[redacted]

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[redacted]orting Team Leader
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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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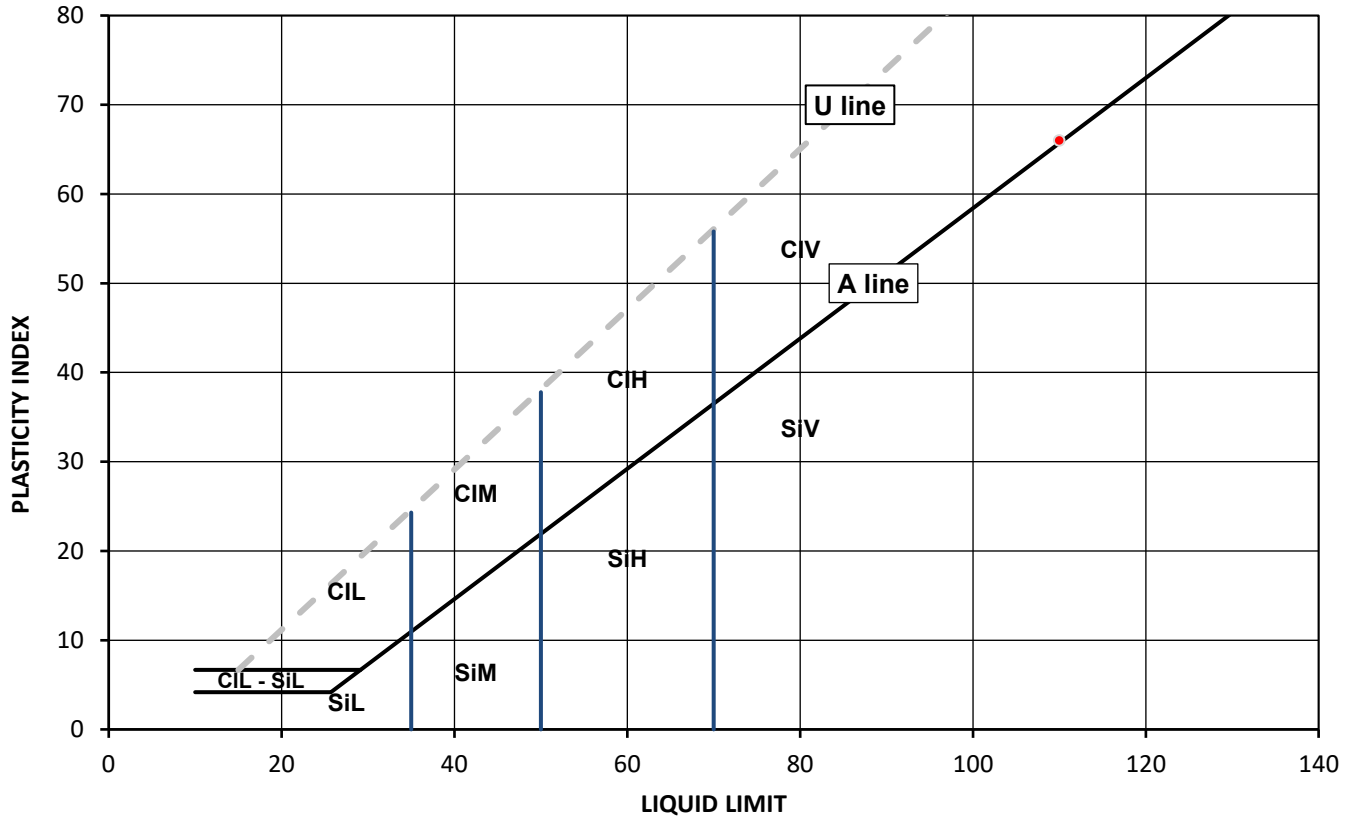
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		Date Sampled:	25/10/2024
		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	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:

[redacted]rting Team Leader
and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

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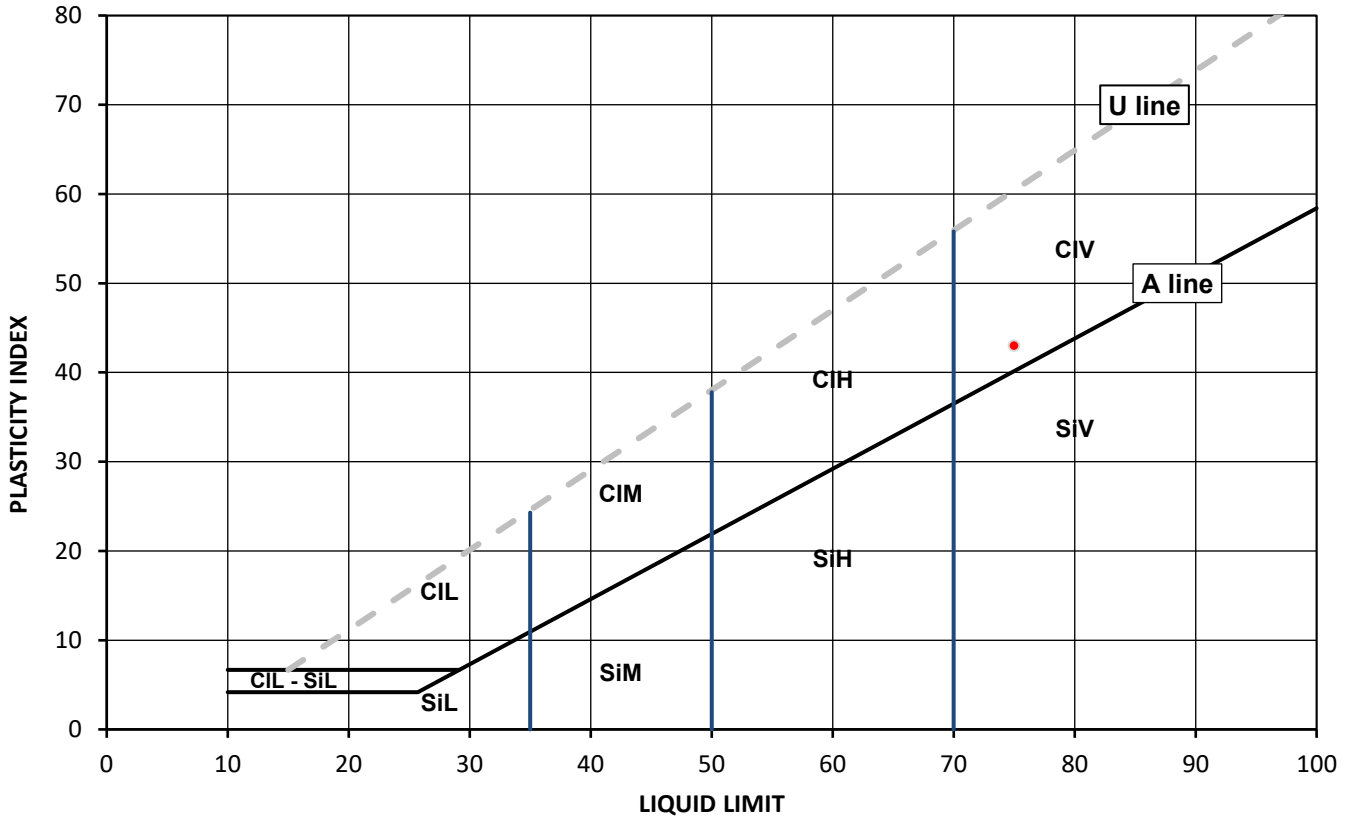
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Client Address:	Wardell Armstrong LLP, Unit 5, Newton Business Centre, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH	Job Number:	24-051554-1
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		Date Received:	28/10/2024
Contact:	Shannon Connell	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:

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[redacted]orting Team Leader
and on behalf of i2 Analytical Ltd

ate 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

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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

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:

[redacted]rting Team Leader
for and on behalf of i2 Analytical Ltd

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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:

[redacted] ting Team Leader

for and on behalf of i2 Analytical Ltd

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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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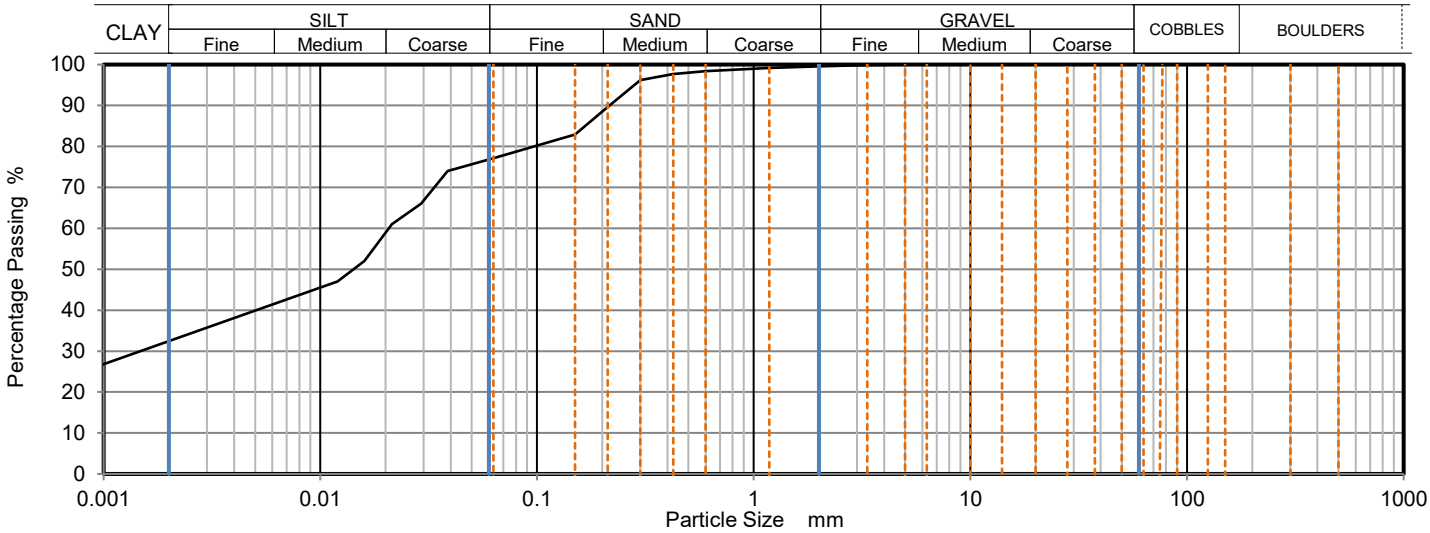
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Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

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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ate Reported: 25/11/2024

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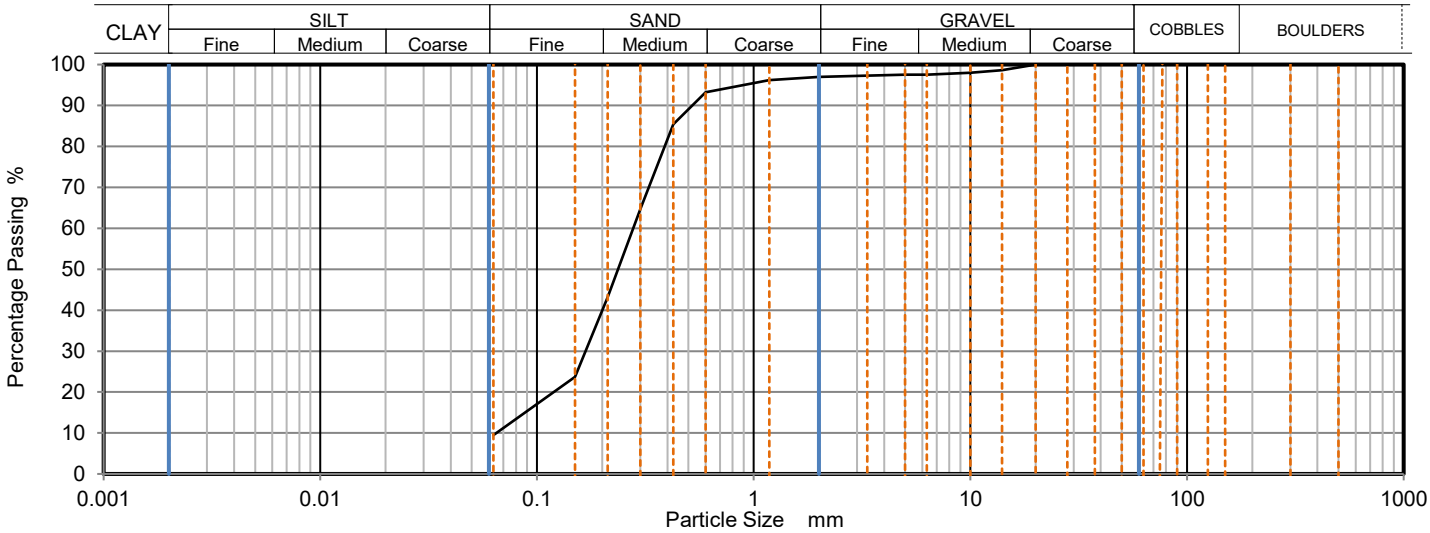
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		Date Received:	28/10/2024
Contact:	Shannon Connell	Date Tested:	14/11/2024
Site Address:	Cell 3, Frodsham Marshes, Frodsham, Cheshire	Sampled By:	Not Given

