Offshore Wind Power Limited

West of Orkney Windfarm Onshore EIA Report

Volume 1, Chapter 8 – Geology and Hydrology

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West of Orkney Windfarm

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8 GEOLOGY AND HYDROLOGY

Chapter summary

This chapter of the Onshore Environmental Impact Assessment (EIA) Report assesses the potential effects from the onshore Project on geological and hydrological receptors. This includes direct, indirect, whole project assessment, cumulative, inter-related effects, inter-relationships and transboundary effects.

The topography of the onshore study area is characterised by cliffs at the landfall options at the north of the onshore export cable corridor and gently sloping elevations inland, with the onshore export cable corridor partly following the Forss Water valley and crossing the River Thurso. The onshore study area is underlain by Middle Old Red Sandstone bedrock forming a moderately productive aquifer. The majority of soils within the onshore study area are mineral soils, with small pockets of carbon-rich organic deposits (peat) on the western section of the onshore export cable corridor, to the south of Halkirk. The onshore study area is located across five catchments, with just over half in the River Thurso catchment, which is classed as a Special Area of Conversation (SAC) for Atlantic salmon. There are two known Private Water Supplies (PWS) in the onshore Project area and overlap with a Drinking Water Protected Area (DWPA).

The following impacts were identified as requiring assessment:

- Construction and decommissioning:
  - Groundwater flows and levels;
  - Soil compaction and erosion;
  - Changes to soil and groundwater quality;
  - Changes in flow to and/or contamination of vulnerable receptors;
  - Contamination of surface watercourses or waterbodies;
  - Changes to surface water runoff;
  - Risk of flooding to the development and increased risk of flooding in areas downstream; and
  - Interactions with contaminated land.
- Operation and maintenance:
  - Changes to soil and groundwater quality;
  - Changes in flow to and/or contamination of vulnerable receptors;
  - Contamination of surface watercourses or waterbodies; and
  - Risk of flooding to the development and increased risk of flooding in areas downstream.

The assessment has taken account of embedded mitigation measures for the assessment of potential effects.

No significant impacts to any geological or hydrological receptors are predicted. As such there is no requirement for secondary mitigation measures for the onshore Project. There are potential uncertainties in the knowledge base in relation to PWS and surface water quality. The Scottish Environment Protection Agency (SEPA) has requested monitoring for 6 months prior to, and throughout, the onshore Project construction stage.

An assessment of cumulative effects found the combined effect to not be significant in EIA terms for each receptor assessed. There is limited potential for inter-related effects between the onshore Project stages and the effects are considered to be not significant. There are no potential inter-related effects within an onshore Project stage. The potential impacts are localised and will not affect other European Economic Area (EEA) states.

8.1 Introduction

This chapter of the Onshore Environment Impact Assessment (EIA) Report presents the geological and hydrological receptors of relevance to the onshore Project and assesses the potential impacts from the construction, operation and maintenance and decommissioning of the onshore Project on these receptors. Where required, mitigation is proposed, and the residual impacts and their significance are assessed. Potential cumulative and transboundary impacts are also considered.

Table 8-1 below provides a list of all the supporting studies which relate to and should be read in conjunction with the geology and hydrology impact assessment. All supporting studies are appended to this Onshore EIA Report and issued on the accompanying Universal Serial Bus (USB).

Table 8-1 Supporting studies

DETAILS OF STUDY	LOCATIONS OF SUPPORTING STUDY
Climate and Carbon Assessment	Onshore EIA Report, Supporting study (SS) 1: Climate and carbon assessment.
Groundwater-Dependent Terrestrial Ecosystems (GWDTE) Assessment	Onshore EIA Report, SS2: Groundwater-dependent terrestrial ecosystems (GWDTE) assessment.
Flood Risk and Drainage Assessment	Onshore EIA Report, SS3: Flood risk and drainage assessment.

The impact assessment presented herein draws upon information presented within other impact assessments within this Onshore EIA Report. Equally, the geology and hydrology impact assessment also informs other impact assessments. This interaction between the impacts assessed within different topic-specific chapters on a receptor is defined as an 'inter-relationship'. The chapters and impacts related to the assessment of potential effects on geology and hydrology are provided in Table 8-2.

Where information is used to inform the impact assessment, reference to the relevant Onshore EIA Report chapter is given.

The following specialists have contributed to the assessment:

- Water Research Centre (WRC): Phase 1 peat surveys and reconnaissance survey, baseline description, impact assessment and Onshore EIA Report chapter write up and associated supporting studies; and
- Caledonian Conservation Limited: National Vegetation Classification (NVC) habitat mapping data presented in chapter 10: Non-avian terrestrial ecology.

Table 8-2 Geology and hydrology inter-relationships

CHAPTER	IMPACT	DESCRIPTION
Terrestrial non-avian ecology (chapter 10, Onshore EIA Report) **Terrestrial ornithology (chapter 11, Onshore EIA Report)**	Impacts on groundwater flow, levels and quality on habitats or protected species. Impacts on surface watercourses or waterbodies and the effect of changes to surface water runoff.	Impacts on groundwater flow, levels and quality could indirectly affect terrestrial non-avian ecology and terrestrial ornithology, for example, due to pollution or changes to water or nutrient supply. Impacts on surface watercourses or waterbodies could indirectly affect terrestrial non-avian ecology and terrestrial ornithology, for example, due to reduction in water quality from sediment release or pollution.
Land-use and other users, including forestry (chapter 12, Onshore EIA Report)	Impacts on soil quality, compaction, and erosion.	Impacts on soil quality, compaction, and erosion (including agricultural land and peatland) could impact land use and other users.
Air quality (chapter 14, Onshore EIA Report)	Generation of dust from excavations and stockpiles.	All excavation works can give rise to dust, particularly in dry and windy conditions. This would indirectly affect the air quality as a result of airborne dust.

