Frodsham Solar DCO - EN010153

Written Representations

Cheshire West and Chester Council

(S90 of the Planning Act 2008)

(Rule 10 The Infrastructure Planning (Examination Procedure) Rules 2010)

Deadline 1

22 December 2025

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1. Introduction and terms of reference

1.1 This document is CWCC's Written Representations (**WR**), submitted at Deadline 1 of the Examination.

1.2 The WR has been prepared in the name of the Head of Planning and Place Making under the Council scheme of Officer delegation.

1.3 Consideration has been given to the National. Significant Infrastructure Projects: Advice for Local Authorities in preparing the WR.

1.4 The purpose of the WR it to clarify and supplement the CWCC's RR (**RR-037**), and the WR should be read in conjunction with the RR and Local Impact Report (LIR) which is also submitted at Deadline 1 of the Examination.

1.5 Cheshire West and Chester Council (**CWCC**) is the host local authority for the Frodsham Solar Project (**the Proposed Development**). The Order Limits of the DCO include land wholly within the administrative boundary of CWCC.

1.6 CWCC will endeavour to complete a Statement of Common Ground (**SoCG**) with the Applicant. The Applicant provided the Council with a first draft of the SoCG on 10 December 2025. Comments on this first draft have yet to be provided back to the Applicant. An update on progress will be provided for **Deadline 2** 19 January 2026).

1.7 The ExA's Rule 8 Letter of 16 December (**PD-008**) requires the written representation to identify those parts of the application where there is agreement and those parts with which there is not agreement, explaining the reasons why. The WR provides details of where there are concerns and the reasons for those concerns. A brief account is given where there are no particular concerns, and further details are expected to be included in the draft Statement of Common Ground.

1.8 At Deadline 1, the Council has also provided:

1) Summary of oral representations made on behalf of the Council at the issue specific hearing 1 (ISH1) held on 2nd and 3rd December 2025

2) The Council's Local Impact Report (LIR)

3) The Council's written responses on the draft DCO, along with a summary of comments on the ISH1 Agenda items including those items not covered in the oral representations at ISH1 are included as an Appendix to the WR (**Appendix A**). The items not covered in oral representations at ISH1 were:

    - Agenda item 5 b Access track impacts, removal and reinstatement
    - Agenda item 5i National Character Areas (NCA) (in relation to the landscape)
    - 5j Residential visual amenity assessment (RVAA)

1.9 Please note that whilst the WR does make reference where practical to the latest versions of the documents in the Examination Library including **PD2-001** to **PD2-033** the Council's comments on the documents provided at Procedural Deadline B (21 November 2025) will be made at Deadline 3 (28 January 2026) as set out in the Rule 8 letter.

2. Summary of key representations

2.1. **Biodiversity matters:** Biodiversity issues remain at the centre of CWCC's concerns.

2.2. As set out in the relevant representations and LIR there are multiple issues and concerns in relation to ecology (para. 3.6-3.8 of **RR-037**). CWCC have concerns that the provision of the Non Breeding Bird Mitigation Area (NBBMA)(and other ecological mitigations) are unlikely to be sufficient to mitigate for the Frodsham Solar development. The Applicant's approach of additive enhancement to the FWF mitigation centres around Cell 3 to mitigate for the proposed development occupying a substantial area of Functionally Linked Land (FLL) to the Mersey Estuary, and including development on land already performing as mitigation for Frodsham Wind Farm (i.e. Cell 2 and part of Cell 5) and areas of the site outside the designated mitigation areas that currently support non-breeding bird species, without any significant quantitative replacement habitat, is fraught with inherent risks to subsequent changes and events. The mitigation is concentrated in the central area of the NBBMA between the two main FWF east and west clusters of turbines. The NBBMS results in the bird population being more concentrated in one smaller area, with less opportunity for dispersal to other parts of the existing FLL. As a result, the mitigation provided would appear more vulnerable to adverse events, whether this be from predation, spread of invasive species or other unforeseen events. In addition, the solar panels render some of the currently unobstructed bird flight paths from the Mersey Estuary and within the Site, to other parts of the Site and FLL outside of the Site. This also applies to concerns regarding degradation of the Frodsham, Helsby and Ince Marshes Local Wildlife Site.

2.3. The Design Approach Document (**APP-130**) paragraph 2.5.2 refers to the Mitigation Hierarchy, and avoidance, followed by minimisation of impacts. The recommendations for suggested changes further below, are considered to assist in driving the project back up the hierarchy in a proportionate manner.

2.4. *"Applicants must apply the mitigation hierarchy and demonstrate that it has been applied. … Applicants should demonstrate that all residual impacts are those that cannot be avoided, reduced or mitigated"* (EN-1 Paragraph 4.2.11). CWCC have concerns that the mitigation hierarchy has not been followed.

2.5. **Appendix 25** to the LIR is a Welsh Government decision (October 2025) relating to a solar farm with battery storage units on land near Llanwern. Whilst the policy background differs and site circumstances will be individual to each scheme, attention is drawn to the decision as the issues in that case, in particular ecology landscape are in common with the Frodsham Solar situation. In terms of ecology, similarities include debate regarding the sufficiency of mitigation proposals

2.6. Paragraph 5 *“the proposed scheme is not located within any internationally designated ecological site, but it lies in close proximity to the Severn Estuary SPA, SAC, and Ramsar site, as well as the River Usk SAC*.”

2.7. Paragraph 10 *“ Several protected bird species use the site although most of the ornithological interests is of site or local value. However, there is particular concern for Lapwing, a red-listed species with a declining local population. While a 12-hectare mitigation area is proposed, NRW and others question whether it is large enough to fully compensate for habitat loss or support population recovery. Overall, the Inspector is not certain that the Lapwing mitigation area is a sufficient size to at least compensate for the loss of arable and open pasture habitat let alone reach the level of ‘enhancement’ needed to meet the section 6 duty in the Environment (Wales) Act (the Act).”*

2.8. Paragraph 12 *“Nevertheless, the Inspector considers their concerns in respect of the potential harmful effects on Lapwing and SCB are such that they offend the duty in the Act to protect and enhance biodiversity*”.

2.9. The stepwise approach in Wales (referred to in the above decision) differs from England, but the mitigation hierarchy principles remain.

2.10. **Other matters:** There are other concerns in relation to the impact of the development; notably adverse landscape and visual impacts, and adverse impacts in terms of the harm from allowing inappropriate development in the Green Belt and the associated loss of openness to the Green Belt. The Council does not consider these aspects to be effectively mitigated and the residual impacts need to be weighed in the planning balance. In addition, other concerns regarding biodiversity include protected species such as adverse impacts on Badgers and Otter populations, as well as lack of compensation for habitat losses proposed in terms of achieving no net loss.

2.11. **Overview:** CWCC support the principle of Frodsham Solar in terms of the benefits of addressing an acknowledged national urgent need in terms of developing renewable energy projects and expect this to carry great weight.

2.12. For the non-HRA residual impacts, such as the Green Belt and landscape aspects, there would need to be exceptional circumstances to outweigh the benefits; and the starting point for the test of very special circumstances in relation to Green Belt policy will be considered as being met (EN-1 paragraphs 4.2.16 and 4.2.17).

2.13. CWCC await Natural England’s comments in relation to the Habitat Regulation Assesement (HRA) matters, but at present in relation to the Mersey Estuary RAMSAR SPA and SSSI, it is not demonstrated that the development would not have a significant adverse impact on the Functionally linked land associated with the Mersey Estuary designation, due to impacts on functionally linked land. In terms of Habitat Regulation Assessment, it is the LPA’s view that the current Information to Inform Habitat Regulations Assessment has insufficient information on which the ExA, as the competent authority can make an assessment, and that the current information demonstrates adverse impacts on the Mersey Estuary RAMSAR and SPA.

3. Comments on the draft DCO

3.1. Below is a summary of some main comments in relation to the Articles, Schedule 1 (Authorised Development), Schedule 2 (Requirements), Schedule 12 and Protective Provisions (Schedule 25 and 26).

3.2. In addition, there are comments relating to the need for a planning performance agreement (PPA) as discussed in ISH1.

3.3. There were a number of issues raised at ISH1 whereby the Applicant was to consider the drafting of the DCO. CWCC reserves the right to comment on these proposed amendments in Deadline 3.

Articles

3.4. The main comments on the Articles relate to:

- **Definition of permitted preliminary works** – the removal of site clearance and remedial works from the definition due to concerns regarding control and fall outside of the construction phasing plan. There is the potential for significant impact on habitats which hasn't been accounted for. **Appendix A** sets this out in detail.

- **Article 8 - Defence to proceedings in respect of statutory nuisance** – CWCC is concerned that Article 8 goes further than the model DCO provisions in that it seeks to extend the defence to a statutory nuisance claim to not just the construction and maintenance of the authorised development but also the 'operation, use or decommissioning' of the authorised development. CWCC's position is that the additional wording takes the defence further than the model DCO provisions. In the Explanatory Memorandum there is no justification for the additional defence relating to the 'operation, use or decommissioning' and CWCC does not consider it necessary and takes the defence too far.

- **Part 3, Street Works - Articles 9-16** – concerns regarding the wide scope of the powers sought particularly in relation to street works undertaken outside of the Order limits which appears to go beyond what is required for the authorised development. **Appendix A** sets this out in further detail.

- **Article 39 Felling or lopping of trees and removal of hedgerows** – Article 39 should apply to approved removal and not retained features – see **Appendix A** for further detail,

Schedule 1 Authorised Development

3.5. The main comments on Authorised Development relate to:

- The ambiguity / duplication of creation of skylark habitat (Work No. 6A) and works to create skylark habitat (Work No. 6B); and the inclusion of 'maintain' in the definition as raised by the ExA at ISH1.

- Addition of Work No 6D to include creation and maintenance of habitat works (new scrapes) by the LUM (Fig 2.2. Indicative Operational Layout) of **APP-109** and new wetland area adjacent to the NBBMA (between fields A01 and A02)).

Schedule 2 Requirements

3.6. The main comments on the current draft DCO Schedule 2 Requirements relate to:

- **Requirement 2 – Commencement of the Authorised Development**
    - Add a requirement to serve notice on the relevant planning authority that the development is to commence. We would suggest 14 days' notice is served of when the authorised development is intended to commence.
- **Requirement 3 Phasing f development and final commissioning**
    - 3(4) add requirement for notification of the gross electrical output capacity / export capacity of each phase (and the cumulative total) to be confirmed as part of the notice
- **Requirement 6 Detailed design approval**
    - add to 6.1. provision of details of fencing; drainage; power cables (with details of conduiting); anti-reflective coating to solar modules; and landscape programme.
- **Requirement 9 – LEMP**
    - add reference to landscape implementation as well as management
    - 9 (2) b) hedgerows (add reference to hedgerows to be retained, and replacing gaps in existing hedgerows)
    - 9 (2) e) implementation timetable add 'for landscaping works' for clarity
    - 9 (3) add reference to replacement of trees on a 2:1 ratio, and hedgerows on a 3:1 ratio
    - 9 (4) add reference to LEMP being carried out for the operational life of the development
    - add reference to works being carried out in accordance with Arboricultural method statement (as well as LEMP)
    - add details of BNG monitoring
- **Requirement 12 – CEMP**
    - 12 (2) add the following: pre-construction updated habitat surveys; habitat constraints plan and precautionary measures; surface water management plan (including pollution control); community liaison plan and complaints procedure; security and lighting details; soils management plan; procedures and controls for working outside core construction hours;
- **Requirement 13 – OEMP**

  - 13 (2) e) Add need for updated CEMP and CTMP in relation to major replacement activities
  - 13 (2) add f) operational noise management plan
- **Requirement 14 – CTMP**
  - 14 (2) add reference to implementation of travel plan
  - add reference to carrying out pre and post-construction condition surveys of accesses (including PROW) and making good any defects caused at end of construction
  - inclusion of traffic routing, signage, management plan (with 'no tolerance' policy for contractor breaches)
  - need for updated CEMP in relation to major replacement activities
- **Requirement 15 – PROW**
  - add reference to publicity and signage of PROW diversions/closures
  - include details of measures to minimise the extent and duration of closures
- **Requirement 17 – Ground conditions**
  - add provisions for the sub mission of a remediation strategy and verification plan prior to construction. Add provision for a verification report to be submitted following completion of remedial work. The remediation strategy needs to address historic contamination. Rewording recommended in line with the Land Contamination Risk Management (**LCRM**) approach for dealing with land contamination.
- **Requirement 19 – Skills, supply chain and employment**
  - Add provision for monitoring, reporting and provision for an adaptive skills, supply chain and employment plan
- **Requirement 20 – Decommissioning**
  - Periodic review of commissioning end state (linked to monitoring of biodiversity)
  - Commencement of decommissioning following cessation of energy generation or duration of DCO (40years from final commissioning)
  - Provision for seasonal biodiversity surveys prior to final DEMP
  - Clarification of decommissioning end state (e.g. no mention of access tracks in Section 2.4 of oDEMP (**PD2-020**); provision of 'restoration plan'
  - Retention of habitat mitigation areas included in 'end state' for hand-back to landowners;
  - Addition of restoration aftercare provisions
  - Period for completion of decommissioning
  - See **Appendix A** for further detail.

3.7. A number of additional Schedule 2 Requirements are suggested, and the Council intends to hold further discussions with the Applicant regarding these. The main additional requirements suggested relate to:

- Construction hours – See Appendix A to this WR for example wording
- Unexpected contamination (possible addition to Requirement 17)
- Arboricultural method statement (possible addition to Requirement 9)
- Public rights of way diversions
- Permissive paths
- Provision for NBBMA management and monitoring, including period of post-decommissioning monitoring and mitigation to target state.

- Decommissioning fund/security
- Requirement for written approval of Schedule 2 requirements
- Undertaker to have pre-submission consultation requirement with consultation body prior to submission of application to discharge requirement
- Control over the programme of phasing for the Runcorn CO2 Spur pipeline (to avoid / control potential cumulative impact

3.8. Whilst recognising that there are advantages to deferring matters to the various control documents (oCEMP, oLEMP etc) such as providing flexibility, CWCC consider that it is important for certain elements to be covered explicitly in the requirements. There are a number of reasons for this, not least transparency.

3.9. The more streamlined and easier to navigate the various controls, the more efficient the discharge process is liable to be. Experience in dealing with TCPA permissions confirms that having a comprehensive list of planning conditions (requirements in the case of a DCO) forms the basis of understanding of what details/actions need to follow at the implementation stage. Commitments made in application submission documents can often be missed or inadvertently sidelined at the discharge stage. This is part of the reason for recommending key documents such as the NBBMS and oFlood Warning and Evacuation Plan are submitted and identified in their own right as opposed to being appendices to other documents (e.g oLEMP and FRA).

3.10. The added complexity and volume of accompanying material associated with the DCO process, demands a clear set of requirements and clarity in any documents to be certified. For example, exercising control under the Design Parameters Statement (**APP-132**) is liable to be more robust that reference to the Design Approach Document (**APP-130**). It may be preferable for the Applicant to extract relevant points to be certified from the Design Approach Document (e.g. Project Design Principles).

3.11. With reference to enabling efficient discharge of requirements, the suggested inclusion of a pre-submission consultation requirement prior to formal submission of a discharge application, with the relevant consultee (and preferably the host authority too) is liable to be essential for timely and positive discharge of the formal submissions.

3.12. The importance of the NBBMS, NBBMA and other habitat mitigation areas is so significant that it warrants inclusion with specific requirement(s) relating to the implementation and maintenance /management. Control to ensure an appropriate conservation body and the arrangements for long-term stewardship of the mitigation areas is critical.

3.13. Provision of a restoration plan to accompany the oDEMP would be consistent with EN-3 paragraph 3.10.137/ *"The Secretary of State should ensure that the applicant has put forward outline plans for decommissioning the generating station when no longer in use and restoring the land to a suitable use (taking into account paragraphs 2.10.59 and 2.10.60)".*

Schedule 12 - Procedure for the discharge of requirements

3.14. With regard to the procedure for discharge of requirements, the period of eight weeks appears reasonable to CWCC, on the basis that the 8 weeks starts again from the receipt of additional information if this is required.

3.15. In ISH1, the Applicant advised that they would amend the time period to appeal under paragraph 4(2) to 42 days. CWCC supports that amendment.

3.16. CWCC has some concerns that 5 working days for the appointed person to notify the parties of additional information required is too short in paragraph 4(3) and considers this should be more flexible and be provided as soon as reasonably practicable.

3.17. CWCC considers the timescale of 10 working days to submit representations pursuant to an appeal in paragraph 4(4) to be too short and would support an amendment to this time period to 20 working days in accordance with the aforementioned advice note.

Schedule 25 and 26 - Protective Provisions

3.18. **Schedule 25 – Protective provisions for the protection of the drainage authority** contains drafting irregularities and missing definitions. CWCC (in its capacity as LLFA) will share an updated draft of Schedule 25 with the Applicant and update the ExA at Deadline 2. It is expected that the content of Schedule 25 can be agreed relatively quickly with the Applicant.

3.19. **Schedule 26 – Protective provisions for the protection of the highway authority** – CWCC reserves its position on this Schedule until it has a chance to review the Applicant's position on the Articles in the dDCO relating to Street Works (9-16).

Planning Performance Agreement

3.20. CWCC is preparing a draft planning performance agreement to share with the Applicant with the intent that this provides the additional resource needed to ensure the timely discharge of the requirements post-decision. CWCC will update the ExA at Deadline 2 as to progress with the Applicant.

4. Biodiversity Matters

4.1. The following main biodiversity topic areas are dealt with below:

- Mersey Estuary RAMSAR, SPA and SSSI
- Protected Species
- Local Wildlife Sites
- Biodiversity Net Gain
- Peat
- EIA and HRA

Mersey Estuary RAMSAR SPA and SSSI

4.2. (7.7 RR) A substantial part of the Order Limits, serves as FLL to the Mersey Estuary SPA and Ramsar site, (as shown on Page 20 of the Identification of Functionally Linked Land supporting SPA waterbirds in the North-West of England – Phase 2 October 2023 Natural England Commissioned Report NECR483) (**Appendix B**) As per the Executive Summary, FLL is considered to be critical to, or necessary for, the ecological or behavioural functions in a relevant season of a qualifying feature for which a Special Areas of Conservation (SAC) Special Protection Area (SPA) Ramsar site has been designated.

4.3. Currently, it is not demonstrated that the development would not have a significant impact on the Functionally linked land associated with the Mersey Estuary.

Construction:

4.4. There are various issues in terms of construction impacts on non-breeding birds qualifying species for the Mersey Estuary that have not been fully assessed, and some impacts have been missed, which casts doubt over the assessment and therefore adequacy of mitigation proposals. This is in relation to noise and visual impacts during construction which could have been avoided by amendments to layout, impacts of flight path disruption not taken into account and also the phasing of the scheme in relation to functional level of the NBBMA.

4.5. (7.12 RR) The information on elevational differences between the Cells and whether this lessens or increases impacts on the NBBMA in terms of noise and visual disturbance seems to conflict between the two documents and does not seem to have been fully assessed to conclude whether these impacts are positive or negative.

4.6. (7.13 RR) Birds are currently flying over areas that will be subject to noise and visual disturbance generated whilst Cells 1, 2 and 5 are constructed, to get to and from Cell 3 and Cell 6. Figures 10a (Teal and Shelduck) and 10d (Black-tailed godwit) of the Environmental Statement: Volume 2 Appendix 8-1: Ornithological Survey Report (**APP-082**), demonstrates birds are flying across Cells 1, 2 and 5 to get to and from Cell 6. This issue of flight path disruption during construction have not been fully assessed.

4.7. (7.14 RR) Paragraph 8.7.43 of Environmental Statement: Volume 1 Chapter 8: Ornithology (**APP-041**) states that the noise and vibration assessments are detailed in ES Vol 2 Appendix 4-1: Noise Impact Assessment (**APP-054**). These identify that, without mitigation, predicted noise levels (LAeq) from construction works—particularly within Cell 3 of the NBBMA and areas within 180 m of Cell 3’s eastern boundary could exceed disturbance thresholds for qualifying bird species of the Mersey Estuary SPA and Ramsar site. It also states that Saturday works within 120m of the SSSI north of Cells 2 and 3 may also require mitigation, although it is not clear why Saturday works are singled out for assessment. Justification as to why the SADA in these areas was not reduced to ensure noise was not at a level of significant impact within range of the NBBMA, is required.

4.8. (7.43-7.45 RR) In Appendix 2-2 Construction Phasing (**APP-051**), the Western array construction begins immediately after the NBBMA construction is complete. In paragraph 8.7.28 of the Environmental Statement: Volume 1 Chapter 8: Ornithology

(**APP-041**), it is stated that the habitats in the NBBMA would become attractive to SPA species immediately on completion of earthworks, and therefore mitigation would be functional at that time. However, although some habitats will be ready for occupation by birds, such as the muddy areas, the wet grassland is unlikely to be in place immediately and so the area will not achieve the existing functional level prior to works and certainly not required for mitigation the impacts of construction on Cells 2 and 5. The Eastern Array recorded some non-breeding bird species and so no works should take place on this area until the NBBMA is functional. This will impact negatively on the non-breeding bird population.

4.9. The Skylark Mitigation Area is not included in the Construction Phasing programme. This should be in place prior to works on areas with breeding Skylarks, otherwise the Skylark population will be negatively impacted.

Operation:

4.10. There are concerns that the solar panels will cause displacement and reduction in population size of non-breeding bird associated with the designated site, due to reduction of land available for use and obstruction of flight paths from the site to functionally linked land within and outside of the Order Limits. There will be disruption of flight paths and foraging grounds originally protected under the Frodsham Windfarm Mitigation proposal. This will also reduce the area of Functionally linked land, decreasing its resilience and ability to sustainably support non-breeding bird populations and disrupt flight of non-breeding birds to and from areas of functionally linked land within and adjacent to the site. In addition, the introduction of an expanded and upgraded public right of way network across the marsh has not been fully assessed and should be reduced in extent near sensitive areas.

4.11. (7.15 RR) Frodsham Windfarm (FWF) Mitigation areas comprise Cells 2, 3 and half of Cell 5. These are areas dedicated to compensate for the impacts of the FWF development (displacement of non-breeding birds, access to and loss of functionally linked land). Currently, there is unobstructed access from the Estuary to mitigation cells 2, 3 and 5 and 6. Cell 6 is outside of the Order Limits, but adjacent to its boundary, mapped as functionally linked-land and recorded a high concentration of qualifying bird species during the bird surveys. Unobstructed access from the Estuary to Cell 6 was designed into the Frodsham Windfarm Mitigation proposal. Note that the one of the Windfarm mitigation obligations is to retain Cell 6 in its active dredging receptor state, due to its importance for non-breeding birds. The development of Cells 2 and 5 will reduce the unobstructed access gap between the two existing wind turbine arrays from 1.9km to 1.1km, restricting access for birds from the northern Estuary boundary to Cell 6. This is likely to have a significant effect on qualifying SPA species in terms of displacement due to disruption of flight paths and also use of existing mitigation cells 2 and 5 in conjunction with usage of Cell 6. Qualifying bird species have also been also recorded on Cell 1, as is the case historically and in some areas of the wider SADA (Eastern array), with a high concentration in an area known as “The Lum”, adjacent to Cell 1, with birds flying from Cell 1 to other mitigation cells on site.

4.12. There are concerns that during operation of the solar farm, the proposed solar panels in the western parts of Cells 2 and 5 will lead to disruption of the flight paths of birds flying from the Estuary to Cell 6, due to not being able to forage on Cells 2 and 5, glint and glare effects and possible issues with the birds mistaking the panels for water. It is noted that the Glint and Glare Assessment did not include impacts on ecological receptors. In paragraph 6.6.4 of the Information to Inform Habitats Regulations Assessment (APP-125), impacts are addressed briefly, stating that the bird species associated with the SPA/Ramsar generally move across the flat estuarine landscape in broad, dispersed flight paths, meaning their exposure to visual elements, such as solar panel reflections or structural outlines is brief and intermittent. This, however, does not address the scale of impact of such a large area of solar panels across the landscape. If exposure is accepted to be intermittent and brief, it still may not be insignificant, due to the scale.

4.13. (7.16 RR) The disruption of connectivity of Cell 6 from Cells 2 and 5 and part of Cell 3 also raises concerns regarding the fragmentation of the area of FLL, in terms of visual disturbance and reduction in area available to the birds to land around the favoured Cells 1 and 6. Although disturbance or displacement of qualifying bird species from FLL and disruption to bird flight paths due to glint and glare effects have been included as elements in the HRA, these have not been fully assessed and impacts on Cell 6 and therefore the FLL as a whole, have not been considered as an operational impact.

Footpaths:

4.14. (7.8 RR) Impacts from disturbance on the designated site due to the proposed increased and upgraded footpath/ PRoW network have not been included as an impact during the operation of the Proposed Development, which is a significant omission.

4.15. (7.18 RR) There are existing paths on Site, in varying condition and status. There are proposals to introduce new footpaths and upgrade existing ones, some of which will accommodate cycle and equestrian use. These elements will have negative impacts on the non-breeding species recorded on Site, in terms of human disturbance (visual and noise). Increased quality in footpaths will lead to more intense use and new footpaths will lead to disturbance across a wider area than currently occurs. The elevated position of some of the paths will also increase levels of disturbance.

4.16. (7.18) There is a new footpath proposed along part of the eastern boundary of the NBBMA (Footpath A) and the eastern and western boundaries of Cell 1 (Footpath B), adjacent to the Mersey Estuary as shown in Figure 1 Route Hierarchy plan in the Outline Landscape and Ecology Management Plan (APP-144). These footpaths cause the most concern in terms of impacts on non-breeding birds.

4.17. (7.21. RR) Bird screens are proposed for mitigation in some locations, as shown in Figure 2-3a and 2-3b Illustrative Environmental Masterplan of the Environmental Statement: Volume 3 Chapter 2 Figures. However, if these are deemed to be required along significant lengths of boundaries, it suggests that the impact is significant and that the design should be altered to achieve a wider buffer along that edge to avoid disturbance, as an avoidance measure. In addition, screens will only mitigate visual impacts for birds already landed on the Estuary side of the Site, not those within the Site.

4.18. (7.23 RR) It is stated in paragraph 5.6.19 of the Information to Inform Habitats Regulations Assessment (APP-125) that during the operational phase, disturbance or displacement could occur through the development delivering increased public access to the land; however, this is considered likely to be comparable to the current farming related activity levels and recreational activities, which include unregulated fishing within the NBBMA. This is not concurred with, as there is a significant difference in small-scale infrequent impacts that ad-hoc fishing and operation of machinery cause, as opposed to a network of new and upgraded footpaths across the area. Further assessment is required.

4.19. (7.25. RR) Recreational disturbance is an identified pressure on the Mersey Estuary RAMSAR/SPA/SSSI, with additional Habitat Regulations Assessment requirements on residential developments within the Zone of Influence (DEFRA Magic mapping) and a Recreational Mitigation Strategy formed by neighbouring local planning authorities (Merseyside Environmental Advisory Service).

4.20. (7.26 RR) The Frodsham Neighbourhood Plan (see Policy Compliance Document (APP-129) has policies specifically in relation to recreation, aiming to support recreation for developments only where there is no impact on biodiversity. Policy EDVE2: Tourism and the Visitor Economy of the Frodsham Neighbourhood Plan states that "Proposals that enhance and improve existing tourist attractions and facilities or that create new sustainable tourism opportunities will be supported where they are in accordance with Local Plan policies ECON3 and STRAT9. Subject to their accordance with other relevant policies in the Neighbourhood Plan, developments will be supported, where they:

4.21. • Demonstrate that potential effects on biodiversity, noise and environmental impacts have been explored and avoidance and mitigation measures employed"

4.22. • Will not result in adverse impacts on the ecological value and function of Frodsham Marshes

4.23. (7.27 RR) Policy GSRL4: Creating New Green/Open Spaces of the Frodsham Neighbourhood Plan states: To encourage developments that create or develop additional green community/recreational spaces. In accordance with other relevant policies in the Neighbourhood Plan, development will be supported where they:

4.24. • Will not result in adverse impacts on the ecological value and function of Frodsham Marshes.

4.25. These policies are currently not complied with.

Decommissioning:

4.26. There are concerns with decommissioning of the non-breeding bird mitigation area, due to the impacts being different to that during construction, due to the birds having been restricted to smaller areas. There are also concerns with long-term management of the NBMMA not being secured, with no control over its apparent decommissioning if handed back to landowners.

4.27. (7.30 RR) Throughout the relevant documents it is stated that as the land would be handed back to the landowners on completion of decommissioning, the long-term retention of the landscaping improvement works cannot be assumed. This is concerning when considering the likely dependency of qualifying bird species on the NBBMA and has not been fully accounted for in terms of adverse impacts at the decommissioning stage. The impacts could be worse than at the construction stage, as the provision of land for non-breeding birds is in a much smaller area than currently, so will be significantly more vulnerable to disturbance. This should be reassessed. If the non-breeding bird mitigation area is not retained post-development, this is a significant impact and not comparable to construction activity impacts, as is asserted. A possible solution could be retention of the NBBMA in the long-term.

4.28. (7.31 RR) Part-decommissioning will occur when the solar panels require replacement approximately halfway through the Proposed Development (Table 2-13 Indicative Operational Lifespan of Proposed Development Components (Chapter 2 Proposed Development (**APP-035**). The NBBMA will be more vulnerable to disturbance than currently, where the birds are spread across a wider area. With the construction traffic routed along the southern boundary of Cell 3 (Appendix A of the Transport Assessment (**APP-134**)), this means that the qualifying bird species are vulnerable. This impact has not been taken into consideration. This will also coincide with the Frodsham Windfarm decommissioning (2042) and this has not been considered as a cumulative impact.

4.29. (7.47 RR) Some of the documents refer to the NBBMA being taken on long-term to form a reserve. Due to the long-term success of the NBBMA being essential to the integrity of the designated site, this approach of specialised long-term management is agreed with, however, there is no confirmation of this at this stage. This is required to be secured.

Cumulative Impacts:

4.30. There are concerns that the cumulative construction impacts of the Runcorn Carbon Dioxide Spur have not been fully assessed or mitigated for. The pipeline route runs through the most sensitive areas of the Order Limits in terms of non-breeding birds, restricting timelines for reducing impacts. Impacts should be fully assessed, mitigated for and controlled securely.

4.31. (7.33 RR) the Runcorn Carbon Dioxide Spur Pipeline project (Ref 78) in paragraph 6.7.3.1 of the Information to Inform Habitats Regulations Assessment (**APP-125**), it is stated that the pipeline runs through Cells 1, 2 and 5, but in Paragraph 7.1.6 goes on to state that it runs through Cells 1, 3 and 5 as well. The route of the pipeline has changed during the PEIR stage, which may explain the inconsistency. The pipeline is proposed to run through Cell 1, Cell 2 and Cell 3 (NBBMA) and so introduces further additional impacts to the Cells included in the Non-breeding Bird Mitigation Strategy (NBBMS), as well as Cells used by qualifying SPA bird species elsewhere in the Order Limits. This could have significant adverse cumulative effects on the NBBMS. The only likely lower impacts would be if the pipeline was installed at the same time as construction works on each of the Cells involved. Further assessment and detail is required on how this can be achieved and how significant impacts will be avoided.

including assessment of the various phasing scenarios between the two projects and all sensitive areas within the site and how significant impacts will be avoided.

4.32. This could have significant adverse cumulative effects on the NBBMA and further assessment and detail is required, including assessment of the various phasing scenarios between the two projects and all sensitive areas within the site and how significant impacts will be avoided.

4.33. (7.34 RR) The Frodsham Wind Farm will be impacted by the project in terms of its mitigation and also in terms of the mitigation proposed for the Proposed Development. This should be included as a project for assessment of cumulative/in-combination effects. See Operational impacts section.

Survey Data and Non-Breeding Bird Mitigation Strategy:

4.34. There are concerns that the survey data is not robust enough on which to base a Non-Breeding Bird Mitigation Strategy and that the methodology used is flawed. This means that impacts to non-breeding bird populations are more significant than currently assessed and the NBBMS is inadequate. In addition, the principle of providing a higher quality smaller mitigation area in place of larger mitigation areas is flawed, as this will reduce areas for birds to move if displaced, render the bird populations more vulnerable to disease and reduces the contiguous area of functionally linked land and therefore its resilience and long-term viability.

4.35. (7.36 - 7.41 RR) No single year of the three years of non-breeding bird surveys included all areas of the site, and only one year had surveys of the NBBMA, leading to queries regarding the robustness of the data and therefore the mitigation proposal. Even with the inconsistent survey data, wide usage of non-breeding qualifying bird species was recorded across the Site.

4.36. (7.52-7.56 RR) Cleeve Hill Solar Park Mitigation: The Cleeve Hill Solar Park Mitigation is referenced in the report as an example of how to calculate the amount of area required for non-breeding bird mitigation. However, there seem to be conflicting figures through the documents, between the Information to Inform Habitats Regulations Assessment (APP-125) and Outline Non-Breeding Bird Mitigation Strategy (oNBBMS) (APP-144). The 2024/25 non-breeding survey data is not included in the ONBBMS. The Cleve Hill example does not account for the fact that the majority of the proposed NBBMA is already acting as a NBBMA, casting doubt on its application to this development and value in mitigation strategy.

4.37. (7.49-7.51) Documents state that a key focus of the NBBMS is in relation to foraging habitats for curlew, lapwing and golden plover, i.e., those SPA species which regularly utilise grassland habitats and for which FWF provides some specific mitigation. However, other SPA species impacted by the Proposed Development, such as Teal, Shelduck, Dunlin, Redshank and Black-tailed godwit also require mitigation and this has not been taken into account.

4.38. The new NBBMA, which comprises Cell 3 and a small section of Cell 2, is proposed to compensate for the loss of existing mitigation Cells 2 and 5, as well as areas that recorded qualifying bird species in the rest of the Site. The proposed reduction in existing mitigation areas means that the bird population is dependent on one smaller area of mitigation land, reducing the ability to use different areas nearby if temporary or permanent disturbances occur on that land. The range of the bird population will be reduced and it will become more vulnerable to disease, competition for food resources and overcrowding.

4.39. This will have significant impacts on the non-breeding bird population and designated site.

Protected Species

Breeding birds

4.40. There are concerns that the Skylark Mitigation Area has been reduced significantly since the PEIR stage of the development without justification, that the SMA is not appropriately located and has not been surveyed to assess current Skylark presence and therefore suitability. In addition, those breeding birds relying on mitigation in field edges may be disturbed by the introduction of new and upgraded public rights of way, which has not been assessed.

4.41. (7.58 RR) The introduction of footpaths along some of the green buffers between the development and areas retained for breeding bird mitigation in the Western and Eastern Arrays has not been assessed in terms of impacts on these areas. This means that impacts could be higher than have been mitigated for.

4.42. (7.60 RR) There is no clear explanation of the Skylark baseline currently on Site in terms of area, quality of habitat and distribution, and how the proposed mitigation (NBBMA and Skylark Mitigation Area (SMA)) is adequate. The SMA location is not near to any areas where Skylark were recorded during the surveys, as they favoured the northern area of the Site, across Cells, 1, 2 and 3. The survey results as shown in Environmental Statement: Volume 2 Appendix 8-1: Ornithological Survey Report (**APP-082**), show that of the 21 pairs recorded, there are nine pairs of Skylark in the NBBMA area already, as well as in Cells 1, 2 and 5. The Proposed Development will significantly restrict their current range, due to lack of open areas and disturbance from new and upgraded footpaths. This could mean that the Skylark Mitigation Area is not adequate and could reduce the Skylark population in the area.

4.43. (7.77-7.80 RR) The SMA has not been fully surveyed for breeding birds to establish the baseline. Other bird species may be impacted by the proposed enhancements for Skylarks and this has not been assessed. If Skylarks are not using the area currently, there should be an assessment as to why this may be. This could include non-habitat related factors, such as location beneath pylons and proximity to the M56 motorway, which are both potentially sub-optimal factors for a species that are known to avoid predator-perches. As stated in 8.8.44 of Chapter 8 of the Environmental Statement Volume 1 Chapter 8: Ornithology (**APP-041**) "Skylarks prefer large, uninterrupted landscapes free from tall trees or hedgerows, which supports their territorial displays and reduces predator risk." This is a further concern noting that the SMA has been reduced from approx. 30ha at the PEIR stage, to 5.5ha. This could mean that the Skylark Mitigation Area is not adequate and could reduce the Skylark population in the area.

Bats

4.44. There are concerns that trees proposed for removal have not been subject to bat survey and so bat roosts presence and the mitigation and compensation measures required are unknown.

4.45. (7.83 - 7.84 RR) Paragraph 7.7.16 of the Environmental Statement: Volume 1 Chapter 7: Terrestrial Ecology (APP-040) stated that no trees with features suitable to support roosting bats were identified during the PEA or during either the 2023 or 2024 extended UKHab surveys. Paragraph 7.7.72 of the Environmental Statement: Volume 1 Chapter 7: Terrestrial Ecology (APP-040) states that trees present within the Main Development Area would be retained and protected during construction. However, the Frodsham Solar Arboricultural Assessment (APP-146) details removal of G034 to enhance the NBBMA, and G067, G069, a section of G099 and A106 to facilitate the development.

4.46. It should be confirmed that the trees listed for removal in the Arboricultural report were surveyed for bat roosting potential. If not, Bat roosting surveys should be carried out on these trees by a suitably qualified ecologist to best practice guidelines.

4.47. Further tree surveys could be required, to ascertain the status of the bat population on site and any mitigation required. It is likely this could be mitigated for in terms of roosting provision with retaining tree roosts and attaching limbs to other trees and bat boxes on retained trees.

4.48. (7.85-7.88 RR) Bat surveys were carried out July-November 2023, which missed the Spring survey season and did not include the NBBMA. During some surveys the static detectors stopped working. Paragraph 7.8.32 of the Environmental Statement: Volume 1 Chapter 7: Terrestrial Ecology (APP-040) states that any individual length of hedgerow removal would likely be no greater than 6m. This would be unlikely to significantly disrupt any bat foraging lines and proposed planting (proposed no closer than 50m to any existing wind turbines) would compensate for these losses. Although the activity surveys were limited, due to the lack of likely significant impacts on foraging and commuting habitats and likely benefits to such habitats from the proposals, there are no significant concerns regarding foraging and commuting bats.

Otters

4.49. There are concerns regarding the obstruction of Otters from feeding areas, due to solar farm fencing and fencing of the NBBMA, over this extensive area of suitable habitat. This could reduce the natural range of Otters in the area.

4.50. (7.89-7.91 RR) 7.6.27 and 7.6.27 of Environmental Statement: Volume 1 Chapter 7: Terrestrial Ecology (APP-040) and 7.6.26 of Environmental Statement: Volume 1 Chapter 7: Terrestrial Ecology (APP-040) concluded that the mustelid scats and mammal holes found in the NBBMA were likely to be Otter. It is not clear why further survey work, such as erecting cameras in the locations where evidence was found, were not carried out, to confirm the finding and provide a robust baseline.

4.51. Paragraph of the states that "the larger ditches located along the southeastern boundary of the SADA, together with the series of ponds and ditches located within the NBBMA, may be suitable for resting, foraging or commuting otter." These ditches provide a likely route for Otters from the River Weaver up to Cell 6 and through to the NBBMA.

4.52. Therefore, presence on site is assumed as in 7.6.28 of Environmental Statement: Volume 1 Chapter 7: Terrestrial Ecology (APP-040) which states "Taking into account the desk study records, the presence of suitable habitat within and adjacent to the Main Development Area and the extensive home range of otters, it is considered likely that otters are utilising watercourses located within the Main Development Area and may occasionally utilise the ditch network"

4.53. (7.92-7.93 RR) 7.8.45 and 7.8.110 of the of the Environmental Statement: Volume 1 Chapter 7: Terrestrial Ecology (APP-040) states that "Although the Proposed Development will result in the cessation of access to otter within the NBBMA, considering the presence of suitable habitat within the surrounding landscape such as the River Weaver, extensive network of ditches remaining available to otter within the SADA and within surrounding the Site, and large open waterbody directly south of the Main Development Area (in Cell 6), the cessation of access to the NBBMA is unlikely to adversely affect free movement of otter throughout the landscape, or the availability of food or shelter resources." Relying on areas outside the control of the Applicant to justify or mitigate impacts caused by the Proposed Development is not accepted.

4.54. 7.93-7.94 RR). Otters are likely travelling to the NBBMA to use a food resource, likely due to the fish within the fishing pools. The fishing pools will be removed and the area will be fenced off as part of the NBBMS so that Otters will no longer be able to access the area. This is likely to remove an important food source, causing displacement and restricting the local range of the species. In terms of range, it is assumed that the solar panels fences will not restrict access through the ditch network in the SADA. If this is not the case, further assessment is required.

4.55. It is not clear whether Otters are using the Manchester Ship Canal or travelling through the SADA to get to the NBBMA. Mitigation measures have been considered if they are travelling through the SADA, such as standard buffers from watercourses, any new crossings being open-span and some existing culverts being upgraded to open-span crossings, which will enhance some ditch connectivity. This however, does not mitigate for the loss of food resource and loss of access to the NBBMA that the development proposes, where Otters are likely present currently. This is likely to have a negative impact on the local Otter population and restrict their range.

Badgers

4.56. The applicant should make simple changes to the proposed layout to ensure appropriate buffers from the network of setts are implemented. There are concerns that the development will obstruct badgers foraging and commuting routes and that the introduction of footpaths will displace badgers from the area, due to the limited areas on the Marsh on which they can build new setts coinciding with the areas where upgraded and new public rights of way are proposed. Recommended surveys by the applicant's own ecologist and requested by the LPA to ascertain commuting and foraging impacts have not been carried out.

4.57. (7.105 RR) Comments within the CWCC PEIR Response remain largely the same and are substantiated by an expansion in the Badger population on Site in range and size, as well as further impacts due to the introduction of an expanded and upgraded footpath network. There is an extensive population across the Site and impacts from solar farm construction and operation, including introducing long-term human disturbance in the form of an upgraded and expanded footpath network, have not been fully mitigated or compensated.

4.58. (7.106 RR) Although discussions with the Applicant were based on the fact that most of the setts are on field/embankment boundaries so are unlikely to be impacted due to the biodiversity/landscape buffers proposed, paragraph 4.4.2 and 4.4.3 of the Environmental Statement: Volume 2 Appendix 7-2: Protected Ecological Species Baseline Report (Confidential Badger Annex) (**APP-078**) state that [redacted], [redacted] and one main sett and three outlier setts [redacted]. The "avoid" step of the mitigation hierarchy has not been followed, with standard 30m buffers from Badger setts not designed into the proposed layout. Simple amendments in the proposed layout would reduce direct impacts on Badger setts during construction and operation.

4.59. (7.108 - 7.109 RR) In terms of Badger commuting and foraging, there is a likelihood that Badgers foraging territory, or links between them, will be disrupted. This is due to the predator-fencing around 64ha of the 253ha of the Site and the rest of the solar array is proposed to be fenced. The solar array fencing will have mammal gaps, but access to the areas of land will still be significantly restricted.

4.60. Badger bait-marking surveys were previously requested, to obtain information about interactions between setts and different badger clans on Site, as well as pathways through the Site, so that impacts could be clearly understood and mitigated. This study was also recommended in paragraph 4.5.25 of RSK Survey in Annex 2 Frodsham Renewable Energy Development Preliminary Ecological Appraisal Report (RSK Biocensus, 2023) (Redacted) of Environmental Statement: Volume 2 Appendix 7-1 (**APP-075**). The recommendation in the report was made when there were only 2 main setts and 5 outlier setts on Site in 2022 and no footpaths were proposed i.e. when potential impacts were significantly lower.

4.61. In addition, a proposal for an upgraded and extended footpath network across the Order Limits has been proposed. Some of these are on the raised areas between Cells, in a similar location as the Badgers. [redacted], likely due to the scrub habitats present and some areas within the Cells being wetter and/or flooding. This means that the badgers' opportunities to create new setts away from human disturbance if required and ability to respond to sett closures is reduced, again, increasing significance of impacts. [redacted]

4.62. as shown on Figure 1 (Indicative Route Hierarchy) of the Outline Landscape and Ecology Management Plan (APP-144) is a [redacted]

[redacted] These should be re-routed and/or downgraded.

Reptiles

4.63. Justification on survey extent is required.

4.64. (7.113 RR) The Site provides suitable Reptile habitat in the form of marshy and rough grassland with hedgerows and a ditch network. Reptile surveys were undertaken in 2022 on the Preliminary Site Boundary. This did not include the NBBMA, which comprises ditches and larger open water areas, so a different habitat to the rest of the Order Limits, reducing the ability to extrapolate survey results to this area. Further justification is required as to why omission of this area in the survey does not affect the results and mitigation proposals.

Local Wildlife Sites

4.65. There are concerns the development will lead to the rescinding part of the LWS designation, and the remaining area of the LWS vulnerable to degradation, due to unmitigated impacts on non-breeding birds and other qualifying criteria.

4.66. (7.117 RR) In the Frodsham, Helsby and Ince Marshes, where the main Proposed Development will take place, the main development area will cover approximately 20% of this LWS (Statutory and non-statutory sites or Features of Nature Conservation Plans (APP-012).

4.67. (7.119 RR) Paragraph 7.8.8 of the Environmental Statement: Volume 1 Chapter 7: Terrestrial Ecology (APP-040) states that “The terrestrial ecology features for which all three LWSs are designated for comprise static habitat features, with the exception of invertebrates for which Frodsham, Helsby and Ince Marshes LWS and Frodsham Field Studies Centre LWS are also cited.”. It is not clear what this means, as there are other terrestrial ecology features, such as mammals, that are qualifying criteria of the Frodsham, Helsby and Ince Marshes LWS. Table 7.9 of the same does not list birds or mammals as qualifying features. In Table 3-2: Non-statutory Designated Sites of the Environmental Statement: Volume 2 Appendix 7-2: Protected Ecological Species Baseline Report (**APP-076**), it also states that invertebrates are the only faunal qualifying feature. The impacts on the LWS should be assessed against all of its qualifying features.

4.68. Wildlife Corridors/buffers qualifying feature: At a smaller scale, although there will be wildlife corridors left between areas of panels, the accessibility of these to wildlife is reduced, in terms of Otters and Badgers restricted by fencing, raising concerns with food sources being restricted and badger clan interactions being disrupted, both of which are likely to lead to displacement. At a larger scale, birds are restricted in landing and utilising existing FWF mitigation cells 2 and 5 and cell 1 in the wider Order Limits. The LWS currently provides buffering habitat to the Mersey Estuary RAMSAR/SPA/SSSI and the reduction in area that can function as such is a significant concern.

4.69. (7.123 RR) Birds: There are significant concerns regarding non-breeding birds, relating to reduction in habitat, indirect disturbance, long-term sustainability of the population and increased human disturbance from an upgraded footpath network. Please see non-breeding bird sections RR 7.51-7.58). REF THIS DOC NUMBER

4.70. (7.124 RR) Mammals: There are concerns regarding Otters and Badgers, regarding connectivity through the landscape, loss and restriction of access to food resource and displacement. Please see Otter section in RR 7.91 – 7.97 and Badger sections RR 7.106-

Biodiversity Net Gain

4.71. There are concerns regarding the under-valuing and misclassification of habitats, resulting in unaccounted for habitat loss. The mitigation hierarchy has not been followed, to avoid high value habitats and the proposed layout should be amended to rectify this. There is no supporting document to understand methodology behind the metric or to provide further assessment.

4.72. (7.130-7.131 RR) The development is reported to achieve a net gain in habitat units of 11.52% (194.86 units), net gain in hedgerow habitats of 88.92% (48.25 units) and a net gain in watercourse units of 13.35% (14.65 units). However, this includes 65.61 units of reedbed that have not been compensated for, according to metric trading rules. This means that the Headline results are irrelevant, in accordance with Statutory User Guidelines and user guidance for non-statutory version of metrics. This is a significant proportion of the baseline on Site. See Statutory Biodiversity Metric User Guide Table 2 Biodiversity metric rules: “Rule 1 The trading rules of this biodiversity metric must be followed.” And Figure 14 “If trading rules have not been satisfied, then a net gain in biodiversity cannot be claimed”.

4.73. Paragraph 7.7.73 of the Environmental Statement: Volume 1 Chapter 7: Terrestrial Ecology (APP-040) states that even though the reedbed meets UK Habs definitions; “due to the small and isolated nature of the majority of the areas of reedbed within the Main Development Area, these clumps, of reeds, are considered unlikely to function in the same way as larger and ecologically connected areas of the reedbed. Furthermore, the areas of reedbed subject to loss are either dry, encroached with scrub/trees or are not located adjacent to/connected to open water. These areas are therefore considered transient in nature and would likely be subject to continued drying and therefore change in the future. As such, in the absence of the Proposed Development, it is considered likely that these areas would be lost in the short to medium term.” This is not concurred with, as the UK Habs definitions are tailored for the metric and are proportionate and flexible, in terms of their classification. The Reedbeds fit the criteria according to UK Habs and should be considered as such. Although the reedbeds may dry out in the future, that does not justify misclassifying them in the current baseline survey. There is a large amount of Reedbed units generated from the reedbed present on Site, so the areas of reedbed are not insignificant. In addition, to have a wetland habitat not properly compensated for adjacent to a RAMSAR/SPA/SSSI site designated for its wetland habitats, further adds to the unacceptability of this approach.

4.74. (7.133 RR). Reedbed is a high distinctiveness habitat and should be retained in the first instance. No justification has been given for the loss of this habitat, nor for the lack of compensation proposed. The loss of some of the other high distinctiveness habitat on Site, wet woodland, has also not been justified. In line with the approach taken under the statutory biodiversity gain hierarchy, used as a guide, medium high and very high distinctiveness habitats are highlighted in terms of retention and avoidance of impacts. The general mitigation hierarchy should be demonstrated, as detailed in Local Plan Policy Part Two Policy DM44; “16.8 The mitigation hierarchy (avoid, minimise, mitigate, compensate) shall be followed when considering development proposals. Avoidance of damage will always be CWCC's preferred option, with compensation only acceptable as a last resort. Compensation for habitat loss should aim for like for like replacement and either be delivered on-site or off-site, secured by planning conditions, planning obligations and/or biodiversity offsetting mechanisms within the borough.”.

4.75. (7.134-7.137 RR) An amended layout should be provided, to avoid loss the higher distinctiveness habitats of reedbed and woodland as much as possible, with any residual losses justified. Further reedbed and woodland habitats should be created on Site to resolve this issue. The same should be carried out with medium distinctiveness habitats.

4.76. A Biodiversity Net Gain Strategy document should be provided, to understand the approach taken on Site and provide justifications for decisions made on retention and loss of habitats.

4.77. Currently the Proposed Development is considered to generate a significant net loss in biodiversity that also impacts on the Local Wildlife Site and adjacent national and international designations.

4.78. See 7.137 RR for technical issues with the metric that are likely to significantly alter the metric results.

Peat

4.79. There are concerns that impacts on peat have not been assessed and mitigated for.

4.80. (7.138-7.141 RR) 7.138. Table 7-3: Scoping of Ecological Features of the Environmental Statement: Volume 1 Chapter 7: Terrestrial Ecology (APP-040) states that “There are no peat dependent ecological habitats or species within the Main Development Area. Furthermore, ground investigation surveys undertaken of the SADA identified no peat to a depth of 5.0 m. As such, the Proposed Development would not impact any peat that may be present”. However, this does not account for compaction and hydrological impacts and this should be assessed.

4.81. Table 10-3: Scoping Responses with respect to Ground Conditions states “The impact of disturbance and/or removal of peat on climate change and removal of peat resource has also been considered within ES Vol 1 Chapters 7: Terrestrial Ecology (APP-040)”, however, it is not clear where this assessment is.

4.82. A clearer assessment of the peat depths across the Site and assessment of compaction and hydrological impacts is required.

4.83. Peat is also referred to in CWCC's representations on archaeology **(RR-037** Section 8) and as part of the ISH1 representations (**Appendix A**). Reference is made to the Geoarchaeological Desk Based Assessment (RU.3.3.8.4) (July 2025) (Rev A) by Oxford Archaeology submitted to support the Hynet Runcorn CO2 Spur application 25/02108/FUL) and this is provided at **Appendix C**.

EIA and HRA

4.84. **Mersey Estuary RAMSAR SPA and SSSI:** Currently, it is not demonstrated that the development would not have a significant adverse impact on the Functionally linked land associated with the Mersey Estuary designation, due to impacts on functionally linked land. In terms of Habitat Regulation Assessment, it is the LPA's view that the current Information to Inform Habitat Regulations Assessment has insufficient information on which the ExA, as the competent authority can make an assessment, and that the current information demonstrates adverse impacts on the Mersey Estuary RAMSAR and SPA.

4.85. There are concerns that the Applicant has yet to provide a full assessment of the cumulative impacts, particularly in relation to the Runcorn Carbon Dioxide Spur Pipeline by Liverpool Bay CCS Ltd (TCPA application 25/02108/FUL) and the Hynet North West Hydrogen Pipeline by Cadent Gas Ltd which is at pre-application stage for a DCO consent (EN060006).

4.86. On application 25/02108/FUL, Natural England currently advises that insufficient information has been provided to inform the conclusions of the Habitats Regulations Assessment. Further information is required to demonstrate that the proposed development will not impact on existing mitigation land for the Frodsham Wind Farm and/or have an in-combination impact on mitigation proposed as part of the Frodsham Solar Farm Development Consent Order which may impact on SPA bird populations outside of the designated sites. (**Appendix C)**

5. Summary of recommendations for suggested changes to address Biodiversity matters

5.1. Biodiversity issues provide the focus of CWCC's reasons for recommending that the Applicant makes amendments to the project, with a change notification if appropriate.

Proposed Layout:

5.2. There are concerns that there is not enough stand-off from the designated site itself, from areas where non-breeding birds are located and from proposed mitigation areas. In addition, solar panels are proposed in locations that will disrupt flight paths of non-breeding birds to and from the Estuary to areas within and adjacent to the Order Limits.

5.3. Eastern Array: (7.68-7.69 RR) An area adjacent to this referred to as “The Lum”, is a piece of land protruding into the River Weaver where a high concentration of qualifying bird species have been recorded. A large proportion of this looks to be retained, however, there is limited buffer area to protect against disturbance of these birds and so the area should be expanded to ensure no impact.

5.4. Further east, an area referred to as the “Redwall Reedbed” is designated as an area of moderate potential functionally linked land in Natural England’s Identification of Functionally Linked Land supporting SPA waterbirds in the North-West of England – Phase 2 October 2023 Report NECR483. This is shown the Information to Inform Habitats Regulations Assessment report (EN010153/DR/5.3))(**APP-125**), which is field parcel 11 in Figure 4 “the Proposed Development Areas - With Cells” of the same document and is designated as an area of priority habitat reedbed in Natural England’s Magic mapping tool. There is habitat loss proposed in this area. Although there were lower numbers of non-breeding birds recorded here than in other areas and there is a buffer from the River in this field parcel, the expansion of the area of land retained would help to provide further habitat for birds if managed and also assists with issues with reedbed habitat loss in BNG calculations.

5.5. (7.69-7.76 RR) Western Array: The integrity of the remaining functionally linked land is at risk due to the reduced area available to qualifying bird species, increasing isolation and vulnerability;

- The connectivity across the remaining functionally linked land, both on and adjacent to the Site, is disrupted;

- Reduction in mitigation areas means that the bird population is dependent on one smaller area of mitigation land, reducing the ability to use different areas nearby if temporary or permanent disturbances occur on that land. The range of the bird population will be reduced and it will become more vulnerable to disease, competition for food resources and overcrowding; and

- The solar panels are proposed very close to areas of ecological sensitivity.

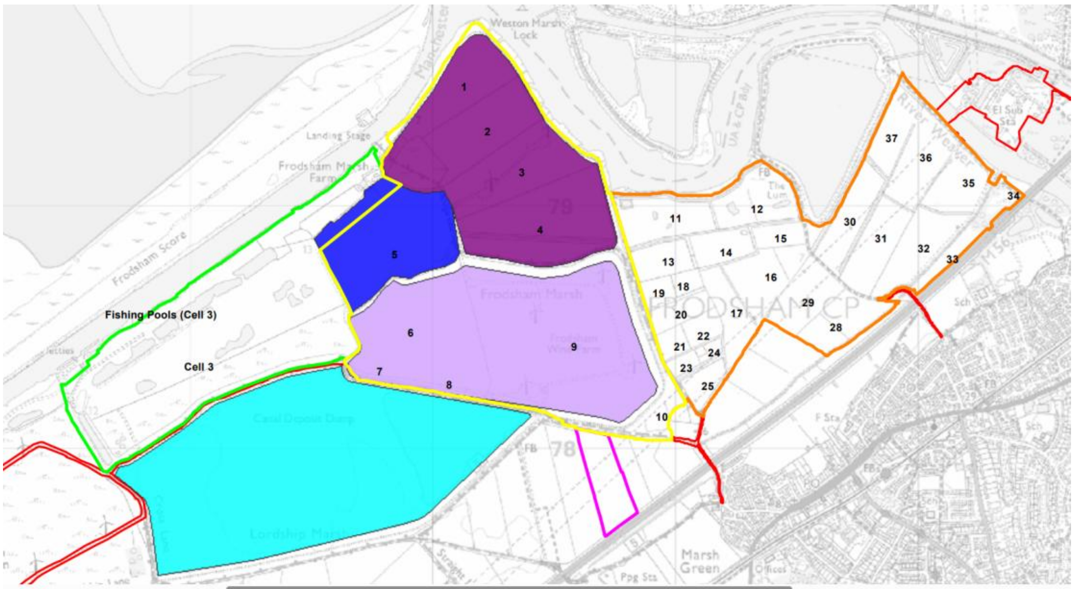
5.6. (7.70 RR) Cell 2 and the eastern and northern areas of Cell 1 also support qualifying bird species. There is minimal buffer from the solar panels along the northern and eastern boundaries of Cell 1, raising concern regarding the impacts on non-breeding birds.

5.7. (7.71-7.72 RR) In paragraph 8.8.6 of the Environmental Statement: Volume 1 Chapter 8: Ornithology (**APP-041**), it states that buffer zones documented in Goodship and Furness (202225) suggest that (depending on the nature of the disturbance) effects out to 100 m and up to 650 m (curlew) may be detectable by some species during the non-breeding season. Therefore, the solar panels should be drawn back by a minimum of 100m from areas of qualifying non-breeding bird use, i.e. Cells, 1, 2, 3 and 6. For example, the proposal currently provides only 20-50m stand-off between the River Weaver and panels on Cell 1 and solar panels approx. 20m from Cell 3 (NBBMA). This means that the mitigation proposed is inadequate and will negatively impact the on-breeding bird population on site.

5.8. The main recommended changes are described below. Please refer to Fig A1.1 Rev P01 Illustrative Environmental Masterplan Key Plan (**PD2-024** - oLEMP) and Works Plans – Sheet 3 of 5 (Rev P02) (**AS-007** - 2.3 Works Plans):

a) To remove solar panels (Works nos 1,5) from the perimeter of Cell 1 (Fig 1-4 of **APP105**) along the boundary to the River Weaver to the north east and to the boundary of the Manchester Ship Canal to the north west; and replace by providing increased green infrastructure (Works no 6A) and to incorporate this into (Fig **PD2-024** oLEMP).

b) To substantially draw back solar panels from the NBBMA eastwards, on field 5, 6 and 7 as shown in Figure 4 in the Information to Inform Habitat Regulations Assessment (**PD2-010**) to reduce impacts during construction and during operation, to increase the mitigation area available and to reinstate the unobstructed access from the Estuary and within the Site to Cells 5 (inside the site) and 6 (outside the site).



Extract of Fig 4 from the information to inform HRA (**PD2-010**)

c) To increase the depth of the green infrastructure to the west of the LUM (point G on Fig A1.1) between the River Weaver/Frodsham footpath FP61 (Fig 1-5 of **APP-105**) (Works no 6A); this would involve a small reduction in the extend of Works nos 1,5 (removal of circa 2 rows of solar panels as shown on Fig A1.3 on **PD2-024**). To retain reedbed within The Lum area as shown as Reedbed priority habitat on Natural England's Magic Mapping system (Field 12 as shown in Figure 4 in the Information to Inform Habitat Regulations Assessment (**PD2-010**).

d) To either i) omit the proposed permissive footpaths A and B (as shown in Figure 1 Route Hierarchy plan in the Outline Landscape and Ecology Management Plan (**PD2-024**); or ii) alternatively re-route the permissive paths to draw them away from the NBBMA and Cell 1 and the Mersey Estuary. For example, Footpath A could still provide a loop for users, if it was drawn back from the NBBMA, to the east, between Field parcels 8 and 9 as shown in Figure 4 “the Proposed Development Areas - With Cells” of the Information to Inform Habitats Regulations Assessment (EN010153/DR/5.3) (**APP-125**). Footpath B could be drawn back down to the south, between Field parcels 2 and 3 of the same document, which would resolve part of the issue along the northern and eastern boundary. See further below for extracts of the PROW and permissive paths plans.

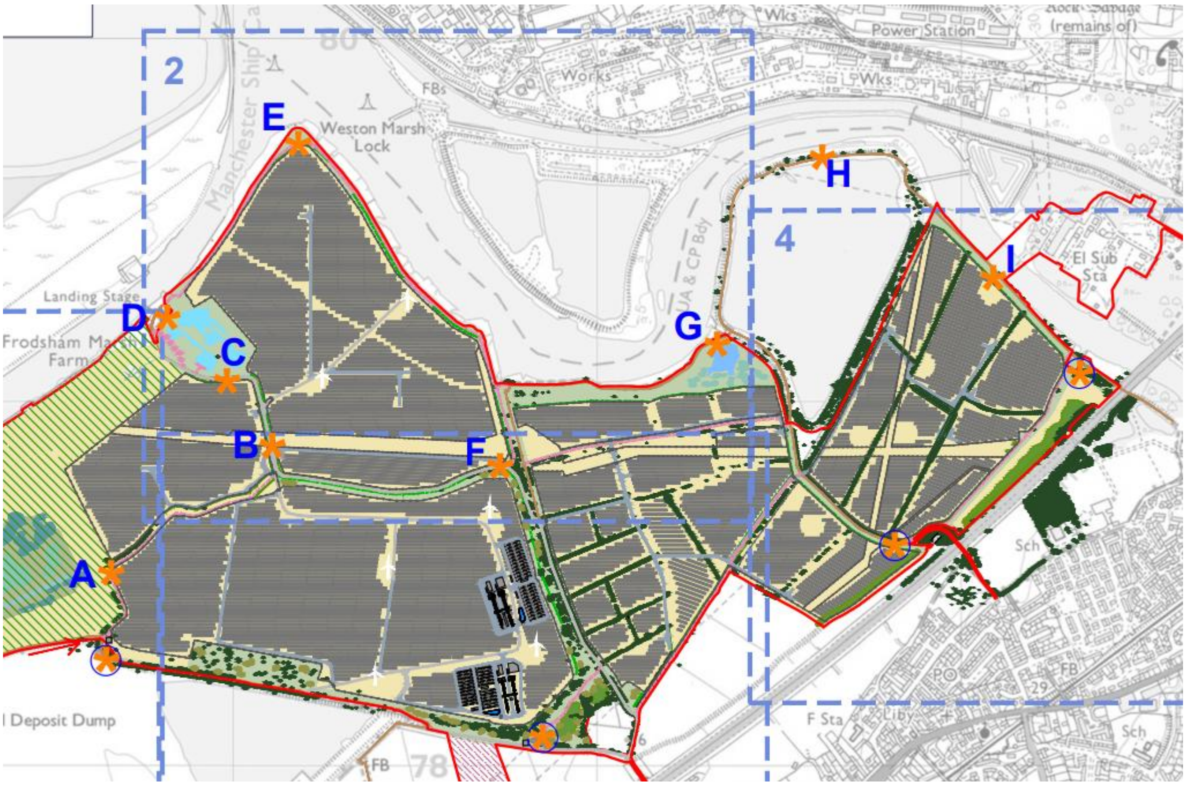
e) To set development back a minimum of 30m from all Badger setts.

5.9. The suggested change in a) provides:

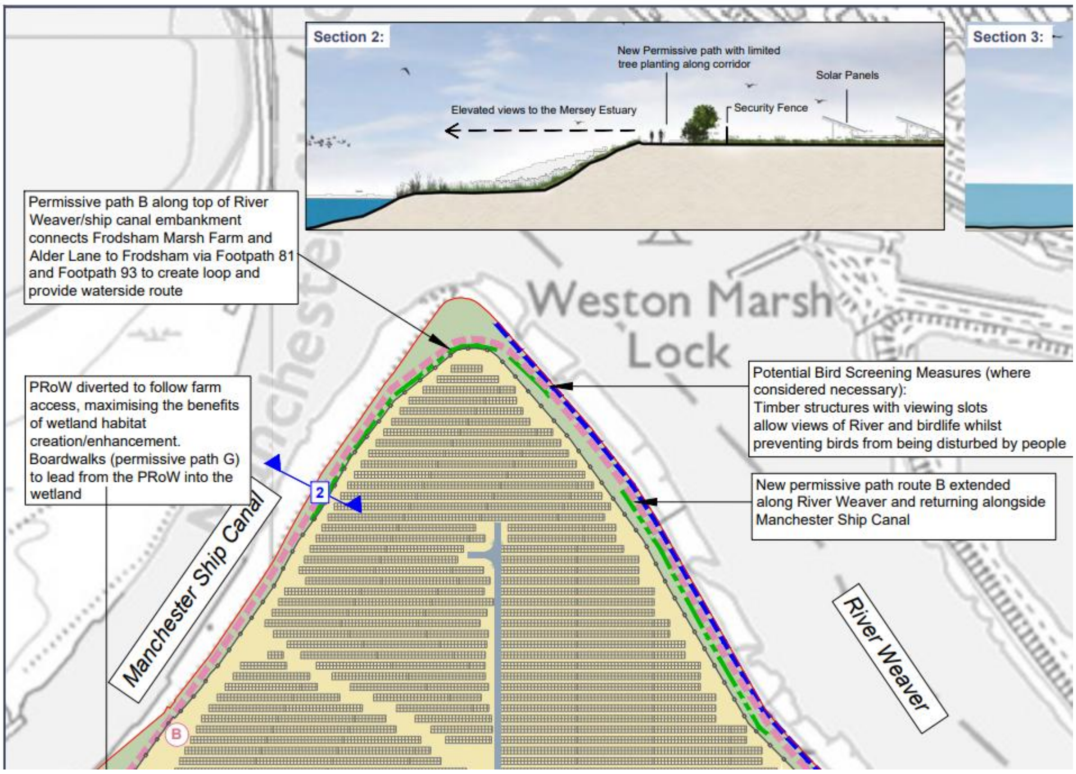
i. Improved habitat connectivity between the NBBMA and the LUM (points D to G on Fig A1.1). This would be consistent with the Project Design Principles (Appendix A – Design Principle 3 c, and f in **APP-130**);

ii. Increased retention of grassland habitat for qualifying non-breeding birds on the FLL associated with the Mersey Estuary SPA / RAMSAR adjacent to the Manchester Ship Canal (see cross section 2 below) and mud banks to the River Weaver on the east side of Cell 1 (see cross section 5 below).

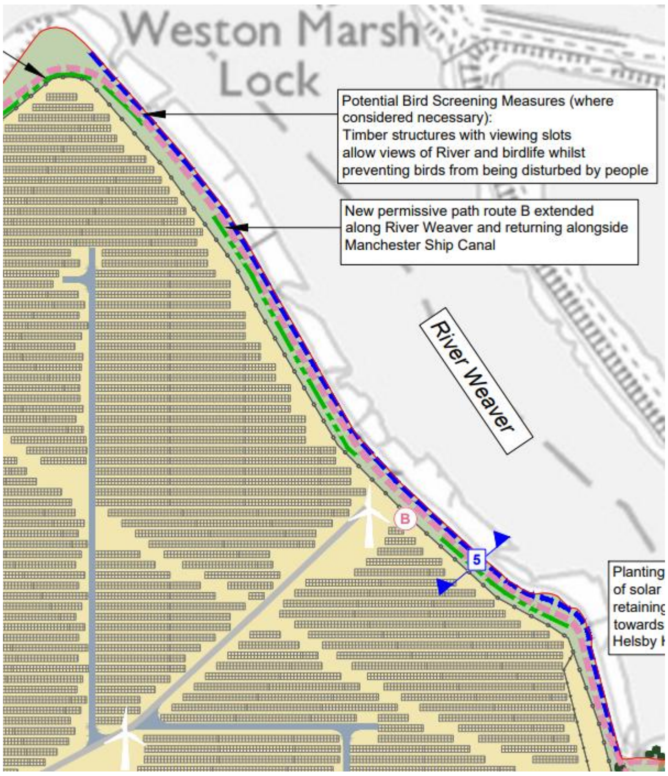
iii. To increase retention of Skylark breeding areas and ensure adequate compensation for habitat loss and reduce dependence on the SMA, which is currently not demonstrated as adequate provision.



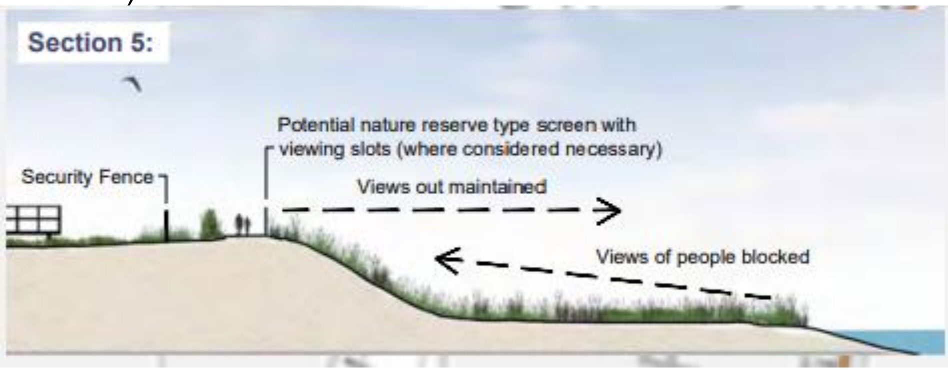
Extract of Fig A1.1 Rev P01 Illustrative Environmental Masterplan Key Plan (**PD2-024** - oLEMP)



Extract of Fig A1.3 Rev P01 Illustrative Environmental Masterplan Sheet 2 (**PD2-024** - oLEMP)



Extract of Fig A1.3 Rev P01 Illustrative Environmental Masterplan Sheet 2 (**PD2-024** - oLEMP)



Cross section extract from Fig A1.3 Rev P01 Illustrative Environmental Masterplan Sheet 2 (**PD2-024** - oLEMP)

5.10. The suggested change in b) provides:

i. Retention of unobstructed access from the Estuary to Cell 6.

ii. Increased retention of grassland habitat for qualifying non-breeding birds on the FLL associated with the Mersey Estuary SPA / RAMSAR

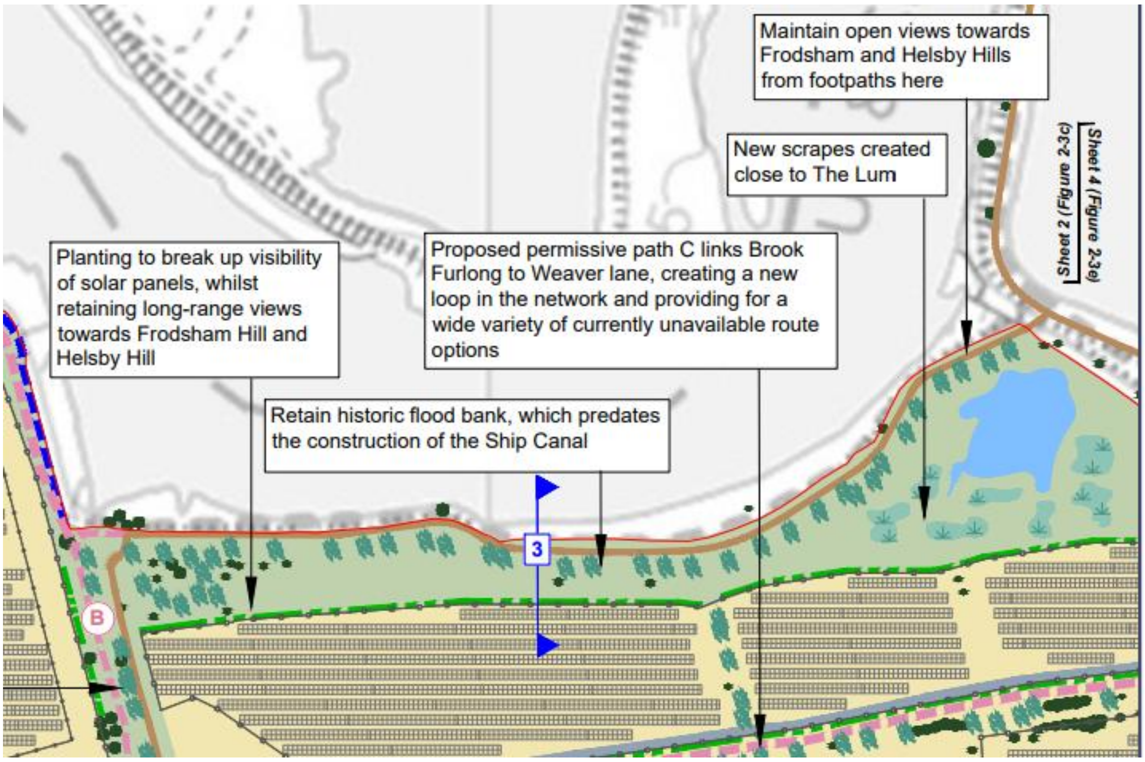
iii. To increase retention of Skylark breeding areas and ensure adequate compensation for habitat loss and reduce dependence on the SMA, which is currently not demonstrated as adequate provision.

5.11. The suggested change in c) provides:

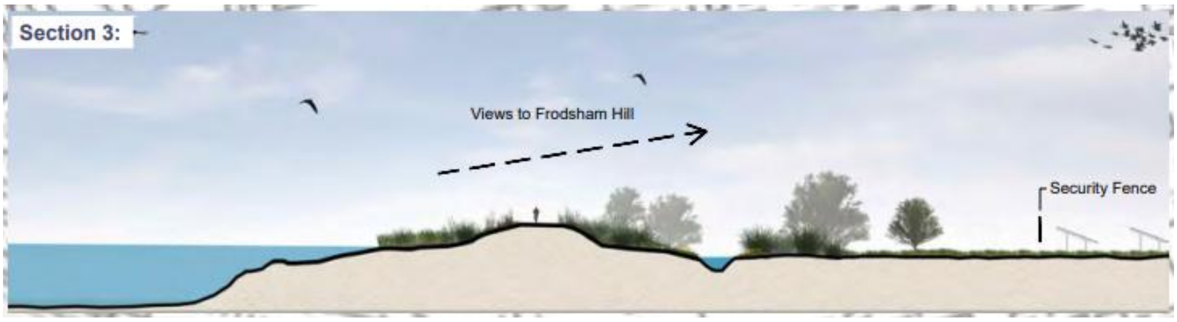
iv. increased habitat for qualifying non-breeding birds adjacent to the LUM, and in the shelter of the flood bank to the River Weaver (much of the space between the river and the proposed solar panels (shown in Section 3 on Fig A1.3 of **PD2-024** below) is vegetated and unsuitable feeding ground for qualifying non-breeding birds. The ExA is requested to consider this location in relation to notes taken at the unaccompanied site inspection on 13 August 2025 (**EV1-01**) (*Note: views intermittently obscured by vegetation*).

v. It also further improves habitat connectivity between the NBBMA and the LUM (points D to G on Fig A1.1).

vi. Further retention of priority reedbed habitats.



Extract of Fig A1.3 Rev P01 Illustrative Environmental Masterplan Sheet 2 (**PD2-024** - oLEMP)

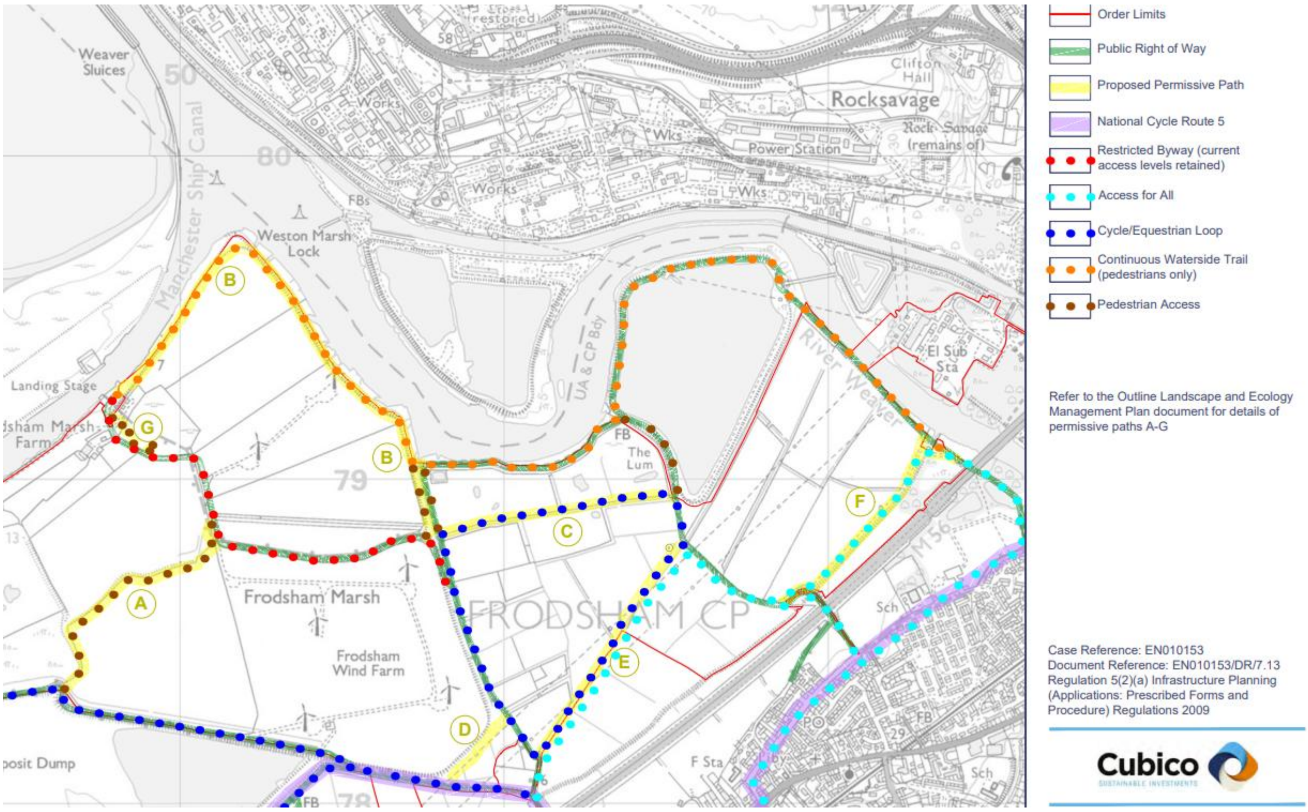


Cross section extract from Fig A1.3 Rev P01 Illustrative Environmental Masterplan Sheet 2 (**PD2-024** - oLEMP)

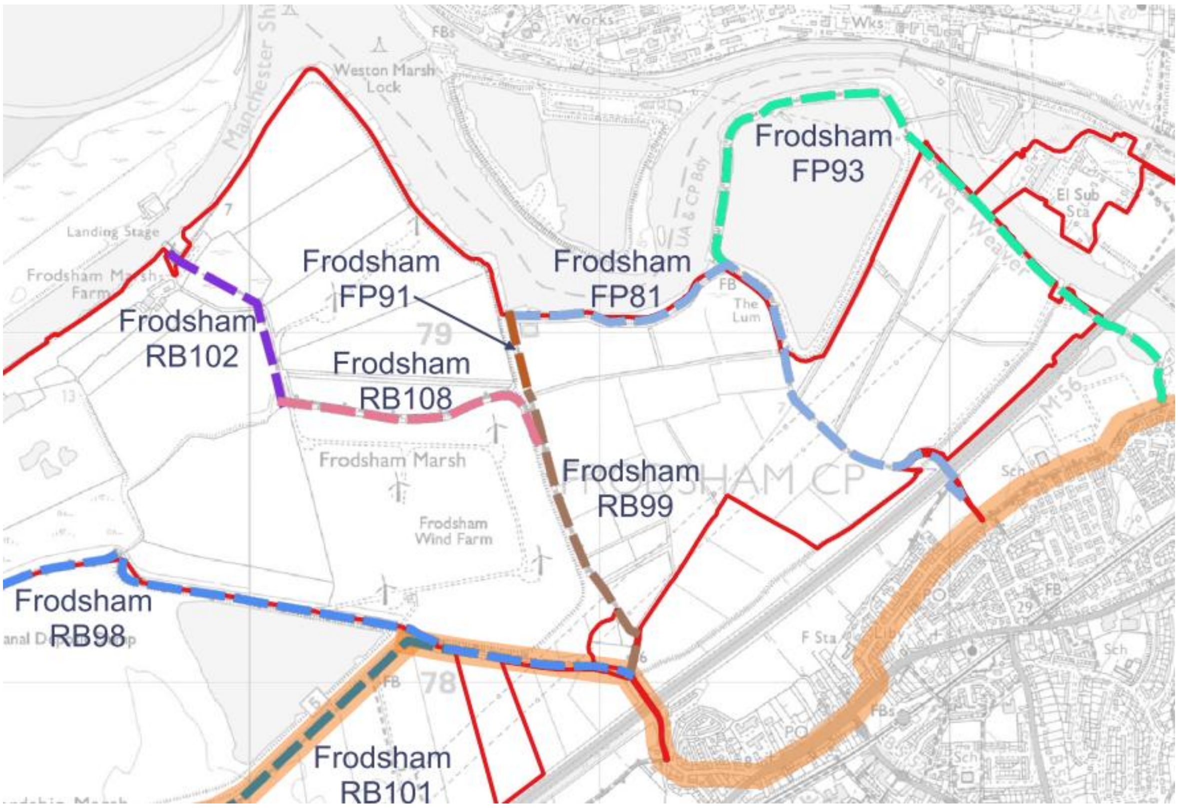
5.12. The suggested change in d) is:

i. considered to be more consistent with the Applicant's Planning Statement (**APP-128**), where it states "*New permissive paths through the Site will be guided to less sensitive areas"* and

ii. would reduce elements that will have adverse impacts on the non-breeding species recorded on Site, in terms of human disturbance (visual and noise). Please refer to Paragraphs 7.17 to 7.28 of **RR-037**, and paragraph 7.18 in particular provides detail of the concentrations of qualifying non-breeding birds occurred along the eastern and northern boundaries of Cell 1, as well as across the Canal on Frodsham Score.



Extract of Fig 1 Indicative Route Hierarchy (**PD2-024** - oLEMP)



Extract of Fig 1.5 Public Rights of Way (**APP-105**)

5.13. The suggested change in e) provides:

i. Less direct impact to Badger setts
ii. Ability to move setts within retained areas near to setts if disturbed
iii. Increased connectivity across the SADA.

6. Green Belt

6.1. There is disagreement between CWCC and the Applicant over whether the development is inappropriate development in the Green Belt, due to the differing interpretation over whether the site is grey belt.

6.2. CWCC consider the site to be Green Belt and not grey belt for the reasons set out in **RR-037**.

6.3. Further comments on the Applicant's response to Relevant Representations (**PD2-027**) including responses on the Green Belt issues will be provided for **Deadline 3** (28 January 2026).