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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and on behalf of i2 Analytical Ltd

ate Reported: 25/11/2024

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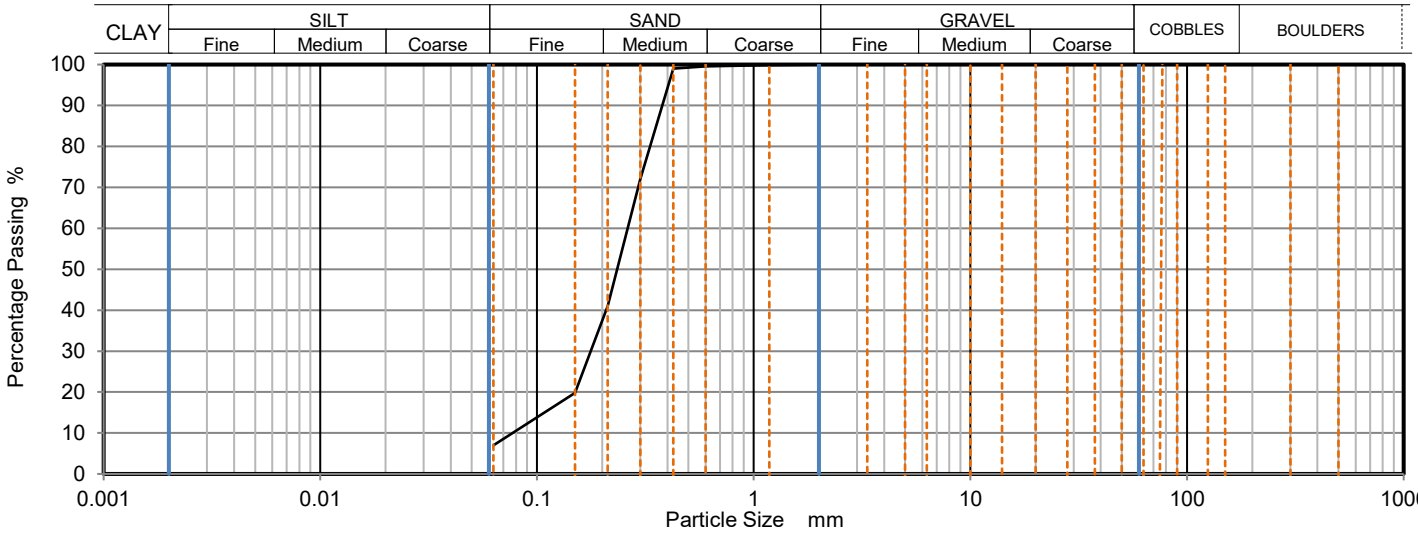
4041

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:	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

Remarks:

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and on behalf of i2 Analytical Ltd

te 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
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Brackmills Industrial Estate
Northampton NN4 7EB

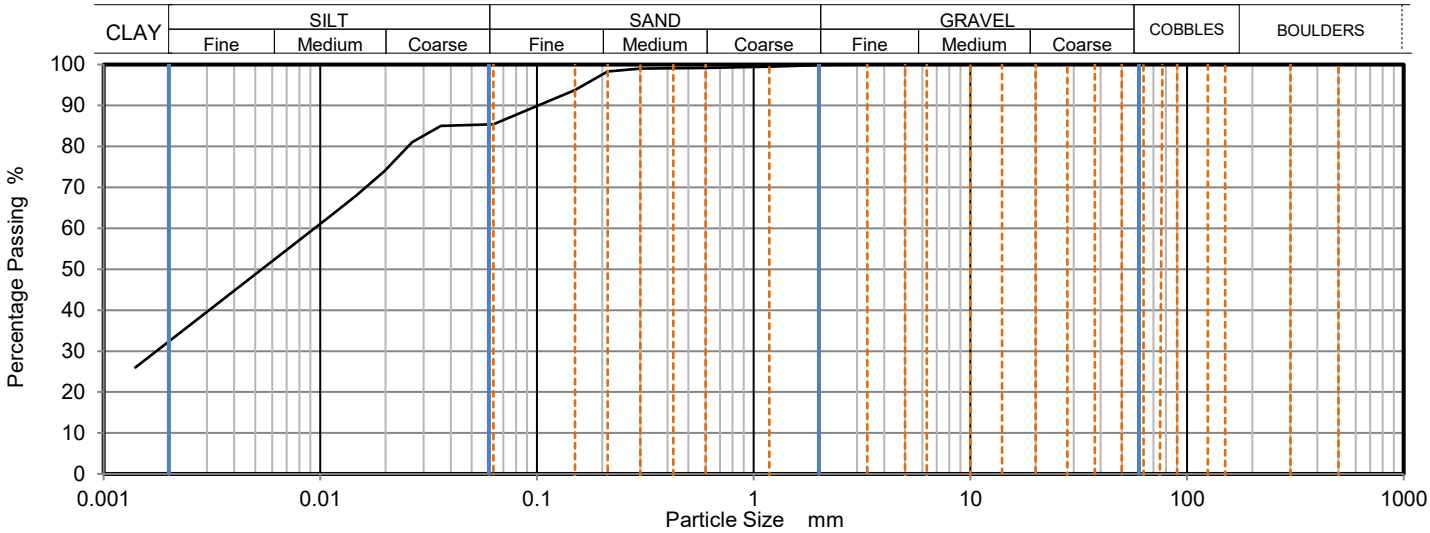
4041

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:	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

Remarks:

[redacted]

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te 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
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Brackmills Industrial Estate
Northampton NN4 7EB

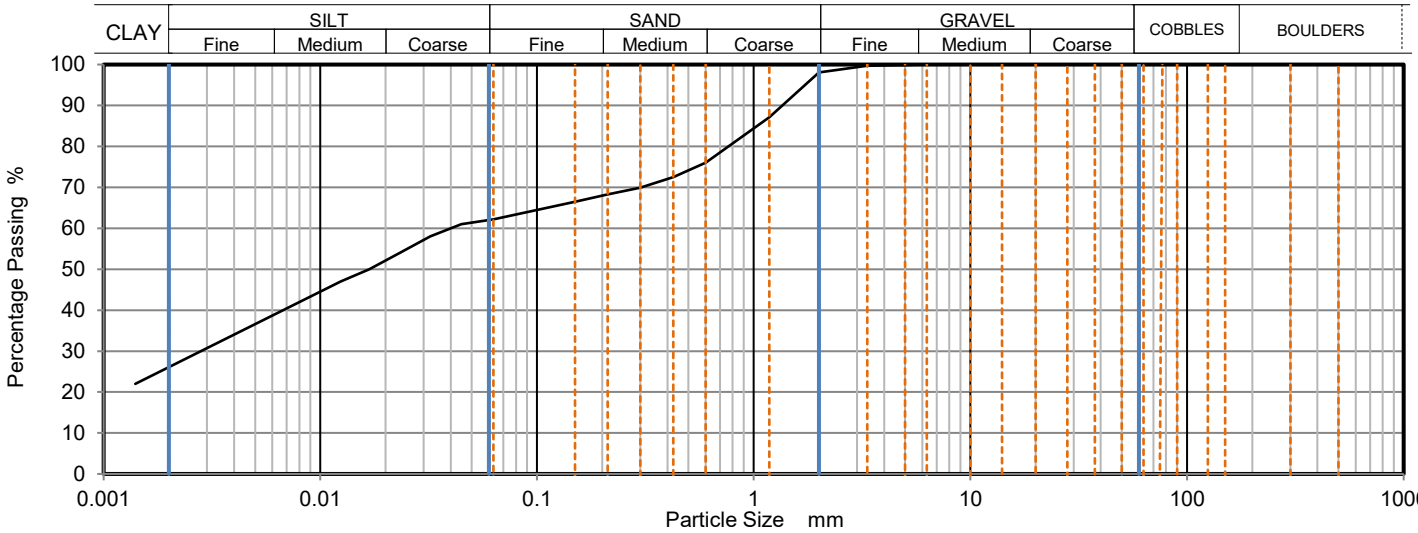
4041

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:	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

Remarks:

[redacted]

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and on behalf of i2 Analytical Ltd

ate Reported: 25/11/2024

TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

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Brackmills Industrial Estate
Northampton NN4 7EB

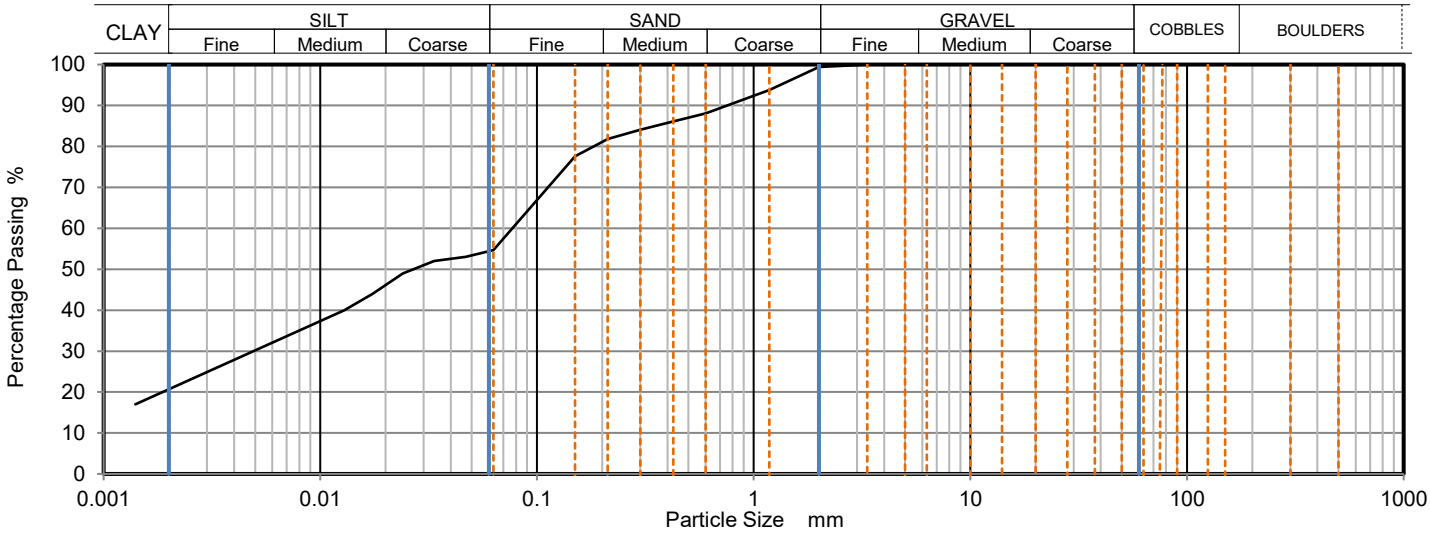
4041

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:	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

Remarks:

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[redacted]rting Team Leader
and on behalf of i2 Analytical Ltd

ate 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:	[redacted]

	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:	[redacted]

		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:	[redacted]

		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**	

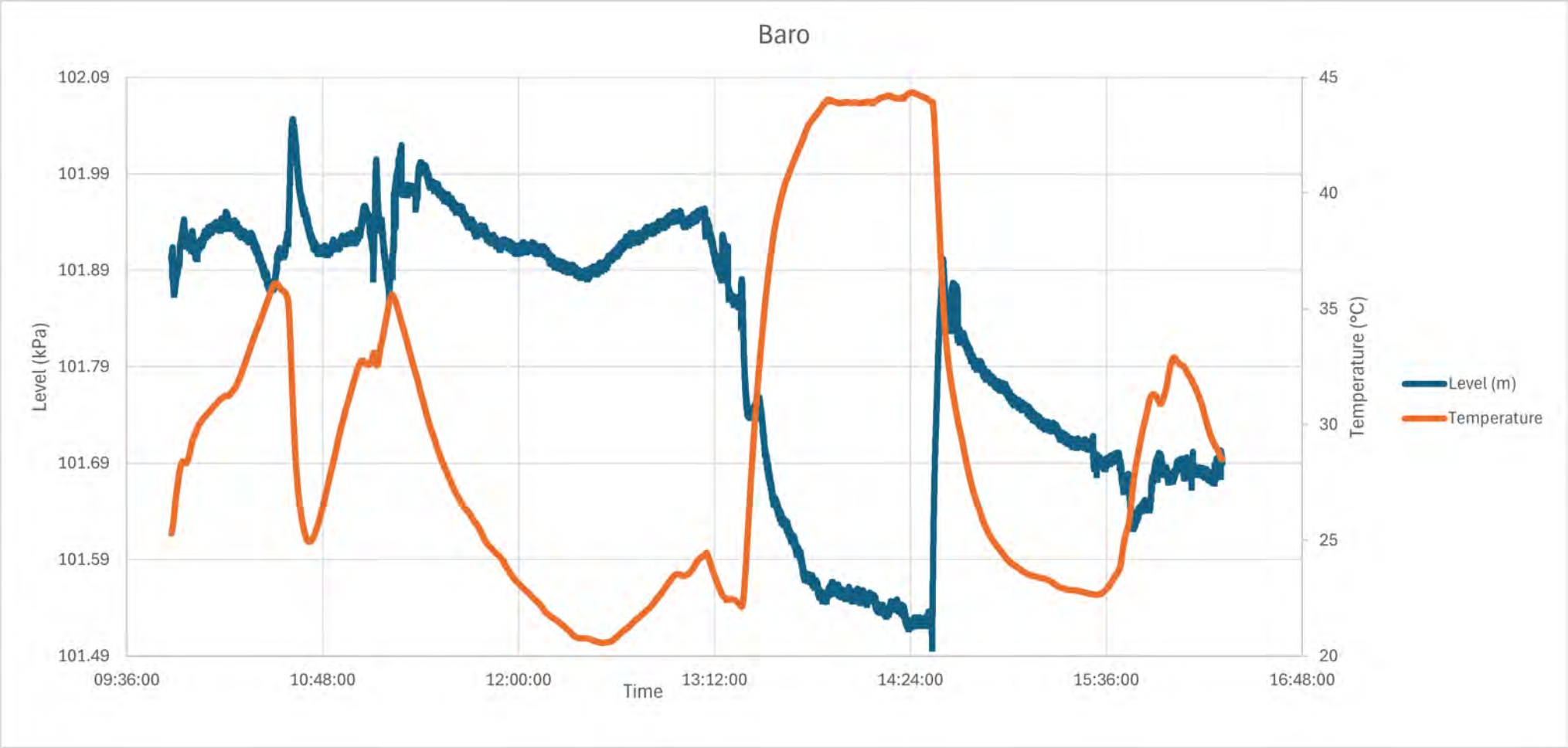
SITE INFORMATION:

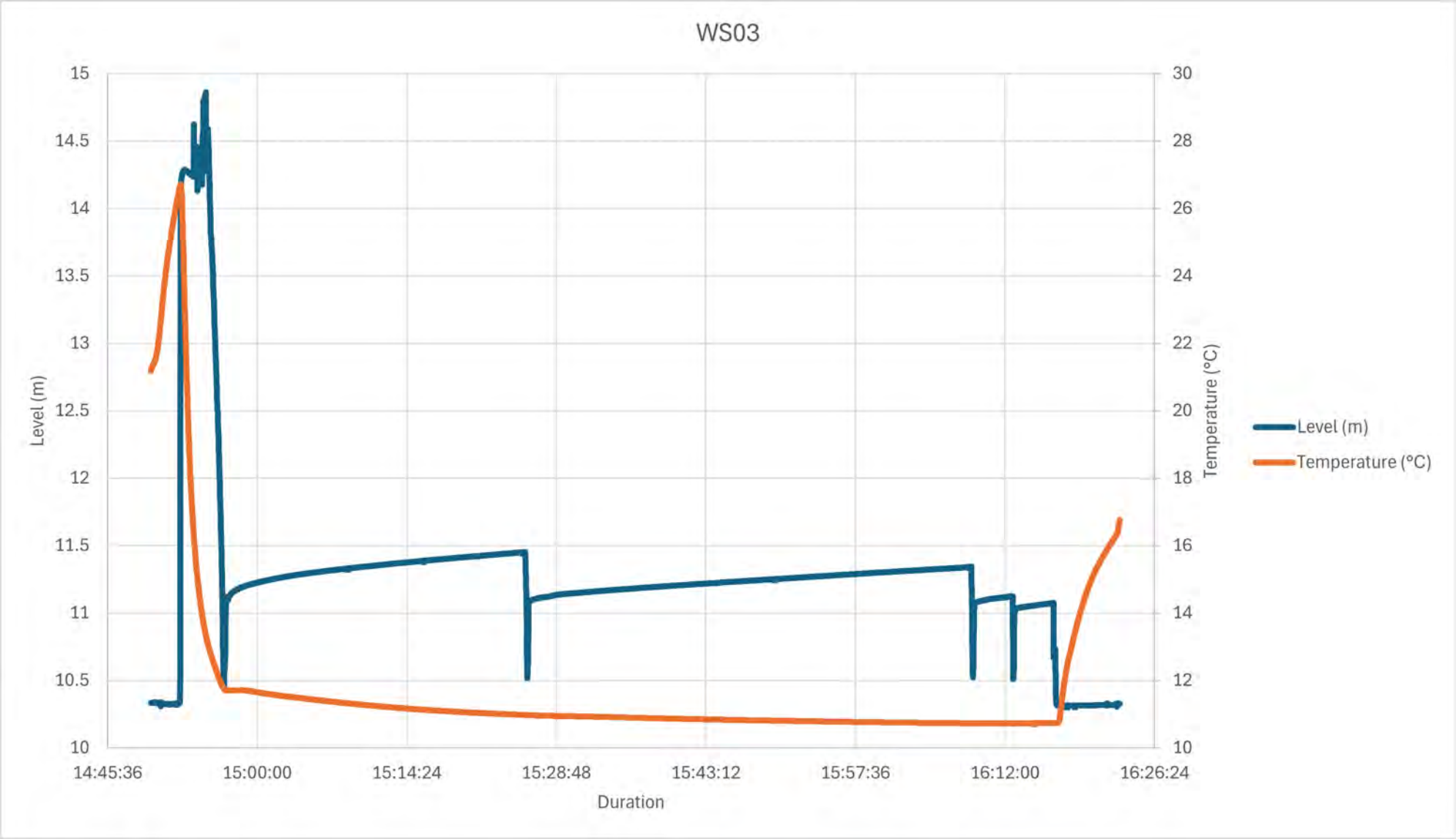
Nature of ground:	X	Soft-landscaping		Hardstanding	
State of ground:		Dry	X	Wet	
		Frozen		Snow	
Wind:		Calm		Moderate	Strong
Cloud cover:		None		Cloudy	Overcast
Preciptation:		None		Moderate	Heavy

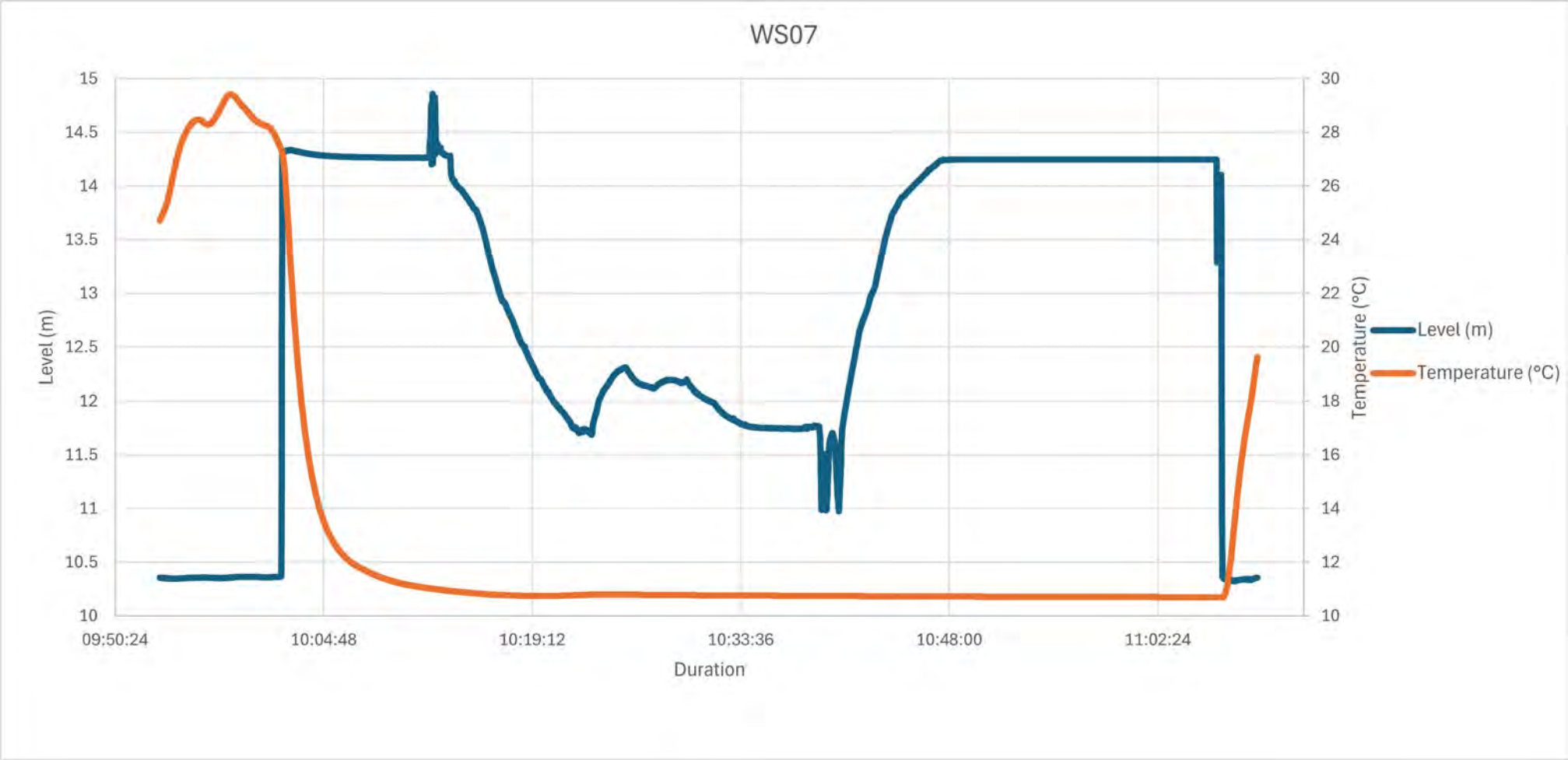
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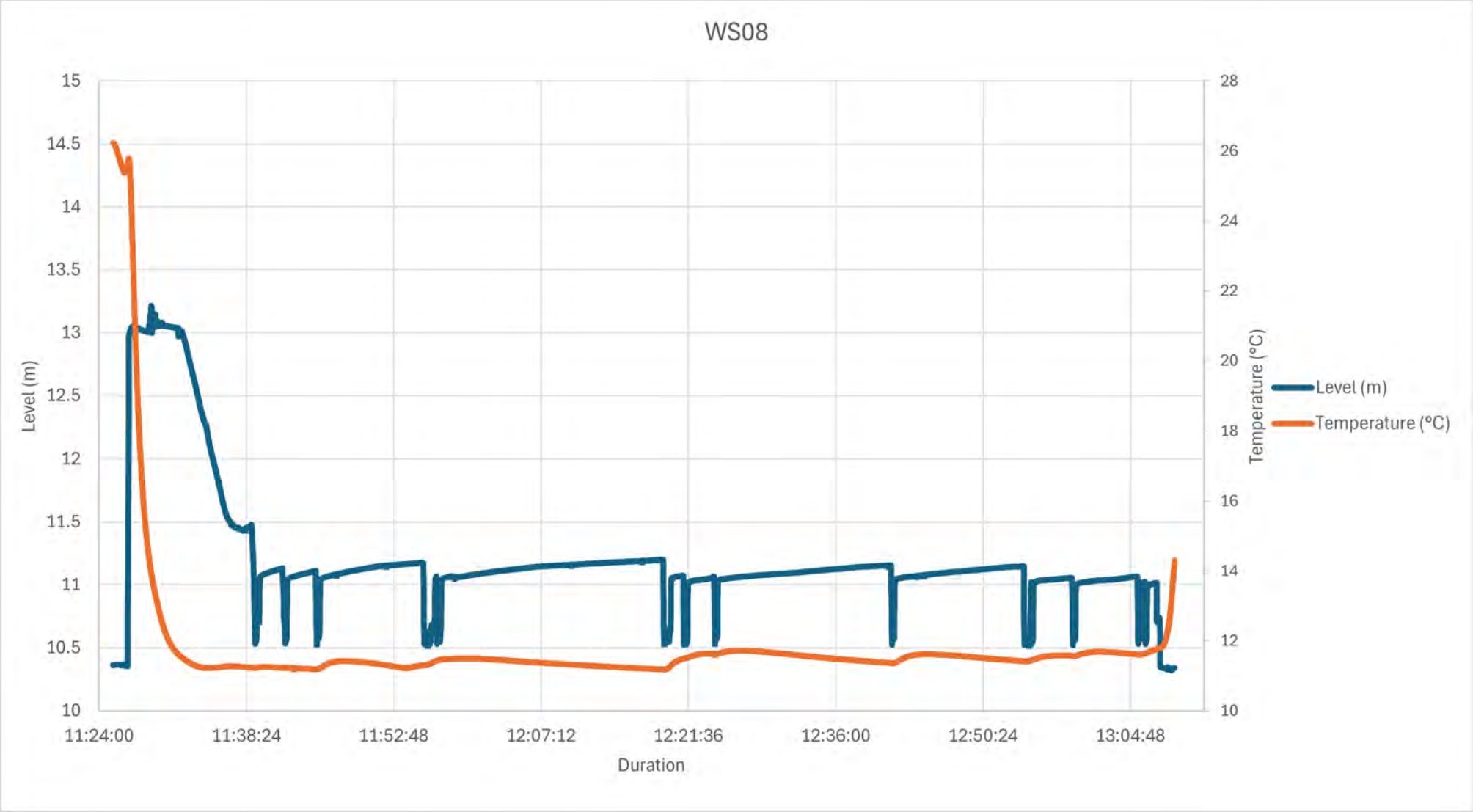
Appendix E