8.2 Legislation, policy and guidance

Over and above the legislation presented in chapter 3: Planning policy and legislative context, the following legislation, policy and guidance are relevant to the assessment of impacts from the onshore Project on geology and hydrology:

- Legislation:
  - The European Union (EU) Water Framework Directive (WFD)[1] (2006/60/EC) and associated daughter Directives including the Groundwater Daughter Directive (Protection of Groundwater Against Pollution, 2006/118/EC): The WFD was created to implement management systems for various bodies of water, such as rivers, lochs, estuaries, coastal waters, and groundwater. Following the UK's withdrawal from the EU on the 1st January 2021 (Brexit) the legislation was transposed. Scotland has incorporated the WFD into its legal framework through the Water Environment and Water Services (Scotland) Act 2003. The Protection of Groundwater Against Pollution (2006/118/EC) legislation established a regime that set groundwater quality standards and introduced measures to prevent or limit inputs of pollutants into groundwater. In Scotland,

[1] *The EU Directives have been included as a reference, but it is noted that following the United Kingdom (UK) withdrawal from the EU these Directives are not legally binding, although the EU Withdrawal Act (2018) maintains the requirements of the EU Directives into domestic law as retained EU Law.*

activities which may impact the water environment, including groundwater, are controlled by The Water Environment (Controlled Activities) (Scotland) Regulations 2011;
- The European Mining Waste Directive (2006/21/EC): the European legislation which was developed in response to mining accidents that caused significant environmental damage. In Scotland, the legislation is implemented through The Management of Extractive Waste (Scotland) Regulations 2010, which regulate the natural materials which need to be disturbed and separated at mines and quarries in order to access minerals;
- The European Floods Directive (2007/60/EC): the European legislation for the assessment and management of flood risks, implemented in Scotland with the Flood Risk Management (Scotland) Act 2009;
- The Environmental Protection Act 1990 (as amended): UK legislation which makes provision for the improved control of pollution arising from certain industrial and other processes;
- The Water Environment and Water Services (Scotland) Act 2003; this aims to classify surface waters according to their ecological status and sets targets for restoring and improving this status;
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended): these regulations were introduced under The Water Environment and Water Services (Scotland) Act 2003 to define the regulatory procedures for engineering activities, impoundments, as well as discharges to or abstractions from the water environment;
- The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013; these regulations were introduced under The Water Environment and Water Services (Scotland) Act 2003 to designate specific areas in Scotland as protected zones to safeguard the quality of drinking water sources and ensure appropriate measures are taken to prevent contamination.
- The Pollution Prevention and Control (Scotland) Regulations 2012: which provide an integrated pollution control regime for Scotland for the purposes of implementing Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions and of regulating other environmentally polluting activities not covered by the Industrial Emissions Directive; and
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017: which aim to safeguard human health with the use of water quality standards to avoid the adverse effects of contamination of water intended for human consumption.

- Policy:
  - National Planning Framework 4 (NPF4) (Scottish Government, 2023a): sets out key national planning policies that form part of the statutory development plan. It also outlines key policy links with regards to land use and development of land in the north of Scotland and rural areas. Specific policies related to this chapter include: Policy 5 (Soils) which intends to protect carbon-rich soils, restore peatlands and minimise disturbance to soils from development and Policy 22 (Flood risk and water management) which intends to strengthen resilience to flood risk by promoting avoidance as a first principle and reducing the vulnerability of existing and future development to flooding;
  - The Highland-wide Local Development Plan (HwLDP) (The Highland Council (THC), 2012): sets out a strategy to support the growth of all communities across THC region. It seeks to enable sustainable Highland communities, safeguard the environment, support a competitive, sustainable and adaptable Highland. Specific policies related to this chapter include:
    - Policy 55 (Peat and Soils): requires development proposals to demonstrate how they will avoid unnecessary disturbance, degradation, or erosion of peat and soils. Unacceptable disturbance of peat is not permitted unless the adverse effects are clearly outweighed by social, environmental, or economic benefits of the development proposal;

    - Policy 62 (Geodiversity): development proposals will be supported that include measures to protect and enhance geodiversity interests of international, national, and regional / local importance in the wider countryside;
    - Policy 63 (Water Environment): states that THC will endorse development proposals that do not compromise the objectives of the Water Framework Directive, aimed at safeguarding and enhancing Scotland's water environment;
    - Policy 64 (Flood Risk): development proposals should avoid flood-prone areas and promote sustainable flood management. Proposals within or bordering medium to high flood risk areas must comply with the Scottish Planning Policy[2] by submitting information, such as a Flood Risk Assessment, to demonstrate compliance;
    - Policy 66 (Surface Water Drainage): requires all proposed development to be drained by Sustainable Urban Drainage Systems (SuDS) designed in line with The SuDS Manual (Construction Industry Research and Information Association (CIRIA) C697) and, when necessary, the Sewers for Scotland Manual 2nd Edition;
    - Policy 72 (Pollution): allows proposals that may result in significant pollution only when a detailed assessment report on the levels, character, transmission, and receiving environment of the potential pollution and appropriate mitigation measures are provided;
  - The Caithness and Sutherland Local Development Plan (CaSPlan) (THC, 2018): according to the policy's Environment and Heritage Strategy, safeguards for the protection of natural and historic environments and their valued assets are implemented by the policies of the HwLDP; and
  - Groundwater protection policy for Scotland (Scottish Environment Protection Agency (SEPA), 2009): The policy protects the legitimate use of groundwater and provides a common SEPA framework to protect groundwater quality and maintain the groundwater resource.
- Guidance:
  - SEPA's Position Statement WAT-PS-10-01 - Assigning Groundwater Assessment Criteria for Pollutant Inputs (SEPA, 2014): guidance on the criteria that should be used to assess groundwater pollution and the thresholds required to protect groundwater quality. The guidance aims to ensure that pollutant inputs to groundwater are managed and controlled effectively to prevent adverse impacts on the environment;
  - SEPA's Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 2011 - A Practical Guide (SEPA, 2022a): provides guidance on the regulatory requirements for activities that may impact the water environment in Scotland. The guide covers the environmental permitting process, assessment criteria, and compliance obligations;
  - SEPA's Land Use Planning System, SEPA Guidance Note 31 - Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems (SEPA, 2017)[3]: provides guidance to planners, developers, and decision-makers on how to assess the potential impacts of development proposals on groundwater abstractions and GWDTE. The guidance explains how to identify and evaluate the potential risks to these environmental resources, and provides recommendations for mitigation measures to ensure their protection;

[2] *The Scottish Planning Policy has been superseded by the NPF4.*

[3] *These documents are being reviewed and updated to reflect new policies introduced in NPF4. Changes in the guidance will be reviewed and implemented where necessary.*