6.4. Very Special Circumstances must be demonstrated if the ExA considers the site to be Green Belt and not grey belt, and CWCC acknowledge that under EN-1 (Para. 4.2.17) (as CNP Infrastructure) the starting point is that the development would be considered to have met the test of very special circumstances in relation to justifying development in the Green Belt.

6.5. Whilst the BESS element of the project is not directly a renewable energy generating development it does appear to fall within the definition of 'other energy infrastructure, fuels, pipelines and storage infrastructure, which fits within the normal definition of "low carbon infrastructure", as referred to in the definition of Critical national priority (CNP) in the Glossary to EN-1. The Helios Renewable Energy Project DCO granted on 3 December 2025 (EN010140) included a BESS and in the ExA's report to the Secretary of State (8.4.1) considered the proposed development to be covered by the critical national priority of law carbon infrastructure as set out in paragraph 4.2.5 of NE-1.

6.6. CWCC consider that allowing this development in the Green Belt will have far reaching consequences in terms of the application of Green Belt policy on this site and surrounding area for some considerable time.

6.7. CWCC maintain that the impact of the Proposed Development on the Green Belt and openness would be substantial and needs to be considered in the planning balance.

7. Landscape and visual effects

7.1. There is disagreement between CWCC and the Applicant over landscape harm associated with the proposed development.

7.2. CWCC's concerns are set out in **RR-037**. Further representation has been made in response to the ISH1 hearing in **Appendix A**, particularly with regard to the National Character Areas (NCA)

7.3. Details for NCA60 Mersey Valley and NCA 62 Cheshire Sandstone Ridge are provided at **Appendix E** and **Appendix F** respectively. Attention is drawn to the photographs within the documents

Expansive views from open and elevated land, including intertidal mud/sand flats and saltmarsh in the Mersey Estuary. The vast industrial developments at Runcorn dominate many views.

Extract from NCA60

A war memorial stands at the northern tip of the NCA, prominently located on the highest ground and is a distinctive local landmark.

Extract from NCA 62 – noting the war memorial as a distinctive local landmark

Extract from NCA 62 – noting the "wide appreciation of the strong contrast etc.2

7.4. Further comment on the Residential Visual Amenity Assessment is also provided in **Appendix A**.

7.5. The impacts referred to in the Local Impact Report, including reference to trees and hedges.

7.6. With reference again to **Appendix 25** in the LIR and the Welsh Government decision (October 2025) relating to a solar farm with battery storage units on land near Llanwern, the Landscape and Visual Amenity considerations are also worthy of note in relation to Frodsham Solar.

7.7. At paragraph 24 "*The site itself is not within a nationally designated landscape, but it lies near sensitive areas, including the Wilcrick Moor aspect area and several Historic Landscape Character Areas (HLCAs). … … While the ES concludes that the overall landscape character would not be dramatically altered, it identifies Moderate Adverse effects, which the Inspector states are acknowledged as significant*."

7.8. Attention is drawn to the Visual Impact **paragraphs 27 to 37**, where there a several parallels with the Frodsham Solar development and impacts.

7.9. CCWC's representations to date have focussed on the impacts from the representative viewpoint 9 at Frodsham Hill War Memorial. However, the impacts on the enjoyment of the PROW in and around the site are also key, and the journey through the site for users of the path network will be markedly different from today's experience, and it is likely that the value of the experience will be substantially reduced as a result of the development, despite efforts by the Applicant to mitigate the impacts through enhancements and establishment of permissive paths.

8. Water Environment - Flood risk, drainage and water quality

8.1. CWCC's representations are set out in **RR-037** and the impacts are also addressed in the LIR. There are no further comments to make at this stage.

9. Transport and highways

9.1. CWCC's representations are set out in **RR-037** and the impacts are addressed in the LIR. There are no further comments to make at this stage.

10. Cumulative and In-combination Effects (APP-046)

10.1. In addition to CWCC's representations set out in **RR-037**, concerns over cumulative impacts have been raised in the representations for ISH1, with particular reference to Liverpool Bay CCS Limited's proposed Runcorn Carbon Dioxide Spur Pipeline and with Cadent Gas Limited's proposed HyNet North West Hydrogen Pipeline (**Appendix A).** Further details are provided below.

Hynet Runcorn CO2 spur pipeline

10.2. The proposed route for the Hynet Runcorn CO2 spur pipeline passes through the SADA (Cell 1 and a small part of Cell 2) and the NBBMA (Cell 3 and a relatively narrow section of the northern part of Cell 2). The Proposed Site Layout Plans are provided at **Appendix G.**

10.3. Section 4.5 of Planning, Design and Access Statement (Rev A) (July 2025) Runcorn Carbon Dioxide Spur Pipeline (pages 35-36 of **Appendix H**) indicates that the construction programme for the Hynet Runcorn CO2 spur pipeline would commence March 2027 and continue until December 2028, with a 22 month construction programme; and Table 2-1 of the Outline Environmental Management Plan (Rev A July 2025) (**Appendix I**) provides more detail in relation to the indicative installation programme of the underground pipeline within Cells 1, 2 and 3 as being April 2027 to October 2027. The Runcorn Spur Pipeline Habitat Regulations Assessment (Table 7_3) is provided in relation to the in-comnination assessment for the spur application (**Appendix J**).

10.4. The updated draft oCEMP **(PD2-016**) for Frodsham Solar confirms that the construction of the NBBMA would be undertaken at start of the development programme and that this will be scheduled oustide the peak non-breeding bird season (March to October). It is stated that the NBBMA would take 6 months to construct[1] and would be created and functional in advance of construction works commencing within the SADA.

10.5. Clarification should be provided as how the timing of the Hynet Runcorn CO2 spur pipeline works may be controlled.

10.6. There has been suggstion that control over the Hynet Runcorn CO2 spur pipeline works would need to be applied via planning condition on any Hynet Runcorn CO2 spur pipeline permission. However, at present and in advance of any permission for

[1] As referred to in the LIR, the Construction Dust Assessment (APP-055 refers to 9 months (para 6.2.6), and such discrepancies should be clarified.

the Hynet Runcorn CO2 spur pipeline, it is considered that the worst-case scenario needs assessment as part of the consideration of the Frodsham Solar application. The worst case scenario would appear to be where the Hynet Runcorn CO2 spur pipeline installation is programmed post construction of the NBBMA. Impacts may be dependant on the method on installation of the pipeline, e.g. whether there is open trench excavation or directional drilling. Directional drilling may present different challenges to the laying of the pipeline in trenches, e.g. in avoiding newly installed drainage infrastructure associated with the NBBMA.

10.7. Assessment of all the reasonable scenarios should be carried out.

10.8. The impacts associated with installing the Hynet Runcorn CO2 spur pipeline prior to commencement of Frodsham Solar may present challenges arising from the Hynet Runcorn CO2 spur pipeline being installed in advance of proposed alterations to the exising ground levels within Cell 3 to establish the NBBMA.

10.9. The least environmental impact may be associated with co-ordinating the two projects together. However there may be commercial or opther reasons why this is not practical, and the Applicant's assessment should address this, giving reasons.

10.10. The establishment of a joint working group as a means to co-ordinate operations would be welcome, but this does not substitute from establishing parameters and effective controls over works programme, where there may be significant adverse impacts from the cumulation of activities. It is also noted that establishment of the joint working group under the Commitment Register (Rev P02) (**PD2-012**) C130 is limited to a situation of overlap of the projects.

"In the event that it becomes clear, pre construction of the Proposed Development, that the construction phases of the Proposed Development will overlap with one or both of the HyNet projects (Runcorn Spur CO2 Pipeline or the Cadent Hydrogen Pipeline), the Applicant will establish a joint working group. This group will include inviting representatives from the construction teams of the relevant projects and from CWCC. The purpose of the working group will be to coordinate and agree construction programming to prevent significant cumulative/in-combination effects, with particular emphasis on potential impacts on the Mersey Estuary SPA"

10.11. The potential cumulative issues are not limited to situations where the projects overlap, the sequential development of projects, one after another, or within a relatively short period of time would be likely to represent a cumulaitve adverse impact, and this would not be addressed by the committement in relation to a joint working group.

10.12. The representations from Liverpool Bay CCS Ltd (**RR_011**) in relation to impacts on the Hynet Runcorn CO2 Spur Pipeline are noted, and it is expected that the Applicant for Frodsham Solar will provide an upate for Deadline 1, and CWCC will repsond for Deadline 3.

Hynet North West Hydrogen Pipeline

10.13. The Hynet NW Hydrogen Pipeline Project is understood to have been paused, as referred to in The Hynet NW Hydrogen Pipeline Project Update Nov 2025 **Appendix K**. However, the cumulative impacts should still be assessed.

Frodsham windfarm (FWF)

10.14. The Applicant has taken the existence of FWF as part of the baseline to the Frodsham Solar assessment. Consideration should be given to the temporary nature of FWF. The FWF consent provides a 25-year operational life and requires demolition restoration and aftercare of the windfarm at the expiry of the deemed permission under Section 90 of the Town and Country Planning Act 1990 (**RR-037** Appendix E) (conditions 48 to 54). The decommissioning provisions apply from 14 February 2042 (**RR-037** Appendix F) or earlier if energy generation ceases. The provisions provide for decommissioning, restoration and two years of aftercare.

10.15. It may be reasonable to assume that proposals for FWF repowering will be submitted, as a likely scenario, but a worst-case position should be assessed, and this is liable to be the decommissioning of FWF around 2042.

10.16. The implication of FWF being a temporary permission ought to be factored into the assessment of the impacts of Frodsham Solar, and notably in relation to the landscape and visual assessment. The urbanising influence of the wind turbines should be recognised as temporary, and as such for a substantial length of the proposed lifetime of Frodsham Solar (circa 28 years, between 2042 and 2070) the solar project will be the dominating influence on the landscape character. It may be reasonable to regard the decommissioning of FWF relatively early in the life of Frodsham Solar as reducing the landscape impacts from the current baseline, but equally, it should be acknowledged that any justification for adding Frodsham Solar to the landscape based on the influence of the existing FWF is a temporary addition to the landscape.

10.17. The worst-case scenario also needs to take account of the potential for cumulative impacts relating to the decommissioning activities of FWF coinciding with or being within a short-timeframe in relation to any Frodsham Solar major replacement activities.

11. Decommissioning

11.1. CWCC's concerns relating to decommissioning are set out in **RR-037** and further expanded upon in the representations for ISH1 (**Appendix A).** For information **Appendix L** provides some further detail in relation to the changed ownership of Frodsham Wind Farm following its commissioning.

12. Community Benefit Fund

12.1. CWCC welcomes the principle of the Applicant's proposed Community Benefit Fund (CBF) (Section 5,5 of the Planning Statement) (**APP-128**).

12.2. The details of the CBF were not discussed with CWCC prior to the submission of the DCO application. There has been initial discussion with the Applicant over the CBF, following submission of the Relevant Representations but no draft or further details of the CBF has been provided by the Applicant to date. CWCC will update the ExA at relevant points throughout the Examination.

12.3. CWCC have expressed the view that the fund should be extended to include additional/separate contributions in relation to the BESS not just the Solar generating station.

12.4. CWCC have raised the point with the Applicant, following the Government's consultation on Community Benefits and Shared Ownership of Low Carbon Energy Infrastructure (July 2025), that the examples given in terms of level of benefit are considerably higher than the £500 pa/per MW sum currently proposed for Frodsham Solar. This equates to £73,500 pa assuming 147MW Solar; or some £2,940,000 over the 40-year life span.

12.5. Reference has been made to the Scottish Government's Good Practice Principles for Community Benefits from Onshore Renewable Energy Developments, and an expectation/recommendation of £5,000 per MW of installed capacity for onshore wind. The illustrative example in the consultation document for various sized solar schemes utilises £1,000 per MW for solar.

12.6. The consultation paper also expects that elements such as the BESS be linked to CBF contribution, additional to the Solar element.

12.7. Whilst any mandatory arrangement is liable to be some time off, and it is not liable to be retrospective, CWCC expect undertakers to provide commensurate levels of community benefit on a voluntary basis.

12.8. Frodsham Windfarm Ltd (with a capacity of 50MW) contributes an annual grant of £120,000 to the Marshes Community Benefit Fund (**Appendix M**).

12.9. In considering the CBF proposals, it is expected that the mechanism for delivery/implementation ensures a minimum CBF requirement. There should also be indexation on the contributions. Provision for increasing the CBF contributions at key stages of the project is also expected, for instance on any repowering or retrofitting of the scheme, reflecting any newly installed capacity.

12.10. It should be clear in any mechanism controlling the CBF that it is an obligation on the relevant licence-holder in situations where there may be a change of ownership/undertaker.

12.11. Governance/administration and enforcement provisions for the CBF need to be detailed.

12.12. As funding is normally linked to the energy capacity of the Solar project this is one reason why transparency over the final MW capacity of the development is appropriate and should be secured through the DCO, even if there is no upper limit of MW capacity in the DCO itself.

12.13. Whilst CBF funding is often linked to the operational commissioning date, CWCC have asked the Applicant to consider provision of initial contributions in advance of this, as this is liable to foster the sort of benefits from a CBF that the Government recognises as important, such as the role local communities have in hosting such infrastructure, increasing community acceptability of projects, improving community engagement and lasting relationships with the developer. Similarly, continuation of funding during decommissioning would likely add to acceptance by the local community.

12.14. CWCC consider it important to conclude the basis of the CBF during the Examination Period. This would provide appropriate transparency to the process.

13. Adequacy of control documents

13.1. Various updates have been made to the control documents as provided at Procedural Deadline B (21 November 2025) and CWCC will respond to these for Deadline 3 (28 January 2026) as set out in the Rule 8 letter.

14. Conclusion

14.1. CWCC's written representations should be read in conjunction with its relevant representations (RR_037) and the LIR.

14.2. CWCC will continue to work positively and proactively with the Applicant with a view to resolving matters, recognising the overall importance and benefits of the Proposed Development (with CNP status), but also the significance of the location in habitat terms with links to internationally designated Mersey Estuary.

14.3. CWCC's greatest concern with the DCO application at this stage is in relation to habitat concerns by extending the NBBMA to include additional areas comprised in parts of Cells 1, 2 and 5 and addressing Natural Environment Officer's comments on Proposed layout in Section 7 above. Addressing these concerns at the design stage would have been preferable, and whilst this relates to mitigation rather than compensation the Applicant should take account of the advice at paragraph 5.4.29 of NPS – EN12.

14.4. Other points in the RR should be addressed where practical, but the above is seen as the main area where the mitigation needs to be enhanced to avoid/address significant impact of the Proposed Development.

[2] It is vital that applicants consider the need for compensation as early as possible in the design process as 'retrofitting' compensatory measures will introduce delays and uncertainty to the consenting process

SUMMARY OF WRITTEN REPRESENTATIONS

1. In summary to CWCC's Written Representations (WR):

2. CWCC's primary concerns relate to the Biodiversity aspects, along with Green Belt, Landscape and Visual Amenity impact. The WR's need to be read in conjunction with the Local Impact Report (LIR).

Comments on the draft DCO

3. The main comments on the draft DCO are set out in Appendix 2 to the Written Representations. The following are highlighted in the comments. In terms of the DCO Articles: there are comments on removing site clearance and remedial works from the definition of permitted preliminary works; concerns over limitation on statutory nuisance powers; use of street works powers outside the Order Limits; and powers in relation to trees. Comments on the Authorised Development relate to Skylark mitigation and the habitat works. A range of detailed comments are made on the Scheule 2 Requirements and Protective Provisions.

Biodiversity

Mersey Estuary RAMSAR SPA and SSSI

4. Currently, it is not demonstrated that the development would not have a significant impact on the Functionally linked land associated with the Mersey Estuary.

   Construction:

5. There are various issues in terms of construction impacts on non-breeding birds qualifying species for the Mersey Estuary that have not been fully assessed, and some impacts have been missed, which casts doubt over the assessment and therefore adequacy of mitigation proposals. This is in relation to noise and visual impacts during construction which could have been avoided by amendments to layout, impacts of flight path disruption not taken into account and also the phasing of the scheme in relation to functional level of the NBBMA.

   Operation:

6. There are concerns that the solar panels will cause displacement and reduction in population size of non-breeding bird associated with the designated site, due to reduction of land available for use and obstruction of flight paths from the site to functionally linked land within and outside of the Order Limits. There will be disruption of flight paths and foraging grounds originally protected under the Frodsham Windfarm Mitigation proposal. This will also reduce the area of Functionally linked land, decreasing its resilience and ability to sustainably support non-breeding bird populations and disrupt flight of non-breeding birds to

and from areas of functionally linked land within and adjacent to the site. In addition, the introduction of an expanded and upgraded public right of way network across the marsh has not been fully assessed and should be reduced in extent near sensitive areas.

Decommissioning:

7. There are concerns with decommissioning of the non-breeding bird mitigation area, due to the impacts being different to that during construction, due to the birds having been restricted to smaller areas. There are also concerns with long-term management of the NBMMA not being secured, with no control over its apparent decommissioning if handed back to landowners.

Cumulative Impacts:

8. There are concerns that the cumulative construction impacts of the Runcorn Carbon Dioxide Spur have not been fully assessed or mitigated for. The pipeline route runs through the most sensitive areas of the Order Limits in terms of non-breeding birds, restricting timelines for reducing impacts. Impacts should be fully assessed, mitigated for and controlled securely.

Survey Data and Non-Breeding Bird Mitigation Strategy:

9. There are concerns that the survey data is not robust enough on which to base a Non-Breeding Bird Mitigation Strategy and that the methodology used is flawed. This means that impacts to non-breeding bird populations are more significant than currently assessed and the NBBMS is inadequate. In addition, the principle of providing a higher quality smaller mitigation area in place of larger mitigation areas is flawed, as this will reduce areas for birds to move if displaced, render the bird populations more vulnerable to disease and reduces the contiguous area of functionally linked land and therefore its resilience and long-term viability.

Proposed Layout:

10. There are concerns that there is not enough stand-off from the designated site itself, from areas where non-breeding birds are located and from proposed mitigation areas. In addition, solar panels are proposed in locations that will disrupt flight paths of non-breeding birds to and from the Estuary to areas within and adjacent to the Order Limits.

<u>**Protected Species**</u>

Breeding birds

11. There are concerns that the Skylark Mitigation Area has been reduced significantly since the PEIR stage of the development without justification, that the SMA is not appropriately located and has not been surveyed to assess current Skylark presence and therefore suitability. In addition, those breeding

birds relying on mitigation in field edges may be disturbed by the introduction of new and upgraded public rights of way, which has not been assessed.

Bats

12. There are concerns that trees proposed for removal have not been subject to bat survey and so bat roosts presence and the mitigation and compensation measures required are unknown.

Otters

13. There are concerns regarding the obstruction of Otters from feeding areas, due to solar farm fencing and fencing of the NBBMA, over this extensive area of suitable habitat. This could reduce the natural range of Otters in the area.

Badgers

14. The applicant should make simple changes to the proposed layout to ensure appropriate buffers from the network of setts are implemented. There are concerns that the development will obstruct badgers foraging and commuting routes and that the introduction of footpaths will displace badgers from the area, due to the limited areas on the Marsh on which they can build new setts coinciding with the areas where upgraded and new public rights of way are proposed. Recommended surveys by the applicant's own ecologist and requested by the LPA to ascertain commuting and foraging impacts have not been carried out.

Reptiles

15. Justification on survey extent is required.

Local Wildlife Sites

16. There are concerns the development will lead to the rescinding part of the LWS designation, and the remaining area of the LWS will be left vulnerable to degradation, due to unmitigated impacts on non-breeding birds and other qualifying criteria.

Biodiversity Net Gain

17. There are concerns regarding the under-valuing and misclassification of habitats, resulting in unaccounted for habitat loss. The mitigation hierarchy has not been followed, to avoid high value habitats and the proposed layout should be amended to account for this. There is no supporting document to understand methodology behind the metric or to provide further assessment.

Peat:

18. There are concerns that impacts on peat have not been assessed and mitigated for.

Summary of recommended changes to the Frodsham Solar project

19. CWCC recommend various changes to the Authorised Development with a view to addressing principal biodiversity concerns:

    a. To remove solar panels (Works nos 1,5) from the perimeter of Cell 1 (Fig 1-4 of **APP105**) and replace with green infrastructure (Works no 6A).

    b. To draw back solar panels from the NBBMA eastwards, on field 5, 6 and 7 as shown in Figure 4 in the Information to Inform Habitat Regulations Assessment (**PD2-010**).

    c. To increase the depth of the green infrastructure to the west of the LUM (point G on Fig A1.1) between the River Weaver/Frodsham footpath FP61 (Fig 1-5 of **APP-105**) (Works no 6A); To retain reedbed within The Lum area.

    d. To either i) omit permissive footpaths A and B (as shown in Figure 1 Route Hierarchy plan in the Outline Landscape and Ecology Management Plan (PD2-024); or ii) alternatively re-route the permissive paths.

    e. To set development back a minimum of 30m from all Badger setts.

Green Belt and Landscape

20. CWCC disagree with the Applicant over whether this Green Belt site should be treated as grey belt for the reasons set out in **RR-037**. Allowing this development in the Green Belt will have far reaching consequences in terms of the application of Green Belt policy on this site and surrounding area.

21. In terms of landscape impacts further representation is made in response to the ISH1 hearing in **Appendix A**, particularly with regard to the National Character Areas (NCA)

22. CCWC's landscape representations have focussed on the impacts from the representative viewpoint 9 at Frodsham Hill War Memorial. However, the impacts on the enjoyment of the PROW in and around the site are also key.

Other environmental uses: water environment, transport

23. CWCC refer to the relevant representations and LIR in relation to other topic areas.

Cumulative and In-combination Effect

24. Concerns relating to cumulative impact, and in particular the (lack of) controls over the phasing and programming of projects, notably Hynet Runcorn CO2 spur pipeline.

25. There is also a need to address the cumulative impacts in relation to Frodsham Wind Farm.

Decommissioning

26. CWCC's concerns relating to decommissioning are set out in **RR-037** and further expanded upon in the representations for ISH1 (**Appendix A).**

Community Benefit Fund

27. CWCC welcomes the principle of a Community Benefit Fund (CBF) (Section 5,5 of the Planning Statement) (**APP-128**). The details of the fund have yet to be confirmed, and various issues already discussed with the Applicant are set out.

Responses in relation to ISH1

28. **Appendix A** provides CWCC's written response to ISH1 Agenda items and forms a key part to CWCC's Written Representations. This covers draft DCO matters, and the other agenda items from ISH 1.

APPENDICES

Appendix A - Council's written response to draft DCO and ISH1 Agenda items

Appendix B - Functionally Linked Land map extract

Appendix C - Runcorn CO2 Spur Pipeline Geoarchaeological study (25_00293_FUL)

Appendix D - Natural England letter 18 December 2025 on 25/02108/FUL Runcorn Carbon Dioxide Spur Pipeline

Appendix E - NCA 60 Mersey Valley

Appendix F - NCA 62 Cheshire Sandstone Ridge

Appendix G - FWF Proposed Site Layout Plans for 25/02108/FUL Runcorn Carbon Dioxide Spur Pipeline (4 plans)

Appendix H- Planning, Design and Access Statement (Rev A) (July 2025) for 25/02108/FUL Runcorn Carbon Dioxide Spur Pipeline (Section 4.5 pages 35-36)

Appendix I - Outline Environmental Management Plan (Rev A July 2025) for 25/02108/FUL Runcorn Carbon Dioxide Spur Pipeline (Table 2-1)

Appendix J - Runcorn Spur Pipeline Habitat Regulations Assessment (Table 7_3)

Appendix K - Hynet NW Hydrogen Pipeline Project Update Nov 2025

Appendix L - In Frodsham webpage – Frodsham Farm ownership

Appendix M - Marshes Community Benefit Fund

Appendix A (CWCC Written Representations):

CWCC's written response to ISH1 Agenda items (including those not covered in the oral representations)

Extracts from the ISH1 Agenda are provided in blue

3 GENERAL MATTERS

ISH 1 Agenda	CWCC comments
3 a)	Securing the mitigation relied on in the assessment
	i) Please could the applicant carry out a thorough audit and advise whether each item of mitigation identified and relied on in the ES ... . is provided in one of more of (*the documents listed in the ISH agenda*)
	CWCC will respond to the Applicant's audit if necessary, at Deadline 3.
	ii) Is the mitigation in the dDCO and/ or outline management plans: • provided to at least the same level of detail as set out in the ES • sufficiently defined so that they would be likely to result in the residual effects identified in the ES • including all relevant provisions for further survey requirements, monitoring and maintenance
	CWCC will respond to the Applicant's response, if necessary, at Deadline 3.
	CWCC recommend that the NBBMS be made a separate document in the ES Appendix, not as currently drafted as an appendix to the oLEMP. This is due to its importance. Schedule 10 'Documents and plans to be certified' of the draft DCO should be amended accordingly.
	The oDEMP needs to cover aftercare/restoration provisions.
	iii) With reference to paragraph 4.1.18 of the Overarching National Policy Statement for Energy (NPS EN-1), does the applicant consider that all secured mitigation is relevant to planning, necessary to make the proposed development acceptable in planning terms, directly related to

	the proposed development, fairly and reasonably related in scale and kind to the proposed development, and reasonable in all other respects?
	CWCC will respond to the Applicant's response, if necessary, at Deadline 3. PINS Advice note fifteen for drafting DCOs suggests use of a Table of Mitigation. "*16.3 A 'Table of Mitigation' should be provided, usually as part of the ES, setting out precisely how and where mitigation measures relied upon in the ES are secured in the draft DCO".*
3 b)	Submission of outline management plans and strategies
	Please could the applicant submit into the examination the following outline documents mentioned in the application documents: (List on ISH 1 agenda)
	For the Applicant to comment (noting that the Applicant does not currently propose to submit all the documents listed in agenda item 3 b) at the Examination stage.

4 THE DRAFT DEVELOPMENT CONSENT ORDER (including the scope of the proposed development)

ISH 1 Agenda	CWACC comments
4	**THE DRAFT DEVELOPMENT CONSENT ORDER (including the scope of the proposed development)**
4 a)	Part 1 – Preliminary
	Interpretation - Order limits, permitted preliminary works, commence, maintain
	The ExA raised concerns regarding the definition of "commencement", which included remedial works, as well as the definition of "permitted preliminary works" which also included remedial works. In addition, Requirement 12 (1)(3) states that commencement includes preliminary works and remedial works for Work package 6c (NBBMA creation).

	The ExA also raised concerns regarding the definition of "site clearance", as it was too vague and again, was included in both the definition of commencement and also permitted preliminary works.
	CWCC agree that the definition of permitted preliminary works is drawn too widely, especially with inclusion for provision of (i) site clearance, and (e) remedial work in respect of contamination etc. and also (f) diversion and laying of apparatus; and much of Work No. 8. Advice Note Fifteen: drafting DCOs refers to defining commencement at 5.7 21. noting that advance works may be likely to have significant environmental effects, in terms of noise, impacts on protected species or archaeological remains.
	The ExA showed the proposed indicative construction phasing plan (**APP-051**) "6.2 Environmental Statement: Volume 2 Appendix 2-2: Indicative Construction Phasing and Resource Schedule", which seeks to ensure that works are phased so as not to impact any existing mitigation areas, or land used by non-breeding birds in the wider site, prior to the NBBMA being functional and providing compensation for that habitat loss.
	CWCC consider that if site clearance and remedial works are included in permitted preliminary works, these fall outside of the definition of commencement and so are not controlled by the construction phasing plan. There could be a situation where the site is cleared of vegetation, with no mitigation area available for non-breeding birds, leading to significant negative impacts on the non-breeding bird population. There could be significant impacts on the habitat on site and further detail in the construction phasing plan should be provided to take account of remedial works. It is CWCC's position that site clearance and remedial works should be removed from the permitted preliminary works definition, as it requires control and are outside of the proposed construction phasing plan. In addition, the construction phasing plan should be updated to provide further detail on remedial works and site clearance should take place in accordance with the construction phasing plan.
4 b)	Part 3 – Streets

	Article 10. Power to alter layout, etc. of streets Article 12. Temporary prohibition or restriction of use of streets and public rights of way, and authorising vehicular use on public rights of way Article 13. Permanent stopping up of, and creation of new public right of way and authorising vehicular use of public rights of way Article 14. Access to Work
	Article 10 The ExA raised concerns regarding the wide scope of Article 10 in that it authorises street works inside the Order limits (the extent of those are set out in column 2 of Schedule 4) but also goes wider and allows street works to be undertaken outside of the Order limits. CWACC agrees with the ExA and considers the scope of Article 10 to go beyond what is required for the authorised development. If works are required outside of the Order limits, what is required and where? There should be specific powers for CWCC to approve any such works by providing its consent. In addition, in accordance with other made DCOs, there should be a requirement to restore any street which has been temporarily altered and that work should be approved by the street authority. Additionally, Article 10(4) appears to be unnecessary as the undertaker is not and will not be the street authority for a street in which the works are carried out as it is a private company not a highway authority. CWCC requires more control in Article 10 to specifically approve any street works outside of the Order limits to retain control of its network and the deemed approval provisions in the current draft DCO do not accord with other consented schemes for example the recently consented Helios Renewable Energy Project DCO. The ExA also asked the Applicant to consider the scope and drafting of Article 12, 13 and 14 and CWCC will reserve its position on these articles until it has the opportunity to consider the Applicant's response and will respond at Deadline 3.
4 c)	Part 4 – Supplementary Powers
	Article 19. Authority to survey and investigate the land.
	CWCC will provide comments once the applicant has commented at Deadline 3.
4 d)	Part 5 – Powers of Acquisition

	Article 23. Compulsory acquisition of rights Article 26. Acquisition of subsoil only Article 30. Temporary use of land for constructing the authorised development Article 31. Temporary use of land for maintaining the authorised development
	CWCC has no comments
4 e)	Part 6 – Miscellaneous and General
	Article 36. Consent to transfer the benefit of the Order Article 39. Felling or lopping of trees and removal of hedgerows
	CWCC would draw the ExA's attention to its comments in the WR/LIR. CWCC's position is that more clarity is needed with approval given to tree and hedge retention and removal plans, and that Article 39 should apply to approved removal and not retained features.
4 f)	Schedule 1 – Authorised Development
	Work no 1-4, 6-8
	CWCC consider Work No. 6 should be expanded to include the mitigation areas added. Work 6A includes (iv) creation of skylark habitat and Work 6B includes solely works to create skylark habitat, so there is duplication. In addition, there is no definition of what constitutes "creation" in either of these work packages. CWCC consider the drafting should be made clearer; and it is helpful to have the mitigation works listed separately from other works. As indicated by the ExA "maintain" is not included in the definitions and should be and CWCC supports this position.
	CWCC commented that creation of newer mitigation areas (new scrapes by The Lum (adjacent to fields B01, B01 and BO3 on Fig 2.2 Indicative Operational Site Layout APP-106) and new wetland area adjacent to the NBBMA (between fields A01 and A02)) were not included in Work No 6 and could be added as separate elements to Work No 6A or added as Work No. 6D. The Applicant commented that they did not need to add an additional work package, as they were supplementary mitigation areas.
4 g)	Schedule 2 - Requirements

	Applicant's position on the omission of construction hours as a Requirement
	In connection with the position on the omission of construction hours as a Requirement CWCC recommends inclusion of an additional requirement relating to the control over hours of working; and that this be worded to allow for controlled working outside of the specified hours via approval under the detailed CEMP. To assist the ExA, CWCC have provided draft wording below: **Hours of Working (construction, replacement activities & decommissioning)** No construction or other operations/works associated with the construction and or decommissioning of the authorised development shall take place outside the hours of 08:00 to 18:00 Mondays to Fridays, and 08:00 to 13:00 on Saturdays or at any time on Sundays or Bank Holidays, except in accordance with a protocol for working outside the permitted hours as approved under the construction environment management plan and/or decommissioning environmental management plan. The replacement activities referred to in the outline operational environmental management plan shall be subject to the same restrictions. There is also a need to incorporate control over the hours of Permitted Preliminary Works in a similar way and CWCC's position is that the control of hours of construction for those works should also be included in the requirements. It is noted that provision for HGV deliveries is covered in the Commitments Register (C30) (**PD2-012**) (with reference to the Construction Traffic Management Plan – Schedule 2: requirement 14). *Construction HGV deliveries will, as far as reasonably practicable, be scheduled outside peak commuter hours (08:00–09:00 and 17:00– 18:00 on weekdays), with no heavy goods vehicle movements outside the standard construction hours unless required by an emergency or expressly agreed in writing by the local highway authority.*
4 h)	Schedule 12 – Procedure for the discharge of requirements
	With regard to the procedure for discharge of requirements, the period of eight weeks appears reasonable to CWCC, on the basis that the 8 weeks starts again from the receipt of additional information if this is required. In terms of Schedule 12 2 (4) (a) and (b) the inclusion of provisions in relation to deemed approval is common to DCOs.

	However, in terms of the detailed drafting there was some discussion regarding timescales for an appeal by the Applicant in paragraph 4(2)(a) whereby instead of the current drafting of 6 months which the ExA and CWCC considered too long, the Applicant confirmed that it would accord with the Advice Note 15 guidelines and amend this to 42 days. CWCC agrees with this amendment. In addition, CWCC has some concerns that 5 working days for the appointed person to notify the parties of additional information required is too short in paragraph 4(3) – CWCC considers this should be more flexible and be provided as soon as reasonably practicable. CWCC considers the timescale of 10 working days to submit representations pursuant to an appeal in paragraph 4(4) to be too short and would support an amendment to this time period to 20 working days in accordance with the aforementioned advice note.
4 i)	Schedule 13- 27 Protective Provisions
	The Applicant's progress update on the protective provisions including an opportunity for those affected parties to respond.
4 j)	The ExA will seek a brief statement from Cheshire West and Chester Council on any principle matters of disagreement it has with the applicant on its dDCO. In relation to the principle areas of disagreement, at this stage CWCC confirmed that these related to the items specifically on agenda item 5 in relation to major replacement during the operational phase, landscape impact and the cumulative impact of the HyNet Hydrogen Pipeline and HyNet CO2 spur.

5 OTHER PLANNING TOPICS

5 a) Major replacements during the operational phase

ISH 1 Agenda	CWCC comments
5 a)	Major replacements during the operational phase
	The ExA considers that clarification is required in relation to potential impacts and mitigation for major replacement activity during the operational phase. Please could the applicant provide the following and please could CWCC comment: i) Clarify the level of major replacement activity considered in the ES and justify why it represents a reasonable worst-case scenario?

	ii) Advise how major replacement activity was considered in ES Chapters 6 [APP-039] and 11 [APP-044]? iii) Clarify whether the anticipated replacement of 20% of DC cables [APP-035] or any other major replacement activities could potentially require below ground works? iv) Provide a reasonable worst case scenario assessment of impacts during major replacement activities, including any below ground works, covering similar relevant issues and to a similar level of detail to that provided for construction activities for each chapter of the ES, including (but not limited to) in relation to habitats and species, soil quality, contaminated land, archaeology, the water environment, traffic, noise, public rights of way, and waste. This should address magnitude of effect (both significant and not significant), mitigation measures, residual effects (both significant and not significant) and reasoning for how the mitigation measures would result in the residual effects. v) If a detailed assessment of impacts is not provided, would the impacts assessed for the construction phase in combination with those assessed for the operational phase represent a reasonable worst case for the ExA to consider in the planning balance for each Chapter of the ES? vi) Ensure that mitigation measures for major replacement activities are secured in the draft DCO [AS-013] and oOEMP [APP-137], covering similar relevant issues and to a similar level of detail to that provided for construction activities, including in the oCEMP [APP-136] and oCTMP [APP-135])? vii) Justify the 50% replacement of solar panels trigger for notification of panel replacement and mitigation measures to be provided to CWCC? Should the trigger be at a lower level, for example just above that anticipated for routine maintenance and damage of repaired components? viii) Ensure that the draft DCO [AS-013] provides a definition of major replacement activities, provides the powers for these to be undertaken during the operational phase, and identifies how they would be controlled? Should this include a requirement for no major replacement activities or mitigation measures to be carried out before they are approved by CWCC and for implementation to be carried out in accordance with the approved major replacement activities and mitigation measures? Should it be required that CWCC could only give approval if it considers that major replacement activities would be unlikely to give rise to any materially new or materially different environmental effects from those assessed in the ES?

	ix) Advise whether, to ensure consistency with the ES, the level of major replacement activity assessed in the ES should be secured as an upper limit in the draft DCO [AS-013]? x) In light of the above, provide updates to each relevant Chapter of the ES, to the draft DCO [AS-013] and to the oOEMP [APP-137]
	CWCC's preference is to see at least some of the above controls built into the draft DCO rather than the oOEMP, due to the potential significant adverse impacts and the need to control this
	There should be clarity on the scope of replacement activities (e.g. replacement of panels not structural supports) and restriction on use of certain machinery (e.g. avoiding use of cranes). CWCC consider it appropriate to establish a much lower threshold for defining major replacement activities, control over the frequency with which activities can be carried out; and inclusion of locational parameters/constraints near sensitive ecological areas. Avoiding sensitive seasons is linked to limiting the extent of replacement in any campaign. Confirmation/clarification on below ground works (DC cables) Major replacement campaigns to be for approval rather than notification to CWCC. Approval to include provision for requiring updated survey information and updated measures in relation to those in the CEMP/CTP. Consideration of other non-habitat impacts during replacement activities (e.g. public rights of way, protection of soils, water environment, noise, waste). Cumulative impacts should also be considered in terms of other works on the site should be included (e.g. decommissioning of Frodsham Wind Farm, or installation of Hynet North West Hydrogen pipeline or similar).
	5.a.i, 5.a.iv, 5.a.v and 5.a.vii) CWCC commented in the hearing that the threshold of 50% replacement of panels as a definition of major replacement and a trigger for notification to the LPA was too high. The Applicant asserted that 50% replacement would take approx. 6 months, which would mean that at least half of the works would be in a sensitive season for non-breeding birds. The Mersey Estuary RAMSAR, SPA and SSSI sites are designated for their spring and autumn passage bird populations, as well as wintering bird populations, so the only lesser sensitive season is in summer (June, July and August). 20% should be used as a maximum level for the major replacement definition and also

	notification would need to be given to CWCC and ideally should be lower, to guard against potential unregulated impacts.
	In addition, impacts of replacement will be more significant closer to mitigation areas (non-breeding bird and breeding bird mitigation areas), so locational qualifiers should be used as a consideration in major replacement definition and notification thresholds e.g. within a certain number of metres from mitigation areas. This should also extend to areas where birds are located (adjacent to the Mersey Estuary and Cell 6). Also, the frequency of replacement should be a factor in the major replacement definition and notification triggers, to ensure that, for example, works (whether associated with Frodsham Solar, or other projects such as Frodsham Wind Farm decommissioning, or Hynet projects) do not occur in a similar area within a few months, which would amount to further cumulative impacts that would not have been assessed. CWCC also commented that "notification" was not enough and that mitigation measures need to be "for CWCC's approval".
	In terms of worst-case scenario, major replacement cannot be considered to be the same impacts as construction impacts, or the same as combining construction and operational impacts. This is because birds will be concentrated in the mitigation areas and areas adjacent to the Mersey Estuary, rather than more widely distributed across the site as they would be during construction. So, any works causing noise and visual disturbance near these smaller, more defined mitigation areas and remaining usable locations adjacent to the Mersey Estuary, will have a more significant impact on larger populations of birds than during construction. In addition, birds will be unable to move to different areas within the DCO Order limit if disturbed, as they would do for example in the earlier stages of construction, thereby limiting their ability to use the site and increasing the risk of displacement. In summary, as well as a lower percentage, major replacement definition and notification triggers should include: • Location • Season • Frequency Worst case scenario should also include cumulative impacts with Frodsham Windfarm Decommissioning, which will occur in 2042/43 and could coincide with major replacement.

	Other biodiversity issues with major replacement include reinstatement of habitat in terms of biodiversity net gain for example. Where underground cables may need to be replaced. the grassland habitats within the panels takes 5-10 years to reach its target condition. Therefore, it needs to be ensured that any major replacement in these areas does not occur late enough in the operational period so that the target habitat condition cannot be met by the end of the operational period, as the proposed BNG targets of no net loss will not be achieved.
	5.a.viii) CWCC agrees with point viii in the agenda. (The DCO should provide a definition of major replacement activities, provides the powers for these to be undertaken during the operational phase, and identifies how they would be controlled. This should include a requirement for no major replacement activities or mitigation measures to be carried out before they are approved by CWCC and for implementation to be carried out in accordance with the approved major replacement activities and mitigation measures. It should be required that CWCC could only give approval if it considers that major replacement activities would be unlikely to give rise to any materially new or materially different adverse environmental effects from those assessed in the ES.)
	5.a.ix) CWCC agrees with point ix in the agenda. (To ensure consistency with the ES, the level of major replacement activity assessed in the ES should be secured as an upper limit in the draft DCO).

5 b) Access track impacts, removal and reinstatement

ISH 1 Agenda	CWCC comments
5 b)	Access track impacts, removal and reinstatement
	This issue was not covered in the oral representations at ISH1 and the ExA requested written submissions.
	i) Please could the applicant clarify the full extent, width and specified form of construction for each section of access track that would be required for routine maintenance during the operational phase, for major replacement campaigns during the operational phase, for the decommissioning phase, and for after the decommissioning phase? ii) Please could the applicant set out the mitigation measures proposed to minimise the adverse impacts of the access tracks during each phase by setting out the benefits and disbenefits of the access tracks

	being removed when they are not required, including (but not limited to) in relation to habitats and species, soil quality, water environment, traffic, public rights of way and waste impacts? iii) Please could the applicant identify the proposals to reinstate the land where any access tracks that would be removed. iv) Please could the applicant advise how relevant measures are secured? v) Please could CWCC comment?
	CWCC will respond to the Applicant's submission on this at Deadline 3. There is a potential issue, that if the access tracks are not provided to an appropriate standard of construction at the construction stage, there will be a need for major access track renewal / upgrade in order to facilitate major replacement activities during the operational phase. In the oDEMP – (**PD2-020**) Decommissioning activities are described in Section 2.4 – but there is a lack reference to **access tracks.** *2.4 All solar PV modules, mounting poles, above ground cabling, inverters, transformers, BESS equipment, the Frodsham Solar Substation, and fencing would be removed from the Site and recycled or disposed of in accordance with good practice and market conditions at that time. It is also likely that below ground cabling would be removed from Site and recycled. Cables will only be left ….* For decommissioning, the removal of access tracks would seem to be the starting point for a temporary development, for returning the land back to its former use, but there may be environmental benefits in not removing any aggregates (e.g. reducing CO_2 emissions from road haulage) and leaving to naturally regenerate. Regard should be given to the Environment Agency's views on waste implications.

5 c) Underground cable removal

ISH 1 Agenda	CWCC comments
5 c)	Underground cable removal
	i) Please could the applicant set out whether the design of the underground cables would mitigate potential impacts at the time of decommissioning? If they are to be removed how would the design mitigate impacts, including to soil quality, ecology, and the water

	environment. If they are to remain in place would there be any implications in relation to buried waste or limitations on the future use of the site? ii) Are there similar issues in relation to other underground installations, including piling and drainage? iii) Does the Environment Agency or CWCC have any concerns, including in relation to the potential for underground cables, piling, and drainage to be left in place after decommissioning?
	CWCC consider that removal of cables no longer serving an operational purpose would be the presumption. Following ISH1 it is understood that the low voltage DC cables would be in conduits and removed. The issue of removal of medium voltage cables is yet to be determined. Decommissioning activities are described in the oDEMP – (**PD2-020**) 2.4.2 the oDEMP sets out the approach to removal being a benefits/impact analysis; any proposal to retain cabling should be for approval by CWCC. An assessment of the design approach to facilitate removal is recommended. An assessment of the relative impacts of using ducting / conduits rather than laying in open trenching should be set out as part of the design approval process (Requirement 6). For example, the design parameters statement (**APP-132**) could be amended to add wording to recognise the issue of decommissioning and removal as part of the design / approach and parameters. There is currently nothing to say that designing the development to facilitate decommissioning is a design approach principle.
	Depending on location and technique, application of the CEMP during any underground cable removal should be adequate in terms of mitigation.

5 d) Decommissioning end state

ISH 1 Agenda	CWCC comments
5 d)	Decommissioning end state
	The ExA is considering: • How to deal with uncertainties arising before decommissioning, including changes in legislation, regulation, standards, and best practice, the condition of the site, climate change impacts, etc..

	• Whether it is necessary to have a description of the end state of the site that is currently anticipated following decommissioning for it get enough understanding of the potential impacts of the proposed development. The extent to which decisions during detailed design, construction, operation, and maintenance would have a bearing on decommissioning, whether sufficient measures are secured for those phases in relation to decommissioning, and whether they would benefit from a description of the end-state.
	• Whether it would be appropriate to seek to avoid major surprises from changing circumstances through regular reviews of the anticipated end state and oDEMP [APP-138] up to the start of decommissioning. i) Please could the applicant, CWCC, Environment Agency and Natural England comment on the above matters? ii) Following discussion with CWCC, Environment Agency and Natural England, please could the applicant suggest how they might be addressed and update the dDCO [AS-013], and relevant management plans including (but not limited to) the oLEMP [APP144], oCEMP [APP-136], oOEMP [APP-137], oDEMP [APP-138] and oSMP [APP-141] accordingly?
	• How to deal with uncertainties arising before decommissioning, including changes in legislation, regulation, standards, and best practice, the condition of the site, climate change impacts, etc..
	CWCC consider that provision for a review of the oDEMP (linked to habitat monitoring during the operational phase) would be appropriate.
	• Whether it is necessary to have a description of the end state of the site that is currently anticipated following decommissioning for it get enough understanding of the potential impacts of the proposed development.
	CWCC agrees that the end state should be defined, so certainty on the state of the mitigation areas at the time of handover back to landowners can be secured. CWCC recommended that the following issues be incorporated: • Clarification of decommissioning end state (e.g. no mention of access tracks in Section 2.4 of oDEMP (**PD2-020**); provision of ‘restoration plan’ (preferably as part of the oDEMP) • Retention of habitat mitigation areas included in ‘end state’ for hand-back to landowners; • Addition of appropriate restoration aftercare provisions

	Regarding mitigation Cells 2, 3 and 5 of the Frodsham Wind Farm, at the decommissioning end state, these are no longer obligated to be in the management condition they are currently, as the Wind Farm would have been decommissioned at that point. Therefore, the decommissioning end state may not simply be the same as the current baseline and it should be clarified what condition these areas will be in at the point of handover.
	Following on from this, the Applicant states there is no guarantee what happens to the mitigation areas after the handover back to landowners. If there is no post-operational long-term management of the NBBMA and other mitigation areas, the landowner could, for example, fill in wetland scrapes, with no controls or mitigation put in place. This could have significant adverse impacts on the non-breeding bird populations and designated sites.
	• The extent to which decisions during detailed design, construction, operation, and maintenance would have a bearing on decommissioning, whether sufficient measures are secured for those phases in relation to decommissioning, and whether they would benefit from a description of the end-state.
	CWCC agree that a description of the end state would be beneficial, as noted above.
	• Whether it would be appropriate to seek to avoid major surprises from changing circumstances through regular reviews of the anticipated end state and oDEMP [APP-138] up to the start of decommissioning.
	CWCC also agrees that regular reviews at appropriate intervals should be undertaken to inform the decommissioning end state should take place, especially as any further ecological surveys carried out during the period would require review and assessment that the decommissioning end state is appropriate, if change has occurred throughout the operational period.
	CWCC recommended that the following issues be addressed incorporated: • Periodic review of commissioning end state (linked to monitoring of biodiversity) • Provision for seasonal biodiversity surveys prior to final DEMP

5 e) Decommissioning timing

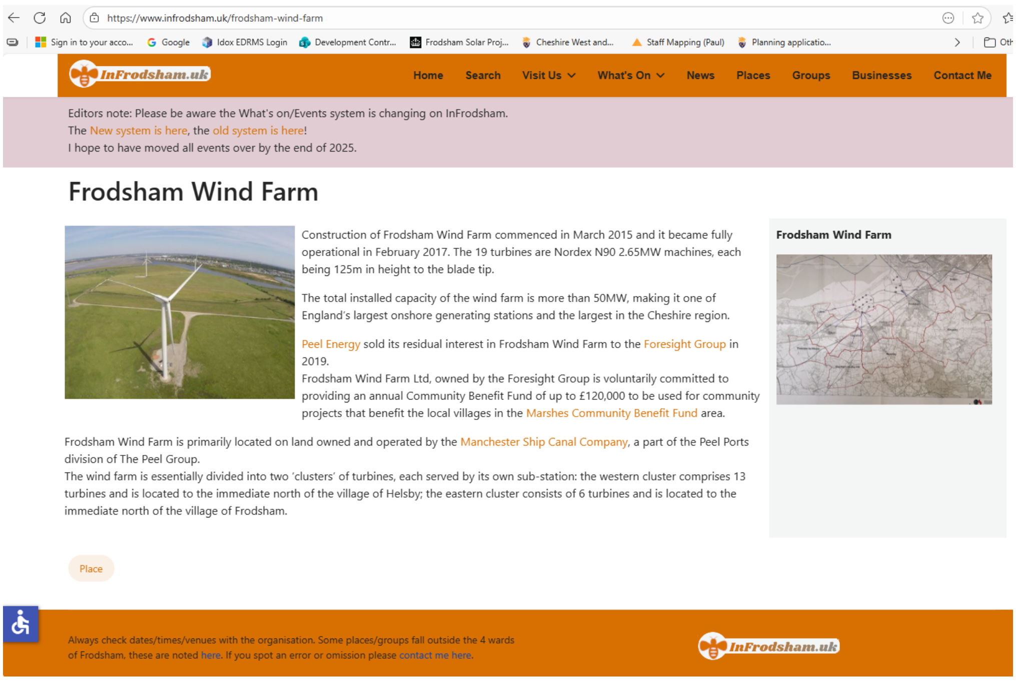
ISH 1 Agenda	CWCC comments
5 e)	Decommissioning timing
	i) Please could CWCC advise whether provisions similar to those on Oaklands Farm Solar Park would address its concerns? ii) Please could the applicant comment and, following discussion with CWCC, update the dDCO [AS-013] accordingly?
	CWCC welcome provisions similar to the Oaklands Farm Solar Park. It is recommended that the following issues be addressed incorporated. • Periodic review of commissioning end state (linked to monitoring of biodiversity) • Commencement of decommissioning following cessation of energy generation or duration of DCO (40years from final commissioning) • Provision for seasonal biodiversity surveys prior to final DEMP • Clarification of decommissioning end state (e.g. no mention of access tracks in Section 2.4 of oDEMP (**PD2-020**); provision of 'restoration plan' • Retention of habitat mitigation areas included in 'end state' for hand-back to landowners; • Addition of restoration aftercare provisions • Period for completion of decommissioning
	CWCC would request that that phasing is secured into the decommissioning timing over the 18-24 month period. This should be the reverse of the construction phasing; therefore, the Western array should be removed first, then eastern array, to ensure that non-breeding birds can re-populate these areas at the earliest opportunity and so impacts are reduced.

5 f) Decommissioning funding

ISH 1 Agenda	CWCC comments
5 f)	Decommissioning funding
	i) Please could CWCC advise whether provisions similar to those on Oaklands Farm Solar Park would address its concerns? Should those provisions also secure the timing of when the decommissioning fund/ financial guarantee should be available to the local planning authority?

	ii) ii) Please could the applicant comment and, following discussion with CWCC, update the dDCO [AS-013] accordingly?
	Whilst there is no policy backing for a decommissioning fund or security in NPS EN-1 of EN-3 for renewable energy. Provision for ensuring decommissioning would be consistent with sustainable development principles.
	Under LP1 Policy ENV7 'Alternative energy supplies' it is CWCC's policy that: *"Proposals should be accompanied by appropriate arrangements for decommissioning and reinstatement of the site when its operational lifespan has ended"*. Securing a fund would be consistent with EN-03Paragraph.3.10.159 as a means of securing the decommissioning of the generating station after the expiration of its permitted operation to ensure that inoperative plant is removed after its operational life.
	In considering what is appropriate regard should be given to the scale of the development associated with a DCO project. A failure to adequately plan and make financial provision for decommissioning runs the risk of leaving a considerable burden on both CWACC (and landowner) to secure timely and appropriate decommissioning and restoration of the site at the end of the consented period.
	Securing funding for decommissioning is important to the delivery of decommissioning. It is an important phase of the development and securing a funding mechanism is a reasonable precautionary measure to avoid the need for subsequent enforcement. An analogy can be seen in Section 278 Agreements (Highways) where a bond or similar is secured for the benefit of the Highway Authority in case of the developer defaulting on the works or in the worst-case scenario becoming insolvent. A responsible undertaker will need to make appropriate provision for funding in any event. By including it as a requirement it avoids potential difficulties towards the end of the project. The Funding Statement (**APP-019**) simply refers to the costs of decommissioning being covered by revenue generated by the Proposed Development. There is no detail on how the revenue would be secured for decommissioning during the operational life of the development nor held and by whom. The funding requirements might be reviewed and updated as circumstances dictate with CWCC not having any visibility of this.

	CWCC welcomes consideration of a requirement similar to the draft Oaklands DCO (even though this was *not taken forward by SoS*). The SoS's reasons for omitting the decommissioning fund requirement are noted, (para's 4.36 to 4.45 and 7.6 of the decision letter (19 June 2025). The decision not to include the draft requirement related whether it was necessary and relevant. With regard to relevance, it is understood that the Applicant has (or will have) agreement with the landowners regarding decommissioning before the land is returned, but it is in the public interest to ensure that timely decommissioning is secured, and removal at the end of the consent period is necessary to give purpose to the ES assessment of the development as time-limited. The uncertainly regarding the availability of funding, and potential changes in undertakers during the life of the development, as seen and evidenced at Frodsham Wind Farm, and the implications of not securing appropriate funding, give rise to such a requirement being necessary. It is noted in terms of precedent that the Helios Renewable Energy Project Order 20-25 (3 December 2025) (Requirement 5 (3) makes some provision in relation to a decommissioning security provision; albeit not in as a robust form as the draft requirement on Oaklands DCO.
	Oaklands DCO draft: *Decommissioning fund 27.—(1) No phase of the authorised development may commence until a decommissioning fund or other form of financial guarantee that secures the cost of performance of all decommissioning obligations under Requirement 22 of this Order has been submitted to and approved by the local planning authority. (2) The value of the decommissioning shall be agreed between the undertaker and the local planning authority or, failing agreement, determined (on application by either party) by a suitably qualified independent professional as being sufficient to meet the costs of all decommissioning obligations referred to in Requirement 22 of this Order. (3) The decommissioning fund shall be maintained in favour of the local planning authority until the date of completion of the works to be undertaken in accordance with Requirement 22 of this Order. (4) The value of the decommissioning fund shall be reviewed by agreement between the Undertaker and the local planning authority by a suitably qualified independent professional no less than every five years and increased or decreased to take account of any*

	variation in costs of compliance with decommissioning obligations and best practice prevailing at the time of each review.
	Experience from the Frodsham Wind Farm development shows that the original undertaker will often transfer a development once operational to another undertaker or undertakers (noting that there is both the Solar PV and BESS which may be subject to different operation / operators). Therefore, it is not only necessary to ensure that Applicant has the necessary funding to construct, operate and decommission the Proposed Development, there should be a robust mechanism for ensuring the funding for decommissioning is available to potential future undertakers and this should be transparent Peel Energy initiated construction of Frodsham Wind Farm and the windfarm was commissioned on 13th February 2017. It is understood that there have been subsequent changes in ownership and operators of the windfarm (with the involvement of Belltown Power and the Foresight Group). It is understood that Peel Energy sold its residual interest in the windfarm (Frodsham Wind Farm Ltd) to the Foresight Group in 2019. Frodsham Wind Farm is not subject to a decommissioning fund, but the above change in ownership illustrates how commercial interests are liable to change during the lifetime of the project, and there is no guarantee that subsequent operators will have the funds necessary to carry out decommissioning.
	 https://www.infrodsham.uk/frodsham-wind-farm Sign in to your acco... Google Idox EDRMS Login Development Contr... Frodsham Solar Proj... Cheshire West and... Staff Mapping (Paul) Planning applicatio... Oth InFrodsham.uk Home Search Visit Us What's On News Places Groups Businesses Contact Me Editors note: Please be aware the What's on/Events system is changing on InFrodsham. The New system is here, the old system is here! I hope to have moved all events over by the end of 2025. **Frodsham Wind Farm** Construction of Frodsham Wind Farm commenced in March 2015 and it became fully operational in February 2017. The 19 turbines are Nordex N90 2.65MW machines, each being 125m in height to the blade tip. The total installed capacity of the wind farm is more than 50MW, making it one of England's largest onshore generating stations and the largest in the Cheshire region. Peel Energy sold its residual interest in Frodsham Wind Farm to the Foresight Group in 2019. Frodsham Wind Farm Ltd, owned by the Foresight Group is voluntarily committed to providing an annual Community Benefit Fund of up to £120,000 to be used for community projects that benefit the local villages in the Marshes Community Benefit Fund area. Frodsham Wind Farm is primarily located on land owned and operated by the Manchester Ship Canal Company, a part of the Peel Ports division of The Peel Group. The wind farm is essentially divided into two 'clusters' of turbines, each served by its own sub-station: the western cluster comprises 13 turbines and is located to the immediate north of the village of Helsby; the eastern cluster consists of 6 turbines and is located to the immediate north of the village of Frodsham. Frodsham Wind Farm Place Always check dates/times/venues with the organisation. Some places/groups fall outside the 4 wards of Frodsham, these are noted here. If you spot an error or omission please contact me here. InFrodsham.uk

	Extract from InFrodsham.uk website (last accessed 16 December 2025)
	The Applicant should provide clarification on the funding needed to carry out decommissioning, how this will be secured from the revenue generated by the Proposed Development and how this will be managed
	In terms of the timing of when the fund should be available, it is important to ensure that funding is in place and available for use from final commissioning of the development, in the event that there is a change in circumstances that leads to the project not generating electricity as anticipated, and the period for decommissioning being triggered earlier than the 40 year duration of the development consent. It is anticipated that the funds would be made available within a reasonable period following CWCC serving notice on the undertaker following cessation of energy generation for more than 6 months / or at the end of 40 years, and the lapse of a period of 3 months without the undertaker progressing decommissioning.
	Requirement 20 relating to decommissioning needs to include provision for a timetable for implementation of decommissioning, not just that decommissioning commences.
	Restoration and aftercare provision is also needed for Requirement 20.

5 g) Peat deposits

ISH 1 Agenda	CWCC comments
5 g	Peat deposits

	i) Please could the applicant provide a drawing to show: • the location and top level of any peat identified in any investigations November 2025 • the locations and levels to which peat has not been found in the investigations undertaken for the proposed development • how those levels compare with the levels of the underside of piling, foundations, drainage and cable trenches, and other groundworks • the indicative locations proposed for future ground investigations ii) Please could the applicant comment on uncertainties in the level of the peat and on the reasonable worst-case potential for it to be disturbed by piling, foundations, drainage and cable trenches, or other groundworks. iii) Please could the applicant set out on the mitigation proposed for potential disturbance to the peat? iv) Please could the applicant update the ES [APP-044], dDCO [AS013] and oWSAI [AS-029] accordingly? v) Please could Historic England and CWCC comment, including on the level of harm?
	In response to the ExA's request for CWCC's comments as to whether its concerns were more in relation to mitigating impacts and harm to archaeology, or more in relation to potential benefits of the proposed development in providing more information on the historic environment, the *Cheshire Archaeology Planning Advisory Service* has provided the following supporting information and clarification.
	Frodsham Solar DCO - Actions for Deadline 1: Archaeology The Archaeology Planning Advisory Service's (**APAS**) response to the proposal for the construction of the proposed development has been informed by information submitted in support of the proposal as well as information held in the Cheshire Historic Environment Record (**CHER**) concerning previous developments in the vicinity of the site, as well as the wider area, which have produced evidence comparable to that which may be present within the proposed development area. The key documents comprise: Section 11 (Cultural Heritage in the initial Preliminary Environmental Information Report or PEIR; Chapter 11 (Cultural Heritage) in the Environmental Impact Assessment (APP-044) and the full desk-based assessment prepared by AOC Archaeology (Appendices 11.1-6 in the EIA)(APP-099 to APP-104). In addition, APAS has also taken account of the exploratory fieldwork undertaken by Wardell Armstrong which sought to establish the extent of any surviving surface peat deposits as well the presence or absence and extent of any peat deposits existing beneath estuarine alluvium. The latter forms the present ground surface (where not obscured by

	recent deposition of material derived from dredging of the Manchester Ship Canal). These investigations are described in the report entitled "Peat Reconnaissance Survey – Wildfowlers" (APP-097 Appendix I). An outline Written Scheme of Investigation (WSI) (AS-029) has also been prepared by AOC Archaeology to address the archaeological mitigation which is likely to be required in order to address Requirement 18 in the draft DCO. All of these documents appear in the library of supporting documentation which accompanies the application. Another key report comprises a geoarchaeological study prepared by Oxford Archaeology (Appended to CWCC's Written Representations) in support of the HyNet Runcorn Spur application, which forms part of the wider HyNet Carbon Dioxide Pipeline DCO and will see the construction of a pipeline to the north of the proposed solar farm but still within the same estuarine environment. Crucially, this report includes a number of transects across the solar farm area which, on the basis of detailed desk-based research, provide a more detailed picture of the sedimentary sequence (including peat) than had previously been obtained. This report, which is now contained in the CHER, was made available to the Applicant's archaeological consultants once the HyNet Runcorn Spur application had been submitted and the Oxford Archaeology study became document in the public domain. APAS has also considered the results from previous nearby developments which have affected wetland environments, in order to define more precisely the potential of the solar farm to preserve significant deposits. Key sites include: the work at the Resource Recovery Park on the Ince Marshes (where the c 10m deep sedimentary sequence was examined); the investigations undertaken during the recent upgrade to the A51 where it crosses the river Gowy (resulting in the assessment of associated peat and recovery of a late prehistoric human skull) and the investigations during the installation of a new pipeline in the Gowy Valley (where a peat deposit was subject to full analysis). All these projects generated significant new information on Cheshire's past environments as well as, occasionally, producing unexpected discoveries such as a late prehistoric skull form the A51 works. In terms of surface archaeological remains within the proposed development the number of sites is limited and comprises some earthworks representative of past cultivation (ridge and furrow) and

	some recent industrial remains consisting of the surface remains of brick-built shafts. The outline WSI (AS-029) proposes that the mitigation for these remains should comprise representative trial trenches across the ridge and furrow as well as a basic building recording exercise for the surface remains of those shafts affected by the development. APAS advises that these proposals represent an appropriate strategy which will address Requirement 18, with regard to surface archaeology. It is not denied that other archaeological remains could also be present beneath the ground surface and it would certainly be advised that the archaeological mitigation referenced above should be expanded to include a watching brief for any activities that are designed to improve drainage, such as cutting new ditches or deepening existing ones. However, any such deposits are likely to comprise individual objects or, on occasion, human remains which were deposited in wetland environments in later prehistory. As such, their presence is too unpredictable and sparse to be susceptible to field evaluation and they may very well be buried at a depth where they will not be disturbed by the development. APAS has consistently advised, in an approach strongly endorsed by Historic England (**HE**), that the main archaeological interest of the site lies in the potential for any peat deposits to provide a detailed picture of the development of the environment in the area, including any human impact, over the last c 11,500 years (the Holocene or period since the end of the last Ice Age). Such potential might be termed **paleoenvironmental**. The reports submitted in support of the EIA suggest that no peat is present within 5m of the present ground level within the area of the solar farm and that any peat deposits are at a depth where they would not be disturbed by development. APAS and HE consider that this conclusion is potentially misleading, given the documented presence of an "upper" peat deposit at the nearby Ince Marshes, whose top level lies immediately underneath the surface alluvium at a depth of c 1m. This apparent absence might be a result of limited field survey to date or could be due to the fact that the samples were obtained from within former river channels where the peat has been eroded away. In view of this uncertainty, the outline WSI contains proposals for a programme of geoarchaeological field investigation across the site which will involve the drilling of boreholes (locations to be informed by the Oxford Archaeology study) through the sedimentary sequence in order to establish the precise nature of the peat deposition within the solar farm area.

	APAS, supported by HE, also advise that where peat is detected at whatever depth it would be reasonable to subject the most complete borehole core to a programme of paleoenvironmental assessment and, if justified by the quality of the data, full analysis to cover areas including pollen, macrofossils, charcoal, insects, etc. This is an approach that has successfully employed on a number of development-led project in Cheshire in recent years, including the Ince Marshes and the other sites in the Gowy Valley referenced above, as well as other developments across the county and country at large. It is recognised that in many instances the bulk of the deposits subject to analysis will remains largely undisturbed but it is advised that paleoenvironmental work of this kind represents a legitimate aspect of the mitigation and delivers significant public benefit in terms of enhancing knowledge of the environment in which past communities lived and operated. In summary, therefore, it is expected that Requirement 18 in the draft DCO will be discharged by a limited programme of standard archaeological mitigation, comprising: investigation of affected surface features including ridge and furrow and industrial features as well as a watching brief if new drains are excavated or existing drains significantly monitored. In addition, there should be a full programme of paleoenvironmental work in line with the procedures outlined above. Each aspect of the advised mitigation works should be defined in detailed WSIs, which should include provision for production of a report. Where particularly significant discoveries are made, there may be a need for formal publication in an appropriate journal.
	Principal Planning Officer's additional comment: In relation to the point about whether a full programme of paleoenvironmental work is needed as a result of the impacts of the development, CWCC considers that it is appropriate to require further work due to the proposed development being carried out. There remains a question mark over whether the proposed development would disturb peat deposits, and further geoarchaeological investigation in the form of a purposive borehole survey is warranted (particularly in light of the additional information from the HyNet Runcorn CO2 pipeline spur). The oWSI (**AS-029**) confirms: *"Boreholes will need to be drilled to top of pre-Holocene superficial or solid geology (e.g. terrace gravels or bedrock), whichever is encountered first. Where possible the pre-Holocene deposits will be*

	drilled into a further c. 0.5m to prove they are in situ. Continuous core samples will be collected throughout the drilled deposit sequence. The cores will be retained by the Archaeological Contractor." Chapter 11 of the ES (**APP-044**) in Table 11-10 identifies the 'Probable peat deposits underlying the Site' as having an '*Unknown, Potentially High importance*' as a (non-designated) heritage asset. Later in the chapter (11.8.7) it refers to the indirect effects on archaeological remains as *limited:* *"The potential for indirect effects upon hitherto unknown buried archaeological remains is considered to be limited to the potential effects of any changes to the ground conditions which could affect the preservation of any buried peats and preserved organic deposits"*. However, with the additional information from the Runcorn CO2 pipeline spur assessment, it is considered effects are more likely. There is a possibility that impacts on peat deposits could occur during the construction period as indicated in HE's relevant representation (**RR-033):** *"While the majority of the peats are believed to lie at a depth of more than 5 metres below ground level (bgl), and therefore below the level that would be impacted by the Proposed Development, it is possible that in some areas peats may survive at more shallow depths than 5 metres bgl"*. CWCC welcomes the Applicants acknowledgment and commitment to carrying out further archaeological investigation and recording (C45 and C46 of the Commitments Register (**PD2-12).** There is an implicit recognition that there may be peat disturbance in the commitment C74, which is caveated by '*As far as reasonably practical* ...). The additional commitment C124 relating to use of low-pressure piling machinery should any areas of peat be identified is also noted. This commitment should be clarified to account for peat found at any stage of the development not just 'prior to construction'. The proposed development will sit above the area of interest for a considerable time, thereby inhibiting the opportunity to reveal further the significance of the archaeological interest of the site. The heritage asset would be expected to be left 'in situ' but in practice this equates to being lost for the duration of the development and carrying a programme of work to better reveal the significance of the asset prior to construction would be consistent with EN-1 paragraph 5.9.15: *"Applicants should look for opportunities for new development within Conservation Areas and World Heritage Sites, and within the setting of heritage assets, to enhance or better reveal their significance. Proposals that preserve those elements of the setting that make a*

	positive contribution to the asset (or which better reveal its significance) should be treated favourably”
	Examples of other cases where similar investigations/assessment and reporting have been carried out in Cheshire West and Chester Council’s administrative area are: 1. The pollen and macrofossil analysis caried in connect with the Ince Marshes Resource Recovery/Protos project, which revealed a full sequence of deposits spanning the period since the end of the last ice Age (the Holocene). This work has been published in Chapter 14 of Garner, D, 2016 Hillforts of the Cheshire ridge: investigations undertaken by the Habitats and Hillforts Landscape Partnership Scheme 2009-2012, *Archaeopress*, Oxford 2. Analysis of pollen and macrofossils from peat in advance of housing development at Relicks Moss, Delamere Centre for Archaeology, which revealed a sequence c 5m deep and covering much of the earlier Holocene. The report reference is: University of Salford, 2019 Palaeoenvironmental Investigation: Relicks Moss, Station Road, Delamere, Cheshire, Unpublished report in the Cheshire Historic Environment record (ECH6735) 3. Analysis of peat deposits obtained from the Gowy Valley in advance of the construction of a boating lake near Tarvin. Again, the sequence covered much of the Holocene. The report reference is: Grant, F R, 2013 Pollen Analytic Assessment of Seventeen Sub-samples from Hockenhull Hall, Tarvin, Cheshire, Unpublished report in the Cheshire Historic Environment record (ECH5885) There are numerous other examples but these three all involved analysis of deposits that were going to be disturbed but not wholly destroyed. APAS commissioned a review of this type of work by a retired Regional Science Advisor at Historic England, which was published in the peer review Journal of the Chester Archaeological Society and was supportive of the approach outlined above. The reference is: Huntley, J, 2020 Development-led palaeoenvironmental work in Cheshire: a review, *J Chester Archaeol Soc*, **90**, 123-160. Historic England’s Regional Science Advisors have also supported work of this kind and have actively advocated it not just on the present Nationally Significant Infrastructure Project but also HyNet Carbon Dioxide Pipeline DCO.

5 h) Ground conditions at the non-breeding bird mitigation area

ISH 1 Agenda	CWCC comments
5 h	Ground conditions at the non-breeding bird mitigation area
	CWCC's Environmental Protection Officer has provided the following comments to the ExA's questions.
	Do you think the ground conditions have been adequately characterised?
	The Smith Grant Environmental Consultancy (May 2025) Stage 1 Geo-Environmental Assessment for Frodsham Solar Ltd Ref: R3091-R01-v8 (**APP-096**) provides a detailed account of the historic land use of the site and ground conditions based on the findings of the following site investigations which are summarised within the report: • Wardell Armstrong (March 2014) 'Frodsham Wind Farm. Preliminary Site Investigation'. • Wardell Armstrong (April 2015) 'Frodsham Wind Farm Phase 2 Site Investigation'. • Wardell Armstrong (April 2024) 'Cell 3 Ground Investigation Report' V2. & factual information provided by Wardell Armstrong concerning ground investigation performed on Cell 3 in June 2024. • SGP (March 2025) MSCDDG Cell 3 Summary of Chemical Results. • SGP (July 2024) Wildfowlers Land: Summary of Chemical Results. • Wardell Armstrong (April 2015) 'Frodsham Wind Farm. Condition 38: Hydrocarbon Contamination Within Cell 3'. • Wardell Armstrong (January 2015) 'Frodsham Wind Farm Piling Risk Assessment'. • Wardell Armstrong (August 2024) 'Peat Reconnaissance Survey – Wildfowlers Land'. Ref: GM12793 report 009. • SGP (March 2025) Preliminary Site investigation and Assessment completed for BESS and Frodsham Electrical Substation • Smith Grant (March 2025) MSCDG Cell 3 – Summary of Chemical Test Results Recorded during Third Party Ground Investigation Sufficient investigation has been undertaken at this preliminary risk assessment phase. Further site investigation works are proposed to further characterise the site and inform the final mitigation measures. It is understood that ground gas monitoring will only be undertaken if

	any enclosed structures are proposed. CWCC concur with this approach. Health and safety of construction workers will be dealt with through separate legislation.
	Are you content with the applicant's assessment that there would be no residual significant effects?
	Table 10-15 (Assessment of likely impacts and residual effects with additional mitigation applied) in Chapter 10 of the ES (**APP-043**) identifies all potential impacts associated with ground conditions and lists the additional mitigation measures and monitoring requirements. The applicant concludes that through the implementation of incorporated and additional mitigation measures there would be no significant residual effects on human health, groundwater, surface water, ecology, land and livestock receptors or buildings/ground stability have been identified. Overall, the effects are predicted to be not significant with respect to ground conditions, contamination and land instability and no significant residual effects having been identified. CWCC concur with this assessment but would recommend that the views of the Environment Agency are obtained with regard to controlled waters.
	In addition, CWCC's Natural Environment Officer has provided the following comments below: The ExA also raised the issue of the high pH of the remediated soils and whether this would jeopardise the delivery of the NBBMA as other neutral grassland. It is considered that clarification from the Applicant's consultant would be appropriate to answer this, and CWCC could then respond if needed.
	It is considered that clarification from the Applicant's consultant would be appropriate to answer this, and CWCC could then respond if needed.

5 i) National Character Areas (NCA) (in relation to the landscape)

ISH 1 Agenda	CWCC comments
5 i	National Character Areas (NCA) (in relation to the landscape)
	This issue was not covered in the oral representations at ISH1 and the ExA requested written submissions.
	i) Please could the applicant provide further justification for why it considers that effects on NCAs would be less than on local character areas? Is the applicant's approach supported by relevant guidance? Are the relative size and scale of the areas the only consideration? ii) Recognising that NCAs are sensitive receptors within their own right, please could the applicant set out, with clear justification and November 2025 reasoning, the potential effects of the proposed development on NCAs? iii) Please could CWCC comment?
	CWCC's Landscape Architect has provided the following commentary below. In summary, whilst the assessment has yet to be presented, it is not anticipated likely that the assessment of the National Character Areas (**NCA**) as sensitive receptors would result in a significant effect on the host NCA 60: Mersey Valley, i.e. the proposed development would not be of such significance to change the character of the NCA. Nor would the proposed development have a significant effect on the adjacent NCA:62 Sandstone Ridge, which overlooks the site. However, there are key attributes of the NCAs that are relevant to the assessment of the proposed development's impact in terms of landscape character. In context, CWCC has highlighted the significant local impact on the Local Character Area (**LCA**) e.g. from Frodsham Hill and the war memorial, but acknowledge the lesser impact from Helsby Hill, and thereby consider the impacts would be locally significant rather than national. PINS Scoping Opinion (**APP-049**) identified the NCAs to be sensitive receptors in their own right. CWCC subsequently agreed with the Applicant that the more detailed Landscape Character Areas provide a more focussed appreciation of the landscape character. However, CWCC also commented that Natural England's NCA analysis with landscape attributes and opportunities ought to be addressed in the LVIA.

	It was agreed that NCAs should be included in the LVIA and that scoping out of the NCAs in terms of the significance of impacts on the NCAs is justified. The Applicant produced a technical note (**APP-066**) in response to the Scoping Opinion. Whilst CWCC's preliminary view is that the proposed development would not have significant effect on the NCA as a sensitive receptor, and noting that the Applicant has referenced the attributes of the NCA in Chapter 6 Landscape and Visual (Paragraphs 6.6,27 to 6.6.29 (**APP-039**) and the NCA characteristics are included in the Landscape Character Baseline (**APP-068**), CWCC consider that it is important to highlight the NCA attributes in more detail, as context to the importance of the landscape character aspects that CWCC have already raised concerns about (based on the LCAs), as these same attributes are also part of the National Character Area qualities. CWCC's Landscape Architect has highlighted/underlined some of the comments from the application submission documents, and the ISH1 agenda to then provide further commentary below.
	APP039 - **Volume 1: Chapter 6: Landscape and Visual Amenity** 6.6 Baseline Conditions 6.6.29 These NCAs provide background and context to more detailed landscape character assessments produced at county and district levels. **Their broad geographic reach means that the key characteristics identified as typical of a particular <u>NCA may not</u> necessarily apply to a specific location within that NCA.** ES Volume 2 Appendix 6-5 [EN010153/DR/6.3] (**APP-068**) summarises the key characteristics and other relevant information for each NCA within the Study Area **CWCC Landscape Response**<u>:</u> There is agreement in principle that the focus of the LVIA should be based on the Local Landscape Character Area as per the CWCC Landscape Strategy. However, there is disagreement that for both NCA 60 Mersey Valley (site lies within) and NCA 62 Sandstone Ridge (overlooking the site) the key characteristics identified "as typical of a particular NCA may not necessarily apply to a specific location". The key characteristics for both NCA are relevant to the site and its surroundings. Furthermore, for NCA 62, this area includes the landscape designation of Area of Special County Value (ASCV).

	APP-049 - 3.1 Landscape and Visual - Applicant's proposed matters to scope out Inspectorate's comments 3.1.2 Paragraphs 7.4.17, 7.4.18 and Table 7.4 Effects on National Character Areas – all phases The Applicant proposes to scope out effects on NCAs due to scale of the Proposed Development in comparison to the broad nature of NCAs which add context to the more detailed Landscape Character Areas identified at a district level. **The Inspectorate considers NCAs to be sensitive receptors within their own right and considers that the ES should identify, locate and assess impacts to NCAs where there is the potential for significant effects to occur.** **CWCC Landscape Response**: • Both NCA 60 Mersey Valley (site within) and NCA 62 Sandstone Ridge identify key characteristics which are relevant to the site and its surroundings. • These key characteristics contribute to the site being a highly valued landscape and of high sensitivity to change. • It is significant that both of the NCA documents include representative views across the site within the documents. This also includes an image of the war memorial within the Sandstone Ridge NCA 62. These views illustrate the unique character, local value and distinctiveness of the site and its relationship to both NCAs.
	i) Please could the applicant provide further justification for why it considers that effects on NCAs would be less than on local character areas? Is the applicant's approach supported by relevant guidance? Are the relative size and scale of the areas the only consideration?
	CWAC Landscape Response: As the site characteristics relate to the National Character Area (both NCA 60 and NCA 62) site description and key characteristics, CWCC is of the opinion that the proposed development has the potential to negatively impact on both the NCA and the Local Character Areas.
	i) Recognising that NCAs are sensitive receptors within their own right, please could the applicant set out, with clear justification and reasoning, the potential effects of the proposed development on NCAs?
	CWCC Landscape Response: NCA 60 Mersey Valley: Potential Effects as indicated in the NCA Profile: Loss of greenspace and public amenity. Impact on expansive views. Loss of large scale, open, predominately flat, high-quality farmland between developments. Impacts on enjoyment of

	recreational rights of way networks. Impact on sense of Place: impact on the senses of inspiration and escapism that may be provided by the broad panoramic views to the west across the Mersey Estuary. Impacts on Communities who also value their local greenspaces as places of local distinctiveness that provide opportunities to engage with nature close to where they live and work, and that helps encourage a sense of community. NCA 62 Cheshire Sandstone Ridge: Potential Effects as indicated in the NCA Profile: Potential effects on expansive views to walkers. The ridge affords long distance views out of the NCA. The view provides a wider appreciation of the strong contrast in landscape characteristic and topography between the ridge and the surrounding plain.
	i) Please could CWCC comment?
	CWCC Landscape Response: CWCC agree the NCAs are sensitive receptors within their own right. CWCC considered that it is unlikely that significant effects on the NCA would occur and it was reasonable to scope this out of the ES. However, in hindsight with further consideration to the key elements of the landscape character in relation to the site, which are relevant to the NCA, inclusion of assessment in the ES to identify, locate and assess impacts to NCAs would determine whether there is the potential for significant effects to occur. In any event, the LVIA should explicitly consider the NCA characteristics in more detail than initially set out.

5 j) Residential visual amenity assessment (RVAA)

ISH 1 Agenda	CWCC comments
5 j)	Residential visual amenity assessment (RVAA)
	This issue was not covered in the oral representations at ISH1 and the ExA requested written submissions.
	i) Please could the applicant comment, with reasoning, on the level of glint and glare (e.g. in terms of intensity and duration) that could reasonably be considered to make a property an unattractive and unsatisfactory place to live? Please could CWCC comment?
	It is noted from Technical Guidance Note 02/19 that *"with respect to visual impact the focus of GLVIA3 and LVIA is on public views and public visual amenity. Residential Visual Amenity Assessment (RVAA) is a stage beyond LVIA and focusses exclusively on private views and private visual amenity"*.