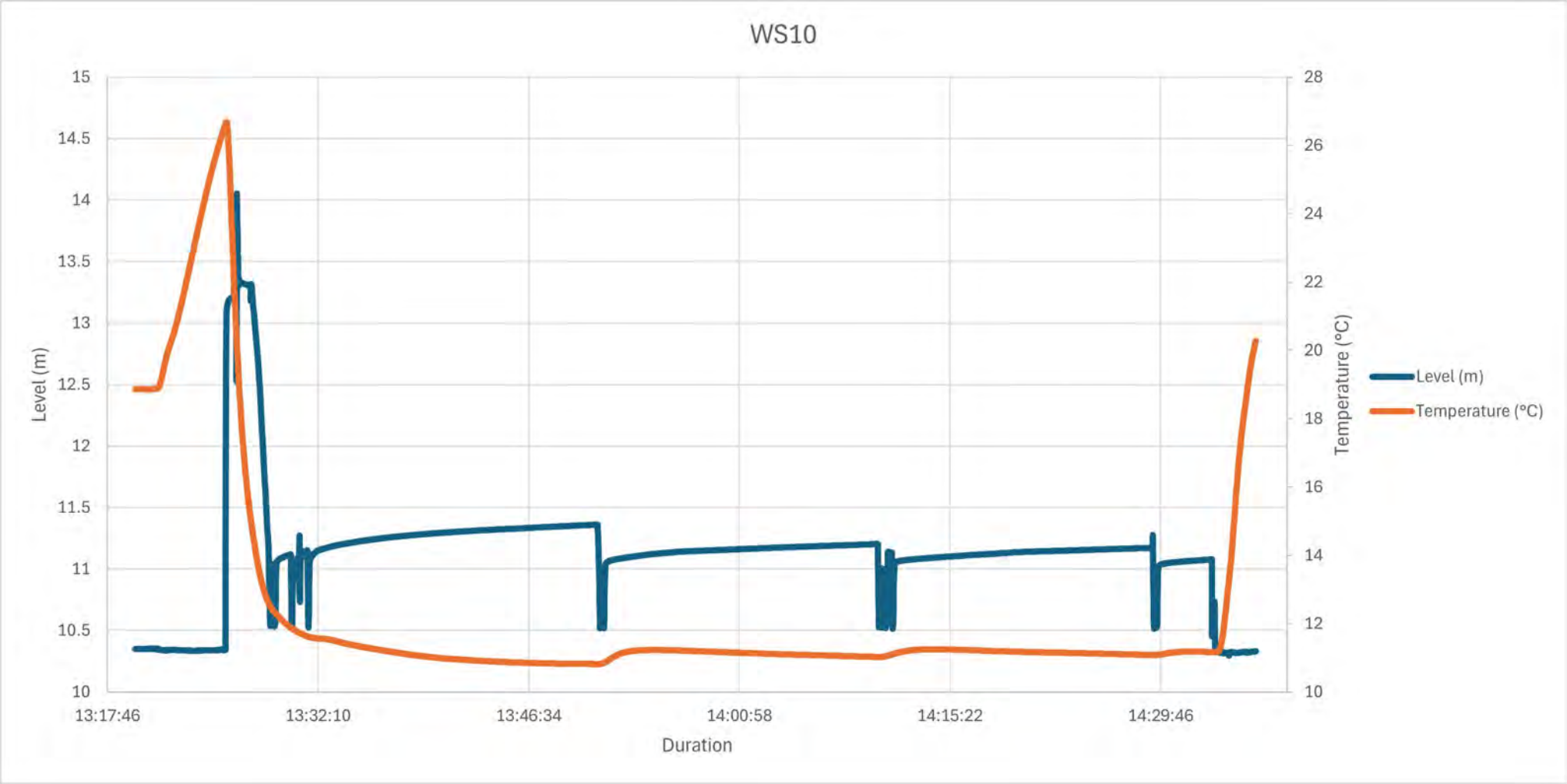
Variable Head Test Graphs


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

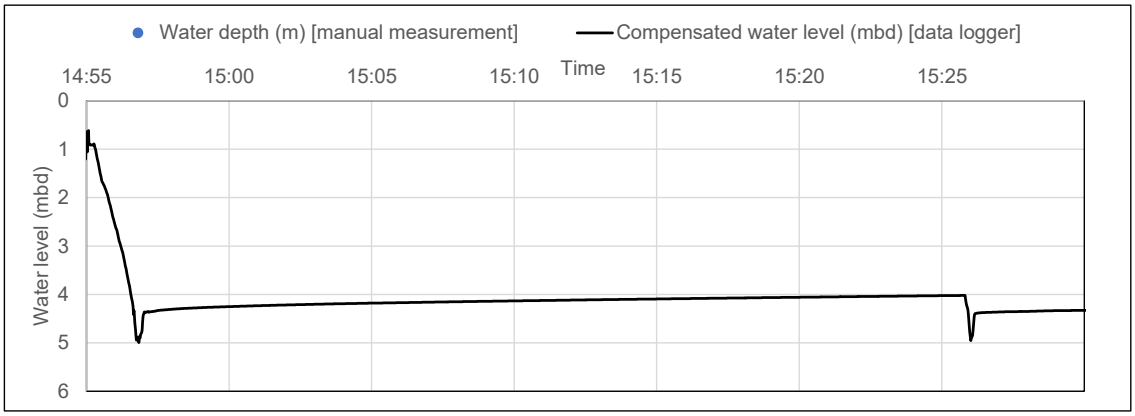
Analysis of open system hydraulic test

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	

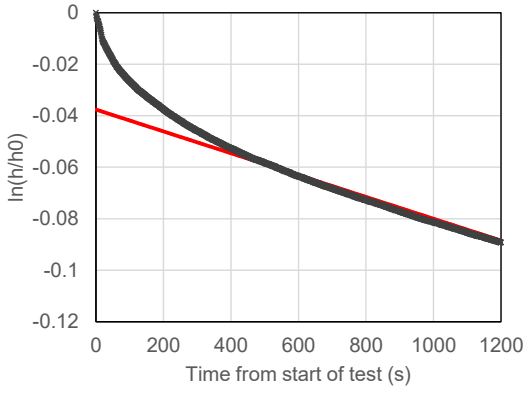


Test analysis

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.

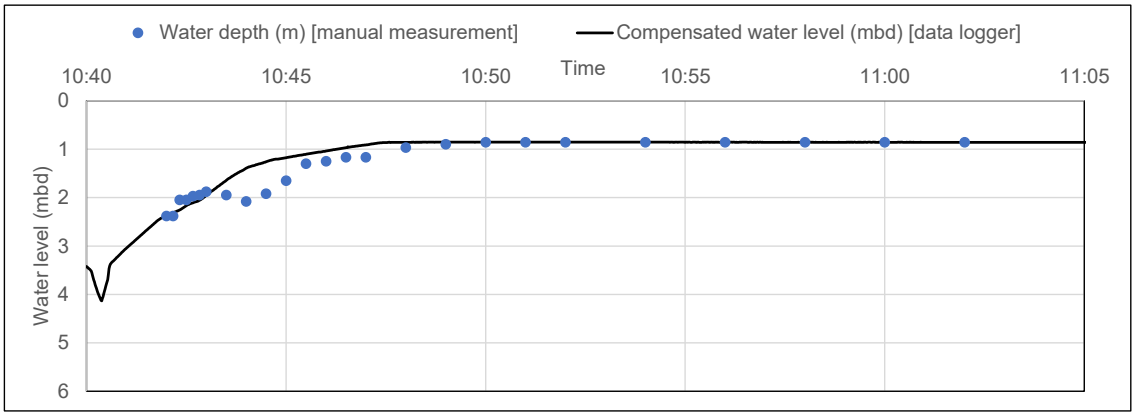
Analysis of open system hydraulic test

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

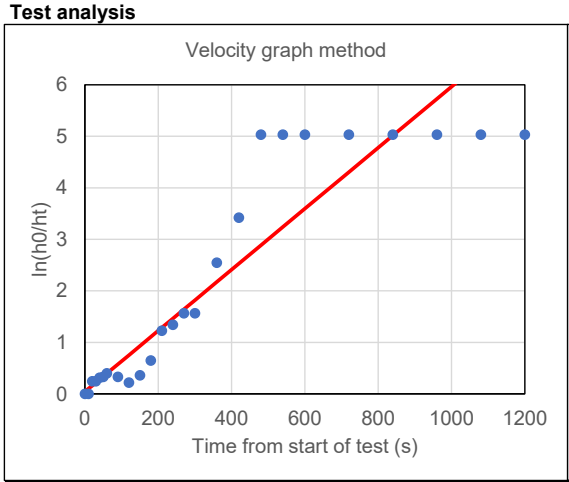
Notes: Water sampling completed before start of hydraulic test. Logger installed in borehole at 10:00. Wasp pump used to lower water level before start of test. Pump on at 10:15. Monitoring of level recovery started 10:42.

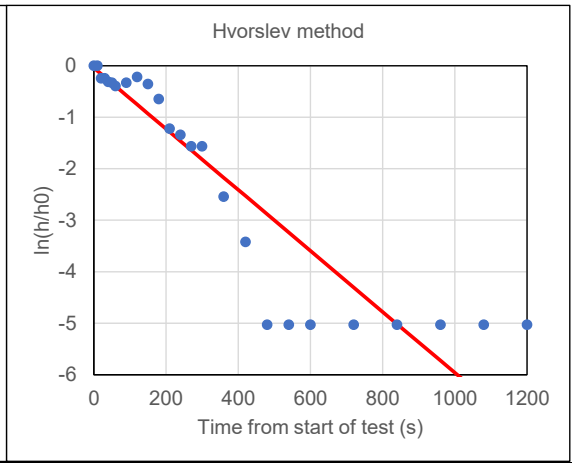
Test data

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

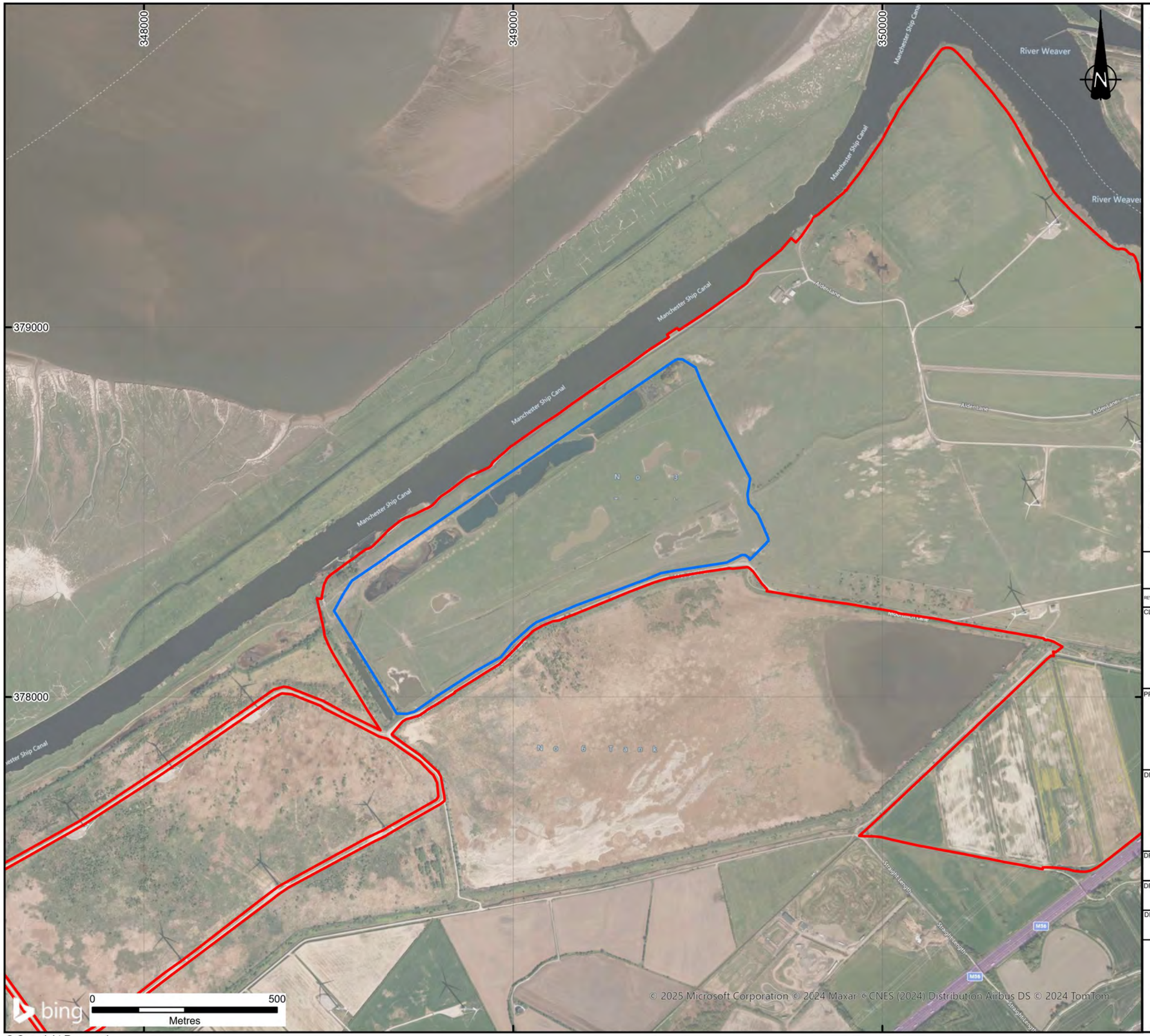




Shape factor (F) (m)	2.10E+00	Gradient	-5.92E-03
Cross section (S) (m2)	7.85E-03	t0 (s) [Hvorslev time]	1.61E+02
Alpha (/t)	5.92E-03	k (m/s)	2.33E-05
k (m/s)	2.22E-05	k (m/d)	2.01E+00
k (m/d)	1.92E+00		

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

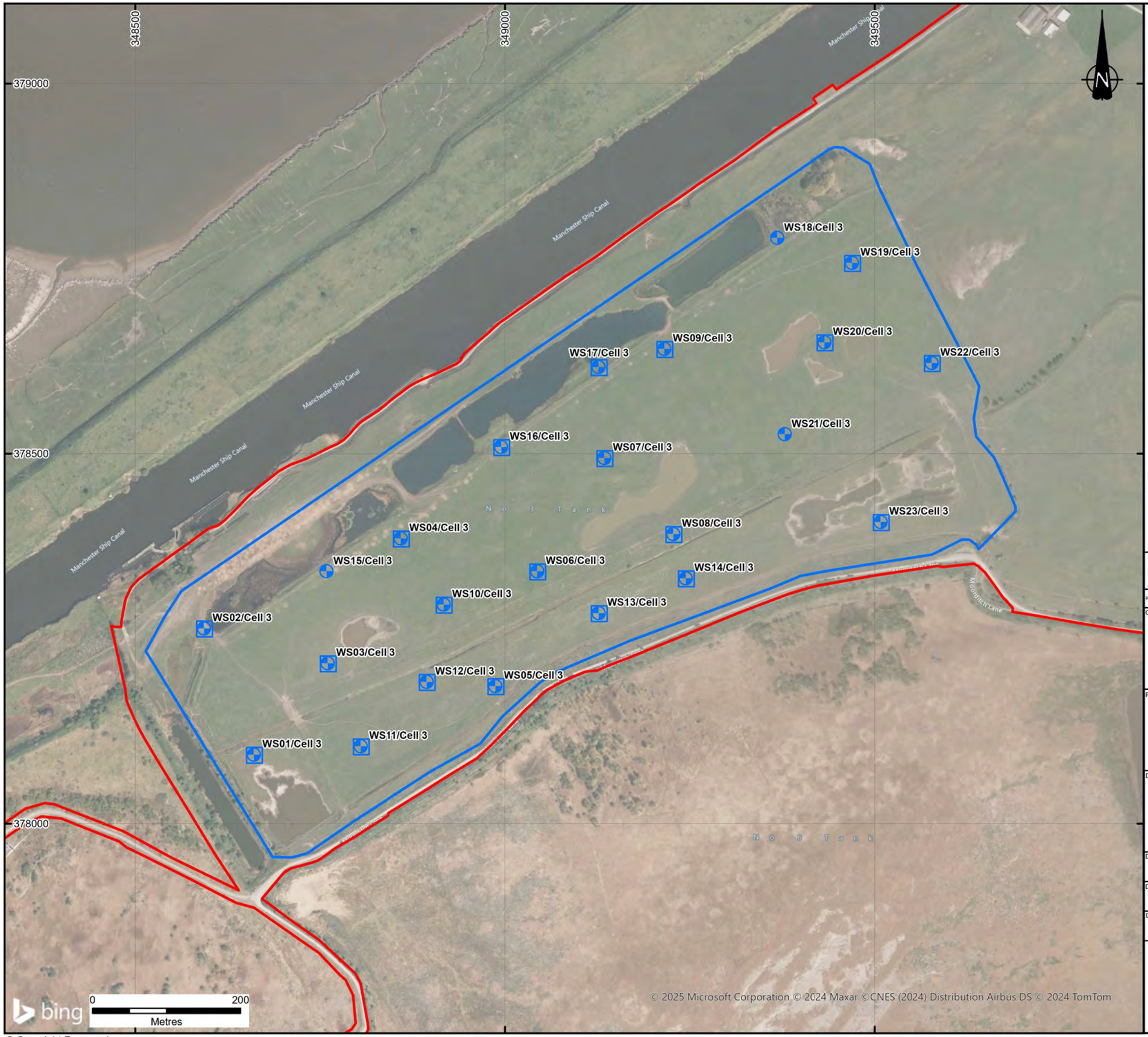
DRG No.	REV	SUIT. CODE
GM12793-004	C	--

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
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ENERGY AND CLIMATE CHANGE
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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

[redacted]

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ENERGY AND CLIMATE CHANGE
ENVIRONMENT AND SUSTAINABILITY
INFRASTRUCTURE AND UTILITIES
LAND AND PROPERTY
MINING AND MINERAL PROCESSING
MINERAL ESTATES
WASTE RESOURCE MANAGEMENT

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4 SOAKAWAY TESTING....8
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6 CONCLUSIONS....12

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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

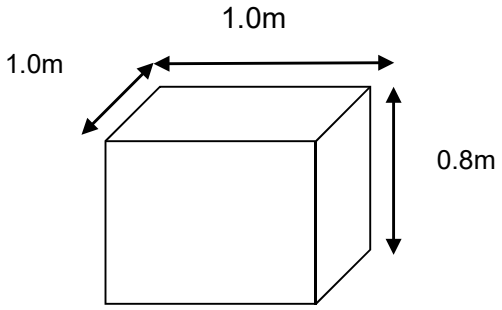
In-situ Soakaway Test Record – Test No: SA02

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.