- SEPA Technical Flood Risk Guidance for Stakeholders (SEPA, 2022b)[1]: guidance on flood risk assessment, flood protection measures, flood warning systems, and emergency planning, intended to support stakeholders in making informed decisions to protect people, property, and the environment from the impacts of flooding;
- SEPA Flood Risk Standing Advice for Planning Authorities and Developers (SEPA, 2020)[1]: covers topics including flood risk assessment, flood protection measures, and mitigation strategies, and is intended to ensure that new developments are resilient to flooding and do not increase flood risk elsewhere;
- Scottish Government's Planning Advice Notes (PAN) (Scottish Government, 2023b):
    - PAN 51 - planning, environmental protection and regulation, 2006: provides guidance on integrating environmental protection and regulation into the planning process, including the requirements of environmental impact assessment and strategic environmental assessment. The guidance sets out the key principles and procedures for ensuring that environmental considerations are taken into account at every stage of the planning process;
    - PAN 61 - sustainable urban drainage systems, 2001: the guidance outlines the principles of SuDS, design considerations, and legal and regulatory requirements to ensure effective management of surface water runoff;
    - Flood risk - planning advice, 2015: provides guidance on flood risk management and the planning process in Scotland. The policy highlights the importance of considering flood risk at an early stage of the planning process and provides advice on flood risk assessments, flood protection measures, and emergency planning;
    - PAN 79 - water and drainage, 2006: guidance on water supply, surface water drainage, sewage treatment, and sustainable drainage systems, and aims to ensure that new developments do not have adverse impacts on the water environment;
- SEPA's Guidance for Pollution Prevention (GPP) (2021):
    - GPP 1 - Understanding your environmental responsibilities – good environmental practices, 2020: provides guidance on good environmental practices and emphasises the need for developers to take responsibility for minimising their environmental impact by adopting a proactive approach to pollution prevention, rather than simply responding to incidents after they occur;
    - GPP 2 - Above ground oil storage tanks, 2017: provides recommendations for the safe storage of oil in above ground storage tanks to prevent environmental pollution. The guidance covers the design, installation, operation, and maintenance of tanks, as well as spill prevention and response measures;
    - GPP 3 - Use and design of oil separators in surface water drainage systems, 2022: provides guidance on the use and design of oil separators in surface water drainage systems to prevent pollution caused by the discharge of oils, fuels, and other pollutants. The guidance covers aspects such as design considerations, installation, and maintenance requirements for oil separators;
    - GPP 4 - Treatment and disposal of wastewater where there is no connection to the public foul sewer, 2017: provides advice on how to manage wastewater where there is no access to a public foul sewer, including treatment and disposal methods. The guidance covers the legal requirements, best practices, and various options available for wastewater management;
    - GPP 5 - Works and maintenance in or near water, 2017: provides guidance on good environmental practices for works and maintenance activities near or in water. The guidance includes information on preventing pollution, minimising impacts on habitats, and ensuring compliance with regulations;
    - GPP 13 - Vehicle washing and cleaning, 2017: provides guidance on the safe and sustainable management of vehicle washing and cleaning activities to prevent pollution of surface water and groundwater;

    - GPP 21 - Pollution incident response planning, 2017: provides guidance on developing pollution incident response plans, which aim to minimise the harm caused by pollution incidents, protect human health, and the environment. The guidance outlines the key elements of an effective response plan, including notification procedures, risk assessments, contingency planning, and incident management arrangements;
    - GPP 22 - Dealing with spills, 2018: provides guidance on how to prepare for and respond to spills of hazardous substances. The guidance outlines the steps to take in the event of a spill, including risk assessment, containment, and clean-up, as well as measures to prevent future spills;
- Pesticides - code of practice for using plant protection products in Scotland (Scottish Government, 2007): guidance on the safe and effective use of pesticides to protect human health and the environment. The guidance covers topics including risk assessment, application techniques, record-keeping, and disposal of pesticide waste, and is intended to ensure that pesticides are used responsibly and in accordance with best practice;
- Flood Risk and Drainage Impact Assessment Supplementary Guidance (THC, 2013): provides guidance for developers and planning authorities on assessing and managing flood risk in the Highland region of Scotland. The guidance covers topics such as flood risk assessment methodologies, flood protection measures, and drainage impact assessments, and is intended to ensure that new developments are resilient to flooding and do not increase flood risk elsewhere;
- Climate change allowances for flood risk assessment in land use planning, Land Use Planning System (SEPA, 2019): provides guidance for planners and developers on how to incorporate climate change projections into flood risk assessments for land use planning purposes. The guidance provides recommended allowances to be used when assessing flood risk under future climate change scenarios, and is intended to ensure that new developments are resilient to future climate impacts;
- Peatland Survey. Guidance on Developments on Peatland (Scottish Government, Scottish Natural Heritage, SEPA, 2017): provides guidance for developers and planning authorities on how to assess and manage the impacts of development on peatlands. The guidance includes peatland assessment methodologies, mitigation measures, and restoration techniques, and is intended to ensure that peatland habitats are protected and enhanced, and that the ecosystem services provided by peatlands are maintained;
- Developments on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste (Scottish Renewables and SEPA, 2012): guidance is intended to promote sustainable development practices that minimise the environmental impacts of development on peatlands and reduce carbon emissions associated with peat extraction and use;
- Review of Cabling Techniques and Environmental Effects Applicable to the Offshore Windfarm Industry, Technical Report, January 2008 (UK Department for Business Innovation & Skills, 2008): report providing recommendations for reducing the environmental impacts of cable installation and operation, including guidance on cable route selection, cable burial techniques, and cable material selection for offshore windfarms; and
- Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Department for Environment, Food and Rural Affairs (DEFRA), 2009): provides guidance for developers and contractors on sustainable soil management practices during construction activities. The code of practice covers topics such as soil assessment, soil handling and storage, and soil reuse and restoration, and is intended to minimise soil degradation and promote the sustainable use of soils in construction activities.

Despite their age, older documents, or documents that are not Scotland-specific, are included as they provide general advice still relevant to this assessment.

8.3 Scoping and consultation

Stakeholder consultation has been ongoing throughout the EIA and has played an important part in ensuring the scope of the baseline characterisation and impact assessment are appropriate with respect to the onshore Project and the requirements of the regulators and their advisors.