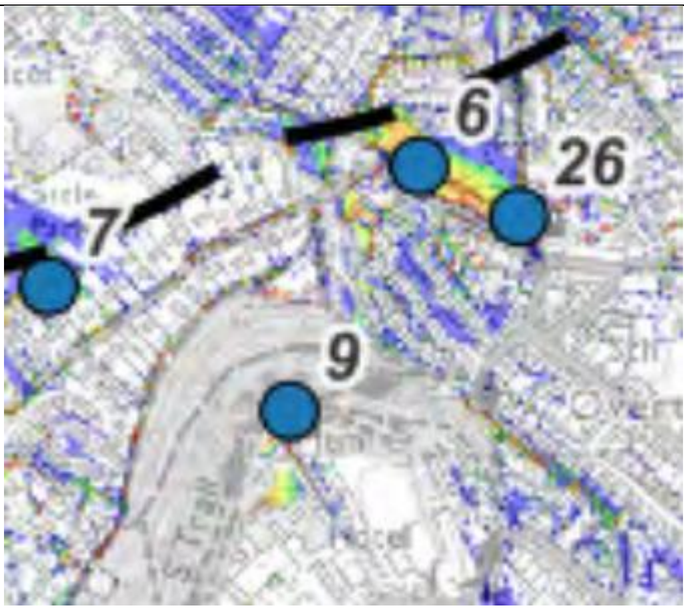
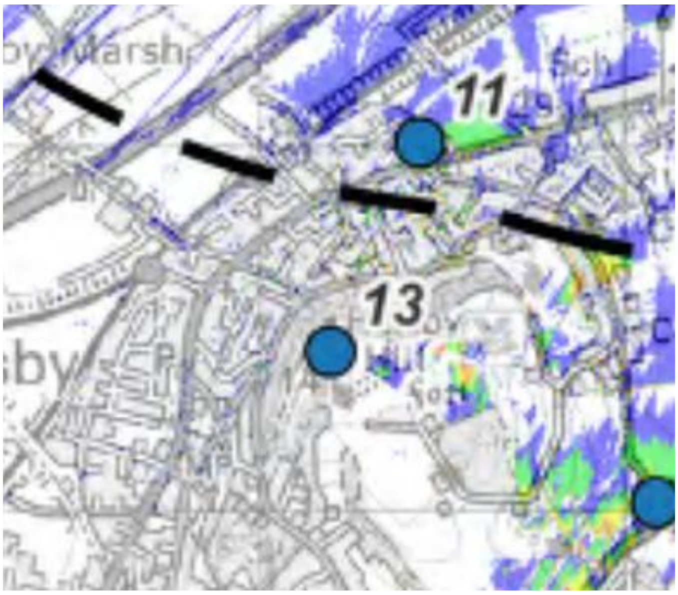
	The purpose of an RVAA would be to assist in determining whether the proposed development is likely to change the visual component / visual amenity of a residential property to such an extent that residential amenity is an issue. Nearby residential properties are to the south of the M56, and a combination of distance and intervening landscaping generally provide filtering of the views of the development from the nearest residential properties. The travellers sites are notable as the main residential use to the north of the M56. The need for RVAA is dealt with in **APP-067 -** Appendix 6-4 Residential Properties). CWCC concurs with the broad findings of the above appendix justifying the exclusion of a RVAA from the LVIA, and the conclusion that visual change would not occur to such a degree that the living conditions of residents would be affected to the degree that any property would become an unattractive and unsatisfactory place (but not necessarily uninhabitable) place to live. CWCC do not raise any principle concerns with the conclusions of the Glint & Glare Assessment (**APP-056**). However, there are some apparent anomalies that justify further explanation from the Applicant.
	The Glint and Glare Assessment [APP-056] states that: • for 16 assessed dwellings, views would be limited by existing vegetation and/ or other dwellings such that effects are predicted to be experienced for less than three months per year and less than 60 minutes on any given day • for 15 assessed dwellings effects were predicted for less than 60 minutes on any given day but for more than three months per year, despite partial screening.
	ii) Please could the applicant clarify the level of glint and glare at residential receptors along Ship Street in the vicinity of Viewpoint 3? Are similar levels anticipated at any other residential receptors?
	For Applicant to confirm.
	iii) Is CWCC content with the applicant's residential amenity threshold of whether the visual change due to the proposed development November 2025 would make a property an unattractive and unsatisfactory place to live? If not, why not?
	The thresholds within the Glint and Glare assessment appear to be reasonable (i.e. the 3 month and 60 minute durations) and it is understood this approach has been accepted in other solar farm cases

	iv) Does CWCC consider that the applicant has provided sufficient information for it to be clear that the threshold would not be breached? What further information, if any, should be provided?
	It would be helpful to have further details of how many minutes/months each property identified as having 'low' impact is potentially exposed to (e.g. at what point is low attributed, and at what point would 'moderate' be given).
	v) Does CWCC have any other outstanding concerns about RVAA?
	CWCC does not raise any major concerns about the absence of a formal RVAA as part of the ES, and the Glint and Glare Assessment provides a useful tool. The thresholds within the assessment appear to be reasonable (i.e. the 3 month and 60 minute durations) and accepted in other solar farm examples. However, there are some matters which do require further clarification. There appears to be an inconsistency between the documents over the number of dwellings effected, i.e. whether it is 3 dwellings or 15 dwellings: **APP-067** (paragraph 1.1.4) refers to 3 dwellings: *ES Volume 2 Appendix 1-1 [EN010153/DR/6/2] includes an updated Glint and Glare Assessment identifying that only three residential receptors (all located along Ship Street at the edge of Frodsham) would require mitigation to reduce potential glint and glare effects.* It would be useful to have confirmation of which 3 dwellings this refers to. Paragraph 2.1 of the Glint and Glare Assessment (APP-056) *"2.1 Solar Panel Layout Background Based on the results of the initial geometric modelling undertaken at the PEIR stage, mitigation was recommended for nine road receptors and* ***three dwelling*** *receptors i.e. where* ***moderate*** (bold added) *impacts were predicted. A further two road receptors were deemed to be a low impact; however, mitigation was still proposed due to effects being predicted from within a road user's primary field-of-view (FOV)."* It is noted that the initial modelling predicted 'moderate' impact on these dwellings. Notwithstanding this early reference to three dwellings which has then been referred to in APP-067, the Glint and Glare Assessment conclusions go on to refer to the 16 dwellings with less than three months and less then 60 minutes per day of potential exposure, and a further 15 dwellings where exposure is for more than 3 months. The impact is described as low (having regard to the effects being restricted to above ground floor rooms, coincidence with periods of direct sunlight, and panels being mostly 1km

	from the receptors). No further mitigation is recommended. Whereas mitigation is referred to elsewhere e.g. *"vii) Use of antireflective material on Solar PV Modules to limit glint and glare effects (delivered via the oOEMP [EN010153/DR/7.6])"* (para 6.7.10 of **APP-039**) Chapter 6 LVA. *"iv) New planting to minimise glint and glare effects from the outset."* para 6.7.11 of **APP-039**) Chapter 6 LVA.
	There is also a wider point needing clarification, with regard to explaining the change from the earlier Glint and Glare assessment, where **moderate** (rather than just low) impact is referred to: **APP-048** (Scoping Report) chapter 17.2 deals with Glint and Glare and Appendix 17.1 has a preliminary Glint and Glare assessment (Nov 2022). At 17.2.8 of the scoping report it refers to a site visit to the location where **moderate** impact envisaged. The Nov 2022 Glint and Glare assessment refers to: "*A moderate impact is predicted upon observers within 24 of the assessed dwellings. Mitigation for these dwellings is recommended"*.
	Overall, CWCC considers that it is unlikely there would be significant effect in terms of glint and glare subject to appropriate mitigation. The photograph below provide an indicative view opposite a pair of the more exposed properties along Ship Street.

	  See Figure J78 for dwelling receptors 76 to 78 for context
	 Figure J78 Reflecting panels and partial screening for dwelling receptors 76 to 78 Solar Photovoltaic Glint and Glare Study Frodsham Solar Project 189
	It may well be a legacy issue, but '*Image 3 – View from properties where 'moderate'; Glint and Glare impacts are predicted (LVIA Viewpoint 3)'* in **APP-067** refers to 'moderate' not 'low' impact.

	Document Reference: EN010153/DR/6.2 Frodsham Solar May 2025 Appendix 6-4: Residential Properties **Image 3 – View from properties where 'moderate' Glint and Glare impacts are predicted (LVIA Viewpoint 3)** 
	There is a need to ensure anti reflective coating to solar modules is included in the detailed design approval under Schedule 2 Requirements (Part 6 (1) (see Oaklands DCO issue for precedent - *Sched 2 Art 47 detailed design approval (k))*.
	There is a need to ensure any mitigation for Glint and Glare is maintained through the operational phase of the development (see **Byers Gill DCO** issue for precedent – Requirement 12 and maintenance section in oLEMP).
	As noted in RR 6.24 the representation provided by the Zone of Theoretical Visibility (ZTV) mapping on Figures 6-4c, 6-4d **APP-109** appears to underrepresent the actual visibility of the SADA as shown in Viewpoint 9 Frodsham Hill War Memorial. This is likely because the small area at Viewpoint 9 is not picked up at the level of the ZTV, rather than an inconsistency as such, but the difference is drawn to the attention of the ExA. Similarly , Viewpoint 19 from Helsby Hill appears to also show limited visibility of the SADA. It may assist the ExA if the Applicant was able to provide a table with the viewpoints/co-ordinates for each of the viewpoints in the LVA and reference to the percentage of solar PV modules that the ZTV base information reveals should be theoretically viability from the respective viewpoint. Below are extracts from Fig's 6-4c and 6-4c Zone of Theoretical Visibility APP- ES Vol 3 Ch 6 LVA Fig 1 03 13 **(APP-109)** in relation to viewpoints 9 and 13. The actual visibility of panels at the war memorial appears close to 100%, and at Helsby Hill, a substantial percentage too.
	ZTV for Viewpoint 9 (Frodsham War Memorial)

	
	Viewpoint 9 (APP-113) (enlarged extract) 
	ZTV for Viewpoint 13 (Helsby Hill) 
	Viewpoint 13 (APP-114) (enlarged extract – with solar array)

5 k) HyNet Hydrogen Pipeline and Runcorn Carbon Dioxide Spur Pipeline

ISH 1 Agenda	CWCC comments
5 k)	HyNet Hydrogen Pipeline and Runcorn Carbon Dioxide Spur Pipeline
	i) Please could the applicant advise on any updates to the proposed pipelines, including any discussions with the promoters and any information that has become available since the ES was prepared?
	ii) Please could the applicant advise on any consequences of the updates for the proposed development, cumulative impacts, and related mitigation, and submit any related updates accordingly?
	iii) Please could the applicant advise whether a SoCG would be prepared with each promoter and whether these would include sufficient information for the ExA to understand the extent to which the projects are coordinated, for example: ……
	v) Please could the applicant provide a first draft of the SoCG at deadline 1 and update at each deadline?
	v) Please could Cadent and LBCCS work with the applicant on the SoCG set out above and to ensure that they are kept up to date during the examination?
	vi) Please could Cadent, LBCCS and NGET separately provide an overall update on progress and any outstanding concerns at each deadline up to the end of the examination?
	vii) Do Cadent, LBCCS or NGET have any other comments?
	5.k.iii) CWCC agrees an overview of the proposed development and the other projects, including scope and anticipated timings for consenting, detailed design, construction, operation and (if appropriate) decommissioning and a plan showing the limits of the proposed

	development and the other projects, above and below ground installations, mitigation areas, and areas for construction, operation and maintenance activities and access, are required for a robust cumulative impact assessment.
	CWCC notes that the HyNet Runcorn CO2 Spur pipeline has moved into the full application stage (25/02108/UL) since the last iteration of the ES cumulative impacts assessment and so assessment of this requires updating in the ES and HRA.
	CWCC advises the current cumulative impact assessment is not robust. In 8.11.25 of ES Chapter 8 Ornithology (**APP- 041**), the applicant's proposal is to avoid simultaneous construction and recommends phasing; however, phasing construction could have more of an impact. For example, if the proposed development and pipeline are constructed within a few months or year or two of each other, this would amount to continued long-term cumulative disturbance, past the original assessed impacts. There are more cumulative scenarios than currently assessed, and these should be clearly set out and assessed. CWCC advised the following scenarios should be assessed, as well as the impacts on different areas within these scenarios, including impacts on Cells 1, 2, 5 and the NBBMA, and if works are simultaneous or not: - Solar farm built after pipeline - Solar farm built the same time as pipeline - Solar farm built before pipeline In addition, impacts on any habitats, species and the LWS in the same area should be addressed, as well as impacts on Biodiversity Net Gain.
	It is CWCC's advice that the issues are so crucial and complex, with so little flexibility in timescales in terms of non-sensitive seasons (**a maximum of** only 3 months of the year), that a working party (as suggested by the Applicant) would not provide enough control or oversight and that the mitigation measures should be secured by way of a suitably worded legal agreement to restrict the proposed development appropriately. A timeline of both projects should be assessed and secured within this legal agreement.

	In the absence of an appropriately worded agreement the ExA is requested to consider appropriate provision in the Requirements to ensure appropriate controls.
	It appears that the Hynet North West Hydrogen Pipeline (EN060006) project has been paused (update provided by Cadent Gas Ltd in November 2025), but consideration needs to be given to the potential cumulative impacts arising from both projects, as timelines are likely to still be close enough to cause cumulative impacts.

Appendix B - Functionally Linked Land Map

Identification of Functionally Linked Land supporting SPA waterbirds in the North-West of England – Phase 2

Appendix 5 – Functionally Linked Land Maps for the Dee Estuary, Mersey Estuary and North Wirral Foreshore

BOWLAND ECOLOGY. 2022. December 2022

Natural England Commissioned Report NECR483

www.gov.uk/natural-england

NATURAL ENGLAND

BOW17/1311 Natural England Functionally Linked Land (FLL) Project - Phase 2

Drawing Title: CAWOS FLL Plans

Drawn by: HD
Checked by: LB
Date: 10/10/22

NATURAL ENGLAND

bowland ecology

Legend

Special Protection Area

CAWOS FLL

Low potential

High potential

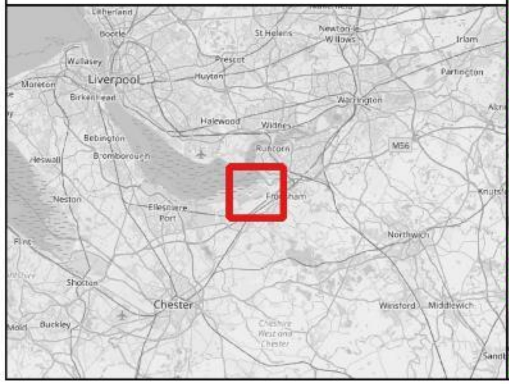
Previously identified FLL (NECR361 Appendix 9)

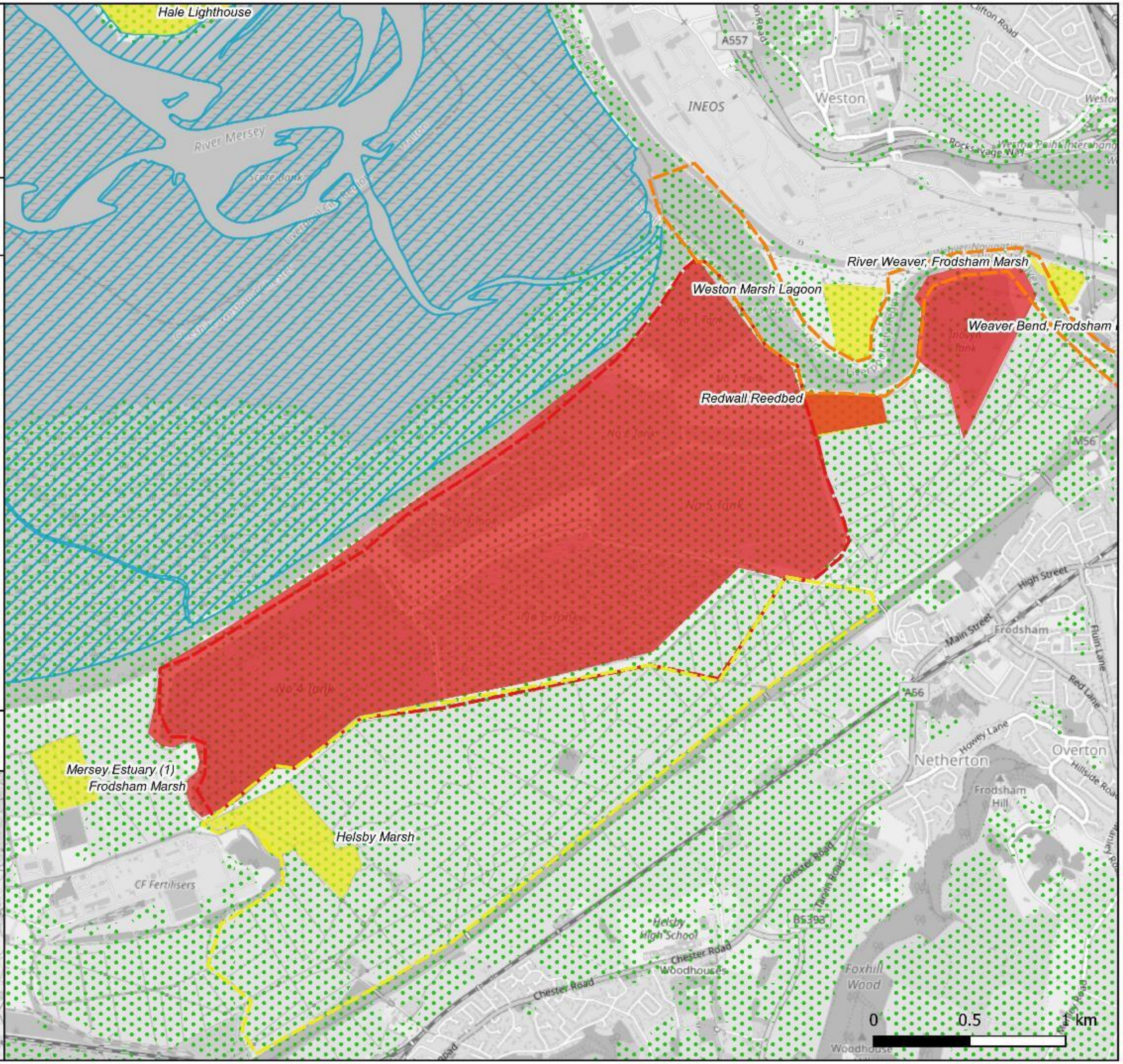
Low potential

Moderate potential

High potential

Site Location





Appendix C (WR)
25_00293_FUL_Runcorn CO2 Spur Pipeline Geoarchaeological study

ENVIRONMENTAL STATEMENT (VOLUME III)

APPENDIX 8.4 – GEOARCHAEOLOGICAL DESK-BASED ASSESSMENT

Runcorn Carbon Dioxide Spur Pipeline Proposed Development

Town and Country Planning Act 1990

Document Reference Number RU.3.3.8.4

Applicant: Liverpool Bay CCS Limited

REVISION: A

DATE: July 2025

DOCUMENT OWNER: WSP UK Limited

PUBLIC

Runcorn Carbon Dioxide Spur Pipeline

Frodsham, Cheshire

Geoarchaeological Desk Based Assessment Report

April 2025

Client: WSP UK Limited

oxford archaeology

Issue No: V1
OA Reference No: FRODGEDA
NGR: 349627 377175

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Document Title:	Runcorn Carbon Dioxide Spur Pipeline, Frodsham, Cheshire
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Runcorn Carbon Dioxide Spur Pipeline, Frodsham, Cheshire

Geoarchaeological Desk Based Assessment

Written by Thomas Bruce and Elizabeth Stafford

With illustrations by Caroline Souday and Lucy Gane

Contents

List of Figures

Summary

Oxford Archaeology (OA) was commissioned by WSP UK Limited, on behalf of Liverpool Bay CCS Limited, to undertake a geoarchaeological desk-based assessment (GDBA) and deposit model for the Runcorn Carbon Dioxide Spur Pipeline Proposed Development in Frodsham (the 'site'), within the county of Cheshire, currently under the administration of the Cheshire West and Chester Unitary Authority (CWCC).

The assessment aims to produce a quantitative deposit model and baseline review characterising the topography, bedrock geology, and associated superficial sediment sequences present throughout the site. The assessment utilises LiDAR imagery, geological mapping, historic borehole records, and geotechnical ground investigation data initially collected for engineering purposes. This data is used in conjunction with wider narratives of regional landscape evolution and archaeological records drawn from previous research, in particular work undertake at Helsby Marsh by the BGS (Wilson 2004), and development-led research at Ince Marshes (RSK 2016). The report aims to provide an initial assessment of geoarchaeological potential with reference to depositional environments that may conceal archaeological remains, and those that preserve significant palaeoenvironmental archives.

Eleven sediment facies representing various depositional environments were identified as forming the broad litho-stratigraphical sequence. Together, they reflect a tripartite pattern of estuarine evolution common to many UK estuaries. These sequences have been correlated with the results of the two previous borehole investigations in the vicinity which have been radiocarbon dated. An initial period of wetland expansion and freshwater peat deposition occurred in the early Mesolithic, driven by riverine ponding as a consequence of rising sea-levels. Marine transgression commencing in the mid to late Mesolithic resulted in increased tidal influences, with widespread deposition of silts, clays and sands. A second period of wetland expansion ensued during the late Mesolithic as the rate of regional sea-level rise slowed towards the mid-Holocene. This led to a period of prolonged freshwater peat development that lasted until the later Bronze Age, after which increased sediment influx into the Mersey estuary resulted in further minerogenic deposition.

The inferred archaeological, geoarchaeological and palaeoenvironmental potential and significance of the sediment sequences have been assessed across the site. This concludes the preservation of organic sequences and the potential to preserve evidence of past environments and evidence of occupation of regional significance is greater in western areas of the site as opposed those beneath Frodsham Depositing Grounds and adjacent to the Mersey-Weaver confluence in the east.

ACKNOWLEDGEMENTS

Oxford Archaeology would like to thank WSP UK Limited for commissioning this project on behalf of Liverpool Bay CCS Limited.

The project was managed for Oxford Archaeology by Elizabeth Stafford and the report prepared by Thomas Bruce. Figure and illustrations were prepared by Caroline Souday and Lucy Gane.

1 INTRODUCTION

1.1 Project background

1.1.1 Oxford Archaeology (OA) was commissioned by WSP UK Limited, on behalf of Liverpool Bay CCS Limited, to undertake a geoarchaeological desk-based assessment (GDBA) and deposit model for the Runcorn Carbon Dioxide Spur Pipeline Proposed Development in Frodsham (the 'site'), within the county of Cheshire, currently under the administration of the Cheshire West and Chester Unitary Authority (CWCC) (Fig. 1, NGR 349627, 377175).

1.1.2 The Runcorn Carbon Dioxide Spur Pipeline Proposed Development comprises the development of a new carbon dioxide pipeline from the Viridor Energy from Waste (EfW) Facility, located in Runcorn, to an above ground installation located at Ince, to the west of Frodsham. The site will form part of the HyNet Project, the aim of which is to reduce carbon dioxide emissions from industry and transport and support economic growth in the North West of England and North Wales. Carbon dioxide will be captured from the Viridor EfW Facility and transported to the Ince AGI, which forms part of the Main Onshore Carbon Dioxide Pipeline, and then securely stored in the existing depleted oil and gas fields below Liverpool Bay.

1.1.3 A project design for the GDBA was produced by WSP in consultation with Mark Leah of Cheshire Archaeology and Planning Advisory Service (CPAS) for CWCC (WSP 2025). Overall, the aim of this non-intrusive GDBA is to produce a report and deposit model to assess the geoarchaeological and palaeoenvironmental potential of the Runcorn Spur Pipeline Proposed Development, forming an appendix to the Environmental Statement. The assessment incorporates data from completed geotechnical ground investigations (GI) and other previous works in the area including other geoarchaeological assessments and historic borehole data.

1.2 Location, topography and geology

1.2.1 The site runs in a broadly north-east to south-west alignment from its northern extent on the south bank of the River Mersey at the River Weaver confluence, and across Frodsham Marshes to its southern limit at Elton Lane, on the north-western outskirts of Elton (Fig. 1).

1.2.2 In the north-east the site follows a line parallel to the Manchester Ship Canal, through Frodsham Depositing Grounds, an area previously used to deposit dredged canal sediments but now used for renewable energy generation (Wardell Armstong 2014). It then turns southwards through arable fields, rough grassland, and pasture, crossing Lordship Lane and the Hoolpool Gutter before heading west into Helsby Marsh, following the southern edge of the CF Fertiliser industrial area and crossing the Hornsmill Brook towards Elton Lane.

1.2.3 Ground elevations along the route within the marshland, remain relatively flat and generally lie between 4.90 and 5.00m OD (Fig. 2). Areas of the route that traverse the Frodsham Depositing Grounds, however, are significantly higher than the surrounding marshland. Deposition of dredged canal sediments (or dredgings) has subsequently artificially raised ground levels in this part of the site to between 10.00 and 12.00m OD, approximately 5m above the surrounding marshland. Naturally occurring higher ground is present to the south and east of site, towards Runcorn, Frodsham, and Helsby, where ground levels rise up to *c* 140m OD.

1.2.4 BGS mapping shows the bedrock geology of the site and the immediate surrounding area to be comprised of a series of faulted Early Triassic sandstones attributed to the Kinnerton, Wilmslow and Chester Formations, with the last two being slightly younger in age (Olenekian) (BGS 2025; Fig. 3). These sandstones are fluvial, lacustrine and marine in origin, deposited in shallow seas or lagoons in a hot, arid climate. There are several fault lines in the region and it is evident that tectonic activity has since deformed this bedrock geology. In the higher ground, to the east and south, the bedrock geology comprises Taporley Siltstone, Helsby Sandstone, and Bollin Mudstone Member Formations, all deposited within the Anisian Stage of the Middle Jurassic (ibid).

1.2.5 The superficial geology of the site consists of Holocene period tidal flat deposits composed of mixed clays, silts, and sands (BGS 2025; Fig. 4). These form both fine-grained (mud flat) and coarser grained (sand flat) sediments forming within the intertidal zone, alternately covered and uncovered with the rise and fall of the tide. To the east and south of the site, towards the higher ground, superficial deposits comprise Devensian glaciofluvial sands and gravel deposits, and Devensian Till diamicton. Both deposits are glacigenic in origin, forming within the last glacial period (115–11.7ka) (ibid). Further Devensian deposits are mapped to the north of site, attributed to the Shirdley Hill Sand Formation sediments, which are aeolian in origin with peat horizons present in lower parts (ibid).

1.3 Archaeological background

1.3.1 A detailed description of the archaeological and historic background is provided in the Runcorn Carbon Dioxide Spur Pipeline Cultural Heritage Baseline Report (WSP 2025). The following background largely summarises the Baseline Report with all reference numbers (A1, A2, etc) relating to assets listed in the gazetteer appended to that report.

Prehistoric (1,000,000 BC – AD 43)

1.3.2 There are no designated heritage assets dating from the prehistoric period recorded within the site.

1.3.3 The earliest evidence of prehistoric activity within the 500m study area dates to the Mesolithic, from post-glacial to late Bronze Age peat deposits (A11) discovered in the Ince and Helsby Marshes. Pollen and macrofossil analysis of these deposits demonstrated evidence of woodland present within the landscape during these periods, and evidence of charcoal was also found. While these peat deposits themselves are not necessarily indicative of settlement activity, the presence of charcoal within them suggests the small-scale burning of woodland or fires from transient camps, indicating that these marshes were being exploited by humans during this time. A potential prehistoric enclosure (A10) located on Helsby Marsh was identified through aerial photography and is thought to date to the Bronze Age or Iron Age, possibly providing an indication as to the scale of late prehistoric occupation in the area. Flint artefacts from the peat deposits on the tidal flats of Helsby Marsh are also suggestive of prehistoric occupation within the area (RSK 2017)

1.3.4 Further prehistoric evidence within the 500m study area is represented by two find spots dating to the Bronze Age, which include a perforated axe hammer (A13) and Bronze Age spearheads (A20). These find spots are not conducive to late prehistoric settlement, but they do suggest that there was human activity within the landscape.

1.3.5 In the surrounding wider landscape, a promontory hillfort of possible Iron Age date is located c 1.8km south-east of site on Helsby Hill.

Roman (AD 43 –410)

1.3.6 There are no designated heritage assets dating to the Roman period located within the site.

1.3.7 There is possible evidence of a Roman road (A12) located within the 500m study area. The only other heritage assets present within the study area are the find spots of several Roman coins (A14, A17, and A18). The presence of these coins and the possible road does not suggest that there was a Roman settlement in this area, but it does suggest that there was Roman activity nearby.

1.3.8 In the wider landscape, the remains of a Roman fortlet can be found *c* 2.2km north-west of the site boundary, to the north of Ince.

Early medieval (AD 410 –1066)

1.3.9 There are no designated heritage assets dating to the early medieval period located within the site or within the 500m study area.

1.3.10 Despite a lack of archaeological evidence, human activity in the study area continued into the early medieval period. Documentary evidence suggests that, although a large part of the study area was still marshland, there was some limited activity in the area. The settlements of Frodsham and Runcorn were beginning to be established during this period.

Medieval (1066 –1540)

1.3.11 There are no designated heritage assets dating to the medieval period located within the site.

1.3.12 During the medieval period, much of the study area would have consisted of marshland and agricultural land. The medieval period within the study area is represented by field systems (A23), which would have been a prominent feature of the landscape. Other examples of archaeological evidence dating from the medieval period is limited to two find spots, which consist of a spindle whorl (A16) and a single cannon ball (A25). The lack of medieval archaeological evidence is likely to be due to the study area being mostly marshland during this period, with any remaining land most likely utilised for agricultural activities.

1.3.13 A probable medieval moated site is present in the wider landscape, *c* 1.8km to the south-west of site, while a medieval monastic grange (Ince Manor) is located in Ince, *c* 2km to the north-east of site.

Post-medieval (1540 –1901)

1.3.14 There are three post-medieval heritage assets located within the site boundary.

1.3.15 Prior to the post-medieval period much of the land within the site and 500m study area consisted of marshland prone to flooding, which was partially utilised for agricultural purposes. During the post-medieval period attempts were made to drain the marshland, with probable flood defences constructed to the east of Frodsham Marsh Farm (A19).

1.3.16 The post-medieval period also saw the development of ports and canals within the study area, with the Weaver Navigation allowing ships to travel further upstream from 1721. The Runcorn and Weston Canal (A3) is located within the site and from 1859 connected Runcorn and the West Point port (A4). The construction of canals and ports in the area allowed the rapid development of industry, which is represented through the presence of limekilns (A6), as well the creation of large man-made lagoons which store dredging deposits across large portions of site.

1.3.17 There are further examples of the construction and development of canals during the post-medieval period within the 500m study area. The Manchester Ship Canal (A1) was built between 1886 and 1894 and represents one of the most significant and substantial post-medieval developments within the 500m study area. Other significant infrastructure developments within the 500m study area include the Bridgewater Docks (A2), which were developed from 1780 onwards.

Modern (1901 – Present)

1.3.18 There are no heritage assets dating to the modern period located within the site.

1.3.19 The heritage assets within the study area that date to the modern period all date from the Second World War. During the Second World War a large amount of military infrastructure was constructed within the study area due to its proximity to the city of Liverpool, which was heavily bombed during the war. This includes a group of military buildings (A7) and two bombing decoys (A9 and A21). There is also the site of a former prisoner of war camp (A8) within the 500m study area, and other Second World War buildings were identified from analysis of aerial photographs.

1.3.20 The site traverses the Frodsham Depositing Grounds, which were previously used to deposit dredgings from the Manchester Ship Canal (Wardell

Armstrong 2014). These grounds were divided into six cells and bounded by a network of earth bunds between 8-10m high.

2 Aims, Objectives and Methodology

2.1 Aims and objectives

2.1.1 The principal aim of this GDBA and deposit model is to provide baseline data on the depth and nature of the sub-surface Quaternary sediments underlying the site and their archaeological and palaeoenvironmental potential. This information is intended to inform potential future mitigation strategies across the site.

2.1.2 The specific objectives of this report are as follows:

i. To characterise the subsurface nature of the proposed development by identifying different depositional units, their location, lateral extent, depth, thickness and likely date. Compile a spreadsheet of sediment date to support deposit modelling and future investigation (through the archive).

ii. Reconstruct the likely past terrain (palaeotopography) and define landscape positions with potential prehistoric settlement or activity.

iii. Identify areas of high palaeoenvironmental potential and significance for targeted environmental sampling with the aim of characterising prehistoric land use.

iv. If warranted, make recommendations for appropriate mitigation strategies.

2.2 Research context

2.2.1 These objectives are intended to support the following strategies and questions within the North West Regional Research Framework (Brennand and Chitty 2006)

- Strategy PH2.4: Characterise the nature of the practices carried out in wetland areas in prehistory and establish whether their use and/or meaning changed through time.
- Strategy PH2.20 - Carry out further field survey in all topographic and geological zones throughout the region.
- General (Prehistory) PH02 - How effective has the North West Wetlands Survey been as a planning and research tool?
- General (Prehistory) PH04: How can we enhance existing datasets for prehistory in the region?
- Environmental PH17: How can a programme of sampling and investigation help to characterise landscape use of the wetlands during the prehistoric period?

- Chronology and Dating PH15: What can identified and surveyed features tell us about Neolithic/Bronze Age time depth and chronologies?
- Environmental PH18: What can palaeoenvironmental analysis of buried soils tell us about prehistoric environments?

2.3 Methodology

2.3.1 The above project aims and objectives have been addressed within the parameters of this GDBA through the following tasks:

i. Review of published geoarchaeological and palaeoenvironmental data relevant to the site and its local context.

ii. Collation of BGS mapped bedrock and superficial geological data to characterise the sedimentary sequences contained within the site boundary.

iii. Examination of topographical and LiDAR data to identify features such as palaeochannels, etc.

iv. Assessment of historic BGS borehole interventions to assess their suitability for inclusion within a geoarchaeological deposit model, or to aid further contextualisation.

v. Creation of a geoarchaeological deposit model and a series of working cross-section transects using project specific GI data, GI data from previous GI works within the Site, and selected historic BGS boreholes.

vi. Identification of specific areas or deposits of high geoarchaeological and palaeoenvironmental potential, or of potential prehistoric activity, to help target significant deposits for the recovery of archaeological / palaeoenvironmental remains during any future works.

vii. Identification of areas of uncertainty that currently lack sufficient data for adequate geoarchaeological assessment, and to make recommendations that would result in greater data coverage if required as part of future works.

2.3.2 These tasks were carried out by a specialist geoarchaeologist in accordance with the Chartered Institute for Archaeologists' Code of Conduct (CIfA 2022), as well as Historic England guidance for deposit modelling (Historic England 2020) and general geoarchaeological work (Historic England 2015).

2.3.3 Deposit descriptions were entered into a relational borehole database (RockWorks) with both major and minor lithological components defined, though these descriptions and interpretations were limited to those made during the course of the GI works.

2.3.4 Data from a total of 47 borehole and trial pit interventions were used to produce a quantitative deposit model for the site (see Table 1, below). This included data from 16 project-specific GI boreholes, 9 boreholes from previous

GI works within the site area (Wardell Armstrong 2014; 2015), and 22 historic BGS borehole / trial pit locations selected after a review of available BGS data (BGS 2025).

2.3.5 Both RockWorks and GIS software packages were used in the analysis and visualisation of this data, in additional to a desk-based assessment of the original GI logs.

2.3.6 The process of geoarchaeological assessment is itself largely founded on gauging the potential for the preservation of archaeological and/or palaeoenvironmental remains within sub-surface deposits. Such preservation is likely to be highest where archaeological remains and associated land surfaces may lie buried beneath depths of sediment, particularly ecotonal areas adjacent to wetlands, on promontories and/or at the confluence of watercourses. The specific formation processes associated with different deposits is also considered, especially for sediments of generally high preservation potential such as peat.

2.3.7 In order to conduct this specialist assessment, this report has drawn on a number of open-access data sources, including Ordnance Survey (OS), British Geological Survey (BGS) mapping, and Environment Agency (EA) Light Detection and Ranging Digital Terrain Model (LiDAR 1m DTM) data, along with relevant published and grey literature reports and a preceding Project Design (WSP 2025).

Table 1: Summary of project specific GI, previous GI, and selected historic BGS interventions

Bore ID	Easting	Northing	Elevation (m OD)	Total Depth (m)	Type	Data Source
Runcorn_01_BH	350221.21	379637.79	10.96	51.00	Sonic borehole	Geotechnics 2025
Runcorn_02_BH	350056.47	379509.38	12.05	12.00	Sonic borehole	Geotechnics 2025
Runcorn_03_BH	349971.36	379320.86	13.34	15.00	Sonic borehole	Geotechnics 2025
Runcorn_04_BH	350105.75	379146.41	11.68	12.44	Sonic borehole	Geotechnics 2025
Runcorn_07_BH	349655.20	378847.40	9.47	10.45	Cable percussion borehole	Geotechnics 2025
Runcorn_08_BH	349453.30	378779.60	10.03	8.00	Cable percussion borehole	Geotechnics 2025
Runcorn_09_BH	349298.70	378662.40	10.04	10.45	Cable percussion borehole	Geotechnics 2025

Bore ID	Easting	Northing	Elevation (m OD)	Total Depth (m)	Type	Data Source
Runcorn_11_BH	348942.30	378444.50	11.10	7.50	Cable percussion borehole	Geotechnics 2025
Runcorn_13_BH	348633.70	378198.20	9.96	12.45	Cable percussion borehole	Geotechnics 2025
Runcorn_17_BH	348422.29	377307.93	4.75	15.45	Cable percussion borehole	Geotechnics 2025
Runcorn_18_BH	348292.05	376959.50	4.82	10.45	Cable percussion borehole	Geotechnics 2025
Runcorn_19_BH	348260.09	376698.93	4.98	12.45	Cable percussion borehole	Geotechnics 2025
Runcorn_20_BH	348147.25	376634.63	4.86	15.50	Cable percussion borehole	Geotechnics 2025
Runcorn_21_BH	347951.05	376425.07	4.98	10.45	Cable percussion borehole	Geotechnics 2025
Runcorn_22_BH	347668.05	376228.00	4.83	15.45	Cable percussion borehole	Geotechnics 2025
Runcorn_23_BH	347612.06	376066.11	4.77	15.45	Cable percussion borehole	Geotechnics 2025
SA1	347839.50	377386.70	10.84	30.90	Cable percussion borehole	Wardell Armstrong 2014
SA2	348347.30	377727.00	12.21	20.45	Cable percussion borehole	Wardell Armstrong 2014
SA3	348741.80	377234.60	4.80	32.40	Cable percussion borehole	Wardell Armstrong 2014
SA4	350566.70	378346.20	10.84	30.00	Cable percussion borehole	Wardell Armstrong 2014
SA5	350215.50	379331.60	11.68	43.45	Cable percussion borehole	Wardell Armstrong 2014
BH25	347636.12	376828.24	5.85	20.00	Cable percussion borehole	Wardell Armstrong 2015

Bore ID	Easting	Northing	Elevation (m OD)	Total Depth (m)	Type	Data Source
BH27	348853.36	377454.81	12.66	30.00	Cable percussion borehole	Wardell Armstrong 2015
BH28	349603.26	378357.49	9.82	35.00	Cable percussion borehole	Wardell Armstrong 2015
BH32	350088.90	378922.89	11.45	20.45	Cable percussion borehole	Wardell Armstrong 2015
SJ47NE141	346895.00	375967.00	4.10	60.00	Rotary core borehole	BGS 2025
SJ47NE142	346944.00	375978.00	4.22	40.00	Cable percussion borehole	BGS 2025
SJ47NE22	346365.00	377335.00	4.94	10.00	Cable percussion borehole	BGS 2025
SJ47NE4	348630.00	376350.00	4.42	63.55	Cable percussion borehole	BGS 2025
SJ47NE46	349050.00	376180.00	5.87	3.00	Trial pit	BGS 2025
SJ47NE77	346680.00	377300.00	5.08	1.04	Borehole - unknown type	BGS 2025
SJ47NE79	347020.00	376740.00	5.24	8.70	Borehole - unknown type	BGS 2025
SJ47NE8/D	347660.00	375600.00	4.19	4.06	Unknown	BGS 2025
SJ47NE8/F	348770.00	376190.00	4.21	3.86	Unknown	BGS 2025
SJ47NE86	349855.00	376918.00	7.91	16.00	Cable percussion borehole	BGS 2025
SJ47NE9/E	347120.00	376560.00	5.52	3.66	Borehole - unknown type	BGS 2025
SJ47NE9/I	348370.00	376880.00	4.00	3.66	Borehole - unknown type	BGS 2025
SJ47NE91	346920.00	376650.00	5.20	28.10	Cable percussion borehole	BGS 2025
SJ47NE96	347294.00	376030.00	4.70	5.00	Windowless sampling borehole	BGS 2025

Bore ID	Easting	Northing	Elevation (m OD)	Total Depth (m)	Type	Data Source
SJ47NE97	347742.00	376003.00	5.21	5.00	Windowless sampling borehole	BGS 2025
SJ57NW102	351460.00	378090.00	4.97	4.40	Trial pit	BGS 2025
SJ57NW15/A	350110.00	377620.00	4.64	3.66	Unknown	BGS 2025
SJ57NW15/D	350930.00	378180.00	4.67	3.96	Unknown	BGS 2025
SJ57NW15/E	351210.00	378260.00	5.00	3.96	Unknown	BGS 2025
SJ57NW17/B	350840.00	378720.00	4.81	3.66	Unknown	BGS 2025
SJ57NW330	351679.00	378055.00	9.04	7.50	Cable percussion borehole	BGS 2025
SJ57NW42	350742.00	378878.00	4.89	3.00	Trial pit	BGS 2025

3 RESULTS

3.1 Geoarchaeological landscape context

Quaternary chronostratigraphy and glaciations

3.1.1 The Pleistocene glacial history of the UK is complex, with the advance and retreat of several ice sheets occurring throughout the period as the climate oscillated between colder (glacial) and warmer (interglacial) stages. Comparatively warmer episodes occurring within glacial stages are then known as 'interstadials', and the intervening prevalence of severe cold conditions as 'stadials'. The last major glaciation across the UK is known as the Devensian, though the cycling of warmer and colder conditions within the stage vary at a regional scale. For instance, the north west of England incorporates the early Devensian 'Chelford Interstadial', characterised by organic-rich channel deposits exposed at Farm Wood and Oakwood Quarries near Chelford, Cheshire, and Uranium/Thorium dated to 86+/-26k BP (Worsely 2015). Similarly, oxygen isotope evidence from the Irish Sea basin places the Last Glacial Maximum limit of the Dimlington Stadial at *c* 38k BP, rather than the traditional date of 18k BP (Chiverrell *et al* 2004; Delaney 2003). Detailed mapping of geological and lithostraphic data across lowland Lancashire by the BRITICE-CHRONO project has further indicated that deglaciation of the last ice sheet was regionally complete by 18.6-17.3k BP (Chiverrell *et al* 2016). Table 2 below presents the generalised framework of this chronostratigraphic sequence, alongside the main archaeological periods recognised within the UK.

3.1.2 Although the solid geology underlying the site was initially formed during the early Triassic, much of the landscape seen today was moulded by events associated with the Devensian glaciation, which blanketed the whole of the Lancashire-Cheshire plain with thick ice sheets that scoured away much of the pre-existing bedrock (Chiverrell *et al* 2004; Innes and Tomlinson 2008). Further erosional processes and the deposition of predominantly clayey Glacial Tills then formed the basis for all subsequent sedimentation, creating a local landscape comprised of undulating plains and low hills (Cowell and Innes 1995).

Table 1: Generalised correlation of Mid-/Late Pleistocene and Holocene chronostratigraphy within the UK

<table>
<tr><th rowspan="2">Geological Epoch</th><th rowspan="2">Archaeological Period</th><th colspan="4">Chronostratigraphy</th></tr>
<tr><th colspan="2">Geological Stage</th><th>Age (years cal BP)</th><th>Marine Isotope Stage (MIS)</th></tr>
<tr><td rowspan="5">Holocene</td><td>Roman to post-medieval</td><td rowspan="5">Flandrian Interglacial</td><td>V - Sub-Atlantic</td><td>2k-present</td><td rowspan="5">1</td></tr>
<tr><td>Later Neolithic to Iron Age</td><td>IV - Sub-Boreal</td><td>5-2k</td></tr>
<tr><td rowspan="3">Mesolithic to Early Neolithic</td><td>III - Atlantic</td><td>7-5k</td></tr>
<tr><td>II - Boreal</td><td>9-7k</td></tr>
<tr><td>I - Pre-Boreal</td><td>11.7-9k</td></tr>
<tr><td rowspan="8">Late Pleistocene</td><td rowspan="3">Upper Palaeolithic</td><td rowspan="7">Devensian Glaciation</td><td>Loch Lomond Stadial (Younger Dryas)</td><td>12.9-11.7k</td><td rowspan="7">2-5d</td></tr>
<tr><td>Windermere Interstadial</td><td>15-12.9k</td></tr>
<tr><td>Dimlington Stadial (Last Glacial Maximum)</td><td>26-15k</td></tr>
<tr><td rowspan="5">Later Middle Palaeolithic</td><td>Upton Warren Interstadial</td><td>ca. 45-25k</td></tr>
<tr><td>Mid-Devensian Stadial</td><td>ca. 61-45k</td></tr>
<tr><td>Chelford Interstadial</td><td>ca. 95-61k</td></tr>
<tr><td>Early Devensian Stadial</td><td>ca. 115-95k</td></tr>
<tr><td colspan="2">Ipswichian Interglacial</td><td>230-115k</td><td>5e</td></tr>
<tr><td rowspan="4">Middle Pleistocene</td><td rowspan="3">Early Middle Palaeolithic</td><td colspan="2">Wolstonian ‘Complex’</td><td>374-230k</td><td>6-10</td></tr>
<tr><td colspan="2">Hoxnian Interglacial</td><td>424-374k</td><td>11</td></tr>
<tr><td colspan="2">Anglian Glaciation</td><td>478-424k</td><td>12</td></tr>
<tr><td>Lower Palaeolithic</td><td colspan="2">Cromerian ‘Complex’</td><td>750-478k</td><td>13-19</td></tr>
</table>

Sea level change in the Liverpool Bay area

3.1.3 Detailed records of early Pleistocene sea level change remain relatively few across the UK, largely due to successive glaciations obliterating earlier deposits (Long and Roberts 1997). However, the marine deposits along the coast of historic Lancashire provide something of an exception, evidencing a series of successive glacio-eustatic and glacio-isostatic sea level shifts since the late Devensian, including the possible existence of a past land bridge between Great Britain and Ireland (Chiverrell *et al* 2004). Detailed studies of Liverpool Bay have incorporated seismic, bathymetric and borehole data to suggest that much of the area, though low-lying, lay above water during the Upper Palaeolithic (Fitch and Gaffney 2011; Fig. 5). As for present-day Lancashire, much of that now submerged landscape would have been shaped by geomorphic processes associated with the Devensian glaciation, creating a series of incised channels and kettle holes developing into larger lakes and braided river systems. The data suggest that several of these river systems followed similar routes to their modern counterparts, such as the Mersey and Dee, and would have provided important navigation routes for prehistoric people.

3.1.4 The early Mesolithic coastline would have lain well to the west of the current Lancashire coast. By approximately 9000 BC the sea level had risen to 37m below modern OD (Research Frameworks 2023; Usai 2005), with concurrent climatic amelioration encouraging the spread of mixed deciduous woodland across the previously tundra-like landscape. Subsequent sea level rise would have shifted this coastline to the east (ie further towards the modern coast of Liverpool Bay), with the lowest-lying areas developing into a mosaic of fenland, reed-swamp and saltmarsh. Sea levels had risen considerably by approximately 7500 BC, though were still 18m below current levels, exposing a wide shelf of now-submerged land between Wales and northwest England. The final inundation of the Bay proceeded relatively rapidly, reaching -7 m OD by 5000 BC and more slowly thereafter (Chiverrell *et al* 2004; Tooley 1978; Usai 2005), during which time an extensive intertidal zone developed along the coastline (Fitch and Gaffney 2011; Fig. 6).

3.1.5 Near-present sea levels were subsequently reached during the mid-Holocene high-stand of *c* 4050 BC, which pollen records indicate occurred in association with the widespread elm decline seen throughout the British Isles (Barlow and Shennan 2011; Middleton *et al* 1995; Peltier 2002). Sea levels then began to fall from this high-stand, with biogenic sedimentation and peat formation further raising the level of previously littoral areas, initially through the formation of areas of saltmarsh, followed by freshwater reed-swamps as the rate of sea level rise further reduced. Sea levels then fluctuated throughout the mid- to late Holocene, mainly in accordance with localised conditions and events associated with the breaching, stabilisation and retreat of sand dunes and gravel bars established during the preceding high levels (Barlow and Shennan 2011; Middleton *et al* 1995).

3.1.6 Importantly, this broad narrative of rising sea levels also encompasses many local variances, both spatial and temporal. Work by Tooley (1974; 1978; 1982) to combine pollen and diatom cores with radiocarbon dates has established a series of twelve marine transgressions and regressive overlap tendencies throughout the Holocene, generally matching the broader regional trend for rapid sea level rise throughout the earlier part of the period. However, not all trans-/regression tendencies are evident across the full extent of the northwest coastline, and localised variation appears to have been the norm (in contrast to the overarching Lytham I-X chronology previously proposed, cf Tooley 1982).

3.1.7 Low dune systems had begun to form along the Formby and Sefton coastlines to the south of the Ribble Estuary from approximately 2800 BC (Innes and Tooley 1993; Usai 2005). From AD 1200 to 1400 these dune systems were substantially reworked as climate instability associated with the so-called 'Little Ice Age' led to widespread coastal erosion and sand blowing. It was not until the 19th century that widespread stabilisation occurred as a result of the deliberate planting of marram grass (Barlow and Shennan 2011; Pye and Neal 1993).

Geomorphological setting

3.1.8 Investigations to model the Holocene evolution of the Mersey Estuary by the BGS between 2000 and 2003 involved coring the extant tidal flat deposits at Ince Banks, an extensive saltmarsh located on the southern shore of the inner Mersey estuary, as well as Ince and Helsby Marshes. Several radiocarbon dates were obtained from peat sequences from these cores (eg borehole Ince 4, Fig.2; located *c* 30m west of geotechnical borehole Runcorn_21_BH, Figs 7 and 13), which in association with isotopic evidence and palaeoenvironmental analysis of pollen, foraminifera and diatoms, permitted the Holocene evolution of the area to be reconstructed (Wilson 2004).

3.1.9 The data suggest that rising water table levels coupled with ponding of riverine water may have developed as a response to rising relative sea level (RSL), resulting in deposition of freshwater peats at this location. The peats have been dated at Helsby Marsh in borehole Ince 4 to the early part of the late Mesolithic period, at 6380–6060 cal BC (Beta7350 ± 60 BP) (Wilson 2004), although the full depth of the sequence at this location was not reached to bedrock. As sea level continued to rise, an expansion of sub-tidal and intertidal zones reached as far inland as Helsby Marsh, approximately 2km inland of the estuary, organic sediments from which have been dated from 5750–5630 cal BC (Beta-173723, 6800 ± 50 BP (ibid).

3.1.10 Marine conditions persisted at Helsby Marsh for a duration of *c* 860 ^{14}C years, during which time RSL rose by approximately 1.13m. As the regional rate of sea-level rise slowed in the mid-Holocene, freshwater peat deposits expanded over former sub-tidal and intertidal surfaces, during the later Mesolithic at 4720– 4910 cal BC (Beta-173099, 5940 ± 40 BP). Terrestrial and semi-terrestrial conditions existed at Helsby Marsh for a duration of *c* 2700 ^{14}C years. An increase in sediment influx into the estuary is recorded from about 4000 ^{14}C yr BP. This greater availability of sediment together with low rates of RSL rise, may have encouraged and maintained development of tidal flats from the later Bronze Age, from around 1540–1410 cal BC (Beta-173724, 3220 ± 40 BP) (ibid).

3.1.11 Development-led investigations by RSK Ltd at Ince Marshes in 2010 (RSK 2012; 2016; 2017. Fig. 2), *c* 400m north of the western end of the current site (adjacent to BGS borehole SJ47NE91; Fig. 7), involved geotechnical investigations and a watching brief, which identified two layers of peat across the site at depths of between *c* 3–6m and 10– 11mbgl. A detailed programme of palaeoenvironmental investigation ensued, which comprised radiocarbon dating and palynological and plant macrofossil analysis of the two peat layers.

3.1.12 Palynological and macrofossil data taken from the lower peat, dated to the early post-glacial period, indicated a transition from wet peaty soils with bog moss (*Sphagnum*), reed swamp and birch (*Betula*)/willow (*Salix*)/juniper (*Juniperus*) scrub, to localised areas of sedge fen, and the regional introduction and spread of pine and hazel, and then oak and elm. Significantly, willow/poplar (*Salix/Populus*) charcoal was recovered some depth below the top of this lower peat, which was dated to 7520–7300 cal BC (8340 ± 50 BP, Beta-297297), which, being unlikely to burn by natural fires, is likely to signify local anthropogenic activity (ibid). Although there was no direct evidence for marine influence, an increase in the number of indeterminate pollen grains and erosion indicators, coupled with a change from peat to silty clay, suggested a change in environmental conditions possibly caused by a rise in RSL.

3.1.13 Palaeoenvironmental evidence from the upper peat layer, dated to 4840 to 4690 cal BC (5900 ± 40 BP, Beta-297296), indicated the local development of alder (*Alnus*) fen carr and later heathland, with mixed deciduous woodland of oak (*Quercus*), hazel (*Corylus*), elm (*Ulmus*), lime (*Tilia*), ash (*Fraxinus*), and birch (*Betula*) on the surrounding drier slopes. This peat layer contained frequent evidence of localised burning. Evidence for cultivation, including cereal pollen, was recorded at a depth of 1.42m and, although the date from this level was spurious, the evidence suggested arable farming was likely to have been taking place in the area, possibly during the late Neolithic to early Bronze Age (ibid). Evidence for possible livestock grazing of wet meadows or open woodland was indicated towards the top of the sequence, which is dated to 1000–840 cal BC (Beta-297293). Increased marine influences, including the presence of foraminifera, were recorded at 1.26m depth. However, peat development ceased following the deposition of a thick layer of silty sandy clay. The surface of the upper peat was also observed and mapped during an archaeological watching brief and was exposed very close to the surface in a couple of areas. No archaeological remains were identified.

3.1.14 The results of both previous investigations at Ince and Helsby Marshes concluded that the Holocene evolution of the Inner Mersey Estuary generally follows the tripartite pattern of estuary evolution common to other estuaries in the UK, which show early Holocene expansion followed by mid-Holocene contraction of the coastal zone driven by changes in the rate of regional RSL rise. This is then followed by the re-establishment of lower intertidal conditions, probably due to an increase in terrigenous sediment influx triggered by catchment disturbance during the late Holocene (Wilson 2004).

3.1.15 Collectively, the borehole data, existing palaeoenvironmental evidence, and sea-level data from Ince Marshes mean that the area has excellent potential for geoarchaeological modelling, and for providing detailed information on stratigraphic and vegetation changes in relation to relative sea level, sediment load, and human occupation and land use. It should be noted that all the sedimentary facies, not just peat layers, may contain important palaeoenvironmental data.

3.1.16 West of the River Weaver, the low-lying 19th century field systems are drained by a network of straight-sided dykes. These cut across various palaeochannels, perhaps vestiges of an estuarine creek system, visible on LiDAR imagery (Fig. 7). Much of the area has been subject to 19th century agricultural improvement, with many of the straight dykes feeding into the Hoolpool Gutter (to the north) and the Hornsmill Brook (to the west), the sinuous forms of which bespeak natural channels. Traces of other watercourses can be seen as palaeochannels on LiDAR imagery (Figs 2 and 7). This stretch of floodplain has seen some previous ground investigation, including two transects (BGS SJ57NW15/A to H and SJ 47NE9/A to N), which, from east to west, show a change from deep sequences of clay, including alluvial blue-grey clay, to clay overlying significant deposits of peat (>4m in depth). These, in turn, overlie sand, or mudstone of the Tarporley Sandstone Formation. Many other boreholes in the area show a similar sequence and with the surface of much of this peat being recorded at relatively shallow depths of between 0.20 and 3.00m.

3.2 LiDAR analysis

3.2.1 The LiDAR-derived DEM/DTM clearly shows the raised ground levels and the extent of the Frodsham Depositing Grounds which span the north and north-eastern parts of the site (Figs 2 and 7). The flat and low-lying marshlands of Frodsham, Helsby and Ince Marshes are also clearly apparent, situated between the River Mersey and the higher ground to the south, east and west, with the River Weaver entering Frodsham Marshes at their eastern extent. An extensive network of palaeochannels and palaeo-creeks can be distinguished from the LiDAR imagery within the marshes themselves, often associated with raised levee banks.

3.2.2 Several of these palaeochannels can been seen within the site boundary. A large, meandering palaeochannel is visible immediately to the south of the Frodsham Depositing Grounds, running southwards from the east of Runcorn_17_BH before meandering westwards and south-eastwards, passing to the east of Runcorn_18_BH and meandering around SJ47NE9/I (Fig. 7). This meandering palaeochannel measures *c* 14m across and is flanked by *c* 16-17m wide levee banks. It appears to join the modern-day course of the Hoolpool Gutter and is likely to have formed either a former course or tributary of it. Another palaeochannel can be seen traversing the site to the east of Runcorn_22_BH, on a south-east to north-west alignment, measuring *c* 11m across. This appears to comprise a former route or tributary of the Hornsmill Brook, which flows along the northern site boundary here. Smaller palaeochannels and paleo-creeks are also visible at the westernmost extent of site, measuring between 3 and 6m wide, displaying a drainage pattern from south to north. Other potential palaeochannels occur to the north of SJ47NE96, between Runcorn_20_BH and Runcorn_21_BH, and between Runcorn_18_BH and Runcorn_19_BH, though many of these are less well defined than those mentioned above.

3.2.3 Whilst some of these palaeochannels will have derived due to natural channel migration, the majority are likely to have formed through the historic drainage and reclamation of the marshes. The canalisation and diversion of many of these palaeochannels will have transformed the natural marshland drainage system into the present-day network of drainage ditches. The courses of the Hornsmill Brook and Hoolpool Gutter also appear to have been altered and canalised in the past, particularly along and across the Manchester Ship Canal. Extensive modification of the marshland drainage system appears to have also occurred to the north-eastern parts of Frodsham Marsh, where LiDAR imagery shows numerous palaeochannels and palae-creeks and also suggests the course of the River Weaver has moved north-eastwards to its current position, where it is now contained within artificial levees and flood defences (cf. Figure 7).

3.2.4 The marshlands remain relatively flat throughout, though, subtle variations in topography over the marshes themselves are apparent in the LiDAR imagery. Ground elevations increase closer to the River Mersey and River Weaver, from south to north and south-west to north-east. In the Frodsham and Ince Marshes, ground levels range between *c* 4.50m OD and *c* 5.00m OD, falling to *c* 4.00m OD to the south and south-west in Helsby Marsh, and to *c* 3.80m OD in the far south-western corner of the marshland area, east of Elton. This pattern of elevation change is almost certainly due to increased sedimentation rates closer to the Mersey and Weaver rivers where riverine, tidal, and estuarine influences would be more pronounced. Sediment deposition within the marshes has occurred through a combination of floodplain aggradation (overbank flooding) and tidal / estuarine silting, the rates of which would vary with marine transgressions and regressions.

3.3 Deposit model

3.3.1 The results of the litho-stratigraphic deposit modelling are presented below. The detailed lithological descriptions from the GI logs are presented in Appendix A. A series of five litho-stratigraphic cross sections are presented in Figures 8–12.

3.3.2 Project specific GI works utilised in this report consisted of 12 deep cable percussion boreholes and four sonic boreholes (Fig. 7). An additional nine cable percussion boreholes from previous GI works undertaken throughout the site area were also used to inform this deposit model. Other previous GI interventions undertaken over the site area were also assessed but not included in the final deposit model as they occurred over the Frodsham Depositing Ground and only contained modern dredged deposits.

3.3.3 As outlined in Section 2.3, an assessment of historic BGS borehole data was undertaken from interventions within a 500m radius of the site, and of these, 22 interventions have been included in the deposit model. These locations are of sufficient quality and lithological detail to draw meaningful interpretations and were chosen to fill in gaps in the GI data along to route (Transect 1) and to give wider depositional context to deposits within the wider marshland area (Transects 2-5).

3.3.4 Analysis of this data identified a broad series of sediment facies across the site and immediate surroundings:

I. Topsoil / Subsoil
II. Made Ground
III. Tidal / Estuarine Alluvium (fine-grained)
IV. Upper Peat
V. Organic / Peaty Alluvium
VI. Lower Peat
VII. Tidal / Estuarine Alluvium (coarse-grained)
VIII. Glaciofluvial Deposits
IX. Glacial Till
X. Glaciolacustrine Deposits
XI. Sandstone Bedrock

3.3.5 Table 3 provides a summary of the depths (mbgl) and elevations (m OD) for each of these units.

XI. Sandstone bedrock

3.3.6 The solid bedrock geology underlying the Site comprises sandstone of the Kinnerton and Chester Formations deposited within the Early Triassic Period (BGS 2025, Figure 3). These formations form part of the larger Sherwood Sandstone Group, which consists of a broad group of sandstones, mudstones, and siltstones present in several different sedimentary basins within the UK. These lithologies are fluvial, lacustrine and marine in origin and initially formed under lagoons and shallow seas when climatic conditions in Britain were hot and arid (Howard *et al* 2008). GI and BGS records describe the sandstone as red to reddish brown, with the upper surface occurring as reddish-brown sand and silty sand.

3.3.7 None of the project-specific boreholes encountered this bedrock geology, though previous GI works and historic BGS borehole data show the basal bedrock to occur at between -18.36 and -46.20m OD (SA1, SJ47NE141), rising to *c* -4.09m and c 6.84m OD along the edges of the higher ground on the periphery of the marshes (SJ47NE86, SJ57NW330). The recording of bedrock at -18.36m OD at SA1 and substantially lower at SJNE141 (-46.20m OD) suggests a possible bedrock trough to the western and south-western parts of the marshlands, corresponding to lower ground elevation levels. Higher bedrock elevations at SA1, SA3 and SJ47NE4 (-18.36, -27.00, and -29.11m OD) indicate a possible bedrock ridge through the central part of site, while an absence of bedrock at depths of up to -40m OD at Runcorn_01_BH suggests a further trough to the northeast.

X. Glaciolacustrine deposits

3.3.8 Glaciolacustrine deposits were recorded in six of the borehole records and comprised laminated deposits of reddish brown and brown silty clays with occasional silts, sands, and gravels. Laminations largely consisted of silt and sand and were noted as *c* 10mm thick. These types of deposits would have formed under pro-glacial lakes fed by glacial meltwater during the course of the Pleistocene and are representative of generally cold climate conditions, though many glacial lakes persisted long into warmer interglacial conditions.

3.3.9 The laminated deposits recorded in the GI and BGS data are interdigitated with Glacial Till and glaciofluvial deposits, both units also of Pleistocene age, while multiple glaciolacustrine horizons are noted within many of the same boreholes. There is no obvious trend to the distribution of these glaciolacustrine deposits other than being generally found in the lower parts of the Pleistocene sediment stack throughout the marshlands, at elevations below -11m OD, and none form the late-Pleistocene / early-Holocene land surface. These deposits were also noted at a higher elevation of 1.91m OD at the lower slopes of the higher ground at SJ47NE86 to the south of the site, mirroring the bedrock topography.

IX. Glacial till

3.3.10 Almost ubiquitous throughout the boreholes deep enough to encounter Pleistocene sediments, glacial till deposits form stiff reddish brown to brown, gravelly, silty to sandy clays of varying thicknesses that were lain down during the last major glaciation (Devensian) and are generally well mixed and homogeneous deposits. As per the glaciolacustrine deposits above, glacial till sediments are also intercalated with the other Pleistocene units with multiple units again present within the same borehole, further highlighting Pleistocene stratigraphic complexity. This is further shown by their varied elevation, occurring at between -5.25m OD (Runcorn_17_BH) to -37.44m OD (Runcorn_01_BH) throughout the marshland area, though elevations at most locations varied between *c* -8.00 to *c*.-12.00m OD. Approaching the higher ground to the south-east, glacial till was recorded at 5.47m OD, just 0.40mbgl, reflecting the shift in depositional environment caused by the underlying bedrock topography.

3.3.11 The upper surface of glacial till deposits in boreholes Runcorn_17_BH, Runcorn_22_BH, Runcorn_23_BH, BH27, SJNE141, and SJ47NE4 forms the palaeo-surface of the Pleistocene topography under the marshes at these locations, between 10.00 and 24.00mbgl (-5.25 and -11.34m OD).

VIII. Glaciofluvial deposits

3.3.12 Glaciofluvial deposits are present in the vast majority of the deeper boreholes and generally consist of medium dense brown to reddish, orangey, and greyish brown fine to medium sands and fine to coarse sandy gravels. These deposits are fluvial in origin, deposited by cold climate channel systems. They are similarly interdigitated with the glacial till and glaciolacustrine deposits and multiple horizons have also been recorded within the same borehole. They commonly appear towards the top of the Pleistocene stratigraphic sequence between *c*-4.00 and -8.00m OD, though their elevations vary widely between -3.78 and -32.45m OD (BH28, SJNE47141).

3.3.13 At the majority borehole locations these deposits comprise the upper parts of the Pleistocene stratigraphic sequence and form the late-Pleistocene land surface (Runcorn_01_BH, Runcorn_20_BH, SA1-5, BH25, BH28, SJ47NE142, SJ47NE86, and SJ47NE91). Under the marshland areas, this surface appears at -4.16 and -10.75m OD (SA1, SA3), occurring between 10.00 and 18.10mbgl. Towards the higher ground to the south-east of site (SJ47NE86), glaciofluvial deposits occur at 7.01m OD, just 0.90mbgl, mirroring what is shown in the glacial till.

VII. Tidal / Estuarine alluvium (coarse-grained)

3.3.14 Coarse-grained sandy alluvial units tend to form the upper part of the Pleistocene and the lower part of the Holocene stratigraphy, though similarly described deposits do also occur intermittently higher up the sedimentary sequence (Figs 8– 12). Deposits are described as light to dark brown, and light to dark grey, medium dense fine to coarse sands and clayey sands with variable gravel content. These deposits are intercalated with finer-grained alluvium and peat deposits throughout the Holocene sequence and become particularly prevalent beneath the lower peat horizon (where present), and towards the confluence of the River Weaver and River Mersey in the north-east of the site (Figs 8-10). The coarse-grained nature of these deposits implies deposition under moderate to high energy flow conditions, suggesting fluvial and/or estuarine influences, an assertion supported by their prevalence closer to the active river channels. Their pervasiveness towards the base of the Holocene sequence indicates a dynamic environment of in-channel deposition spanning the late-glacial to early post-glacial transition. Sandy deposits occurring towards the top of the Holocene sequence are almost certainly estuarine in origin, most likely formed within and adjacent to tidal creek systems and through overbank flooding.

3.3.15 Elevations of the lower deposits range between -3.52m and -6.28m OD (Runcorn_21_BH, SJ47NE142), while horizons appearing further up the Holocene sequence and within the north-east of the site were recorded between 4.56 and 1.12m OD. The large range in elevations demonstrates the high degree of variability in the distribution of these deposits and the complexity in depositional conditions related to localised channel activity.

3.3.16 The thickest of these deposits occur close to the confluence of the River Weaver and the River Mersey in the north-east, where they were observed up to 7.50m thick (Runcorn_01_BH) and form the entirety of the remaining Holocene sequence in Runcorn_01_BH, Runcorn_03_BH, and Runcorn_04_BH (the upper parts being overlain by made ground deposits). Further south-west, into the marshes, coarse sandy alluvial deposits were recorded beneath lower peat deposits at the base of the Holocene sequence, reaching thicknesses of up to 4.00m and 4.30m thick (Runcorn_07_BH, SJ47NE91). Sandy alluvium observed in the upper parts of the sequence typically range between 0.70m and 1.10m thick, indicative of short-term changes in depositional environment. Sandy alluvium in SJ47NE97 and SJ57NW17/B was, however, recorded up to 1.70m and 2.13m thick respectively. The former borehole location is situated adjacent to the current Hornsmill Brook, while the latter is close to the River Weaver.

VI. Lower peat

3.3.17 A lower horizon of dark brown to black, spongy, fibrous to pseudo-fibrous peat was present in thirteen borehole locations. All are situated within the south-western parts of the marshland area, throughout Ince and Helsby Marshes and the south-western parts of Frodsham Marsh. Transect 1 (Fig. 8) shows their extent from south-west to north-east, while Transect 2 (Fig.9) and Transect 3 (Fig. 10) display their continuity from north-west to south-east. Conversely, they appear absent from the north-eastern half of Transect 1 (Fig. 8) from Runcorn_17_BH onwards., and entirely from Transects 4 and 5 (Figs 11 and 12). Locations where the lower peat deposits are recorded within the site boundary include Runcorn_18_BH to Runcorn_22_BH.

3.3.18 The lower peat horizon overlies coarse sandy alluvium in most locations, signifying a change in environmental setting as riverine ponding ensued as a response to rising relative sea-level in the early Holocene. It appears between -1.76 and -4.86m OD (SA1, SJ47NE22), generally between 7.00 and 8.00mbgl, and varies in thickness from 0.50m to 2.80m (Runcorn_18_BH, SJ47NE142). As detailed in Section 3, lower peat deposits identified at Ince Marsh (RSK 2012; 2016, 2017) date from the early post-glacial period to the latter part of the early Mesolithic, while those present at Helsby Marsh (Wilson 2004) date from the early part of the late Mesolithic period, indicating an expansion from lower-lying areas in the north-west towards higher ground in the south-east Stratigraphic correlations between the lower peat deposits shown in Transects 1–3 and those recorded previously at Ince and Helsby Marshes suggest these lower peat horizons are likely to be of similar age (Fig. 13).

V. Organic / Peaty alluvium

3.3.19 Transects 1-5 (Figs 8–12) show that deposits described as organic / peaty alluvium in the GI records occur discontinuously within the Holocene sediment sequence. They comprise soft greyish brown, grey, and blueish grey silts and clays with occasional to frequent detrital organic material and amorphous peat clasts / lenses. These deposits are interdigitated with the alluvial and peat sediments, occurring at a wide range of elevations, from -

3.45 (BH32) to 4.44m OD (SJ47NE79), and varying in thickness from 0.12m to 5.70m (SJ47NE79, SJ47NE22). Their localised occurrence signifies a episodic erosional events and increased sediment influx into the wetland, though their high organic content still suggests a low energy back water environment.

IV. Upper peat

3.3.20 A widespread upper peat horizon was recorded throughout the majority of boreholes and can be tracked over south-western and central site areas, though becomes notably absent towards the confluence of the River Weaver and Mersey Estuary (Figs 8–12). This peat horizon consists of dark brown to black, fibrous to amorphous, silty to clayey, peat and occurs intercalated with in the finer-grained alluvium and organic/peaty alluvial deposits. The surface of this horizon generally lies between 2–4m OD, though some undulations do occur (eg 0.54m OD in SA4, 4.53m OD in Runcorn_08_BH). Within the Frodsham Depositing Grounds, this horizon appears between 5.50 and 10.30mbgl but occurs much closer to the ground surface over the adjacent marshlands where it is present at depths as little as 0.65mbgl (SJ47NE141), though largely appears between 1.00 and 3.00mbgl. Substantial depths of these deposits survive, with thicknesses of between 1.10m and 3.65m recorded (SA2, SJ47NE141).

III. Tidal / Estuarine alluvium (fine-grained)

3.3.21 Fine-grained alluvial deposits are widespread throughout the area. They comprise soft to firm, grey, greyish brown and oxidised orangey brown silty and sandy clays with occasional sandy silts. Coarser material, such as pebbles or cobbles, is infrequent and organic material rare within these deposits. These deposits generally form the upper part of the Holocene sequence but do also appear at depth where they are intercalated with the coarse-grained alluvium, peat horizons, and organic/peaty alluvium. The surface of these deposits occurs between 7.47 and 1.45m OD (Runcorn_07_BH, BH32). The apparent lower elevations beneath the Frodsham Depositing Grounds generally (Transects 1 and 5) may be due to some truncation and/or compression due to the weight of the overlying dredged deposits. Over the marshlands these alluvial deposits are typically present at <0.50mbgl, whereas they lie below *c* 7 to 10m of made ground in the north-east of the site.

II. Made ground

3.3.22 Significant modern made ground deposits have been recorded to the north-eastern parts of the site, within the location of the Frodsham Depositing Grounds, which were in use up until 2015. These deposits cap the sedimentary sequence where present and reach thicknesses of up to 11.8m (Runcorn_02_BH). They comprise of mixed clays, silts, and sands with variable gravel content and are the dredged sediments (or dredgings) from the Manchester Ship Canal. These deposits significantly raise ground levels to approximately 5m above the surrounding marshes.

I. Topsoil / Subsoil

Modern topsoil and subsoil deposits cap the Holocene sediment sequence in the low-lying marshes. These sediments form soft dark brown sandy clays and clays that are typically <0.30m thick. No buried topsoil was recorded in the borehole logs across the Frodsham Depositing Grounds which may suggest this horizon may have been removed/truncated prior to depositing of the dredged material.

Table 3: Summary of sediment facies

All measurements record the top of the unit at its first occurrence in the stratigraphic sequence, red numbers indicate the level of presumed late Pleistocene palaeo-surface, shaded cells denote peat horizons.

Key: I – Topsoil / Subsoil; II – Made ground; III – Tidal / estuarine alluvium (fine-grained); IV – Upper peat; V – Organic / peaty alluvium; VI – Lower peat; VII – Tidal / estuarine alluvium (coarse-grained); VIII – Glaciofluvial deposits; IX – Glacial till; X – Glaciolacustrine deposits; XI – Sandstone bedrock

	Depth (mbgl)											Elevation (m OD)										
Borehole	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
	T	MG	ALL F	UP	ALL O	LP	ALL C	GFL	GT	GL	BR											
Runcorn_01_BH	0.00	0.25	-	-	-	-	10.50	17.50	48.40	22.30	-	10.96	10.71	-	-	-	-	0.46	-6.54	-37.44	-11.34	-
Runcorn_02_BH	0.00	0.30	-	-	-	-	-	-	-	-	-	12.05	11.75	-	-	-	-	-	-	-	-	-
Runcorn_03_BH	0.00	0.20	-	-	-	-	11.00	-	-	-	-	13.34	13.14	-	-	-	-	2.34	-	-	-	
Runcorn_04_BH	0.00	0.20	-	-	-	-	10.50	-	-	-	-	11.68	11.48	-	-	-	-	1.18	-	-	-	-
Runcorn_07_BH	0.00	0.50	2.00	-	-	-	9.50	-	-	-	-	9.47	8.97	7.47	-	-	-	-0.03	-	-	-	-
Runcorn_08_BH	0.00	0.30	5.80	5.50	7.50	-	-	-	-	-	-	10.03	9.73	4.23	4.53	2.53	-	-	-	-	-	-
Runcorn_09_BH	0.00	0.30	5.10	7.30	-	-	-	-	-	-	-	10.04	9.74	4.94	2.74	-	-	-	-	-	-	-
Runcorn_11_BH	0.00	0.20	7.00	-	-	-	-	-	-	-	-	11.10	10.90	4.10	-	-	-	-	-	-	-	-
Runcorn_13_BH	0.00	0.50	-	-	8.20	-	-	-	-	-	-	9.96	9.46	-	-	1.76	-	-	-	-	-	-
Runcorn_17_BH	0.00	-	1.50	1.80	-	-	0.40	11.50	10.00	-	-	4.75	-	3.25	2.95	-	-	4.35	-6.75	-5.25	-	-
Runcorn_18_BH	0.00	-	0.50	2.30	-	8.00	8.50	-	-	-	-	4.82	-	4.32	2.52	-	-3.18	-3.68	-	-	-	-
Runcorn_19_BH	0.00	-	1.00	1.80	-	7.70	9.50	-	-	-	-	4.98	-	3.98	3.18	-	-2.72	-4.52	-	-	-	-
Runcorn_20_BH	0.00	-	1.20	1.80	-	7.80	0.30	13.00	14.70	-	-	4.86	-	3.66	3.06	-	-2.94	4.56	-8.14	-9.84	-	-
Runcorn_21_BH	0.00	-	0.50	3.50	-	7.90	8.50	-	-	-	-	4.98	-	4.48	1.48	-	-2.92	-3.52	-	-	-	-

	Depth (mbgl)											Elevation (m OD)										
Borehole	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Runcorn_22_BH	0.00	-	1.20	3.00	4.50	7.40	0.50	-	13.30	-	-	4.83	-	3.63	1.83	0.33	-2.57	4.33	-	-8.47	-	-
Runcorn_23_BH	0.00	-	0.80	2.00	-	8.00	9.50	-	12.80	-	-	4.77	-	3.97	2.77	-	-3.23	-4.73	-	-8.03	-	-
SA1	-	0.00	6.80	-	-	12.60	13.10	15.00	19.20	-	29.20	-	10.84	4.04	-	-	-1.76	-23.94	-4.16	-8.36	-	-18.36
SA2	-	0.00	8.50	10.30	-	-	15.60	17.70	-	-	-	-	12.21	3.71	1.91	-	-	-27.81	-5.49	-	-	-
SA3	0.00	-	1.10	1.90	1.70	-	9.90	15.55	16.95	-	31.80	4.80	-	3.70	2.90	3.10	-	-5.10	-10.75	-12.15	-	-27.00
SA4	-	0.00	8.30	10.30	-	-	-	16.60	22.70	-	-	-	10.84	2.54	0.54	-	-	-	-5.76	-11.86	-	-
SA5	-	0.00	7.30	-	-	-	12.80	18.10	21.80	-	-	-	11.68	4.38	-	-	-	-1.12	-6.42	-10.12	-	-
BH25	-	0.00	1.30	-	-	9.10	9.50	11.40	14.50	-	-	-	5.85	4.55	-	-	-3.25	-3.65	-5.55	-8.65	-	-
BH27	-	0.00	9.40	11.00	11.8	-	14.60	27.50	24.00	-	-	-	12.66	3.26	1.66	0.86	-	-1.94	-14.84	-11.34	-	-
BH28	-	0.00	7.00	7.70	9.50	-	-	13.60	-	21.10	-	-	9.82	2.82	2.12	0.32	-	-	-3.78	-	-11.28	-
BH32	-	0.00	10.00	-	14.90	-	-	-	-	-	-	-	11.45	1.45	-	-3.45	-	-	-	-	-	-
SJ47NE141	0.00	-	0.15	0.65	-	8.50	9.50	36.55	12.55	29.05	50.30	4.10	-	3.95	3.45	-	-4.40	-5.40	-32.45	-8.45	-24.95	-46.20
SJ47NE142	0.00	-	0.09	1.30	1.60	7.70	10.50	11.90	12.30	22.10	-	4.22	-	4.13	2.92	2.62	-3.48	-6.28	-7.68	-8.08	-17.88	-
SJ47NE22	0.00	-	0.50	2.90	2.20	9.80	1.90	-	-	-	-	4.94	-	4.44	2.04	2.74	-4.86	3.04	-	-	-	-
SJ47NE4	0.00	-	0.23	0.91	-	7.32	8.53	19.20	10.67	-	33.53	4.42	-	4.19	3.51	-	-2.90	-4.11	-14.78	-6.25	-	-29.11
SJ47NE46	0.00	-	-	-	-	-	-	-	0.40	-	-	5.87	-	-	-	-	-	-	-	5.47	-	-
SJ47NE77	-	-	0.07	-	-	-	-	-	-	-	-	-	-	5.01	-	-	-	-	-	-	-	-
SJ47NE79	-	-	0.17	1.85	0.80	8.36	-	-	-	-	-	-	-	5.07	3.39	4.44	-3.12	-	-	-	-	-
SJ47NE8/D	0.00	-	0.20	0.95	-	-	-	-	-	-	-	4.19	-	3.99	3.24	-	-	-	-	-	-	-
SJ47NE8/F	0.00	-	0.15	1.60	-	-	-	-	-	-	-	4.21	-	4.06	2.61	-	-	-	-	-	-	-
SJ47NE86	-	0.00	-	-	-	-	-	0.90	7.50	6.00	12.00	-	7.91	-	-	-	-	-	7.01	0.41	1.91	-4.09
SJ47NE9/E	0.00	-	0.35	1.50	-	-	-	-	-	-	-	5.52	-	5.17	4.02	-	-	-	-	-	-	-

	Depth (mbgl)											Elevation (m OD)										
Borehole	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
SJ47NE9/I	0.00	-	1.80	-	-	-	0.30	-	-	-	-	4.00	-	2.20	-	-	-	3.70	-	-	-	-
SJ47NE91	0.00	-	0.20	1.80	-	9.10	10.80	15.10	22.10	25.80	-	5.20	-	5.00	3.40	-	-3.90	-5.60	-9.90	-16.90	-20.60	-
SJ47NE96	0.00	-	0.20	1.95	-	-	-	-	-	-	-	4.70	-	4.50	2.75	-	-	-	-	-	-	-
SJ47NE97	0.00	-	0.25	3.30	2.30	-	0.60	-	-	-	-	5.21	-	4.96	1.91							
SJ57NW102	-	-	0.00	-	1.30	-	-	-	-	-	-	-	-	4.97	-	3.67	-	-	-	-	-	-
SJ57NW15/A	0.00	-	0.30	1.50	-	-	3.35	-	-	-	-	4.64	-	4.34	3.14	-	-	1.29	-	-	-	-
SJ57NW15/D	0.00	-	0.30	-	-	-	-	-	-	-	-	4.67	-	4.37	-	-	-	-	-	-	-	-
SJ57NW15/E	0.00	-	0.30	-	-	-	-	-	-	-	-	5.00	-	4.70	-	-	-	-	-	-	-	-
SJ57NW17/B	0.00	-	0.61	-	-	-	1.53	-	-	-	-	4.81	-	4.20	-	-	-	3.28	-	-	-	-
SJ57NW330	-	0.00	-	-	-	-	-	-	-	-	2.20	-	9.04	-	-	-	-	-	-	-	-	6.84
SJ57NW42	0.00	-	0.15	-	0.80	-	-	-	-	-	-	4.89	-	4.74	-	4.09	-	-	-	-	-	-

4 Discussion and conclusions

4.1 Summary of litho-stratigraphical sequence

4.1.1 The deposit model and accompanying data tables described in Section 3.3 have generally served well in broadly characterising the nature of the sub-surface sediment sequence underlying the site. The model analysed selected GI and BGS borehole records alongside LiDAR imagery to identify a basic tripartite Holocene depositional sequence of intercalated peat and minerogenic clays silts and sands, overlying Pleistocene glacial sediments and sandstone bedrock geology.

4.1.2 The Pleistocene sequence forming the basement topography includes glacial till, glaciolacustrine and glaciofluvial facies that when combined reach substantial thicknesses of tens of metres beneath the marshes, carving out a deeply incised valley that was subsequently infilled with *c* 10-15m of Holocene sediments. This indicates that the Pleistocene palaeo-topography of this area was much lower-lying than present, as illustrated in the regional topographic models in Figures 5 and 6 which shows the valley running from the higher ground in the east into the Irish Sea to the north-west. On the lower slopes of the higher ground to the south-east these Pleistocene sediments occur up to 0.40m below the ground surface (SJ47NE46, Table 3), revealing a slope in the late Pleistocene topography of *c* 11m from 5.47m OD at SJ47NE46 to -6.25m OD at SJ47NE4, approximately 500m apart.

4.1.3 The upper part of the Pleistocene and base of the Holocene sequence is dominated by coarse-grained sandy deposits, reflecting moderate to high energy depositional conditions, possibly due to steeper channel gradients and low sea level in the late glacial and early Holocene. Subsequent higher rates of relative sea level change will have also increased intertidal influences, resulting in the expansion of many UK estuaries during this period (Wilson 2004).

4.1.4 The basal sandy deposits are subsequently overlain by a lower peat horizon, present throughout south-western parts of the marshland area (Helsby and Ince Marshes). Rising sea levels throughout the early Holocene caused the expansion of wetland environments and the deposition of freshwater peats as ground water levels rose and the ponding of riverine water ensued. Previous palaeoenvironmental investigations into peat deposits at both Ince and Helsby Marshes dated the accumulation of this lower peat horizon to the early Holocene (Mesolithic) at *c* 10, 000-7300 cal BC and 6300-5600 cal BC respectively at differing elevations (RSK 2016; Wilson 2004). Stratigraphic comparison between these deposits and the lower adjacent peats identified in the current deposit model indicate that they are likely to be of similar age (Fig. 13). As sea level continued to rise, sub-tidal and intertidal zones reached as far inland as Helsby Marsh. Peat formation ceased and extensive minerogenic deposition of fine-grained silts and clays with occasional organic/peaty deposits occurred.

4.1.5 A second, upper, peat horizon has been recorded extending over much of the marshland area indicating a reduction in the rate of sea-level rise and further expansion of wetland environments during the mid-Holocene. On Ince Marshes this peat accumulation with terrestrial and semi-terrestrial conditions has been dated from the late Mesolithic to late Bronze Age *c* 4850-850 cal BC, and Helsby Marsh to *c* 4900-1400 cal BC (RSK 2016; Wilson 2004; Fig. 13).

4.1.6 Further tidal / estuarine alluvial deposits, predominantly comprised of fine-grained silts and clays, overlie the upper peat horizon. An increase in sediment influx into the Mersey estuary, coupled with low rates of sea-level rise may have encouraged the development of tidal flats from the later Bronze Age onwards (Wilson 2004). Both coarse- and fine-grained alluvium, become dominant towards confluence of the Rivers Weaver and Mersey, where there is a general lack of organic content, and reflects the increased tidal and intertidal influences and higher sedimentation rates caused by the increasing proximity to active channels and estuary.

4.1.7 The Holocene stratigraphic sequence is capped by modern topsoils and subsoils throughout the low-lying marshes, and by artificial made ground, comprising canal dredgings within the site of the former Frodsham Depositing Grounds.

4.2 Reliability of the deposit modelling and site interpretations

4.2.1 General issues inherent to desk-based deposit modelling relate to the use of engineering logs from geotechnical ground investigations with no direct observation by a geoarchaeologist. Geotechnical data is not always of the same type or detail as is typically employed within geoarchaeology, especially where finely laminated or otherwise stratified sediments are concerned and depths quoted are often approximations from open hole drilling with limited core recovery to record finer detail. Boreholes drilled without casings installed can also result in partial side wall collapse into the base of borehole resulting in mixing of sediment from differing depths. Percussion rigs can also compress soft sediments, such as peat, especially when they occur at greater depths (Barham and Bates 1994; Bates and Bates 2000).