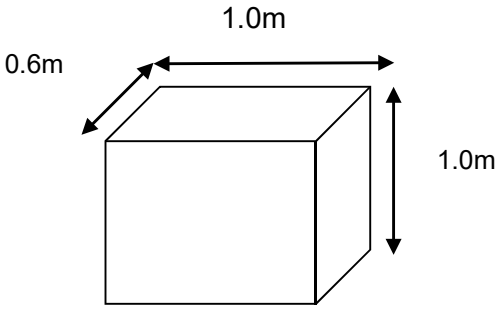
In-situ Soakaway Test Record – Test No: SA03

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

Approved by:

[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

[redacted]

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.
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: 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

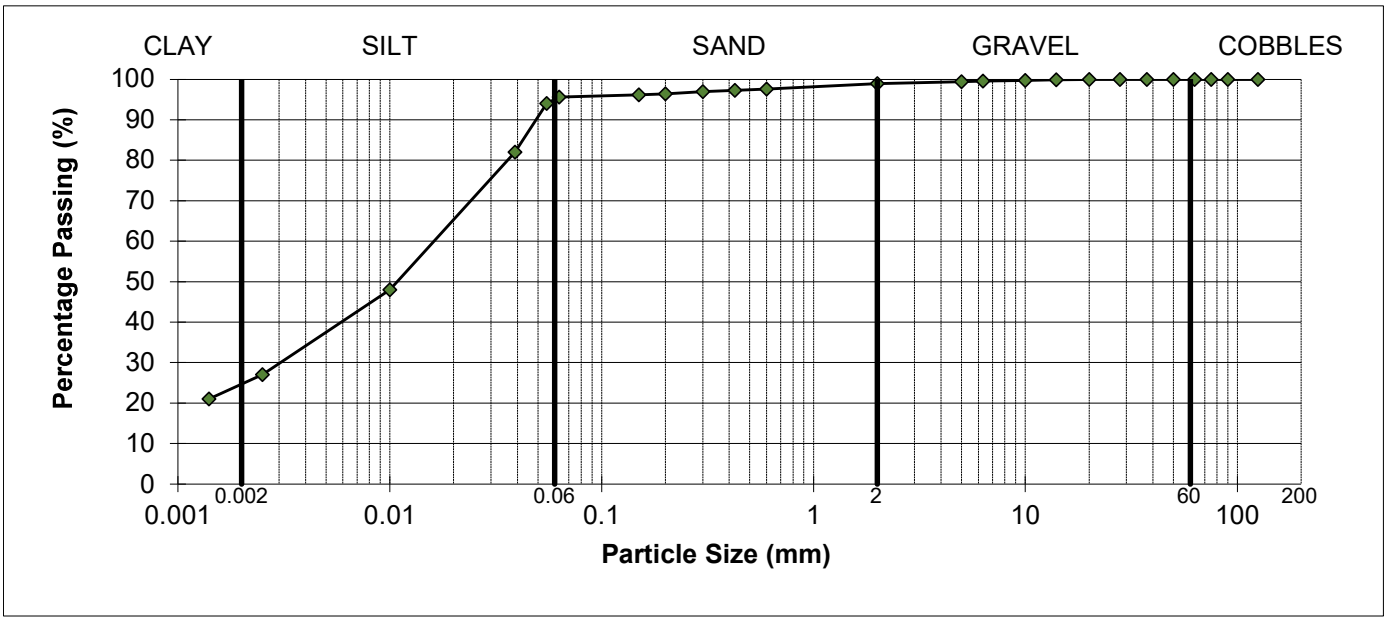
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

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 [redacted] ATE 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

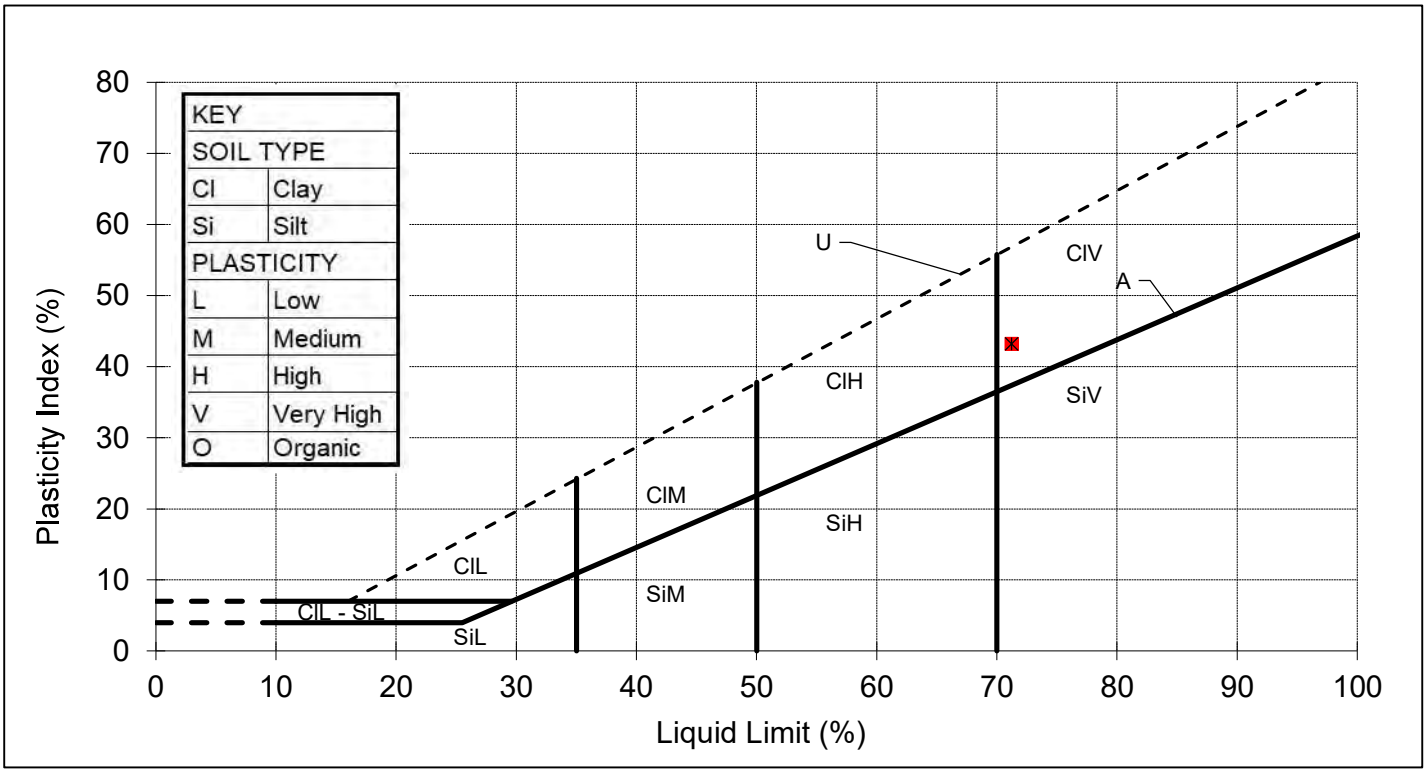
CLIENT	Wardell Armstrong LLP
SITE	GM13229 - Roseachre
JOB NUMBER	MRN 24066/3

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 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

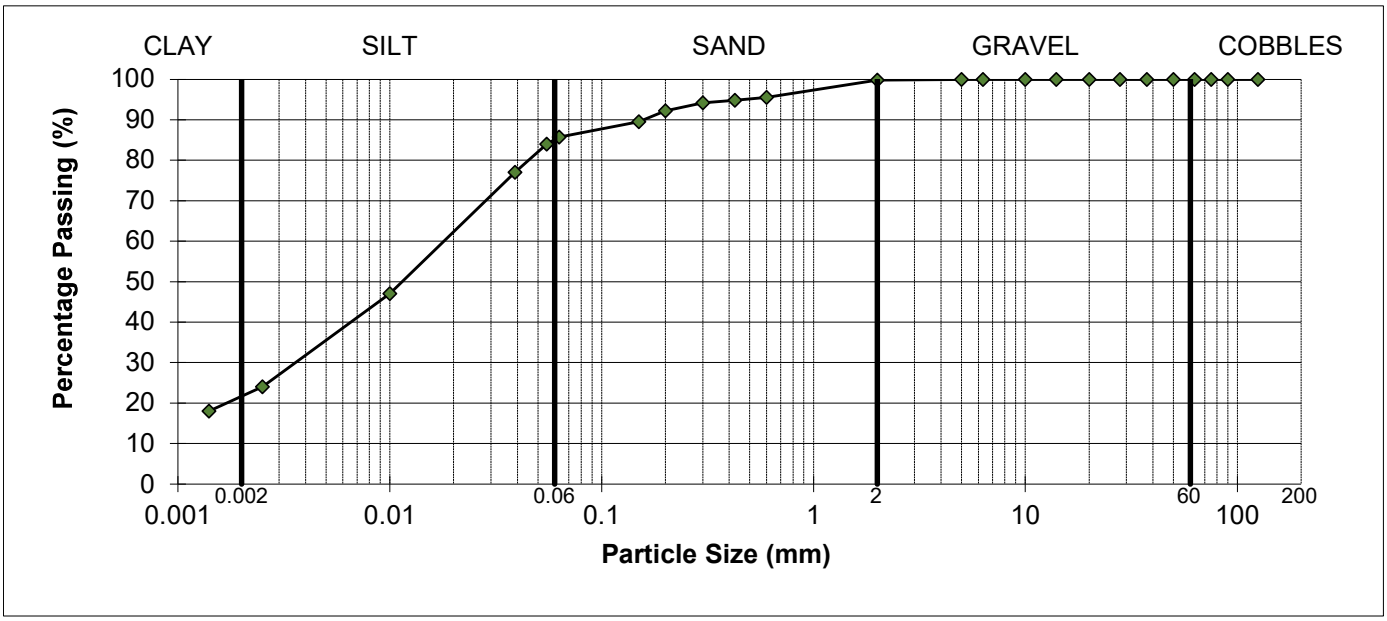
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

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 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

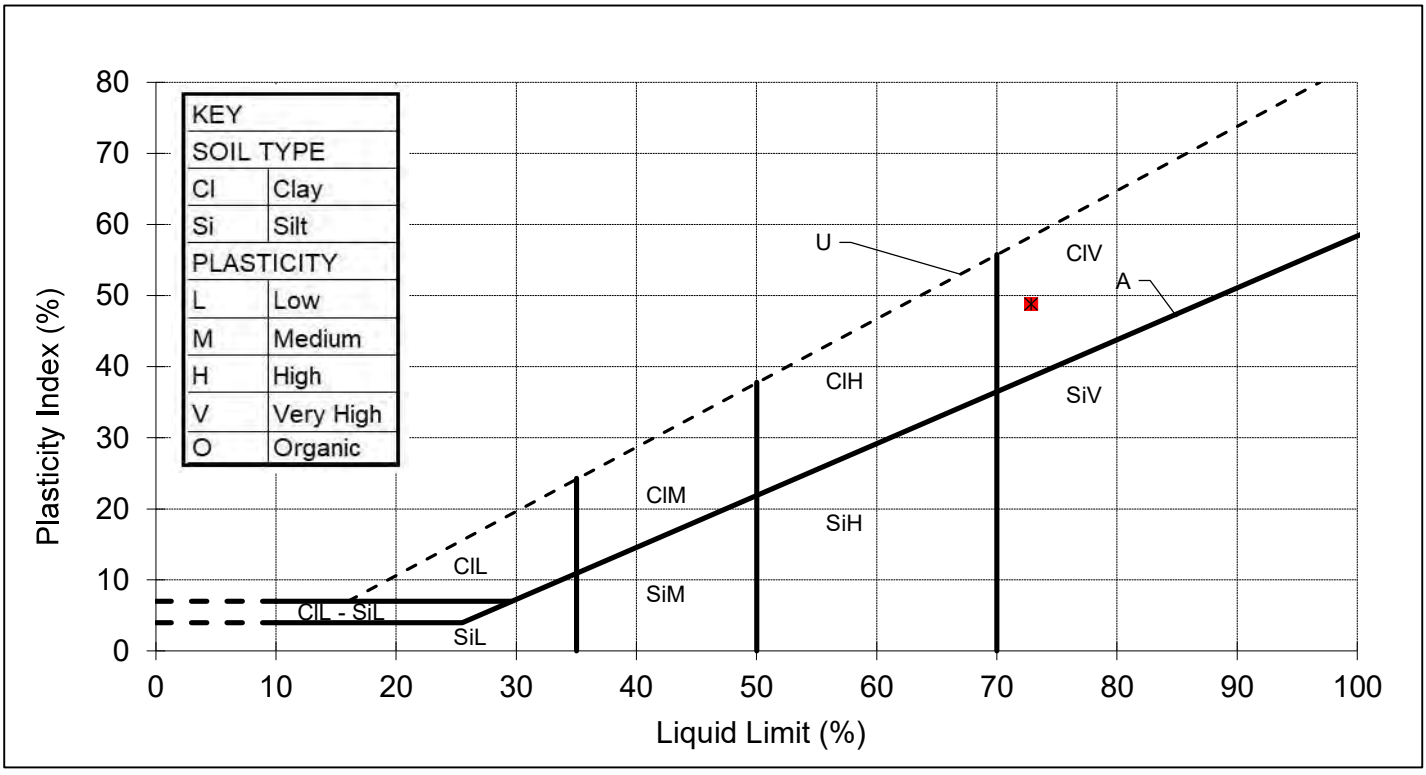
CLIENT	Wardell Armstrong LLP
SITE	GM13229 - Roseachre
JOB NUMBER	MRN 24066/3