The Scoping Report was submitted to the Scottish Ministers (via Marine Scotland - Licensing Operations Team (MS-LOT[4]) and THC on 1st March 2022, who then circulated the report to relevant consultees[5]. A Scoping Opinion was received from The Highland Council on 9th May 2022. Relevant comments from the Scoping Opinion specific to geology and hydrology are provided in Table 8-4 below, which provides a response on how these comments have been addressed within the Onshore EIA Report. The Scoping Opinion supersedes any pre-application advice provided by THC which was received on the 10th February 2021.

Further consultation has been undertaken throughout the pre-application stage. Table 8-3 below summarises the consultation activities carried out relevant to geology and hydrology.

Table 8-3 Consultation activities for geology and hydrology

CONSULTEE AND TYPE OF CONSULTATION	DATE	SUMMARY
THC, SEPA and NatureScot - meeting	17th August 2022	Meeting to discuss the need for and scope of various assessments relating to geology and hydrology including peat surveys and assessment; flood risk and drainage impact assessment; assessment of groundwater-dependent habitats; and contaminated land. Information regarding Private Water Supply (PWS) and the protection of designated areas was also discussed. This discussion has informed the geology and hydrology impact assessment and the supporting studies presented alongside the Application in support of this chapter.
SEPA - letter	19th December 2022	Letter outlining the distribution of peat, potentially GWDTEs and potentially sensitive PWS within the onshore study area. SEPA confirmed the contents of the letter was satisfactory. Additionally, SEPA commented that for construction within 250 metres (m) of any PWS source monitoring should meet the requirements in Appendix 5 of their guidance document 'Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems' (SEPA, 2017). SEPA also noted that monitoring of sensitive PWS should occur 6 months pre-construction as well as during the period of groundworks to clearly define baseline conditions. These comments have been noted and PWS are discussed in sections 8.4.4.8 and 8.6 of this chapter.
Consultation with local landowners	Various	Consultation with local landowners provided details on overground and underground utilities within their landholding plus information relating to PWS where relevant. This information has been used to inform the impact assessment.

[4] MS-LOT have since been renamed Marine Directorate - Licensing Operations Team (MD-LOT).

[5] The Scoping Report was also submitted to Orkney Islands Council (OIC), as the scoping exercise included consideration of power export to the Flotta Hydrogen Hub, however, this scope is not covered in this Onshore EIA Report and will be subject to a separate Planning Application to OIC.

Table 8-4 Comments from the Scoping Opinion relevant to geology and hydrology

CONSULTEE	COMMENT	RESPONSE
THC	Carbon balance calculations should be undertaken and included within the EIA Report with a summary of the results provided focusing on the carbon payback period for the windfarm.	Carbon balance calculations and the carbon payback period are considered and detailed within SS1: Climate and carbon assessment.
THC	The EIA Report should include a full assessment on the impact of the development on peat. The assessment of the impact on peat must include peat probing for all areas where development is proposed. The Council are of the view this should include probing not just at the point of infrastructure as proposed by the scheme but also covering the areas of ground which would be subject to micrositing limits.	Peat depth and peat management are assessed in Outline Management Plan (OMP) 3: Outline Peat Management Plan (PMP) which is provided as part of the Planning Permission in Principle (PPP) Application. The survey method for peat probing and assessment are also provided within OMP3: Outline PMP and were confirmed with SEPA in the consultation letter dated 19th December 2022.
THC	SEPA can provide detailed advice on methodology for peat probing and the peat assessment. Their response is attached as an appendix to this letter. This sets out the range of information which requires to be provided inclusive of: Peat depth map; Table detailing the quantities of acrotelmic, catotelmic and amorphus peat which will be excavated; Details of reuse of peat and how it will be kept wet following disturbance /excavation; Peat Management Plan.	Peat depth and peat management are assessed in OMP3: Outline PMP. The survey method for peat probing and assessment are also provided within OMP3: Outline PMP and were confirmed with SEPA in the consultation letter dated 19th December 2022. A table detailing the quantities of acrotelmic, catotelmic and amorphus peat that will be excavated will be detailed in the final PMP which will be appended to the final Construction Environment Management Plan (CEMP) at post-consent stage.
THC	NatureScot have advised that they consider that peatland impacts in their interests should be considered under the non-avian terrestrial ecology section of the EIAR. A site-specific peat and NVC habitat survey will be required to confirm the quality and distribution of peatland across the development site plus an appropriate buffer. The extent of priority peatland habitat loss and damage, both direct and indirect must be included in the EIAR. You should utilise the advice in the following guidance from NatureScot:	The guidance from NatureScot has been utilised in this assessment. The errors identified by NatureScot are noted and have since been amended. All designations within the study area that have relevance to geology and hydrology are reported in section 8.4.4.10. Comments provided from NatureScot are addressed fully below.

CONSULTEE	COMMENT	RESPONSE
	Advising on carbon-rich soils, deep peat and priority peatland habitat in development management https://www.nature.scot/advising-carbon-rich-soilsdeep-peat-and-priority-peatland-habitat-development-management Guidance on Development on Peatland https://www.nature.scot/professionaladvice/planning-and-development/planning-and-development-advice/planningand-development-standing-advice-and-guidance-documents Peat landslide hazard and Risk assessment https://www.nature.scot/professionaladvice/planning-and-development/planning-and-development-advice/planningand-development-standing-advice-and-guidance-documents Good Practice during Windfarm Construction https://www.nature.scot/guidancegood-practice-during-wind-farm-construction NatureScot have highlighted errors in table 3-3 in relation to the River Thurso SSSI, Caithness and Sutherland SAC, Achanarras Quarry SSSI and Broubster Leans SSSI. These must be corrected to ensure that the assessment is appropriately targeted. Please see the NatureScot response attached as an appendix to this response for details.	
THC	The EIAR should fully describe the likely significant effects of the development on the local geology including aspects such as borrow pits or construction compounds, earthworks, site restoration and the soil generally including direct effects and any indirect. Proposals should demonstrate construction practices that help to minimise the use of raw materials and maximise the use of secondary aggregates and recycled or renewable materials. Where borrow pits are proposed the EIAR should include information regarding the location, size and nature of these borrow pits including information on the depth of the borrow pit floor and the borrow pit final reinstated profile. This can avoid the need for further applications.	Potential impacts from all aspects of the onshore Project on local geology and soils are assessed in section 8.6. Peat management is discussed in OMP3: Outline PMP. Mitigation measures have been outlined in section 8.5.4. Borrow pits are not being considered for the onshore Project.