4.2.2 These issues are reinforced when comparing the level of detail recorded in the sequences presented in Figure 13. Ince boreholes 3 and 4 were drilled by the BGS and a full core sequence recorded and subsampled for research purposes (Wilson 2004), whereas the remaining, less detailed, borehole lithologies were recorded for geotechnical purposes. The samples from the lower peat in BH406 derived from bulk samples recovered during cable percussion drilling, with cores only recovered from the upper peat in BH405 (RSK 2016).

4.2.3 Taking this into account, the reported depths of the litho-stratigraphic deposit model produced in this report should be considered a broad indication of the sub-surface sedimentary architecture, and it is likely that much greater complexity is present both spatially and with depth across the site, reflecting a complex and time transgressive mosaic of environments associated with prehistoric wetlands that may include shifting palaeochannel zones, areas of open water, reedswamp and terrestrial alder carr fringed by encroaching saltmarsh and tidal flats.

4.2.4 Issues related to interpretation of environments of deposition associated with the identified sedimentary facies relate the body of sand at the base of the inferred Holocene sequence. It was not clear from the logs whether this represents a fining-up sequence associated with the underlying late Pleistocene fluvial gravels or sediments related to early Holocene sedimentation as a consequence of marine inundation within the wider estuary The data resolution is also not wholly sufficient to definitively confirm the absence of the lower peats to the eastern parts of site, or the absence of either peat units close to the River Weaver and Mersey confluence.

4.2.5 In terms of data distribution, the boreholes used in the deposit model were quite widely spaced, albeit fairly evenly distributed within the site boundary, and generally extended into the underlying Pleistocene strata. Borehole data analysed beyond the site boundary in order to provide a wider context, however, was more sparsely distributed. Much of the historical data was of variable quality from older ground investigations, was of shallow depth and with limited survey data. Only a selection of the more reliable and deeper historical borehole data was used in the modelling. Due to the data distribution and similarity of the borehole sequences it was not considered 3d modelling of surfaces or deposit thicknesses would produce significantly more information than that presented in the transect profiles and could potentially produce inaccurate or misleading results.

4.3 Assessment of geoarchaeological potential and significance

4.3.1 Stratigraphic sequences previously investigated from two studies at Helsby and Ince Marshes (RSK 2016; Wilson 2004) bear marked similarities with the sequence recorded in this GDBA. Palaeoenvironmental work on the Helsby and Ince sequences demonstrated that they preserve regionally significant paleoenvironmental archives spanning the majority of the Holocene. This implies a similar significance to the deposits present throughout the site. This potential appears greater in south-western areas., while those closer to the confluence of the River Weaver and Mersey estuary in the north-east are considered to have lower potential due to the apparent scarcity of organic deposits, as well as the greater possibility of reworking and erosion through fluvial processes.

4.3.2 Previous analytical work has been carried out on pollen, macroscopic plant remains and diatoms, with chronological control provided by radiocarbon dating (RSK 2016, Wilson 2004). There is also potential to investigate other types of evidence such as insects and foraminifera as well as luminescence dating techniques for inorganic sands and silt. Overall, there is the potential to further elucidate and provide greater detail on past vegetation change and palaeohydrology at a local scale by investigating and analysing borehole cores from a wider area of the marshes beyond the two published sequences. In turn this may then be reviewed within the regional context and the extensive corpus of research related to the wetlands and prehistoric occupation of the NW and Irish Sea littoral.

4.3.3 In terms of archaeological potential, the site traverses low-lying marshland, comprising the present-day Frodsham, Ince, and Helsby Marshes, which is bounded to the north by the Mersey estuary, and higher ground to the south, west and east. Palaeoenvironmental evidence demonstrates that wetland environments, sometime terrestrial or semi terrestrial, eg alder carr, have expanded over this area for two extended periods, the first during the early Mesolithic, and then again during the late Mesolithic, Neolithic, through to the late Bronze Age.

4.3.4 Wetland environments would have been highly appealing locations for human populations due to their rich and varied resources, that may include for example wildfowl hunting, fishing, gathering reeds for thatching and basketry. In addition, the wider river valley provides a sheltered routeway or corridor to access resources further towards the coast related to areas of saltmarsh, sand flats and marine environments, which as sea-levels rose rapidly in the early Holocene moved closer to the site as the tidal head moved upstream resulting in deposition of estuarine alluvium.

4.3.5 The higher, drier, ground on the nearby slopes at the edges of the wetland (an ecotonal zone) could have acted as a focus for occupation, although any early prehistoric activity and edge environments further into the marsh are likely to buried at significant depth, ie several metres, as demonstrated in this report.

4.3.6 Perhaps more significantly, the evidence has shown that organic remains and peats of later, ie. post *c* 5000 cal BC, prehistoric date survives within the stratigraphic sequence within the upper *c* 2m of the Holocene sediments in the western part of the site. The waterlogged nature of these sediments offers the potential for organic archaeological remains, such as timber structures (eg trackways, bridges, jetties, hunting platforms) to survive, as well as insitu artefact scatters, although their position is difficult to predict based on their localised nature and the current distribution of data. Isolated finds have been recovered from the marshes as detailed in Section 3, as well as an undated enclosure thought to be of potential prehistoric date. Significantly, palynological work on the upper peat at Ince Marsh revealed a sequence of terrestrial alder carr that later developed into drier heathland with mixed deciduous woodland on the surrounding drier slopes. There was frequent evidence of localised burning throughout these deposits at Ince Marsh, coinciding with potential evidence of cereal cultivation from the late Neolithic or early Bronze Age. Possible evidence of livestock grazing was also noted to occur, dated to the late Bronze Age. It is clear that during the Neolithic and Bronze Age periods there was ongoing human activity within and around these marshes. (RSK 2016). The occurrence of isolated finds or evidence of low level agricultural/pastoral activities may be considered of local and regional significance respectively. However, evidence of more extensive activity such as prehistoric timber structures and artefact scatters associated with seasonal occupation or transient hunting camps may be considered to be of regional if not national significance depending on the extent, date and complexity.

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APPENDIX A LITHOLOGICAL DESCRIPTIONS

Table A1: Lithological descriptions derived from project specific, selected previous GI, and selected historical BGS borehole logs

Bore ID	Top Depth (m)	Base Depth (m)	Lithology	Sediment Facies	Description
Runcorn_01_BH	0.00	0.25	Sandy clay loam	Topsoil	Grass over TOPSOIL: Soft dark brown slightly sandy clay.
Runcorn_01_BH	0.25	1.20	Gravelly clay	Made Ground	MADE GROUND: Very soft brown slightly sandy slightly gravelly clay. Gravel is angular to subangular fine to medium of various lithologies.
Runcorn_01_BH	1.20	4.50	Gravelly silt	Made Ground	MADE GROUND: Very soft dark grey slightly sandy slightly gravelly silt. Gravel is angular to subangular fine to medium of various lithologies.
Runcorn_01_BH	4.50	10.50	Gravelly sandy silt	Made Ground	MADE GROUND: Firm dark grey mottled black slightly sandy slightly gravelly silt with a strong organic odour. Gravel is angular to subangular fine to medium of various lithologies.
Runcorn_01_BH	10.50	10.90	Gravelly sand	Tidal / Estuarine Alluvium (coarse-grained)	Loose brown slightly gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse of various lithologies.
Runcorn_01_BH	10.90	17.50	Gravelly sand	Tidal / Estuarine Alluvium (coarse-grained)	Grey slightly gravelly fine SAND. Gravel is angular to subangular fine of various lithologies.
Runcorn_01_BH	17.50	20.00	Sandy gravel	Glaciofluvial deposit	Grey slightly sandy angular to subangular fine to coarse GRAVEL of various lithologies.
Runcorn_01_BH	20.00	21.00	Sandy gravelly clay	Glaciofluvial deposit	Firm laminated brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine of various lithologies
Runcorn_01_BH	21.00	22.30	Gravel	Glaciofluvial deposit	Loose grey angular to subangular fine to coarse GRAVEL of various lithologies.
Runcorn_01_BH	22.30	25.50	Clay	Glaciolacustrine deposit	Stiff laminated brown CLAY.
Runcorn_01_BH	25.50	31.40	Sand	Glaciofluvial deposit	Very dense brown fine to medium SAND.

Runcorn_01_BH	31.40	42.40	Clay	Glaciolacustrine deposit	Stiff laminated brown CLAY.
Runcorn_01_BH	42.40	45.00	Sand	Glaciofluvial deposit	Brown angular to subangular fine SAND.
Runcorn_01_BH	45.00	47.80	Sandy gravel	Glaciofluvial deposit	Brown sandy rounded to subrounded fine to coarse GRAVEL.
Runcorn_01_BH	47.80	48.40	Clay	Glaciolacustrine deposit	Stiff laminated brown CLAY.
Runcorn_01_BH	48.40	51.00	Sandy gravelly clay	Glacial Till	Stiff brown slightly sandy gravelly CLAY.
Runcorn_02_BH	0.00	0.30	Sandy clay	Topsoil	Grass over TOPSOIL: Soft dark brown slightly gravelly sandy clay. Gravel is angular to subangular fine to medium of various lithologies.
Runcorn_02_BH	0.30	1.20	Gravelly sandy clay	Made Ground	MADE GROUND: Soft brown slightly gravelly sandy clay. Gravel is angular to subangular fine to coarse of various lithologies.
Runcorn_02_BH	1.20	9.20	Sandy silt	Made Ground	MADE GROUND: Very soft dark grey and black sandy silt. Strong organic odour.
Runcorn_02_BH	9.20	10.70	Sandy clay	Made Ground	PROBABLE MADE GROUND: Stiff brown slightly gravelly sandy clay. Gravel is angular to subangular fine to coarse of various lithologies.
Runcorn_02_BH	10.70	12.00	Sand	Made Ground	Grey and black fine to medium SAND. Strong hydrocarbon odour.
Runcorn_03_BH	0.00	0.20	Clay	Topsoil	Grass over TOPSOIL: Soft dark brown clay
Runcorn_03_BH	0.20	1.30	Gravelly sandy clay	Made Ground	MADE GROUND: Soft brown slightly gravelly sandy clay. Gravel is angular to subangular fine to medium of various lithologies.
Runcorn_03_BH	1.30	11.00	Sandy silt	Made Ground	MADE GROUND: Very soft dark grey slightly sandy slightly gravelly silt. Gravel is angular to subangular fine to medium of various lithologies. Strong organic odour.
Runcorn_03_BH	11.00	15.00	Gravelly sand	Tidal / Estuarine Alluvium (coarse-grained)	Loose grey slightly gravelly fine to medium SAND. Gravel is subangular to subrounded fine to medium of various lithologies.
Runcorn_04_BH	0.00	0.20	Clay	Topsoil	Grass over TOPSOIL: Soft dark brown clay with some rootlets

Runcorn_04_BH	0.20	1.20	Gravelly sand	Made Ground	MADE GROUND: Loose brown slightly gravelly fine to medium sand. Gravel is angular to subangular fine to medium of various lithologies.
Runcorn_04_BH	1.20	6.50	Gravelly silt	Made Ground	MADE GROUND: Very soft dark grey mottled black slightly gravelly silt. Gravel is angular to subangular fine to medium of various lithologies.
Runcorn_04_BH	6.50	7.50	Gravelly sandy clay	Made Ground	PROBABLE MADE GROUND: Stiff brown slightly gravelly sandy clay. Gravel is angular to subangular fine of various lithologies.
Runcorn_04_BH	7.50	10.50	Gravelly sandy clay	Made Ground	PROBABLE MADE GROUND: Soft brown slightly gravelly sandy clay. Gravel is angular to subangular fine of various lithologies.
Runcorn_04_BH	10.50	12.44	Gravelly sand	Tidal / Estuarine Alluvium (coarse-grained)	Loose grey slightly gravelly fine to coarse SAND. Gravel is angular to subangular fine to medium of various lithologies. Strong putrid odour.
Runcorn_07_BH	0.00	0.50	Clayey sand	Topsoil	Grass over TOPSOIL: Very soft dark orangish brown very clayey sand with many rootlets.
Runcorn_07_BH	0.50	0.80	Silty clay loam	Made Ground	MADE GROUND: Very soft dark brownish grey slightly sandy slightly silty clay with rare rootlets and black hydrocarbon pockets.
Runcorn_07_BH	0.80	1.20	Clayey silt	Made Ground	MADE GROUND: Very soft black slightly clayey silt with a strong hydrocarbon odour.
Runcorn_07_BH	1.20	2.00	Sandy silt	Made Ground	MADE GROUND: Very soft dark grey slightly sandy organic silt with a slight hydrocarbon odour.
Runcorn_07_BH	2.00	4.80	Silty sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Soft to firm dark grey slightly sandy very silty CLAY with rare organics.
Runcorn_07_BH	4.80	9.50	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Firm to stiff light brownish grey slightly sandy CLAY with rare organic material.
Runcorn_07_BH	9.50	10.45	Silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense light grey slightly silty fine to coarse SAND.

Runcorn_08_BH	0.00	0.30	Sandy clay	Topsoil	Grass over TOPSOIL: Very soft dark brown slightly sandy clay with many rootlets.
Runcorn_08_BH	0.30	0.50	Gravelly sandy clay	Made Ground	MADE GROUND: Very soft dark brown sandy gravelly clay with some rootlets. Gravel is angular to subangular of various lithologies including brick and coal fragments.
Runcorn_08_BH	0.50	1.00	Clayey silt loam	Made Ground	MADE GROUND: Very soft dark orangish greyish brown slightly sandy slightly clayey silt with a strong hydrocarbon odour.
Runcorn_08_BH	1.00	1.20	Sandy silt	Made Ground	MADE GROUND: Very soft black slightly sandy silt with a strong hydrocarbon odour.
Runcorn_08_BH	1.20	2.50	Sandy silt	Made Ground	MADE GROUND: Very soft dark grey very sandy silt.
Runcorn_08_BH	2.50	5.50	Silty sand	Made ground	Loose dark grey very silty fine to coarse SAND with rare roots.
Runcorn_08_BH	5.50	5.80	Clayey peat	Upper Peat	Spongy dark brown slightly sandy slightly clayey amorphous PEAT with occasional rootlets. H7, strong organic odour.
Runcorn_08_BH	5.80	7.50	Clay	Tidal / Estuarine Alluvium (fine-grained)	Firm to stiff light grey CLAY.
Runcorn_08_BH	7.50	8.00	Clay	Organic / Peaty Alluvium	Soft to firm dark brownish grey slightly organic CLAY with rare decayed roots.
Runcorn_09_BH	0.00	0.30	Clay	Topsoil	Grass over TOPSOIL: Firm dark brown clay with many rootlets.
Runcorn_09_BH	0.50	0.70	Silty clay	Made Ground	MADE GROUND: Firm light brownish grey slightly silty clay.
Runcorn_09_BH	0.70	1.20	Gravelly clayey silt	Made Ground	MADE GROUND: Soft Dense dark grey slightly gravelly slightly clayey silt. Gravel is subangular to subrounded medium to coarse of various lithologies. Strong hydrocarbon odour.
Runcorn_09_BH	1.20	1.70	Clayey silt	Made Ground	MADE GROUND: Very soft dark grey black slightly clayey silt. Strong hydrocarbon odour.
Runcorn_09_BH	1.70	5.10	Gravelly clayey sand loam	Made Ground	MADE GROUND: Loose dark grey slightly gravelly slightly silty slightly clayey fine to coarse sand. Gravel is rounded medium to coarse of

					various lithologies. Strong hydrocarbon odour.
Runcorn_09_BH	5.10	7.30	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Stiff light bluish grey slightly silty CLAY with rare rootlets.
Runcorn_09_BH	7.30	9.20	Clayey peat	Upper Peat	Plastic dark grey amorphous clayey PEAT. H8/9, strong organic odour, no water residue, still some visible fibres.
Runcorn_09_BH	9.20	10.45	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Soft dark grey slightly sandy slightly silty CLAY.
Runcorn_11_BH	0.00	0.20	Clayey sand	Topsoil	Grass over TOPSOIL: Very soft dark orangish brown slightly clayey sand with many rootlets.
Runcorn_11_BH	0.20	0.50	Gravelly silty clay loam	Made Ground	MADE GROUND: Soft dark greyish brown slightly gravelly slightly sandy slightly silty clay. Gravel is subangular to subrounded medium to coarse of various lithologies including sandstone.
Runcorn_11_BH	0.50	1.10	Silty clay loam	Made Ground	MADE GROUND: Very soft dark brown slightly sandy very silty clay. Slight hydrocarbon odour.
Runcorn_11_BH	1.10	1.20	Sandy silt	Made Ground	MADE GROUND: Very soft dark greyish black very sandy silt. Strong hydrocarbon odour.
Runcorn_11_BH	1.20	2.00	Sandy silt	Made Ground	MADE GROUND: Very soft black slightly sandy silt. Strong hydrocarbon odour.
Runcorn_11_BH	2.00	7.00	Silty clay	Made Ground	Very soft to stiff light greyish brown sandy slightly silty CLAY. Strong hydrocarbon odour.
Runcorn_11_BH	7.00	7.50	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Stiff light orangish grey sandy slightly silty CLAY with bands of organic material.
Runcorn_13_BH	0.00	0.50	Sandy clay	Topsoil	Grass over TOPSOIL: Very soft slightly sandy clay with some rootlets. Gravel is subangular to subrounded fine to coarse of sandstone and coal fragments.
Runcorn_13_BH	0.50	1.00	Sandy clay	Made Ground	MADE GROUND: Very soft dark brown very sandy clay with a slight hydrocabron odour. Gravel is angular to subrounded fine to coarse of coal porcelain and various lithologies.

Runcorn_13_BH	1.00	1.20	Gravelly sandy silt	Made Ground	MADE GROUND: Very soft dark orangish brown and black slightly gravelly very sandy silt. Gravel is subangular to subrounded fine to coarse of various lithologies. Strong hydrocarbon odour.
Runcorn_13_BH	1.20	2.00	Gravelly sandy silt	Made Ground	MADE GROUND: Very soft black slightly sandy slightly gravelly silt. Gravel is subangular to subrounded medium to coarse of various lithologies. Strong hydrocarbon odour.
Runcorn_13_BH	2.00	3.30	Gravelly silty clay	Made Ground	MADE GROUND: Soft black slightly gravelly very silty CLAY. Gravel is angular to subangular medium to coarse of various lithologies. Strong hydrocarbon odour.
Runcorn_13_BH	3.30	3.40	Sandy peat	Made Ground	Firm dark brown slightly sandy amorphous PEAT, slight sulphurous odour.
Runcorn_13_BH	3.40	6.30	Silty sand	Made Ground	Dark brownish grey very silty SAND with a strong hydrocarbon odour.
Runcorn_13_BH	6.30	8.20	Silty sandy clay	Made Ground	Firm light brownish grey slightly sandy slightly silty CLAY with a strong hydrocarbon odour.
Runcorn_13_BH	8.20	9.00	Silty clay	Organic / Peaty Alluvium	Firm dark orangish greyish brown slightly silty CLAY with pockets of peat and occasional decayed roots. Peat is partly amorphous with visible organic matter, sulphuric odour, H7-H8.
Runcorn_13_BH	9.00	12.45	Sandy silt	Organic / Peaty Alluvium	Soft light grey and brown slightly sandy SILT with bands of peat. Peat is amorphous with some plant structure still visible, some water seepage when squeezed, H7-H8.
Runcorn_17_BH	0.00	0.10	Clayey sand	Topsoil	Grass over TOPSOIL: Brown clayey fine to coarse sand with some rootlets.
Runcorn_17_BH	0.10	0.40	Sandy clay	Subsoil	Firm grey mottled brown sandy CLAY with occasional decayed roots.
Runcorn_17_BH	0.40	1.50	Silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Orangish brown mottled greyish brown silty fine SAND.

Runcorn_17_BH	1.50	1.80	Clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft grey CLAY.
Runcorn_17_BH	1.80	3.20	Clayey peat	Upper Peat	Soft brown amorphous clayey PEAT.
Runcorn_17_BH	3.20	4.00	Clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft bluish grey CLAY with a low organic content.
Runcorn_17_BH	4.00	6.20	Clayey silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Grey silty fine SAND with bands of clay.
Runcorn_17_BH	6.20	7.40	Clayey sand	Tidal / Estuarine Alluvium (coarse-grained)	Grey clayey fine to medium SAND with very low organic content.
Runcorn_17_BH	7.40	10.00	Silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense dark brown very silty fine to coarse SAND.
Runcorn_17_BH	10.00	11.50	Gravelly clay	Glacial Till	Stiff dark reddish brown slightly gravelly CLAY. Gravel is subrounded to rounded medium to coarse of various lithologies.
Runcorn_17_BH	11.50	15.45	Clayey sand	Glaciofluvial deposit	Medium dense dark brown slightly clayey fine to coarse SAND.
Runcorn_18_BH	0.00	0.30	Sandy gravelly clay	Topsoil	Soft dark brown slightly sandy slightly gravelly CLAY with some rootlets and woody debris. Gravel is subrounded to rounded medium to coarse of various lithologies.
Runcorn_18_BH	0.30	0.50	Clayey sand	Subsoil	Medium dense light orangish brown slightly clayey fine to coarse SAND.
Runcorn_18_BH	0.50	1.20	Gravelly clay	Tidal / Estuarine Alluvium (fine-grained)	Soft light orangish grey mottled brownish grey slightly gravelly CLAY. Gravel is subrounded to rounded fine to medium of various lithologies.
Runcorn_18_BH	1.20	2.00	Sandy gravelly clay	Tidal / Estuarine Alluvium (fine-grained)	Soft to firm light orangish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies.
Runcorn_18_BH	2.00	2.30	Sandy silt	Tidal / Estuarine Alluvium (fine-grained)	Very soft light bluish grey slightly sandy SILT.
Runcorn_18_BH	2.30	4.30	Peat	Upper Peat	Spongy dark brown pseudo-fibrous PEAT with occasional rootlets. Strong organic odour, no

					water residue, some plant matter still visible, H7-8.
Runcorn_18_BH	4.30	8.00	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft to soft dark bluish grey sandy CLAY.
Runcorn_18_BH	8.00	8.50	Peat	Lower Peat	Spongy dark brown pseudo-fibrous PEAT with occasional rootlets. Very strong organic odour, no yellowy residue in water, slow organic matter still visible by mostly decomposed, H8.
Runcorn_18_BH	8.50	10.45	Clayey sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense dark grey slightly clayey fine to coarse SAND.
Runcorn_19_BH	0.00	0.10	Sandy clay	Topsoil	Grass over TOPSOIL: Very soft dark brown slightly sandy clay with many rootlets.
Runcorn_19_BH	0.10	1.00	Sandy clay	Subsoil	Very soft dark orangish brown slightly sandy CLAY with rare rootlets.
Runcorn_19_BH	1.00	1.20	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Soft dark brown very sandy CLAY.
Runcorn_19_BH	1.20	1.80	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft dark bluish grey very silty CLAY.
Runcorn_19_BH	1.80	3.80	Silty peat	Upper Peat	Very soft dark bluish grey slightly sandy silty PEAT. H8, some plant structure still visible, amorphous, sulphuric odour.
Runcorn_19_BH	3.80	7.70	Sandy silt	Tidal / Estuarine Alluvium (fine-grained)	Very soft Loose dark grey slightly sandy SILT.
Runcorn_19_BH	7.70	8.50	Silty peat	Lower Peat	Plastic dark grey black slightly sandy very silty PEAT. H7-H8, plant structure not visible, half the material squeezes through fingers, fibres and roots not decomposed.
Runcorn_19_BH	8.50	9.50	Sandy silt	Tidal / Estuarine Alluvium (fine-grained)	Soft dark bluish grey slightly sandy SILT.
Runcorn_19_BH	9.50	12.45	Silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense dark brownish grey slightly silty fine to coarse SAND.
Runcorn_20_BH	0.00	0.10	Clay	Topsoil	Grass and wheat over TOPSOIL: Very soft dark brown clay with many rootlets.

Runcorn_20_BH	0.10	0.30	Sandy gravelly clay	Subsoil	Very soft dark brown slightly sandy slightly gravelly CLAY with some rootlets. Gravel is subangular to subrounded medium to coarse of various lithologies.
Runcorn_20_BH	0.30	1.20	Clayey sand	Tidal / Estuarine Alluvium (coarse-grained)	Dense light orangish brown slightly clayey fine to coarse SAND.
Runcorn_20_BH	1.20	1.80	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Soft dark brownish grey very silty CLAY.
Runcorn_20_BH	1.80	3.00	Peat	Upper Peat	Spongy dark brown fibrous PEAT, H8 humiliation scale, still visible rootlets not decomposed, strong sulfurous odour.
Runcorn_20_BH	3.00	4.00	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Very soft light grey slightly sandy slightly silty CLAY.
Runcorn_20_BH	4.00	7.80	Clayey silt loam	Tidal / Estuarine Alluvium (fine-grained)	Very soft dark bluish grey slightly sandy slightly clayey SILT.
Runcorn_20_BH	7.80	8.50	Peat	Lower Peat	Firm dark brown fibrous PEAT, H8 humification, wood remnants, strong sulfurous odour.
Runcorn_20_BH	8.50	13.00	Silty sand loam	Tidal / Estuarine Alluvium (coarse-grained)	Loose dark brownish grey slightly clayey slightly silty fine to coarse SAND.
Runcorn_20_BH	13.00	14.70	Gravelly clayey sand loam	Glaciofluvial deposit	Dense dark greyish brown slightly gravelly slightly silty slightly clayey fine to coarse SAND. Gravel is subrounded to well rounded fine to coarse of various lithologies.
Runcorn_20_BH	14.70	15.50	Sandy gravelly clay	Glacial Till	Stiff dark orangish brown slightly sandy slightly gravelly CLAY. Gravel is subrounded to rounded fine to coarse of various lithologies.
Runcorn_21_BH	0.00	0.30	Sandy clay	Topsoil	Soft dark brownish grey silty sandy CLAY with occasional rootlets.
Runcorn_21_BH	0.30	0.50	Clayey sand	Subsoil	Medium dense light cream brown slightly clayey fine to coarse SAND.
Runcorn_21_BH	0.50	2.00	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Soft light orangish brown sandy CLAY.
Runcorn_21_BH	2.00	3.50	Gravelly silt	Tidal / Estuarine Alluvium (fine-grained)	Soft slightly gravelly SILT. Gravel is subangular to subrounded fine to medium of mudstone.

Runcorn_21_BH	3.50	5.00	Peat	Upper Peat	Soft spongy brown amorphous PEAT, H8.
Runcorn_21_BH	5.00	7.90	Sandy silt	Tidal / Estuarine Alluvium (fine-grained)	Soft grey sandy SILT.
Runcorn_21_BH	7.90	8.50	Clayey peat	Lower Peat	Soft spongy brown amorphous clayey PEAT, H8.
Runcorn_21_BH	8.50	10.45	Silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Brownish grey silty fine to coarse SAND.
Runcorn_22_BH	0.00	0.30	Clay	Topsoil	Grass over TOPSOIL: Very soft dark brown clay with occasional rootlets.
Runcorn_22_BH	0.30	0.50	Sandy clay	Subsoil	Soft dark brown slightly sandy CLAY with rare rootlets.
Runcorn_22_BH	0.50	1.20	Clayey sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense dark orangish brown slightly clayey fine to coarse SAND.
Runcorn_22_BH	1.20	2.00	Sandy silt	Tidal / Estuarine Alluvium (fine-grained)	Soft dark grey very sandy SILT.
Runcorn_22_BH	2.00	3.00	Silt	Tidal / Estuarine Alluvium (fine-grained)	Very soft dark grey SILT.
Runcorn_22_BH	3.00	3.80	Silty peat	Upper Peat	Firm dark grey very silty fibrous PEAT. Organic material easily identifiable, chunks of wood visible, no odour, H2.
Runcorn_22_BH	3.80	4.50	Silty peat	Upper Peat	Plastic dark grey brown very silty pseudo-fibrous PEAT. Strong hydrocarbon odour with some visible plant matter, H7.
Runcorn_22_BH	4.50	5.00	Organic silt	Organic / Peaty Alluvium	Soft dark brown grey organic SILT with occasional pockets of peat.
Runcorn_22_BH	5.00	7.40	Silt	Tidal / Estuarine Alluvium (fine-grained)	Very soft dark grey SILT.
Runcorn_22_BH	7.40	9.50	Silty peat	Lower Peat	Spongy dark brownish grey very silty pseudo-fibrous PEAT. High organic content with strong organic odour, H7.
Runcorn_22_BH	9.50	11.50	Clayey sand	Tidal / Estuarine Alluvium (coarse-grained)	Dense dark grey slightly clayey fine to coarse SAND.
Runcorn_22_BH	11.50	13.30	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Soft dark grey sandy CLAY.

Runcorn_22_BH	13.30	15.45	Sandy gravelly clay	Glacial Till	Stiff to very stiff dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of various lithologies.
Runcorn_23_BH	0.00	0.30	Gravelly clay	Topsoil	Grass over TOPSOIL: Very soft dark brown slightly sandy slightly gravelly clay with some rootlets. Gravel is subangular fine to medium of various lithologies.
Runcorn_23_BH	0.30	0.80	Clayey sand	Subsoil	Medium dense light orangish brown slightly clayey fine to coarse SAND.
Runcorn_23_BH	0.80	1.20	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Soft to firm dark greyish brown slightly sandy CLAY.
Runcorn_23_BH	1.20	2.00	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft dark greyish brown silty CLAY.
Runcorn_23_BH	2.00	3.80	Clayey peat	Upper Peat	Firm spongy dark greyish brown clayey fibrous PEAT. With large chunks of intact wood and strong organic odour, H3.
Runcorn_23_BH	3.80	5.00	Clayey silt	Tidal / Estuarine Alluvium (fine-grained)	Very soft to soft dark grey slightly clayey SILT.
Runcorn_23_BH	5.00	8.00	Clayey silt loam	Tidal / Estuarine Alluvium (fine-grained)	Very soft to soft dark grey slightly sandy slightly clayey SILT.
Runcorn_23_BH	8.00	9.50	Silty peat	Lower Peat	Spongy dark brown grey very silty pseudo-fibrous PEAT. With some visible organic matter and slight organic odour, H7.
Runcorn_23_BH	9.50	12.00	Clayey sand loam	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense dark grey slightly silty slightly clayey fine to coarse SAND.
Runcorn_23_BH	12.00	12.80	Clayey gravelly sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense dark grey slightly gravelly slightly clayey fine to coarse SAND. Gravel is subrounded to rounded medium to coarse of various lithologies.
Runcorn_23_BH	12.80	15.45	Sandy CLAY	Glacial Till	Stiff to very stiff dark orangish greyish brown slightly sandy CLAY.
SA1	0.00	0.20	Silty clay	Made Ground	Dark brown silty clay
SA1	0.20	0.50	Sandy silt	Made Ground	Dark brown sandy silt. Sand is fine to medium

SA1	0.50	6.80	Silty clay	Made Ground	Very soft dark brown locally dark grey silty clay. Slight hydrocarbon odour
SA1	6.80	7.50	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Light brownish grey mottled orange silty clay. Occasional organic material
SA1	7.50	12.60	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft, becoming softer with depth, dark brown occasionally stained dark grey silty clay. From 7.50 to 8.00m and 11.90 and 12.80m there are occasional sand bands
SA1	12.60	13.10	Silty peat	Lower Peat	Dark brown silty peat. Very frequent organic material
SA1	13.10	13.70	Sandy silt	Tidal / Estuarine Alluvium (coarse-grained)	Loose light greyish brown very sandy silt. Sand is fine to medium
SA1	13.70	15.00	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Firm light greyish brown sandy silty clay. Sand is fine to medium
SA1	15.00	19.20	Sand	Glaciofluvial deposit	Medium dense, becoming very dense with depth, dark brown sand. Sand is fine to medium
SA1	19.20	29.20	Silty clay	Glacial Till	Stiff, becoming very stiff with depth, dark brown silty clay. Occasional fine to medium subrounded sandstone gravels. Slightly sandy between 19.20 and 20.30m
SA1	29.20	30.90	Kinnerton Formation Sandstone	Sandstone Bedrock	Reddish brown sandstone
SA2	0.00	0.40	Silty sand	Made Ground	Light brown silty sand. Sand is fine to medium. Frequent organic material
SA2	0.40	2.05	Silty clay loam	Made Ground	Very soft dark grey sandy silty clay. Sand is fine to medium. Occasional organic material
SA2	2.05	8.50	Silty clay	Made Ground	Very soft dark grey locally light brown silty clay
SA2	8.50	10.30	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft light brown mottled orange and grey silty clay. Rare organic fragments
SA2	10.30	11.20	Silty peat	Upper Peat	Loose dark brown silty peat. Very frequent organic material
SA2	11.20	15.60	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Firm light grey sandy silty clay. Sand is fine. Rare organic fragments

SA2	15.60	17.70	Silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense light grey silty sand. Sand is fine to medium. Rare fine gravels from 16.60m
SA2	17.70	20.45	Sand	Glaciofluvial deposit	Dense, becoming very dense with depth, light brown sand. Sand is fine to medium. Occasional fine to medium subrounded to subangular gravels from 17.90m
SA3	0.00	1.10	Silt	Topsoil	Dark brown stained reddish brown silt. Frequent rootlets
SA3	1.10	1.70	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft light greyish brown silty clay
SA3	1.70	1.90	Clayey silt	Organic / Peaty Alluvium	Very loose light greyish brown peaty clayey silt
SA3	1.90	3.60	Silty peat	Upper Peat	Very loose dark brown silty peat. Very frequent organic material
SA3	3.60	7.80	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Very soft light grey sandy silty clay. Sand is fine to medium
SA3	7.80	9.90	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft, becoming stiff with depth, dark brown locally light grey silty clay. Frequent organic material. Becomes dark greyish brown from 8.00m
SA3	9.90	12.30	Silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense light brown gravelly silty sand. Sand is fine to medium. Gravel is fine to medium subrounded to subangular
SA3	12.30	12.80	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Reddish brown silty clay. Occasional fine to medium sands
SA3	12.80	15.30	Silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense light orange brown silty sand. Sand is fine to medium with a little coarse
SA3	15.30	15.55	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Dark brown silty clay. Rare fine to medium subrounded gravels
SA3	15.55	16.95	Silty sand	Glaciofluvial deposit	Dense light orange brown silty sand. Sand is fine to medium
SA3	16.95	18.50	Silty clay	Glacial Till	Dark brown silty clay. Rare fine gravels
SA3	18.50	19.05	Silty sand	Glaciofluvial deposit	Light orange brown silty sand. Sand is fine to medium
SA3	19.05	31.80	Sandy clay	Glacial Till	Stiff dark brown sandy clay. Sand is fine to medium. Occasional fine to

					medium subrounded to subangular sandstone gravels
SA3	31.80	32.40	Chester / Wilmslow Formation Sandstone	Sandstone Bedrock	Reddish brown sandstone
SA4	0.00	0.60	Sandy silt	Made Ground	Light brown sandy silt. Sand is fine. Frequent rootlets
SA4	0.60	8.30	Silty clay	Made Ground	Very loose dark grey locally light brown silty clay
SA4	8.30	10.30	Sandy silt	Tidal / Estuarine Alluvium (fine-grained)	Very soft light greyish brown very sandy silt. Sand is fine to medium
SA4	10.30	13.30	Silty peat	Upper Peat	Very loose dark brown silty peat. Very frequent organic material
SA4	13.30	16.60	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Firm, becoming stiff with depth, light greyish brown silty clay. Occasional fine gravels. Frequent fine to medium subrounded to subangular gravels between 13.20 and 13.40m
SA4	16.60	22.70	Silty sand	Glaciofluvial deposit	Dense, becoming very dense with depth, light orange brown gravelly silty sand. Sand is fine to medium with a little coarse. Becomes less gravelly from 21.05m
SA4	22.70	30.00	Silty clay	Glacial Till	Very stiff dark brown silty clay. Occasional fine to medium subrounded to subangular sandstone gravels
SA5	0.00	1.20	Sandy silt	Made Ground	Dark orange brown sandy silt. Sand is fine to medium. Becomes dark brown with occasional rootlets from 0.60m
SA5	1.20	7.30	Silty clay loam	Made Ground	Very soft dark grey locally dark brown slightly sandy silty clay. Sand is fine to medium. Slight hydrocarbon odour. Becomes more sandy between 4.50 and 5.30m
SA5	7.30	12.80	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft, becoming firm with depth, dark greyish brown silty clay. Frequent organic fragments. Occasional fine sand bands. Organic fragments absent from 9.00m. Becomes soft from 9.95m but firm from 10.50m

SA5	12.80	13.40	Clayey sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense dark grey clayey sand. Sand is fine to coarse
SA5	13.40	16.00	Sandy clay loam	Tidal / Estuarine Alluvium (fine-grained)	Stiff dark greyish brown silty sandy clay. Occasional fine sand bands. Occasional fine to medium subrounded to subangular flint gravels
SA5	16.00	18.10	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Firm dark grey stained orange brown silty clay. Staining absent from 17.00m
SA5	18.10	21.80	Sandy gravel	Glaciofluvial deposit	Dense dark grey sandy gravel and cobbles. Sand is fine to medium. Gravel is fine to medium subrounded to subangular siltstone and mudstone. Abundant subangular to subrounded siltstone cobbles
SA5	21.80	23.00	Silty clay	Glacial Till	Dark reddish brown silty clay. Occasional fine sand bands. Occasional fine to medium subrounded to subangular gravels
SA5	23.00	25.40	Sand	Glaciofluvial deposit	Medium dense dark reddish brown sand. Sand is fine to coarse. Rare fine to medium subrounded to subangular siltstone fragments
SA5	25.40	26.90	Silty clay	Glacial Till	Dark brown slightly silty clay
SA5	26.90	32.60	Sand	Glaciofluvial deposit	Dense, becoming medium dense with depth, dark reddish brown sand. Sand is fine to coarse
SA5	32.60	43.45	Clay	Glacial Till	Stiff, becoming very stiff with depth, dark brown boulder clay
BH25	0.00	0.40	Gravelly soil	Made Ground	Grass over gravelly soil
BH25	0.40	1.30	Silty clay loam	Made Ground	Soft to firm, thinly to thickly laminated grey mottled black, brown and red sandy gravelly silty clay with low cobble content. Gravel is angular to subangular fine to coarse of various lithologies including mudstone, limestone, sandstone and concrete. Cobbles of concrete are angular
BH25	1.30	2.90	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Soft to firm thinly laminated light grey mottled orange silty clay

BH25	2.90	9.10	Clayey silt loam	Tidal / Estuarine Alluvium (fine-grained)	Locally laminated black mottled brown clayey silt, becoming sandy to very sandy with occasional pockets of fibrous peat. Thinly laminated between 5.00 and 7.00m. Becomes sandy to very sandy between 7.00 and 9.00m. Occasional pockets of peat between 8.00 to 8.50m
BH25	9.10	9.50	Clayey peat	Lower Peat	Black slightly sandy clayey amorphous peat
BH25	9.50	10.50	Sand	Tidal / Estuarine Alluvium (coarse-grained)	Light brown and grey medium and coarse sand
BH25	10.50	11.40	Clayey sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense light brown and grey slightly gravelly slightly clayey fine to coarse sand. Gravel is angular to subangular fine and medium of various lithologies including quartz and quartzite
BH25	11.40	14.50	Sand	Glaciofluvial deposit	Medium dense grey slightly gravelly silty fine and medium sand, locally with occasional pockets of soft brown clay. Gravel is angular to subangular fine and medium of various lithologies including quartz and quartzite. Pockets of brown clay between 13.50 and 14.50m
BH25	14.50	20.00	Silty clay loam	Glacial Till	Firm to stiff brown slightly sandy slightly gravelly silty clay. Thinly laminated between 18.00 and 20.00m. Gravel is angular to subangular fine to coarse of various lithologies
BH27	0.00	2.80	Sandy clay	Made Ground	Soft to firm thinly laminated dark brown mottled light brown and orange slightly gravelly sandy clay. Gravel is angular to subrounded fine and medium of various lithologies
BH27	2.80	3.20	Silty clay loam	Made Ground	Soft to firm dark grey and dark brown sandy silty clay with (probable) lenses of red medium and coarse sand

BH27	3.20	5.60	Silty clay loam	Made Ground	Firm thinly laminated light grey mottled orange and black sandy silty clay with pockets of brown fine to coarse sand and locally pockets of organic material and very sandy clayey silt with occasional rootlets with slight hydrocarbon odour between 5.00 and 5.60m. Laminations of black silt with strong hydrocarbon odour between 4.00 and 4.50m
BH27	5.60	7.80	Silty clay loam	Made Ground	Soft to firm, becoming firm with depth, thinly laminated light grey and mottled orange brown slightly sandy silty clay with locally abundant plant remains. Firm with abundant plant remains between 7.50 and 7.80m
BH27	7.80	9.40	Silty clay loam	Made Ground	Soft light grey mottled brown thinly laminated very sandy silty clay
BH27	9.40	11.00	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Soft to firm light grey mottled orange slightly sandy, becoming sandy silty, clay with rootlets and roots. Becomes sandy silty clay between 10.00 and 11.00m
BH27	11.00	11.80	Clayey peat	Upper Peat	Dark brown and black clayey fibrous peat with pockets of soft grey clay
BH27	11.80	12.50	Clay	Organic / Peaty Alluvium	Firm thinly laminated light grey clay with abundant roots and plant remains with pockets of amorphous peat between 12.45 and 12.50m
BH27	12.50	14.60	Silty clay loam	Organic / Peaty Alluvium	Soft locally thinly laminated brown and grey very sandy silty clay with peat and plant remains. Thinly laminated grey silty sand band between 13.00 and 13.45m
BH27	14.60	24.00	Clayey sand	Tidal / Estuarine Alluvium (coarse-grained)	Loose locally medium dense light brown slightly gravelly slightly clayey fine to coarse sand. Gravel is angular to subangular fine to coarse of various lithologies including basalt, quartz, mudstone and sandstone. Medium dense between 16.00 and 16.95m

BH27	24.00	27.50	Silty clay loam	Glacial Till	Stiff brown slightly sandy slightly gravelly silty clay, Gravel is angular to subangular fine and medium of various lithologies
BH27	27.50	30.00	Clayey sand	Glaciofluvial deposit	Medium dense orangish brown clayey fine and medium sand
BH28	0.00	1.50	Silty clay loam	Made Ground	Firm dark grey mottled black gravelly sandy silty clay. Gravel is angular fine and medium of limestone
BH28	1.50	7.00	Clayey silt loam	Made Ground	Thickly laminated black mottled brown sandy clayey silt with a very strong hydrocarbon odour
BH28	7.00	7.70	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Very soft light grey slightly sandy silty clay
BH28	7.70	9.50	Silty peat	Upper Peat	Black and brown amorphous peat with occasional bands of soft light grey sandy clayey silt
BH28	9.50	13.60	Clayey silt loam	Organic / Peaty Alluvium	Light grey mottled brown sandy clayey silt with occasional large and medium pockets of amorphous peat and abundant plant remains
BH28	13.60	21.10	Silty sand	Glaciofluvial deposit	Medium dense becoming dense (from 18.50m) dark brown mottled grey silty medium and coarse sand
BH28	21.10	22.00	Silty clay loam	Glaciolacustrine deposit	Firm thinly laminated dark brown slightly gravelly slightly sandy silty clay. Gravel is angular to subangular fine and medium of various lithologies including basalt
BH28	22.00	25.00	Sand	Glaciofluvial deposit	Medium dense brown silty fine and medium sand with occasional shell fragments
BH28	25.00	26.90	Silty clay loam	Glaciolacustrine deposit	Firm thinly laminated light brown silty clay with abundant silt laminae. Becomes slightly sandy silty clay from 26.50m
BH28	26.90	35.00	Silty sand	Glaciofluvial deposit	Medium dense to dense brown slightly gravelly fine to coarse sand with occasional small and medium pockets of light brown silty clay. Gravel is angular to subangular fine and medium of basalt
BH32	0.00	1.00	Sandy clay	Made Ground	Soft brown and grey slightly sandy gravelly clay with medium cobble

					content. Gravel is angular to subangular fine to coarse of various lithologies including sandstone, brick and concrete. Cobbles are angular to subangular of concrete
BH32	1.00	4.00	Silty clay loam	Made Ground	Very soft to soft brown mottled black and grey thinly laminated, locally slightly gravelly, sandy silty clay with a slight hydrocarbon odour. Slightly gravelly with pockets of light grey mottled orange sandy clay between 2.00 and 2.45m. Occasional rootlets. Gravel is angular to subangular fine to coarse of various lithologies including red sandstone
BH32	4.00	10.00	Silty clay loam	Made Ground	Firm locally thinly laminated, light grey mottled orange and black slightly sandy silty clay with roots and rootlets. Thinly laminated between 4.00 and 4.50m, 6.00 and 6.45m, 7.50 and 9.00m. Vertically laminated between 6.70 and 7.50m
BH32	10.00	12.00	Clay	Tidal / Estuarine Alluvium (fine-grained)	Soft light grey clay with plant remains and roots
BH32	12.00	14.90	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Very soft thinly laminated brown sandy silty clay
BH32	14.90	18.00	Silty clay loam	Organic / Peaty Alluvium	Soft to firm thinly laminated light grey sandy silty clay with abundant pockets of peat and plant remains
BH32	18.00	20.00	Sandy silt	Organic / Peaty Alluvium	Locally thinly laminated light grey very sandy sit with pockets of peat and plant remains between 18.50 and 18.70m. Thinly laminated between 18.70 and 20.00m
BH32	20.00	20.45	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Very soft light grey thinly laminated very sandy silty clay
SJ47NE141	0.00	0.15	Clay	Topsoil	Topsoil
SJ47NE141	0.15	0.65	Clay	Tidal / Estuarine Alluvium (fine-grained)	Brown mottled grey clay
SJ47NE141	0.65	1.20	Peat	Upper Peat	Peat

SJ47NE141	1.20	4.30	Peat	Upper Peat	Peat
SJ47NE141	4.30	8.50	Sandy silt	Tidal / Estuarine Alluvium (fine-grained)	Soft grey sandy silt
SJ47NE141	8.50	9.50	Peat	Lower Peat	Peat
SJ47NE141	9.50	12.55	Silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Silty sand with occasional gravel
SJ47NE141	12.55	14.05	Clay	Glacial Till	Soft to firm boulder clay
SJ47NE141	14.05	14.70	Clay	Glacial Till	Boulder clay
SJ47NE141	14.70	21.10	Clayey silt	Glacial Till	Clayey silt
SJ47NE141	21.10	24.55	Gravelly clayey silt	Glacial Till	Clayey silt with occasional gravel
SJ47NE141	24.55	29.00	Clay	Glacial Till	Boulder clay
SJ47NE141	29.00	29.05	Gravelly clay	Glacial Till	Sandstone cobble
SJ47NE141	29.05	36.55	Gravelly silt	Glaciolacustrine deposit	Laminated silts with occasional gravel
SJ47NE141	36.55	44.05	Sandy silt	Glaciofluvial deposit	Clayey sandy silt
SJ47NE141	44.05	50.30	Silty sand	Glaciolacustrine deposit	Silty sands with laminated silts
SJ47NE141	50.30	54.65	Silty sand	Weathered Sandstone bedrock	Fine to medium silty sands
SJ47NE141	54.65	55.80	Silty sand	Weathered Sandstone bedrock	Fine to coarse silty sand
SJ47NE141	55.80	60.00	Kinnerton Formation Sandstone	Sandstone Bedrock	Sherwood sandstone
SJ47NE142	0.00	0.90	Clay	Topsoil	Soft brown mottled orangish brown and grey clay, frequent rootlets
SJ47NE142	0.09	1.30	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Soft brown mottled orangish brown and grey slightly sandy clay, occasional silt lenses (10-20mm)
SJ47NE142	1.30	1.60	Peat	Upper Peat	Firm, locally pseudo-fibrous black peat
SJ47NE142	1.60	2.60	Silty clay loam	Upper Peat	Plastic, dark brown slightly sandy amorphous peat with occasional lenses (5mm) of silty clay.
SJ47NE142	2.60	7.70	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Very soft bluish grey silty clay

SJ47NE142	7.70	8.10	Peat	Lower Peat	Firm black pseudo-fibrous peat with occasional dark grey clay lenses (4mm), strong organic odour.
SJ47NE142	8.10	10.50	Peat	Lower Peat	Spongy pseudo-fibrous peat with occasional dark grey clay lenses (4mm). Strong organic odour
SJ47NE142	10.50	11.10	Silty sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense grey silty fine to medium sand
SJ47NE142	11.10	11.90	Sand	Tidal / Estuarine Alluvium (coarse-grained)	Medium dense bluish grey fine to medium sand
SJ47NE142	11.90	12.30	Gravelly sand	Glaciofluvial deposit	Medium dense grey gravelly fine to medium sand. Gravel is sub-angular to sub-rounded fine to coarse of various lithologies, including sandstone and siltstone
SJ47NE142	12.30	19.50	Gravelly clay	Glacial Till	Stiff reddish brown slightly sandy slightly gravelly clay, sub-angular to sub-rounded gravel of sandstone, mudstone and quartzite
SJ47NE142	19.50	22.10	Sandy silt	Glaciofluvial deposit	Soft brown sandy silt, sand is fine to medium.
SJ47NE142	22.10	26.00	Silty clay	Glaciolacustrine deposit	Firm, thinly laminated reddish brown silty clay
SJ47NE142	26.00	34.50	Sandy clay	Glacial Till	Firm to stiff reddish brown gravelly sandy clay. Gravel is sub-angular to sub-rounded fine to coarse of various lithologies including sandstone and mudstone
SJ47NE142	34.50	39.00	Sandy clay	Glacial Till	Firm brown slightly sandy clay, occasional lenses (5-30mm) of light brown and grey sand. Occasional sub-rounded to rounded gravel of various lithologies including flint, sandstone and mudstone
SJ47NE142	39.00	40.00	Sandy clay	Glaciolacustrine deposit	Soft to firm thickly laminated brown slightly sandy clay, laminae are light brown of silty fine sand and sandy silt
SJ47NE22	0.00	0.50	Sandy silt	Topsoil	Loose brown sandy silt
SJ47NE22	0.50	1.90	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Firm becoming soft brown and mottled red-brown and orange-brown sandy silty clay with some

					fine gravel and some organic staining
SJ47NE22	1.90	2.20	Sandy gravel	Tidal / Estuarine Alluvium (coarse-grained)	Loose brown clayey silty sandy angular fine sandstone gravel
SJ47NE22	2.20	2.90	Silty clay	Organic / Peaty Alluvium	Soft light greyish brown silty clay with organic pockets and some fine gravel
SJ47NE22	2.90	4.10	Peat	Upper Peat	Soft fibrous black and mottled orange-brown slightly silty clayey peat
SJ47NE22	4.10	9.80	Silty clay	Organic / Peaty Alluvium	Very soft light blue-grey very silty clay with pockets of black peat
SJ47NE22	9.80	10.00	Peat	Lower Peat	Firm black fibrous peat
SJ47NE4	0.00	0.23	Clay	Topsoil	Topsoil
SJ47NE4	0.23	0.91	Clay	Tidal / Estuarine Alluvium (fine-grained)	Mottled Clay
SJ47NE4	0.91	3.96	Peat	Upper Peat	Peat
SJ47NE4	3.96	7.32	Silt	Tidal / Estuarine Alluvium (fine-grained)	Silt
SJ47NE4	7.32	8.53	Peat	Lower Peat	Peat
SJ47NE4	8.53	9.75	Sand	Tidal / Estuarine Alluvium (coarse-grained)	Grey Sand
SJ47NE4	9.75	10.67	Sand	Tidal / Estuarine Alluvium (coarse-grained)	Running Sand
SJ47NE4	10.67	19.20	Sandy clay	Glacial Till	Sandy Clay
SJ47NE4	19.20	21.95	Sand	Glaciofluvial deposit	Running Sand
SJ47NE4	21.95	24.99	Clay	Glacial Till	Stiff Clay
SJ47NE4	24.99	33.53	Sandy clay	Glacial Till	Sandy Clay
SJ47NE4	33.53	36.58	Wilmslow Sandstone Formation	Sandstone Bedrock	Sandstone
SJ47NE4	36.58	53.34	Wilmslow Sandstone Formation	Sandstone Bedrock	Sandy Marl with clay and stones
SJ47NE4	53.34	61.57	Wilmslow Sandstone Formation	Sandstone Bedrock	Sandstone
SJ47NE4	61.57	63.55	Wilmslow Sandstone Formation	Sandstone Bedrock	Sandstone

SJ47NE46	0.00	0.40	Clay	Topsoil	Grass over topsoil
SJ47NE46	0.40	3.00	Sandy clay	Glacial Till	Soft brown sandy clay with a little fine to coarse gravel, becoming very stiff below 2 m
SJ47NE77	0.00	0.07	Void	Void	Core missing
SJ47NE77	0.07	0.32	Clayey silt	Tidal / Estuarine Alluvium (fine-grained)	Very dark greyish brown firm clayey silt. Occasional rootlets
SJ47NE77	0.32	0.87	Silt	Tidal / Estuarine Alluvium (fine-grained)	Dark yellowish brown firm silt
SJ47NE77	0.87	1.04	Sandy silt	Tidal / Estuarine Alluvium (fine-grained)	Dark yellowish brown soft, slightly very fine sandy silt
SJ47NE79	0.00	0.04	Void	Void	Core missing
SJ47NE79	0.04	0.17	Void	Void	Disturbed ground
SJ47NE79	0.17	0.65	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Dark grey into dark brown at 0.32 m, into grey at 0.52 m, firm silty clay
SJ47NE79	0.65	0.80	Silt	Tidal / Estuarine Alluvium (fine-grained)	Greyish brown soft silt
SJ47NE79	0.80	0.92	Silty clay	Organic / Peaty Alluvium	Brown soft silty clay, occasional organic fragments
SJ47NE79	0.92	1.04	Clay	Tidal / Estuarine Alluvium (fine-grained)	Grey soft clay
SJ47NE79	1.04	1.07	Void	Void	Core missing
SJ47NE79	1.07	1.16	Clay	Tidal / Estuarine Alluvium (fine-grained)	Grey very soft clay
SJ47NE79	1.16	1.57	Silt	Tidal / Estuarine Alluvium (fine-grained)	Yellowish brown very soft clayey silt
SJ47NE79	1.57	1.75	Clay	Tidal / Estuarine Alluvium (fine-grained)	Grey soft clay grading down into … (see below)
SJ47NE79	1.75	1.85	Silty clay	Organic / Peaty Alluvium	Very dark greyish brown organic silty clay
SJ47NE79	1.85	2.07	Peat	Upper Peat	Black peat, occasional wood fragments
SJ47NE79	2.07	2.22	Void	Void	Peat and clay mix. Cavings
SJ47NE79	2.22	3.07	Peat	Upper Peat	Black to very dark brown peat. Phragmites fragments throughout. Occasional wood fragments

SJ47NE79	3.07	3.33	Void	Void	Peat and clay mix. Cavings
SJ47NE79	3.33	3.40	Peat	Upper Peat	Very dark brown peat. Sharp contact
SJ47NE79	3.40	3.51	Silty clay	Organic / Peaty Alluvium	Grey soft silty clay. Phragmites throughout but more abundant towards top
SJ47NE79	3.51	4.07	Clayey silt	Tidal / Estuarine Alluvium (fine-grained)	Grey soft clayey silt
SJ47NE79	4.07	4.15	Void	Void	Peat and clay mix. Cavings
SJ47NE79	4.15	5.07	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Grey soft interlaminated silt and silty clay
SJ47NE79	5.07	5.43	Silty clay	Organic / Peaty Alluvium	Grey soft silty clay. Phragmites throughout but more abundant towards top
SJ47NE79	5.43	6.07	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Grey soft interlaminated silt and silty clay
SJ47NE79	6.07	7.07	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Grey soft interlaminated silt and silty clay
SJ47NE79	7.07	8.07	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Grey soft interlaminated silt and silty clay
SJ47NE79	8.07	8.09	Silty clay	Organic / Peaty Alluvium	Very dark greyish brown organic silty clay
SJ47NE79	8.09	8.32	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Grey soft clay with occasional Phragmites grading down into ... (see below)
SJ47NE79	8.32	8.36	Clay	Organic / Peaty Alluvium	Dark grey organic clay
SJ47NE79	8.36	8.54	Peat	Lower Peat	Very dark brown peat. Occasional wood fragments
SJ47NE79	8.54	8.70	Peat	Lower Peat	Black and very dark brown peat. Occasional wood fragments
SJ47NE8/D	0.00	0.20	Clay	Topsoil	Topsoil
SJ47NE8/D	0.20	0.95	Clay	Tidal / Estuarine Alluvium (fine-grained)	Clay
SJ47NE8/D	0.95	3.50	Peat	Upper Peat	Peat
SJ47NE8/D	3.50	4.06	Clay	Tidal / Estuarine Alluvium (fine-grained)	Bungum
SJ47NE8/F	0.00	0.15	Clay	Topsoil	Topsoil

SJ47NE8/F	0.15	1.60	Clay	Tidal / Estuarine Alluvium (fine-grained)	Clay
SJ47NE8/F	1.60	3.30	Peat	Upper Peat	Peat
SJ47NE8/F	3.30	3.86	Clay	Tidal / Estuarine Alluvium (fine-grained)	Bungum
SJ47NE86	0.00	0.90	Silty sand	Made ground	Orange brown and dark brown silty fine to medium sand with occasional pockets of firm brown sandy clay
SJ47NE86	0.90	1.20	Sand	Glaciofluvial deposit	orange brown gravelly medium sand, gravel fine -medium SA-SR quartzite and sandstone
SJ47NE86	1.20	6.00	Sand	Glaciofluvial deposit	medium dense red brown fine to medium sand
SJ47NE86	6.00	7.50	Silt	Glaciolacustrine deposit	firm to stiff thinly laminated brown clay, with grey brown silt in laminated surfaces
SJ47NE86	7.50	11.60	Sandy clay	Glacial Till	stiff, fissured brown sandy clay with occasional gravel. Gravel fine to medium SA sandstone and basalt
SJ47NE86	11.60	12.00	Silty gravelly sand	Glaciofluvial deposit	orange brown slightly silty gravelly sand. Sandstone gravel
SJ47NE86	12.00	16.00	Wilmslow Sandstone Formation	Sandstone Bedrock	very stiff, fissured brown sandy clay with occasional SA gravel
SJ47NE9/I	0.00	0.30	Clay	Topsoil	
SJ47NE9/I	0.30	1.80	Sand	Tidal / Estuarine Alluvium (coarse-grained)	
SJ47NE9/I	1.80	3.66	Clay	Tidal / Estuarine Alluvium (fine-grained)	Blue clay
SJ47NE91	0.00	0.20	Clay	Topsoil	Topsoil
SJ47NE91	0.20	1.80	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Soft brown silty clay
SJ47NE91	1.80	2.90	Peat	Upper Peat	Soft dark brown fibrous peat
SJ47NE91	2.90	9.10	Clayey silt	Tidal / Estuarine Alluvium (fine-grained)	Soft grey clayey laminated silt
SJ47NE91	9.10	10.80	Peat	Lower Peat	Soft dark brown fibrous peat

SJ47NE91	10.80	15.10	Sand	Tidal / Estuarine Alluvium (coarse-grained)	Soft firm medium grey sand
SJ47NE91	15.10	18.10	Gravelly sand	Glaciofluvial deposit	Medium dense brown, fine to medium sand with common gravel
SJ47NE91	18.10	22.10	Sand	Glaciofluvial deposit	Very dense brown fine to medium sand with rare gravel
SJ47NE91	22.10	23.60	Silty clay loam	Glacial Till	Stiff brown sandy, silty clay with rare gravel.
SJ47NE91	23.60	25.80	Clayey sand	Glaciofluvial deposit	Dense brown fine to medium clayey sand
SJ47NE91	25.80	28.10	Silty clay	Glaciolacustrine deposit	Stiff brown laminated silty clay
SJ47NE96	0.00	0.20	Sandy clay	Topsoil	Dark brown slightly sandy clay.
SJ47NE96	0.20	0.90	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Firm brown mottled grey, orange and red slightly sandy clay with occasional lenses of sand
SJ47NE96	0.90	1.95	Silty clay loam	Tidal / Estuarine Alluvium (fine-grained)	Firm grey mottled orange brown slightly sandy silty clay.
SJ47NE96	1.95	5.00	Peat	Upper Peat	Firm, spongy black and red brown fibrous peat with frequent wood fragments, strong organic odour, not bottomed.
SJ47NE97	0.00	0.25	Sandy gravelly clay	Topsoil	grass onto soft to firm brown sandy gravelly clay topsoil
SJ47NE97	0.25	0.60	Gravelly clay	Tidal / Estuarine Alluvium (fine-grained)	soft to firm dark brown gravelly clay
SJ47NE97	0.60	2.30	Clayey sand	Tidal / Estuarine Alluvium (coarse-grained)	light brown slightly clayey fine to coarse sand
SJ47NE97	2.30	3.30	Clay	Organic / Peaty Alluvium	soft to firm grey clay with lenses of organic black sediment
SJ47NE97	3.30	5.00	Peat	Upper Peat	spongy dark reddish brown fibrous peat with frequent plant matter and wood fragments
SJ57NW102	0.00	1.30	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	grass over soft brown very sandy clay
SJ57NW102	1.30	4.00	Peaty clay	Organic / Peaty Alluvium	very soft grey peaty clay
SJ57NW102	4.00	4.40	Sandy silt	Tidal / Estuarine Alluvium (fine-grained)	Grey clayey sandy silt

SJ57NW15/A	0.00	0.30	TOPSOIL	Topsoil	Topsoil
SJ57NW15/A	0.30	1.50	Clay	Tidal / Estuarine Alluvium (fine-grained)	Blue clay
SJ57NW15/A	1.50	3.35	Peat	Upper Peat	Peat
SJ57NW15/A	3.35	3.66	Sand	Tidal / Estuarine Alluvium (coarse-grained)	Sand
SJ57NW15/D	0.00	0.30	Clay	Topsoil	Topsoil
SJ57NW15/D	0.30	2.15	Clay	Tidal / Estuarine Alluvium (fine-grained)	Clay
SJ57NW15/D	2.15	3.96	Clay	Tidal / Estuarine Alluvium (fine-grained)	Blue clay
SJ57NW17/B	0.00	0.61	Clay	Topsoil	Soil
SJ57NW17/B	0.61	1.53	Clay	Tidal / Estuarine Alluvium (fine-grained)	Clay
SJ57NW17/B	1.53	3.66	Sand	Tidal / Estuarine Alluvium (coarse-grained)	Sand
SJ57NW317	0.00	0.30	Sandy clay	Topsoil	Grass onto soft to firm dark brown sandy clay topsoil
SJ57NW317	0.30	2.00	Sandy clay	Tidal / Estuarine Alluvium (fine-grained)	Soft to firm brown and grey sandy clay
SJ57NW317	2.00	3.70	Silty	Organic / Peaty Alluvium	Soft laminated grey and black silt
SJ57NW330	0.00	0.30	Tarmac	Made ground	tarmac surfacing
SJ57NW330	0.30	2.20	Stone and rubble	Made ground	medium to dense stone rubble and hard-core material
SJ57NW330	2.20	7.50	Sandstone	Weathered Sandstone Bedrock	weathered sandstone
SJ57NW42	0.00	0.15	Clay	Topsoil	Grey clayey topsoil
SJ57NW42	0.15	0.80	Silty clay	Tidal / Estuarine Alluvium (fine-grained)	Stiff to very stiff mottled grey-brown friable fissured silty clay
SJ57NW42	0.80	3.00	Silty clay	Organic / Peaty Alluvium	Soft very dark grey to black organic very silty clay

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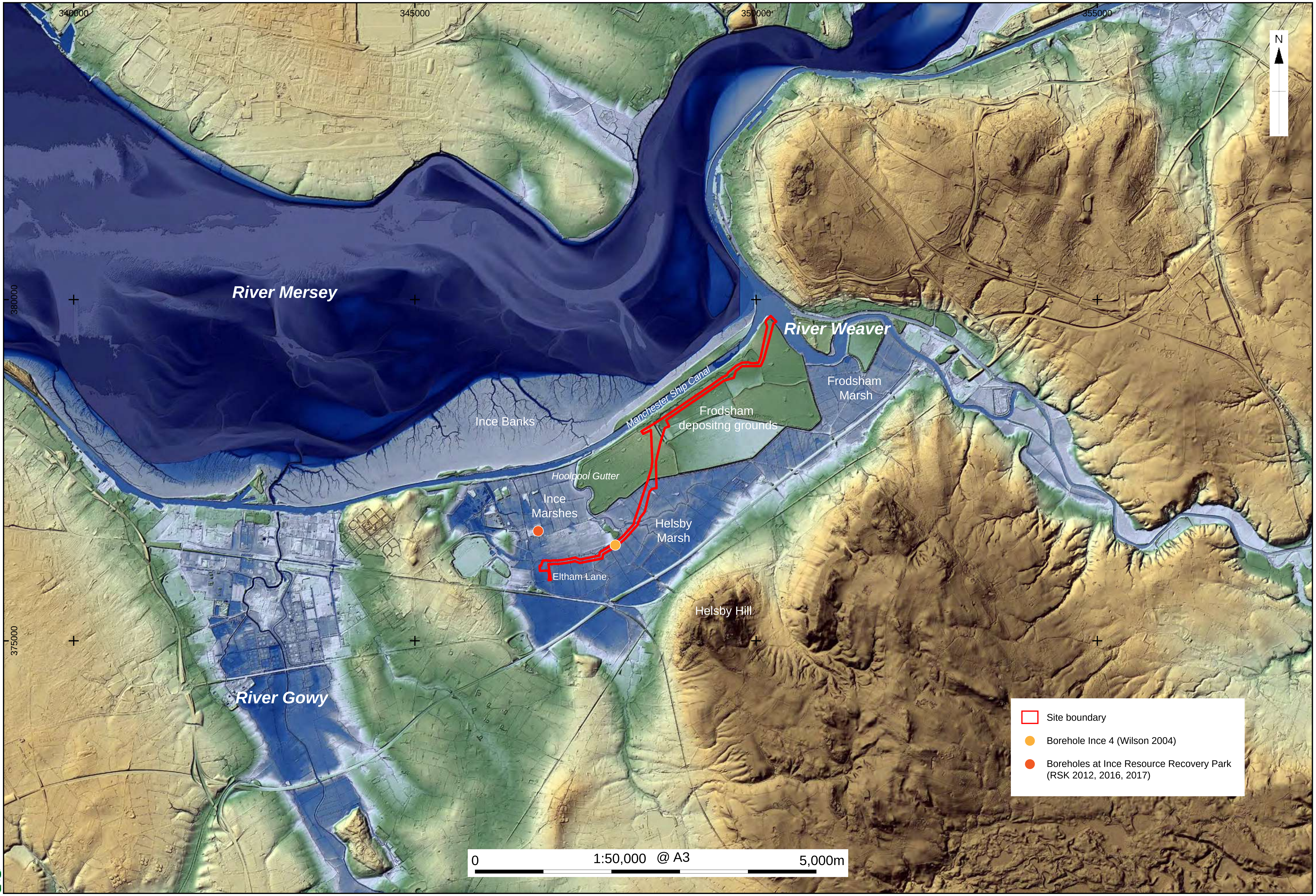
Figure 1: Site location



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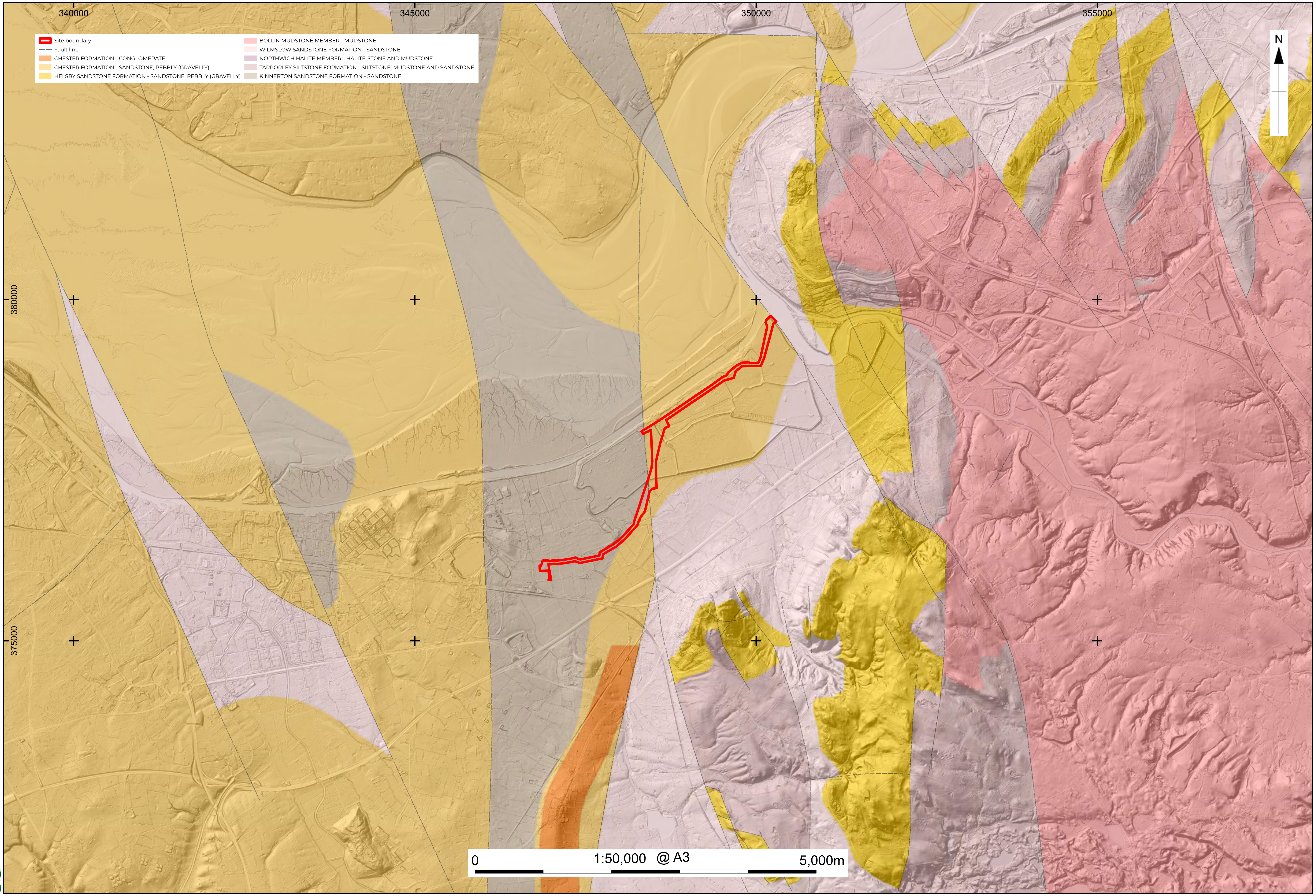
World Hillshade: Esri, Intermap, NASA, NGA, USGS

Figure 2: Regional LiDAR and previous sample sites



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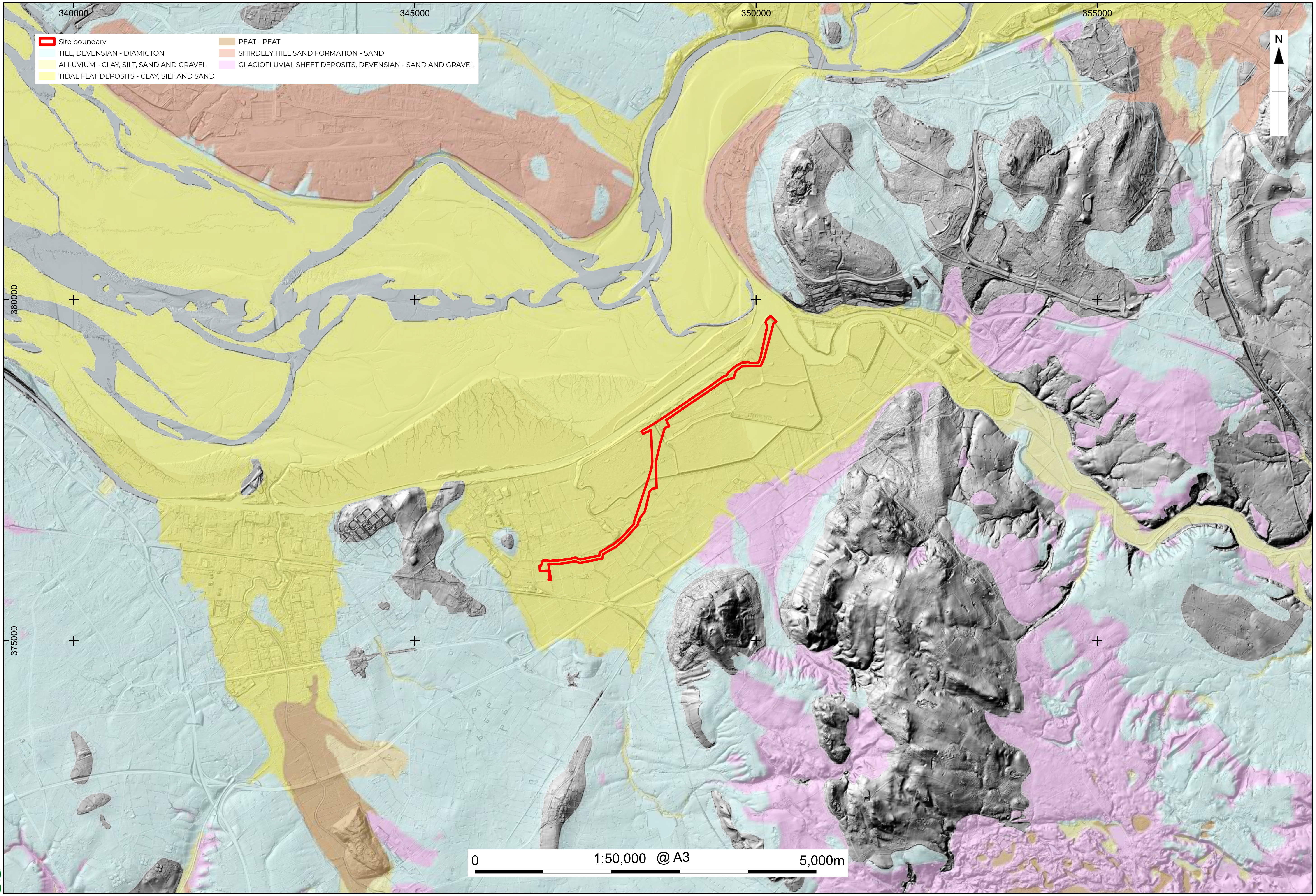
World Terrain Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
BGS 50000 scale digital geology:

Figure 3: Bedrock geology



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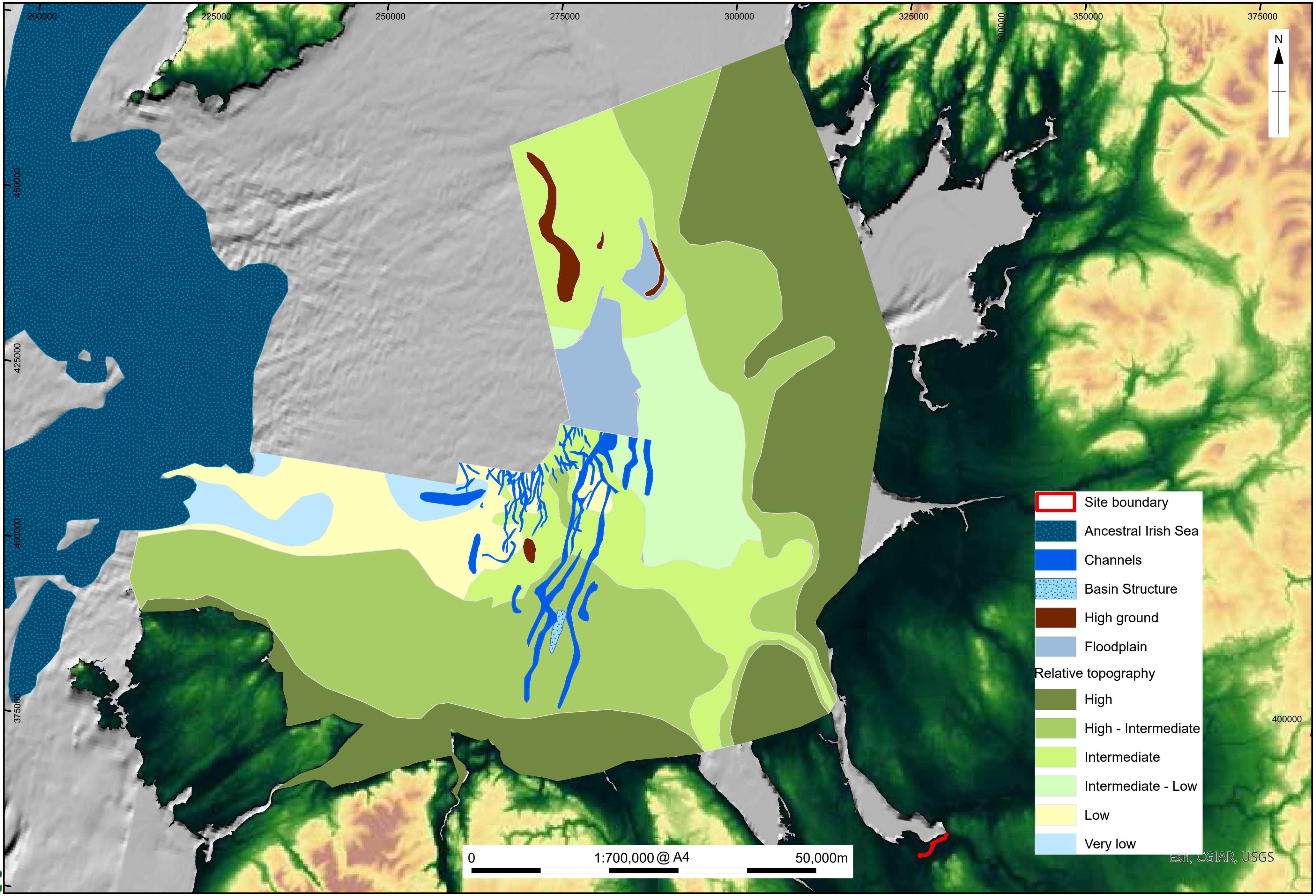
World Terrain Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
BGS 50000 scale digital geology:
World Hillshade: Esri, Intermap, NASA, NGA, USGS

Figure 4: Superficial geology



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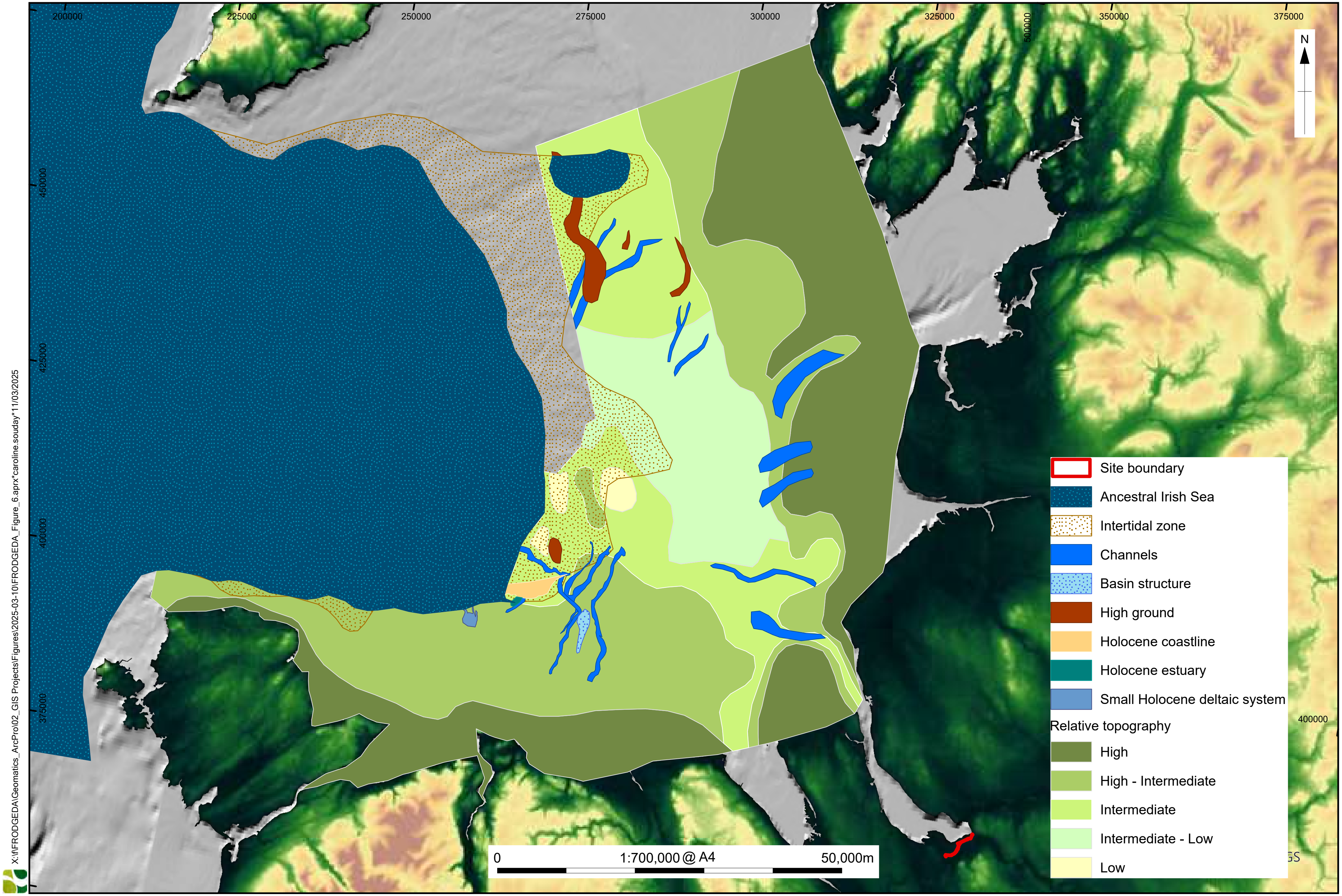
Data Sources: Client, The Crown Estate, MMO, NRW, ScotGov, MarineRegions.org
DTM model License: CC-BY-4.0 and GEBCO_2023 bathymetric data

Figure 5: Liverpool Bay in the Late Palaeolithic (redrawn after Fitch and Gaffney, 2011, fig. 58)



Data Sources: Client, The Crown Estate, MMO, NRW, ScotGov, MarineRegions.org
DTM model License: CC-BY-4.0 and
GEBCO_2023 bathymetric data

Figure 6: Liverpool Bay in the Mesolithic (redrawn after Fitch and Gaffney, 2011, fig. 58)