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 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

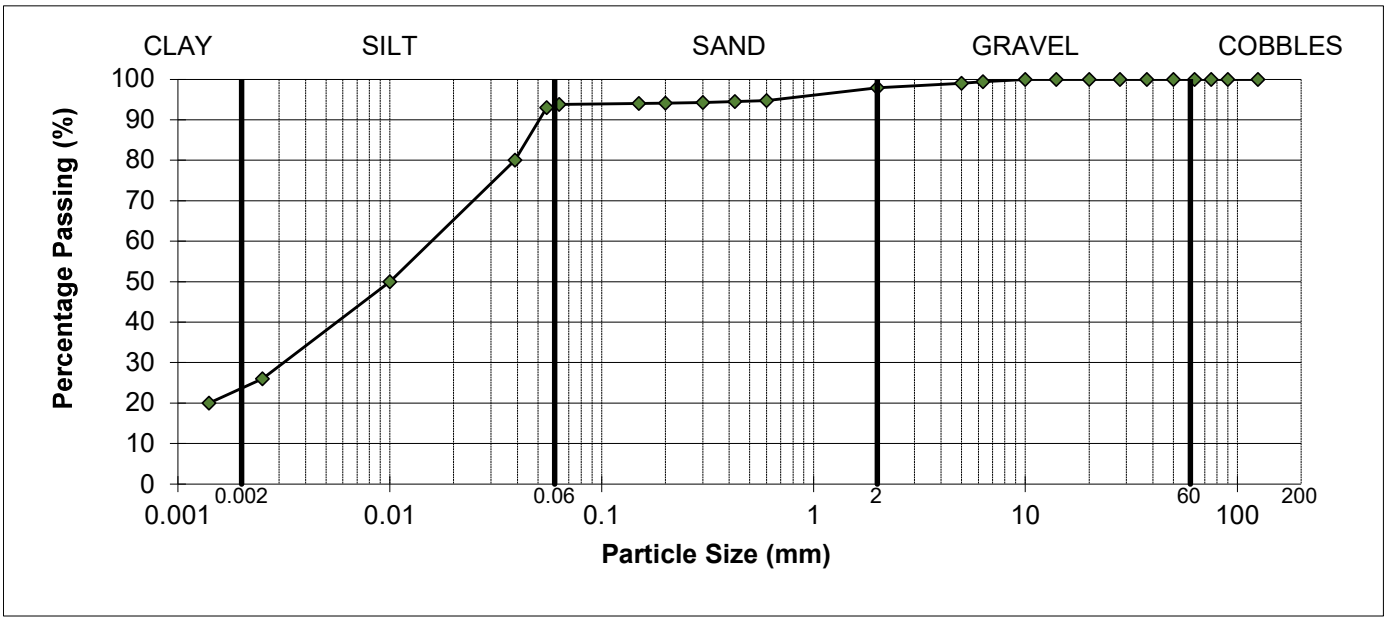
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

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 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

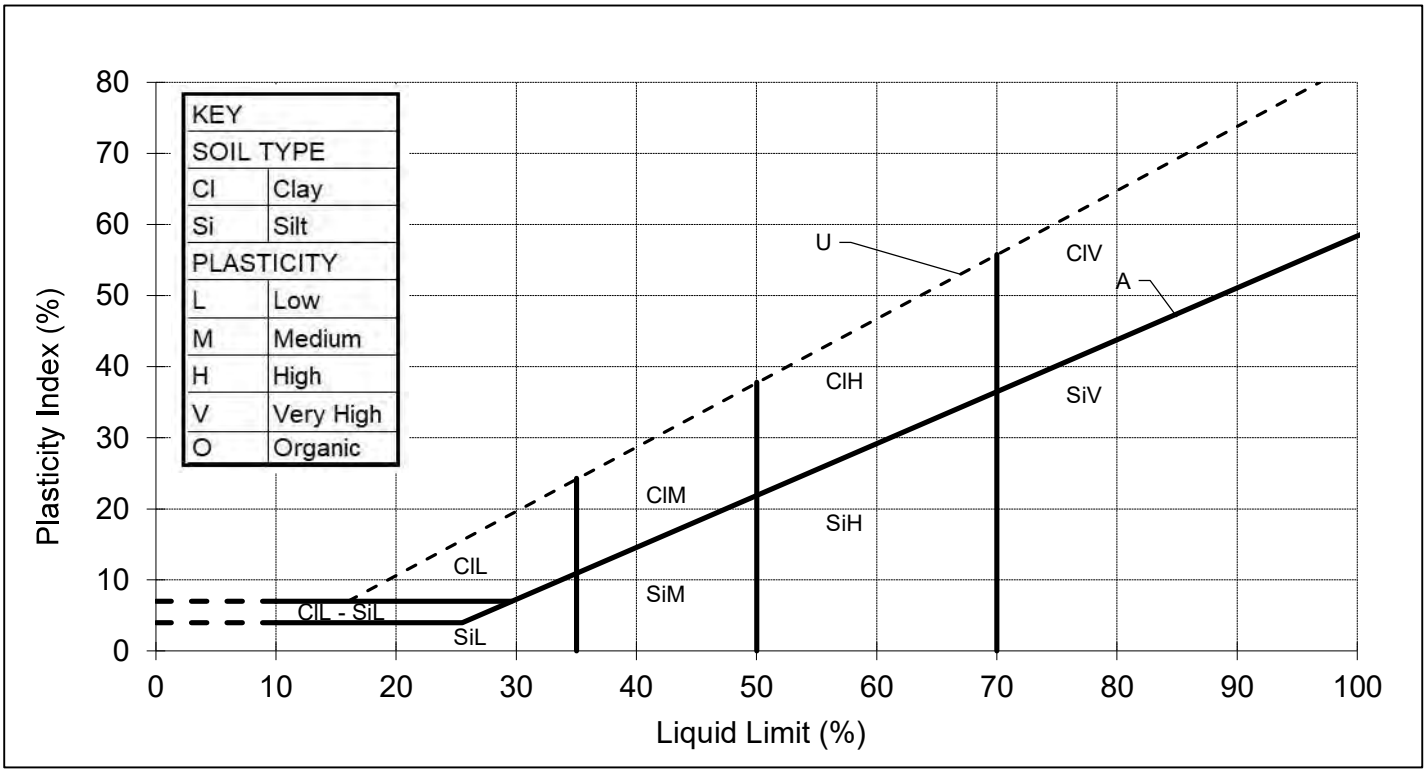
CLIENT	Wardell Armstrong LLP
SITE	GM13229 - Roseachre
JOB NUMBER	MRN 24066/3

SAMPLE LABEL	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 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

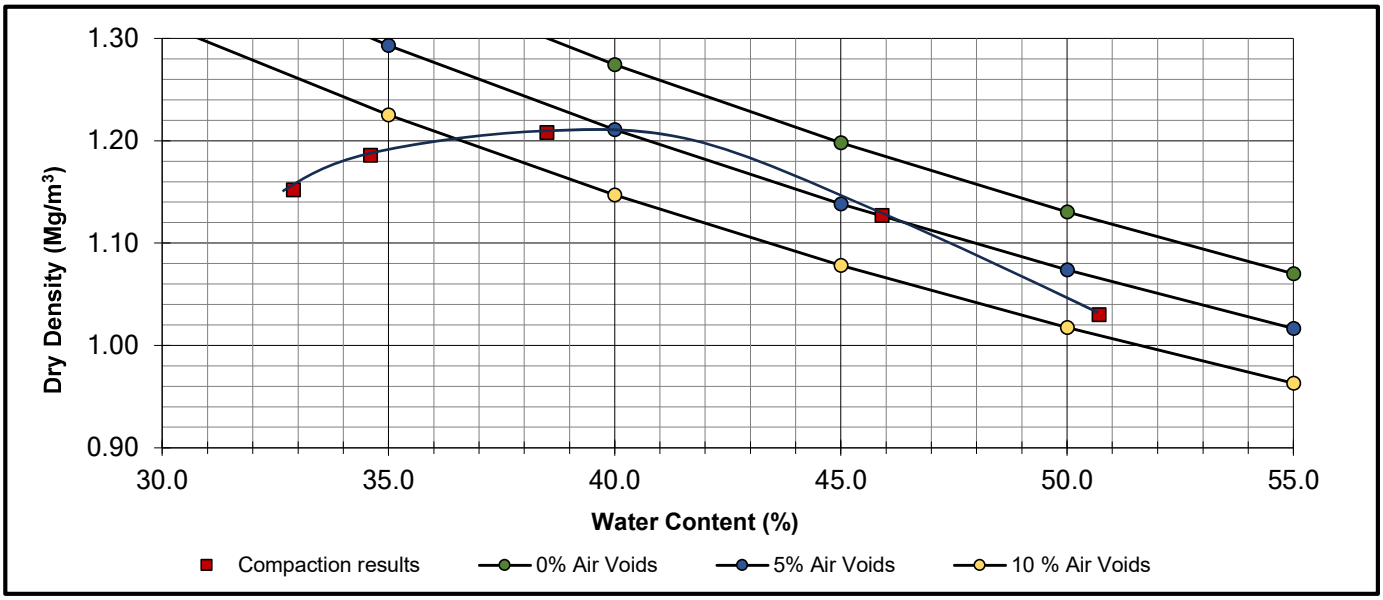
CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

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)

REMARK [redacted]

NAME [redacted] DATE 08-Mar-24

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] 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

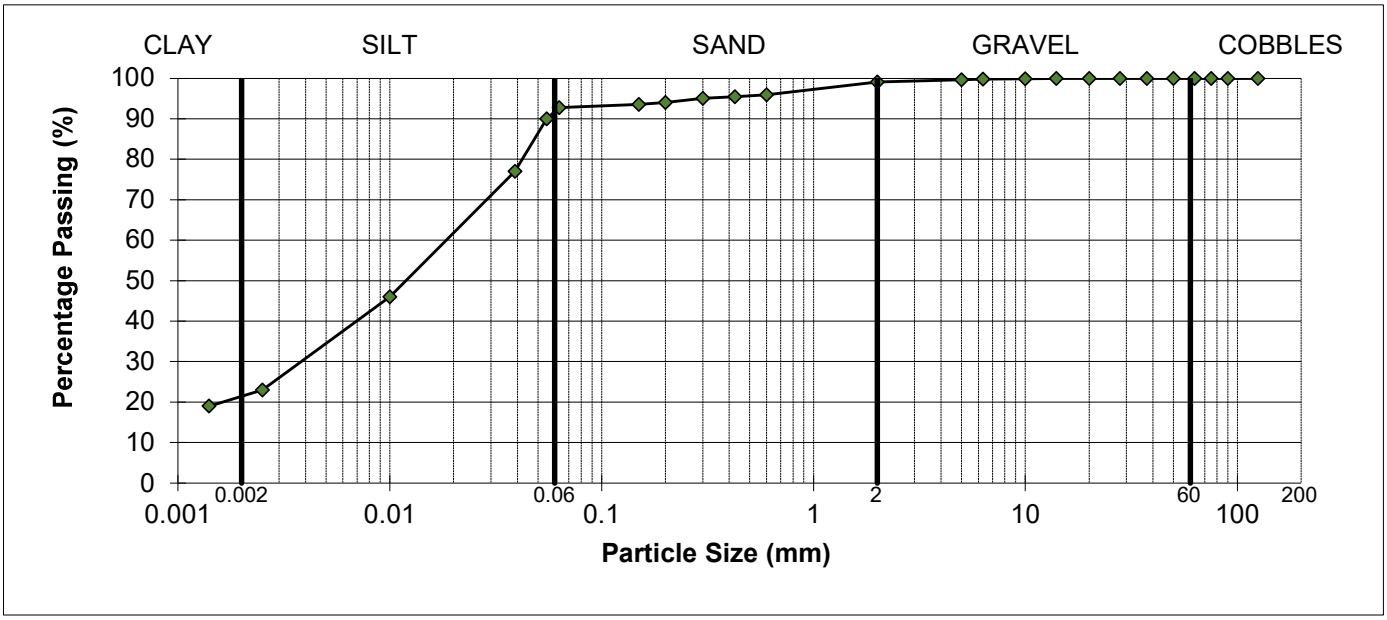
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	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

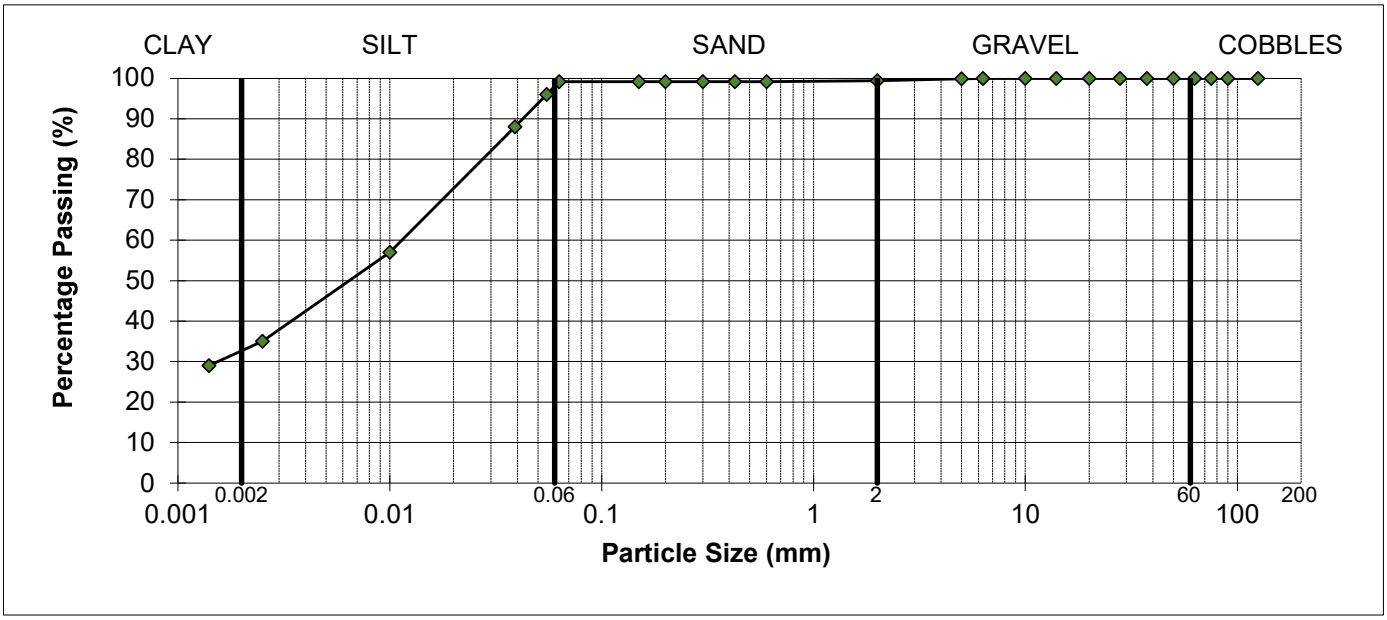
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