CONSULTEE	COMMENT	RESPONSE
THC	The EIAR needs to address the nature of the hydrology and hydrogeology of the site, and of the potential impacts on GWDTEs, water courses, water supplies including private supplies, water quality, water quantity and on aquatic flora and fauna. Impacts on watercourses, lochs, groundwater, other water features and sensitive receptors, such as water supplies, need to be assessed. Measures to prevent erosion, sedimentation or discolouration will be required, along with monitoring proposals and contingency plans. Assessment will need to recognise periods of high rainfall which will impact on any calculations of run-off, high flow in watercourses and hydrogeological matters. You are strongly advised at an early stage to consult SEPA as the regulatory body responsible for the implementation of the Controlled Activities (Scotland) Regulations 2005 (CAR), to identify if a CAR license is necessary and the extent of the information required by SEPA to assess any license application.	Baseline hydrology and hydrogeology are provided in section 8.4.4. Potential impacts on watercourses, water supplies including private supplies, water quality and water quantity are discussed in section 8.6. GWDTE are assessed in SS2: GWDTE assessment. Potential impacts on aquatic flora and fauna are assessed in chapter 10: Terrestrial non-avian ecology. The effects of high rainfall events and the necessary attenuation are considered in SS3: Flood risk and drainage assessment. Embedded mitigation measures have been outlined in section 8.5.4. Details of proposed monitoring will be agreed post-consent when the detailed design is available, as this will influence monitoring location selection. SEPA were consulted on 17th August 2022 to discuss the need for and scope of various assessments relating to geology and hydrology. An Application for a CAR licence under the Water Environment (Controlled Activities) (Scotland) Regulations 2011[6] will be made post-consent.
THC	If culverting should be proposed, either in relation to new or upgraded tracks, then it should be noted that SEPA has a general presumption against modification, diversion or culverting of watercourses. Schemes should be designed to avoid crossing watercourses, and to bridge watercourses where this cannot be avoided. The EIA Report will be expected to identify all water crossings and include a systematic table of watercourse crossings or channelising, with detailed justification for any such elements and design to minimise impact. The table should be accompanied by photography of each watercourse affected and include dimensions of the watercourse. It may be useful for the Applicant to demonstrate choice of watercourse crossing by means of a decision tree, taking into account factors including catchment size	The current Application is for PPP and therefore at the current time there is not the level of detail available to provide all the information requested by SEPA. Details for all water crossings, with detailed justification, will be provided post-consent once the design is finalised as the necessary level of detail will not be available until detailed design is complete. Embedded mitigation measures have been outlined in section 8.5.4.

[6] *Please note that the Water Environment (Controlled Activities) (Scotland) Regulations 2005 have been revoked by the Water Environment (Controlled Activities) (Scotland) Regulations 2011.*

CONSULTEE	COMMENT	RESPONSE
	(resultant flows), natural habitat and environmental concerns. Further guidance on the design and implementation of crossings can be found on SEPA's Construction of River Crossings Good Practice Guide.	
THC	The need for, and information on, abstractions of water supplies for concrete works or other operations should also be identified. The EIAR should identify whether a public or private source is to be utilised. If a private source is to be utilised, full details on the source and details of abstraction need to be provided.	Concrete batching is anticipated to be required however the details of this, including water supply source, are not yet finalised. Full details, including any requirement for water abstraction in support of concrete batching, will be provided post-consent.
THC	The Applicant will be required to carry out an investigation to identify any private water supplies, including pipework, which may be adversely affected by the development and to submit details of the measures proposed to prevent contamination or physical disruption. An onsite survey will be required.	PWS are assessed in section 8.4.4.8. Information regarding PWS was provided to SEPA in December 2022 and local landowners completed a short questionnaire to provide details of PWS, associated pipework and other information. Data obtained from THC were also used in the assessment.
THC	Detailed comments have been provided by SEPA on impacts on the water environment, in particular on buffers to water courses and pollution prevention, by SEPA.	Impacts on the water environment are assessed in section 8.6 and SS3: Flood risk and drainage assessment. All relevant CAR applications will be submitted for authorisation post-consent. GWDTE and associated buffers are assessed in SS2: GWDTE assessment. Embedded mitigation measures have been outlined in section 8.5.4. This includes pollution prevention measures. Comments from SEPA are addressed fully below.
THC	The Council's Flood Risk Management Team have no comment on the scope of the proposed assessment in relation to flood risk and drainage.	Noted.

CONSULTEE	COMMENT	RESPONSE
THC	Where there is a demonstrable requirement for peat landslide hazard and risk assessment (PLHRA), the assessment should be undertaken as part of the EIA process to provide the determining authority with a clear understanding of whether the risks are acceptable and capable of being controlled by mitigation measures. The Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (Second Edition), published at http://www.gov.scot/Publications/2017/04/8868, should be followed in the preparation of the EIA report, which should contain such an assessment and details of mitigation measures.	There is no demonstrable requirement for peat landslide hazard and risk assessment as the substantial majority of groundworks will be located in areas without peat. All areas of peat will be avoided by design wherever possible. The minimal footprint of potential works within areas of peat is such that the risk of peat landslide is effectively managed by design and further assessment is unwarranted.
THC	The EIAR needs to address the aquatic interests within local watercourses, including downstream interests that may be affected by the development, for example increases in silt and sediment loads resulting from construction works; pollution risk / incidents during construction; obstruction to upstream and downstream migration both during and after construction; disturbance of spawning beds / timing of works; and other drainage issues. The EIAR should evidence consultation input from the local fishery board(s) where relevant.	Potential impacts on watercourses are discussed in section 8.6. Potential impacts on terrestrial flora and fauna from groundwater are assessed in chapter 10: Terrestrial non-avian ecology and impacts on freshwater ecology receptors are assessed in chapter 9: Freshwater ecology. The local district salmon fishery boards (Northern and Caithness) have been consulted throughout the EIA process and this is detailed in chapter 9: Freshwater ecology.
THC	The EIAR should include an assessment of the effects on Ground Water Dependent Terrestrial Ecosystems (GWDTE). Please contact SEPA for detailed advice.	GWDTE are assessed in SS2: GWDTE assessment. A consultation meeting with SEPA was held on 17th August 2022 and GWDTE were discussed with advice provided.
Environmental Health, THC	Thank you for consulting the contaminated land team on this Application. Having checked our database, historical Ordnance Survey maps and aerial photos, there are a number of sites with potential sources of contamination within the EIA Scoping area. The Applicant proposes to include potential contamination within the EIA scope. Therefore we will review the EIA when submitted.	The onshore Project area has been refined and reduced since scoping. Potentially contaminated sites have been considered within the assessment. The baseline for contaminated land is provided in section 8.4.4.11. Contaminated land assessment is provided in section 8.6.1.8.