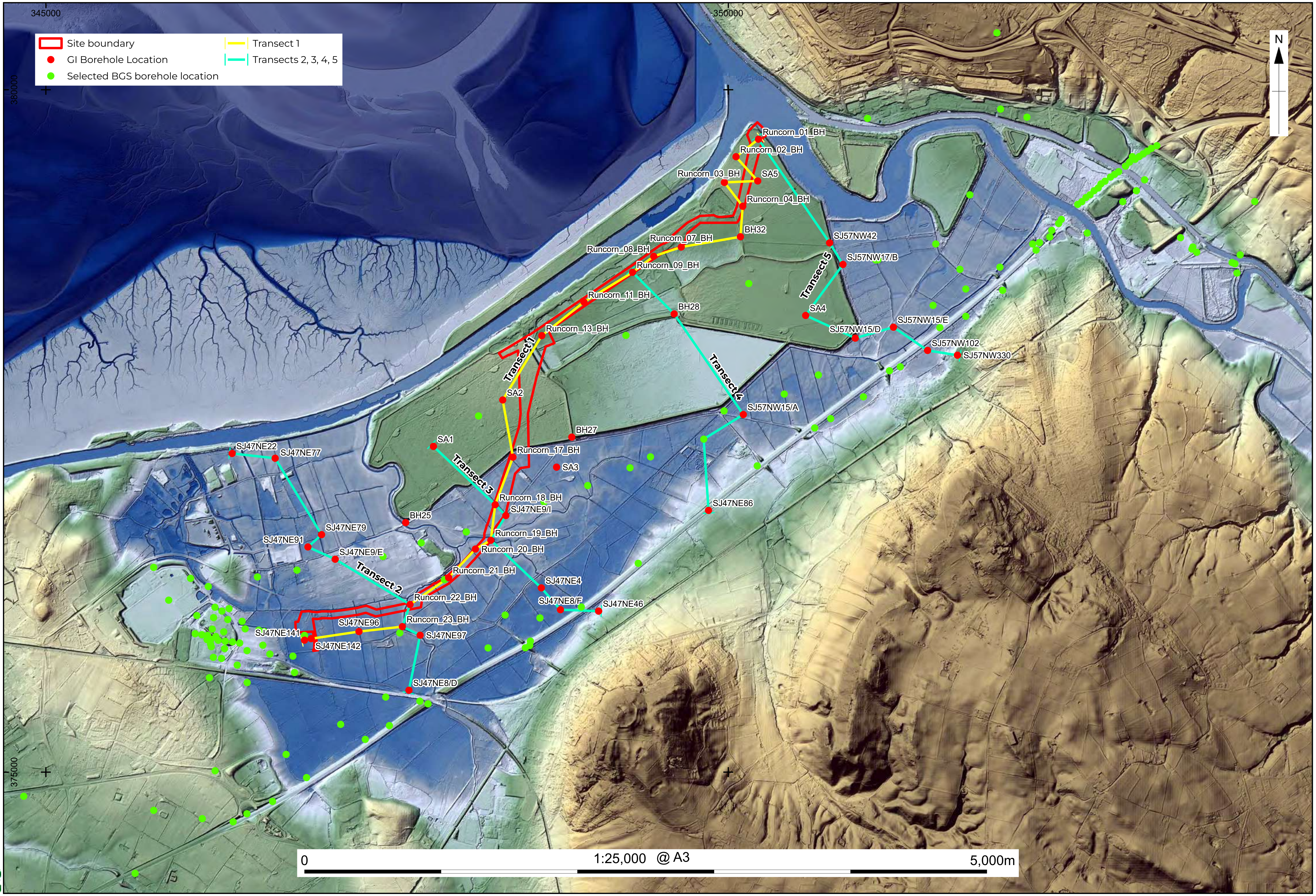


Figure 7: Transect and GI Borehole location

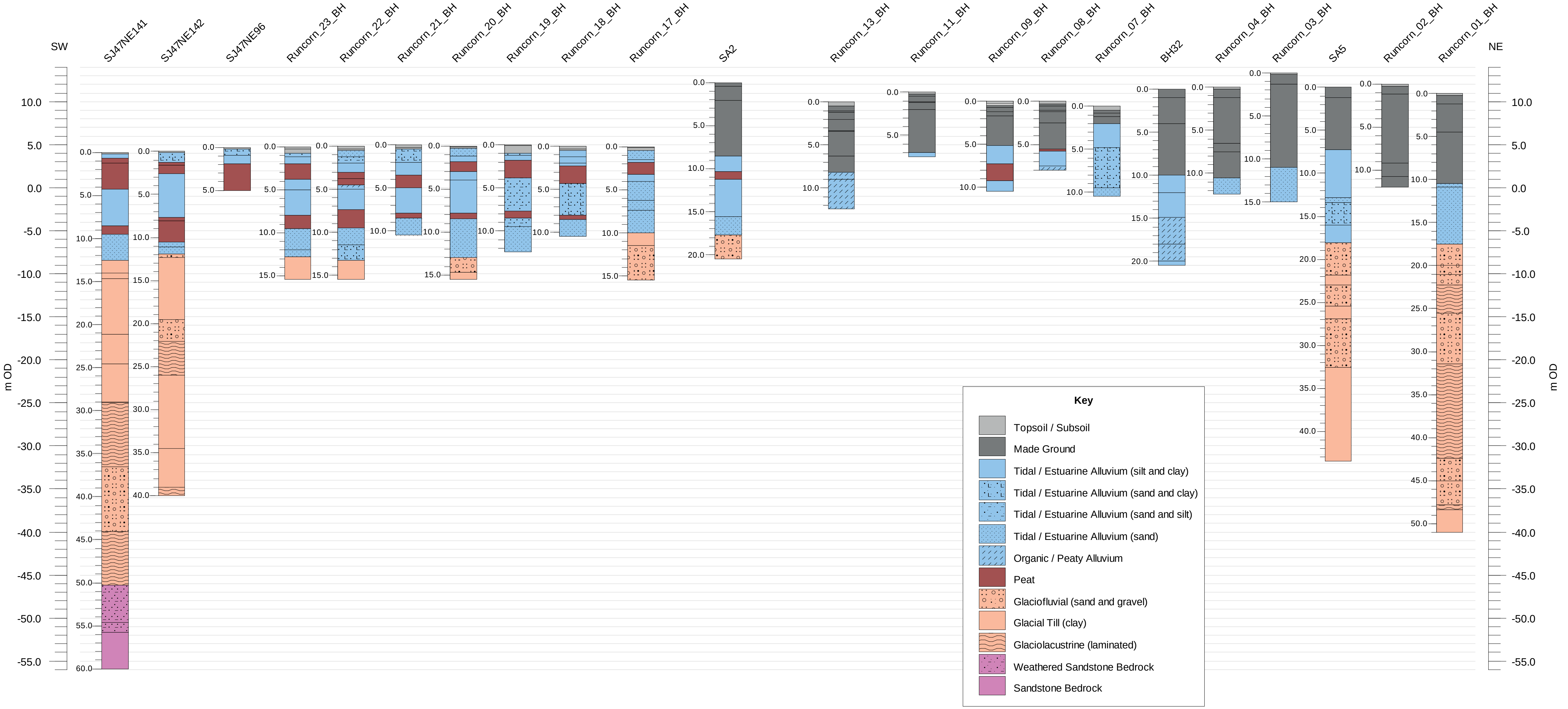


Figure 8: Litho-stratigraphic Transect 1

filelocation*sitecode*invoicecode*sitename*yourinitials*00.00.08

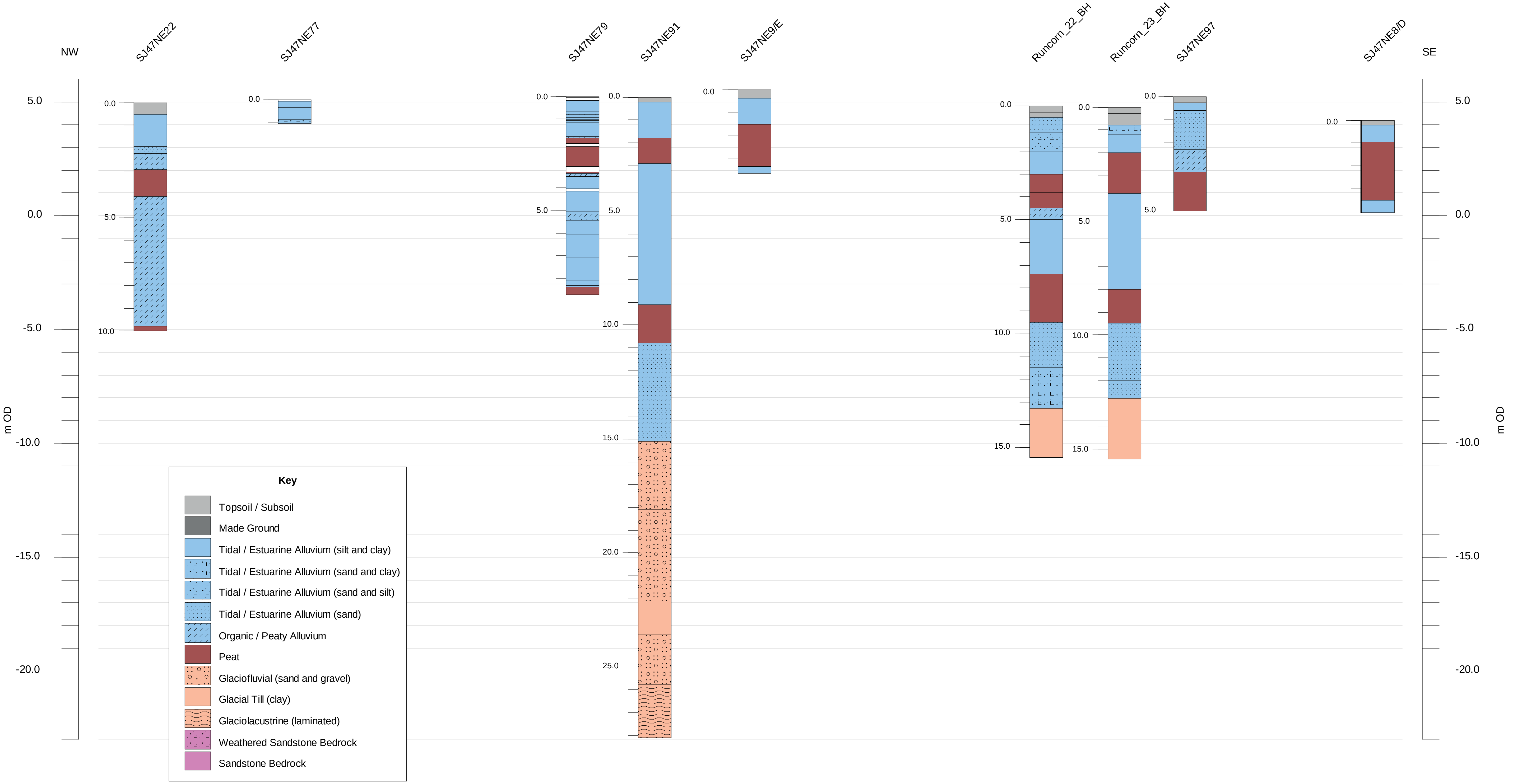


Figure 9: Litho-stratigraphic Transect 2

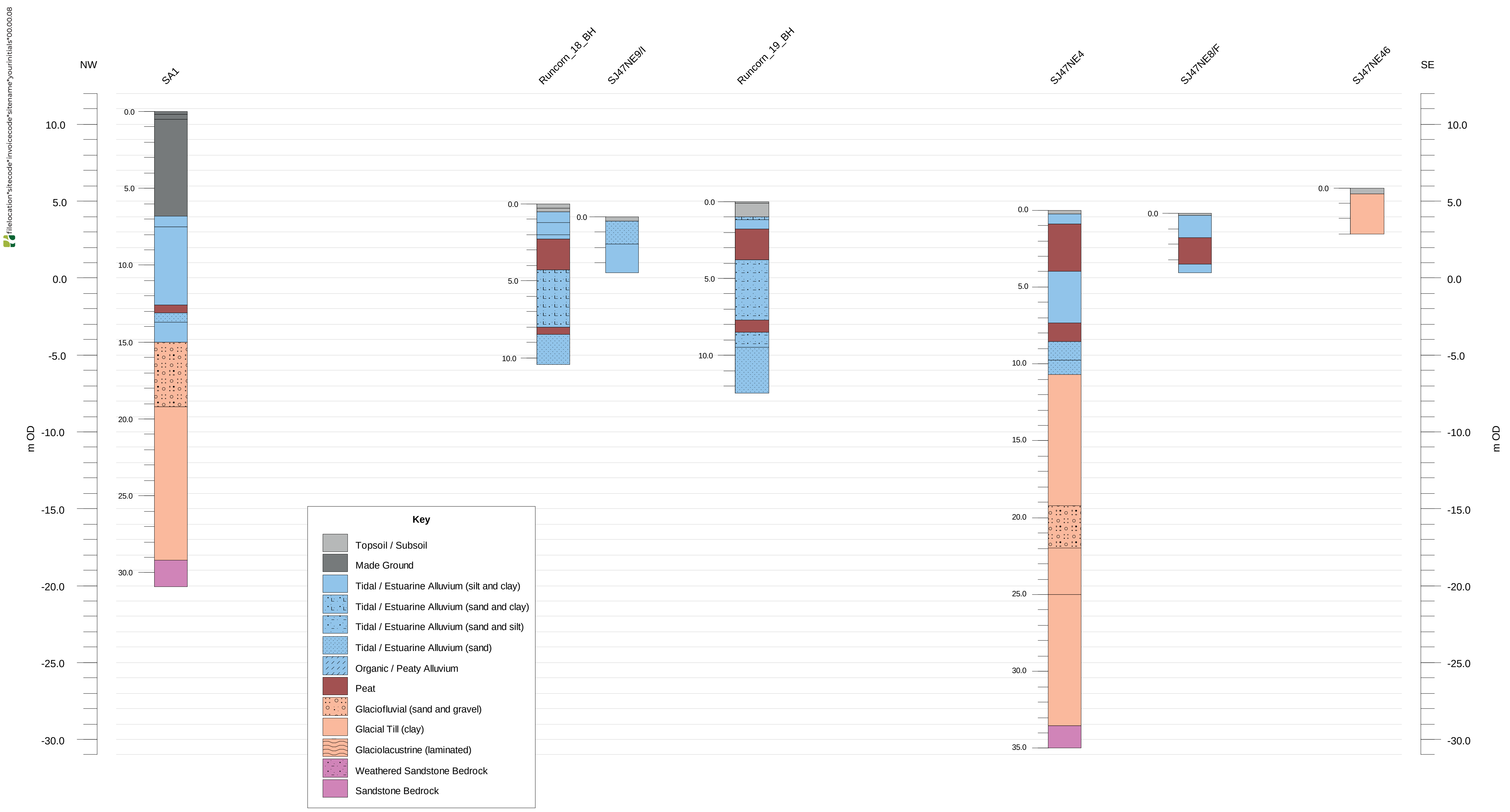


Figure 10: Litho-stratigraphic Transect 3

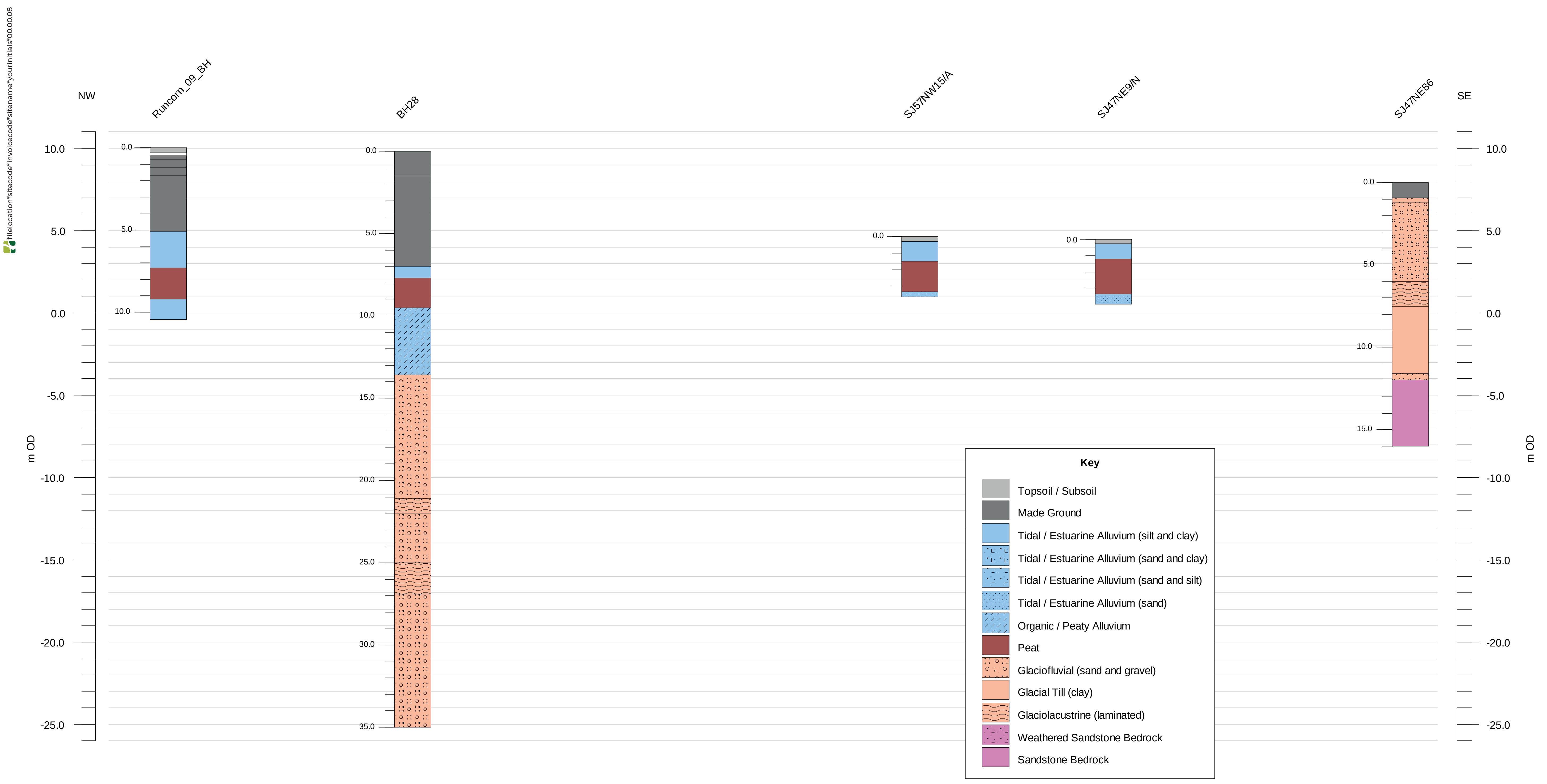


Figure 11: Litho-stratigraphic Transect 4

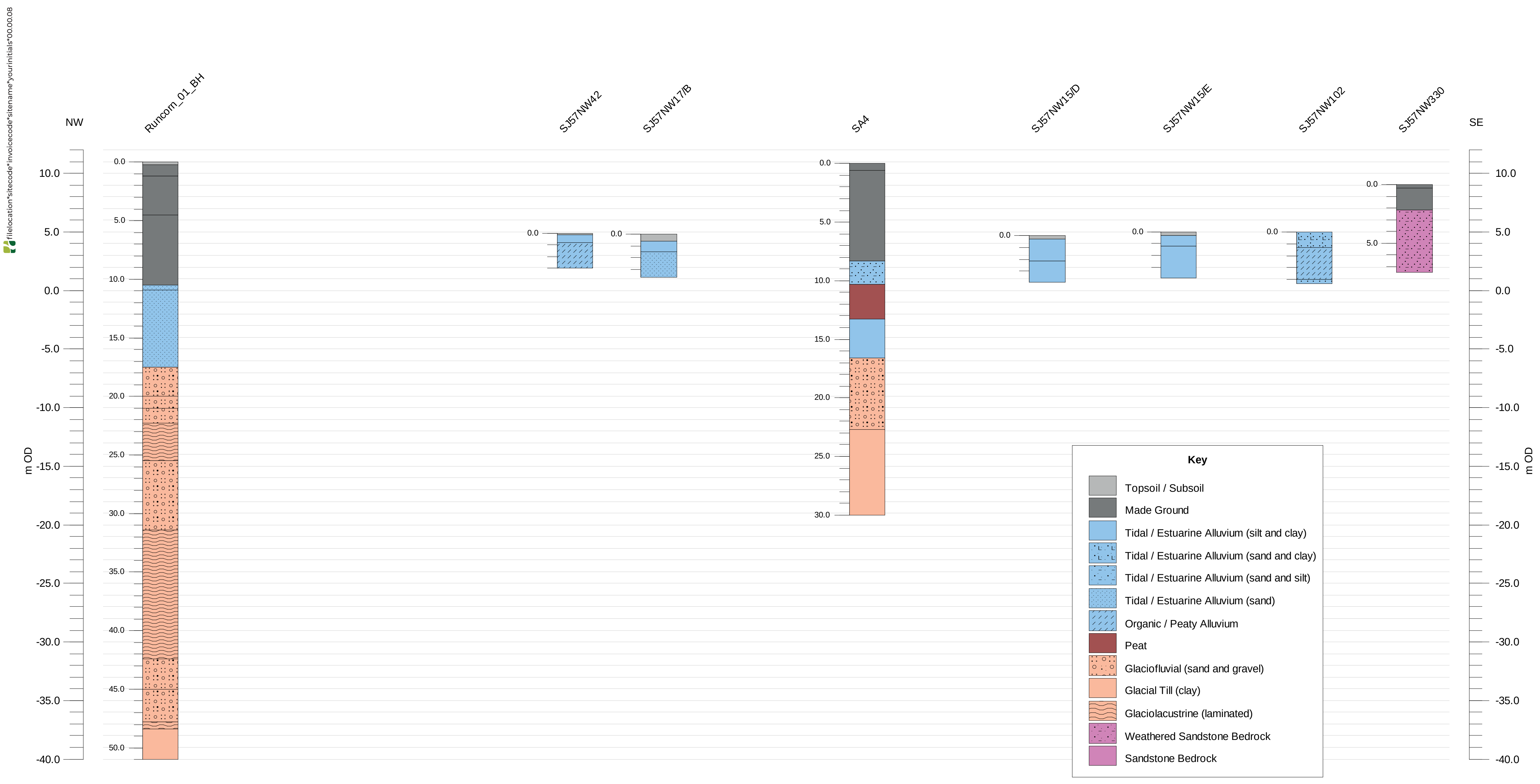


Figure 12: Litho-stratigraphic Transect 5

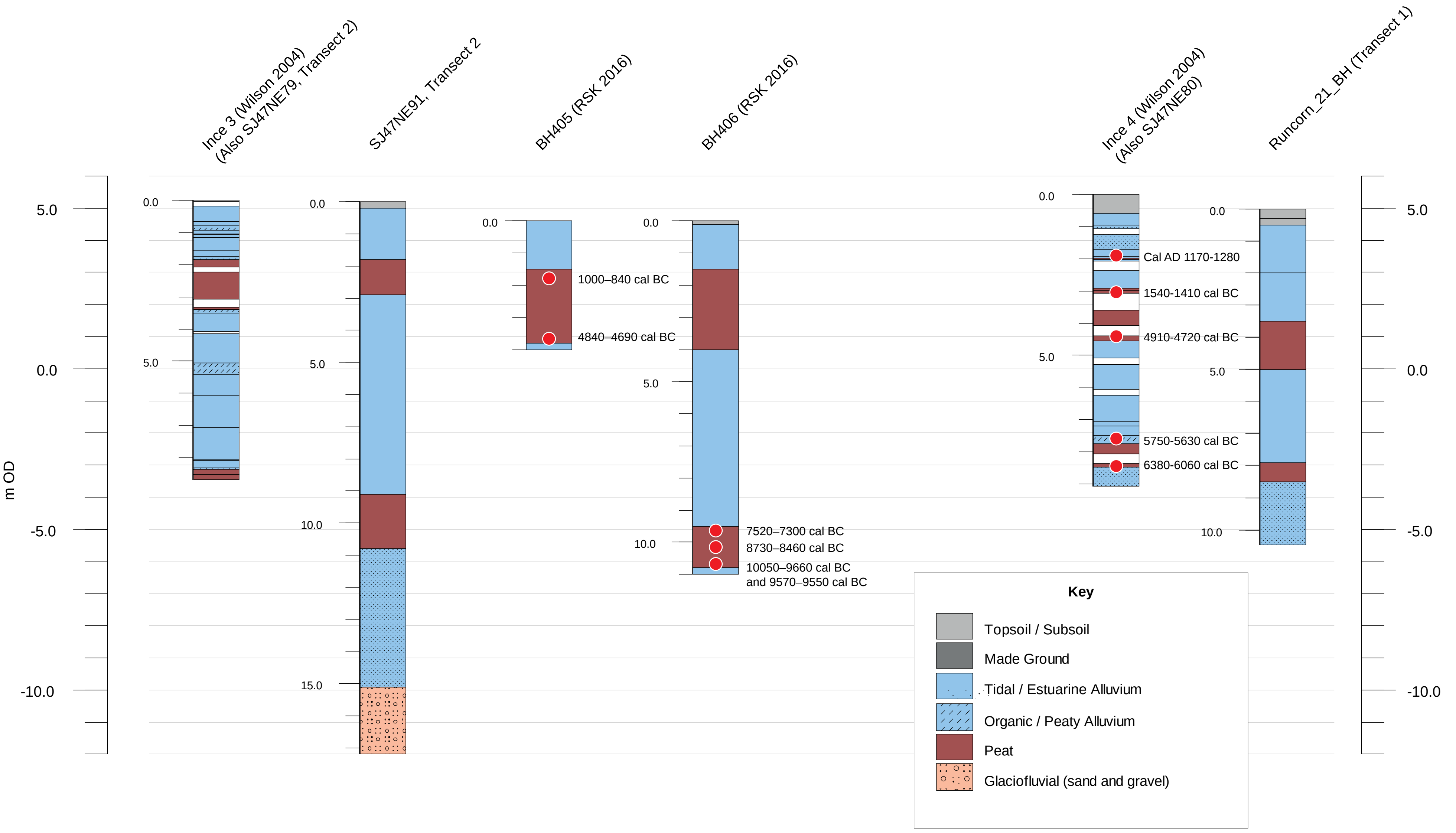


Figure 13: Comparison of previous radiocarbon calibrated dated sequences with selected boreholes from Transects 1 and 2

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Planning consultation: Proposed construction of a new carbon dioxide spur pipeline, an Above Ground Installation (AGI), plus ancillary works and equipment to serve Viridor Energy from Waste (EfW) Facility Carbon Capture Plant at Runcorn Carbon Dioxide Spur Pipeline

Thank you for your consultation on the above, dated and received by Natural England on 28 August 2025.

Natural England is a non-departmental public body. Our statutory purpose is to ensure that the natural environment is conserved, enhanced, and managed for the benefit of present and future generations, thereby contributing to sustainable development.

Summary of Natural England's advice
In summary, Natural England advises that insufficient information has been provided to inform the conclusions of the Habitats Regulations Assessment.

Further information is required to demonstrate that the proposed development will not impact on existing mitigation land for the Frodsham Wind Farm and/or have an in-combination impact on mitigation proposed as part of the Frodsham Solar Farm Development Consent Order which may impact on SPA bird populations outside of the designated sites.

Internationally and nationally designated sites
The application site is at its closet point within 100m of the Mersey Estuary Special Protection Area (SPA), Ramsar and Site of Special Scientific Interest (SSSI).

In considering the European site interest, Natural England advises that you, as a competent authority under the provisions of the Habitats Regulations, should have regard for any potential impacts that a plan or project may have. The Conservation Objectives for each European site explain how the site should be restored and/or maintained and may be helpful in assessing what, if any, potential impacts a plan or project may have.

Natural England has also published Conservation Advice Packages which provide additional detailed information on Marine Protected Areas.

Please see the subsequent sections of this letter for our advice relating to SSSI features.

Habitats Regulations Assessment (HRA)
Natural England notes that the HRA has not been produced by your authority, but by the applicant (Habitats Regulations Assessment, dated July 2025 by ENI). As competent authority, it is your responsibility to produce the HRA and be accountable for its conclusions. We provide the advice

enclosed on the assumption that your authority intends to adopt this HRA to fulfil your duty as competent authority.

Natural England notes that an appropriate assessment of the proposal has been undertaken in accordance with regulation 63 of the Conservation of Species and Habitats Regulations 2017 (as amended). Natural England is a statutory consultee on the appropriate assessment stage of the Habitats Regulations Assessment process, and a competent authority should have regard to Natural England's advice.

The appropriate assessment concludes that your authority is able to ascertain that the proposal will not result in adverse effects on the integrity of any of the sites in question.

Having considered the assessment, Natural England's advice is that the assessment is not sufficiently rigorous or robust to justify this conclusion. We advise that your authority should not adopt this HRA and that you should not grant planning permission at this stage.

We advise that the below additional work on the assessment is required to enable it to be sufficiently rigorous and robust. Natural England should be re-consulted once this additional work has been undertaken and the appropriate assessment has been revised.

Additional information required

Natural England's main concerns regarding this development relate to the potential for operational impacts of the section of pipeline that is planned within Cell 3 of the Frodsham dredging lagoons, this area is secured as mitigation land for SPA birds under the permission for the Frodsham Wind Farm (Cheshire West and Chester Council ref. 14/02525/DIS).

The HRA does not consider the operational impacts of the pipeline on the existing mitigation land or the habitats within the mitigation area that are being proposed by the Frodsham Solar Farm development which will overlap with the pipeline and therefore also has the potential for in-combination impacts. The extent of the in-combination issues needs to be fully considered within the HRA.

There is potential for the pipeline to impact on the hydrology of the mitigation area and so impact on the existing and planned wetland habitats which will secure alternative supporting habitat for SPA birds which are displaced due to a loss of functionally linked land as a result of the wind farm and the solar farm. The long-term impacts of the pipeline within this mitigation area and on the function of the supporting habitats needs to be considered within the HRA.

It is stated that soil stabilisation techniques will be required within Cells 1-4 to support the construction corridor and enable excavation of the pipeline trench and we welcome the description that the applicant has provided on this within the HRA. However, the impacts of the soil stabilisation requirements on wetland habitats within Cell 3 must be considered within the HRA. There is a concern regarding the pipeline and required soil stabilisation works to either block or alter the movement of water within Cell 3 and so limit the amount of suitable habitat for SPA birds.

It is also not clear how the timing of construction works will be aligned with the overlapping Frodsham Solar Farm development and secured. Information from the applicant of the solar farm suggests that the construction works for the spur pipeline may not come ahead of the solar farm and so all alternative scenarios should be considered within the HRA.

Noting that it has been some time since the HRA was submitted, we advise any recent updates as result of discussions with the solar farm applicants are updated within the HRA by the applicant and we ask that clarity is provided on any measures to secure construction timing.

Mersey Estuary SSSI
Our concerns regarding the potential impacts upon the SSSI coincides with our concerns regarding the potential impacts upon the international designated sites and so are set out above.

Please note that if your authority is minded to grant planning permission contrary to the advice in this letter, you are required under Section 28I (6) of the Wildlife and Countryside Act 1981 (as amended) to notify Natural England of the permission, the terms on which it is proposed to grant it and how, if at all, your authority has taken account of Natural England's advice. You must also allow a further period of 21 days before the operation can commence.

Other advice
Further general advice on the protected species and other natural environment issues is provided at Annex A.

If you have any queries relating to the advice in this letter, please contact me on the details below. For any new consultations, or to provide further information on this consultation please send your correspondences to consultations@naturalengland.org.uk.

Please consult us again once the information requested above, has been provided.

Yours sincerely,

[redacted]or Coastal Planning Casework
[redacted]cashire Area Team
aturalengland.org.uk

Annex A - Natural England general advice

Protected Landscapes
Paragraph 189 of the National Planning Policy Framework - GOV.UK (www.gov.uk) (NPPF) requires great weight to be given to conserving and enhancing landscape and scenic beauty within Areas of Outstanding Natural Beauty (known as National Landscapes), National Parks, and the Broads and states that the scale and extent of development within all these areas should be limited. Paragraph 190 requires exceptional circumstances to be demonstrated to justify major development within a designated landscape and sets out criteria which should be applied in considering relevant development proposals. Section 245 of the Levelling-up and Regeneration Act 2023 (legislation.gov.uk) places a duty on relevant authorities (including local planning authorities) to seek to further the statutory purposes of a National Park, the Broads or an Area of Outstanding Natural Beauty in England in exercising their functions. This duty also applies to proposals outside the designated area but impacting on its natural beauty.

The local planning authority should carefully consider any impacts on the statutory purposes of protected landscapes and their settings in line with the NPPF, relevant development plan policies and the Section 245 duty. The relevant National Landscape Partnership or Conservation Board may be able to offer advice on the impacts of the proposal on the natural beauty of the area and the aims and objectives of the statutory management plan, as well as environmental enhancement opportunities. Where available, a local Landscape Character Assessment can also be a helpful guide to the landscape's sensitivity to development and its capacity to accommodate proposed development.

Wider landscapes
Paragraph 187 of the NPPF highlights the need to protect and enhance valued landscapes through the planning system. This application may present opportunities to protect and enhance locally valued landscapes, including any local landscape designations. You may want to consider whether any local landscape features or characteristics (such as ponds, woodland, or dry-stone walls) could be incorporated into the development to respond to and enhance local landscape character and distinctiveness, in line with any local landscape character assessments. Where the impacts of development are likely to be significant, a Landscape and Visual Impact Assessment should be provided with the proposal to inform decision making. We refer you to the Guidelines for Landscape and Visual Impact Assessment (GLVIA3) - Landscape Institute for further guidance.

Biodiversity duty
Section 40 of the Natural Environment and Rural Communities Act 2006 (legislation.gov.uk) places a duty on the local planning authority to conserve and enhance biodiversity as part of its decision making. We refer you to the Complying with the biodiversity duty - GOV.UK (www.gov.uk) for further information.

Designated nature conservation sites
Paragraphs 193-195 of the NPPF set out the principles for determining applications impacting on Sites of Special Scientific Interest (SSSI) and habitats sites (Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)). Both the direct and indirect impacts of the development should be considered.

A Habitats Regulations Assessment is needed where a proposal might affect a habitat site (see Habitats regulations assessments: protecting a European site - GOV.UK (www.gov.uk) and Natural England must be consulted on 'appropriate assessments' (see Appropriate assessment - GOV.UK (www.gov.uk) for more information for planning authorities).

Natural England must also be consulted where development is in or likely to affect a SSSI and provides advice on potential impacts on SSSIs either via the SSSI Impact Risk Zones (England) (arcgis.com) or as standard or bespoke consultation responses. Section 28G of the Wildlife and Countryside Act 1981 places a duty on all public bodies to take reasonable steps, consistent with the proper exercise of their functions, to further the conservation and enhancement of the features for which an SSSI has been notified (Sites of special scientific interest: public body responsibilities - GOV.UK (www.gov.uk).

Air Quality

Natural England has produced *'Air pollution and development: advice for local authorities. How to assess sector-specific planning applications that could affect air quality on a protected site'.* This standing advice is to help planning authorities understand the impact on statutory protected sites from particular developments that emit specific air pollutants. The advice covers emissions of ammonia (NH_3), nitrogen oxides (NO, NO_2 or NO_x), nitrogen deposition, acid deposition and sulphur dioxide (SO_2).

The standing advice is Natural England's formal statutory advice and is a material consideration. It provides decision makers with the information needed to fulfil their statutory duties when making decisions on planning applications with potential air pollution impacts.

Note that this advice cannot be used to assess Nationally Significant Infrastructure Projects (NSIPs) or local plans.

Protected Species

Natural England has produced Protected species and development: advice for local planning authorities - GOV.UK (standing advice) to help planning authorities understand the impact of particular developments on protected species.

Natural England will only provide bespoke advice on protected species where they form part of a Site of Special Scientific Interest or in exceptional circumstances. A protected species licence may be required in certain cases. We refer you to Wildlife licences: when you need to apply (www.gov.uk) for more information.

Local sites and priority habitats and species

The local planning authority should consider the impacts of the proposed development on any local wildlife or geodiversity site, in line with paragraphs 187, 188 and 192 of the NPPF and any relevant development plan policy. There may also be opportunities to enhance local sites and improve their connectivity to help nature's recovery. Natural England does not hold locally specific information on local sites and recommends further information is obtained from appropriate bodies such as the local environmental records centre, wildlife trust, geoconservation groups or recording societies. Emerging Local nature recovery strategies - GOV.UK (www.gov.uk) may also provide further useful information.

Those habitats and species which are of particular importance for nature conservation are included as 'priority habitats and species' in the England Biodiversity List published under section 41 of the Natural Environment and Rural Communities Act 2006. Most priority habitats will be mapped either as Sites of Special Scientific Interest on the Magic website or as Local Wildlife Sites. We refer you to Habitats and species of principal importance in England (gov.uk) for a list of priority habitats and species in England. You should consider priority habitats and species when applying your 'biodiversity duty' to your policy or decision making

Natural England does not routinely hold priority species data. Such data should be collected when impacts on priority habitats or species are considered likely.

Consideration should also be given to the potential environmental value of brownfield sites, often found in urban areas and former industrial land. We refer you to the Brownfield Hub - Buglife for more information and Natural England's Open Mosaic Habitat (Draft) - data.gov.uk (Open Mosaic Habitat inventory), which can be used as the starting point for detailed brownfield land assessments.

Biodiversity and wider environmental gains

Development should provide net gains for biodiversity in line with the NPPF paragraphs 187(d), 192 and 193. Unless exempt major development (defined in the National Planning Policy Framework (publishing.service.gov.uk) glossary) is required by law to deliver a biodiversity gain of at least 10% from 12 February 2024 and this requirement was extended to minor development from April 2024. For nationally significant infrastructure projects (NSIPs), it is anticipated that the requirement for biodiversity net gain will be implemented from May 2026.

Biodiversity Net Gain guidance (gov.uk) provides more information on biodiversity net gain and includes a link to the Biodiversity Net Gain Planning Practice Guidance (gov.uk).

The statutory biodiversity metric should be used to calculate biodiversity losses and gains for terrestrial and intertidal habitats and can be used to inform any development project. We refer you to Calculate biodiversity value with the statutory biodiversity metric for more information. For minor development sites, The Small Sites Metric may be used where these sites meet the criteria to use this Small Sites Metric. This is a simplified version of the statutory biodiversity metric and is designed for use where certain criteria are met.

The mitigation hierarchy as set out in paragraph 193 of the NPPF should be followed to firstly consider what existing habitats within the site can be retained or enhanced. Where on-site measures are not possible, provision off-site will need to be considered.

Where off-site delivery of biodiversity gain is proposed on a special site designated for nature (e.g. a SSSI or habitats site) prior consent or assent may be required from Natural England. More information is available on Sites of Special Scientific Interest: managing your land

Development also provides opportunities to secure wider biodiversity enhancements and environmental gains, as outlined in the NPPF (paragraphs 8, 77, 109, 125, 187, 188, 192 and 193). Opportunities for enhancement might include incorporating features to support specific species within the design of new buildings such as swift or bat boxes or designing lighting to encourage wildlife.

The Environmental Benefits from Nature Tool - Beta Test Version - JP038 (naturalengland.org.uk) may be used to identify opportunities to enhance wider benefits from nature and to avoid and minimise any negative impacts. It is designed to work alongside the statutory biodiversity metric.

Natural environment - GOV.UK (www.gov.uk) provides further information on biodiversity net gain, the mitigation hierarchy and wider environmental net gain.

Ancient woodland, ancient and veteran trees

The local planning authority should consider any impacts on ancient woodland and ancient and veteran trees in line with paragraph 193 of the NPPF. The Natural England Access to Evidence - Ancient woodlands Map can help to identify ancient woodland. Natural England and the Forestry Commission have produced Ancient woodland, ancient trees and veteran trees: advice for making planning decisions - GOV.UK (www.gov.uk) (standing advice) for planning authorities. It should be considered when determining relevant planning applications. Natural England will only provide bespoke advice on ancient woodland, ancient and veteran trees where they form part of a Site of Special Scientific Interest or in exceptional circumstances.

Best and most versatile agricultural land and soils

Local planning authorities are responsible for ensuring that they have sufficient detailed agricultural land classification (ALC) information to apply NPPF policies (Paragraphs 187, 188). This is the case regardless of whether the proposed development is sufficiently large to consult Natural England. Further information is contained in the Guide to assessing development proposals on agricultural land - GOV.UK (www.gov.uk). Find open data - data.gov.uk on Agricultural Land Classification or use the information available on MAGIC (defra.gov.uk).

The Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (publishing.service.gov.uk) provides guidance on soil protection, and we recommend its use in the design and construction of development, including any planning conditions. For mineral working and landfilling, we refer you to Reclaim minerals extraction and landfill sites to agriculture - GOV.UK (www.gov.uk), which
provides guidance on soil protection for site restoration and aftercare. The Soils Guidance (quarrying.org) provides detailed guidance on soil handling for mineral sites.

Should the development proceed, we advise that the developer uses an appropriately experienced soil specialist to advise on, and supervise soil handling, including identifying when soils are dry enough to be handled and how to make the best use of soils on site.

Green Infrastructure
For evidence-based advice and tools on how to design, deliver and manage green and blue infrastructure (GI) we refer you to Green Infrastructure Home (naturalengland.org.uk) (the Green Infrastructure Framework). GI should create and maintain green liveable places that enable people to experience and connect with nature, and that offer everyone, wherever they live, access to good quality parks, greenspaces, recreational, walking and cycling routes that are inclusive, safe, welcoming, well-managed and accessible for all. GI provision should enhance ecological networks, support ecosystems services and connect as a living network at local, regional and national scales.

Development should be designed to meet the 15 GI How Principles (naturalengland.org.uk). The GI Standards can be used to inform the quality, quantity and type of GI to be provided. Major development should have a GI plan including a long-term delivery and management plan. Relevant aspects of local authority GI strategies should be delivered where appropriate.

The Green Infrastructure Map (naturalengland.org.uk) and GI Mapping Analysis (naturalengland.org.uk) are GI mapping resources that can be used to help assess deficiencies in greenspace provision and identify priority locations for new GI provision.

Access and Recreation:
Natural England encourages any proposal to incorporate measures to help improve people's access to the natural environment. Measures such as reinstating existing footpaths, together with the creation of new footpaths and bridleways should be considered. Links to urban fringe areas should also be explored to strengthen access networks, reduce fragmentation, and promote wider green infrastructure.

Rights of Way, Access land, Coastal access and National Trails:
Paragraphs 105, 185, 187 and 193 of the NPPF highlight the important of public rights of way and access. Development should consider potential impacts on access land, common land, rights of way and coastal access routes in the vicinity of the development.

Consideration should also be given to the potential impacts on any nearby National Trails. We refer you to Find your perfect trail, and discover the land of myths and legend - National Trails for information including contact details for the National Trail Officer.

The King Charles III England Coast Path (KCIIIECP) is a National Trail around the whole of the English Coast. It has an associated coastal margin subject to public access rights. Parts of the KCIIIECP are not on Public Rights of Way but are subject to public access rights. Consideration should be given to the impact of any development on the KCIIIECP and the benefits of maintaining a continuous coastal route.

Appropriate mitigation measures should be incorporated for any adverse impacts on Rights of Way, Access land, Coastal access, and National Trails.

Further information is set out in the Planning Practice Guidance on the Natural environment - GOV.UK (www.gov.uk).

60. Mersey Valley

Appendix E (WR) NCA 60
Mersey Valley

www.naturalengland.org.uk

NATURAL ENGLAND

Introduction

As part of Natural England's responsibilities as set out in the Natural Environment White Paper[1], Biodiversity 2020[2] and the European Landscape Convention[3], we are revising profiles for England's 159 National Character Areas (NCAs). These are areas that share similar landscape characteristics, and which follow natural lines in the landscape rather than administrative boundaries, making them a good decision-making framework for the natural environment.

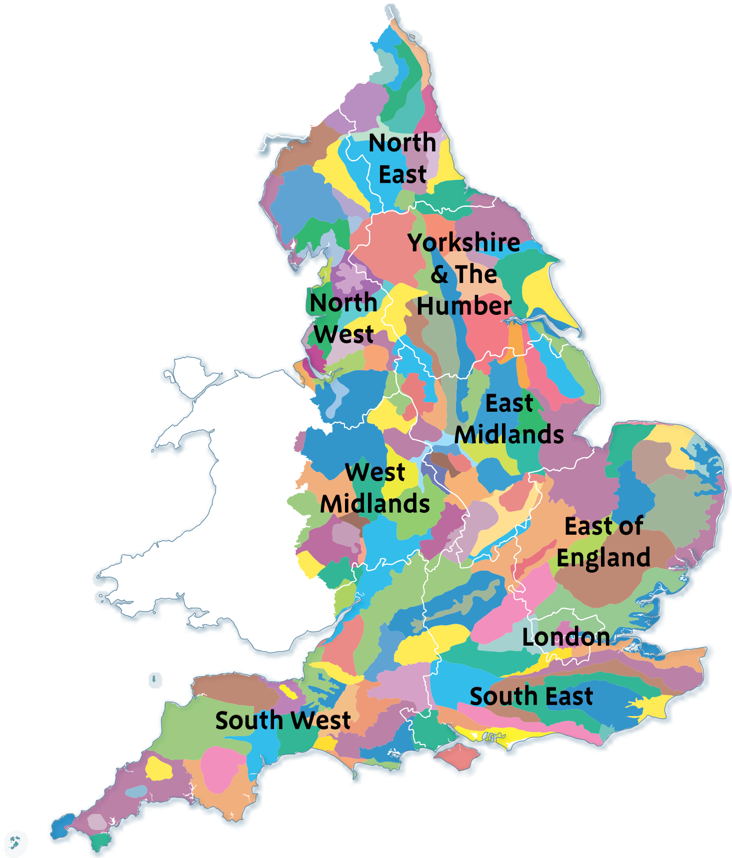
NCA profiles are guidance documents which can help communities to inform their decision-making about the places that they live in and care for. The information they contain will support the planning of conservation initiatives at a landscape scale, inform the delivery of Nature Improvement Areas and encourage broader partnership working through Local Nature Partnerships. The profiles will also help to inform choices about how land is managed and can change.

Each profile includes a description of the natural and cultural features that shape our landscapes, how the landscape has changed over time, the current key drivers for ongoing change, and a broad analysis of each area's characteristics and ecosystem services. Statements of Environmental Opportunity (SEOs) are suggested, which draw on this integrated information. The SEOs offer guidance on the critical issues, which could help to achieve sustainable growth and a more secure environmental future.

NCA profiles are working documents which draw on current evidence and knowledge. We will aim to refresh and update them periodically as new information becomes available to us.

We would like to hear how useful the NCA profiles are to you. You can contact the NCA team by emailing ncaprofiles@naturalengland.org.uk

National Character Areas map



[1] The Natural Choice: Securing the Value of Nature, Defra (2011; URL: www.official-documents.gov.uk/document/cm80/8082/8082.pdf)
[2] Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services, Defra (2011; URL: www.defra.gov.uk/publications/files/pb13583-biodiversity-strategy-2020-111111.pdf)
[3] European Landscape Convention, Council of Europe (2000; URL: http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm)

Summary

The Mersey Valley National Character Area (NCA) consists of a wide, low-lying river valley landscape focusing on the River Mersey, its estuary, associated tributaries and waterways. It is a varied landscape that extends from the mosslands near the Manchester Conurbation NCA in the east, to the Merseyside Conurbation NCA and the wide estuary with intertidal mudflats/sand flats and salt marsh in the west. The River Mersey is tidal from Howley Weir in Warrington. The area encompasses a complex mix of extensive industrial development and urban areas, with high-quality farmland in between.

Farmland in the north of the Mersey Valley NCA is predominantly arable, while in the south there is a mix of arable and pasture. Field pattern is regular and large scale, often defined by degraded hedgerows with isolated hedgerow trees. In the east, open, flat farmland is found on the rich, dark peaty soils of the former mosses, with a complex network of drainage ditches.

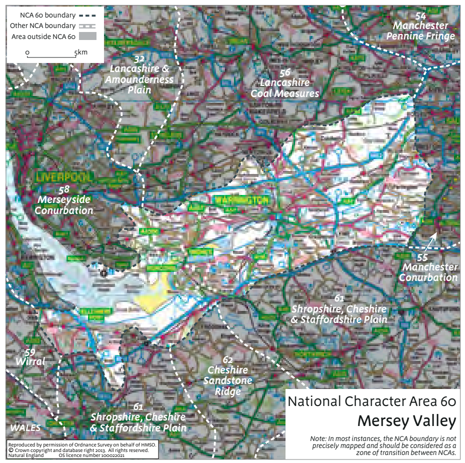
Urban and industrial developments line the banks of the River Mersey. Industrial infrastructure is often prominent, with large-scale, highly visible development including chemical works and oil refineries. The Manchester Ship Canal links the estuary to the heart of Manchester, perpetuating the industrial development of the area. There is a dense communication network of major roads, railways, canals and transmission lines. The urban and suburban areas provide housing for those working in neighbouring conurbations, as well as in the industries of the Mersey Valley.

The Mersey Estuary's extensive intertidal mudflats/sand flats and fringing salt marshes sustain internationally significant bird populations. There are remnant pockets of lowland raised bog, including the Manchester Mosses Special Area of Conservation, centring on a once extensive area of mossland. Rixton Clay Pits are a mosaic of pools and other habitats, with an internationally designated population of great crested newts.

The habitats around the rivers and the estuary provide a natural defence against flooding. Positive management of the area's organic soils and wetlands such as lowland raised bogs could result in significant gains in carbon sequestration. Local Nature Reserves and country parks offer opportunities for people to enjoy the natural environment.

Key challenges include integrating the development pressures associated with the towns, industry and transport, with the protection and enhancement of the landscape and the internationally significant habitats. Understanding, planning for and adapting to climate change, particularly in the dynamic estuary and river environment, is a further challenge. There are opportunities for providing accessible greenspace and recreational provision, as well as improving habitat quality and distribution. Other benefits could include providing better water quality and storage, minimising soil erosion and increasing carbon storage. All these can strengthen landscape resilience and adaptation to climate change.

Click map to enlarge; click again to reduce.



Part of a relict mossland on a farm in Glazebury, which has been restored under environmental stewardship.

Statements of Environmental Opportunity

- **SEO 1**: Conserve and enhance the Mersey Valley's rivers, tributaries and estuary, improving the ability of the fluvial and estuarine systems to adapt to climate change and mitigate flood risk while also enhancing habitats for wildlife and for people's enjoyment of the landscape.

- **SEO 2**: Promote the Mersey Valley's historic environment and landscape character and positively integrate the environmental resource with industry and development, providing greenspace within existing and new development, to further the benefits provided by a healthy natural environment, as a framework for habitat restoration and for public amenity.

- **SEO 3**: Manage the arable and mixed farmland along the broad linear Mersey Valley, and create semi-natural habitats, woodlands and ecological networks, to protect soils and water, enhance biodiversity, increase connectivity and improve the character of the landscape, while enabling sustainable food production.

- **SEO 4**: Manage and enhance the mossland landscape in the east, safeguarding wetlands including the internationally important lowland raised bogs, to conserve peat soils, protect and enhance biodiversity, conserve archaeological deposits, contribute to landscape character and store carbon.

Description

Physical and functional links to other National Character Areas

The Mersey Valley and Merseyside Conurbation National Character Areas (NCAs) lie within the same river basin and share a similar ecological character. The River Mersey forms a central, low-lying area and a corridor of movement for wildlife. The Mersey Estuary, an area of transition from marine to freshwater habitats, supports marine, subtidal and terrestrial maritime species. The significant mosaic of remnant mosses to the west of Manchester forms an important corridor of wetland habitats, linking with the Lancashire Coal Measures NCA in the north.

The River Mersey starts at the confluence of the River Tame and the River Goyt in the Manchester Conurbation NCA. It flows west, passing through Warrington where the river becomes tidal. It widens to form the upper Mersey Estuary between Warrington and Runcorn. The Mersey Estuary continues towards the Merseyside Conurbation NCA, and flows into Liverpool Bay in the Irish Sea. The Mersey Estuary Special Protection Area (SPA) and Ramsar site crosses both the Mersey Valley and the Merseyside Conurbation NCAs.

There are expansive views available from open and elevated land and the Mersey Estuary. In the west of the NCA, the Mersey is estuarine in character with intertidal mudflats/sand flats, salt marsh and low exposed cliffs. This creates an almost flat landscape with broad panoramic views. The vast industrial developments at Runcorn dominate views from across the Shropshire, Cheshire and Staffordshire Plain and the Cheshire Sandstone Ridge NCAs and from the M56 motorway. To the west of Runcorn, the valley widens out and intertidal areas, along with neighbouring NCAs, become more evident. In contrast, views from urban areas are typically limited by the relative flatness of the flood plain.

The Mersey Valley and Merseyside Conurbation NCAs share a number of major communication routes, with roads, rail and electricity power lines crossing the area. Motorway and mainline railway networks are dominant features of the landscape as major east–west and north–south infrastructure routes cross, for example the M6, M56 and M62. There a number of significant waterways, including the Manchester Ship Canal. Many of the settlements provide housing for those working in the Merseyside and Manchester conurbations, as well as in the industries of the Mersey Valley.

Expansive views from open and elevated land, including intertidal mud/sand flats and saltmarsh in the Mersey Estuary. The vast industrial developments at Runcorn dominate many views.

Key characteristics

- The landscape is low-lying, focusing on the broad linear valley of the River Mersey; it is estuarine in the west and has extensive areas of reclaimed mossland in the east.
- Underlain by Triassic sandstone, the surface geology is principally drift material: marine and river alluvium in the valley bottom, extensive areas of till, pockets of glacial sands and gravels, with peat in some drainage hollows.
- The Mersey Estuary is a defining element in the landscape, with expansive intertidal mudflats/sand flats and low exposed cliffs.
- The River Mersey flows from east to west, joined by associated tributaries, although the Mersey itself is often obscured from view.
- Trees and woodland are mainly associated with settlements, occasional parkland and isolated woodland blocks; and in recent years new community woodlands have been planted.
- Large-scale, open, predominantly flat, high-quality farmland occurs between developments, with primarily arable farming to the north of the valley and a mixture of arable and dairying to the south.
- The field pattern is regular and large scale, often defined by hedgerows with isolated hedgerow trees; many hedgerows are intermittent and have been replaced by post-and-wire fencing, while field boundaries on the mosses are marked by ditches.
- A range of important wetland habitats remain, including estuarine mudflats/sand flats and fringing salt marshes in the west, remnants of semi-natural mosslands and pockets of basin peats in the east, with the broad river valley in between.
- The predominant building material is red brick though some sandstone construction remains, and some survival of earlier timber frame.
- There are densely populated urban and suburban areas, with major towns particularly at the river crossings, including Runcorn, Widnes and Warrington.
- There is large-scale, highly visible industrial development, with docks, chemical works and oil refineries.
- The river valley has a dense communication network with motorways, roads, railways and canals running east–west, and power lines are also prominent.

The Mersey Valley today

The Mersey Valley NCA consists of a wide, low-lying river valley landscape focusing on the River Mersey, its estuary, associated tributaries and waterways, although the Mersey itself is often obscured from view. It is a varied landscape that extends from the Merseyside Conurbation NCA and the wide Mersey Estuary in the west, to the flat mosslands near the Manchester Conurbation NCA in the east. The area encompasses a complex mix of extensive industrial development and urban areas, with high-quality farmland in between.

This is an area defined largely by its generally low-relief topography, with an average elevation of just 23 m, rising locally to 144 m towards the Cheshire Sandstone Ridge NCA. The south side of the valley slopes more steeply than the north. The River Mersey flows from east to west, forming a central, low-lying area.

The River Mersey is a defining element in the landscape, having created the valley landform and contributed to the area's industrial and settlement history. Throughout the area the river is heavily controlled with high levee banks and course straightening. Downstream of Howley Weir in Warrington, the Mersey is tidally influenced, flowing into a large sheltered estuary on the Irish Sea coast. The Mersey Estuary has extensive intertidal mudflats and sand flats, which are exposed at low tide, and fringing salt marshes. The rising and falling of the tide make this a dynamic landscape, as the nature of views is constantly changing. The River Mersey itself, however, is often obscured, inaccessible, and blocked from view by industry. In Ellesmere Port, for example, it is barely obvious at all that the town is situated on the Mersey.

The Mersey Valley has a dense communication network, crossed by roads, motorways and power lines.

Areas of generally high-quality agricultural land are intermixed between urban and industrial development. Two substantial bands of farmland follow the slopes of the Mersey Valley, though these are often fragmented at the periphery of urban and industrial developments. To the north of the Mersey, the farmland has a large-scale, open character dominated by arable fields. To the south, the area is a mix of arable and dairying. In the east of the Mersey Valley, open, flat farmland occurs on the rich, dark peaty soils of the former mosses. A few small remnants of semi-natural mossland vegetation remain, but in general this is a highly cultivated landscape dissected by a complex network of drainage ditches. The diversity of farmland provides a significant habitat for farmland birds.

Large-scale, open, predominantly flat farmland is interspersed between development and densely populated urban and suburban areas.

The field pattern is generally regular and large-scale, but within an inherited framework of earlier irregular boundaries. Fields are often defined by hedges with isolated hedgerow trees. Many of the hedgerows are intermittent and have been replaced by post-and-wire fencing. Ditches form the field boundaries on the mosses.

Trees and woodland are mainly associated with settlements. There are some trees along field boundaries and watercourses, and isolated woodland blocks particularly in the east. In recent years new community woodlands have been created, adding to the greenspace resource for local people and improving the image of the area. The area is covered by Mersey Forest and Red Rose Forest community forests, together providing a network of green spaces, woodlands and street trees and creating high-quality environments.

The Mersey Valley NCA is particularly important for the concentration of lowland fens and lowland raised bogs. While most mossland has been converted to agriculture or lost to development, several examples have survived as degraded raised bog on the Mersey flood plain. This centres on the once extensive area of mossland known as Chat Moss. Risley Moss, Astley and Bedford Mosses and Holcroft Moss form the internationally recognised Manchester Mosses Special Area of Conservation (SAC). The intertidal mudflats/sand flats, salt marshes and rocky shores of the Mersey Estuary provide feeding and roosting sites for internationally significant bird populations, with extensive areas designated as a Ramsar site and an SPA. The Atlantic salmon has begun to return to the River Mersey and its tributaries. There are large areas of flood plain grazing marsh habitat in the area, notably at Frodsham, Helsby, Ince Marshes and Gowy Meadows, providing habitats for wading birds, amphibians and mammals.

Rixton Clay Pits are parts of an extensive disused brickwork quarry excavated in glacially derived clay deposits. Extraction of clay has left a mosaic of pools surrounded by diverse habitats including species-rich grassland, scrub and woodland. Here, among the amphibians common frog, common toad and smooth newt, is an internationally important breeding population of great crested newts, and the area has been designated as an SAC. Other wetland sites include Woolston Eyes Site of Special Scientific Interest (SSSI), where lagoons set aside to receive dredging from the Manchester Ship Canal form large areas of open water, reedbed and scrub vegetation. The site is nationally important for wintering wildfowl and supports a diverse breeding bird assemblage.

The character of this landscape has been highly influenced by the urban and industrial developments lining the banks of the River Mersey. The high density of urban areas has led to landfill developments appearing in the landscape. Artificial deposit grounds are also visible, such as ash lagoons at Fiddlers Ferry. Industrial infrastructure is often prominent, with large-scale, highly visible development including docks, chemical works and oil refineries. Notable landmarks are typically represented by infrastructure such as Runcorn Bridge, the Manchester Ship Canal, expansive industrial sites and Fiddlers Ferry Power Station. The cumulative effect is a complex mix of industrial and urban areas, intermingled with high-quality farmland and the estuary.

The area is densely populated with the towns of Warrington, Widnes, Runcorn, Ellesmere Port, Frodsham and Irlam, as well as some extensive villages such as Culcheth and Lymm, often providing housing for commuters to Liverpool and Manchester. Urban areas are often interspersed with greenbelt. The predominant building material is brick, although traditional red sandstone construction survives in limited areas, as well as extremely rare examples of timber-framed construction. Welsh slate and clay tile roofs can be found. While the older housing stock is characterised by red brick building materials, with some earlier timber frame, the proliferation of materials in more recent development has created an overall disjointed character associated with a mix of building styles.

The majority of the NCA has low levels of tranquillity, with the comparatively highest tranquillity levels being found in the Mersey Estuary, and around the mosslands towards Manchester.

The Mersey Valley has a dense communication network running both east to west and north to south, with major motorways, roads, railways and canals. The Manchester Ship Canal runs roughly parallel with the Mersey from Eastham, on the southern shore of the Mersey Estuary, almost to the centre of Manchester. The Bridgewater Canal crosses the Mersey Valley, creating a recreational link with the neighbouring urban areas of Manchester to the east and Leigh to the north, and meets with the Manchester Ship Canal at Runcorn Dock. The Shropshire Union Canal and Leeds and Liverpool Canal also pass through this NCA, while the route of the former Sankey Canal runs through Warrington to the Mersey Estuary at Runcorn. The River Weaver is navigable in its lower reaches. The area is crossed by transmission lines such as those radiating out from Fiddlers Ferry Power Station. A number of major roads cross the area, including the M6, M56 and M62 motorways. The West Coast Main Line crosses this NCA, while a large part of this area is occupied by Liverpool Airport. Recreational trails also serve to connect people, including the long-distance footpaths of the Trans Pennine Trail, Sandstone Trail and Mersey Way.

Recreation is supported by the area's rights-of-way network. The large populations locally, both within the towns of the Mersey Valley and the two adjacent conurbations, have access to the canal network, local nature reserves and country parks, as well as more formal facilities such as golf courses. There are also parklands such as Dunham Massey Park, Castle Park (Frodsham) and Walton Hall Gardens.

The landscape through time

The solid geology of the Mersey Valley is dominated by red sandstones and mudstones of Triassic age (248–205 million years old) that underlie virtually the entire area. To the south of the River Mersey, the landform is a series of low, but prominent, sandstone ridges. These harder, coarse, red sandstones outcrop along the Mersey Valley between Lymm and Runcorn. They also form prominent cuesta features that overlook the towns of Frodsham and Helsby. Pebbles are scattered through the sequence and include the well-known Chester Pebble Beds. Mudstones of the Triassic Mercia Mudstone Group underlie much of the land to the north of the Mersey Estuary and east to Warrington. The Permo-Triassic sandstone forms an important aquifer, providing public and private water supplies to towns, farms and industry.

Surface outcrops of the underlying geology are rare and the majority of the Mersey Valley is mantled by thick deposits of till and pockets of Quaternary-age sand and gravel that formed in and beneath glaciers and ice sheets. During the last glacial advance, ice deposited till, sands and gravels over much of the Mersey area. Also associated with the glacial advance are deposits of fine, wind-transported silt known as loess. Brick earth deposits are a notable feature near Rixton. An important feature in the east of the Mersey Valley is the occurrence of peat where mosslands developed in drainage hollows in the early post-glacial period. They are most common on the western fringe of Manchester and include areas such as Chat Moss.

The Mersey Valley has historically formed a natural frontier zone with the Mersey channel providing a natural barrier of water, tidal flats and marshland. The valley may also have formed a provincial boundary during the Roman period and possibly a tribal frontier even earlier. This frontier land once contained many fortifications, most of which have been lost to modern industrial development.

Frodsham Road and Railway Cuttings Site of Special Scientific Interest; a sequence of sandstones representing the upper part of the Triassic Helsby Sandstone Formation.

Prehistoric settlement appears to have been located close to the River Mersey, or its tributaries, on minor promontories, which in the east avoided the areas of mossland. A Roman industrial settlement was established at Wilderspool, Warrington, at a convenient crossing point across the Mersey, and a Roman road running between Northwich and Wigan crossed the Mersey Valley at this point.

During the medieval period, the route of the Roman road continued to be used and the area contained several medieval moated sites, while medieval towns were established at Warrington, Halton, Hale and Widnes.

There are a number of significant waterways including the Manchester Ship Canal.

Ancient enclosures are poorly represented, with scattered examples most notable to the east, between Warrington and Urmston. For the most part, the area is characterised by successive changes to the underlying pattern of ancient fields – improvements and modifications in the 18th, 19th and 20th centuries matched to urban demands. The resulting pattern is predominantly arable to the north of the River Mersey and mixed with dairying to the south. In the late 18th century and 19th century, the regular pattern of enclosed fields, found to the south of the Bridgewater Canal and extending south into the Cheshire Plain, resulted from estate improvements and the intensification of the cheese industry – a defining feature of the Cheshire Plain. Agricultural expansion to feed the growing population in Manchester started to have an impact on the mosses in the late 18th century.

The River Mersey was first made navigable between Manchester and Warrington in the early 18th century. Sections of the River Weaver were also made navigable in the 18th century. The earliest canals in the area were constructed from the mid-18th century. The Bridgewater Canal was constructed to enable coal from a mine at Worsley, along with other goods, to be transported efficiently and cheaply to the rapidly expanding towns and cities.

In the 19th century, ports connected to the canal system were established at Runcorn, Widnes and Ellesmere Port. The railway network linking Manchester and Liverpool opened in 1830. The Manchester Ship Canal, built between 1887 and 1894, allowed seagoing vessels to navigate from Ellesmere Port to the newly constructed docks at Salford.

Also in the 19th century, the industrial development of ship-building, engineering, tanning and the manufacture of soap and alkali were established at Runcorn; and chemical factories at Widnes. The proximity of the Lancashire coalfields to the north and the salt and ore deposits of the Cheshire Plain to the south allowed the areas around Runcorn, Widnes and Warrington to become the focus for major chemical industries, steel and wire works, textiles, tanning and breweries.

Many of the mosslands were reclaimed for arable land in the 20th century. When it became technically feasible to drain the bogs, peat cutting was carried out on a larger scale and, with the addition of manure or fertiliser, conversion to arable farmland also became a viable option. By the early part of the 20th century, very little peat bog remained unaltered. Elsewhere, hedgerows have suffered through field expansion, neglect, and replacement with post-and-wire fencing.

During the 20th century, the manufacture of chemicals remained a significant industry. The focus of the chemical industry became Runcorn, while at Widnes many former chemical plants were redeveloped for new industrial uses. New industries in light manufacturing, new technology and oil refining were also established in the Mersey Valley. There is evidence of anti-aircraft gun sites defending the Mersey Valley and the conurbations during the Second World War. The ordnance works at Risley formed a large military establishment. Cold War sites include nuclear bunkers and the vast US Army depot at Burtonwood.

In the 20th century, residential development saw significant expansion. The populations of Runcorn and Warrington doubled in the latter part of the 20th century following the construction of new towns in both of these settlements. The rapid expansion and industrial background of many of the towns have limited the potential for historic character to influence the appearance of urban areas. A network of motorways and large roads has been constructed to serve the major towns and industrial areas and link the neighbouring conurbations. Heavy industry declined in the 1970s and 1980s but the growth of the new towns led to a great increase in employment in light industry, distribution and technology.

In the 21st century, the area continues to be a focus for industrial and housing development, as well as new and upgraded transport routes. Liverpool Airport has expanded, with the completion of a new passenger terminal in 2002. Construction on the new 2 km-long Mersey Gateway crossing between Runcorn and Widnes starts in 2014. The loss and decline of mosslands have largely halted and there have been significant areas brought into conservation management.

Industrial infrastructure is often prominent, with large-scale, highly visible, development including chemical works and oil refineries lining the banks of the Mersey.

Ecosystem services

The Mersey Valley NCA provides a wide range of benefits to society. Each is derived from the attributes and processes (both natural and cultural features) within the area. These benefits are known collectively as 'ecosystem services'. The predominant services are summarised below. Further information on ecosystem services provided in the Mersey Valley NCA is contained in the 'Analysis' section of this document.

Provisioning services (food, fibre and water supply)

- **Food provision:** To the north of the River Mersey, agriculture is dominated by arable cultivation and to the south pasture becomes more frequent, with mixed farming (arable and dairying) predominating. On the dark, rich peaty soils of the former mosses, farming is mixed. Over 30 per cent of this NCA is Grade 1 or Grade 2 agricultural land. Sustainable agricultural practices can contribute to the production of high-quality food.

- **Biomass energy:** There may be some opportunities within the Mersey Valley NCA for both short rotation coppice (SRC) and miscanthus to be accommodated without significant landscape effects, due to the low-lying valley character, the complex land use pattern including arable and mixed farmland, and the existing urban influence on the landscape. Power stations locally are exploring ways of achieving more energy production through use of renewable biomass sources, and their decisions may have an impact on the crops grown in close proximity. Provision of SRC and miscanthus as a source of renewable energy could contribute towards addressing climate regulation. There are opportunities from arboricultural arisings and waste wood as well as small amounts from existing woodland including the newer community woodlands.

- **Water availability:** Surface water abstraction within the NCA is heavily dominated by industrial abstraction, and to a lesser extent, agriculture. There are no surface water abstractions for public water supply primarily due to water quality issues. In contrast, the main abstraction from groundwater is for domestic water supply. The Triassic sandstone forms an important aquifer.

Regulating services (water purification, air quality maintenance and climate regulation)

- **Climate regulation:** Large areas of soils with a high carbon content occur, reflecting the NCA's soil types which contain organic-rich or peaty layers. The peaty and organic soils of the NCA have an important role in carbon sequestration and storage. Adopting management options that reduce the soil disturbance, erosion and oxidation is likely to result in retaining carbon stores. Carbon storage and sequestration are provided by the NCA's woodland, mudflats, salt marsh and marine sediments. Positive management of wetland, woodland and estuarine habitats could result in carbon sequestration, and woodland creation in suitable locations could further increase this.

- **Regulating water quality:** Water quality is variable, reflecting pollution from the industrial heritage of the NCA, as well as other sources of pollution. Significant improvements in water quality have occurred in the catchment area over recent years. In urban areas, the waterside is now seen as a positive focus for regeneration. Improvements to water quality mean that salmon and sea trout have returned to the River Mersey. However, there is still much to be done to address water quality issues. Habitats such as woodlands, wetlands and grasslands can help to capture sediments and contaminants before they enter watercourses.

- **Regulating water flow:** The River Mersey flows west through the NCA and enters the Irish Sea at Liverpool Bay. The Mersey is tidally influenced downstream from Howley Weir (Warrington). The catchment is largely low-lying with a few steeper areas. The catchment has been heavily modified for industrial purposes, and this has affected the natural response of river flows. The Manchester Ship Canal, which was built for navigation, reduces fluvial flood risk through Warrington. The response to rainfall is generally slow but is much faster for some of the smaller tributaries flowing through urbanised areas. Some properties are at risk of fluvial flooding, including in Warrington. Where rivers discharge into an estuary, such as the River Weaver at Runcorn, there can potentially be either a fluvial or tidal flood event or both at the same time. Wetlands, woodlands and other habitats can alleviate speed of run-off.

The Silver Jubilee Bridge crosses the River Mersey and the Manchester Ship Canal at Runcorn Gap between Runcorn and Widnes.

- **Regulating coastal flooding and erosion**: Intertidal mudflats/sand flats and salt marsh vegetation in the Mersey Estuary are subject to tidal flooding. Intertidal habitats such as mudflats/sand flats and salt marsh effectively absorb the energy of waves, and thus provide a natural defence against sea level rise and flooding. These habitats are valuable for control of sea flooding but are under threat due to sea level rise, and the consequent coastal squeeze. The process of erosion and accretion on mudflats/sand flats and salt marshes is necessary to maintain a succession of diverse habitats.

Cultural services (inspiration, education and wellbeing)

- **Sense of place/inspiration:** Senses of inspiration and escapism may be provided by the broad panoramic views to the west across the Mersey Estuary. The many views of the extensive industrial complexes and docks, lit up at night, can also be dramatic and inspirational. The natural heritage of the river valley is important, being close to where people live as well as providing valuable wildlife corridors, and contributes to providing a sense of place and inspiration. Communities also value their local green spaces as places of local distinctiveness that provide opportunities to engage with nature close to where they live and work, and that helps to encourage a sense of community.

- **Sense of history:** The history of the landscape is largely associated with the River Mersey and Estuary, including evidence of strategic crossing points in the form of ancient fortifications at Warrington. Areas of peat have the potential to preserve organic remains, such as pollen. There is extensive industrial heritage, particularly linking to the development of the ports, trade, industry, canals and railways. There is evidence of sites defending the Mersey Valley during the Second World War as well as Cold War sites. Other aspects of history likely to be particularly evident to the public are the reclaimed mosslands and the Registered Parks and Gardens of Dunham Massey and Castle Park (Frodsham).

- **Recreation**: There are large populations locally, both within the towns of the Mersey Valley and the two adjacent conurbations. Local woodlands and the two Community Forests have generated local interest to increase woodland and other habitats, create wildlife corridors and provide access for people. Local Nature Reserves and country parks also provide opportunities for people to enjoy the natural environment. Communities value their local green spaces as places of local distinctiveness that provide opportunities to engage with nature close to where they live and work, to improve physical and mental health and encourage a sense of community.

- **Biodiversity**: The Mersey Estuary is of international significance, with large areas designated as a Ramsar site and as an SPA for its extensive intertidal habitats such as mudflats and internationally important bird populations. Examples of degraded raised bog habitat have survived on the Mersey flood plain, including the Manchester Mosses SAC. The ponds at Rixton Clay Pits SAC provide breeding sites for an important population of great crested newts. Other wetland sites include Woolston Eyes SSSI, where lagoons set aside to receive dredging from the Manchester Ship Canal form large areas of open water, reedbed and scrub vegetation.

- **Geodiversity**: Peat-forming bogs and the dynamic intertidal environments are both examples of active geomorphological processes. Geological exposures, for example of sandstone sequences, make an important contribution to understanding of the origin and geological development of the NCA.

Rixton Clay Pits are a mosaic of pools and other habitats, with an internationally designated population of great crested newts. The site is also a Local Nature Reserve, providing opportunities for people to enjoy and learn about the natural environment.

Statements of Environmental Opportunity

SEO 1: Conserve and enhance the Mersey Valley's rivers, tributaries and estuary, improving the ability of the fluvial and estuarine systems to adapt to climate change and mitigate flood risk while also enhancing habitats for wildlife and for people's enjoyment of the landscape.

For example, by:

- Maintaining and enhancing the Mersey Estuary Special Protection Area (SPA) and Ramsar site; bringing habitats into and maintaining favourable condition, such as the intertidal sediments and salt marshes to support the internationally important populations of migratory bird species and assemblage of waterfowl.
- Maintaining and enhancing the biodiversity of the Mersey Estuary, its tributaries and its wider flood plain, including adjacent farmland and wetland that provide habitats supporting wildlife.
- Conserving the open and exposed character of the mudflats/sand flats and salt marshes along the Mersey Estuary, with its expansive estuary views, and enhancing the estuarine habitats that contribute to landscape character and support the wide range of wildlife.
- Improving understanding of the many features and functions of the Mersey Estuary, including its active geomorphological processes and wildlife value, making provision for it to adapt to coastal change.
- Ensuring the retention of mudflats and salt marshes where possible, and allowing space for the continuing dynamic estuarine processes, to retain biodiversity and geomorphological interest and provide a cost-effective defence against erosion/flooding.
- Promoting opportunities to improve the natural functioning of the Mersey Estuary and potentially reduce flood risks through providing space for intertidal habitats to develop and move in response to coastal change, to enhance estuarine habitats and create additional habitats by managed realignment at strategic locations.
- Working with key partners and landowners to identify suitable sites for flood storage, as well as optimising design and implementation of future flood storage areas to create new wetland habitats, such as flood plain grazing marsh, and creating links with existing semi-natural habitats.
- Identifying river stretches for restoration (for example, re-connecting rivers to their flood plains) and taking opportunities to de-culvert and re-naturalise rivers and remove redundant weirs and other obstacles, to provide space for water storage and alleviate speed of run-off, as well as providing connectivity and habitats for wildlife.
- Maintaining and enhancing semi-natural grassland, flood meadows and wet grasslands associated with river flood plains as feeding and breeding sites for wetland birds and for their botanical interest; maintaining and enhancing the coastal and flood plain grazing marshes bordering the River Mersey and its tributaries, to attract wetland birds and as refuges for estuarine species at times of severe weather.

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SEO 1: Conserve and enhance the Mersey Valley's rivers, tributaries and estuary, improving the ability of the fluvial and estuarine systems to adapt to climate change and mitigate flood risk while also enhancing habitats for wildlife and for people's enjoyment of the landscape.

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- Managing and enhancing habitats such as wetlands and grasslands to capture sediments and contaminants before they enter watercourses; and establishing buffers such as permanent grassland along watercourses.
- Enabling sustainable recreational and educational access for people to sensitively enjoy access to the River Mersey and Estuary where appropriate, for the benefits that contact with the natural environment brings.
- Supporting management to ensure that the River Mersey continues to improve as a clean and ecologically diverse river; seeking to re-connect people, both physically and visually, with the River Mersey, and protecting and enhancing these connections where they do exist.
- Promoting the multiple benefits of a healthy waterside environment.

Remnant pockets of lowland raised bog, such as at Astley Moss, where the habitat supports common cotton grasses and hairs tail cotton grass with occasional sphagnum mosses, as well as birds and invertebrates.

SEO 2: Promote the Mersey Valley's historic environment and landscape character and positively integrate the environmental resource with industry and development, providing greenspace within existing and new development, to further the benefits provided by a healthy natural environment, as a framework for habitat restoration and for public amenity.

For example, by:

- Capitalising on the strengths of the location, through conserving and enhancing the Mersey River valley, parks and urban green spaces and enabling people to access and enjoy them.
- Carefully designing and integrating green infrastructure within housing, business, transport and industrial development, linking new developments with the wider countryside; looking for opportunities to provide access and outdoor recreation, to retain and enhance landscapes, visual amenity and biodiversity, or to improve damaged and derelict land.
- Developing networks of linear habitats, corridors and stepping stones within housing and industrial development, linking developments with the wider countryside, making a more permeable landscape to enable species movement and to enable urban populations to engage with the natural environment through better access provision.
- Creating new woodlands and planting individual trees in appropriate urban and industrial areas and settlements, such as school playing fields, open spaces, streets, highway verges, institutional grounds, derelict land, on tipped and industrial land and development sites for multi-purpose use as part of the community forest initiative, including innovative wood fuel, timber and forest industries, enhancement of recreation, landscape and biodiversity interests, helping to assimilate new infrastructure, and providing benefits for water quality, soil quality and flood risk management.
- Creating tranquil areas of woodland and other habitats for people to enjoy and increasing opportunities for users to access, and to benefit from, the health and social rewards that their local environment affords them.
- Seeking ways to protect the sense of place and interpret the National Character Area's (NCA's) historic and cultural identity to ensure a better understanding of past land use and retain evidence of the relationships between features for the future.
- Conserving open and expansive views of the landscape, such as views from the top of Runcorn Hill.
- Developing sustainable urban drainage systems (SUDS) in new and existing development to improve infiltration and manage surface water.
- Planning to manage over-abstraction from groundwater and rivers through careful and efficient use of water.
- Conserving the NCA's heritage assets, including archaeological sites, historic buildings and the character of the parkland and villages and ensuring high-quality design.
- Maintaining the wood-pasture management system at Dunham Park, and other parklands, making provision for eventual replacement of trees, while retaining moribund and dead standing timber.

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SEO 2: Promote the Mersey Valley's historic environment and landscape character and positively integrate the environmental resource with industry and development, providing greenspace within existing and new development, to further the benefits provided by a healthy natural environment, as a framework for habitat restoration and for public amenity.

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- Promoting sustainable recreation and education opportunities linked to biodiversity, for example at local nature reserves and country parks, and providing interpretation for people to understand and enjoy wildlife and the benefits of the natural environment.
- Providing opportunities for users to access the natural environment sustainably through conserving and enhancing recreational routes, including long-distance footpaths and strategic green links, ensuring that paths are maintained and that some surfaced paths are provided for use by all levels of ability, to enable people to benefit from the health and social rewards that their local environment affords them.
- Deepening appreciation among landowners, industry and the public of the links between geology, landscape and wildlife habitat and their relevance to conserving biodiversity and to sustainable development; providing improved interpretation and educational facilities to increase visitors' understanding and enjoyment of the NCA's natural and historic features.
- Maintaining and where possible enhancing all the existing rock exposures and natural landforms, including Sites of Special Scientific Interest (SSSI), which make important contributions to an understanding of the origin and geological development of the Mersey Valley NCA.

At Dunham Park a large number of the oak and beech trees are ancient, with some dating back to the 17th century. The associated dead wood beetle fauna is exceptionally rich and includes a number of rare species.

SEO 3: Manage the arable and mixed farmland along the broad linear Mersey Valley, and create semi-natural habitats, woodlands and ecological networks, to protect soils and water, enhance biodiversity, increase connectivity and improve the character of the landscape, while enabling sustainable food production.

For example, by:

- Conserving the character and wildlife habitats associated with the arable and mixed farming systems, and seeking opportunities to manage and create semi-natural habitats and ecological networks within the farmed environment, which will protect soils and water and enhance biodiversity and the landscape.
- Providing significant year-round habitats that will benefit farmland birds, such as over-wintered stubbles, conservation headlands and buffer strips in arable fields.
- Planning to link and connect fragmented habitats into a more cohesive whole, providing corridors and stepping stones for wildlife, enabling movement of species, and enhancing the landscape.
- Seeking opportunities to restore and enhance hedgerows, field boundary trees and field margins to encourage a network of habitats to link fragmented habitats, to act as a windbreak and bind/filter out the soil in times of flood.
- Protecting historic parklands to enhance the landscape, and creating succession plans to increase the age range of trees in parkland settings.
- Improving water quality, through carefully managing nutrient inputs and providing buffer strips adjacent to watercourses such as in the River Mersey, River Weaver and their tributaries.
- Providing new educational access with interpretation of environmental gains that promote the re-connection between farming, food and the public.
- Exploring and promoting the marketing of quality local produce to nearby extensive urban populations.
- Protecting woodlands, including ancient woodlands, and encouraging the appropriate management of existing woodlands through measures such as diversifying the age structure of tree populations and retaining veteran trees and fallen timber; increasing the extent and continuity of semi-natural woodland in appropriate locations, particularly through enlarging and linking existing woodland sites; and ensuring that any planting complements open habitats for ground-nesting birds.
- Protecting and enhancing the quality of ponds, including those at the internationally designated Rixton Clay Pits Special Area of Conservation (SAC), buffering infield ponds and wetlands and seeking to create new wetland habitats, thus creating strong habitat networks, improving water quality, and establishing stepping stones of wetland habitat.
- Encouraging opportunities to improve, maintain and expand habitats, such as woodlands, grasslands and wetlands, which may increase the sense of tranquillity.

SEO 4: Manage and enhance the mossland landscape in the east, safeguarding wetlands including the internationally important lowland raised bogs, to conserve peat soils, protect and enhance biodiversity, conserve archaeological deposits, contribute to landscape character and store carbon.

For example, by:

- Managing and enhancing the Manchester Mosses SAC and other important lowland raised bog habitats.
- Managing areas of lowland raised bog and adjacent land, restoring peat soils to protect wildlife and increase the ability of habitats to actively store and sequester carbon from the atmosphere.
- Restoring and improving the condition of lowland bogs by working with landowners to manage and restore water table levels, and providing hydrological buffer zones of fens, wet pastures or wet woodland to help to manage water.
- Seeking opportunities to re-establish the geomorphological function of mosslands to safeguard the records of palaeo-environmental evidence and to prevent damage to potential buried archaeological remains.
- Seeking opportunities for restoring, enhancing and linking fragmented wetland habitats in former peat-cutting areas and farmlands to realise the potential for restoration schemes and create a complex mossland landscape capable of sustaining the full range of mossland habitats.
- Encouraging the restoration of lowland raised bogs and the mosaic of wetland habitats to conserve wildlife and retain the open character of the NCA's mossland landscape.
- Improving people's understanding and enjoyment of the mosslands and the network of lowland raised bogs by providing access and interpretation where possible.
- Seeking opportunities to extend areas of wetland along rivers and in valley bottoms.
- Managing the ditch network to increase their contribution to biodiversity interest.
- Managing existing woodlands, while conserving mossland habitats, to contribute to the character of the wider area.

Supporting document 1: Key facts and data

Area of Mersey Valley National Character Area (NCA): 44,718 ha

1. Landscape and nature conservation designations

There are no protected landscape designations within the Mersey Valley NCA.