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 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

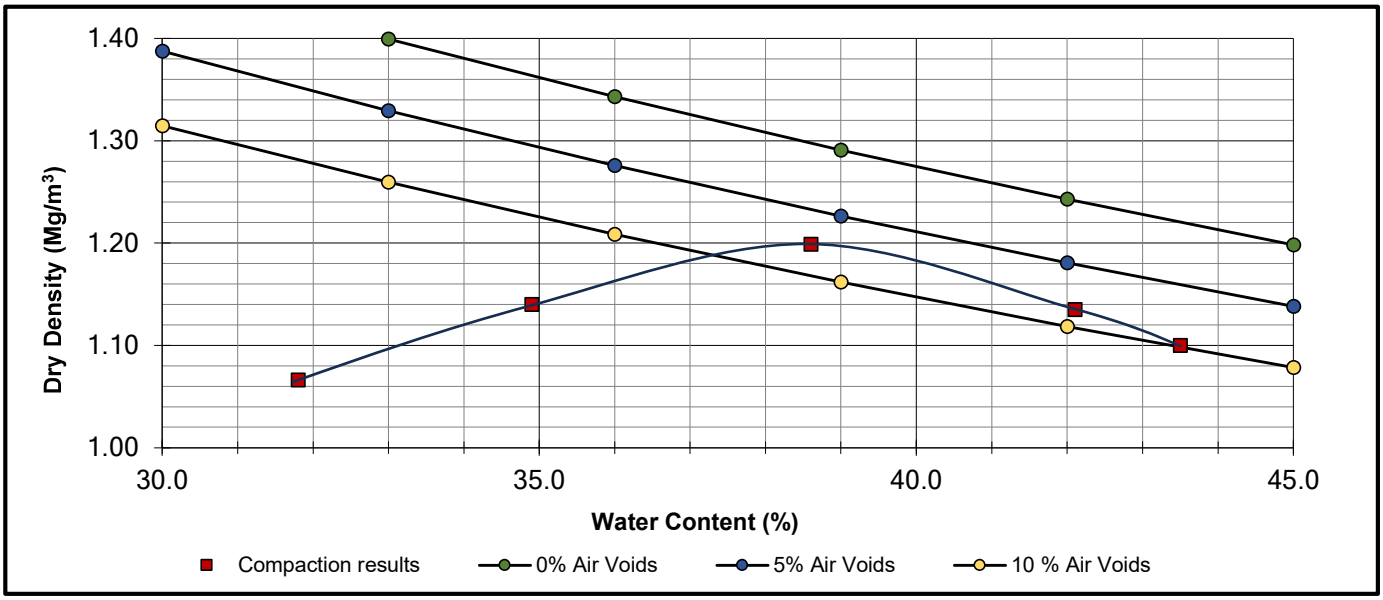
CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

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)

REMARK

NAME [redacted] 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

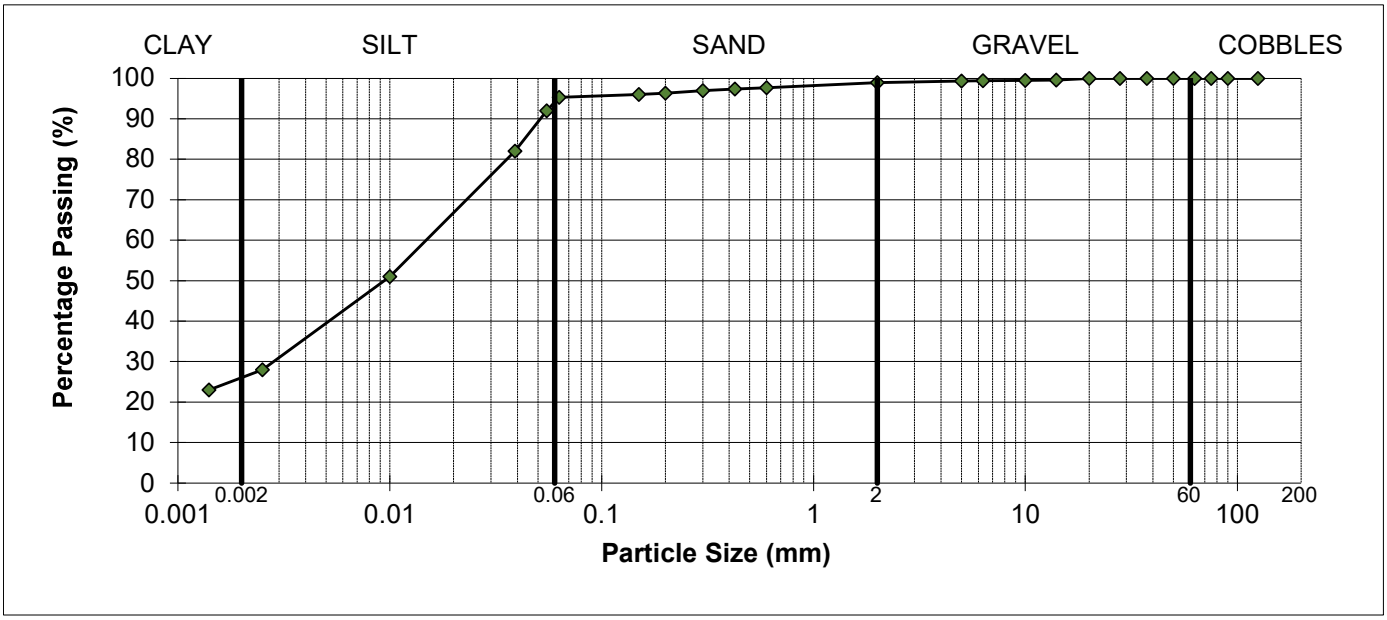
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	Wardell Armstrong LLP
SITE	GM12793
JOB NUMBER	MRN 24066/6

SAMPLE LABEL	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 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

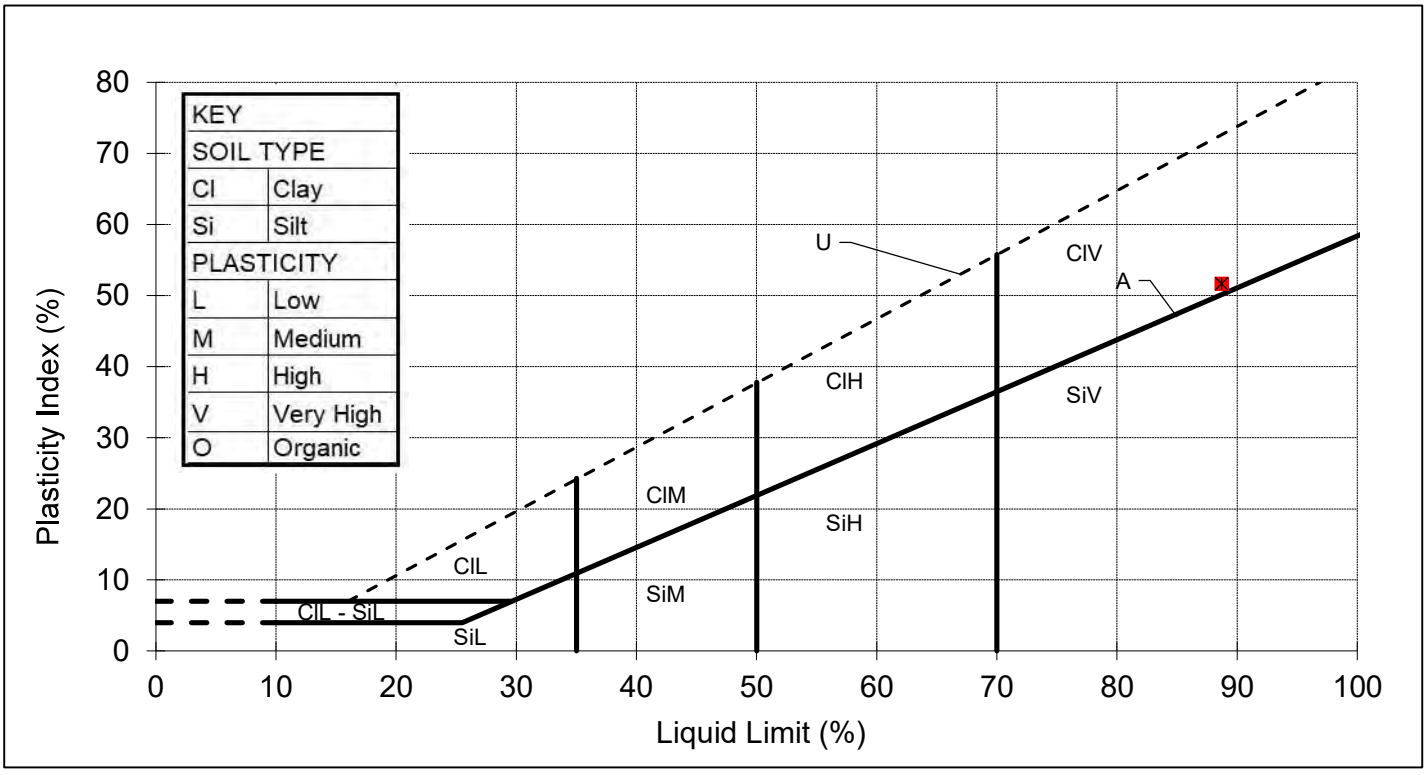
CLIENT	Wardell Armstrong LLP
SITE	GM13229 - Roseachre
JOB NUMBER	MRN 24066/3

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 [redacted]

SIGNED

NAME

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

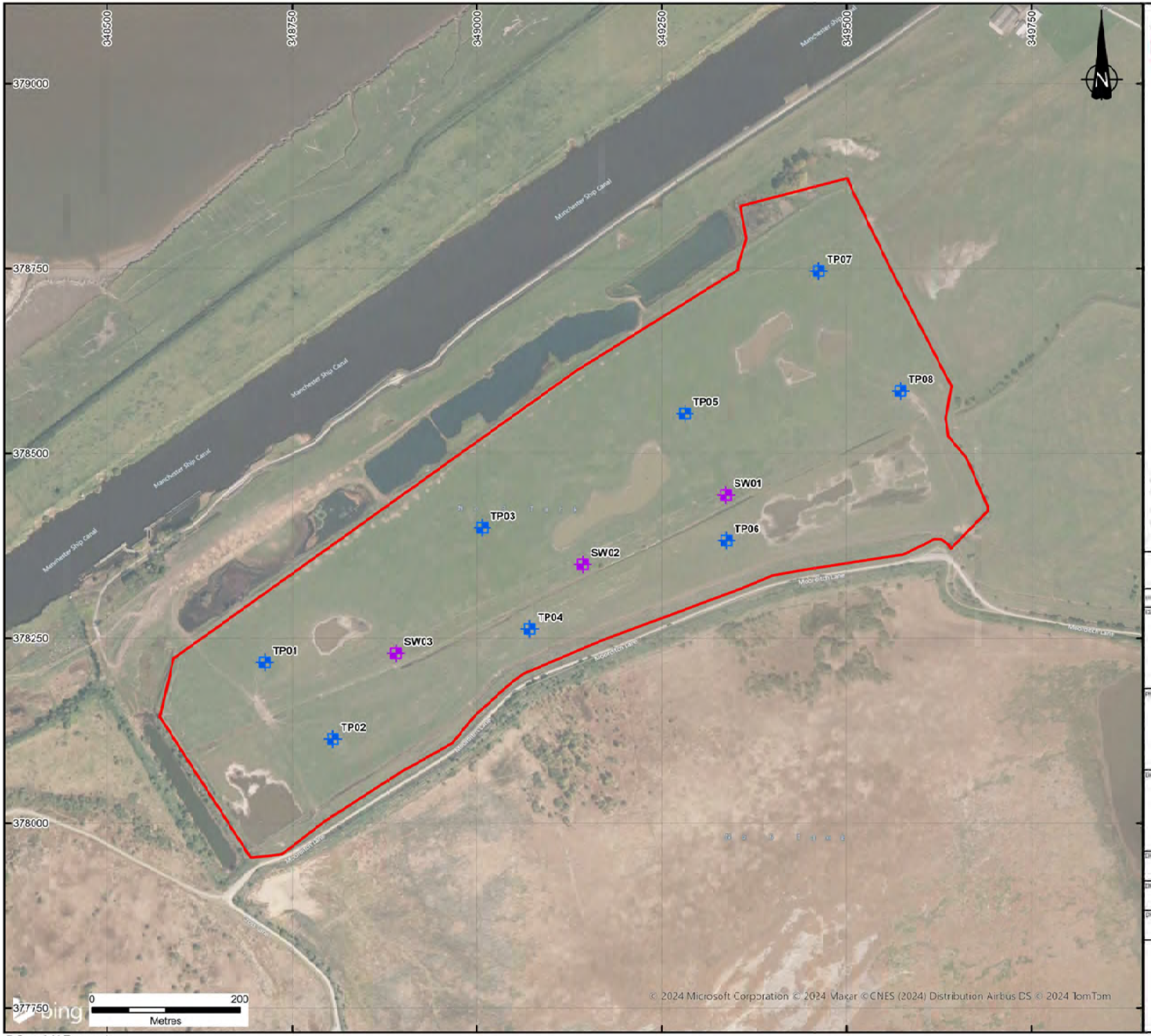
DRAWING TITLE

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		

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wardell armstrong

Wardell Armstrong
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i2 Analytical Ltd.
7 Woodshots Meadow,
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Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

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]

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.

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: 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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The results included within the report relate only to the sample(s) submitted for testing.

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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The results included within the report relate only to the sample(s) submitted for testing.

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.