CONSULTEE	COMMENT	RESPONSE
Flood Risk Management Team, THC	The Flood Risk Management Team does not wish to comment on this Application.	Noted.
Scottish Water	Scottish Water has no objection to this Planning Application; however, the Applicant should be aware that this does not confirm that the proposed development can currently be serviced and would advise the following:	Noted, please see our response to individual comments below.
Scottish Water	According to our records, the development proposals impact on existing Scottish Water assets.	Noted. The Scottish Water Asset Impact Team will be contacted post-consent.
Scottish Water	The Applicant must identify any potential conflicts with Scottish Water assets and contact our Asset Impact Team via our Customer Portal to apply for a diversion.	Noted. The Scottish Water Asset Impact Team will be contacted post-consent.
Scottish Water	The Applicant should be aware that any conflict with assets identified may be subject to restrictions on proximity of construction. Please note the disclaimer at the end of this response.	Noted. The Scottish Water Asset Impact Team will be contacted post-consent.
Scottish Water	A review of our records indicates that the proposed activity falls within two drinking water catchments where a Scottish Water abstraction is located. Scottish Water abstractions are designated as Drinking Water Protected Areas (DWPA) under Article 7 of the Water Framework Directive. Loch Calder supplies Loch Calder Water Treatment Works and it is essential that water quality and water quantity in the area are protected.	Since the submission of the Scoping Report the Project Design Envelope (PDE) has been refined, specifically cable landfall options have reduced from 16 to two (Crosskirk and Greeny Geo). These refinements have reduced the options that have needed to be assessed in the EIA. Loch Calder is upstream of the onshore study area. Therefore, there is no potential for impact from the onshore Project associated infrastructure. The River Thurso catchment (a Drinking Water Protected Area (DWPA)) is also within the onshore study area with the River Thurso running across the onshore Project area.

CONSULTEE	COMMENT	RESPONSE
		DWPAs are detailed in section 8.4.4.8. Drainage systems will be in place for the onshore Project to protect water resources as detailed in SS3: Flood risk and drainage assessment. Additionally, CAR licences, if required, will be obtained post-consent.
Scottish Water	In the event of an incident occurring that could affect Scottish Water we should be notified immediately using the Customer Helpline number 0800 0778 778.	Noted. This has been provided within the Outline CEMP provided alongside this PPP Application.
Scottish Water	The activity within this catchment is close to the loch and therefore travel times of any pollution event will be short and water quality protection measures must be implemented and we must be made aware of what these measures will be and when work will commence on site.	Loch Calder is upstream of the onshore study area. Therefore, there is no potential for impact from the onshore Project associated infrastructure. The River Thurso catchment (a DWPA) is also within the onshore study area with the River Thurso running across the onshore Project area. Drinking Water Protected Areas are detailed in section 8.4.4.8. Drainage systems will be in place for the onshore Project to protect water resources as detailed in SS3: Flood risk and drainage assessment. Additionally, CAR licences, if required, will be obtained post-consent.
Scottish Water	Scottish Water have produced a list of precautions for a range of activities. This details protection measures to be taken within a DWPA, the wider drinking water catchment and if there are assets in the area. Please note that site-specific risks and mitigation measures will require to be assessed and implemented. These documents and other supporting information can be found on the activities within our catchments page of our website at www.scottishwater.co.uk/slm	The documents and supporting information on protection measures for DWPAs have been consulted on the Scottish Water website. Drainage systems will be in place for the onshore Project to protect water resources as detailed in SS3: Flood risk and drainage assessment. Additionally, CAR licences, if required, will be obtained post-consent.
Scottish Water	We welcome receipt of this notification about the proposed activity within a drinking water catchment where a Scottish Water abstraction is located.	Noted and information on drinking water catchments is provided in section 8.4.4.

CONSULTEE	COMMENT	RESPONSE
Scottish Water	The fact that this area is located within a drinking water catchment should be noted in future documentation. Also anyone working on site should be made aware of this during site inductions.	Assessment of the impacts from the Project on DWPAs has been made and detailed in Section 8.6. As detailed in OMP1: Outline CEMP, inductions will occur for all personnel working on site and they will be made aware of all procedures to be followed during the works including mitigations to be employed for water resource protection.
Scottish Water	We would request further involvement at the more detailed design stages, to determine the most appropriate proposals and mitigation within the catchment to protect water quality and quantity.	As detailed design is progressed, post-consent, Scottish Water will be consulted with to determine the most appropriate proposals and mitigation within the catchment to protect water quality and quantity.
Scottish Water	We would also like to take the opportunity, to request that 3 months in advance of any works commencing on site, Scottish Water is notified at protectdwsources@scottishwater.co.uk. This will enable us to be aware of activities in the catchment and to determine if a site meeting would be appropriate and beneficial.	This is noted and Scottish Water will be notified as required.
Scottish Water	For reasons of sustainability and to protect our customers from potential future sewer flooding, Scottish Water will not accept any surface water connections into their combined sewer system.	Noted. Surface water drainage proposals are outlined in SS3: Flood risk and drainage assessment.
Scottish Water	There may be limited exceptional circumstances where we would allow such a connection for brownfield sites only, however this will require significant justification from the customer taking account of various factors including legal, physical, and technical challenges.	The site is not brownfield, so the surface water drainage system will not drain into the combined sewer system.