Source: Natural England (2011)

1.1 Designated nature conservation sites

The NCA includes the following statutory nature conservation designations:

Tier	Designation	Name	Area (ha)	% of NCA
International	Ramsar	Mersey Estuary	968	2
European	Special Protection Area (SPA)	Mersey Estuary SPA	968	2
	Special Area of Conservation (SAC)	Manchester Mosses SAC; Rixton Clay Pits SAC	184	<1
National	National Nature Reserve (NNR)	n/a	0	0
	Site of Special Scientific Interest (SSSI)	A total of 13 sites wholly or partly within the NCA	1,585	4

Source: Natural England (2011)

Please note: (i) Designated areas may overlap (ii) all figures are cut to Mean High Water Line, designations that span coastal areas/views below this line will not be included.

There are 83 local sites in the Mersey Valley covering 2,963 ha which is 7 per cent of the NCA.

Source: Natural England (2011)

- Details of individual Sites of Special Scientific Interest can be searched at: **http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm**
- Details of Local Nature Reserves (LNR) can be searched at: **http://www.lnr.naturalengland.org.uk/Special/lnr/lnr_search.asp**
- Maps showing locations of Statutory sites can be found at: **http://magic.Defra.gov.uk/website/magic/** – select 'Rural Designations Statutory'

1.1.1 Condition of designated sites

SSSI condition category	Area (ha)	Percentage of NCA SSSI resource
Unfavourable declining	43	3
Favourable	1,320	83
Unfavourable no change	31	2
Unfavourable recovering	187	12

Source: Natural England (March 2011)

- Details of SSSI condition can be searched at: **http://www.sssi.naturalengland.org.uk/Special/sssi/reportIndex.cfm**

2. Landform, geology and soils

2.1 Elevation

The Mersey Valley elevation ranges from slightly above sea level to a maximum height of 144 m. The mean elevation is relatively low at 23 m.

Source: Natural England 2010

2.2 Landform and process

The Mersey Valley NCA consists of a broad linear valley with large-scale, open, predominantly flat farmland supporting substantial bands of mixed agriculture.

Source: Mersey Valley Countryside Character Area Description

2.3 Bedrock geology

The solid geology of the Mersey Valley is dominated by red sandstones and mudstones of Triassic age (248-205 million years old) that underlie almost the entire area. To the south of the River Mersey the landform is a series of low, but prominent sandstone ridges.

Source: Natural England 2010

2.4 Superficial deposits

The surface geology consists principally of superficial deposits. The valley bottom is underlain by estuarine and river alluvium bordered in places by wind-blown sand. Much of the remainder of the area is mantled by glacial till with pockets of sand and gravel. Brick earth deposits are a notable feature near Rixton. Outcrops of Triassic sandstone bedrock poke through the superficial deposits to the east and south of Runcorn. An important feature in the east of the Valley is the occurrence of peat, covering 9 per cent of the NCA. These mosslands developed in drainage hollows in the early post-glacial period.

Source: Mersey Valley Countryside Character Description, Natural England 2010

2.5 Designated geological sites

Tier	Designation	Number
National	Geological Site of Special Scientific Interest (SSSI)	2
National	Mixed Interest SSSI	0
Local	Local Geological Sites	12

There is a wide mixture of geological site types, but the majority are inland outcrops, disused quarries, road sections and geomorphology sites. Frodsham Railway and Road Cuttings SSSI, for example, shows a sequence of sandstones representing the upper part of the Triassic Helsby Sandstone Formation.

Source: Natural England (2011)

- Details of individual Sites of Special Scientific Interest can be searched at: **http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm**

2.6 Soils and Agricultural Land Classification

Small amounts of Grade 1 agricultural land occur to the north-east of Warrington with larger expanses of Grade 2 land found around the perimeter of the NCA. Grade 3 soils more common in the south and to the north of Warrington.

Source: Natural England (2010)

The main grades of agricultural land in the NCA are broken down as follows (as a proportion of total land area):

Grade	Area (ha)	% of NCA
Grade 1	2,629	6
Grade 2	11,283	25
Grade 3	13,610	30
Grade 4	675	1
Grade 5	1,856	4
Non-agricultural	1,957	4
Urban	12,515	30

Source: Natural England (2010)

- Maps showing locations of Statutory sites can be found at: http://magic.Defra.gov.uk/website/magic/ – select 'Landscape' (shows ALC classification and 27 types of soils).

3. Key water bodies and catchments

3.1 Major rivers/canals

The following major rivers/canals (by length) have been identified in this NCA.

- Manchester Ship Canal 44 km
- Bridgewater Canal 30 km
- River Mersey 24 km
- River Bollin 7 km
- Leeds and Liverpool Canal 6 km
- Shropshire Union Canal 6 km
- Weaver Navigation 6 km
- River Weaver 5 km
- Trent and Mersey Canal 1 km

Source: Natural England (2010)

Please note: Other significant rivers (by volume) may also occur. These are not listed where the length within the NCA is short.

3.2 Water quality

The total area of Nitrate Vulnerable Zone is 20,468 ha or 46 per cent of the NCA.

Source: Natural England (2010)

3.3 Water Framework Directive

Maps are available from the Environment Agency showing current and projected future status of water bodies at: http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

4. Trees and woodlands

4.1 Total woodland cover

Woodlands cover an area of 3,383 ha, 8 per cent of the NCA, of which less than 1 per cent is ancient woodland. The NCA contains 2 Community Forests: the Red Rose Community Forest and the Mersey Community Forest.

Source: Natural England (2010), Forestry Commission (2011)

4.2 Distribution and size of woodland and trees in the landscape

Trees and woodland are scarce within the NCA and often associated with areas of settlement.

Source: Mersey Valley Countryside Character Description

4.3 Woodland types

A statistical breakdown of the area and type of woodland found across the NCA is detailed below.

Area and proportion of different woodland types in the NCA (over 2 ha)

Woodland type	Area (ha)	% of NCA
Broadleaved	2,645	6
Coniferous	114	<1
Mixed	253	1
Other	371	1

Source: Forestry Commission (2011)

Area and proportion of ancient woodland and planted ancient woodland within the NCA.

Type	Area (ha)	% of NCA
Ancient semi-natural woodland	131	<1
Planted Ancient Woodland (PAWS)	2	<1

Source: Natural England (2004)

5. Boundary features and patterns

5.1 Boundary features

Hedgerows represent the dominant boundary feature though many have now been replaced with post-and-wire fencing.

Source: Mersey Valley Countryside Character Area description; Countryside Quality Counts (2003)

5.2 Field patterns

Ancient enclosures are poorly represented with scattered examples most notable to the east between Warrington and Urmston. For the most part the area is characterised by successive changes to the underlying pattern of ancient fields – improvements and modifications in the 18th, 19th and 20th centuries matched to urban demands. In the north the field pattern is open with large fields. To the south the field pattern has become fragmented, with degraded hedgerows and the invasion of scrub into many fields.

Source: Mersey Valley Draft Historic Profile; Mersey Countryside Character Area description; Countryside Quality Counts (2003)

6. Agriculture

The following data has been taken from the Agricultural Census linked to this NCA.

6.1 Farm type

In 2009 the Mersey Valley contained 335 registered holdings within the Agricultural Census. These consisted predominantly of a mix of arable and horticulture (47 per cent), mixed farming (7 per cent) and livestock (21 per cent).

Source: Agricultural Census, Defra (2010)

6.2 Farm size

The majority of registered holdings in the area in 2009 were under 50 ha, though comparison with figures from 2000 suggests that this is changing with a shift towards larger holdings over this period.

Source: Agricultural Census, Defra (2010)

6.3 Farm ownership

2009: Total farm area = 18,001 ha; owned land = 9,337 ha

2000: Total farm area = 17,188 ha; owned land = 10,079 ha

Source: Agricultural Census, Defra (2010)

6.4 Land use

The total farm area for registered holdings within the Mersey Valley in 2009 was 18,000 ha. Forty per cent of this area was recorded as being under cereals and 44 per cent as grass and uncropped land with the remainder largely split between cash roots, oilseeds and other arable. This pattern of agricultural land use has remained largely unchanged since 2000.

Source: Agricultural Census, Defra (2010)

6.5 Livestock numbers

Livestock in Mersey Valley is made up of a mixture of cattle (9,000 animals), sheep (8,000 animals) and approximately 5,000 pigs. Over the last decade there has been a considerable decrease in the number of cattle and pigs within the NCA and an increase in the number of sheep.

Source: Agricultural Census, Defra (2010)

6.6 Farm labour

Farm labour within the NCA is predominately provided by principal farmers (accounting for 62 per cent of the work force). Over the last decade there has been a considerable decline in full time and casual labour.

Source: Agricultural Census, Defra (2010)

Please note: (i) Some of the Census data is estimated by Defra so will not be accurate for every holding (ii) Data refers to Commercial Holdings only (iii) Data includes land outside of the NCA belonging to holdings whose centre point is within the NCA listed.

7. Key habitats and species

7.1 Habitat distribution/coverage

The central Mersey Valley once contained large tracts of lowland peat bog which had developed through the infill of shallow lakes, initially by swamp and fen vegetation, then by a woodland phase and finally, resulting from climatic changes, the establishment of peat bog vegetation. When it became technically feasible to drain the bogs, peat cutting was carried out on a large scale for fuel and other uses and, with the addition of manure or fertiliser, conversion to arable farmland became a viable option. By the early part of the 20th century very little peat bog in the Mersey Basin remained unaltered. Some of the best agricultural land in the NCA is now found on former mossland. The mosslands belong to a category of peatland known as lowland raised bog, so-called because the most active growth occurs in the middle where the specialised plants can draw up and retain sufficient water to raise the water table to a higher level than occurs at the margins. Remnants of this internationally important habitat remain to the north-east of the NCA. Coastal and flood plain grazing marsh can also be found as the Mersey winds to the east of Warrington. This provides habitat for breeding waders and wintering wildfowl. Mudflats occur to west of the NCA at the estuary. In addition the NCA contains important arable habitats. These support nationally important assemblages of arable birds.

Source: : Urban Mersey Valley Natural Area Profile, Natural England (2012)

7.2 Priority habitats

The Government's new strategy for biodiversity in England, Biodiversity 2020, replaces the previous Biodiversity Action Plan (BAP) led approach. Priority habitats and species are identified in Biodiversity 2020, but references to BAP priority habitats and species, and previous national targets have been removed. Biodiversity Action Plans remain a useful source of guidance and information.

More information about *Biodiversity 2020* can be found at;

http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/protectandmanage/englandsbiodiversitystrategy2011.aspx

The NCA contains the following areas of mapped priority habitats (as mapped by National Inventories). Footnotes denote local/expert interpretation. This will be used to inform future national inventory updates.

Priority habitat	Area (ha)	% of NCA
Coastal and flood plain grazing marsh	1,204	3
Broadleaved mixed and yew woodland (broad habitat)	880	2
Mudflats	513	1
Lowland raised bog	341	1
Lowland dry acid grassland	80	<1
Purple moor grass and rush pasture	66	<1
Lowland meadows	32	<1
Lowland calcareous grassland	23	<1
Lowland heathland	11	<1
Upland hay meadows	8	<1
Maritime cliff and slope	8	<1
Reedbeds	7	<1

Source: Natural England (2011)

- Maps showing locations of priority habitats are available at: **http://magic.Defra.gov.uk/website/magic/** select 'Habitat Inventories'

7.3 Key species and assemblages of species

- Maps showing locations of priority habitats are available at: **http://magic.Defra.gov.uk/website/magic/**
- Maps showing locations of S41 species are available at: **http://data.nbn.org.uk/**

8. Settlement and development patterns

8.1 Settlement pattern

Settlements are largely clustered around the main Mersey ports. The situation of the Mersey Valley (lying between the Lancashire coalfields to the north and the Cheshire Plain, with its salt and ore deposits, to the south) and associated trades have been a major influence on settlement pattern and development.

Source: Mersey Valley Countryside Character Area description; Countryside Quality Counts (2003)

8.2 Main settlements

The main settlements within the NCA are; Runcorn, Widnes and Warrington. The total estimated population for this NCA (derived from ONS 2001 census data) is: 459,724.

Source: Mersey Valley Countryside Character Area description; Countryside Quality Counts (2003)

8.3 Local vernacular and building materials

The predominant building material is red brick. Traditionally the buildings in this region would have been similar to the half-timbered buildings on the Shropshire, Cheshire and Staffordshire Plain. These have been engulfed and destroyed by the suburban sprawl of large housing estates. The village of Hale, adjacent to Liverpool Airport, has retained its distinctive character with many thatched houses lining the western approach.

Source: Mersey Valley Countryside Character Area description; Countryside Quality Counts (2003)

9. Key historic sites and features

9.1 Origin of historic features

The Mersey Valley has historically formed a natural frontier zone of impenetrable marshes. This area represented the boundary between English Mercia and Danish Northumbria. The valley may also have formed a provincial boundary during the Roman period and possibly a tribal frontier even earlier. This frontier land once contained many fortifications, most of which have been lost to modern industrial development.

Important strategic sites were located at Warrington which represented the lowest bridging point where a Roman road crossed the valley. This crossing was protected by a Castle Rock located on the south side of the river, which was removed in 1862 to improve navigation. There are only limited remains of ancient fortifications and, following local government reorganisation in 1974, the valley no longer represents a regional boundary.

Early settlement has largely been overwhelmed by urban and industrial expansion in the last 100 to 150 years – subsuming former areas of high density dispersed farming settlement as well as former villages. This has resulted in very low survival of pre-1750 farmstead buildings.

Source: Mersey Countryside character Description; Draft Historic Profile

9.2 Designated historic assets

This NCA has the following historic designations:

- 2 Registered Parks and Gardens covering 155 ha
- 0 Registered Battlefields
- 33 Scheduled Monuments
- 779 Listed Buildings

Source: Natural England (2010)

- More information is available at the following address: **http://www.english-heritage.org.uk/caring/heritage-at-risk/**
- **http://www.english-heritage.org.uk/professional/protection/process/national-heritage-list-for-england/**

10. Recreation and access

10.1 Public access

- Less than 1 per cent of the NCA 37 ha is classified as being publically accessible.
- There are 515 km of public rights of way at a density of 1.1 km per km^2.
- There are no National Trails within the NCA.

Sources: Natural England (2010)

The table opposite shows the breakdown of land which is publically accessible in perpetuity:

Access designation	Area (ha)	% of NCA
National Trust (Accessible all year)	162	<1
Common Land	11	<1
Country Parks	66	<1
CROW Access Land (Section 4 and 16)	80	<1
CROW Section 15	57	<1
Village Greens	41	<1
Doorstep Greens	2	<1
Forestry Commission Walkers Welcome Grants	831	2
Local Nature Reserves (LNRs)	361	1
Millennium Greens	14	<1
Accessible National Nature Reserves (NNRs)	0	0
Agri-environment Scheme Access	0	0
Woods for People	1,168	3

Sources: Natural England (2011)

Please note: Common Land refers to land included in the 1965 commons register; CROW = Countryside and Rights of Way Act 2000; OC and RCL = Open Country and Registered Common Land.

11. Experiential qualities

11.1 Tranquillity

Based on the CPRE map of tranquillity (2006) there are small areas to the east of the NCA that experience the highest tranquillity. However, the majority of the NCA is recorded as having low levels of tranquillity. The lowest values are found in Warrington and other urban areas.

A breakdown of tranquillity values for this NCA is detailed in the table below:

Category of tranquillity	Score
Highest value within NCA	8
Lowest value within NCA	-112
Mean value within NCA	-51

Sources: CPRE (2006)

- More information is available at the following address: **http://www.cpre.org.uk/what-we-do/countryside/tranquil-places/in-depth/item/1688-how-we-mapped-tranquillity**

11.2 Intrusion

The 2007 Intrusion Map (CPRE) shows the extent to which rural landscapes are 'intruded on' from urban development, noise (primarily traffic noise), and other sources of visual and auditory intrusion. This shows the whole NCA to be either disturbed or urban.

A breakdown of intrusion values for this NCA is detailed in the table below.

Category of intrusion	1960s (%)	1990s (%)	2007 (%)	% change (1960s-2007)
Disturbed	72	77	71	-1
Undisturbed	6	1	n/a	n/a
Urban	20	21	29	9

Sources: CPRE (2007)

Notable trends from the 1960s to 2007 are the increase in urban area since the 1990s.

- More information is available at the following address: **http://www.cpre.org.uk/resources/countryside/tranquil-places**

12. Data sources

- British Geological Survey (2006)
- Natural Area Profiles, Natural England (published by English Nature 1993-1998)
- Countryside Character Descriptions, Natural England (regional volumes published by Countryside Commission/Countryside Agency 1998/1999)
- Joint Character Area GIS boundaries, Natural England (data created 2001)
- National Parks and AONBs GIS boundaries, Natural England (2006)
- Heritage Coast Boundaries, Natural England (2006)
- Agricultural Census June Survey, Defra (2000,2009)
- National Forest Inventory, Forestry Commission (2011)
- Countryside Quality Counts Draft Historic Profiles, English Heritage (2004)*
- Ancient Woodland Inventory, Natural England (2003)
- Priority Habitats GIS data, Natural England (March 2011)
- Special Areas of Conservation data, Natural England (data accessed in March 2011)
- Special Protection Areas data, Natural England (data accessed in March 2011)
- Ramsar sites data, Natural England (data accessed in March 2011)
- Sites of Special Scientific Interest, Natural England (data accessed in March 2011)
- Detailed River Network, Environment Agency (2008)
- Source protection zones, Environment Agency (2005)
- Registered Common Land GIS data, Natural England (2004)
- Open Country GIS data, Natural England (2004)
- Public Rights of Way Density, Defra (2011)
- National Trails, Natural England (2006)
- National Tranquillity Mapping data, CPRE (2007)
- Intrusion map data, CPRE (2007)
- Registered Battlefields, English Heritage (2005)
- Record of Scheduled Monuments, English Heritage (2006)
- Registered Parks and Gardens, English Heritage (2006)
- World Heritage Sites, English Heritage (2006)
- Incorporates Historic Landscape Characterisation and work for preliminary Historic Farmstead Character Statements (English Heritage/Countryside Agency 2006)

Please note all figures contained within the report have been rounded to the nearest unit. For this reason proportion figures will not (in all) cases add up to 100%.
The convention <1 has been used to denote values less than a whole unit.

Supporting document 2: Landscape change

Recent changes

Trees and woodlands

- The majority of woodland falls within the Mersey and Red Rose community forests, together providing a network of green spaces, woodlands, street trees and creating high quality environments. This has resulted in tree and woodland cover increasing and woodlands being brought into positive management. In recent years new community woodlands have been created in this area, for example, Windy Bank Wood (40 ha) and Upper Moss Side (74 ha) managed by the Forestry Commission. The Public Forest estate also have significant new community woodland areas on the boundaries of the NCA; Wheatacre (44 ha), Sutton Manor (64 ha) and Higher Folds (132 ha).

- Between 1999 and 2003 an area equivalent to 14 per cent of the 1999 total stock was approved for new planting under a Woodland Grant Scheme agreement (170 ha). In 1999 about 27 per cent of the established eligible National Inventory of Woodlands and Trees stock was covered by a Woodland Grant Scheme management agreement.

Boundary features

- Hedgerows represent the dominant boundary features, though many have fallen into disrepair and have now been replaced with post and wire fencing. Between 1999 and 2003 Countryside Stewardship capital agreements for linear features included fencing (28 km), hedge management (9 km), hedge planting and restoration (22 km), and restored boundary protection (15 km). In 2011 boundaries under Environmental Stewardship options were ditches (54 km), hedgerows (295 km) and woodlands (5 km).

Agriculture

- Changes have occurred in the agricultural landscape, with a move away from traditional horticultural practice towards more arable farming (cereals and oil seeds). Between 2000 and 2009 horticulture and general cropping decreased, while production of cereals increased.

- Between 2000 and 2009 there was a decrease in the number of cattle and pigs, and an increase in the number of sheep. In 2009 there were 8,848 cattle (10,927 in 2000), 7,768 sheep (6,856 in 2000) and 4,615 pigs (9,792 in 2000).

- Where farmland has been fragmented by industrial or urban development, field patterns have been lost or fragmented.

Settlement and development

- The rate of change to urban is high in some areas, especially around Widnes, Great Sankey, Lymm, Stockton Heath and Runcorn. There is a marked concentration of commercial developments evident to the east of Lymm and Runcorn. Dispersed development in open countryside is evident north of the M62.

- The area is heavily industrialised, with cluster growth based on chemicals, automotives and the vast manufacturing complexes at Ellesmere Port and Runcorn. The area is a focus for new and upgraded industrial development and transport links. Liverpool Airport has expanded, with the completion of a new passenger terminal in 2002.

- The potential of the area to provide renewable energy has been considered by developers, and there is at least one consented large scale wind energy scheme.

Semi-natural habitat

- In 2011, 83 per cent (1,320 ha) of Sites of Special Scientific Interest (SSSI) were in favourable condition, 12 per cent (187 ha) were in unfavourable recovering condition, 2 per cent (31 ha) were in unfavourable condition, and 3 per cent (43 ha) were in unfavourable declining condition.

- The most extensive annual Countryside Stewardship agreements in 2003 were for managing inter-tidal habitats (635 ha).

- In the years between 1990 and 2004 extensive areas of mossland were lost to landfill and to peat cutting. The mossland SSSI all had areas of sphagnum-dominated wet bog habitat, however even these sites showed signs of drying out along their edges[4]. This loss and decline has now largely been halted and there have been significant areas of mossland brought into conservation management. Approximately 264 ha of mossland are managed under the Higher Level Stewardship Scheme and a further 32 ha of mossland is being restored under planning conditions. There are also some areas of fen and marshy grassland being managed as a buffer adjacent to the mosslands.

- Significant effort has been made to improve the condition of flood plain grazing marsh, notably around Frodsham, Helsby and Ince Marshes and in the lower Gowy. Large areas of flood plain grazing marsh are now managed sensitively for species such as wading birds, amphibians and mammals.

Historic features

- Only about 68 per cent of historic farm buildings remain unconverted, and most are intact structurally. Moreover, in 1918 about 2 per cent of the area was historic parkland. By 1995 it is estimated that 54 per cent of the 1918 area had been lost. About 31 per cent of the remaining parkland is covered by a Historic Parkland Grant, and 32 per cent is included in an agri-environment scheme.

Coast and rivers

- Historically, the Mersey Estuary catchment has been associated with shipping, manufacturing, the chemical industry, mining and agriculture. These industries left a legacy of environmental issues and by the 1980s the Mersey and its tributaries were some of the most polluted watercourses in Europe. The area still has clusters of pharmaceutical and chemical industries. Although outputs from these are regulated, discharges can adversely impact on water quality. Accumulated pollution in the sediment of the estuary remains a problem. However, through successful campaigns and investment, the River Mersey's water quality has greatly improved as shown by the return of salmon to the river[5].

- The Manchester Ship Canal is a physically modified water body. Barriers within the canal affect young salmon migrating from the upper Mersey catchment. Many of the urban rivers are either enclosed by culverts, or barriers such as weirs have meant fish have not been able to pass through. Salmon are returning to the River Bollin after fish passes were installed at Heatley and Little Bollington weirs. Structures such as eel passes have been built to allow fish to move more freely; for example on the River Gowy.[6]

[4] *Mosslands of Northwest 1 (Merseyside, Lancashire and Grater Manchester) State and extent of surviving acid mossland habitats,* Dr Paul Thomas and Martin Walker (2004)

[5] *North West River Basin District: Challenges and choices,* Environment Agency (June 2013)

[6] *North West Landscape Framework – Climate Change Assessment – 2010/11,* Natural England (accessed October 2013; URL: www.naturalengland.org.uk/regions/north_west/ourwork/climatechangeassessment.aspx)

Minerals

- Many of the peat deposits in the Mersey Valley have been worked extensively in the past and today a large percentage of these areas have been 'reclaimed' to agricultural land. Limited extraction of peat is still in operation within the area. However, some extraction sites are being restored to semi-natural habitat, including lowland raised bog, such as Little Woolden Moss.

Drivers of change

Climate change

- The North West Landscape Framework Climate Change Assessment 2010/11[7] assessed the exposure of the area and its natural assets to the impacts of climate change and its capacity to adapt.

- Mosslands are vulnerable to the drying of peat soils, reducing both their carbon storage capacity and also their ability to re-hydrate. The net effect of this process is both to increase carbon emissions from the soils and to decrease its resistance to further drying.

- Mudflats/sand flats and salt marshes are vulnerable to sea level rise due to storm events, particularly where they lie in front of flood defences and consequently have no way of moving in-land.

- In urban areas the lack of habitats and generally flat topography make species movement and ecosystem function very restricted.

- Some farmland soils are vulnerable to increased drying with reduced summer rainfall. The low variation in topography and intensive land use make the area less likely to cope with climate change. Providing reasonable variation with arable, pastoral and woodland mosaics will help to increase variability thereby reducing its vulnerability.

- Changes to water bodies through drier summers and wetter winters and effects on parkland landscapes through increased storm events may occur. Changes to woodland and trees in the driest places are possible.

- Understanding and planning for increased tidal and fluvial flood risk in vulnerable parts of the area. Predicted changes in rainfall patterns with future climate change may increase river flows in the Mersey, which may in turn affect river channel meandering and siltation rates. In the long term there is uncertainty over the balance between sediment supply from Liverpool Bay and sea level rise[8].

- Shifts in agriculture are possible as a result of longer drier summers resulting in the growth of more drought tolerant planting, possibly double cropping and new crops, along with an increased focus on biomass fuel planting to increase renewable forms of energy production.

- Potential for increased incidents of pests and diseases able to migrate further north, as well as competition with native species from invasive species, which are able to expand their habitat ranges, as temperatures increase.

- Carbon sequestration and storage by habitats such as salt marshes, mosslands and organic soils, which are important features of this NCA, could help reduce atmospheric carbon dioxide levels.

[7] *North West Landscape Framework – Climate Change Assessment – 2010/11,* Natural England (accessed October 2013; URL: **www.naturalengland.org.uk/regions/north_west/ourwork/climatechangeassessment.aspx**)
[8] *North West England and North Wales Coastal Group Shoreline Management Plan 2.* Accessed from: http://**www.mycoastline.org/index.php/shoreline-management/smp2**

Other key drivers

- The area faces challenges around providing and managing critical infrastructure to support the delivery of future growth and new development, such as water supply, electricity supply and waste. Innovative approaches may be needed to address this.

- There is continuing industrial and manufacturing development alongside pressure for expansion of housing land. Some of the landfill sites across the landscape are open and active, others have recently closed and some have issues with leaching or ongoing management. Nevertheless, they present opportunities for restoration, for example to woodland, meadows and pasture with amenity access.

- There is continuing pressure for new and upgraded transport routes. The Mersey Gateway Project, for example, is a major scheme to build a new six lane bridge over the Mersey between the towns of Runcorn and Widnes. The project aims to be more than just a bridge, but also a transformational catalyst, connecting communities and encouraging regeneration. Construction is due to start in 2014 and be completed in 2017. The planned route for the proposed high speed railway between London and the north-west also crosses this NCA. There are further proposals to expand Liverpool Airport.

- There is pressure to accommodate renewable energy schemes, such as wind and tidal power, although there are challenges around feasibility in this complex area. Other potential future energy development includes fracking.

- There is continuing pressure for further development of housing and industry which would open up opportunities for creating a high quality natural environment through providing green infrastructure.

- There are particular challenges around managing ecological connectivity for species movement as set out in the report 'Making space for nature'. Projects such as the Life ECOnet toolkit[9] offer an approach to linking priority habitats to form a coherent and sustainable network that will improve conditions for many species of plants and animals.

- Green infrastructure approaches to the integration of built and undeveloped land uses provide an opportunity to link potentially fragmented elements of historic land use into a more cohesive whole. The Liverpool City Region Green Infrastructure Framework is being developed to maximise the benefits that the city region can gain from the sustainable management of its natural environment. The framework covers the whole of Merseyside plus Warrington and Halton[10].

- Opportunities offered by the Community Forests and forest plans[11].

- The Mersey Valley and its tributaries have extensive coverage of non-native invasive terrestrial plants associated with lowlands and river courses namely Himalayan balsam, Japanese knotweed and giant hogweed.

- Challenges around managing new pests and diseases, such as *Chalara fraxinea* (or ash dieback).

[9] Accessed from **http://maps.cheshire.gov.uk/econet/index.asp**
[10] *Liverpool City Region and Warrington Green Infrastructure Framework DRAFT Action Plan*, The Mersey Forest (January 2013) (accessed October 2013; URL: **www.merseyforest.org.uk/our-work/green-infrastructure/liverpool-city-region-green-infrastructure-framework/**
[11] www.merseyforest.org.uk/plan; **http://www.redroseforest.co.uk/web/**

Supporting document 3: Analysis supporting Statements of Environmental Opportunity

The following analysis section focuses on a selection of the key provisioning, regulating and cultural ecosystem goods and services for this NCA. These are underpinned by supporting services such as photosynthesis, nutrient cycling, soil formation and evapo-transpiration. Supporting services perform an essential role in ensuring the availability of all ecosystem services.

Biodiversity and geodiversity are crucial in supporting the full range of ecosystem services provided by this landscape. Wildlife and geologically-rich landscapes are also of cultural value and are included in this section of the analysis. This analysis shows the projected impact of Statements of Environmental Opportunity on the value of nominated ecosystem services within this landscape.

Recreational trails including long distance paths, also serve to connect people. Cyclists at an access point next to the river at Mersey Way, Hale.

Statement of Environmental Opportunity	Food provision	Timber provision	Water availability	Genetic diversity	Biomass provision	Climate regulation	Regulating water quality	Regulating water flow	Regulating soil quality	Regulating soil erosion	Pollination	Pest regulation	Regulating coastal erosion	Sense of place/inspiration	Sense of history	Tranquility	Recreation	Biodiversity	Geodiversity
SEO 1: Conserve and enhance the Mersey Valley's rivers, tributaries and estuary, improving the ability of the fluvial and estuarine systems to adapt to climate change and mitigate flood risk while also enhancing habitats for wildlife and for people's enjoyment of the landscape.	↔ **	↔ **	↑ **	N/A ***	↔ **	↑ **	↑ **	↑ **	↗ **	↗ **	↗ **	↗ **	↑ **	↗ **	↗ **	↗ **	↗ **	↑ ***	↗ ***
SEO 2: Promote the Mersey Valley's historic environment and landscape character and positively integrate the environmental resource with industry and development, providing greenspace within existing and new development, to further the benefits provided by a healthy natural environment, as a framework for habitat restoration and for public amenity.	↔ **	↗ **	↗ **	N/A ***	↗ **	↗ **	↗ **	↗ **	↗ **	↗ **	↗ **	↗ **	↔ **	↑ ***	↑ ***	↗ ***	↑ **	↗ **	↗ **

Ecosystem Service

Note: Arrows shown in the table above indicate anticipated impact on service delivery: ↑ = Increase ↗ = Slight Increase ↔ = No change ↘ = Slight Decrease ↓ = Decrease. Asterisks denote confidence in projection (*low **medium***high) ° symbol denotes where insufficient information on the likely impact is available.

Dark plum = National Importance; Mid plum = Regional Importance; Light plum = Local Importance

Statement of Environmental Opportunity	Food provision	Timber provision	Water availability	Genetic diversity	Biomass provision	Climate regulation	Regulating water quality	Regulating water flow	Regulating soil quality	Regulating soil erosion	Pollination	Pest regulation	Regulating coastal erosion	Sense of place/inspiration	Sense of history	Tranquillity	Recreation	Biodiversity	Geodiversity
SEO 3: Manage the arable and mixed farmland along the broad linear Mersey Valley, and create semi-natural habitats, woodlands and ecological networks, to protect soils and water, enhance biodiversity, increase connectivity and improve the character of the landscape, while enabling sustainable food production.	↗ ***	↔ ***	↗ **	N/A ***	↗ **	↗ **	↗ **	↗ **	↗ **	↗ **	↗ **	↗ **	↔ ***	↗ **	↔ **	↗ **	↗ **	↑ ***	↔ **
SEO 4: Manage and enhance the mossland landscape in the east, safeguarding wetlands including the internationally important lowland raised bogs, to conserve peat soils, protect and enhance biodiversity, conserve archaeological deposits, contribute to landscape character and store carbon.	↔ **	↘ **	↗ **	N/A ***	↔ **	↑ ***	↗ **	↗ **	↗ ***	↗ ***	↗ **	↗ **	↔ ***	↗ ***	↗ **	↗ ***	↔ **	↑ ***	↗ ***

Note: Arrows shown in the table above indicate anticipated impact on service delivery: ↑ = Increase ↗ = Slight Increase ↔ = No change ↘ = Slight Decrease ↓ = Decrease. Asterisks denote confidence in projection (*low **medium***high) ° symbol denotes where insufficient information on the likely impact is available.

Dark plum = National Importance; Mid plum = Regional Importance; Light plum = Local Importance

Landscape attribute	Justification for selection
A low-lying landscape focusing on the broad linear valley of the River Mersey; estuarine in the west and with extensive areas of reclaimed mossland in the east.	■ The River Mersey flows from east to west, forming a central, low-lying area. ■ Distinctive river valley landscape focusing on the Mersey, its estuary and associated tributaries and waterways, although the Mersey itself is often obscured. ■ Downstream of Warrington Weir, the Mersey is tidally influenced. ■ In the east, small pockets of former mossland remain among land drained by ditches. ■ Generally low relief topography, with an average elevation of just 23 m, rising locally to 144 m towards the Cheshire Sandstone Ridge. ■ Some long distance views from elevated land such as Runcorn Hill, Helsby Hill and Overton Hill.
Underlain by Triassic sandstone, surface geology is principally drift material; marine and river alluvium in the valley bottom, extensive areas of till, pockets of glacial sands and gravels, with peat in some drainage hollows.	■ An important feature is the occurrence of peat soils (covering 9 per cent of the NCA). ■ Two geological Sites of Special Scientific Interest (SSSI). ■ 12 Local Geological Sites, including a Local Nature Reserve. ■ The Permo-Triassic sandstone forms an important aquifer providing public and private water supplies to towns, farms and industry.
The Mersey Estuary is a defining element in the landscape, with expansive intertidal mud/sand flats and low exposed cliffs.	■ In the west, the Mersey is estuarine in character with intertidal mud and sand flats and low exposed cliffs. ■ Estuarine habitats, in particular mudflats/sand flats and fringing salt marshes, contribute to landscape character and support a wide range of wildlife. ■ Open and expansive views out to and across the estuary. ■ Dynamic estuarine processes. ■ Constantly changing views with the flow and ebb of the tide. ■ The area around the river crossings at Runcorn and Widnes has become particularly industrialised.

Landscape attribute	Justification for selection
The River Mersey flows from east to west, joined by associated tributaries, although the Mersey itself is often obscured from view.	■ Tributaries include the rivers Weaver, Bollin, Ditton Brook and Sankey Brook. ■ The Manchester Ship Canal generally follows the original route of the River Mersey. ■ The Mersey itself is often obscured, inaccessible, and blocked from view by industry; in Ellesmere Port, for example, it is barely obvious at all that the town is situated on the Mersey.
Trees and woodland are mainly associated with settlements, occasional parkland and isolated woodland blocks; and in recent years new community woodlands have been planted.	■ Woodland covers 7.6 per cent of the NCA (3,383 ha). ■ The Red Rose Community Forest and Mersey Community Forest cover much of the area. ■ The majority of Dunham Park is pasture-woodland or park-woodland and has been managed as such since medieval times. ■ 132 ha ancient semi-natural woodland.
Large-scale, open, predominantly flat high-quality farmland between development, with primarily arable farming to north of valley and a mixture of arable and dairying to the south.	■ Two substantial bands of farmland follow the slopes of the broad linear Mersey Valley. ■ To the north of the Mersey the farmland has a large-scale open character dominated by arable fields which extend up to the Lancashire Coal Measures. ■ To the south, the area is a mix of arable and pasture which extends to the Shropshire, Cheshire and Staffordshire Plain. ■ In the east an extensive area comprising large-scale, open, flat farmland on the dark, rich peaty soils of the former mosses. ■ Grade 1 agricultural land on mosses west of Manchester and on the north side of the Mersey south of Speke; areas of Grade 2 and 3 land are intermixed between urban and industrial development.
Field pattern is regular and large-scale, often defined by hedgerows with isolated hedgerow trees; many hedgerows are intermittent and have been replaced by post and wire fencing; while field boundaries on the mosses are marked by ditches.	■ Where farmland has been fragmented by industrial or urban development field patterns are becoming fragmented fields are often defined by hedgerows and isolated hedgerow trees, many of which are intermittent and have been replaced by post and wire fencing. ■ Fields on the mosses are bounded by ditches.

Landscape attribute	Justification for selection
A range of important wetland habitats remain including estuarine mud/sand flats and fringing salt marshes in the west, remnants of semi-natural mosslands and pockets of basin peats in the east, with the broad river valley in between.	■ Mersey Estuary Special Protection Area (SPA) and Ramsar site covers 2 per cent of the NCA (968 ha). Estuarine habitats are of major importance for over wintering waders and wildfowl and as a valuable staging post for migrating birds in spring and autumn. ■ Manchester Mosses Special Area of Conservation (SAC). ■ Rixton Clay Pits SAC. ■ Relict semi-natural bog habitats include those at Astley and Bedford Moss, parts of Astley Moss East and Botany Bay Wood, Twelve Yards Road, Light Oaks Moss, Little Woolden Moss and Caddishead Moss, Holcroft Moss and Risley Moss. ■ Other wetland sites include Woolston Eyes, where lagoons, set aside to receive dredging from Manchester Ship Canal, provide important habitat for wintering wildfowl and breeding birds in summer, with its large areas of open water, reedbed and scrub vegetation. ■ A total of 13 SSSI wholly or partly within the NCA, covering 4 per cent (1,585 ha). ■ 83 local sites covering 7 per cent of the NCA (2,963 ha).
The predominant building material is red brick though some sandstone construction remains and some survival of earlier timber frame.	■ Many 19th and 20th century buildings have been built from brick. ■ The use of building stone tends to be confined to older buildings, churches, bridges and retaining walls. ■ Traditionally the buildings in this region would have been similar to the half-timbered buildings on the Shropshire, Cheshire and Staffordshire Plain. ■ Examples of the Cheshire vernacular, where timber-framed buildings were constructed on a stone plinth, can be found, an example being the 16th-century Speke Hall. ■ The village of Hale has retained its distinctive character with many thatched houses.
Densely populated urban and suburban areas, with major towns particularly at the river crossings, including Runcorn, Widnes and Warrington, where there is continuing residential expansion.	■ The character of this landscape has been highly influenced by the urban and industrial developments lining the banks of the Mersey. ■ The urban areas are characterised by a dispersed cluster of small to medium sized towns, located along the immediate banks and flood plain of the River Mersey.

Landscape attribute	Justification for selection
Large-scale highly visible industrial development, with docks, chemical and oil refineries.	■ There is significant industrial land use in the area including oil refinement, salt production, manufacturing industry and chemical processing. ■ Industrial infrastructure is often prominent, with large-scale, highly visible, development including docks, chemical plants and oil refineries. ■ With the proximity of the Lancashire coalfields to the north and the salt and ore deposits of the Cheshire Plain to the south, the areas around Runcorn and Widnes have become the focus for major chemical industries. ■ Large-scale industry has also developed along the Mersey, especially the oil refineries at Ellesmere Port and the Fiddlers Ferry Power Station.
The river valley has a dense communication network with motorways, roads, railways and canals running east–west; power lines are also prominent.	■ The Manchester Ship Canal links the Mersey Estuary to the heart of Manchester and contributed to the industrial development of the area. ■ The River Weaver Navigation, Bridgewater Canal, Leeds and Liverpool Canal and Shropshire Union Canal cross this NCA. ■ To the west is Liverpool Airport, while two railways and two motorways (M56, M62) connect east to west, and the M6 runs north–south across the eastern end of the area.

Landscape opportunities

- Positive management of urban fringe landscapes including woodland planting, and hedgerow restoration and planting to assimilate development.
- Conserve green spaces and create greenspace, including individual trees, groups of trees, woodlands, urban parks, canals and other habitats, in appropriate urban and industrial areas and settlements, such as school playing fields, open spaces, streets, highway verges, institutional grounds, derelict land, tipped and industrial land and development sites, for their many benefits, including providing places for recreation, to improve quality of life and to create places of relative tranquillity locally.
- Ensure that greenspace is provided within urban and industrial areas, providing access opportunities, and pockets of tranquillity, and enhance the ecological diversity, such as providing new planting and leaving uncut areas of grass and wildflowers.
- Conserve woodlands, including ancient woodlands, and plant woodlands as a buffer.
- Establish woodlands, copses, hedgerows and other habitats to assimilate new and existing industrial and residential development into the landscape.
- Manage and restore hedgerows and field boundary trees in the farmland areas away from the mosses, wetlands and estuary, to strengthen field patterns, and aim to link fragmented and degraded habitats.
- Maintain agricultural productivity on good quality land between settlements.
- Manage agricultural land to improve the landscape and as a habitat resource, particularly for farmland birds such as corn bunting, grey partridge and lapwing.
- Conserve open and expansive views of the landscape, such as views from the top of Runcorn Hill, Helsby Hill, Overton Hill and the Cheshire Sandstone Ridge.
- Plan to link and connect potentially fragmented habitats into a more cohesive whole and enable movement of species.
- Protect, restore and buffer the mosslands and wetland areas, including lowland raised bogs.
- Conserve the historic buildings and character of the villages ensuring high quality design.
- Maintain and enhance the estuarine habitats, in particular mudflats/sand flats and salt marshes, that contribute to landscape character, provide tranquil places and support the wide range of wildlife.
- Conserve the open and expansive estuary views, including mudflats/sand flats and salt marshes along the Mersey Estuary.
- Allow for the continuing dynamic estuarine processes. Plan for and proactively seek opportunities to enhance estuarine habitats alongside coastal adaptation programmes.
- Provide improved interpretation and educational facilities to increase visitors' understanding and enjoyment of the NCA's natural and historic features, and engage the local community in its future management.
- Conserve and manage the banks of the linear features such as canals, roads, railways, for their biodiversity interest.
- Conserve the river corridor and enhance the visual unity of the Mersey river valley.
- Promote links between a healthy environment and economic growth, for example by promoting the benefits of a clean and healthy waterside environment as a positive focus for regeneration.

Ecosystem service analysis

The following section shows the analysis used to determine key ecosystem service opportunities within the area. These opportunities have been combined with the analysis of landscape opportunities to create Statements of Environmental Opportunity.

Please note that the following analysis is based upon available data and current understanding of ecosystem services. It does not represent a comprehensive local assessment. Quality and quantity of data for each service is variable locally and many of the services listed are not yet fully researched or understood. Therefore the analysis and opportunities may change upon publication of further evidence and better understanding of the inter-relationship between services at a local level.

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Food provision	Arable systems Grazing Horticulture Soils	Total farm area in 2009 was 18,001 ha, with 21 per cent livestock, 47 per cent arable and horticulture, and 7 per cent mixed farms. Grades of agricultural land (Grade 1, 6 per cent; Grade 2, 25 per cent; Grade 3, 30 per cent; Grade 4, 1 per cent and Grade 5, 4 per cent). In 2009 total cattle 8,848; total sheep 7,468; total pigs 4,615. To the north of the River Mersey agriculture is dominated by arable cultivation. To the south of the River Mersey pasture becomes more frequent. Mixed farming with arable and dairying predominates. **Continued on next page...**	Regional	Agriculture is important to the area with over 30 per cent of the NCA being Grade 1 or Grade 2 agricultural land. However, the Agricultural Classification of Land masks a number of distinct differences across the area, with some land being used for turf production or equestrian use rather than food provision. There has also been an historic loss of agricultural land to industrial development and settlement expansion, along with a decline in field boundaries, particularly to the north. Some existing farming practices help to maintain important farmland bird species. There is some grazing of the coastal marshes by sheep and by cattle.	Work with the local farming community to explore how to produce food sustainably, while conserving soils and protecting water quality. Maintain biodiversity, through sustainable agricultural practices. Manage and restore hedges and field boundary trees in the farmland areas away from the mosses and wetlands to protect soils, water and enhance biodiversity and the landscape, as well as contributing to the production of high quality food. Manage and restore mosses and estuarine wetlands.	**Food provision** **Regulating soil quality** **Regulating soil erosion** **Regulating water quality** **Pollination** **Pest regulation** **Sense of place / inspiration** **Biodiversity**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Food provision cont		**... continued from previous page** On the dark rich peaty soils of the former mosses farming is mixed, with arable cropping, potatoes and some limited horticulture.		The rich peaty soils in the drained mosslands are highly fertile, highly cultivated and dissected by a complex drainage network. Expansion of food production could place further pressure on remaining fragmented semi-natural mossland habitats. The combination of high quality land next to extensive urban populations, along with good communication routes, could provide nearby markets for locally branded products, thereby reducing food miles and re-establishing local pride in the farming industry.	Explore and promote the marketing of quality local produce to nearby extensive urban populations.	

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Timber provision	Broadleaf woodland Conifer woodland Mixed woodland 2 Community Forests	Existing woodland 3,383 ha (broadleaf 2,645 ha, conifer 114 ha, mixed 253 ha). There are 132 ha ancient semi-natural woodland and 2 ha of Plantations on Ancient Woodland Sites (PAWS). The Red Rose and Mersey Community Forests.	Local	Woodland cover is limited across most of the area but there are some opportunities for woodland creation. Increasing woodland cover in appropriate locations such as on the fringes of urban and industrial areas and improving management of existing woodlands would provide opportunities to create innovative wood fuel and timber industries locally. This has multiple benefits including mitigating climate change as well as providing improved sense of place and an increase of habitats for wildlife and recreational use, and can also assist with assimilating new development into the landscape. The open character and wetland in some locations within the Mersey Valley, and the extensive urban and industrial areas, will limit the opportunities for expanding commercial timber production. There is a need to ensure that new woodlands and hedgerow trees are planted to enhance the local landscape character in terms of typical scale, type and location and avoid impacting on existing features of historic interest, open character or semi-natural habitats such as in the mosslands.	Encourage the appropriate management of existing woodlands. Create new woodlands in suitable locations such as on the fringes of urban and industrial areas for multi-purpose use as part of the Community Forest initiative including innovative wood fuel, timber and forest industries. Seek to ensure that new woodland strengthens the local landscape and enhances biodiversity, providing opportunities for recreation and, benefits for water quality, soil quality and flood risk management where possible. Create new woodlands to assimilate new development into the landscape to enhance local landscape character, but avoiding planting in open landscapes such as along the estuary or in semi-natural habitats such as the mosslands.	**Timber provision** **Biomass energy** **Regulating water quality** **Regulating water flow** **Regulating soil erosion** **Tranquillity** **Recreation** **Biodiversity**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Water availability	Rivers Aquifers Precipitation Semi-natural habitats	Geology is dominated by sandstones that are part of the Permo-Triassic sandstone aquifer. The NCA overlays a variety of groundwater management units (GWMUs) consisting of major sandstone aquifers, with groundwater abstractions mainly for public water supply[12]. The principal rivers in the NCA are the River Mersey and its tributaries the River Bollin, Ditton Brook, Sankey Brook and Glaze Brook. Surface water abstraction within the lower Mersey area is heavily dominated by industrial abstraction, and to a lesser extent, agriculture.[13] There are no surface water abstractions for public water supply primarily due to water quality issues.[13] The River Weaver flows from the south to its confluence with the Manchester Ship Canal and the Mersey Estuary just north of Frodsham.	Regional	The Lower Mersey catchment has had a long history of heavy groundwater abstraction mainly for domestic water supply and industry. This over abstraction, which continued into the 1980s, has lowered groundwater levels below surface and sea level. This has occurred in places such as the coastal strip around Warrington, Widnes, and Ellesmere Port, resulting in saline intrusion from the Mersey Estuary. The extensive built-up areas of the towns, roads and industrial areas create impervious surfaces that cause water to run off land more quickly. Improving permeability in urban and industrial areas through providing green spaces can improve infiltration rates. Increases in semi-natural habitats within the wider countryside, such as areas of grassland and woodland, can improve water infiltration.	Plan to manage over-abstraction from groundwater and rivers through careful and efficient use of water. There are opportunities to develop sustainable urban drainage systems (SUDs) in new and existing development to improving infiltration and manage surface water as well as increasing greenspace. Increasing the area of greenspace within urban and industrial areas would also provide benefits for access, recreation and biodiversity. Seek opportunities to create habitats in the wider countryside such as permanent grassland or woodlands, to improve infiltration, which also reduces rate of run-off and can capture sediments and contaminants.	**Water availability** **Regulating water flow** **Regulating water quality** **Biodiversity** **Sense of place / inspiration** **Geodiversity**

[12] *Lower Mersey and Alt abstraction licensing strategy,* Environment Agency (February 2013) (accessed October 2013; URL: http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/LIT_7881_35d3ed.pdf)

[13] *Liverpool City Region and Warrington Green Infrastructure Framework DRAFT Action Plan,* The Mersey Forest (January 2013) (accessed October 2013; URL: www.merseyforest.org.uk/our-work/green-infrastructure/liverpool-city-region-green-infrastructure-framework/

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Genetic diversity	N/A	N/A	N/A	N/A	N/A	**Genetic diversity**
Biomass energy	Woodland Red Rose and Mersey Community Forests 19 wood fuel boilers 1 wood fuel supplier	Woodland cover (7.6 per cent) offers limited potential for the provision of biomass. The indicative opportunities for energy crop yields are that the NCA predominantly has a low potential yield for SRC with some areas of medium or high potential, while potential miscanthus yield is high. For information on the potential landscape impacts of biomass plantings within the NCA, refer to the tables on the Natural England website[14].	Regional	In this NCA the existing woodland cover (7.6 per cent) offers limited potential for the provision of biomass, either through bringing unmanaged woodland under management or as a by-product of commercial timber production. Schemes such as wood allotments in the Mersey Forest enable woodland owners to engage local communities and manage their woods at the same time. People get fresh air, exercise, new skills, and a cheap, locally sourced renewable fuel, while the woodland receives important thinning to ensure its future health. There are opportunities from arboricultural arisings and waste wood as well as small amounts from existing woodland including the newer community woodlands. Power stations, including Fiddlers Ferry, are exploring ways of achieving more energy production through use of renewable biomass sources, and their decisions may impact on the crops grown in close proximity, such as miscanthus. **Continued on next page...**	Seek opportunities to encourage sustainable management of woodlands where appropriate, to produce surplus timber and biomass for local use, such as wood-fired boilers. Increase the extent of woodland where this would not impinge on sites of nature conservation value or obstruct long views and where new woodland can enhance the habitat mosaic. Seek opportunities to accommodate SRC and miscanthus without impacting upon other services.	**Biomass energy** **Timber provision** **Biodiversity** **Recreation**

[14] http://www.naturalengland.org.uk/ourwork/farming/funding/ecs/sitings/areas/default.aspx

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biomass energy cont				**... continued from previous page** There may be opportunities within the Mersey Valley for both SRC and miscanthus to be accommodated without significant landscape effects, due to the low-lying valley character, the complex land use pattern including arable and mixed farmland, and the existing urban influence on the landscape. However this is also an area under much pressure where there are sensitive views, habitats and other interests to be taken into account. Increased provision of SRC and miscanthus as a source of renewable energy could contribute towards addressing climate regulation, and assimilate new development into the landscape, but could also decrease provision of food if grown on the generally good quality farmland.		

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Climate regulation	Soils Wetlands including lowland raised bogs Woodland Estuarine habitats	Soil carbon levels are low (0–5 per cent) across much of the western half of the NCA, reflecting the 52 per cent coverage by mineral soils. Large areas of higher carbon content (20–50 per cent) occur, largely in the east of the NCA, reflecting the area's remaining soil types which all contain organic-rich or peaty layers. These cover a total of 45 per cent of the area, and include raised peat bog soils (9 per cent). Carbon storage is also provided by the woodland within the NCA (7.6 per cent of NCA), especially where it is brought under management. Salt marsh soils (2 per cent) can have elevated organic matter levels and be an important carbon store.	National	The peaty and organic soils of the NCA have an important role in carbon sequestration and storage. Raised peat bog soils provide an important store of carbon. Peat cutting, drainage and reclamation for agriculture can lead to loss of carbon stocks. Oxidation can make the peat vulnerable to both wind and water erosion. Adopting management options which reduce the soil disturbance, erosion and oxidation is likely to result in retaining carbon stores. Positive management of wetlands, including lowland raised bog, could result in significant gains in carbon sequestration. In cultivated areas, some soils may have potential for carbon sequestration by conserving soil structure and increasing the organic matter content, for example by introducing buffer strips alongside watercourses, and converting cropped land to grassland or woodland. **Continued on next page...**	Encourage the management, enhancement and expansion of areas of lowland raised bog to increase their ability to actively store and sequester carbon. Bring the Manchester Mosses SAC and other local sites into favourable condition. Encourage the buffering of lowland raised bogs by working with adjacent land managers to raise water table levels and create fen and wet woodland, to protect the hydrological function of the bog and improve carbon storage. Take actions to reduce soil loss in cultivated areas. Encourage introduction and adoption of low input grassland management to promote carbon sequestration, and the creation of unfertilised grassland buffer strips in arable areas.	**Climate regulation** **Timber provision** **Regulating water flow** **Regulating soil erosion** **Regulating coastal erosion** **Biodiversity** **Geodiversity**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Climate regulation cont				**... continued from previous page** Carbon storage and sequestration is provided by the area's woodland and can also be provided by the mudflats, salt marsh and marine sediments, all of which store high levels of organic matter. Some of these may be lost through sea level rise. Wetland, woodland and estuarine habitats should be protected, managed and enhanced and expanded where possible and appropriate.	Seek opportunities to extend areas of wetland along rivers and in valley bottoms. Seek opportunities to increase the carbon storage potential of the area through the conservation management of woodlands and the planting of new woodland where appropriate. Seek opportunities to conserve and expand areas of mudflats and salt marsh, such as through managed realignment schemes allowing intertidal habitats to develop.	

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water quality	Precipitation Rivers, streams and canals Semi-natural habitats Nitrate Vulnerable Zone 20,486 ha (46 per cent of the NCA)	The Mersey Valley NCA includes parts of the Upper Mersey, the Mersey Estuary, and the Weaver Gowy catchments. The number and status (in 2012) of the water bodies are presented in the North West River Basin District: Challenges and Choices[15]. There are 85 water bodies within the Upper Mersey Catchment. 12 are at good quality (14 per cent); 60 are moderate (71 per cent); 13 are poor (15 per cent). In the Upper Mersey Catchment pollution from waste water affects 36 per cent of the water bodies; pollution from towns, cities and transport affects 19 per cent of the water bodies; pollution from rural areas affects 15 per cent of the water bodies and includes slurry, manure and silage liquor. There are 32 water bodies within the Mersey Estuary Catchment. Twenty-one are at moderate quality (66 per cent); 8 are poor (25 per cent); 3 are bad (9 per cent). **Continued on next page...**	National	The Mersey Basin Campaign (1985–2010) was set up to improve water quality in the Mersey Basin, thereby stimulating the regeneration of derelict land beside the river and its tributaries. Significant water quality improvements have occurred. In urban areas, the waterside is now seen as a positive focus for regeneration[16]. Improvements to water quality mean that salmon and sea trout have returned to the Mersey. The coarse fisheries are improving but there is still much to be done. In the Upper Mersey Catchment, investment is needed to target waste water infrastructure. With an extensive transport network and large urban areas, pollution from towns, cities and transport is widespread. Residential and trade developments are significant sources of pollution in the form of discharges from storm water overflows and urban run-off. Releases from industrial discharges and historical landfills have also caused localised water quality problems.	Manage and enhance habitats such as wetlands and grasslands to capture sediments and contaminants before they enter watercourses. Identify river stretches for restoration by re-connecting rivers to their flood plains and take opportunities to de-culvert and re-naturalise rivers to provide space for water, enabling natural geomorphological processes and dissipating the energy of the flows, while also creating habitats for wildlife. There are opportunities to develop SUDS in new development and industrial areas to improve infiltration and water quality. Work with local land managers to encourage adoption of improved land management practices, such as matching nutrient inputs	**Regulating water quality** **Water availability** **Regulating water flow** **Biodiversity** **Recreation** **Sense of place / inspiration**

[15] *North West River Basin District: Challenges and choices*, Environment Agency (June 2013) http://www.naturalengland.org.uk/ourwork/farming/funding/ecs/sitings/areas/default.aspx

[16] Mersey Basin Campaign Study: 2006 Final Report, *Government Office North West (July 2006)* (accessed October 2013; URL: www.merseybasin.org.uk/archive/assets/57/original/57_EKOS_Consulting_2006_Evaluation_of_the_MBC_report_to_Govt_Office_NW.pdf

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water quality cont		**... continued from previous page** There are three designated bathing waters in the Mersey Estuary Catchment. All are predicted to achieve the standards required for bathing. There are two designated shellfish waters in the Mersey Estuary Catchment. Both fail the bacteriological standards. Pollution from waste water affects 94 per cent of the water bodies. Pollution from towns, cities and transport affects 72 per cent of the water bodies in the Mersey Estuary Catchment; pollution from rural areas affects 34 per cent of the water bodies. There are 85 water bodies within the Weaver Gowy Catchment. Nine are at good quality (11 per cent); 40 are at moderate quality (47 per cent); 27 are classed as poor (31 per cent); 4 are classed as bad (5 per cent); 5 are currently not assessed (6 per cent). Pollution from waste water is a significant issue in 72 per cent of the water bodies in the Weaver Gowy Catchment; pollution from rural areas is a significant issue in 71 per cent of water bodies. Groundwater drinking water supplies are affected by nitrate and parts of the sandstone aquifer in the west have been designated as a Safeguard Zone. **Continued on next page...**		Most houses and businesses in the Mersey Estuary Catchment are connected to the sewer network, but sometimes the sewerage systems do not discharge as they should or household waste water is wrongly connected. Similarly, ageing sewage treatment infrastructure can also cause problems. It is increasingly important that developments include sustainable urban drainage systems to control both run off and pollutants washed into watercourses. Pollution from wastewater is a significant issue, as the greatest contribution to phosphorus in the watercourses is from sewage treatment works. Future investment needs to take account of both the current capacity of the wastewater infrastructure and the capacity that will be needed in areas targeted for growth, such as Warrington and Runcorn. Many of the rivers in the catchment have been modified through channelisation, culverting and flood protection schemes; these modifications may pose barriers to fish migration and impact on the overall condition of the watercourse.	to crop requirements, to address water quality issues across the river catchment. On cropped land, establish buffers such as permanent unfertilised grassland or scrub along watercourses to capture nutrients and sediments.	

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water quality cont		**... continued from previous page** This mixed picture reflects pollution from the industrial heritage of the NCA, as well as discharges from major sewage treatment plants such as St Helens, Huyton and Liverpool. The catchment has a rich industrial past, and consequently, the Mersey became known as one of the most polluted rivers in Europe. Historic chemical industries also left a legacy of contaminated land.		The Environment Agency's approach includes creating suitable juvenile habitat for River Mersey fry; local investigations to find the origins, cause and solutions to pollution; investigating contaminated land issues and possible remediation; implementing measures to tackle oil pollution in ports, harbours and docks to improve water quality and reduce sedimentation; improving waste water treatment works; improving elver and eel passes in tributaries of the Lower Mersey to encourage eel migration currently obstructed by man-made barriers. Current water quality issues also include the impacts of agricultural activities which can lead to high nitrate and pesticide concentrations occurring in surface and groundwater. This has led to the designation of a Nitrate Vulnerable Zone.		

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water flow	Rivers and canals Wetlands Estuary Precipitation	The River Mersey flows west through the area and enters the Irish Sea at Liverpool Bay. The Mersey is tidally influenced downstream from Howley Weir (Warrington). The catchment has been heavily modified for industrial purposes, and this has affected the natural response of river flows. The Manchester Ship Canal, which was built for navigation, reduces fluvial flood risk through Warrington[17]. The catchment is largely low lying with a few steeper areas. The response to rainfall is generally slow but is much faster for some of the smaller tributaries flowing through urbanised areas. Some properties are at risk of fluvial flooding, including in Warrington. Where rivers discharge into an estuary or the sea, such as the River Weaver at Runcorn, there can potentially be either a fluvial or tidal flood event or both at the same time. Therefore, flood damage in tidal and fluvial flood risk areas like Stanlow, Runcorn and Frodsham, could be relatively high[18]. **Continued on next page...**	National	Surface water flooding can occur throughout the catchment but usually only causes a low level of risk. Some of the urban areas of Warrington have high surface water flood risk. Isolated sewer flooding affects various locations across the catchment and there is an ongoing programme of work to maintain and improve public sewers in Warrington. The Environment Agency's preferred approach to managing flood risk is to address the issues in the upper catchment of the Mersey and its tributaries including investigating the use of upstream flood storage, for example using redundant reservoirs to store storm run-off or storage on agricultural land and beneficial land management changes. Appropriately designed SUDs will also be encouraged. Around the mosslands, there is a network of drainage ditches connected to an arterial network of streams, including Moss Brook and Glaze Brook, which have been enlarged and re-aligned over time and are at risk of flooding as they are low-lying and have relatively narrow flood plains.	Seek opportunities to increase water storage and alleviate the speed of run-off through the expansion of wetlands and other habitats such as reedbeds and wet woodland in flood plains. There are opportunities to develop SUDs in new development and industrial areas to alleviate the speed of run-off. Identify river stretches for restoration by re-connecting rivers to their flood plains and take opportunities to de-culvert and re-naturalise rivers to provide space for water, enabling natural geomorphological processes and dissipating the energy of the flows, while also creating habitats for wildlife.	**Regulating water flow** **Water availability** **Regulating water quality** **Biodiversity** **Sense of place / inspiration**

[17] *Mersey Estuary Catchment Flood Management Plan Summary Report,* Environment Agency (December 2009) (accessed October 2013; URL: **www.environment-agency.gov.uk/research/planning/33586.aspx)**

[18] *Weaver Gowy Catchment Flood Management Plan*, Environment Agency (2009) (accessed October 2013; URL: **www.environment-agency.gov.uk/research/planning/114513.aspx**)

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water flow cont		**... continued on next page** The main sources of flooding are river flooding mainly from the Mersey's tributaries; Sankey Brook affects Warrington, Ditton Brook affects Widnes. Tidal flood risk exists at several locations along the Mersey Estuary. There are tidal defences for many of the areas at risk. There are areas where tidal flood risk combines with fluvial flood risk on the lower reaches of the tributaries, and on the stretch of the Mersey between Arpley Landfill Site and Woolston Weir in Warrington.		Water storage can be enhanced through the restoration and creation of habitats such as woodlands wetlands, ponds and other features, which also good for wildlife. Woodlands in flood plains and near to rivers allow the river to spread out over its natural flood plain, retaining water and slowing its progression downstream.	Ensure that drainage ditches and adjacent land are managed in ways which will conserve the biodiversity value of the remnant mosslands, maintain the peat soils, and which will facilitate their management. Manage brooks such as Glaze Brook to create a more natural, responsive environment. This could include creating wet grasslands, reedbeds and willow planting to increase biodiversity and amenity value.	

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil quality	Soils Geology	There are 10 main soilscape types in this NCA: ■ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (44 per cent); ■ Naturally wet very acid sandy and loamy soils (19 per cent); ■ Raised bog peat soils (9 per cent); ■ Freely draining slightly acid sandy soils (6 per cent); ■ Loamy and clayey flood plain soils with naturally high groundwater (6 per cent); ■ Loamy and sandy soils with naturally high groundwater and a peaty surface (5 per cent); ■ Salt marsh soils (2 per cent); ■ Freely draining slightly acid loamy soils (2 per cent); ■ Freely draining very acid sandy and loamy soils (2 per cent); ■ Loamy and clayey soils of coastal flats with naturally high groundwater (2 per cent).	Regional	The soils covering 10 per cent or more of the NCA are described below. The slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils may suffer compaction and/or capping as they are easily damaged when wet. In turn this may lead to increasingly poor water infiltration and diffuse pollution as a result of increased surface water run-off. Management measures that avoid compaction and increase organic matter levels can help reduce these problems. On cropped land these could include avoiding the use of heavy machinery, careful timing of cultivations, incorporating fallow into rotations, over-wintering stubble. The naturally wet very acid sandy and loamy soils can have a weak structure but are easily worked. Topsoil compaction can occur as well as cultivation pans. The raised bog peat soils are variable, often modified by drainage, peat cutting and reclamation for agriculture. All peaty soils are high risk soils, as these soils are susceptible to shrinkage and wastage, during which the peat dries out and oxidises. **Continued on next page...**	On grazed land, encourage sound land management practices which minimise/reduce negative impacts of soil structural deterioration such as extensive grazing, reduced inputs of artificial fertilisers and use of manure in preference, thereby supporting sustainable food provision. On cropped land, encourage the incorporation of fallow into crop rotations, ploughing in of over-wintering stubbles and careful timing of re-seeding and avoiding use of heavy machinery, to avoid compaction. Pursue opportunities to manage peat soils and implement soil protection measures, to prevent drying out, oxidation, and maintain soil structure. Safeguard soils to contribute to sustainable food production. Consider re-wetting peat soils for habitat creation. There may be scope for maintaining carbon stores by reducing cultivation or raising water levels.	**Regulating soil quality** **Food provision** **Regulating soil erosion** **Biodiversity**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil quality cont				**... continued from previous page** Appropriate soil protection measures on arable peat soils include use of cover crops, minimising the damage to plant cover, careful timing of operations, avoiding and addressing soil compaction. Lowland peat soils under agriculture should maintain water levels as high as practical. On grassland or in recreational areas avoid bare soil using sensitive grazing or recreational management techniques.		
Regulating soil erosion	Vegetation cover Soils	The soils that cover just over half (52 per cent) of this NCA are not susceptible to erosion. The remaining soil types that are susceptible to erosion are the freely draining slightly acid loamy soils (2 per cent); freely draining slightly acid sandy soils (6 per cent); freely draining very acid sandy and loamy soils (2 per cent); naturally wet very acid sandy and loamy soils (19 per cent); and raised bog peat soils (9 per cent).	Regional	The freely draining slightly acid loamy soils, the freely draining slightly acid sandy soils, and the freely draining very acid sandy and loamy soils can erode easily, especially on steep slopes, where vegetation is removed or where organic matter levels are low after continuous cultivation. The first two of these soil types are light and at risk of wind erosion, especially where coarse textured (freely draining slightly acid loamy soils), cultivated or left bare. The naturally wet very acid sandy and loamy soils are also susceptible to wind erosion and some variants are also easily eroded by water if heavily trafficked or after heavy rain. **Continued on next page...**	Work with the farming community to safeguard and enhance soil structure, to protect and enhance the soil resource and ensure soils can support sustainable food provision. In cropped areas, manage and enhance riparian habitats to reduce soil erosion rates, creating permanent grassland strips to trap sediment run-off before it enters the streams. In farmed land, encourage the restoration and management of 'gappy' hedgerows in poor condition so that they fill out and	**Regulating soil erosion** **Food provision** **Regulating water quality** **Regulating soil quality** **Biodiversity** **Geodiversity**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil erosion cont				**... continued from previous page** Dry cultivated peat soils are very easily eroded by wind. Peaty soils which have not been fertilised are particularly suited to peat extraction but this can cause the remaining peat to shrink and oxidise, thus becoming susceptible to wind erosion. There is also a risk of wind erosion of these soils and the loamy and sandy soils with naturally high groundwater and a peaty surface (5 per cent of NCA), especially where surfaces are bare or spring crops are grown. Addressing these issues is likely to require a number of different measures, including use of cover crops, minimising the damage to plant cover, careful timing of operations, and avoiding and addressing soil compaction.	act effectively as windbreaks and bind/filter out the soil in times of flood. Seek opportunities to manage and create semi-natural habitats and ecological networks within the farmed landscape which will protect soils and water and enhance biodiversity. Pursue opportunities to manage peat soils and implement soil protection measures, to prevent drying out, oxidation, and maintain soil structure.	

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Pollination	Areas of semi-natural habitats Gardens and allotments Road verges Horticulture	Only about 8 per cent of the area is covered by semi-natural habitats, which support pollinating insects. Hedgerows within some of the farmed land, road verges, canal and railway banks, gardens, allotments and parks can all support pollinating insects.	Local	Insect pollination, mostly by bees, is necessary for production some crops (for example, most fruit trees, berries, oilseed rape and field beans). In 2009, 6 per cent of farms in the Mersey Valley were in horticulture. Providing suitable nectar sources at a landscape scale and the habitat structures required for pollinating insects should help to address the pollination needs of these and other farms. More pollinating sources could be provided by appropriate seeding and management of the network of road verges, motorway, canal and railway banks to encourage flower-rich grasslands.	Maintain and enhance nectar-rich margins and species-rich semi-natural habitats especially hedges, field margins and conservation headlands, to form a coherent network within the agricultural landscape. Seek opportunities to introduce species-rich grassland, and pollen and nectar strips, within urban areas, along motorway and road verges, canal and railway banks, and alongside watercourses such as the Mersey River, and appropriate management to provide habitats that will support pollinating insects.	**Pollination** **Food provision** **Biodiversity**
Pest regulation	Semi-natural habitats Field margins and hedgerows	The habitats in the area support a variety of species, such as beetles, which can regulate the populations of pests such as aphids.	Local	Many hedgerows have been replaced with post and wire fencing. Increasing diversity in species and structure of hedgerows and field margins will increase the ability for these areas to support populations of pest regulating species such as invertebrates, birds and mammals.	Within the farmed landscape, seek opportunities to restore and enhance hedgerows and field margins, and introduce beetle banks to encourage a network of habitats for pest regulating species close to areas of agricultural production.	**Pest regulation** **Food provision** **Biodiversity**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating coastal erosion and flooding	Tidal stretches of all the main rivers Natural intertidal mudflats/sand flats and salt marsh defences	The Mersey Estuary is very industrialised with extensive port facilities power stations and oil refineries. There are also substantial urban areas and the Manchester Ship Canal runs along the southern shoreline of the Inner and Upper estuary. Intertidal mud/sand flats and salt marsh vegetation is subject to tidal flooding. Intertidal habitats are valuable for effectively absorbing the energy from waves and thus provide a natural defence against flooding, but are under threat due to sea level rise. The dynamic process of erosion and accretion on mud/sand flats and salt marshes is necessary to maintain a succession of diverse habitats.	National	The hard defences along much of the estuary make it difficult to find space to allow intertidal habitats to move back ('coastal squeeze') thus exacerbating the impacts of flood waters. In the upper estuary, the long-term plan is to improve the natural functioning of the estuary, and potentially reduce flood risks upstream and create additional habitat[19]. A number of potential areas for managed realignment have been identified in the Upper Estuary. The long-term plan in the Narrows and Inner Mersey Estuary is to maintain the status quo by continuing to provide the same extent of protection currently afforded to property and infrastructure, while allowing natural evolution of the estuary where there are currently no defences present. **Continued on next page...**	Carry out research to better understand changes that will take place in event of sea water rise/ flooding and subsequent impact on estuarine habitats and land use. Understand and address sustainability and environmental priorities. Possible climate change adaptation actions include intertidal habitat roll back, and managed realignment. Where possible, ensure the retention of mudflats and salt marshes, to provide a cost effective defence against erosion and flooding. Work with the Environment Agency, landowners and other stakeholders to identify scope for pulling back flood defences, and for managed realignment schemes in accordance with the Shoreline Management Plan. Ensure that these sites are managed to create high quality habitats for biodiversity and sense of place.	**Regulating coastal erosion and flooding** **Climate regulation** **Regulating soil erosion** **Sense of place / inspiration** **Recreation** **Biodiversity** **Geodiversity**

[19] *North West England and North Wales Shoreline Management Plan SMP2 – main document and Mersey Estuary (Unit 11a 7),* North West and North Wales Coastal Group (July 2010) (accessed from http://mycoastline.org/index.php?option=com_frontpage&Itemid=1)

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating coastal erosion and flooding cont				**... continued from previous page** In the Upper Mersey Estuary managed realignment was assessed as an alternative policy to offset for the potential loss of internationally designated habitat elsewhere (due to hold the line policies and predicted sea level rise resulting in coastal squeeze) and to help manage flood risk[20]. The risks from contamination related to potential flooding or erosion of historical landfills and industrial sites are uncertain and future studies will be required to address these uncertainties.		

[20] *Mersey Estuary Catchment Flood Management Plan Summary Report,* Environment Agency (December 2009) (accessed October 2013; URL: www.environment-agency.gov.uk/research/planning/33586.aspx)

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
A sense of place/ inspiration	The Mersey River and Estuary Mosslands Farmland Extensive industrial complexes and docks Canals Country Parks, Local Nature Reserves, Parks and other green spaces	Sense of place is provided by the river valley and estuary of the Mersey and its associated tributaries and waterways, edged by major settlements including Ellesmere Port, Warrington, Runcorn and Widnes, and extensive areas of oil refineries, chemical works, docks and other industrial activities. Varied landscape ranging from intertidal mudflats/sand flats and low exposed cliffs in the west, to homogenous, large-scale open arable farmland in the north. Mixed arable with dairying occurs to the south of the Mersey, often defined by degraded hedgerows, while in the east small pockets of former mossland remain amongst land drained by ditches. Here land use is defined by farming, industry and residential use, while isolated blocks of woodland are also a feature. Elsewhere, woodland and trees are limited to settlements, field boundaries and watercourses. Daresbury village was the birth place of author Lewis Carroll.	Regional	The area has a heavily industrial character, with docks, chemical and oil refineries and extensive urban and suburban areas, and associated transport infrastructure including the Manchester Ship Canal, Bridgewater Canal, Shropshire Union Canal and Leeds and Liverpool Canal. The Manchester Ship Canal is a major feature of the area, and can be seen where the M6 rises over the Thelwall Viaduct high above it and the marshy areas of Woolston Eyes. Senses of inspiration and escapism are likely to be constrained by urban development and industrialisation, although views of the industrial complexes themselves, both during daytime and at night when they are lit up, can be dramatic. **Continued on next page...**	Conserve the open and exposed character of the mud/sand flats and salt marshes along the Mersey Estuary. Improve understanding of the many features and functions of the estuary, including its active geomorphological processes and wildlife value. Improve understanding and enjoyment of the mosslands and the mosaic of lowland raised bogs. Protect the sense of place by conserving and enhancing the Mersey River valley, parks and urban green spaces. Increasing the provision of green spaces, as well as enabling people to access and enjoy them. Seek opportunities to encourage urban populations to engage with the natural environment through better access provision, and volunteering activities within local green spaces, and encouraging their involvement in the future management of sites.	**Sense of place / inspiration** **Sense of history** **Recreation** **Biodiversity**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
A sense of place/ inspiration cont				... **continued from previous page** Inspiration is also provided by the broad panoramic views to the west across intertidal mudflats/sand flats and low, exposed cliffs, with significant areas of grazing marsh and fens and pockets of lowland raised bogs, views from Runcorn Hill. The natural heritage of the river valley, parks and urban green spaces, as well as the parklands such as Dunham Park, Castle Park and Walton Hall Gardens, are important as comparatively tranquil recreational areas being close to where people live, as well as providing valuable wildlife corridors, contributing to providing a sense of place and inspiration.	Carefully design and integrate green infrastructure within housing and industrial development, linking new developments with the wider countryside.	

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of history	Industry Canals Registered Parks and Gardens Scheduled Monuments Listed Buildings Traditional churches and red-brick terraces Local Geological Sites including Local Nature Reserves	The history of the landscape is associated with the Mersey. Historic development, particularly linking to the ports, trade and industry. Aspects of history likely to be particularly evident to the public are the reclaimed mosslands, industrial evidence including canals, railways, and the Registered Parks and Gardens of Dunham Massey and Castle Park, Frodsham. The docks at Ellesmere Port were still in use as late as the 1950s. These now form part of the National Waterways Museum. Evidence of strategic crossing points remain in the form of ancient fortifications at Warrington and, more recently, gun sites defending the Mersey Valley during the Second World War. Twelve Local Geological Sites, one of which is a Local Nature Reserve (Helsby Quarry).	Regional	Areas of peat, including lowland raised bog, have the potential to preserve organic remains including pollen, and other palaeo-environmental evidence. As peat dries out, the organic resource will deteriorate, leading to degradation of the archaeological resource. Managing areas of surviving peat to maintain high water table levels should prevent this. At Dunham Park a large number of the oak and beech trees are ancient, with some dating back to the 17th century. This is the only site in north-west England and one of the few remaining sites in Britain with such a considerable number of old trees. Little remains of early settlement, apart from prehistoric and Roman artefacts found within the river channel and flood plain, and some scattered examples of ancient enclosure to the east, between Warrington and Urmston. This is as a result of the radical changes in the landscape resulting from the expansion of development. **Continued on next page...**	Seek ways to protect, conserve, manage and interpret the area's historic and cultural identity to ensure a better understanding of past land use and retain evidence of the relationships between features for the future. Seek opportunities to conserve and interpret the many layers of historic evidence to raise awareness and to increase public engagement, enjoyment and understanding. Promote a wider understanding of the current landscape in terms of historic development, linking to the ports, trade and industry and connections between Liverpool and Manchester. Increase the appreciation of the New Towns as a planning response to need. Promote a wider understanding the history of the reclamation of the mosslands.	**Sense of history** **Sense of place / inspiration** **Tranquillity** **Recreation** **Biodiversity** **Geodiversity** **Regulating soil erosion**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of history cont				**... continued from previous page** Historic areas include Norton Priory which is surrounded by a New Town development. New Towns represent a particular period in the history of town planning. The ancient Hale Duck Decoy has been restored for use as a nature reserve. There is wide historic interest in the industrialisation of the area based on the Mersey Estuary, the canal network, coal, minerals and links with inland resources (such as sheep and wool) and the port of Liverpool (bringing in cotton). Woolston Eyes SSSI has been formed from lagoons used for taking dredgings from the upper reaches of the Manchester Ship Canal, and is at various stages of colonisation. There is evidence of anti-aircraft gun sites defending the Mersey Valley and the conurbations during the Second World War. The ordnance works at Risley was a large military establishment. Cold War sites include nuclear bunkers and the vast US Army depot at Burtonwood. Helsby Quarry Local Nature Reserve contains a rock tunnel that was once a tramway used to move sandstone from the quarry to Ince Pier for wider distribution.	Maintain the wood-pasture management at Dunham Park, making provision for eventual replacement of trees, while retaining moribund and dead standing timber.	

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Tranquillity	Semi-natural habitats Mersey Forest and Red Rose Forest Country Parks, Local Nature Reserves, parks and other green spaces	Tranquillity is not a feature typically associated with this NCA, with none of it classified as 'undisturbed' according to CPRE data (in contrast to 6 per cent 'undisturbed' in the 1960s)[21]. A sense of tranquillity may nevertheless be associated with the areas of mossland in the east, and the extensive grazing marshes adjacent to the estuary in the west. Relative tranquillity can be found in parks and green spaces within the urban areas, and sites adjacent to the River Mersey.	Local	Despite the overall low levels of tranquillity within this NCA, the parks, woodlands, estuary and mosslands are an important source of relative tranquillity in the local area and are highly valued. Providing increased opportunities and access to a tranquil environment through management, enhancement and expansion of habitats should ensure that these important places can remain tranquil and contribute to biodiversity, sense of place and recreation. The Mersey and Red Rose Community Forests provide opportunities to increase woodland and other habitats, to create quite tranquil areas for people to enjoy.	Encourage opportunities to improve, maintain and expand habitats which may increase the sense of tranquillity such as in the areas of mossland in the east, and, the extensive estuarine habitats in the west. Seek further opportunities in the Red Rose and the Mersey Forest Community Forests to increase woodland and other habitats, to create tranquil areas for people to enjoy. Seek opportunities through new housing, transport and industrial developments to create additional green infrastructure to provide quiet enjoyment and improve wellbeing through increased contact with the natural environment. Opportunities exist to promote the calming and restorative effect that contact with tranquil and sensory environments have on visitors' health and wellbeing, including local green spaces.	**Tranquillity** **Sense of place / inspiration** **Recreation** **Biodiversity**

[21] CPRE Intrusion Map, 2007

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Recreation	Network of footpaths Open access land Mersey Forest and Red Rose Forest Country Parks Local Nature Reserves Registered Parks and Gardens Canal towpaths Woods for people Transpennine Trail, Sandstone Trail and Mersey Way Greenbelt land	Recreation is supported by the area's 513 km rights of way network (with a density of 1.15 km per km²). Open access land (80 ha), country parks (66 ha), Local Nature Reserves (361 ha) and two Registered Parks and Gardens provide recreational access and facilities for quiet enjoyment. There are some multi-use recreational corridors, with long distance footpaths such as the Trans Pennine Trail and Mersey Way. Frodsham provides the starting point for one of the north-west area's popular long distance walking routes the Sandstone Trail, which runs south beyond the NCA to Whitchurch in Shropshire. This is further supported by the canal network, the area's parks and more formal facilities such as golf courses.	Regional	There are large populations locally both within the towns of the Mersey Valley and the two adjacent conurbations. Communities value their local green spaces as places of local distinctiveness that provide opportunities to engage with nature close to where they live and work to improve physical and mental health and encourage a sense of community. Local woodlands and the two community forests have generated local interest to increase woodland and other habitats, create wildlife corridors and access for people. The maturing woodland resource of the community forests provides opportunities for access and recreation. Woodlands can be a green tourism attraction in their own right, and can enhance existing tourist attractions. Local Nature Reserves and country parks also provide opportunities for people to enjoy the natural environment. **Continued on next page...**	There are opportunities to promote sustainable recreation and education linked to biodiversity, for example at Local Nature Reserves and country parks, and provide links between urban areas and the surrounding countryside. Provide interpretation for people to understand and enjoy wildlife and the benefits of the natural environment. Increase opportunities for users to access the natural environment, and to benefit from the health and social rewards that their local environment affords them. Improve access by ensuring that paths are maintained and well signposted, and that some surfaced paths are provided for use by all levels of ability.	**Recreation** **Sense of place / inspiration** **Sense of history** **Tranquillity** **Biodiversity**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Recreation cont				**... continued from previous page** The mosslands are also an educational resource which is currently much underused. Poor water quality in the Mersey has been a deterrent to water-based recreation. It appears likely that as the water quality improves there will be more of a push to provide increased access to the shoreline. There is a network of footpaths in the Upper Estuary, with the potential to extend public access. Future provision of estuary access may supplement the existing resource, but will need to be implemented sympathetically to avoid potential conflicts with the internationally designated nature conservation interest of the estuary. Where environmental assets are sensitive to disturbance seek opportunities to manage recreational practice to minimise impacts. **Continued on next page...**	Seek opportunities to create green spaces, especially within towns, new housing and industrial developments, with easy access enabling communities to re-connect with the natural environment close to where they live, and allowing them to enjoy the health and social rewards it affords them. Maintaining and improving water quality, such as in the rivers and canals, for people and wildlife to enjoy the multiple benefits that clean water provides. Interpreting the mossland and the estuary habitats, to raise awareness, improve public understanding and increase enjoyment of these significant areas.	

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Recreation cont				**... continued from previous page** Footpaths, cycle ways, canal towpaths and bridleways which link green spaces to each other and to residential and employment areas provide a means of encouraging sustainable transport, healthier lifestyles, greener commuting and general enjoyment of open spaces. Where greenbelts have been defined, there are opportunities to provide access, outdoor sport and recreation, to retain and enhance landscapes, visual amenity and biodiversity or to improve damaged and derelict land[22].		