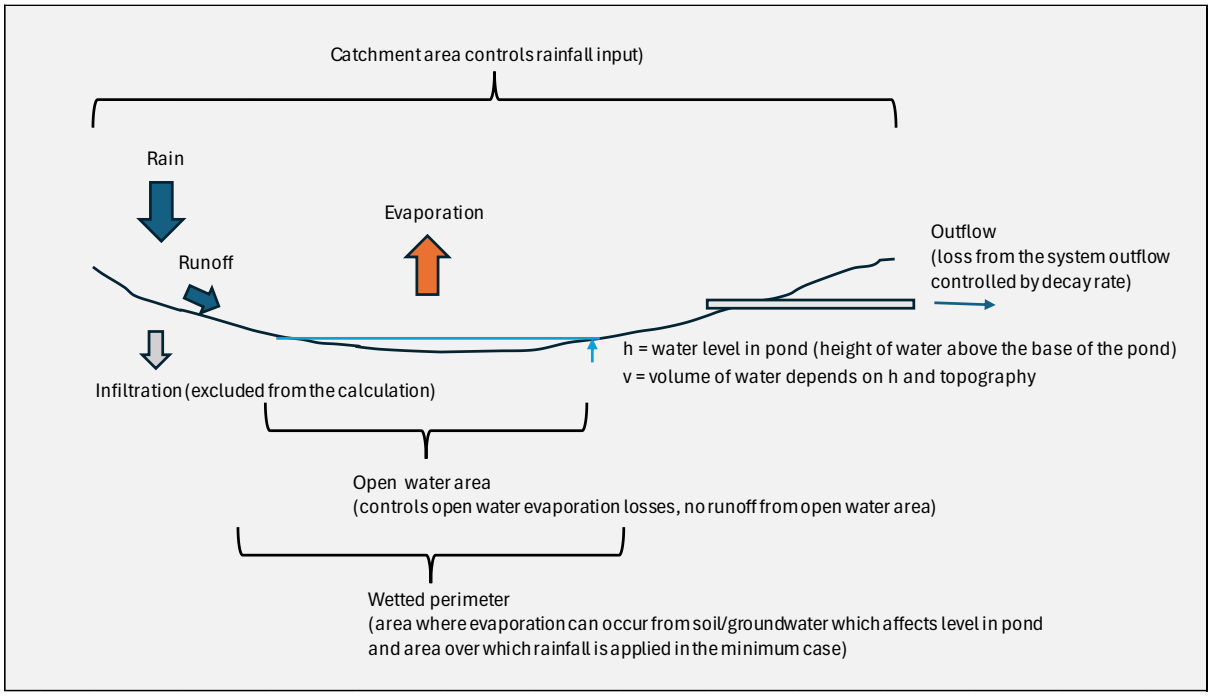


Figure 1. Schematic diagram showing inputs and outputs for the simple water balance model.

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.

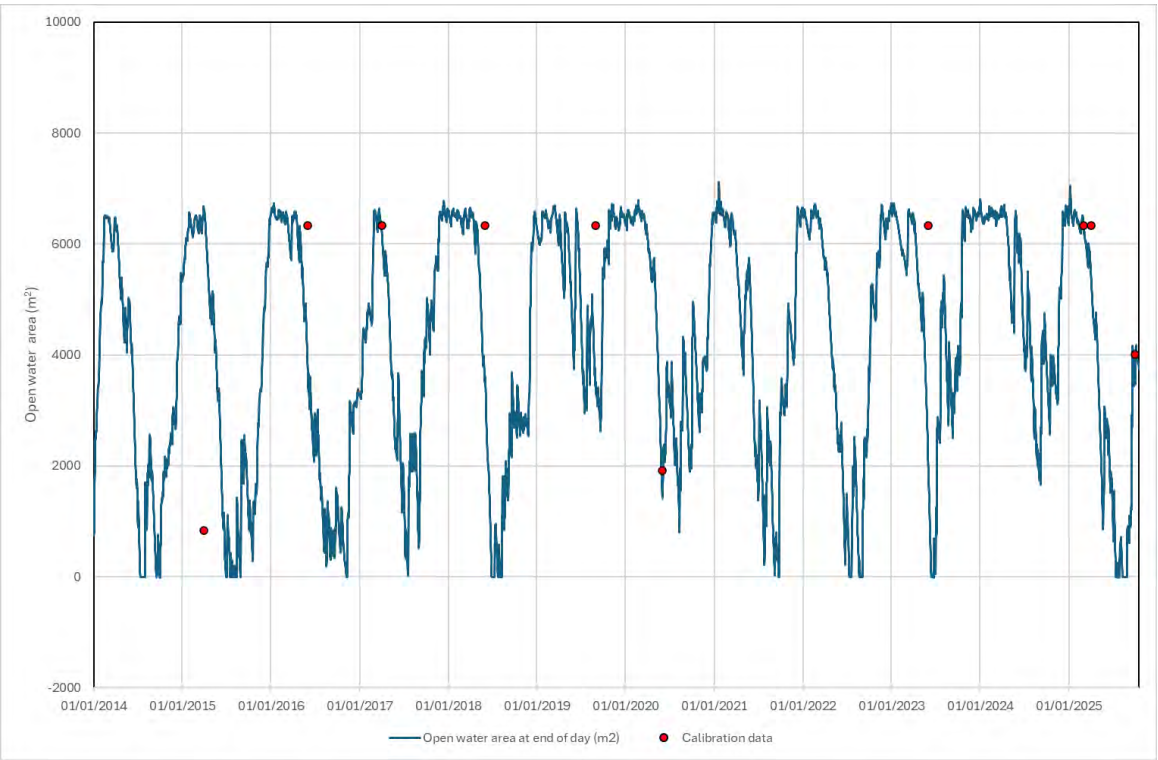


Figure 2. Calibration of the baseline model

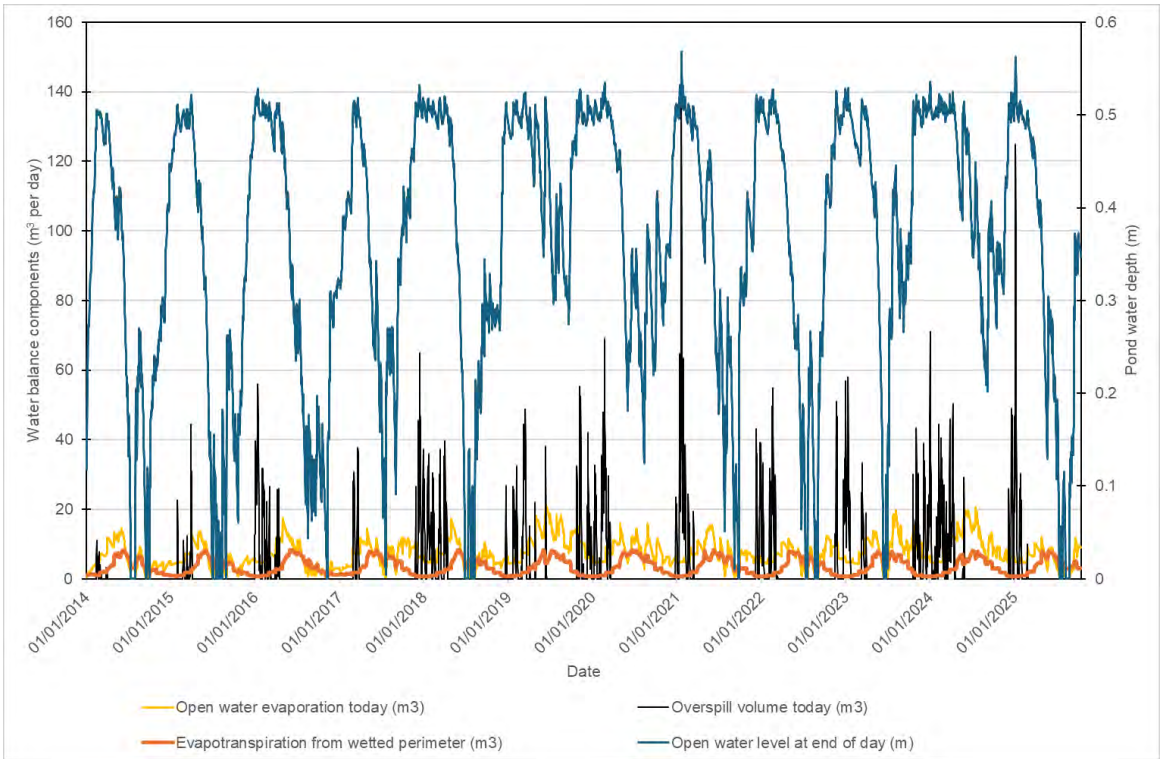


Figure 3. Baseline model: Simulated water levels and outflows

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.

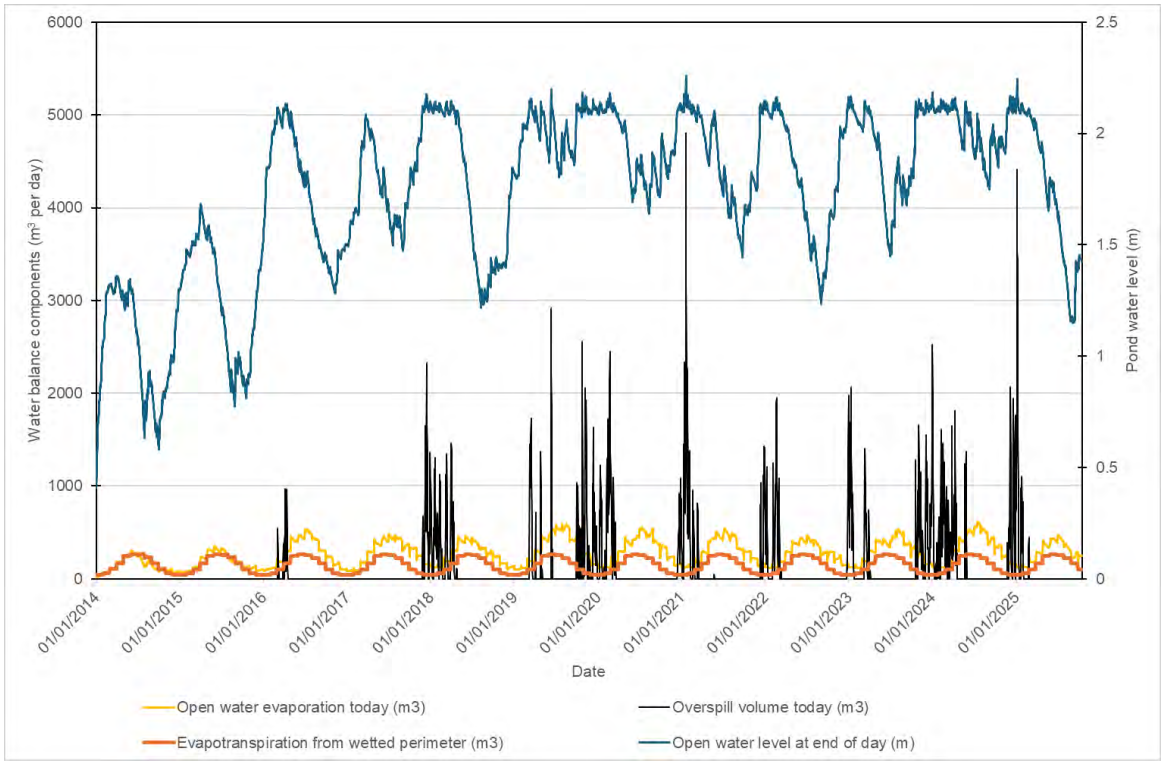


Figure 4. Scenario Model: Simulated water levels and outflows

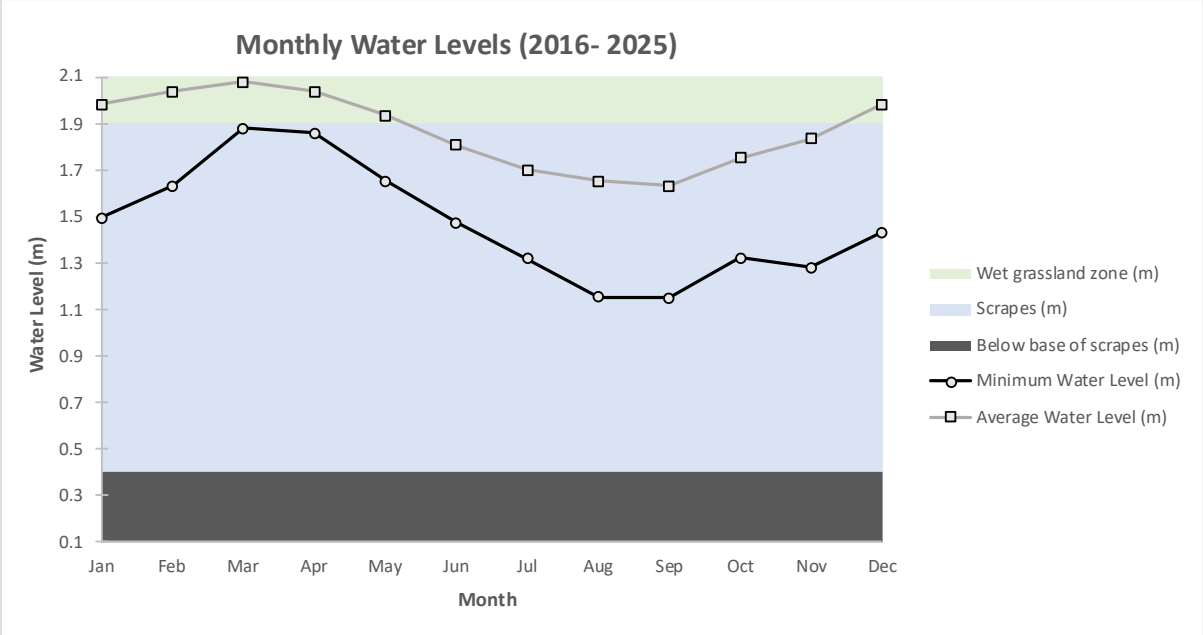


Figure 5. Simulated minimum and average monthly water levels

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.

7.0 Discussion

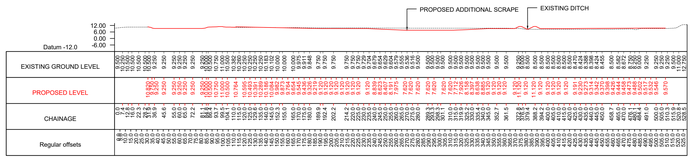
The results of the updated water balance assessment show that the indicative landform changes are likely to be successful at retaining water and ensuring that the wetness of the habitat is increased compared with the current situation.

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