CONSULTEE	COMMENT	RESPONSE
Scottish Water	In order to avoid costs and delays where a surface water discharge to our combined sewer system is anticipated, the developer should contact Scottish Water at the earliest opportunity with strong evidence to support the intended drainage plan prior to making a connection request. We will assess this evidence in a robust manner and provide a decision that reflects the best option from environmental and customer perspectives.	Noted. A surface water discharge to the combined sewer system is not anticipated. Surface water drainage is outlined in SS3: Flood risk and drainage assessment.
SEPA	We consider that the following key issues must be addressed in the Environmental Impact Assessment process. To avoid delay and potential objection, the information outlined below and in the attached appendix must be submitted in support of the Application: a) Map and assessment of any engineering activities in or impacting on the water environment including proposed buffers and details of any related CAR applications. b) Map and assessment of impacts upon Groundwater Dependent Terrestrial Ecosystems (GWDTE) and buffers. c) Map and assessment of impacts upon groundwater abstractions and buffers. d) Peat depth survey and table detailing re-use proposals. f) Schedule of mitigation including pollution prevention measures. i) Map of proposed surface water drainage layout. j) Map of proposed water abstractions including details of the proposed operating regime. k) Decommissioning statement.	The current Application is for PPP and therefore at the current time there is not the level of design detail available to provide all the information requested by SEPA. As much detail as is available is provided below. a) Impacts on the water environment are mapped and assessed in section 8.6 and SS3: Flood risk and drainage assessment. All relevant CAR applications will be submitted for authorisation post-consent. Specific details of engineering activities and buffers of the final cable route in accordance with SEPA guidance will be provided at the detailed design stage, post-consent. b) GWDTE and associated buffers are mapped and assessed in SS2: GWDTE assessment c) Existing groundwater abstractions are discussed in section 8.4.4.8. No groundwater abstractions are proposed. GWDTE are assessed in SS2: GWDTE assessment. Specific details of engineering activities and buffers of the final cable route will be provided at the detailed design stage. d) Peat depth and peat management (including re-use proposals) are assessed in OMP3: Outline PMP. f) Embedded mitigation measures have been outlined in section 8.5.4. This includes pollution prevention measures. i) Surface water drainage is outlined in SS3: Flood risk and drainage assessment. As the infrastructure layout remains to be finalised, a surface water drainage layout map will be provided post-consent.

CONSULTEE	COMMENT	RESPONSE
		j) Concrete batching is anticipated to be required however the details of this are not yet finalised. Full details, including any requirement for water abstraction in support of concrete batching, will be provided post-consent. k) Decommissioning will follow best practice at the time of decommissioning as discussed in section 8.6.3. Mitigation measures have been outlined in section 8.5.4.
SEPA	Further details on these information requirements and the form in which they must be submitted can be found in the attached appendix. We also provide site-specific comments in the following section which can help the developer focus the scope of the assessment.	Response has been made on how the onshore Project has met the requirement and the form in which they must be submitted are set out in the relevant comments. The site-specific comments have been considered throughout this PPP Application and response to which are set out in the relevant comments.
SEPA	Do SEPA agree with the data sources suggested? Yes.	Noted and detailed in section 8.4.2.
SEPA	Are there additional data sources or guidance documents to consider? Yes. We recommend Dynamic Coast 2 data set is added to the list for the Orkney Landfalls but there do not appear to be any potential landfalls that would be in/influenced/in the vicinity to future projected erosion scenarios in the Caithness landfall areas. We confirm data requests can be made via the SEPA website for further information on potential Private Water Supply abstractions.	Noted. This Application solely focusses on the connection to Caithness and a future separate Application will be submitted for the connection to the Flotta Hydrogen Hub. Therefore, and due to the data not showing potential erosion scenarios at the Caithness landfall options, Dynamic Coast 2 data were not used. Data obtained from THC were used to assess effects on PWS.
SEPA	Do SEPA agree the site-specific studies are sufficient to inform the proposed assessment approach? Yes.	Noted and detailed in section 8.4.3.

CONSULTEE	COMMENT	RESPONSE
SEPA	Does the Local Authority hold any records for private water supplies within 1 km of the search area boundary? We confirm our GIS shows several possible groundwater fed PWS within the cable corridor search area. Section 5 in the Appendix below provides further information that should be provided in support of the planning submission. Avoidance by moving any excavation, including cable routes, out with 250 m of any PWS source should be the first principle.	PWS are assessed in section 8.4.4.8. Information regarding PWS was provided to SEPA in December 2022 and local landowners completed a short questionnaire to provide details of PWS, associated pipework and other information. Data obtained from THC were also used in the assessment
SEPA	Do you agree that all receptors and impacts have been identified? Yes. We recommend consideration of the use of Horizontal Directional Drilling (HDD) for not only coastal habitats / the cable landing but also as a possible mitigation measure through sensitive habitats, watercourses etc. Avoidance should be the first principle should GWDTE be present with floating tracks or HDD considered as mitigation measures only if avoidance is not possible.	GWDTE are assessed in SS2: GWDTE assessment. By design, avoidance of GWDTE is the first principle, as outlined in section 8.5.4. Horizontal Directional Drilling (HDD) is the preferred construction method for major watercourse crossings, such as the River Thurso and Forss Water, as detailed further in chapter 5: Project description.
SEPA	Does the Local Authority hold any records of potentially contaminated land, such as landfill sites, within 1 kilometre (km) of the search area boundary? We confirm our GIS does shows 2 potential radioactive sites (former airfields or radar stations) within 1 km of the search areas for the landfall and cable routing (Dounreay Airfield and Brims Mains Airfield) which were active during WWII. At sites with a former use such as a military airfield, radium 226 may be present due to its use in aircraft dials during WWII. Therefore, given the potential near proximity of the proposed development and excavation to these former WWII activity areas, further documentary research (Phase 1 desk study in the first instance) should be undertaken to check whether literature sources and records can reveal information about the potential for radioactive contamination within these boundaries (1km search area from centre of airfield). The desk study findings may also inform the schedule of mitigation commitments in the intended Environmental Management Plan (EMP), to demonstrate that appropriate environmental management measures can be applied during construction/excavation to manage the potential effects of radioactive contamination.	The onshore Project area has been refined and reduced since scoping, excluding the areas of contaminated land out with the onshore Project area. However, potentially contaminated sites have been considered within the assessment. The baseline for contaminated land is provided in section 8.4.4.11. Contaminated land assessment is provided in section 8.6.1.8. This includes consideration of radioactive contamination. The two potential radioactive sites are outwith the onshore Project area.