[22] NPPF (National Planning Policy Framework) Para 81

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biodiversity	Semi-natural habitats Sites of Special Scientific Interest (SSSI) and Local Wildlife sites Rivers Estuary Species Country parks, Local Nature Reserves and other green spaces	Biodiversity priority habitats include: ■ Coastal and flood plain grazing marsh 1,204 ha ■ Broadleaved mixed & yew woodland (broad habitat) 880 ha ■ Mudflats 513 ha ■ Lowland raised bog 341 ha. The NCA contains two SAC, one SPA and one Ramsar site, with 1,600 ha nationally designated as SSSI. There are a further 83 Local Wildlife Sites covering 2,963 ha (7 per cent of the area). There are three country parks and 16 Local Nature Reserves across the NCA.	National	The Mersey Valley river corridor is a significant link across the NCA, particularly connecting freshwater habitats in the east and marine habitats in the west. SSSI and Local Wildlife Sites provide opportunities to conserve important biodiversity habitats in the Mersey Valley. The Mersey Estuary has extensive intertidal mudflats and fringing salt marshes, providing essential feeding and roosting areas for large populations of wading birds and wildfowl. Adjacent farmland and wetland habitats also support wildlife. Significant effort has been made to improve the condition of flood plain grazing marsh, notably around Frodsham, Helsby and Ince Marshes and in the lower Gowy. The Mersey Valley once supported huge expanses of mossland habitat. Many of these areas have been lost to agricultural improvement, peat extraction or development. Relict semi-natural bog habitats are degraded. These habitats have suffered from drainage in the past and are affected by scrub invasion. However there has been management to re-wet and restore parts of the habitat. The vegetation is now recovering over large areas. **Continued on next page...**	Protect and enhance the extent and quality of semi-natural habitats, including the coastal and flood plain grazing marsh, woodland, mudflats and lowland raised bog. Encourage improved management to bring nationally and locally designated habitats, into and maintain favourable condition. Conserve the Mersey Estuary habitats and geomorphological processes and seek opportunities to provide space for intertidal habitats to develop and move in response to coastal change. Enhance connectivity of habitats particularly in the coastal zone and along the river valley corridor. Restore and enhance the biodiversity of the mossland landscape by working with farmers and landowners to restore peat to lowland raised bog where feasible and provide hydrological buffer zones to help to manage water	**Biodiversity** **Food provision** **Water availability** **Climate regulation** **Regulating water quality** **Regulating water flow** **Regulating soil quality** **Regulating soil erosion** **Pollination** **Sense of place / inspiration** **Tranquillity** **Recreation** **Geodiversity**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biodiversity cont				**... continued from previous page** There are also extensive areas of modified peat being used for farming. There is potential for farmland adjacent to the remaining mossland to provide buffer zone, which if managed and water table levels allowed to rise, would result in these areas developing into fen or wet woodland. Woodland habitats include lowland mixed deciduous woodland, wet woodland and wood-pasture and parkland. Some woodlands are ancient semi-natural woodlands. The arable farmland is important for farmland birds. The brown hare is also present in arable land. Pastureland is also valuable habitat for ground nesting birds such as skylarks and lapwings. The network of hedgerows, trees, ditches and associated uncultivated margins form valuable linear habitats, as do the canal banks, road verges, railway banks, gardens and green spaces within urban areas. These provide 'wildlife corridors' enabling movement and migration of species, and food and cover for wildlife. **Continued on next page...**	water table levels and to protect the nature conservation value of the mosses. Seek opportunities in former peat cutting areas and farmlands for restoring, enhancing, buffering and linking of fragmented mosslands. The diversity of farmland could be restored to provide a significant habitat network for farmland birds. Provision of year round habitat for farmland birds should be sought where appropriate. Restore and manage the hedgerows within the farmed landscapes. Develop networks of linear habitats, corridors and stepping stones, making a more permeable landscape to enable species movement.	

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biodiversity cont				**... continued from previous page** Some farmland locations have field ponds and the internationally designated Rixton Clay Pits SAC is in this NCA. Ponds provide breeding sites for amphibia and sustain a range of aquatic invertebrates. Ponds may serve as habitat 'stepping stones' enabling local wildlife migrations. Country Parks, LNRs and other local green spaces provide opportunities to encourage communities to become more involved in biodiversity close to where they live and work, such as taking part in biological recording through events such as Bioblitz, and by volunteering to be involved in site based conservation activities and in the future planning and management of these sites.	Management of the existing ponds and ditches for ecological benefits should be sought where appropriate. Maintain and, where appropriate, enhance the population size and distribution of locally, nationally and internationally important species populations and assemblages which are particularly important within the area including grey partridge, willow tit and lapwing. Use country parks, Local Nature Reserves and other local green spaces to encourage communities to become more involved in biodiversity close to where they live and work.	

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Geodiversity	Geological exposures Geomorphological processes	Two geological SSSI. Twelve Local Geological Sites including an LNR. Sequence of Triassic sandstones and siltstones. Post glacial sediments, including basin peat deposits.	National	Dynamic geomorphological processes of accretion and erosion in the estuary. Examples of soft cliff occur on the shores of the Mersey estuary, such as around Hale Head, but the total resource is very limited in extent. The cliffs are of geological and geomorphological importance for their sedimentary record and display of natural erosive processes. Peat-forming bogs and dynamic intertidal environments are both examples of dynamic geomorphological processes, with the former also maintaining an important palaeoenvironmental record. Supporting opportunities to restore mosslands to re-establish their geomorphological function as a recorder of environmental change will also restore their biodiversity and carbon sequestering role. Geological exposures, for example the sandstone sequences at Frodsham Road and Railway Cuttings SSSI, make an important contribution to the understanding of the origin and geological development of the NCA.	Allow natural evolution of the estuary, as well as the dynamic process of erosion and accretion on mudflats/sand flats and salt marshes to continue where possible. Seek opportunities to restore mosslands to re-establish their geomorphological function and as records of palaeoenvironmental evidence. Maintain and where possible enhance all the existing rock exposures and natural landforms, including SSSI, which make important contributions to an understanding of the origin and geological development of the NCA. Deepen appreciation among landowners, industry and the public, of the links between geology, landscape and wildlife habitat and their relevance to conserving biodiversity and to sustainable development. Protect and maintain geological sites, improving access and interpretation where appropriate in order to increase visitor understanding and enjoyment of these sites.	**Geodiversity** **Climate regulating** **Regulating soil erosion** **Regulating coastal erosion and flooding** **Sense of place / inspiration** **Sense of history** **Biodiversity**

Photo credits

Front cover: The Mersey Estuary is of international significance, with large areas designated as a Ramsar site and as a Special Protection Area with extensive intertidal habitats such as mud/sand flats supporting internationally important bird populations. © Natural England/[redacted]
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Introduction

As part of Natural England's responsibilities as set out in the Natural Environment White Paper,[1] Biodiversity 2020[2] and the European Landscape Convention,[3] we are revising profiles for England's 159 National Character Areas (NCAs). These are areas that share similar landscape characteristics, and which follow natural lines in the landscape rather than administrative boundaries, making them a good decision-making framework for the natural environment.

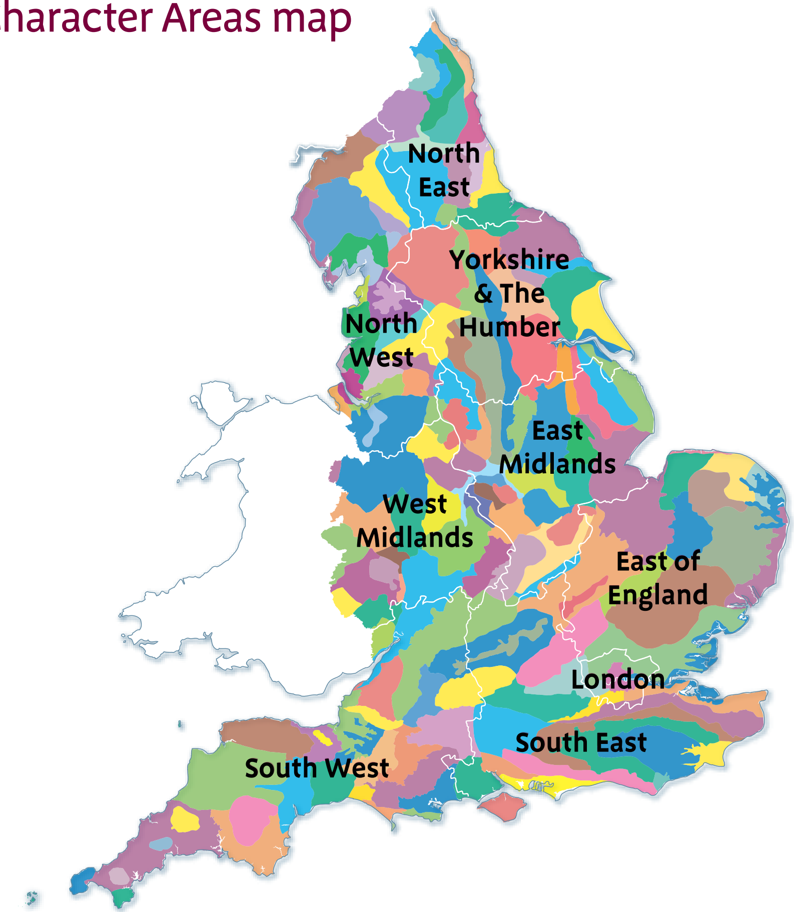
NCA profiles are guidance documents which can help communities to inform their decision-making about the places that they live in and care for. The information they contain will support the planning of conservation initiatives at a landscape scale, inform the delivery of Nature Improvement Areas and encourage broader partnership working through Local Nature Partnerships. The profiles will also help to inform choices about how land is managed and can change.

Each profile includes a description of the natural and cultural features that shape our landscapes, how the landscape has changed over time, the current key drivers for ongoing change, and a broad analysis of each area's characteristics and ecosystem services. Statements of Environmental Opportunity (SEOs) are suggested, which draw on this integrated information. The SEOs offer guidance on the critical issues, which could help to achieve sustainable growth and a more secure environmental future.

NCA profiles are working documents which draw on current evidence and knowledge. We will aim to refresh and update them periodically as new information becomes available to us.

We would like to hear how useful the NCA profiles are to you. You can contact the NCA team by emailingncaprofiles@naturalengland.org.uk.

National Character Areas map



[1] The Natural Choice: Securing the Value of Nature, Defra (2011; URL: www.official-documents.gov.uk/document/cm80/8082/8082.pdf)
[2] Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services, Defra (2011; URL: www.defra.gov.uk/publications/files/pb13583-biodiversity-strategy-2020-111111.pdf)
[3] European Landscape Convention, Council of Europe (2000; URL: http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm)

Summary

The Cheshire Sandstone Ridge National Character Area (NCA) is situated between Malpas and Frodsham and is surrounded on all sides by the Shropshire, Cheshire and Staffordshire Plain NCA, except to the north, where the ridge drops into the Mersey Valley NCA. It is a discontinuous ridge, but is very prominent, rising sharply from the gently rolling topography of the surrounding NCAs.

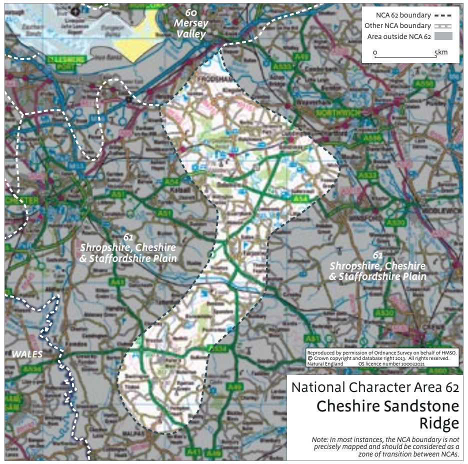
The topography provided by the reddish-pink Triassic sandstone ridge has been exploited for centuries, as evidenced by the remains of defensive fortifications and artefacts from the Bronze and Iron Ages, and the Saxon and Roman periods. The fortifications were linked by a track which now forms part of the Sandstone Trail along the ridge, offering expansive views to walkers. A number of communication masts are prominently located on the highest ground and are visible over a wide area, and a war memorial stands at the northern tip of the NCA, providing a distinctive local landmark.

Compared with the surrounding plain, the NCA has a strong mosaic of broadleaved mixed woodland comprising ancient woodland and some post-medieval conifer plantations, with large blocks of commercially managed conifers to the east. Remnants of a Royal Hunting Forest survive at Delamere and placenames such as Old Pale and New Pale indicate the locations of medieval deer parks.

A thick layer of glacial till covers the lower slopes of the ridge and the surrounding plain is punctuated by numerous ponds and meres. Subsequent colonisation by vegetation has resulted in the establishment of large areas of bog, known as mosses. Some are associated with the development of schwingmoor which is an advancing, floating raft of bog moss. The meres and mosses of the north-west Midlands form a geographically discrete series of nationally important lowland open water and peatland sites, the finest examples of which are considered to be of international importance.

Lowland heathland was once more widespread, but now exists only in discrete areas, for example Bickerton Hill SSSI and Little Budworth Common SSSI. There are also fragmented remnants of lowland meadow dispersed throughout the NCA.

Good links to the road network and its proximity to the M56 and M6 mean that the demand for land for housing, agriculture and mineral extraction is likely to increase. This has the potential to further fragment habitats and change settlement patterns and the vernacular, but can also provide opportunities to create a high-quality built environment with multifunctional green space with links to the rural area.



Click map to enlarge; click again to reduce

Statements of Environmental Opportunities:

- **SEO 1:** Manage and enhance the rivers, streams and wetland habitats, including flood plain grazing marsh and wet woodland, protecting them from diffuse pollution and maintaining the integrity and unique conditions for the preservation of the lakes and standing waters of internationally important sites such as Oak Mere and Abbots Moss to benefit water availability, water quality, landscape character, biodiversity and climate regulation.

- **SEO 2:** Manage and expand areas of semi-natural woodland, restore and reinstate hedgerows and hedgerow trees, protect and restore ancient woodland, for example in the Delamere Forest Park and throughout the Mersey Forest, thus reducing habitat fragmentation to benefit landscape character, biodiversity, resource protection and climate regulation while enhancing the recreational, educational and experiential qualities of the NCA.

- **SEO 3:** Protect and manage the geological sites, with an emphasis on demonstrating the strong link between geology and its influence on landscape and industrial development, and promoting greater understanding of the link between wildlife and geodiversity, particularly in the distribution of habitats and species, recognising the importance of former extraction sites for both geodiversity and biodiversity.

- **SEO 4:** Manage and, where appropriate, expand areas of characteristic heathland and other priority habitats, including lowland meadows and lowland grassland, thus reducing habitat fragmentation to benefit landscape character, sense of place, biodiversity and resource protection while enhancing the recreational and experiential qualities of the NCA.

Oak Mere, a shallow lake formed where three kettle holes coalesced, is unique among the Midland meres. The water is acidic, but compared with other acidic lakes is slightly nutrient-rich. It contains an outstanding assemblage of aquatic plants and animals. The rarely found qualities of the lake water, its associated shoreweed-dominated, aquatic plant community and its invertebrate assemblages are reasons for its Ramsar and SAC designations.

Description

Physical and functional links to other National Character Areas

The Cheshire Sandstone Ridge National Character Area (NCA) extends from the Mersey Valley NCA that forms its north-western boundary and trends south into the surrounding Shropshire, Cheshire and Staffordshire Plain NCA. It is a discontinuous ridge that reappears as groups of small hills within the latter NCA – at Nesscliffe, Grinshill and Hawkstone Park – but is very prominent, rising sharply from the gently rolling topography of the plain, reaching heights of 123 m at Helsby and 227 m at Raw Head in the Peckforton Hills.

The ridge affords expansive, long-distance views out of the NCA to the hills of the Clwydian Range in Wales to the west and to the peaks of the South West Peak NCA to the east. Locations at the northern and southern ends of the ridge afford views of the Mersey Valley and the Shropshire Hills NCAs respectively. The views provide a wider appreciation of the strong contrast in landscape character and topography between the ridge and the surrounding plain.

The lower slopes of the ridge and surrounding areas have been modified by ice sheets that have left a considerable thickness of glacial till punctuated by ponds, meres and mosses. The majority lie in Cheshire and north Shropshire, with a small number of outlying sites in adjacent parts of Staffordshire and Clwyd.

The rivers Weaver and Gowy rise in the Peckforton Hills and, with their tributaries, contribute to the Weaver/Gowy catchment for public, agricultural and industrial water supply outside the NCA. An area extending from Tarporley to Frodsham is underlain by sediments of the Sherwood Sandstone Group that forms the Weaver aquifer. Water is abstracted from the aquifer outside the NCA but outcrops of sandstone within the NCA provide limited recharge areas to the aquifer.

The NCA is crossed by the Shropshire Union Canal which runs west to east linking Ellesmere in the Mersey Valley NCA to Wolverhampton in the Mid Severn Sandstone Plateau NCA. The area has good connections to the road network and is crossed by a number of A roads that link the city of Chester with Nantwich and Northwich in the neighbouring NCA. The M56 and M6 pass close to the NCA. The Sandstone Trail – a long-distance footpath – stretches for 55 km and offers elevated views across the NCA before crossing into the Shropshire, Cheshire and Staffordshire Plain NCA. The National Cycle Network route 70 also crosses the NCA.

The ridge affords expansive, long-distance views out of the NCA. Locations at the northern end of the ridge afford views of the Mersey Valley. The views provide a wider appreciation of the strong contrast in landscape character and topography between the ridge and the surrounding plain.

Key characteristics

- Sandstone ridge with outcrops and bluffs over 100 m high which rise above the surrounding plain, comprising Triassic sandstone and conglomerate, exemplified by Beeston Crag.
- Thin, sandy and gravelly soils in the east with scattered peatlands. Free-draining, thin and generally infertile soils along the ridge.
- Strong mosaic of wet woodland, broadleaved mixed woodland comprising ancient woodland and some post-medieval conifer plantations, which contribute to the wooded character along with large blocks of commercially managed conifers on gravelly soils to the east. The medieval Royal Forest of Delamere, in the north of the area, once covered a vast area of Cheshire.
- Fragmented orchards throughout Cheshire which were once more widespread.
- Regular pattern of fields surrounded by generally well maintained hawthorn hedgerows with scattered mature hedgerow trees surrounded by sunken lanes. Hedgerows give way to drystone walls on the ridge.
- Low-density dispersed livestock farms, with some dairy and arable on gentler slopes.
- Large areas of lowland heathland survive on Bickerton Hill and at Little Budworth Common with fragmented areas of lowland meadow throughout the area, particularly along the Pettypool Brook Valley and along the line of the Shropshire Union Canal.
- Diverse range of woodland and wetland habitats, such as Pettypool Brook Valley SSSI, that supports nationally important species of invertebrates.
- Numerous field ponds, scattered areas of glacial meres and mosses in varying stages of succession, exemplified by internationally important Oak Mere and Abbots Moss.
- The meandering rivers Gowy and Weaver rise in the Peckforton Hills that form a local watershed.
- Remains of iron-age hill forts, burial mounds, ring ditches and castles, and finds of stone tools, occur along the ridgetop. A Roman road crosses the area en route to Manchester from Chester.
- Large historic halls include Peckforton and Utkinton (both listed Grade I), and Tirley Garth to the south-west of Kelsall, a Grade II* Listed Building surrounded by a Grade II* Registered Park and Garden. Beeston and Maiden castles are also popular visitor destinations.
- Sparsely populated with a dispersed settlement pattern of scattered farms and small villages, mostly of medieval origin. Red brick is the dominant building material, together with some local sandstone and timber-frame buildings.
- Former sand pits around Delamere provide a mosaic of wetland and woodland that is now important for biodiversity and recreation.
- The Shropshire Union Canal, the A54 and A51 cross the area and the Sandstone Trail, a long-distance footpath, offers elevated views across the NCA and beyond.
- Communication masts on the ridgetop and the war memorial at the northern end of the ridge are prominent local landmarks.

Cheshire Sandstone Ridge today

Rising up from the surrounding Shropshire, Cheshire and Staffordshire Plain NCA are a number of small sandstone ridges and scarps, the most prominent being the Cheshire Sandstone Ridge which is visually one of the most distinctive landmarks in Cheshire. The ridge provides expansive views and a wider appreciation of the strong contrast in landscape character between the ridge and the plain, due largely to the difference in topography. The ridge also provides the locally rare sight of exposed solid rock comprising striking bluffs of reddish-pink sandstones and conglomerate of the Triassic Period that contrast with the relatively lush pastures devoted to mixed farming and dairy on the surrounding plain.

The sediments of the Sherwood Sandstone Group erode to form free-draining soils that are suitable for arable cultivation where access permits on the lower slopes of the ridge. The steeper slopes are covered with deciduous and mixed woodland, the trees growing to large sizes. Permanent pastures of poor quality extend over the ridge. Gently undulating elevated areas occur to the east of the ridge, with thin and infertile soils supporting important heathland that was once widespread but now survives only in discrete areas, for example at Little Budworth Common Site of Special Scientific Interest (SSSI) and Bickerton Hill SSSI. The latter is the largest area of surviving lowland heath in Cheshire.

The lower slopes of the ridge and surrounding area have been modified by ice sheets that have left a considerable thickness of glacial till (sands and boulder clays) which is punctuated by numerous field ponds, meres and mosses. The meres and mosses of the north-west Midlands form a geographically discrete series of nationally important lowland open water and peatland sites designated as SSSI and Special Areas of Conservation (SAC). The best examples are considered to be of international importance (Ramsar sites). The suite of sites supports an outstanding assemblage of plants and animals; the finest sites have developed a mature schwingmoor comprising floating bog moss with common cotton grass and cranberry. The mosaic of open water and peatland areas, together with fringing heathland and woodland, provides habitats for locally and nationally rare species of aquatic plants, for example planktonic algae, stands of shoreweed and narrow small-reed, as well as for a host of invertebrates, including damselflies and dragonflies such as the nationally rare white-faced dragonfly, and a diversity of beetles and spiders also including a number of nationally rare species. Drier areas of the sites typically support heathland relics, areas of purple moor grass and open semi-natural woodland.

There are extensive tracts of woodland, such as the remains of the medieval Royal Forest of Delamere, in the north of the area that once covered a vast area of Cheshire; these comprise mostly oak and pine with some birch as well as conifer plantations. Peckforton Woods still retains the largest tract of sessile oak in Cheshire. The work of the Mersey Forest includes planting new community woodlands, further strengthening the wooded character of the NCA. The regular pattern of fields with generally well maintained hawthorn hedgerows and scattered mature hedgerow trees surrounded by sunken lanes evoke an enclosed feel that contrasts markedly with the open spaces and wide vistas experienced on the ridgetop. The hedgerows of the lower slopes give way to drystone walls of sandstone on the ridge and there are areas where traditional Cheshire-style curved-topped iron railings are evident.

The area is drained by the rivers Gowy and Weaver that rise in the Peckforton Hills, flowing gently out of the NCA to meander across the adjacent plain. Long stretches of the River Weaver on the northern boundary have been canalised (the Weaver Navigation) to make them navigable, but this has left the original line of the river as a quiet backwater of a once actively meandering river that now provides valuable habitat. Further south, the Shropshire Union Canal crosses the area, providing opportunities for recreation and tourism.

The ridgeline is punctuated by a number of locally distinctive landmarks that are prominent along the skyline. These include modern communication masts; large historic halls and castles such as Peckforton, Beeston and Maiden castles; and the remains of iron-age hill forts, burial mounds and ring ditches. The iron-age hill forts were connected by a trackway following the higher land that now forms the Sandstone Trail, a long-distance footpath that stretches from Frodsham in the north to Whitchurch in the neighbouring NCA in the south, providing walkers with elevated views across and beyond the NCA. A war memorial stands at the northern tip of the NCA, and is another distinctive landmark.

Bickerton Hill SSSI is one of the largest areas of lowland heathland in Cheshire.

There are a number of high-status residences on the ridge, for example the Grade I listed 17th-century Utkinton Hall and the Grade I listed 19th-century hall at Peckforton, which is built in the style of a castle. Tirley Garth to the south-west of Kelsall, constructed in the 20th century, is a Grade II* Listed Building surrounded by a Grade II* Registered Park and Garden which is open to the public through the National Gardens Scheme.

The area is sparsely populated and has a dispersed settlement pattern of mostly medieval origin, comprising individual farms and houses and a series of villages and hamlets, the largest being Frodsham, Cuddington, Tarporley and Kelsall. Red brick and plain clay tiles or Welsh slate are the dominant building materials for farmhouses and farm buildings. Red sandstone rubble walling is often used in boundary walls on the ridge. Traditional timber-frame is regularly seen in farmhouses and cottages.

Quarrying for sandstone and the extraction of silica sand have resulted in large water-filled pits which now provide extensive areas of wetland habitat valuable for biodiversity and offering recreation opportunities.

The area has good connections to the road network and is crossed by a number of A roads that link the city of Chester with Nantwich and Northwich that lie outside the NCA. The M56 and M6 pass close to the boundaries of the NCA.

In addition to the Sandstone Trail there are open access areas such as the National Trust-owned Maiden Castle, a popular destination for walkers. Route 70 of the National Cycle Network passes through the area and there are a number of regional cycle ways.

The landscape through time

The oldest rocks of the area are the sandstones and conglomerate of the Lower Triassic Sherwood Sandstone Group. These rocks were deposited under arid, desert conditions about 250 million years ago and now form the prominent Cheshire Sandstone Ridge that rises above the surrounding plain. The underlying rocks of the plain are almost entirely composed of red to brown sandstones, silts and mudstones of the Mercia Mudstone Formation.

The lower slopes of the ridge and surrounding plain are covered by a thick deposit of glacial till (sands and boulder clays) from the last glacial advance about 18,000 years ago and are punctuated by numerous ponds and meres. Meres have developed in natural depressions in the glacial till caused by moraines as the ice sheet waned about 15,000 years ago. The subsequent development of swamp and carr caused the accumulation of peat which in some cases has led to the complete infilling of the depressions. Eventually the vegetation growing on the peat surface became raised above the surrounding ground water and, supplied only by rainwater, became nutrient poor (oligotrophic) and acidic, thus allowing species such as the bog mosses Sphagnum spp. to colonise it. Hence, over many thousands of years, some meres have developed into mosses, and an invaluable record of the detail of this process is preserved in the layers of peat and mineral sediments. In a few unusual cases, where the water surface becomes directly colonised by floating vegetation and then sphagnum mosses, a quaking bog known as a schwingmoor is formed.

Dense woodland of oak, elm and alder colonised the heavy glacially-derived clay soils of the plain. Clearance of the woodlands began in the late Bronze Age and settlements were concentrated on the drier lands of the ridge.

Evidence of early human occupation can be found on the ridgetop, where the topography has been exploited for centuries, as evidenced by the remains of defensive fortifications and artefacts ranging from the Bronze Age and Iron Age, through to the Saxon and Roman periods. Many below-ground structures such as burial mounds, still legible in the landscape, have revealed finds of stone tools. The fortifications along the ridgetop were linked by an ancient track which today has become the long-distance Sandstone Trail.

During the medieval period it became increasingly common for hunting to take place in deer parks and there are two former sites on the ridge identified by the placenames Old Pale and New Pale. The medieval Royal Forest of Delamere, in the north of the area, covered a vast area of Cheshire and was used for hunting, especially deer. The late medieval period was the most important period for the management of hunting and commercial forests in this area, establishing the settlement patterns of dispersed farmsteads, hamlets and villages we see today.

The NCA has a long heritage of agriculture and is still predominantly grassland with pockets of arable production. Traditionally, since the 14th century, cattle rearing and fattening have taken place with dairying. By the early 19th century, the forest and surrounding agricultural land were enclosed, creating the pattern of small to medium regular fields with straight hawthorn hedgerows we see today. These areas were also subject to significant change by the activities of the local estates to improve their agricultural land. One legacy of this is the high density of infield ponds – the result of the extraction of marl which was used to neutralise the acidic soils.

Evidence of former extractive industries remains visible in the landscape, with numerous small sandstone quarries. The remains of an engine house chimney at Bickerton Hill marks the former copper mine that worked intermittently from around 1690 to the1920s. Quarried sandstone from the ridge has been used extensively in the construction of local buildings and boundary walls, adding a distinctive architecture and colour to the area. The extraction of silica sand from the Delamere sand sheet continues; former sand pits have filled with water and now provide a mosaic of wetland and woodland important for biodiversity and recreation.

Ongoing modern-day development pressure has seen an increase in urban fringe and ribbon development which has suburbanised areas of the countryside, for example the area around Frodsham. However, the Mersey Forest is creating a network of community woodlands and green spaces across Cheshire. The elevated ridges may also become target areas for wind turbines and additional communication masts.

Agricultural holdings have expanded in size in response to the demand for food production but this is eroding semi-natural sites, resulting in increased fragmentation of heathland and unimproved grassland. Local evidence indicates a decline in the overall number of agricultural holdings, particularly small-scale dairying, in favour of mixed farms, equestrian holdings and hobby farms.

Demand for water supply and a decline in water quality pose a threat to the internationally important meres and mosses. Landscape-scale partnerships are working collaboratively to help manage such threats.

View from the Sandstone Ridge looking over the Mersey Valley NCA towards the Mersey Estuary in the distance.

Ecosystem services

The Cheshire Sandstone Ridge NCA provides a wide range of benefits to society. Each is derived from the attributes and processes (both natural and cultural features) within the area. These benefits are known collectively as 'ecosystem services'. The predominant services are summarised below. Further information on ecosystem services provided in the Cheshire Sandstone Ridge NCA is contained in the 'Analysis' section of this document.

Provisioning services (food, fibre and water supply)

- **Timber provision:** Over 12 per cent of the area is woodland, including both broadleaved and conifer plantations, for example Primrose Hill and Nettleford Wood. Delamere Forest and Peckforton Woods are the largest wooded areas; the latter contains the largest tract of sessile oak in Cheshire. The Forestry Commission has also established extensive community woodland of mixed planting with open spaces on the northern slopes of the Old Pale, within the Delamere Forest, in the north of the area. Private woodlands include Peckforton and Bolesworth. Approximately half of the area is within the Mersey Forest which has as an objective the creation of sustainably managed community woodlands that include timber provision to local communities through wood allotments.

- **Water availability:** Groundwater availability in the Weaver/Gowy catchment is good. The rivers Gowy and Weaver rise in the Peckforton Hills towards the south of the area. A secondary aquifer extends from Tarporley in the central area to Frodsham in the north.

Regulating services (water purification, air quality maintenance and climate regulation)

- **Regulating water quality:** The ecological status of the watercourses in the area, according to the Water Framework Directive assessment, is 'moderate' with the exception of Darley Brook ('poor') and the River Gowy from source to Milton Brook ('poor'). A secondary aquifer extends from Tarporley to Frodsham forming part of the Sherwood Sandstone aquifer. According to the Water Framework Directive assessment, the reasons for the failing ecological status of the watercourses include sedimentation, channel modifications and diffuse pollution from fertilisers, pesticides and discharges from septic tanks.

- **Regulating water flow:** Data from the Environment Agency's flood map for rivers indicates that the risk of flooding is restricted to the river valleys and watercourses, both within the NCA and in the neighbouring NCAs. The management of water is critical to the internationally important areas of meres and mosses and other nationally important wetland habitats. Periods of drought can degrade peat soils that can liberate greenhouse gases and lead to catastrophic loss of habitat.

Cultural services (inspiration, education and wellbeing)

- **Sense of place/inspiration:** A strong sense of place is evoked by the prominent ridge with its outcrops and bluffs over 100 m high comprised of Triassic sandstone and conglomerate – especially Beeston Crag and Raw Head geological SSSI – contrasting with the surrounding plain. At many locations solid blocks of woodland (including conifers) and high hedgerows combine to evoke a strong sense of enclosure and a wooded feel in stark contrast to the unrestricted panoramic views afforded by the ridge. Heathland was once a common sight in Cheshire, but has become increasingly fragmented and degraded. The most extensive heathland survives at Bickerton Hill SSSI and is the largest area of surviving lowland heath in Cheshire, providing a glimpse of a historical landscape.

- **Tranquillity:** Statistics obtained from the Intrusion Map (2007) provided by the Campaign to Protect Rural England (CPRE) indicate a 51 per cent increase in 'disturbed' areas from the 1960s to 2007. However, almost half the total NCA area is still considered to be 'undisturbed'. Also notable is the emergence of 'urban' as a feature in the 2007 statistics. Traffic noise is cited as the main disturbance to tranquillity. Despite the reduction in 'undisturbed' areas, the NCA is important in providing the population of the nearby conurbations with the opportunity to experience the contrast between the wide-open, unenclosed landscape on the ridge and the enclosed feel in the valleys, woodland and sunken lanes.

- **Recreation:** For its area, the NCA has an extensive rights-of-way network totalling 362 km. The most notable of these is the Sandstone Trail which stretches for 55 km and links the sites of the iron-age forts on the ridgetop. National Cycle Network routes 70 (the Cheshire Cycleway) and 71 cross the NCA. The former provides a circular route. There are also regional cycle

View looking south-west with Flaxmere Moss SSSI in the foreground, Hatch Mere SSSI in the centre and Blakemere Moss in the distance, set in the expanse of the Delamere Forest.

paths such as the Whitegate Way cycle path. Little Budworth Country Park and Delamere Forest, with the largest area of woodland in Cheshire and its visitor centre, are also popular visitor destinations.

- **Biodiversity:** The NCA contains a strong mosaic of broadleaved mixed woodland, including pine, particularly around the area of Delamere Forest Park. Peckforton Woods SSSI has the largest tract of sessile oak in Cheshire. Half of the ancient woodland is designated Plantations on Ancient Woodland Sites. Ponds are a characteristic feature of the Cheshire landscape and contain a diversity of important wetland species, including great crested newts.

  The meres and mosses of the north-west Midlands form a geographically discrete series of nationally and internationally important lowland open water and peatland sites designated as SSSI, SAC and Ramsar sites. The suite of sites support an outstanding assemblage of plants and animals, and some sites have developed a mature schwingmoor comprising floating bog moss with common cotton grass and cranberry. The drier areas of these sites typically support heathland relics, areas of purple moor grass and open semi-natural woodland which is important for Lepidoptera.

  Large areas of lowland heathland survive on Bickerton Hill SSSI and at Little Budworth Common with fragmented areas of lowland meadow throughout, particularly along the Pettypool Brook Valley and along the line of the Shropshire Union Canal. The wetland communities along the course of Pettypool Brook Valley SSSI comprise Cheshire's most extensive and diverse valley mire system. The mature woodland, with its abundant dead wood, and the extensive peatland habitats support populations of a number of national and county rarities, making it one of Cheshire's foremost invertebrate sites.

- **Geodiversity:** The prominent sandstone ridge with outcrops and bluffs over 100 m high comprising Triassic sandstone and conglomerate, for example Beeston Crag and Raw Head geological SSSI, provides expansive views. In contrast to the surrounding plain, the ridge provides the locally rare sight of solid rock, evoking a sense of place and providing important sites for education and scientific research.

  The escarpment between Tower Wood and Droppingstone Well, known as Raw Head SSSI, is a nationally important geological site for the study of Triassic and glacial geo-morphology. The rivers Weaver and Gowy both illustrate fluvial activity in the form of channel migration and flood plain deposition, representing present-day geo-morphological processes.

  Cheshire possesses mineral resources of national importance in the form of silica sand and building sand. A major extraction area is located around Delamere from the Delamere sand sheet.

  The peatlands and mosses have built up over many thousands of years, thus providing an invaluable record of the detail of this process preserved in the layers of peat and mineral sediments.

Statements of Environmental Opportunity

SEO 1: Manage and enhance the rivers, streams and wetland habitats, including flood plain grazing marsh and wet woodland, protecting them from diffuse pollution and maintaining the integrity and unique conditions for the preservation of the lakes and standing waters of internationally important sites such as Oak Mere and Abbots Moss to benefit water availability, water quality, landscape character, biodiversity and climate regulation.

For example, by:

- Encouraging the uptake of the Catchment Sensitive Farming Programme to benefit water quality and availability by encouraging rainwater harvesting and over-wintering storage of water; to reduce incidences of foul run-off from outdoor feeding areas, silage clamps, yards and cattle tracks; to prevent stock from entering streams or poaching stream banks; and to prevent the poaching of fields by cattle movement.
- Addressing the reasons for the poor ecological condition of rivers in the Weaver/Gowy catchment, as identified by the Water Framework Directive assessment, by preventing the deterioration of water quality caused by high nutrient levels and sedimentation, naturalising channel modifications, removing obstacles to aquatic species and introducing buffer strips.
- Increasing the area of wet woodland and priority wetland sites to improve the connectivity of wetland habitats and rivers to their flood plains to benefit water flow, biodiversity and climate regulation, for example along the Pettypool Brook Valley.
- Raising public awareness of the importance and fragility of meres, mosses and other wetland habitats and the benefits they provide to climate regulation through better interpretation and increased access where possible.
- Encouraging the retention of infield ponds, a characteristic of the Cheshire landscape, especially in arable areas where the threat of infilling is greatest, through the uptake of agri-environment scheme options to benefit biodiversity, sense of place and history.
- Planning and managing sympathetically the restoration of mineral extraction sites to ensure their integration into the pastoral landscape to maintain the sense of place and to provide opportunities for wetland habitat creation and recreation.
- Increasing areas of riparian woodland to benefit the regulation of water flow, availability and biodiversity.
- Avoiding uniform pollarding to conserve and manage mature and over-mature trees within riparian environments, thus ensuring a supply of coarse woody debris, important for aquatic and invertebrate species and to help regulate water flow.
- Judiciously managing riparian woodland to provide adequate shade which can significantly reduce peak summer temperatures, thus maintaining water temperatures within a favourable range for fish and other sensitive freshwater fauna.
- Managing the Shropshire Union Canal and its associated assets to maximise landscape, cultural heritage and recreational value.
- Encouraging landscape-scale partnerships whose objectives contribute to the management and enhancement of the landscape in a holistic way for the benefit of riverine and wetland character biodiversity, climate regulation and recreation.
- Training volunteers to assist with the surveillance of priority habitats and species by surveying to monitor the spread of invasive non-native species and the distribution and population sizes of priority species as evidence of habitat quality.

SEO 2: Manage and expand areas of semi-natural woodland, restore and reinstate hedgerows and hedgerow trees, protect and restore ancient woodland, for example in the Delamere Forest Park and throughout the Mersey Forest, thus reducing habitat fragmentation to benefit landscape character, biodiversity, resource protection and climate regulation while enhancing the recreational, educational and experiential qualities of the NCA.

For example, by:

- Encouraging the management of woodland and, where it does not compromise other habitats and is appropriate to landscape character, encouraging new planting that will link blocks of existing woodland, thus reducing habitat fragmentation and reinforcing the wooded character of the National Character Area (NCA) and sense of history.
- Expanding woodland around Delamere Forest, along the Cheshire Sandstone Ridge and the long-distance trail, avoiding the escarpment ridgeline, with a diversity of species to increase resilience to pests, diseases and climate change.
- Encouraging landscape-scale partnerships in creating and maintaining woodland, for example community woodlands in the Mersey Forest, to provide opportunities for volunteering, education and recreation that also benefit biodiversity, climate regulation and the local economy.
- Finding a financially sustainable solution to woodland management by seeking an economic return on the by-products of woodland management – encouraging woodland allotment schemes, developing supply chains and encouraging demand for wood fuel in urban areas and encouraging the installation of wood fuel boilers in local amenity buildings.
- Increasing access to woodland as part of woodland management, thus increasing the opportunities for quiet recreation and to experience tranquillity, while ensuring that this does not compromise sensitive habitats and bio-security.
- Increasing access to woodland, providing circular routes and all-ability paths to provide opportunities for all sections of the community to experience the benefits of nature for physical activity, health and wellbeing.
- Restoring native woodland in plantations on ancient woodland sites.
- Encouraging the restoration of hedgerows with typical species, by gapping-up and planting their accompanying hedgerow trees; and adopting appropriate cutting regimes and tagging to extend the age range and species diversity to benefit biodiversity and sense of place.
- Encouraging the restoration of hedgerows and boundary sandstone walls to protect the soil resource, particularly on elevated sites and in areas of lighter soils.
- In urban areas, planting blocks of trees and street trees to provide shade, thus mitigating the effects of the urban heat island, increasing water infiltration rates and purifying the air.
- Planting trees around settlements and major highways to screen the visually intrusive urban areas from the surrounding landscape.

SEO 3: Protect and manage the geological sites, with an emphasis on demonstrating the strong link between geology and its influence on landscape and industrial development, and promoting greater understanding of the link between wildlife and geodiversity, particularly in the distribution of habitats and species, recognising the importance of former extraction sites for both geodiversity and biodiversity.

For example, by:

- Protecting and enhancing rock outcrops and the core designated sites, for example Raw Head geological Site of Special Scientific Interest (SSSI) and the suite of Local Geological Sites, and managing them to improve their condition.
- Improving access to and the interpretation of past geo-morphological activity preserved at Local Geological Sites and the present-day geo-morphological activity associated with the rivers Gowy and Weaver.
- Increasing the provision of information and interpretation of sites, thus helping landowners and land managers to understand and appreciate more the assets in their care and to enable visitors to value and enjoy them.
- Providing teaching materials and aids that assist local schools and other educational groups to use the sites for environmental and heritage education that includes industrial development and settlement patterns.
- Raising awareness through Local Geodiversity Action Plans and the planning system of the increasing importance of extractive sites to our understanding of industrial heritage and to the unique habitats they provide, for example the sand pits on the Delamere sand sheet.
- In partnership with geodiversity groups and site owners, enhancing the condition of former extraction sites and natural exposures for a range of mutually beneficial interests including geodiversity, biodiversity, volunteering and educational and scientific purposes.
- Encouraging people to volunteer and become involved in geo-conservation and surveying to assist with the surveillance and ongoing management of sites.
- Raising awareness of other geological assets, for example mineral collections at local museums and the use of local stone in buildings.

The red sandstone crags of Raw Head are more visible in the winter months. This view is from the Sandstone Trail. The area is a SSSI for geological interest for the exposed Triassic sandstones.

SEO 4: Manage and, where appropriate, expand areas of characteristic heathland and other priority habitats, including lowland meadows and lowland grassland, thus reducing habitat fragmentation to benefit landscape character, sense of place, biodiversity and resource protection while enhancing the recreational and experiential qualities of the NCA.

For example, by:

- Expanding and buffering core sites, for example Little Budworth Common and Bickerton Hill SSSI. Restoring degraded heathland through the removal of bracken and the thinning out of young trees to benefit sense of place.
- Seeking opportunities to expand the remaining lowland heathland and lowland acid grassland on the poorer arable land of the northern sandstone ridge. Seeking opportunities for the reversion from improved grassland to acid grassland and or lowland heathland.
- Seeking opportunities in areas under arable cultivation to provide habitats for farmland birds and invertebrates, planting flower-rich field margins to provide sources of nectar to benefit pollinators and support species of predators that can regulate populations of pests that adversely affect crop yields.
- Encouraging local authorities, highways and road maintenance to diversify the species mix of roadside verges to provide wildlife corridors that link areas of high biodiversity, thus providing a more robust ecological network.
- Reducing fertiliser and pesticide inputs, especially along the field margins and adjacent to semi-natural habitats.
- Monitoring the spread of and controlling invasive non-native species, for example Himalayan balsam and Japanese knotweed, and invasive arable weeds, for example broad-leaved dock and creeping thistle, and removing gorse and bracken and controlling brambles.
- Protecting and managing the priority habitat of lowland meadow, for example along the Pettypool Brook Valley and Shropshire Union Canal, and where appropriate seeking opportunities to expand these areas to reverse the fragmentation of this habitat.
- Supporting and encouraging volunteers to assist with the surveillance of priority habitats and recording the distribution and numbers of priority species as indicators of habitat quality.

View across the plain from Bickerton Hill SSSI, the largest area of lowland heathland remaining in Cheshire. The vegetation varies from open heathland to dense developing birch woodland. The site supports several species of reptile including, the adder, common lizard and slow-worm.

Additional opportunity

1: Protect and manage historic landscape character and associated heritage assets that include iron-age hill forts, canals, castles and country houses, traditional orchards and drystone walls. Find sustainable solutions to manage visitor pressure at popular attractions, for example Delamere Forest Park and the Sandstone Trail, while maintaining a high level of public access to enjoy the wealth of recreational experiences on offer.

For example, by:

- Encouraging the uptake of agri-environment scheme options that protect buried artefacts in the agricultural environment.
- Increasing the protection of archaeological sites, increasing the provision of information and interpretation of sites, thus helping landowners and land managers to understand and appreciate more the assets in their care.
- Increasing and improving the interpretation of the Cheshire Sandstone Ridge and its habitats and hill forts to aid visitors' understanding, appreciation and enjoyment of its ecological and historical interest.
- Finding sustainable solutions to manage visitor pressure at popular locations, for example the Sandstone Trail, while maintaining a high level of public access to enjoy the wealth of recreational experiences the NCA offers.
- Protecting and reinstating drystone walls, gate posts and stiles of local sandstone and traditional Cheshire-style painted iron railings throughout the area.
- Increasing visitors' contact with nature by providing better access, circular routes and all-ability trails, thus improving understanding and changing attitudes, as well as improving health and wellbeing.
- Encouraging a wide variety of individual and group participation, promoting health and wellbeing and lifelong learning through volunteering in specific conservation, access and interpretation initiatives.
- Developing educational experiences and resources, promoting the use of the local heritage resources for schools in the area.
- Providing opportunities for heritage and rural skills training to meet rural skills shortages.
- Capturing and sharing skills and good practice in heritage and access management, interpretation and community engagement.

Supporting document 1: Key facts and data

Cheshire Sandstone Ridge
National Character Area (NCA): 22,042 ha

1. Landscape and nature conservation designations

There are no landscape designations within this NCA.

Source: Natural England (2011)

1.1 Designated nature conservation sites

The NCA includes the following statutory nature conservation designations:

Tier	Designation	Designated site(s)	Area (ha)	% of NCA
International	Ramsar	Midlands Meres and Mosses (Phase 1/2)	129	<1
European	Special Protection Area (SPA)	n/a	0	0
	Special Area of Conservation (SAC)	Oak Mere SAC, West Midlands Mosses SAC	107	<1
National	National Nature Reserve (NNR)	n/a	0	0
National	Site of Special Scientific Interest (SSSI)	A total of 13 sites wholly or partly within the NCA	406	<2

Source: Natural England (2011)

Please note: (i) Designated areas may overlap (ii) all figures are cut to Mean High Water Line, designations that span coastal areas/views below this line will not be included.

There are 77 local sites in the Cheshire Sandstone Ridge NCA, covering 1,377 ha which is 6 per cent of the NCA.

Source: Natural England (2011)

- Details of individual Sites of Special Scientific Interest can be searched at: **http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm**
- Details of Local Nature Reserves (LNR) can be searched at: **http://www.lnr.naturalengland.org.uk/Special/lnr/lnr_search.asp**
- Maps showing locations of Statutory sites can be found at: **http://magic.defra.gov.uk/website/magic/** – select 'Rural Designations Statutory'

1.1.1 Condition of designated sites

Condition category	Area (ha)	% of SSSI land in category condition
Unfavourable declining	1	<1
Favourable	132	33
Unfavourable no change	86	21
Unfavourable recovering	187	46

Source: Natural England (March 2011)

- Details of SSSI condition can be searched at: **http://www.sssi.naturalengland.org.uk/Special/sssi/reportIndex.cfm**

2. Landform, geology and soils

2.1 Elevation

The highest point within the NCA is 216 m above sea level. The lowest point is 4 m above sea level. The mean elevation in this NCA is 82 m.

Source: Natural England (2010)

2.2 Landform and process

This area forms a prominent, steep-sided sandstone ridge rising from the Cheshire plain. To the east, the lower slopes of the ridge are cloaked in deposits of glacial sand and gravel.

Source: Cheshire Sandstone Ridge Countryside Character Area Description, Meres and Mosses Natural Area Profile

2.3 Bedrock geology

The underlying geology of the area is mostly reddish-pink Triassic sandstone.

Source: Cheshire Sandstone Ridge Countryside Character Area Description, Meres and Mosses Natural Area Profile

2.4 Superficial deposits

Fluvioglacial deposits of sands and gravels and boulder clays and marls flank the northern part of the ridge.

Source: Cheshire Sandstone Ridge Countryside Character Area Description, Meres and Mosses Natural Area Profile

2.5 Designated geological sites

Designation	Number
Geological Site of Special Scientific Interest (SSSI)	1
Mixed interest SSSI	0

There are 11 Local Geological Sites within the NCA.

Source: Natural England 2011

- Details of individual Sites of Special Scientific Interest can be searched at: http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm

2.6 Soils and Agricultural Land Classification

To the east soils are generally thin, sandy and gravelly and peppered with peatlands. Along the ridge the soils are free draining, thin and generally infertile.

Source: Cheshire Sandstone Ridge Countryside Character Area Description, Meres and Mosses Natural Area Profile

The main grades of agricultural land in the NCA are broken down as follows (as a proportion of total land area):

Agricultural Land Classification	Area (ha)	% of NCA
Grade 1	0	0
Grade 2	3,815	17
Grade 3	15,899	72
Grade 4	1,415	6
Grade 5	140	1
Non-agricultural	773	4
Urban	n/a	0

Source: Natural England (2010)

- Maps showing locations of statutory sites can be found at: http://magic.defra.gov.uk/website/magic/ - Select 'Landscape' (shows ALC and 27 types of soils)

3. Key water bodies and catchments

3.1 Major rivers/canals

The following major rivers/canals (by length) have been identified in this NCA.

Name	Length in NCA (km)
River Weaver	<1
Shropshire Union Canal	6
Weaver Navigation	2

Source: Natural England (2010)

Please note: other significant rivers (by volume) may also occur. These are not listed where the length within the NCA is short.

3.2 Water quality

All of the area is identified as a Nitrate Vulnerable Zone.

Source: Natural England (2010)

3.3 Water Framework Directive

Maps are available from the Environment Agency showing current and projected future status of water bodies at: http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

Delamere Forest is the largest woodland in Cheshire. The flooded area is Blakemere Moss.

4. Trees and woodlands

4.1 Total woodland cover

The NCA contains 2,807 ha of woodland (13 per cent of the NCA), of which 343 ha is ancient woodland.

Source: Natural England (2010), Forestry Commission (2011)

4.2 Distribution and size of woodland and trees in the landscape

Woodland cover at over 13 per cent is relatively high compared with adjacent areas. At Delamere Forest in particular there is more extensive broadleaved and mixed woodlands on the slopes and large blocks of commercially managed conifers on gravelly soils to the east. Pines commonly occur in the woods, plantations and along hedgerows and roadsides.

Source: Cheshire Sandstone Ridge Countryside Character Area Description, Meres and Mosses Natural Area Profile

4.3 Woodland types

A statistical breakdown of the area and type of woodland found across the NCA is detailed below.

Area and proportion of different woodland types in the NCA (over 2 ha).

Woodland type	Area (ha)	% of NCA
Broadleaved	1451	7
Coniferous	829	4
Mixed	211	1
Other	316	1

Source: Forestry Commission (2011)

Area and proportion of Ancient Woodland and Planted Ancient Woodland within the NCA:

Type	Area (ha)	% of NCA
Ancient semi-natural woodland	171	<1
Ancient re-planted woodland (PAWS)	172	<1

Source: Natural England (2004)

5. Boundary features and patterns

5.1 Boundary features

There is a regular pattern of hedged fields, with scattered mature hedgerow trees.

Source: Cheshire Sandstone Ridge Countryside Character Area Description; Countryside Quality Counts (2003)

5.2 Field patterns

Field sizes range from small to medium, in irregular field patterns, and are bounded by full, well-maintained hedgerows.

Source: Natural Area Profile, Countryside Character Area Description

6. Agriculture

The following data has been taken from the Agricultural Census linked to this NCA.

6.1 Farm type

In 2009 there were 332 registered commercial holdings within the Cheshire Sandstone Ridge NCA (down from 349 in 2000). Livestock farms dominated the NCA covering 45 per cent of holdings in 2009, (down from 51 per cent in 2000). Livestock farms are mainly recorded as grazed livestock (95 farms) with some dairy (49 farms). Census returns suggested that the number of dairy farms had declined significantly since 2000. Over this period mixed farming had also increased with mixed farms increasing from 6 per cent in 2000 to 9 per cent of holdings in 2009.

Source: Agricultural Census, Defra (2010)

6.2 Farm size

The majority of farms within this NCA are small to medium in size (with 72 per cent under 50 ha). Notably, 46 per cent are small; under 20 ha. Only 14 per cent of farms in 2009 were over 100 ha. Census returns appear to suggest that the proportion of large farms (over 100 ha) is increasing, although there was relatively little change in farm size over the decade between 2000 and 2009.

Source: Agricultural Census, Defra (2010)

6.3 Farm ownership

2009: Total farm area = 14,302 ha; owned land = 8,554 ha
2000: Total farm area = 14,514 ha; owned land = 9,322 ha

Patterns of farm ownership changed little between 2000 and 2009, with 60 per cent of land 'owned' and 40 per cent 'tenanted' in 2009.

Source: Agricultural Census, Defra (2010)

6.4 Land use

The majority of land in the Cheshire Sandstone Ridge was uncropped (67 per cent of the farmed area) in 2009. Cereals made up an additional 16 per cent, with the remainder made up of other arable crops, cash roots, stock feed and vegetables. The proportion of uncropped land remained stable between 2000 and 2009.

Source: Agricultural Census, Defra (2010)

6.5 Livestock numbers

Cattle numbers decreased by 9 per cent from 2000 to 2009 with sheep numbers decreasing by 16 per cent over the same period. Pig numbers decreased more significantly, reducing by an estimated 33 per cent between 2000 and 2009.

Source: Agricultural Census, Defra (2010)

6.6 Farm labour

Farm labour in this NCA was mainly provided by principal farmers (making up 70 per cent of recorded labour, up from 66 per cent in 2000). The number of salaried managers decreased by 38 per cent between 2000 and 2009. Full-time workers and casual/gang worker numbers also decreased significantly, falling by 30 per cent and 34 per cent respectively over this period.

Source: Agricultural Census, Defra (2010)

Please note: (i) Some of the Census data is estimated by Defra so will not be accurate for every holding (ii) Data refers to Commercial Holdings only (iii) Data includes land outside of the NCA belonging to holdings whose centre point is within the NCA listed.

7. Key habitats and species

7.1 Habitat distribution/coverage

In the north-east of the NCA on the Delamere sandsheet is an important cluster of wetlands associated with the presence of peatlands and water filled glacial hollows. Locally they are known as meres and mosses and are of international conservation significance. A diverse range of wetland habitats occur, scattered across this area including lowland raised bog, fen, wet woodland, reedbed, and eutrophic or mesotrophic standing waters. The sandstone ridge and its slopes support a strong mosaic of broadleaved mixed woodland habitat, sometimes ancient in origins having been continuously wooded. Other wooded areas are much younger, having developed naturally from neglected heathland or grassland. Significant areas have been 'coniferised'. Blocks of sizeable lowland heathland survive on Bickerton Hill and at Little Budworth Common. Remnant areas of lowland meadow are thinly scattered across the area.

Source: Meres and Mosses Natural Area Profile

7.2 Priority habitats

The Government's new strategy for biodiversity in England, Biodiversity 2020, replaces the previous Biodiversity Action Plan (BAP) led approach. Priority habitats and species are identified in Biodiversity 2020, but references to BAP priority habitats and species, and previous national targets have been removed. Biodiversity Action Plans remain a useful source of guidance and information. More information about Biodiversity 2020 can be found at; **http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/protectandmanage/englandsbiodiversitystrategy2011.aspx**

The NCA contains the following areas of mapped priority habitats (as mapped by National Inventories). Footnotes denote local/expert interpretation. This will be used to inform future national inventory updates.

Priority habitat	Area (ha)	% of NCA
Broadleaved mixed and yew woodland (broad habitat)	860	4
Lowland heathland	451	2
Lowland meadows	103	<1
Coastal and flood plain grazing marsh	70	<1
Lowland dry acid grassland	15	<1
Purple moor grass and rush pasture	6	<1
Reedbeds	2	<1

Source: Natural England (2011)

Omitted from the above table is habitat data on fen, eutrophic standing waters and mesotrophic standing waters.

Maps showing locations of priority habitats are available at

- **http://magic.defra.gov.uk/website/magic/** select 'Habitat Inventories'

7.3 Key species and assemblages of species

- Maps showing locations of priority habitats are available at: **http://magic.defra.gov.uk/website/magic/**
- Maps showing locations of S41 species are available at: **http://data.nbn.org.uk/**

8. Settlement and development patterns

8.1 Settlement pattern

There is a dispersed settlement pattern of scattered farms and small villages.

Source: Cheshire Sandstone Ridge Countryside Character Area Description; Countryside Quality Counts (2003)

8.2 Main settlements

The NCA is located between the major centres at Chester and Northwich and supports a series of villages and hamlets, the largest of which are Frodsham, Cuddington, Tarporley and Kelsall. The total estimated population for this NCA (derived from ONS 2001 census data) is 25,053.

Source: Cheshire Sandstone Ridge Countryside Character Area description; Countryside Quality Counts (2003), Natural England (2012)

8.3 Local vernacular and building materials

Red brick is the dominant building material, together with some local sandstone. A few older half-timbered distinctive black and white buildings occur.

Source: Cheshire Sandstone Ridge Countryside Character Area description; Countryside Quality Counts (2003)

9. Key historic sites and features

9.1 Origin of historic features

Several iron-age forts punctuate the sandstone ridge providing evidence of prehistoric settlement. Delamere Forest was a Royal Hunting Forest and colonisation of this area increased from the 15th century. In 1919 the remaining Crown woodlands at Delamere were passed to the Forestry Commission to be managed for timber production. Estates and parklands developed from the 16th century and parts of the area have distinctive 19th and early 20th century estate architecture of cottages, farmsteads, and other buildings such as the Tollemarche Estate.

Source: Countryside Quality Counts Draft Historic Profile, Countryside Character Area Description

9.2 Designated historic assets

This NCA has the following historic designations:

- 1 Registered Parks and Gardens covering 16 ha.
- 0 Registered Battlefields.
- 42 Scheduled Monuments.
- 410 Listed Buildings.

Source: Natural England (2010)

- More information is available at the following address: www.english-heritage.org.uk/caring/heritage-at-risk/
- www.english-heritage.org.uk/professional/protection/process/national-heritage-list-for-england/

10. Recreation and access

10.1 Public access

- 7 per cent of the NCA 1,500 ha is classified as being publically accessible.
- There are 368 km of public rights of way at a density of 1.7 km per km2.
- There are no National Trails within the NCA.

Source: Natural England (2010)

The following table shows the breakdown of land which is publically accessible in perpetuity:

Access designation	Area (ha)	% of NCA
National Trust (accessible all year)	0	0
Common Land	17	<1
Country Parks	64	<1
CROW Access Land (OC and RCL)	36	<1
CROW Section 15	20	<1
CROW Access Land (Section 16 Dedicated)	775	4
Village Greens	1	<1
Doorstep Greens	0	0
FC Walkers Welcome Grants	101	<1
LNRs	0	0
Millennium Greens	<1	<1
Accessible NNRs	0	0
Agri-environment Scheme Access	12	<1
Woods for People	1,417	6

Sources: Natural England (2011)

Please note: Common Land refers to land included in the 1965 commons register; CROW = Countryside and Rights of Way Act 2000; OC and RCL = Open Country and Registered Common Land.

A war memorial stands at the northern tip of the NCA, prominently located on the highest ground and is a distinctive local landmark.

11. Experiential qualities

11.1 Tranquillity

A breakdown of tranquillity values for this NCA are detailed in the table below:

Category of tranquillity	Score
Highest	23
Lowest	-78
Mean	18

Sources: CPRE (2006)

More information is available at the following address: **www.cpre.org.uk/what-we-do/countryside/tranquil-places/in-depth/item/1688-how-we-mapped-tranquillity**

11.2 Intrusion

The 2007 Intrusion Map (CPRE) shows the extent to which rural landscapes are 'intruded on' from urban development, noise (primarily traffic noise), and other sources of visual and auditory intrusion. A breakdown of intrusion values for this NCA is detailed in the following table.

Intrusion category	1960s (%)	1990s (%)	2007 (%)	Percentage change (1960s-2007)
Disturbed	9	41	50	51
Undisturbed	91	59	49	-42
Urban	0	0	1	1

Sources: CPRE (2007)

Notable trends from the 1960s to 2007 are the increases in the areas classified as 'disturbed' since the 1960s. However, almost half the total NCA area is still considered as 'undisturbed'. Also notable is the emergence of 'urban' as a feature on the 2007 return.

- More information is available at the following address: **www.cpre.org.uk/resources/countryside/tranquil-places**

View east from Beeston Castle

12. Data sources

- British Geological Survey (2006)
- Natural Area Profiles, Natural England (published by English Nature 1993-1998)
- Countryside Character Descriptions, Natural England (regional volumes published by Countryside Commission/Countryside Agency 1998/1999)
- Joint Character Area GIS boundaries, Natural England (data created 2001)
- National Parks and AONBs GIS boundaries, Natural England (2006)
- Heritage Coast Boundaries, Natural England (2006)
- Agricultural Census June Survey, Defra (2000,2009)
- National Forest Inventory, Forestry Commission (2011)
- Countryside Quality Counts Draft Historic Profiles, English Heritage (2004)*
- Ancient Woodland Inventory, Natural England (2003)
- Priority Habitats GIS data, Natural England (March 2011)
- Special Areas of Conservation data, Natural England (data accessed in March 2011)
- Special Protection Areas data, Natural England (data accessed in March 2011)
- Ramsar sites data, Natural England (data accessed in March 2011)
- Sites of Special Scientific Interest, Natural England (data accessed in March 2011)
- Detailed River Network, Environment Agency (2008)
- Source protection zones, Environment Agency (2005)
- Registered Common Land GIS data, Natural England (2004)
- Open Country GIS data, Natural England (2004)
- Public Rights of Way Density, Defra (2011)
- National Trails, Natural England (2006)
- National Tranquillity Mapping data, CPRE (2007)
- Intrusion map data, CPRE (2007)
- Registered Battlefields, English Heritage (2005)
- Record of Scheduled Monuments, English Heritage (2006)
- Registered Parks and Gardens, English Heritage (2006)
- World Heritage Sites, English Heritage (2006)
- Incorporates Historic Landscape Characterisation and work for preliminary Historic Farmstead Character Statements (English Heritage/Countryside Agency 2006)

Please note all figures contained within the report have been rounded to the nearest unit. For this reason proportion figures will not (in all) cases add up to 100 per cent. The convention <1 has been used to denote values less than a whole unit.

Supporting document 2: Landscape change

Recent changes and trends

Trees and woodlands

- In 1999 about 7 per cent of the established eligible National Inventory of woodland stock was covered by a Woodland Grant Scheme management agreement. In 2003 this had reduced to 6 per cent.

- Approximately 172 ha or 6 per cent of the ancient woodland cover is on an ancient woodland site. The proportion of these sites covered by a Woodland Grant Scheme agreement has remained around 10 per cent since 1999.

- At the end of 1998 young trees approved for planting under a Woodland Grant Scheme agreement accounted for about 4 per cent of the mature woodland stock.

- Between 1999 and 2003 an area equivalent to 3 per cent of the 1999 total stock was approved for new planting under a Woodland Grant Scheme agreement (69 ha).

- Traditional orchards were once an important part of the Cheshire landscape. Some older farms, smallholdings and cottages still have remnant orchard trees either in the gardens, hedgerows or grassy paddocks set close to houses. Only a few survive, for example in the area around Kingsley and at Edge Grange.

- The Mersey Forest is planting new community woodlands delivering a wide range of associated environmental, economic, health and social benefits through sustainable landscape improvements.

- In recent years, new markets have created demand for wood-fuel biomass which is stimulating woodland management and creation.

Boundary features

- Between 1999 and 2003 Countryside Stewardship agreements for linear features included fencing (29 km), hedge management (8 km), hedge planting and restoration (16 km), and restored boundary protection (25 km).

- By 2011, boundary options under agri-environment schemes totalled 340 km of hedgerow management and over 900 m of stone wall management.

- Local evidence indicates that arable production is increasing, leading to a decline in the condition of hedgerows and in some cases fields have been enlarged, resulting in the loss of some hedgerows.

Agriculture

- Countryside Stewardship uptake for annual area features was above the national average from 1999. Most extensive annual agreements in 2003 were for lowland pastures on neutral/acid soils (124 ha) and regeneration of grassland/semi-natural vegetation (100 ha).

- Loss of grass observed up to 1998/9 has not been reversed although further losses have not been seen. Mix of farm type has remained stable since 1999, but since the early 1990s emphasis has shifted from dairy to lowland cattle and sheep.

- In 2003 Countryside Stewardship annual agreements included overwintered stubble followed by a spring crop (23 ha), overwintered stubble followed by spring / summer fallow (10 ha), and over-wintered stubble followed by a low input spring cereal crop (10 ha).

- Pond density is high; there was a significant uptake of Countryside Stewardship agreements for creation of larger ponds from 1999 and some restoration.

- Recent evidence indicates the uptake of agri-environment scheme options that include infield trees, very low-input grassland, and low input spring cereal and over-wintered stubbles, with historic environment options to protect the hill forts found on the ridge.

- Recent, local evidence suggests that the pastoral character of the lower slopes has been reduced through the introduction of fodder crops such as maize to provide winter feed. Associated with this is improved drainage, which, along with infill and encroachment, has resulted in the loss of field ponds, bogs, and mosses.

- Local evidence indicates a number of holdings converting to equestrian activities.

Settlement and development

- Rates of development outside urban and fringe areas are low.

- Urban fringe and ribbon development pressures and suburbanisation of the countryside have affected some areas, for example the area around Frodsham.

- Local evidence shows that there are areas of modern development which have changed the traditional settlement pattern, such as at Utkinton and Quarry Bank, and the modern village of Kelsall in the west, which grew from a dispersed pattern into a nucleated centre in the 20th century.

- A number of communication masts are prominently located on the highest ground and are visible over a wide area.

View looking west from Bickerton Hill towards Brown Knowl. Mature hedgerow trees give the apperance of a well-wooded landscape.

Semi-natural habitat

- Countryside Stewardship uptake for annual area features tracked above national average from 1999. Most extensive annual agreements in 2003 were for lowland pastures on neutral/acid soils (124 ha) and regeneration of grassland/semi-natural vegetation (100 ha).

- Countryside Stewardship agreements in 2003 included management of ancient water meadows (12 ha).

- Recent, local evidence indicates that the vast majority of the grassland found along the ridge is now species poor/improved grassland which has been modified by extensive fertiliser use and reseeding.

- Ancient woodland represents approximately 12 per cent of the total woodland. Approximately half of this woodland requires restoration.

- Recent evidence indicates the uptake of agri-environment scheme options for wild bird seed plots, with some species-rich grassland and at Bickerton Hill there is a large heathland restoration project.

- The Mersey Forest is planting new community woodlands delivering a wide range of benefits to habitats and biodiversity.

Historic features

- 75 per cent of historic farm buildings remain unconverted. Most are structurally intact.

- Only a limited area of historic parkland is covered by an agri-environment management agreement. In 1918 about 3 per cent of the area was historic parkland. By 1995 it is estimated that 58 per cent of the 1918 area had been lost. Little is now covered by a Historic Parkland Grant, and only 6 per cent is included in an agri-environment scheme.

- More recently, in the south, the former landscape park of Arderne Hall on the northern edge of Tarporley, has been converted to a golfing complex, reflecting the pressure from the nearby large urban conurbation, for recreational land use.

Coast and rivers

- Data obtained from the Environment Agency indicates that the ecological quality, in terms of Water Framework Directive assessment, is 'moderate' with the exception of Darley Brook and the River Gowy from its source to Milton Brook, which is 'poor'.

- Data obtained from the Environment Agency indicates that the chemical water quality of the rivers 'does not require assessment'.

- Countryside Stewardship agreements in 2003 included management of ancient water meadows (12 ha).

Minerals

- The legacy of mineral and ore extraction has led to a diversity of habitats important to biodiversity and recreation.

- The extraction of minerals and ores has taken place over centuries, for example, Copper was mined along the eastern edge of the Bickerton Hills from the 17th century onwards. A Grade II listed engine house chimney is all that remains of the original mine buildings, which were demolished in the 1930s.

- Clear evidence of bronze-age metal-working has been found on Beeston Crag.

- Although there are no working copper mines today, silica sand is extracted from the nationally important reserves of the Delamere sand sheet and the mosaic of worked-out extraction sites has led to the creation of wetland habitats important to biodiversity and recreation.

- Sandstone has been quarried throughout the NCA and continues to be extracted on a small-scale.

- The high density of infield ponds is partly a result of the historic extraction of marl as an agricultural soil improver.

- As the demand for housing and infrastructure increases, so will the demand for raw materials, potentially requiring an increase in productivity from existing extraction sites, resulting in increased lorry movements. Prolonged demand may lead to an increase in the number of planning applications for extensions to existing quarries and the development of new or 'non-operational' quarries.

View towards Burwardsley.

Drivers of change

Climate change

- Projected climate change trends suggest increased rainfall, periods of drought and more frequent storm events. Impacts are expected to increase as the magnitude of climate change increases.

- Climate change exacerbates the risk that many non-native species, insect pests and pathogens may establish and spread. For example, ash die back and acute oak decline pose a threat to the trees throughout the NCA. If unchecked, these and other diseases and pests have the potential to fundamentally change the landscape.

- Projected climate change trends suggest an increase to summer temperatures leading to warmer water temperatures and greater incidences of algal blooms on waterbodies such as the meres and ponds found throughout the NCA.

- The Environment Agency flood risk map indicates that localised flooding occurs along the river valleys. The frequency of these events is likely to increase leading to increased scour and soil erosion and mobilisation of pollutants.

- Extended periods of drought may change the suitability of current agricultural crops and/or methods of cultivation, particularly on the free-draining soils of the NCA.

Other key drivers

- The demand for land for housing and with associated road improvements is likely to increase. Opportunities exist through the National Planning Policy Framework to ensure that new developments contribute to a high-quality built and natural environment that respects the local vernacular and contributes to green infrastructure.

- The need for food security may result in increased agricultural production, with changing farming practices which may adversely impact on field sizes and patterns, ecological habitats, networks and species, and landscape character. For example, if areas of grassland and meadows along river valleys are agriculturally improved for silage and grass leys, a feature of the landscape will be lost.

- A change in the pattern of land ownership with a move towards larger land holdings is likely, with a demand for more centralised and larger buildings with increased visual intrusion and associated changes to landscape character.

- Visitor numbers are likely to increase, thus contributing to the visitor economy and providing opportunities for increasing environmental education and understanding of the local heritage. The challenge will be to manage the impact of visitors on sites by ensuring that paths are adequately signposted and surfaced to prevent erosion and to divert public access away from sensitive habitats and areas of high tranquillity.

- With its elevated topography and higher wind speeds, there is likely to be increasing pressure for additional communication masts and wind turbines along the ridge.

Supporting document 3: Analysis supporting Statements of Environmental Opportunity

The following analysis section focuses on a selection of the key provisioning, regulating and cultural ecosystem goods and services for this NCA. These are underpinned by supporting services such as photosynthesis, nutrient cycling, soil formation and evapo-transpiration. Supporting services perform an essential role in ensuring the availability of all ecosystem services.

Biodiversity and geodiversity are crucial in supporting the full range of ecosystem services provided by this landscape. Wildlife and geologically-rich landscapes are also of cultural value and are included in this section of the analysis. This analysis shows the projected impact of Statements of Environmental Opportunity on the value of nominated ecosystem services within this landscape.

Maiden Castle, one of the largest and most complex iron-age hill forts in Europe.

Statement of Environmental Opportunity	Food provision	Timber provision	Water availability	Genetic diversity	Biomass provision	Climate regulation	Regulating water quality	Regulating water flow	Regulating soil quality	Regulating soil erosion	Pollination	Pest regulation	Regulating coastal erosion	Sense of place / inspiration	Sense of history	Tranquillity	Recreation	Biodiversity	Geodiversity
SEO 1: Manage and enhance the rivers, streams and wetland habitats, including flood plain grazing marsh and wet woodland, protecting them from diffuse pollution and maintaining the integrity and unique conditions for the preservation of the lakes and standing waters of internationally important sites such as Oak Mere and Abbots Moss to benefit water availability, water quality, landscape character, biodiversity and climate regulation.	↗ *	↔ ***	↑ ***	↗ *	↔ ***	↗ **	↑ ***	↑ ***	↗ **	↑ ***	↗ *	↗ *	N/A	↗ *	↗ **	↔ ***	↗ **	↑ ***	↔ ***
SEO 2: Manage and expand areas of semi-natural woodland, restore and reinstate hedgerows and hedgerow trees, protect and restore ancient woodland, for example in the Delamere Forest Park and throughout the Mersey Forest, thus reducing habitat fragmentation to benefit landscape character, biodiversity, resource protection and climate regulation while enhancing the recreational, educational and experiential qualities of the NCA.	↘ ***	↑ **	↗ **	↑ **	↗ ***	↑ ***	↗ ***	↗ ***	↗ ***	↑ ***	↗ ***	↗ ***	N/A	↑ ***	↑ ***	↑ ***	↑ ***	↑ ***	↔ ***
SEO 3: Protect and manage the geological sites, with an emphasis on demonstrating the strong link between geology and its influence on landscape and industrial development, and promoting greater understanding of the link between wildlife and geodiversity, particularly in the distribution of habitats and species, recognising the importance of former extraction sites for both geodiversity and biodiversity.	↔ **	↔ ***	↔ **	↔ **	↔ ***	↔ ***	↔ *	↗ *	↔ ***	↔ **	↔ *	↔ *	N/A	↗ ***	↗ ***	↗ ***	↑ ***	↑ ***	↑ ***
SEO 4: Manage and, where appropriate, expand areas of characteristic heathland and other priority habitats, including lowland meadows and lowland grassland, thus reducing habitat fragmentation to benefit landscape character, sense of place, biodiversity and resource protection while enhancing the recreational and experiential qualities of the NCA.	↘ **	↔ **	↗ ***	↑ ***	↔ **	↑ ***	↗ **	↗ ***	↑ ***	↗ **	↗ ***	↗ *	N/A	↑ ***	↑ ***	↗ *	↗ **	↑ ***	↔ ***

Note: Arrows shown in the table above indicate anticipated impact on service delivery: ↑ = Increase ↗ = Slight Increase ↔ = No change ↘ = Slight Decrease ↓ = Decrease. Asterisks denote confidence in projection (*low **medium***high) ° symbol denotes where insufficient information on the likely impact is available.

National Importance; Regional Importance; Local Importance

Landscape attributes

Landscape attribute	Justification for selection
Prominent sandstone ridge.	■ The prominent sandstone ridge with outcrops and bluffs over 100 m high comprising Triassic sandstone and conglomerate, exemplified by Beeston Crag and Raw Head geological SSSI, provides expansive views. ■ In contrast to the surrounding plain, the ridge provides a locally rare sight of solid rock, evoking a sense of place and providing important sites for education and scientific research. ■ Outcrops of sandstone are the source of local building stone and historically, copper was mined in the Bickerton Hills. ■ The sandstones erode to form sandy, gravelly, free-draining soils that support heathland and woodland.
Strong mosaic of broadleaved mixed woodland.	■ A strong mosaic of broadleaved mixed woodland with ancient woodland contributes to a sense of place and tranquillity, particularly around the areas of Frodsham and Kelsall in the north, Delamere in the centre and the Peckforton Woods in the south, with blocks of ancient semi-natural woodland such as at Alvanley Cliff Wood, Warburton's Wood and Well Wood SSSI. ■ The Mersey Forest is planting new community woodlands, strengthening the wooded character of the NCA and contributing to the recreational and experiential qualities of the area. ■ Some post-medieval conifer plantations and pines are common in the woods, plantations and along hedgerows and roadsides. ■ Large blocks of commercially managed conifers occur on gravelly soils to the south-east.
A regular pattern of hedgerows and walled field boundaries.	■ A regular pattern of hedged fields, with scattered mature hedgerow trees and sunken lanes. ■ Hedgerows give way to drystone walls on the ridge and there are examples of traditional Cheshire-style painted iron railings with curved tops throughout the area. Mainly pastoral on higher ground with some areas of arable. ■ A regular pattern of enclosure with straight boundaries dates predominantly from reorganisation in the 18th and19th centuries but this is set within a broad framework inherited from earlier phases of enclosure including some ancient irregular fields.
Dispersed livestock farms on steeper slopes with arable farming predominating lower down.	■ Low density dispersed livestock farms with some dairy. ■ Arable use on the less-steep, lower slopes. ■ Permanent pastures of poor quality extend over the ridge. Gently undulating, elevated areas occur to the east of the sandstone, with thin and infertile soils.
Meres, mosses and field ponds.	■ Meres and mosses occur at the lower elevations and extend into the surrounding NCA. Collectively, they comprise the largest group of lowland lakes in England and are known as the West Midlands Meres and Mosses – designated SSSI, SAC and Ramsar sites for their internationally important assemblages of flora and fauna, and deposits of peat. ■ There is a high density of infield ponds, a characteristic shared with the neighbouring NCA that owes its existence to both glacial activity and the historic extraction of marl as an agricultural soil improver.

Landscape attribute	Justification for selection
Remnants of once widespread lowland heathland.	■ Thin and infertile soils support important areas of heathland, for example at Little Budworth Common and Bickerton Hill SSSI, the latter being the largest area of surviving lowland heath in Cheshire.
Rivers, streams and canals	■ The NCA is drained by the rivers Gowy and Weaver that rise in the Peckforton Hills which are a local watershed. The rivers contribute to the Weaver/Gowy catchment that supplies water for public, industrial and agricultural uses. ■ The Shropshire Union Canal crosses east–west. Once an important trade route, the canal is now a recreational asset. ■ The River Weaver has been straightened (canalised) in places to improve navigation (the Weaver Navigation Canal), leaving the original line of the river as a quiet backwater that now hosts valuable habitats.
Castles, follies and the remains of iron-age forts.	■ Historic features punctuate the ridgeline. These include castles such as Peckforton, Beeston and Maiden Castle, the remains of early iron-age hill forts, burial mounds and ring ditches. ■ Iron-age hill forts were connected by a trackway following the higher land that now forms a long-distance footpath, the Sandstone Trail.
Dispersed settlement pattern – buildings built of distinctive brick and local building stone with some timber-framed.	■ Basic settlement pattern of dispersed farmsteads, hamlets and small villages dating predominantly from the medieval period. ■ Red brick and plain clay tiles or Welsh slate are the dominant building materials for farmhouses and farm buildings. ■ Farmhouses and cottages are often timber-framed. ■ Hedgerows give way to drystone walls of red sandstone, particularly on the ridge, where the geology has been exploited.
Rights-of-way network that links the population centres with rural areas, offering relative tranquillity.	■ The Shropshire Union Canal was once an important trade route linking Birmingham and the Black Country with the Mersey and is now a popular recreational resource for pleasure craft and walkers along the towpath. ■ The Sandstone Trail – a long-distance footpath along the top of the ridge, stretching for 55 km and offering elevated views across and out of the NCA. ■ The Weaver Navigation Canal was built for the transportation of salt from the mines in Cheshire and is now used widely by pleasure craft. ■ Route 70 of the National Cycle Network also crosses the area.

Landscape opportunities

- Manage core nature conservation sites such as SAC, Ramsar sites, SSSI, NNRs, LNRs and the Local Sites network, to improve their condition and connectivity within the landscape, to enhance character, and to create a coherent, more resilient habitat network while providing opportunities for volunteering, education and community involvement.

- Conserve and protect rock outcrops for their contribution to landscape character and educational value in studying past climate and geo-morphological processes, and for their cultural and historical significance.

- Maintain and buffer the areas of ancient semi-natural woodland by creating and managing transitional scrub communities between woodland and adjoining habitats to benefit biodiversity and landscape connectivity.

- Increase the diversity of tree species in new plantations to help increase the resilience of woodland to the effects of pests, diseases and climate change.

- Manage historic parkland and ancient woodland, with veteran trees, throughout the NCA. Encourage successional planting of native mixed species to maintain the structural diversity and strengthen landscape and historic character.

- Create areas of semi-natural habitats in arable agricultural systems by planting species-rich field margins and providing habitat for farmland birds.

The site of Kelsborrow iron-age hill fort. The remains of iron-age hill forts, burial mounds, ring ditches and castles, and finds of stone tools, occur along the ridgetop.

- Conserve existing orchards and encourage the reinstatement of traditional orchards for the benefits to biodiversity and genetic diversity through the cultivation of traditional varieties.

- Conserve and restore drystone boundary walls and appropriately manage and restore traditional hedgerows with typical species, to benefit soil protection, biodiversity and sense of place.

- Protect and restore the wetlands of the meres and mosses for the benefit of landscape character, people, wildlife and the historic environment.

- Create new or extend wetland landscapes and habitats to increase connectivity and reconnect rivers to their flood plains to benefit water flow and biodiversity.

- Enhance the visual and ecological continuity and character of river corridors and their tributaries through positive management, for example facilitating natural regeneration and where appropriate, planting of riparian trees and vegetation that can provide woody debris and shade for wildlife and people.

- Protect further loss and degradation of heathland and, where appropriate, create new, thus reducing fragmentation and enhancing the habitat mosaic within the landscape to benefit biodiversity and climate regulation.

- Conserve, enhance and improve interpretation of historic assets in the wider landscape including above- and below-ground archaeology and historic sites and buildings for their educational, cultural and historic significance.

- Create new or extend public rights of way and permissive access, including circular routes, to improve the connectivity between settlements and core sites, encouraging physical activity and improving health and well-being for all abilities and user-groups.

- Create new access to woodlands as part of woodland management, increasing the opportunities for quiet recreation and to experience tranquillity, while ensuring this does not compromise sensitive habitats and bio-security, and encouraging visitors away from over-popular sites.

- Create new woodland in urban areas, contributing to green infrastructure; planting blocks of trees to screen settlements and roads from the surrounding landscape and planting street trees to provide shade, mitigating the effect of the urban heat island, increasing water infiltration rates and purifying the air.

Ecosystem service analysis

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Food provision	Livestock farms with some dairy and arable Grass leys, improved and permanent pasture Traditional orchards	The predominant land cover is grass, particularly in the north of the area. Improved grassland and permanent pasture produce grass for grazing, silage or hay. There is some dairying, based on the fertile and productive clay soils. Arable predominates on some of the gentle, more freely-draining side slopes of the sandstone ridges. Traditional orchards were once an important part of the Cheshire landscape. Some older farms, smallholdings and cottages still have remnant orchard trees either in the gardens, hedgerows or grassy paddocks set close to the house. Only a few survive, for example in the area around Kingsley and at Edge Grange.	Local	The increasing demand for food production is likely to continue, leading to a high demand for improved grassland that could result in the loss of semi-natural habitats. In addition, pastoral character could be reduced through the introduction of fodder crops such as maize to provide winter feed. This could lead to larger field sizes and improved drainage which could threaten field ponds and characteristic meres and mosses. However, opportunities exist to incorporate measures to mitigate such consequences. In addition to being a characteristic of the area, orchards are hotspots for biodiversity, supporting a wide range of wildlife and containing priority habitats and species.	Work in collaboration with farmers to safeguard food production while incorporating measures that maintain and enhance habitat networks and enhance the landscape character. For example, incorporating species-rich field margins, managing hedgerows and managing for farmland birds. Encourage the adoption of management techniques advocated by the Catchment Sensitive Farming Programme, such as buffering watercourses and safeguarding wetland habitats and infield ponds, to benefit biodiversity and water quality. Encourage the management and planting of traditional orchards for the benefits to biodiversity, heritage and local markets. For example, orchard planting with communities through the Mersey Forest Plan.[4]	**Food provision** **Biodiversity** **Regulating water quality** **Sense of history** **Sense of place/ inspiration**

[4] www.merseyforest.org.uk/plan/

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Timber provision	Conifer plantations Native woodland Community woodlands	Over 13 per cent of the area is woodland with blocks of woodland, both broadleaved and conifer plantations, including private woodlands and those managed by the Forestry Commission, for example Primrose hill and Nettleford Wood. The Forestry Commission has established extensive community woodland of mixed planting with open spaces on the northern slopes of the Old Pale, within the Delamere Forest, in the north of the area. Approximately half of the area is within the Mersey Forest which has as an objective the creation of sustainably managed community woodlands that include timber provision to local communities.	Regional	The greatest concentration of woodland is in the north of the area around Delamere Forest, which was a vast hunting forest. Approximately half of the area is within the Mersey Forest, which has objectives to plant more community forests that benefit the education, health and well-being of communities, and provide benefits to the local economy through the sale of woodland products.	Seek opportunities to stimulate the wood-products and wood-fuel market in nearby urban areas in order to sustain the management of native woodlands. Managing more woodland for timber will benefit a number of services. Through community woodlands such as those in the Mersey Forest, opportunities exist for woodland allotments, education, training and volunteering. Community woodlands also provide opportunities for research into the benefits of woodland for health and well-being. Ensure that new conifer plantations do not fragment areas of semi-natural woodland.	**Timber provision** **Biodiversity** **Sense of place/ inspiration** **Sense of history** **Climate regulation** **Water availability** **Regulating water flow** **Recreation**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Water availability	River Gowy River Weaver Aquifer	Data from the Environment Agency[5] indicates that groundwater availability in the Weaver/Gowy catchment is good. The rivers Gowy and Weaver rise in the Peckforton Hills towards the south of the area. Data from the Environment Agency [6] indicates the location of a secondary aquifer extending from Tarporley in the central area to Frodsham in the north of the area.	Regional	Although there are no reservoirs in the area, the rivers Gowy and Weaver and their tributaries contribute to Weaver/ Gowy catchment which provides water for public, agricultural and industrial water supply outside the area, for example to Northwich, and Frodsham. Expansion of these settlements will result in increased abstraction. Climate predictions indicate prolonged periods of drought leading to an increased demand for water for crop irrigation, potentially resulting in low flow levels that negatively impact on biodiversity and water quality. Sediments of the Sherwood Sandstone Group form the Weaver aquifer and water is abstracted from the aquifer outside the NCA. Outcrops within the area offer limited recharge areas to the aquifer. In addition to providing water for public, agricultural and industrial use, there are large numbers of designated conservation areas in the catchment, with SSSI, Ramsar site and SAC designations, such as Oak Mere, that are reliant on consistent water availability.	Promote the sustainable use of water in domestic, industrial and agricultural sectors to reduce demand. Where appropriate in the landscape, encourage rainwater harvesting and the construction of winter water-storage reservoirs in agricultural areas and ensure they benefit landscape character and biodiversity. Identify and enhance areas for natural water storage, for example lowland meadows along the River Gowy, expanding flood meadows and creating ponds and scrapes. These measures have multiple benefits. Maintain and extend riparian woodland along the river valleys to increase interception rates and slow the flow of surface water. The freely-draining soils may be valuable for aquifer recharge. This will be enhanced by the maintenance of good structural conditions and increasing organic matter levels through management interventions, to aid water infiltration and protection from pollution.	**Water availability** **Sense of place/ inspiration** **Recreation** **Biodiversity** **Climate regulation** **Regulating water flow**

[5] http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=wfd_groundwaters&layerGroups=default&lang=_e&ep=map&scale=6&x=365500&y=373500#x=368516&y=365086&lg=1,7,9,&scale=5
[6] http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=groundwater&layerGroups=default&lang=_e&ep=map&scale=5&x=368516&y=365086#x=354963&y=376582&lg=3,&scale=6

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Genetic diversity	Traditional orchards	Traditional orchards were once an important part of the landscape. Some older farms, estates, small-holdings and cottages still have remnant orchard trees either in the gardens, hedgerows or grassy paddocks set close to the house. A number of fragmented orchards survive, for example in the area around Kingsley and at Edge Grange.	Local	Local evidence shows that there are over 30 varieties of apple specific to Cheshire. A number were developed in the 18th century, for example Ecclestone Pippin, Lord Derby and Gooseberry Pippin. The genetic diversity preserved in old fruit varieties may be important to future food security by retaining genes for future crop propagation. In addition to being a heritage asset to the area, orchards are hotspots for biodiversity, supporting a wide range of wildlife and containing priority habitats and species including populations of pollinators.	Through agri-environment schemes, landscape-scale partnerships and community woodland partnerships encourage the expansion of existing orchards and the re-instatement of old orchards to preserve heritage varieties and fruit tree suppliers.	**Genetic diversity** **Food provision** **Biodiversity** **Pollination** **Sense of place/ inspiration** **Sense of history** **Recreation**
Biomass energy	Existing woodland Forestry by-products Woodland allotments	Over 13 per cent of the NCA is woodland, providing a resource for biomass in the form of timber from forestry that is unsuitable for its intended purpose, including arisings from arboricultural activities associated with woodland management, such as coppicing and pollarding. The Mersey Forest is establishing woodland allotments, encouraging communities to thin trees to benefit the woodland structure in return for timber for fuel.	Local	The use of arisings from woodland and arboricultural management not suitable for timber provision could be used for biomass production. The steep-sided slopes make the area unviable for commercial biomass production; however, the peripheral lower slopes and flatter lower valleys could support SRC and/or Miscanthus but have a low potential yield. Siting of biomass crops would need to consider impacts on landscape character; with its mosaic of woodland and farmland, the landscape is valued for its scenic contrast with the surrounding plains. Community woodland partnerships, such as the Mersey Forest, identify potential areas for new woodland and are beginning to establish sustainable supply of and demand for biomass.	Seek opportunities for landscape-scale collection of arisings and timber waste in hubs, for example at Delamere, for supply to residential wood-fuel markets close to population centres and supply to biomass boilers in local amenity and civic buildings. Encourage the installation of small-scale wood-fuel boilers in local buildings. Encourage community woodland projects, such as the Mersey Forest Plan, that can provide biomass to local markets and in return secure benefits of woodland management, employment and supporting the transition to a low carbon economy. .	**Biomass energy** **Biodiversity** **Climate regulation** **Sense of place/ inspiration** **Sense of history**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Climate regulation	Soils Woodland Meres and mosses Wetland habitats Heathland	The majority of the NCA has a low soil carbon content of 0–5 per cent[7] reflecting the dominance of mineral soils with a low carbon content, especially where under continuous arable cultivation. Over 13 per cent of the area is covered by woodland and this will be a significant contributor to carbon storage and sequestration. The fen peat soils associated with the meres and mosses have deep peat soils that have large stores of carbon. The significant wetland areas as well as woodland, heathland and grassland including over 1,500 ha of priority habitats will also provide an important carbon storage function in this NCA. In urban areas, planting blocks of trees and street trees will provide shade, thus mitigating the effect of the urban heat island, increasing water infiltration rates and purifying the air.	Local	By increasing organic matter input and by reducing the frequency/area of cultivation in areas where mineral soils occur, carbon sequestration and storage of mineral soils can be increased. Good management of existing woodland can ensure their role in sequestering and storing carbon is optimised and will benefit other services, for example biodiversity. Peat soils, associated with the meres and mosses are very important because of their role in the storage of carbon and other greenhouse gases. Unfortunately historic peat extraction and the lowering of the water table have reduced the effectiveness with which these peatlands contribute to carbon storage. Therefore, the conservation and management of meres and mosses is extremely important for climate regulation in addition to benefits to biodiversity and sense of place. Heathlands are characterised by a cover of 25 per cent dwarf shrubs of the botanical family Ericaceae. Woody shrub species play an important role in carbon sequestration in grassland ecosystems.	Where arable systems prevail, work in collaboration with farmers to ensure appropriate management techniques are employed to enhance organic inputs and reduce fertiliser inputs for the benefits to climate regulation and increased crop yields. Work in landscape-scale partnerships to ensure that woodland is managed for the benefits of climate regulation and biodiversity, for example at Delamere. Work in landscape-scale partnerships on the restoration of meres and mosses and other wetland habitats, to benefit a number of provisioning and regulating services. Create new or extend wetland habitats along the valley of the River Gowy and reverse the fragmentation of the area's heathland to increase connectivity, benefitting biodiversity and climate regulation.	**Climate regulation** **Biodiversity** **Regulating soil erosion** **Regulation of water quality** **Recreation** **Sense of place/ inspiration** **Sense of history**

[7] NSRI National Soils Map for England and Wales, Environment Agency (January 2009)

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water quality	Rivers and their tributaries Aquifer	Data obtained from the Environment Agency[8] indicates that the ecological status of the watercourses in the area is 'moderate' with the exception of Darley Brook (poor) and the River Gowy, from source to Milton Brook (poor). Several sites are within the West Midlands Meres Priority Catchment, of the Catchment Sensitive Farming Programme[9] emphasising the importance of water quality to the NCA's habitats, particularly the meres and mosses that are sensitive to sedimentation and diffuse pollution. A secondary aquifer extends from Tarporley to Frodsham forming part of the Sherwood Sandstone aquifer.	Regional	Reasons for the failing ecological status[10] of the watercourses according to the Water Framework Directive assessment include sedimentation, channel modifications, and diffuse pollution from fertiliser, pesticides and discharges from septic tanks. In addition, the aquatic ecology suffers from current and past industrial discharges compounded by river modifications including weirs and locks that act as barriers to fish migration. The ridge and outcrops of Triassic sandstone can contribute to aquifer recharge, requiring the careful management of fertilisers and pesticides to prevent pollution of groundwater.	Seek opportunities through the Catchment Sensitive Farming Programme and agri-environment schemes to reduce foul run-off from outdoor feeding areas, silage clamps, yards and cattle tracks; prevent stock from entering streams and poaching stream banks, and managing livestock to avoid poaching of fields by cattle movement; buffer watercourses from nutrient run-off. These measures can have a positive effect on ground and surface waters benefiting biodiversity. Physical barriers around arable fields, such as permanent grassland margins, well-maintained hedgerows and boundary walls, can alleviate wind erosion of soil, reducing the risk of sedimentation.	**Regulating water quality** **Regulating water flow** **Regulating soil erosion** **Recreation** **Biodiversity**

[8] http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=wfd_rivers&layerGroups=default&lang=_e&ep=map&scale=6&x=378140.46875&y=361547.44791666674#x=350888&y=368427&lg=1,7,8,9,5,6,&scale=6
[9] www.naturalengland.org.uk/ourwork/farming/csf/default.aspx
[10] River Basin Management Plan, North West River Basin District, Environment Agency (December 2009).

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water flow	Flood plains, rivers and watercourses Semi-natural vegetation Riparian woodland	Data from the Environment Agency's flood map[11] for rivers indicates that the risk of flooding is restricted to the river valleys and watercourses, both within the NCA and in the neighbouring NCAs. The management of water is critical to the internationally important areas of meres and mosses and other nationally important wetland habitats. Periods of drought can degrade peat soils, liberating greenhouse gases and leading to catastrophic loss of habitat.	Regional	The Environment Agency flood risk map indicates that localised flooding occurs along the river valleys. The frequency of these events is likely to increase with climate change, leading to increased scour, soil erosion and mobilisation of pollutants. In urban areas there is an increased risk of damage to buildings and infrastructure. Riparian woodland and lowland meadow, particularly along the Pettypool Brook Valley provide an effective filter and buffer, helping to trap sediment and slowing the flow of surface water. Identifying additional flood storage areas and reconnecting wetland habitats and rivers with their flood plains can help sustain water levels, thus maintaining the integrity of the meres, mosses and wetland habitats.	Seek opportunities to expand semi-natural habitats including riparian woodland and flood plain grazing marsh along river valleys and watercourses to help reduce flow rates during peak flows. This will also benefit biodiversity and reduce diffuse pollution via surface run-off. Support landscape-scale partnerships in the restoration of the meres and mosses and where possible, reconnect rivers to their flood plains to provide flood storage areas that will also benefit biodiversity. Removing constrictions to flow, such as weirs, will also benefit migratory fish and re-naturalising banks can help slow flow rates. Identify natural areas for flood water storage to reduce the reliance on hard-engineering solutions to flooding in settlements. Widen flood plains and ensure they are not inappropriately developed, and ensure that new developments take into account the principles of sustainable urban drainage systems (SUDS) by including green spaces and areas of unsealed surfaces.	**Regulating water flow** **Regulating water quality** **Regulating soil erosion** **Regulating soil quality** **Sense of place/ inspiration** **Biodiversity**

[11] http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=floodmap&layerGroups=default&lang=_e&ep=map&scale=9&x=365500&y=373500#x=355894&y=363688&lg=1,&scale=8

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil quality	Soils derived from the Triassic sandstone Soils derived from glacial till Fen peat soils	Arable systems predominate on the freely-draining soils on the lower, less-steep slopes of the ridge, which can damage the soil structure over a prolonged period of cultivation. The slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils and the fen peat soils may suffer compaction and/or capping as they are easily damaged when wet.	Local	The soil structure of the freely-draining sandy soils can be further damaged where organic matter levels are low after continuous arable cultivation or where soils are compacted. This may be improved by adding organic matter. The soils are also valuable for aquifer recharge where overlying the aquifer, requiring the maintenance of good soil structure to aid water infiltration and the control of fertiliser and pesticide inputs to prevent pollution of groundwater. Compaction and/or capping of slowly permeable soils may reduce water infiltration and increase diffuse pollution as a result of surface water run-off. Increasing organic matter levels can help reduce these problems. Where peaty soils predominate and where appropriate, retain water levels to increase water retention and maintain the soil structure.	Encourage the adoption of Catchment Sensitive Farming techniques to manage arable and livestock systems sustainably, protecting the soil structure, for example by preventing poaching, adopting sustainable stocking levels and avoiding mechanised activities that will compact the soil, especially in wet conditions. Ensure the management of pastures and meadows encourages the build-up of organic matter and encourage management of arable land such as use of green manure and winter stubbles to replace nutrients and improve soil structure. In partnership, continue the restoration of degraded areas of peat and manage wetland habitats to safeguard the carbon-rich soil and re-introduce peat forming vegetation.	**Regulating soil quality** **Food provision** **Water availability** **Climate regulation** **Regulating soil erosion** **Regulating water quality** **Regulating water flow** **Biodiversity** **Sense of place/ inspiration**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil erosion	Soils Field boundary features Semi-natural habitat	The lighter freely draining soils have an enhanced risk of soil erosion on sloping land where cultivated or bare soil is exposed, exacerbated where organic matter levels are low after continuous arable cultivation or where soils are compacted. These soils are also at risk of wind erosion, particularly where left bare, as are the fen peat soils. They are also susceptible to rapid run-off during storm events.	Local	Food production, water quality and the integrity of the meres and mosses are important to the area, therefore the regulation of soil erosion. It is essential to maintain the soil resource for food production and also to reduce sedimentation in the watercourses, meres and mosses. Permanent vegetation cover, for example, pasture alongside river valleys and watercourses, stabilises exposed areas, trapping sediment and slowing water flow. Physical barriers in arable fields can alleviate wind erosion of soil, for example, permanent grassland around field boundaries, well-maintained hedgerows and boundary walls. Riparian woodland and lowland meadow along watercourses offer resource protection against run-off. Conversely, invasive non-native species, for example, stands of Himalayan balsam, can lead to bare earth in the winter months which is when soils are markedly more prone to soil erosion. The restoration of hedgerows may constrain food productivity, but in the longer term maintain the productivity of the land by protecting the soil resource and is likely to lead to an improvement to water quality and prevent soil loss causing sedimentation. Periods of drought may exacerbate soil erosion by wind on the slopes of the ridge, thus reinforcing the importance of hedgerows in soil protection.	Encourage the adoption of Catchment Sensitive Farming techniques to manage arable and livestock systems sustainably and protect the soil resource, for example, buffering watercourses. Encourage the uptake of agri-environment options to establish field margins with permanent grassland or conservation margins. Buffer watercourses to reduce sediment run-off and reduce incidences of bare earth in arable systems for the multiple benefits to resource protection, and biodiversity.	**Regulating soil erosion** **Regulating water quality** **Regulating soil quality** **Food provision** **Regulating water quality** **Biodiversity** **Sense of place/ inspiration**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Pollination	Lowland heathland Lowland meadows Traditional orchards Hedgerows and field margins Road verges	Crops grown within the NCA are not reliant on populations of pollinators, however the traditional orchards in this NCA and orchards and fruit farms in the neighbouring Plain benefit from this service. Areas of lowland heath, meadow, hedgerows and grassland habitats provide sources of nectar for pollinating insects. Late-flowering nectar sources, such as heather, are important in providing supply of nectar over an extended period of time. Residential gardens provide important sources of nectar in settlements and often have more diverse sources of nectar than occurs in agricultural monocultures.	Local	Food crops that are currently grown in the NCA do not rely on pollinators therefore their value is to biodiversity and the few traditional orchards and fruit farms in the neighbouring Plain. This could be a limiting factor should cropping regimes change. An increase to the populations of pollinators may facilitate an increase in the number of orchards and types of crops that could be grown in the future thus expanding the range of food provision and increasing the resilience to the effects of climate change. Collectively, lowland heathland and lowland meadow represent three per cent of the NCA, currently limiting the provision of this service. However, expanding areas of lowland heath and meadow, planting a network of species-rich hedgerows, creating flower-rich field margins in agricultural areas and species-rich roadside verges would all reduce habitat fragmentation.	Seek opportunities to increase nectar provision within the agricultural landscape through promotion of agri-environment scheme options. This would also provide habitat and food source for potential pest regulators, for example, birds. Encourage local authorities, highways and road maintenance contractors to diversify the species mix of roadside verges to provide wildlife corridors that link areas of high biodiversity thus providing a more robust ecological network for pollinators.	**Pollination** **Food production** **Climate regulation** **Regulating soil erosion** **Regulating water quality** **Biodiversity** **Sense of place/ inspiration** **Pest regulation**
Pest regulation	Semi-natural habitat Hedgerows Arable margins Road verges	The contribution to pest regulation services is limited to semi-natural habitat, hedgerows, field margins and road verges.	Local	Semi-natural habitats and hedges proximal to areas of commercial arable agriculture may support species of predators that can regulate populations of pests that adversely affect crop yields, hence food provision. Climate change exacerbates the risk that many non-native species, insect pests and pathogens may establish and spread. For example, ash die-back and acute oak decline pose a threat to the trees throughout the NCA. If unchecked, these and other diseases and pests have the potential to fundamentally change the landscape.	In agricultural areas, expand existing areas or create new semi-natural habitat, for example, beetle banks, headlands and re-instate hedgerows, to provide a mosaic of habitats in areas of monoculture, thus providing a more robust ecosystem that will benefit food production and biodiversity. Monitor occurrence of diseases such as ash dieback and work with landowners and managers to limit spread and introduce bio-security measures where appropriate.	**Pest regulation** **Pollination** **Biodiversity** **Food production** **Sense of place/ inspiration.**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of place/ inspiration	Sandstone ridge Woodland and boundary features Historic assets Lowland heathland Meres and mosses Rivers, streams and canals and field ponds Hedgerows and stone boundary walls Local vernacular Parklands	A strong sense of place is evoked by the prominent sandstone ridge with outcrops and bluffs over 100 m high comprising Triassic sandstone and conglomerate, exemplified by Beeston Crag and Raw Head geological SSSI, contrasting with the surrounding plain. At many locations solid blocks of woodland (including conifers) and high hedgerows combine to evoke a strong sense of enclosure and wooded feel, a complete contrast to the unrestricted panoramic views afforded by the ridge. Heathland was once a common sight in Cheshire, but has become increasingly fragmented and degraded. The most extensive heathland in Cheshire survives at Bickerton Hill SSSI and provides a glimpse of a past landscape.	Regional	The geology of the NCA provides a distinctive character, which should be maintained and enhanced through careful management. Woodland occurs on the slopes of the ridge and there are extensive blocks in the north of the NCA, for example, Delamere, the former Royal Forest of Mara. The sense of enclosure by lush, dense vegetation is further reinforced by sunken lanes between high hedges or valley bottoms below wooded ridgelines. Heathland, meres and mosses provide a tangible link with past landscapes and environments inspiring research and reflection.	There are opportunities to increase interpretation and understanding of the historic assets, geology and land forms illustrating how geology influences settlement patterns, human activity and innovation and relate this to the landscape for visitors to the ridge and those walking the Sandstone Trail. Seek to reverse the fragmentation of lowland heathland and conserve and protect the meres and mosses for future generations and for the benefits to biodiversity and climate regulation.	**Sense of place/ inspiration** **Sense of history** **Recreation** **Biodiversity** **Climate regulation**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of history	Bronze-age artefacts Iron-age hill forts Roman settlements Country houses and castles Royal Forest Sandstone quarries and former copper mines Historic parkland Traditional orchards Settlement pattern	Prehistoric flint scatters and barrows indicate prehistoric activity (Bronze Age and earlier). Early iron-age hill forts were constructed along the ridge and connected by a trackway following the higher land. The Roman villa at Eaton by Tarporley is so far the only known villa in north-west England and an earlier timber building and a farmstead has been excavated at Birch Heath, near Tarporley. A Roman road crosses through the area en route to Manchester from Chester. Large historic halls include Peckforton Castle and Utkinton (listed Grade I), constructed in the 17th century and Tirley Garth to the south-west of Kelsall constructed in the 20th century is a Grade II* Listed Building and is surrounded by a Grade II* Registered Park and Garden. A basic settlement pattern, of dispersed farmsteads, hamlets and small villages dating predominantly from the medieval period. Agricultural improvement partly led to the origin of numerous field ponds. At Bickerton, near Gallantry Bank, there is a sandstone engine house chimney, which is all that remains of a former copper mine, worked intermittently from approximately 1690 to the 1920s.	Local	The strong landscape character of the NCA generated by the imposing geology is heightened by the clear evidence of past human land use. From the construction of defensive forts on the ridge, to field ponds, a consequence of agricultural improvement, to settlements and grand country houses. During the medieval period it became increasingly common for hunting to take place in deer parks and there are two former sites on the ridge which are identified by the placenames Old Pale and New Pale. The area's industrial heritage of sandstone quarrying is still evident in the landscape and the former quarries provide valuable habitats. Evidence of former copper mines is less obvious, restricted to rare glimpses of infrastructure.	Retain the well-preserved historic assets, above and below ground, by ensuring appropriate land management regimes. Manage the impacts of recreation, providing alternative paths away from eroded sites and sensitive habitats. Manage forestry and historic parkland to provide access and recreation while maintaining the historic characteristics of the woodland and areas of tranquillity. Encourage the reinstatement of traditional orchards. Opportunities exist to improve the interpretation of the area's former mining heritage, woodland and historic parkland, allowing visitors to understand, value and enjoy these features.	**Sense of history** **Sense of place/ inspiration** **Geodiversity** **Recreation** **Tranquillity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Tranquillity	Woodland River valleys	Statistics obtained from the 'Intrusion Map 2007' provided by the Campaign for the Protection of Rural England (CPRE) indicates a 51 per cent increase to 'disturbed' areas during the period from the 1960s to 2007. However, almost half the total NCA area is still considered as 'undisturbed'. Also notable is the emergence of 'urban' as a feature on the 2007 statistics. Traffic noise is cited as the main disturbance to tranquillity.	Regional	Despite the reduction to 'undisturbed' areas, the NCA is important in providing to the populations of the nearby conurbations the opportunity to experience the contrast between the wide-open, unenclosed landscape on the ridge to an enclosed feel in the valleys, woodland and sunken lanes. Extensive mosses, for example, Fenn's, Whixall, Bettisfield, Wem and Cadney mosses offer wide-open desolate landscapes.	Retain areas of open landscape, resisting urban development into undisturbed areas. Buffer the areas of the NCA where intrusion is low and sensitively plan any expansion to settlements and roads by planting woodland belts reducing visual impact, noise and light pollution. Encourage the provision of improved access to woodland as part of woodland management to increase the opportunities for people to experience tranquillity, for the calming and restorative effects on people's health and wellbeing. Resist the introduction of urban features in to the rural/village landscape, for example, unnecessary lighting and signage.	**Tranquillity** **Sense of place/ inspiration** **Sense of history** **Biodiversity** **Recreation**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Recreation	Public rights of way and heritage trails Iron-age hill forts National Cycle Network Little Budworth Country Park Shropshire Union Canal Forests	For its area, the NCA has an extensive rights of way network totalling 362 km. The most notable being the Sandstone Trail that stretches for 55 km and links the sites of the iron-age forts on the ridgetop. National Cycle Network routes 70 (the Cheshire Cycleway) and 71 cross the NCA. The former provides a circular route that extends in to the neighbouring NCA. There are also regional cycle paths, for example, Whitegate Way cycle path. Little Budworth Country Park and Delamere Forest with its large forest and visitor centre are also popular visitor destinations. The Shropshire Union Canal crosses east–west. Once an important trade route, the canal is now a recreational asset.	Regional	The NCA offers a host of recreational sites and trails that are close to large conurbations. Little Budworth Country Park and Delamere Forest provide opportunities for visitors to understand and enjoy the history, biodiversity and geology that the NCA has to offer. This is both an opportunity – to educate and increase physical activity – and a challenge to manage visitor numbers and the impact they have on the environment, local infrastructure and tranquility. Projected climate change trends suggest an increase to summer temperatures leading to an increased risk of forest and heathland fires and increased erosion to footpaths.	Encourage responsible use of the area by visitors and manage the impact of visitors on sites by ensuring that paths are adequately signposted and surfaced to prevent erosion and to divert public access away from sensitive habitats and areas of high tranquillity Sustainably manage the demand for water and energy resources and provide recycling facilities at visitor centres, to minimise the impact on the environment and to raise awareness. Support initiatives by the Forestry Commission to increase the recreational resource at Delamere and the Mersey Forest in its aims to create more community woodlands. Increase the number of circular, well-surfaced, routes suitable for all age ranges, abilities and interests. Promote the use of the existing network of rights of way within the NCA and its links with the National Cycle Network and Sandstone Trail. Provide imaginative interpretation of the landscape and its many features (geological, historical, species and habitats) to increase the understanding and enjoyment for all.	**Recreation** **Sense of history** **Sense of place/ inspiration** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biodiversity	Woodland Meres and Mosses Hedgerows Priority habitats – lowland heathland, lowland meadow and flood plain grazing marsh Ponds Designated sites Historic parkland	A strong mosaic of broadleaved mixed woodland, including pine, particularly around the area of Delamere Forest Park. Peckforton Woods SSSI has the largest tract of sessile oak in Cheshire. Half of the ancient woodland is plantations on ancient woodland sites. Ponds are a characteristic feature of the Cheshire landscape and contain a diversity of important wetland species, including great crested newt. The meres and mosses of the north-west Midlands form a geographically discrete series of nationally important lowland open water and peatland sites designated as SSSI and SAC. The finest examples are considered to be of international importance (Ramsar sites). This suite of sites support an outstanding assemblage of plants and animals, the finest have developed a mature schwingmoor comprising floating bog moss with common cotton grass and cranberry. The mosaic of open water and peatland habitats together with fringing heathland and woodland provide habitats for locally and nationally rare species of aquatic plants and invertebrates, for example, planktonic algae, stands of shoreweed and narrow small-reed. A host of invertebrates including damselflies and dragonflies, for example, the nationally rare white-faced dragonfly, and a diversity of beetles and spiders including a number of nationally rare species. The sites also contain the drier areas which typically support heathland relics, areas of purple moor grass and open semi-natural woodland which is important for Lepidoptera. Large areas of lowland heathland survive on Bickerton Hill SSSI and at Little Budworth Common with fragmented areas of lowland meadow throughout the area, particularly along the Pettypool Brook Valley and along the line of the Shropshire Union Canal. The wetland communities along the course of Pettypool Brook Valley SSSI comprise Cheshire's most extensive and diverse valley mire system. The mature woodland with its abundant dead wood, and the extensive peatland habitats, support populations of a number of national and county rarities, making it one of Cheshire's foremost invertebrate sites.	National/ International	The NCA contains nationally and internationally important habitats. Ancient woodland and broadleaved mixed woodland requires management to maintain their structural integrity and species diversity as do hedgerows. Priority lowland heathland and lowland meadows require management to maintain their condition and require protection from further fragmentation. Internationally important wetland sites, for example, at Abbots Moss (SAC and Ramsar site), are lakes associated with schwingmoor development. Schwingmoor is an advancing floating raft of bog moss Sphagnum spp., often containing common cottongrass and the scarce narrow small-reed. These and other wetland sites, for example, Pettypool Brook Valley SSSI have specific water chemistry that requires careful management and protection from diffuse pollution and falling water levels. Warmer summers and wetter winters combined with an increase in demand for food provision in the future is likely to see greater pressure to plough out areas for arable cultivation. Climate change is also likely to result in changes in species composition with a shift from heather to grassland, and drying of peatlands and other wetlands, increasing the risk of erosion and wildfires.	Partnership working at a landscape-scale can begin to manage the threats to the diverse habitats of the NCA. Catchment Sensitive Farming options can help maintain the natural soil profile and protect the local hydrology. This can include working with landowners, water companies and agencies to reduce the abstraction of water, working with farmers to reduce sedimentation caused by surface run-off and reducing diffuse pollution caused by high nutrient levels and pesticides to benefit biodiversity and improve water quality to protect the integrity of the meres and mosses and aquifer recharge areas. Increase the surveillance of key habitats and species by monitoring the distribution and recording of species population sizes as an indicator of habitat quality and providing opportunities for volunteering and training. Maintain and buffer the areas of ancient semi-natural woodland by creating and managing transitional scrub communities between woodland and adjoining habitats to benefit biodiversity and landscape connectivity to help increase resilience to climate change. Manage historic parkland and ancient woodland, with veteran trees, throughout the NCA. Encourage successional planting of native mixed species to maintain the structural diversity and strengthen landscape and historic character.	**Biodiversity** **Sense of place/ inspiration** **Sense of history** **Regulating soil erosion** **Regulating water flow** **Regulating water quality** **Regulating soil quality** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Geodiversity	Natural rock outcrops Road, rail and canal cuttings Traditional local stone vernacular Glacial and present-day geo-morphological processes Minerals and ores Mines and quarries Peatlands and mosses	The prominent sandstone ridge with outcrops and bluffs over 100 m high comprising Triassic sandstone and conglomerate, exemplified by Beeston Crag and Raw Head geological SSSI provides expansive views. In contrast to the surrounding plain, the ridge provides a locally rare sight of solid rock, evoking a sense of place and provides important sites for education and scientific research. The escarpment between Tower Wood and Droppingstone Well, known as Raw Head geological SSSI, is a nationally important geological site. The rivers Weaver and Gowy both illustrate fluvial activity in the form of channel migration and flood plain deposition representing present-day geo-morphological processes. Cheshire possesses mineral resources of national importance in the form of silica sand and building sand. A major extraction area is located around Delamere from the Delamere sand sheet. The peatlands and mosses have built up over many thousands of years, thus providing an invaluable record of the detail of this process that is preserved in the layers of peat and mineral sediments.	Regional	The sediments at Raw Head geological SSSI are mainly fluvial, fine-grained, red sandstones but conglomerate beds are prominent in the upper parts of the section and record the transition to a higher energy depositional environment. There are a number of Local Geological Sites in the NCA, for example, Urchin's Kitchen at Primrose Hill – a meandering dry gorge created by glacial melt water. These sites are important for the study of Triassic geology, palaeo-environments and glacial geo-morphology and require management to maintain the exposures free from scrub encroachment. Large extractive sites can result in the loss of agricultural land with the loss of historic landscapes with their ancient field patterns, traditional features such as hedgerows and ponds, and associated habitats. The restoration of mineral extraction sites can provide an opportunity for the creation of new habitats and landscapes. Small-scale extraction of stone can provide building stone for the repair of vernacular buildings and drystone walls. Preservation of areas of peat and mosses is essential to preserve the record of the palaeo-environment of the last glaciation.	In partnership with geodiversity groups and site owners, enhance the condition of designated sites and manage former extraction sites and natural exposures, for the range of mutually beneficial interests including geodiversity, biodiversity, volunteering and educational purposes. Conserve and protect rock outcrops for their contribution to landscape character and educational value in studying past climate and geo-morphological processes and for their cultural and historical significance. Work in partnership to further the objectives and aspirations of the Local Geodiversity Action Plan that offer opportunities for volunteering and community engagement. Improve access and interpretation of past geo-morphic activity at Local Sites and present-day geo-morphic activity associated with rivers Gowy and Weaver. Sensitive planning and design of quarries can replicate some of the features lost in their development and reinforce the character of the surrounding landscape. Such sites may provide new opportunities for public access and enjoyment. Working with landowners, water companies and agencies to reduce the abstraction of water to prevent the deterioration of peatlands by maintaining the natural soil profile and protecting the local hydrology to benefit geodiversity and biodiversity.	**Geodiversity** **Biodiversity** **Regulating soil quality** **Recreation** **Sense of history** **Sense of place/ inspiration**

Photo credits

Cover photo: Rising up from the surrounding Shropshire, Cheshire and Staffordshire Plain NCA are a number of small sandstone ridges and scarps, the most prominent being the Cheshire Sandstone Ridge which is visually one of the most distinctive landmarks in Cheshire. The view looking north from Bickerton Hill SSSI towards Raw Head SSSI © [redacted] by kind permission of Cheshire West and Chester Council.
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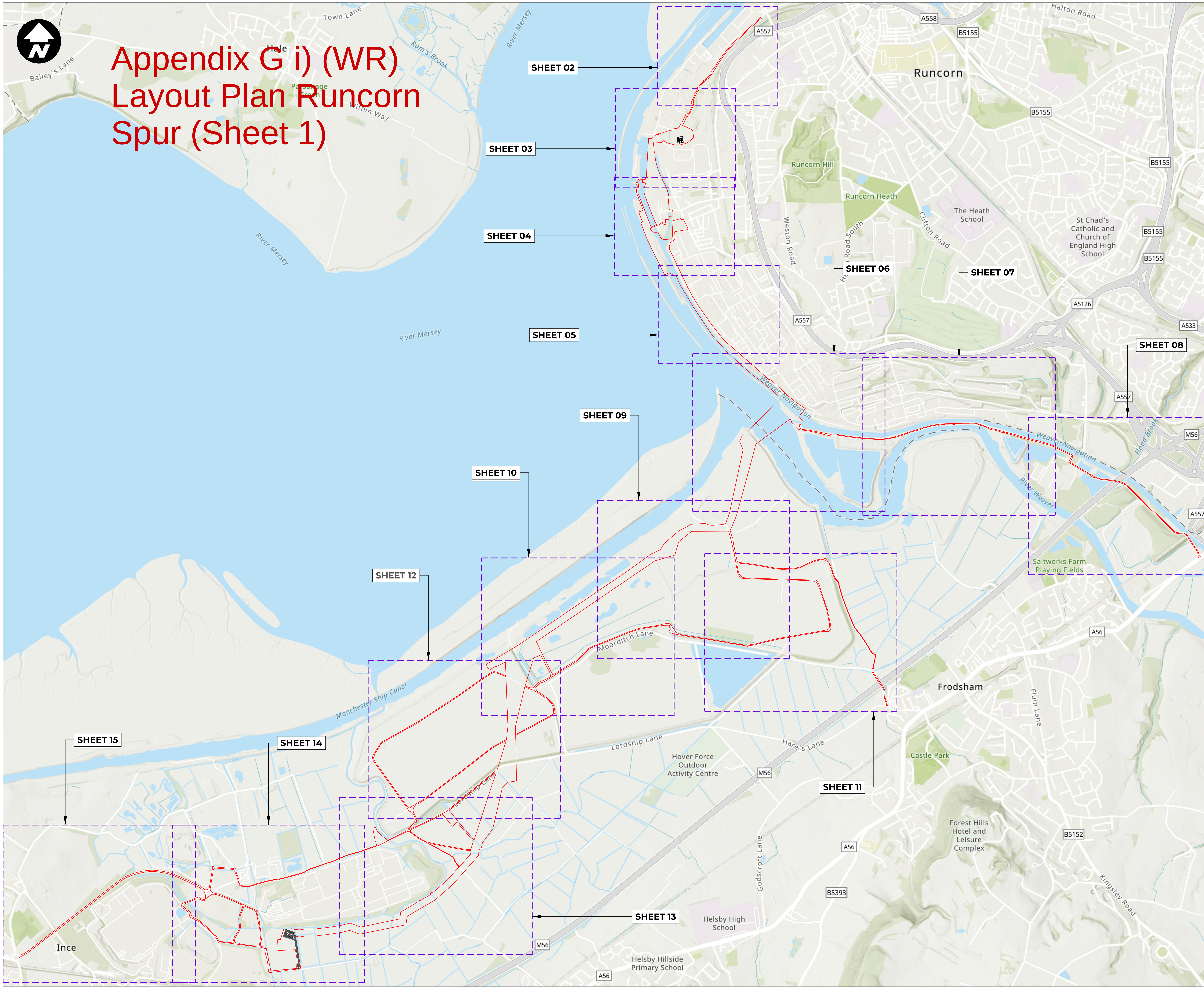
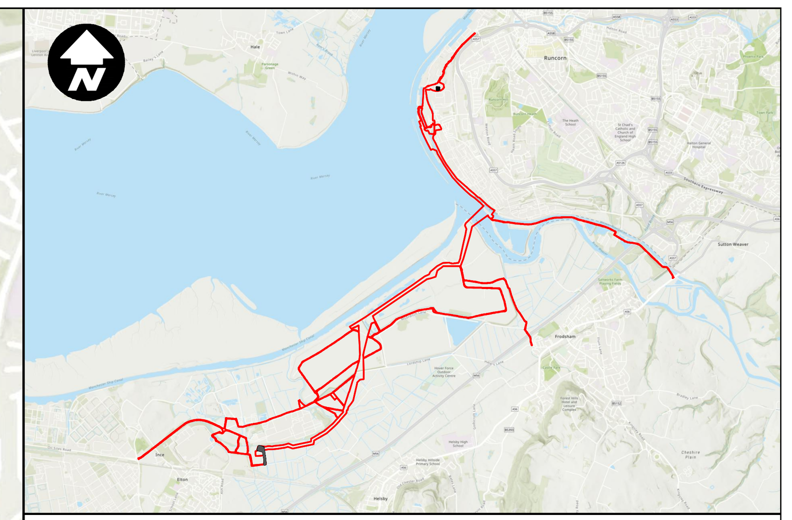
Appendix G i) (WR) Layout Plan Runcorn Spur (Sheet 1)





Key :

PLANNING APPLICATION BOUNDARY

SCALE

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PROJECT TITLE

Runcorn Carbon Dioxide Spur Pipeline

DRAWING TITLE

Proposed Site Layout Plan
Sheet 01 of 15

DRAWING STATUS

FOR TCPA SUBMISSION

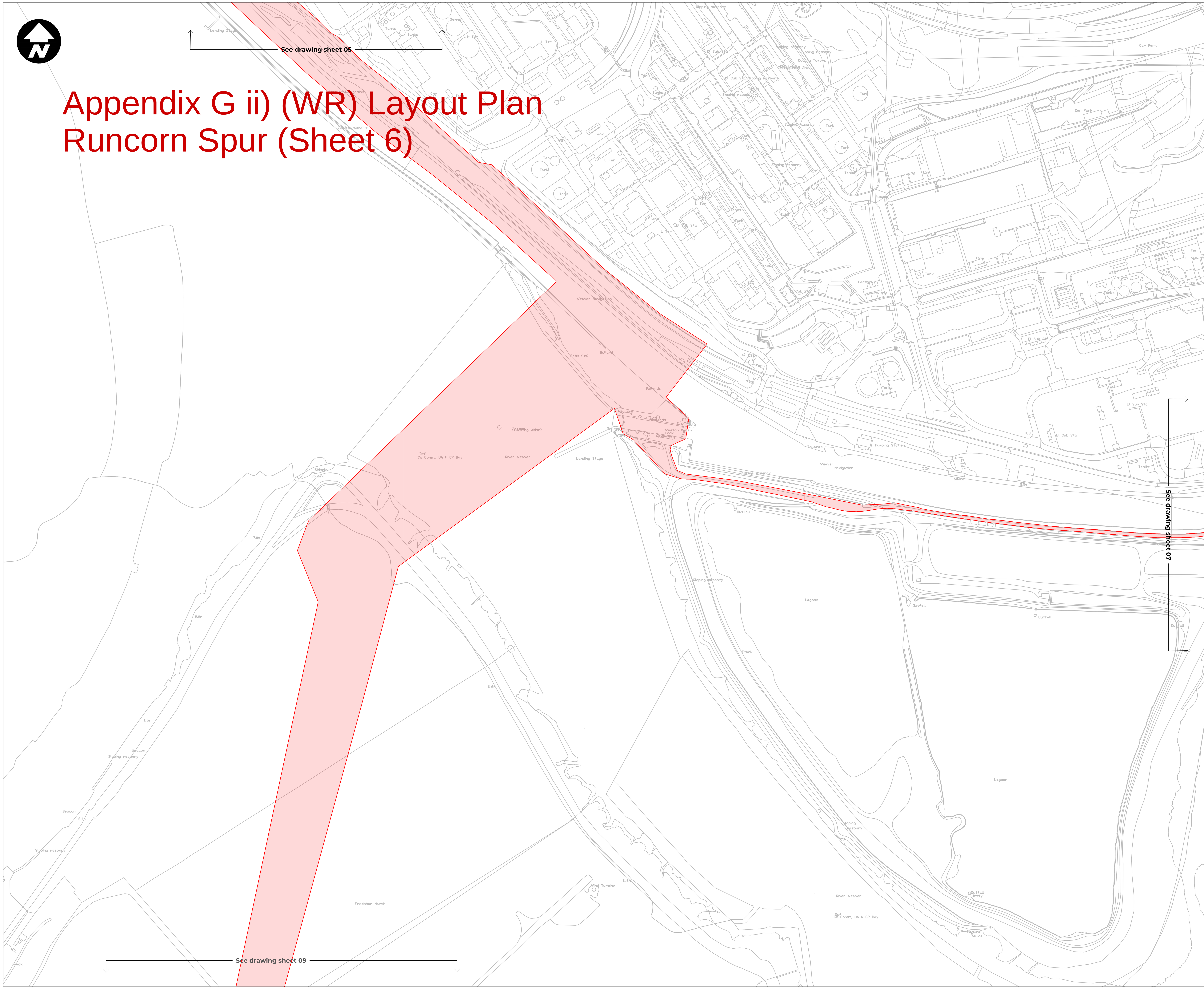
DRAWN	CHECKED	APPROVED	AUTHORISED
TDM	VA	RP	AV

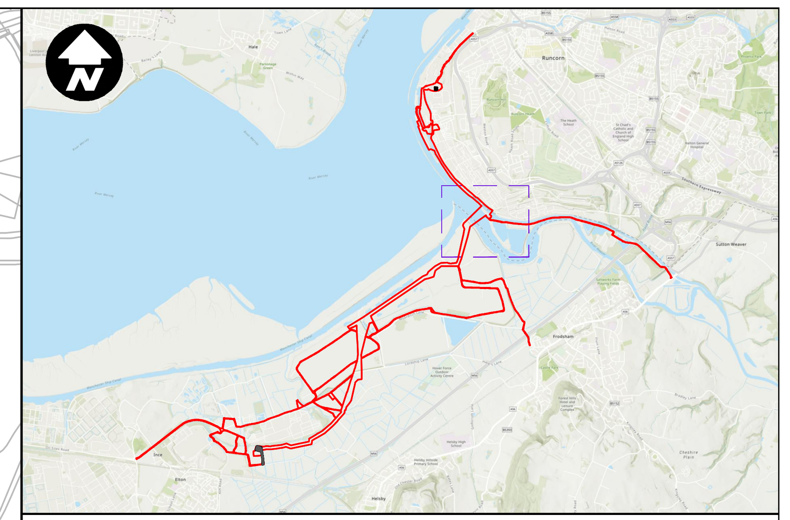
SCALE @ A1 SIZE	DATE	REVISION
1:25,000	09-06-2025	-

DRAWING NUMBER

70116228-RU.2.2.2-LAY-Sheet01

Appendix G ii) (WR) Layout Plan
Runcorn Spur (Sheet 6)





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PLANNING APPLICATION BOUNDARY

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Proposed Site Layout Plan
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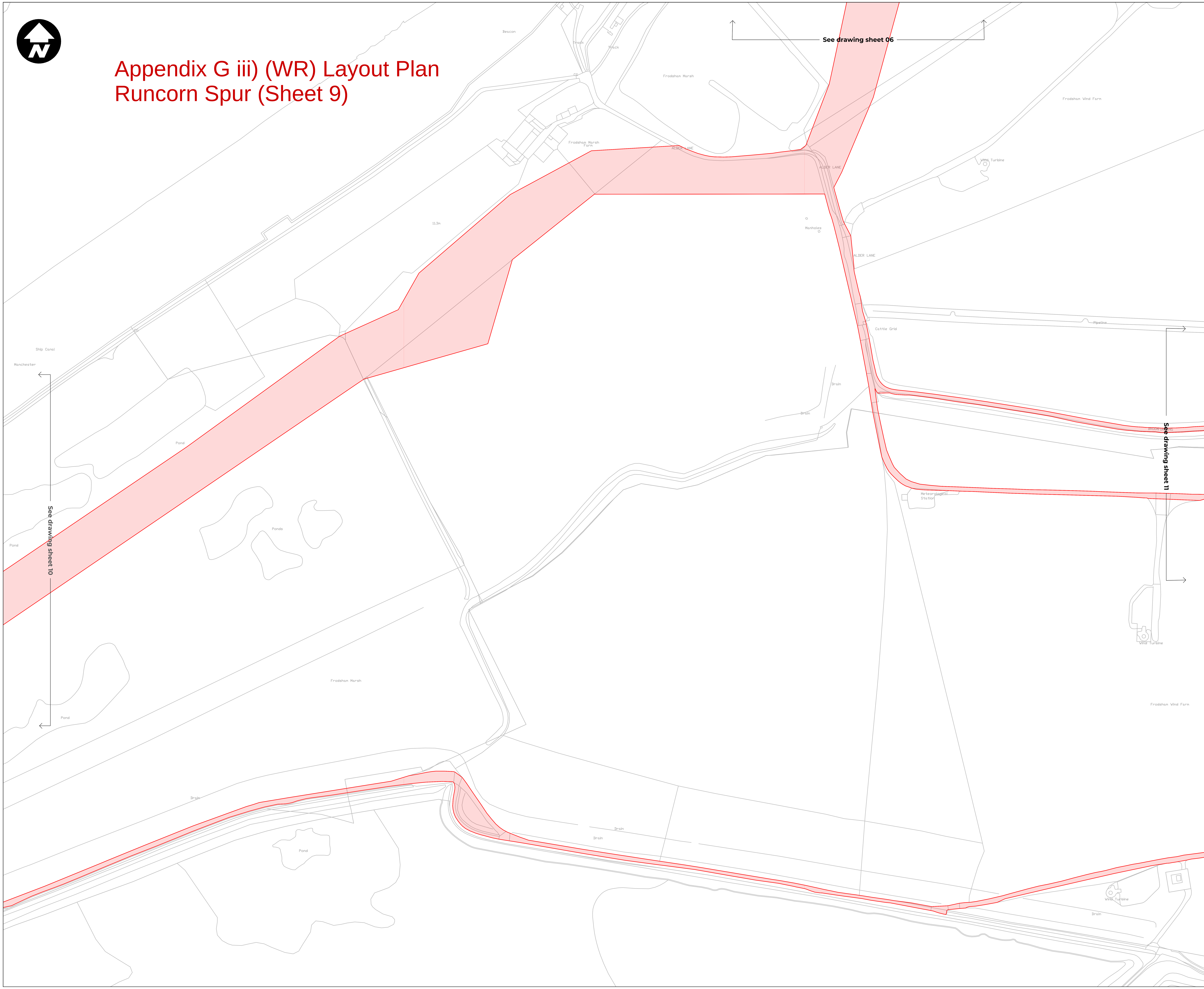
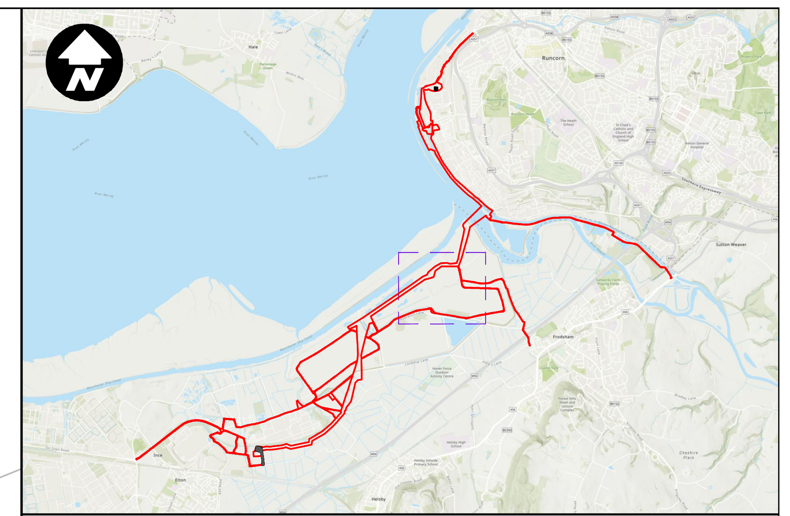
Appendix G iii) (WR) Layout Plan
Runcorn Spur (Sheet 9)





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Runcorn Carbon Dioxide Spur Pipeline

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Proposed Site Layout Plan
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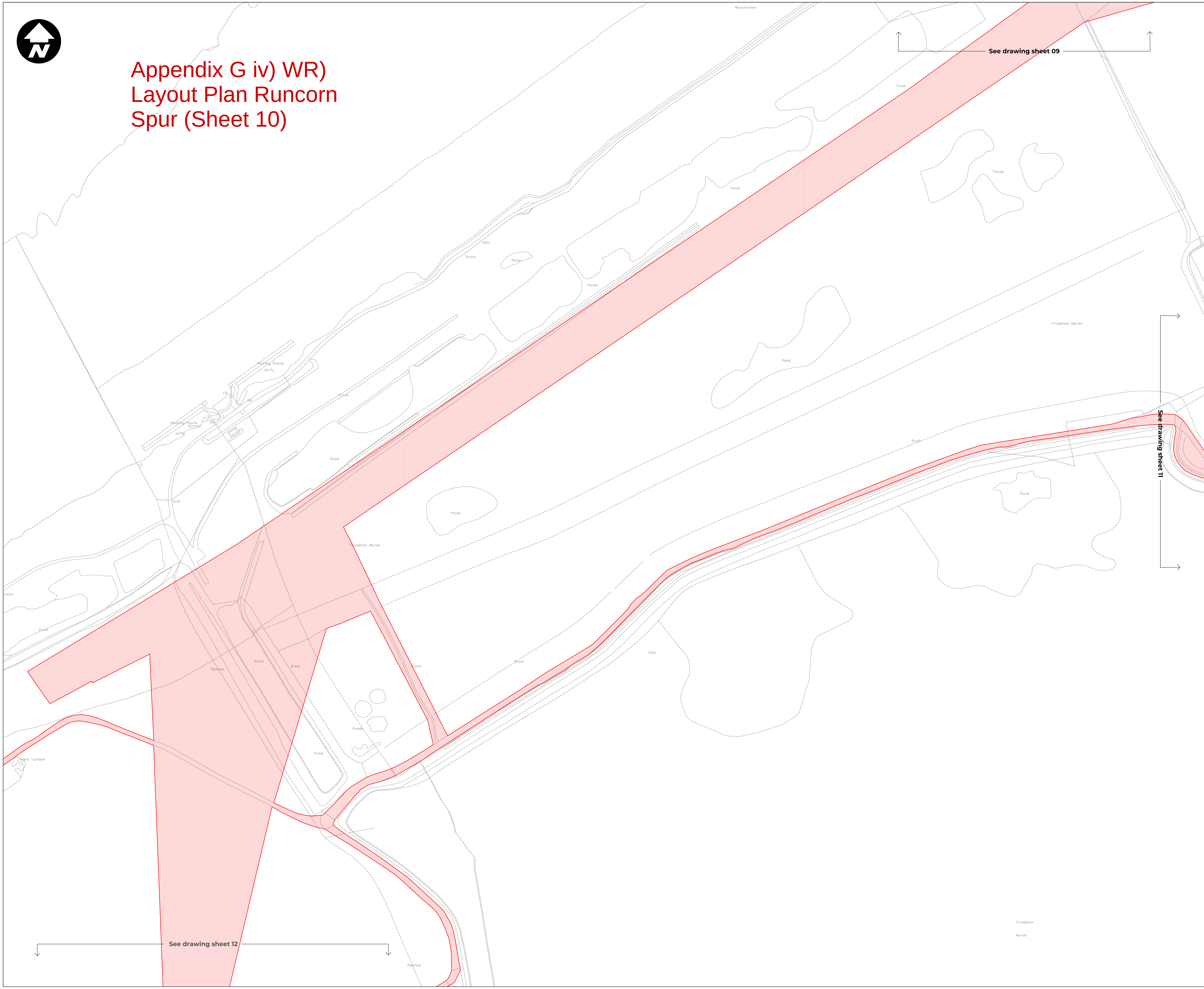
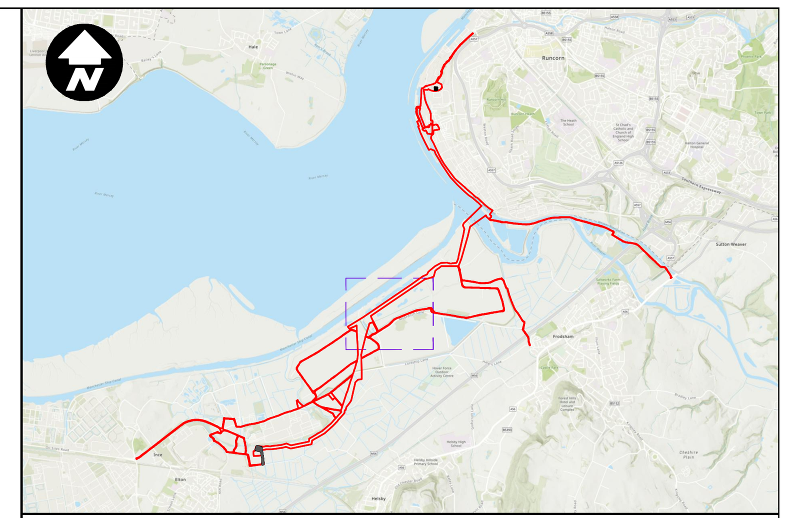
70116228-RU.2.2.2-LAY-Sheet09

Appendix G iv) WR) Layout Plan Runcorn Spur (Sheet 10)





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PLANNING APPLICATION BOUNDARY

SCALE

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SCALE 1:2000 (A1)

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Runcorn Carbon Dioxide Spur Pipeline

DRAWING TITLE

Proposed Site Layout Plan
Sheet 10 of 15

DRAWING STATUS

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Appendix H (WR)
Design_and_Access Runcorn
Spur

PLANNING, DESIGN AND ACCESS STATEMENT

Runcorn Carbon Dioxide Spur Pipeline Proposed Development

Town and Country Planning Act 1990

Document Reference Number RU.2.3

Applicant: Liverpool Bay CCS Limited

English Version

REVISION: A

DATE: July 2025

DOCUMENT OWNER: WSP UK Limited

PUBLIC

4.3.13. Approximate locations of each trenchless crossing compound are shown on the Runcorn Spur Pipeline Proposed Development and Temporary Works Layout Plan (drawing reference: 70116228-RU.2.2.13-LAY-Sheet1). The locations, sizes and layouts of the compounds are subject to change depending on the final pipeline alignment, selection of construction methodology with entrance and exit locations, and detailed agreements with the relevant asset owner and/or regulatory authorities, all of which will be determined by the Construction Contractor post-consent.

4.3.14. Estimated Trenchless Crossing Compound sizes to consider are listed in ES Chapter 3 – Description of the Runcorn Spur Pipeline Proposed Development (document reference: 3.2.3) (not including space for pipe stringing or earthworks which will be outside of the compound area but associated with the trenchless crossing construction works).

4.3.15. Trenchless Crossing Compounds will be in place for the duration of that specific crossing, according to the construction programme and will be dismantled following the cessation of these works. Land will then be reinstated back to its former use.

4.3.16. Further to the general Temporary Construction Compound characteristics outlined in paragraph 4.3.2 of this PDAS, each Trenchless Crossing Compound will also include the following features:

- Equipment yard, supervisor's office and laydown area;
- Crane movement area and staging laydown;
- Specialised trenchless crossing equipment; and
- HDD crossings will include provision for drilling rig and associated ancillaries (control cabinet, power packs, water and bentonite tanks, pumps).

LOCALISED COMPOUNDS

4.3.17. Localised Compounds will be required to serve the construction works. The locations of proposed Localised Compounds are shown on the Runcorn Spur Pipeline Proposed Development and Temporary Works Layout Plan (drawing reference: 70116228-RU.2.2.13-LAY-Sheet1).

4.3.18. Both centralised compounds are proposed to be supplemented by Localised Compounds and are proposed to enable construction of pipeline:

- Adjacent to Ince AGI;
- Adjacent to Runcorn AGI; and
- Inovyn Car Park.

4.3.19. They are expected to be in place for the duration of the construction programme.

4.3.20. Further to the general Temporary Construction Compound characteristics outlined in paragraph 4.3.2 of this PDAS, each Localised Compound will also include the following features:

- Equipment yard, supervisor's office and laydown area; and
- Crane movement area and staging laydown.

4.4. CONSTRUCTION METHODOLOGY

4.4.1. Most of the buried pipeline route will be installed by open trench construction methods. Following the completion of the pre-construction activities, open trench construction will commence with the establishment of the working width.

4.4.2. The working width will be wide enough to allow construction activities to take place safely and efficiently. A standard construction corridor width of 27m is proposed. The construction corridor width may vary if constraints are present, or if there is a particular constructability concern. This will be finalised during detailed design.

4.4.3. Trenchless crossing methods will be required at certain locations to minimise disruption and environmental impacts. Several trenchless crossing methods will be utilised, depending on ground conditions at the crossing location. These methods will include:

- Horizontal Directional Drilling (HDD);
- Guided (GAB) and Unguided Auger Boring (UAG); and
- Micro-Tunnelling.

4.4.4. Descriptions of each of these methods is provided in ES Chapter 3 – Description of the Runcorn Spur Pipeline Proposed Development (document reference: 3.2.3).

4.4.5. Soil stabilisation techniques may be used along the open trench section of pipeline where it goes through areas of unstable made ground in the historic Manchester Ship Canal Deposit Grounds described in Section 3.7 of ES Chapter 3 – Description of the Runcorn Spur Pipeline Proposed Development (document reference: 3.2.3).

4.5. CONSTRUCTION PROGRAMME AND WORKING HOURS

4.5.1. It is anticipated that if planning permission is granted for the Runcorn Spur Pipeline Proposed Development, that construction works will commence in March 2027 and continue until December 2028.

4.5.2. From the commencement of the pre-construction activities to completion of commissioning, the construction programme is expected to last approximately 22 months.

4.5.3. Core working hours are proposed to be from 08.00 to 18.00 on weekdays (excluding bank holidays) and from 08.00 to 13.00 on Saturdays.

4.5.4. Exceptions will be required for extended hours or working outside core hours (including where necessary working on a weekend or Bank Holiday) for activities such as:

- The continuous drilling/tunnelling and pulling phases for trenchless crossings;
- Where daytime working would be excessively disruptive to normal traffic operation;
- Cleaning/testing of the pipeline; and
- Overnight traffic management measures.

4.5.5. Except in the case of an emergency, any work required to be undertaken outside core hours (not including non-intrusive surveys, repairs or maintenance) will be agreed in advance with the LPA.

4.5.6. During the construction stage, there will be a peak workforce of approximately 170 in July 2028. The total anticipated construction works hours is approximately 370,000.

4.6. OUTLINE ENVIRONMENT MANAGEMENT PLAN

4.6.1. An Outline Environmental Management Plan (OEMP) (document reference: RU.4.1) has been prepared and is included within this planning application. The OEMP includes the overarching construction management measures the Construction Contractor will implement to avoid and/or reduce the potential environmental impacts during the construction stage.

4.6.2. The details contained within the OEMP will be used to develop several Environmental Management Plans (EMPs) for the Runcorn Spur Pipeline Proposed Development. For example, a detailed Construction Environmental Management Plan (CEMP) to cover the Construction Stage, an Operation and Maintenance Environmental Management Plan (OMEMP) to cover the Operational Stage and a Decommissioning Environmental Management Plan (DEMP) for the Decommissioning Stage will be produced. For ease of reference, these plans will be referred to as the 'detailed EMP'.

4.6.3. The number, and structure of CEMP will be determined by the appointed Contractor. For example, either side of the River Weaver due to the different nature of the works and different local authority area. Therefore, a CEMP may be produced based on the geographical area covered.

4.6.4. The CEMP will be a live document and swill be maintained by the Construction Contractor and reviewed and updated on a regular basis throughout the Construction Stage as new environmental construction measures are identified and implemented.

4.7. OPERATION AND MAINTENANCE

4.7.1. The AGIs will not be permanently manned as they will be operated remotely and controlled from the Point of Ayr Terminal in Flintshire.

4.7.2. There will be no on-site power generating equipment at the AGIs and the only active source of noise is expected to be the E&I Kiosk, which will be mounted with air conditioning units.

4.7.3. Should there be a need to isolate the Runcorn Spur Pipeline Proposed Development for operational reasons, this will be performed at the AGIs via remote operation. However, the AGIs will also allow for in-person operation, should this be needed. Emergency shut down valves will be located at the AGIs.

4.7.4. Pipeline leak detection technology will be installed and is designed for the early warning and remote identification of major leakages. CO2 point gas detectors will also be installed externally at the Runcorn AGI.

4.7.5. During normal operation, any emission of CO_2 will be limited to planned maintenance activities. Provision for planned temporary venting of CO_2 will be present at the Runcorn AGI.

4.8. DECOMMISSIONING

4.8.1. The Runcorn Spur Pipeline Proposed Development infrastructure is designed to an operational life of 25 years. When the Runcorn Spur Pipeline Proposed Development ceases to be operational and reaches the end of its useful life, the pipeline will be decommissioned safely, filled with nitrogen and left in-situ. Nitrogen is an inert gas which prevents corrosion of the pipeline.

4.8.2. The above ground facilities associated with the AGI and pipeline will be decommissioned and preserved in line with industry best practice and facility owner requirements at the time of decommissioning.

4.8.3. Decommissioning design and works will be undertaken in compliance with all necessary legislation, permits and best practice at that time. This will be set out in the end-of-life DEMP which will be produced by

Appendix I (WR) oEMP
Runcorn Spur

OUTLINE ENVIRONMENTAL MANAGEMENT PLAN

Runcorn Carbon Dioxide Spur Pipeline Proposed Development

Town and Country Planning Act 1990

Document Reference Number RU.4.1

Applicant: Liverpool Bay CCS Limited

REVISION: A

DATE: July 2025

DOCUMENT OWNER: WSP UK Limited

PUBLIC

2.3. WORKING HOURS

2.3.1. Core working hours will be 08.00 to 18.00 Monday to Friday (excluding bank holidays) and from 08.00 to 13.00 on Saturdays. To maximise productivity within core working hours, the Construction Contractor will require a period of up to one hour before and up to one hour after core working hours for the start-up and close-down of activities. This will include, but not be limited to, deliveries, movement to place of work, unloading, maintenance and general preparation works. It will not include the operation of any plant or machinery likely to cause disturbance to local residents or businesses. These periods will not be considered an extension of core working hours.

ADDITIONAL HOURS

2.3.2. Exceptions will be required for extended hours or working outside core hours (including where necessary working on a weekend or Bank Holiday) for activities such as:

- The continuous drilling/tunnelling and pulling phases for trenchless crossings;
- Where daytime working would be excessively disruptive to normal traffic operation;
- Cleaning/testing of the pipeline; and
- Overnight traffic management measures.

2.3.3. Except in the case of an emergency, any work required to be undertaken outside core hours (not including non-intrusive surveys, repairs or maintenance) will be agreed in advance with CWCC/HBC.

2.4. CONSTRUCTION SCHEDULE

2.4.1. A preliminary construction schedule is included in

2.4.2. Table 2-1. Sections presented in the table may not align with the final phasing plan.

2.4.3. More details in the construction phasing, including a phasing plan, will be submitted to CWCC/HBC as part of the detailed CEMP prior to construction.

2.4.4. The detailed CEMP will set out site-specific programme/timing constraints and considerations such as ecological seasonality or restrictions on working hours for noise.

Table 2-1 Indicative Construction Schedule

Activity	Start	Finish
Mobilisation & Enabling Works	Mar 2027	June 2027
Trenchless Crossings (TRS-02 and TRS-03)	Apr 2027	Nov 2027
UG Pipeline Installation (Cells 1, 2 and 3)	Apr 2027	Oct 2027
Trenchless Crossings (TRS-01)	July 2027	Nov 2028
Runcorn AGI & Installation of additional equipment at Ince AGI	Nov 2027	Mar 2028
AG Pipeline Installation – Onshore	Mar 2028	Oct 2028
AG Pipeline Installation – Barge	Apr 2028	Nov 2028
UG Pipeline Installation (Cell 4 and Frodsham Marshes)	Apr 2028	Sep 2028
Pre-Commissioning	Nov 2028	Dec 2028

Appendix J (WR)
Runcorn Spur Pipeline
HRA extract Table 7_3

HABITAT REGULATIONS ASSESSMENT

Report of Information to Inform an Appropriate Assessment

Runcorn Carbon Dioxide Spur Pipeline Proposed Development

Town and Country Planning Act 1990

Document Reference Number RU.4.4

Applicant: Liverpool Bay CCS Limited

REVISION: A

DATE: July 2025

DOCUMENT OWNER: WSP UK Limited

PUBLIC

Table 7-3 - In-Combination Appropriate Assessment

Development reference	Potential in-combination effect	Mitigation
44 – Protos West AGI Spur Pipeline	Loss of land functionally linked to the Mersey Estuary SPA and Ramsar	• As presented within Table 6-2, the loss of land functionally linked to the Mersey Estuary SPA and Ramsar as a result of the Runcorn Spur Pipeline Proposed Development will be temporary and localised. Following installation of the below-ground pipeline through Cells 1-4 and Frodsham Marshes, the area will be back-filled and all habitats reinstated on a like-for-like (or like-for-better) basis (measure RU-BD-051 in the OEMP). • The indicative construction programme for the Runcorn Spur Pipeline Proposed Development (Table 3-2) has been developed so that the majority of works within functionally linked land (Cells 1-4, Frodsham Marshes, Annex A Figure 1) will be completed outside of the wintering bird period (November – March, inclusive). The land take from functionally linked land is therefore only required temporarily while not in use by qualifying species. The area will be reinstated and be available for use again over the winter period, when it is needed. • Similarly, the loss of land functionally linked to the Mersey Estuary SPA and Ramsar as a result of the Protos West AGI Spur Pipeline will be temporary and localised, with the land reinstated on a like-for-like basis following construction. The majority of works will be undertaken outside of the wintering bird period, with only lower impact activities such as back filling anticipated within November. The area will be available for use again by qualifying species of the Mersey Estuary SPA/Ramsar over the winter period. • On this basis, there will be no in-combination effect on the Mersey Estuary SPA and Ramsar as a result of the cumulative loss of functionally linked land.
70 – HyNet North West Hydrogen Pipeline	Loss of land functionally linked to the Mersey Estuary SPA and Ramsar	• As presented within Table 6-2, the loss of land functionally linked to the Mersey Estuary SPA and Ramsar as a result of the Runcorn Spur Pipeline Proposed Development will be temporary and localised. Following installation of the below-ground pipeline through Cells 1-4 and Frodsham Marshes, the area will be back-filled and all habitats reinstated on a like-for-like (or like-for-better) basis (measure RU-BD-051 in the OEMP). • The indicative construction programme for the Runcorn Spur Pipeline Proposed Development (Table 3-2) has been developed so that the majority of works within functionally linked land (Cells 1-4, Frodsham Marshes, Annex A Figure 1) will be completed outside of the wintering bird period (November – March, inclusive). The land take from functionally linked land is therefore only required temporarily while not in use by qualifying species. The area will be reinstated and be available for use again over the winter period, when it is needed. • The HyNet North West Hydrogen Pipeline is currently in the pre-application stage; however, given its nature as an underground pipeline, it can be reasonably assumed that any associated land-take will also be temporary (and be undertaken sequentially) and

Development reference	Potential in-combination effect	Mitigation
		habitat loss will be reinstated following construction. Furthermore, the HyNet North West Hydrogen Pipeline website[15] details that the pipeline will be built "in stages". As such, it is likely that works within functionally linked land will not be undertaken simultaneously. Similarly, the Runcorn Spur Pipeline Proposed Development will be constructed sequentially. Therefore, the amount of functionally linked land under construction at any one time is likely to be a small proportion of the available land in the region. • On this basis, there will be no in-combination effect on the Mersey Estuary SPA and Ramsar as a result of the cumulative loss of functionally linked land.
71 – Frodsham Solar Project	Loss of land functionally linked to the Mersey Estuary SPA and Ramsar	• As part of the mitigation strategy for the Frodsham Solar Project, a 'Non-Breeding Bird Mitigation Area' (NBBMA) will be created, primarily within Cell 3 (Annex A Figure 1). The aim is to mitigate for the displacement of wetland birds which are qualifying features of the Mersey Estuary SPA and Ramsar, as a result of the permanent loss of land required for the solar farm. This area will cover 64 ha in total and will comprise the creation of new ponds, scrapes and wet grassland. • Discussions have been held with Frodsham Solar Project in regards to the overlap between the NBBMA area and the Runcorn Spur Pipeline Proposed Development. The programme for the Runcorn Spur Pipeline Proposed Development has been developed so that all works within Cells 1-3 will be completed prior to works for the Frodsham Solar Project commencing, and prior to creation of the NBBMA. The Runcorn Spur Pipeline Proposed Development will therefore not limit the ability to create, nor subsequently damage, the NBBMA. • On this basis, the majority of functionally linked land temporarily required for the Runcorn Spur Pipeline Proposed Development will have been reinstated prior to the Frodsham Solar Project commencing, and therefore there will be no in-combination effect as a result of the cumulative loss of functionally linked land from these developments. • Consultation is ongoing, and agreements will be confirmed through statements of common ground. • The majority of the works associated with the open-cut underground sections and trenchless crossing activities associated of the Runcorn Spur Pipeline Proposed Development will be undertaken outside of the sensitive wintering bird season. As such, disturbance of qualifying features that maty be using the functionally linked land during the wintering season has been avoided. Due to the availability of suitable functionally linked land throughout the LWS, it is unlikely that the limited works within

[15] https://www.hynethydrogenpipeline.co.uk/dco-project/the-construction-process/

Development reference	Potential in-combination effect	Mitigation
		the passage season or wintering season will in-combination result in adverse effects to species which are qualifying features of the Mersey Estuary SPA and Ramsar site.
72 – HyNet Carbon Dioxide Pipeline	Loss of land functionally linked to the Mersey Estuary SPA and Ramsar	• As presented within Table 6-2, the loss of land functionally linked to the Mersey Estuary SPA and Ramsar as a result of the Runcorn Spur Pipeline Proposed Development will be temporary and localised. Following installation of the below-ground pipeline through Cells 1-4 and Frodsham Marshes, the area will be back-filled and all habitats reinstated on a like-for-like (or like-for-better) basis (measure RU-BD-051 in the OEMP). • The indicative construction programme for the Runcorn Spur Pipeline Proposed Development (Table 3-2) has been developed so that the majority of works within functionally linked land (Cells 1-4, Frodsham Marshes, Annex A Figure 1) will be completed outside of the wintering bird period (November – March, inclusive). The land take from functionally linked land is therefore only required temporarily while not in use by qualifying species. The area will be reinstated and be available for use again over the winter period, when it is needed. • While the Ince AGI built as part of the HyNet Carbon Dioxide Pipeline will require permanent land take from functionally linked land, the total area required is small. As the land required for the Runcorn Spur Pipeline Proposed Development will be reinstated and available for use, there will be a significant amount of suitable habitat available for use throughout the LWS. On this basis, there will be no in-combination effect on the Mersey Estuary SPA and Ramsar as a result of the cumulative loss of functionally linked land.

7.5.3. Following the implementation of the mitigation measures for the Runcorn Spur Pipeline Proposed Development, and those identified for the Other Developments, it is predicted that no in-combination adverse effects on the integrity of any European Sites will occur.

7.5.4. Other Development 70 is at the pre-application stage and therefore information regarding the proposal and any measures to avoid or reduce impacts was not available at the time of writing. However, it is part of the HyNet North West Project, and therefore it is reasonable to assume it will secure appropriate mitigation to avoid any adverse impacts on the integrity of European Sites. The Runcorn Spur Pipeline Proposed Development proposes mitigation to sufficiently address impacts and effects to the European Sites and, as such, any contribution to in-combination effects is considered to be negligible.

7.6. CONCLUSION

7.6.1. The HRA screening presented identified LSEs to European Sites as a result of the Runcorn Spur Pipeline Proposed Development in isolation, via:

- Disturbance of key species which are qualifying features of the Mersey Estuary SPA and Ramsar;
- Hydrological effects to the Mersey Estuary SPA and Ramsar; and
- Changes in air quality to the Mersey Estuary SPA and Ramsar.

7.6.2. The HRA screening also identified potential LSEs to European Sites as a result of the Runcorn Spur Pipeline Proposed Development in-combination with other developments, via:

- The loss of land functionally linked to the Mersey Estuary SPA and Ramsar, in-combination with development 70 – HyNet North West Hydrogen Pipeline; and
- The loss of land functionally linked to the Mersey Estuary SPA and Ramsar, in-combination with development 71 – Frodsham Solar Project.

7.6.3. Following this shadow Stage 2: Appropriate Assessment, it has been identified that mitigation measures will be required to address the identified LSEs. Considering the baseline ecological conditions, the numbers and distribution of species which are qualifying features of these sites, and the proposed mitigation measures, it has been concluded that there will be no adverse effects on the integrity of any European Site, as a result of the Runcorn Spur Pipeline Proposed Development, alone or in-combination and providing mitigation measures specified in Section 7.4 are adhered to. As such, the Habitats

Doc Ref: **HYN02-CN-LTR-CAD-0000-0005**

HyNet North West Hydrogen Pipeline
Delivering clean growth

HyNet North West Hydrogen Pipeline: Project update November 2025

We are writing to update you on the HyNet North West Hydrogen Pipeline Project (the Project).

Over the past year we have been conducting work to finalise the Project's design. This work has been based on feedback we received during public consultations, as well as further technical, environmental and engineering work. We have also been liaising with the Government with regard to its plans to support regional hydrogen pipelines.

Project update

Over the past year we (Cadent Gas Ltd) have been awaiting further information from the Government on the business model mechanism called the Hydrogen Transport Business Model that enables the first regional hydrogen pipelines to be constructed in the UK. Several announcements were made by the Government over the summer relating to the business model and the timings that allow projects such as ours – the HyNet North West Hydrogen Pipeline – to progress. Government have confirmed that they will finalise the business model and start the process for one hydrogen pipeline in the Spring of 2026.

With this information, we have decided to pause the progression of Development Consent Order planning application, until the timeline is clear.

Next steps

We have completed a range of environmental surveys and assessments to support the routing of the Project to date and will continue to maintain/refresh this information throughout 2026, as required.

We thank you for your engagement with the Project to date and we remain committed to engaging with you as the planning for the Project progresses. Once work on the planning application resumes, further engagement will take place with all relevant stakeholders, including landowners, ahead of its submission.

You can register to be kept in touch at **www.hynethydrogenpipeline.co.uk/keep-in-touch** and if you have any questions or require further information please contact us at **info@hynethydrogenpipeline.co.uk** or by phone on **0800 860 6261.**

[redacted]

Project Director - West

HyNet North West Hydrogen Pipeline

Cadent

Appendix L (WR) In Frodsham webpage - Frodsham Wind Farm ownership

Editors note: Please be aware the What's on/Events system is changing on InFrodsham.
The New system is here, the old system is here!
I hope to have moved all events over by the end of 2025.

Frodsham Wind Farm

Construction of Frodsham Wind Farm commenced in March 2015 and it became fully operational in February 2017. The 19 turbines are Nordex N90 2.65MW machines, each being 125m in height to the blade tip.

Frodsham Wind Farm

The total installed capacity of the wind farm is more than 50MW, making it one of England's largest onshore generating stations and the largest in the Cheshire region.

Peel Energy sold its residual interest in Frodsham Wind Farm to the Foresight Group in 2019.
Frodsham Wind Farm Ltd, owned by the Foresight Group is voluntarily committed to providing an annual Community Benefit Fund of up to £120,000 to be used for community projects that benefit the local villages in the Marshes Community Benefit Fund area.

Frodsham Wind Farm is primarily located on land owned and operated by the Manchester Ship Canal Company, a part of the Peel Ports division of The Peel Group.
The wind farm is essentially divided into two 'clusters' of turbines, each served by its own sub-station: the western cluster comprises 13 turbines and is located to the immediate north of the village of Helsby; the eastern cluster consists of 6 turbines and is located to the immediate north of the village of Frodsham.

Marshes Community Benefit Fund

WEBSITE MAIN MENU

About Marshes Community Benefit Fund

Welcome to the Marshes Community Benefit Fund website. The Fund was created in 2016 as an independent entity by the Frodsham Windfarm Limited partners, the Fund is managed by a Panel of independent volunteers and is governed by its Constitution. The Fund receives an annual grant from Frodsham Windfarm Limited of up to £120,000. This annual payment will be provided every year the wind farm operates and is expected to amount to some £3 million. The Marshes Community Benefit Fund (MCBF) Panel will control the administration of the MCBF and will consider applications from groups and organisations for awards of between £250 and £60,000 from the MCBF in each of the two application rounds to be held each year.

Each MCBF Panel Member was selected on the basis of having significant local ties, knowledge of the area and professional skills. An independent organisation vetted the Panel Members and praised its composition. Each Panel Member is contributing their time and skills for free.

The Marshes Community Benefit Fund (MCBF) is managed by a panel of 10 people drawn from the local community.

The Marshes Community Benefit Fund receives funds from

Search this website

MCBF NEWS & UPDATES

- Marshes Community Benefit Fund – 2025 Cycle 2 Press Release
- £683 Awarded t[o] Manley Parish Council by MCBF
- £750 Awarded to St Pauls Church by MCBF
- £2,960 Awarded to Come and Sing Community Choir by MCBF
- £2,000 Awarded to Helsby Litter Network by MCBF

MAIN PAGES

- Apply for Funding
- Golden Grants
- How to Apply
- About Marshes Community Benefit Fund

Frodsham Wind Farm Limited (FWFL). The MCBF will received up to a total of £3m over 25 years from FWFL.

The MCBF is a not for profit unincorporated organisation who purpose is to invest the funds it receives from FWFL for the benefit of the local community. Details of how the MCBF is operated and governed is set out in the MCBF Constitution, this can be found at the bottom of this page.

The Mashes Community Benefit Fund was created in 2016 by Frodsham Wind Farm Ltd.

The fund is managed by a panel drawn from the local community

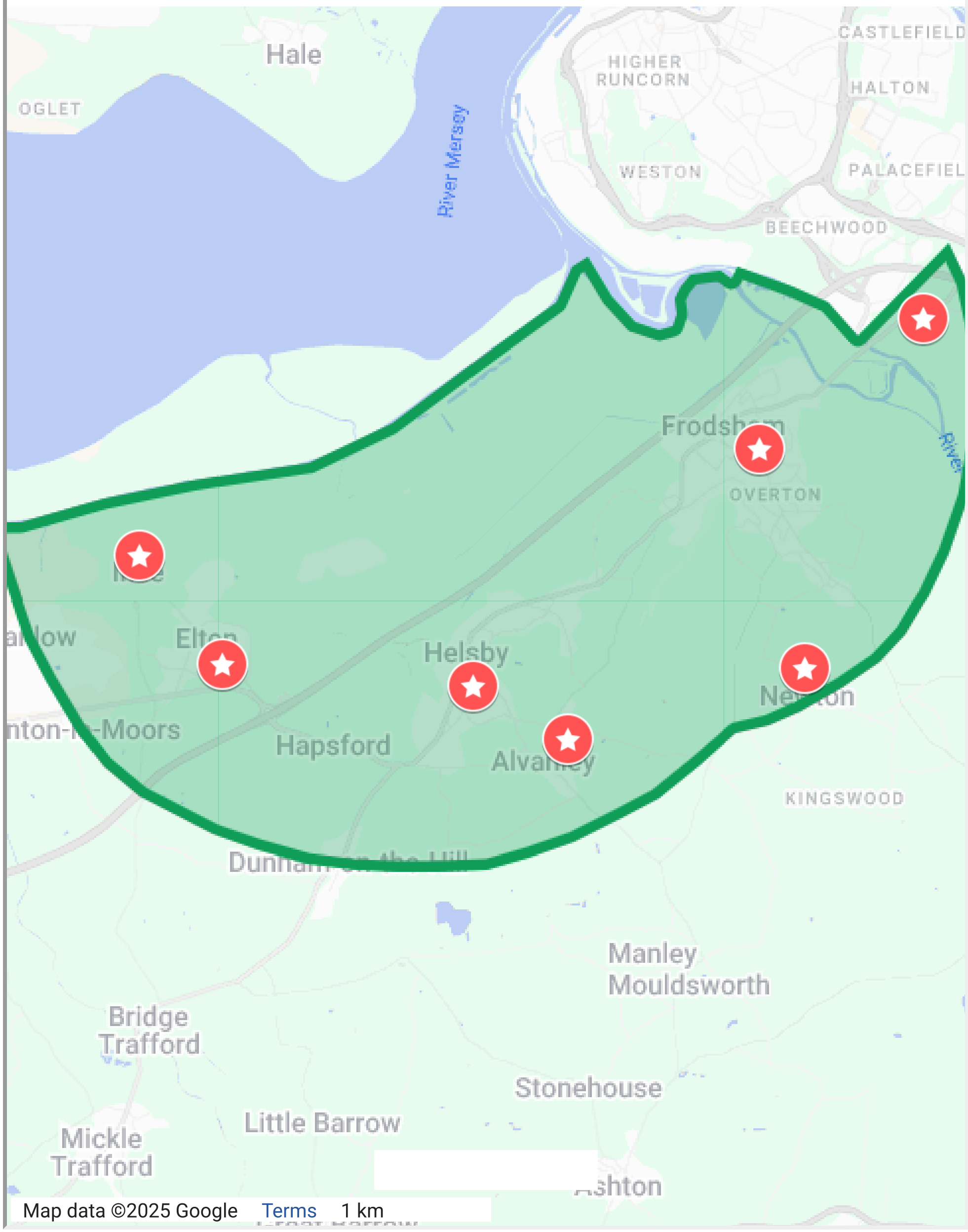
The fund will invest up to a total of £3m over 25 years. Two tranches of grants will be made per year to local projects of up to £60,000 per tranche.

The fund is specifically for the benefit of the community in the local area of the wind farm located on the marshes close to the villages of Frodsham, Helsby and Elton.

The local community served by the MCBF is shown in the map below.

MCBF Local Community ☆

About



MCBF Documents

- MCBF General Guidance ➔
- MCBF Code of Conduct and Conflict ➔
- MCBF Exclusions ➔

Marshes Community Benefit Fund Constitution

Quick Links

- Apply for Funding
- Golden Grants
- How to Apply
- About Marshes Community Benefit Fund
- Frequently Asked Questions (FAQ)
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MCBF News

- Marshes Community Benefit Fund – 2025 Cycle 2 Press Release
- £683 Awarded to Manley Parish Council by MCBF
- £750 Awarded to St Pauls Church by MCBF

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MARSHES COMMUNITY BENEFIT FUND

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