CONSULTEE	COMMENT	RESPONSE
SEPA	The Council are the responsible authority for land contamination issues. However, we recommend the potential for radioactive contamination is scoped into the environmental assessment. The findings of the documentary research and, if appropriate, any recommendations for radiological walkover surveys, should be followed up within the Phase 2 contaminated land investigations if required.	The onshore Project area has been refined and reduced since scoping, excluding the areas of contaminated land outwith the onshore Project area. However, potentially contaminated sites have been considered within the assessment. The baseline for contaminated land is provided in section 8.4.4.11. Contaminated land assessment is provided in section 8.6.1.8. This includes consideration of radioactive contamination. An initial risk screening found there is no pathway between the contaminated sites and the receptors, and therefore no requirement for surveys or contaminated land investigation.
SEPA	SEPA would be pleased to continue to provide advice and support to the Council as required with this development proposal, should radioactive contamination be identified on carrying out the Phase 1 report.	Noted. An initial risk screening found there is no pathway between the contaminated sites and the receptors.
SEPA	Is the proposed consideration of peat acceptable? We note and welcome peat has been scoped into the assessment. Further details on what we would expect to see submitted with the Application can be found in section 3 of the attached appendix.	Noted. Peat depth and peat management (including re-use proposals) are assessed in OMP3: Outline PMP, in accordance with section 3 (Disturbance and re-use of excavated peat and other carbon rich soils) of the aforementioned appendix (Appendix to SEPA Response to 22-00972-SCOP - Detailed scoping requirements).
SEPA	Are there any other relevant consultees who should be consulted with respect to the assessment of effects on hydrogeology and geology? No comment	Noted.

CONSULTEE	COMMENT	RESPONSE
SEPA	Details of regulatory requirements and good practice advice, for example in relation to private drainage, can be found on the regulations section of our website. If you are unable to find the advice you need for a specific regulatory matter, please contact a member of the local compliance team at: nhni@sepa.org.uk If you have queries relating to this letter, please contact planning.north@sepa.org.uk including our reference number in the email subject.	Noted. Regulatory requirements and good practice advice have been used in this report. A list of the legislation, policy and guidance used is presented in section 8.2.
SEPA	All maps must be based on an adequate scale with which to assess the information. This could range from OS 1: 10,000 to a more detailed scale in more sensitive locations. Each of the maps below must detail all proposed upgraded, temporary, and permanent site infrastructure. This includes all tracks, excavations, buildings, pipelines, cabling, site compounds, laydown areas, storage areas and any other built elements. Existing built infrastructure should be re-used or upgraded wherever possible. The layout should be designed to minimise the extent of new works on previously undisturbed ground. A comparison of the environmental effects of alternative locations of infrastructure elements may be required.	Maps are provided in this chapter at an adequate scale. The current Application is for PPP therefore the Project design currently identifies indicative locations for the onshore Project infrastructure. Maps detailing final design and layouts of proposed infrastructure will be provided post-consent.
SEPA	The site layout must be designed to avoid impacts upon the water environment. Where activities such as watercourse crossings, watercourse diversions or other engineering activities in or impacting on the water environment cannot be avoided then the submission must include justification of this and a map showing: a) All proposed temporary or permanent infrastructure overlain with all lochs and watercourses. b) A minimum buffer of 50m around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse and drawings of what is proposed in terms of engineering works. c) Detailed layout of all proposed mitigation including all cut off drains, location, number and size of settlement ponds.	Potential impacts on watercourses are discussed in section 8.6. Water management is discussed in SS3: Flood risk and drainage assessment. As the infrastructure layout remains to be finalised more detail will be provided post-consent.

CONSULTEE	COMMENT	RESPONSE
SEPA	If water abstractions or dewatering are proposed, a table of volumes and timings of groundwater abstractions and related mitigation measures must be provided.	Full details, including any requirement for water abstraction, e.g., for of concrete batching or dewatering, will be provided post-consent and will continue to be considered as the Project goes through detailed design.
SEPA	Further advice and our best practice guidance are available within the water engineering section of our website. Guidance on the design of water crossings can be found in our Construction of River Crossings Good Practice Guide.	Relevant guidance referred to in section 8.2 and has informed the impact assessment as appropriate.
SEPA	Watercourse crossings must be designed to accommodate the 0.5% Annual Exceedance Probability (AEP) flows, or information provided to justify smaller structures. If it is thought that the development could result in an increased risk of flooding to a nearby receptor then a Flood Risk Assessment must be submitted in support of the Planning Application. Our Technical flood risk guidance for stakeholders outlines the information we require to be submitted as part of a Flood Risk Assessment. Please also refer to Controlled Activities Regulations (CAR) Flood Risk Standing Advice for Engineering, Discharge and Impoundment Activities.	Flood risk is discussed in SS3: Flood risk and drainage assessment, in accordance with the technical flood risk guidance for stakeholders. The designs for individual water crossings will be provided post-consent in accordance with Annual Exceedance Probability (AEP) flows with an allowance for climate change.
SEPA	Scottish Planning Policy states (Paragraph 205) that "Where peat and other carbon rich soils are present, applicants must assess the likely effects of development on carbon dioxide (CO_2) emissions. Where peatland is drained or otherwise disturbed, there is liable to be a release of CO2 to the atmosphere. Developments must aim to minimise this release."	Careful design will minimise incursion into peatland. Peat depth and peat management (including storage and re-use proposals) are assessed in OMP3: Outline PMP. The potential for carbon loss from disturbance or loss of peat is assessed in SS1: Climate and Carbon Assessment.
SEPA	The planning submission must a) demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of CO_2 and b) outline the preventative / mitigation measures to avoid significant drying or oxidation of peat through, for example, the construction of access tracks, drainage channels, cable trenches, or the storage and re-use of excavated peat. There is often less environmental impact from localised temporary storage and reuse rather than movement to large central peat storage areas.	The current Application is for PPP and therefore at the current time the final cable route and potential to impact areas of peat is unknown. During detailed design, careful design will minimise incursion into peatland. Peat management (including storage and re-use proposals) is discussed in OP4: Outline PMP.

CONSULTEE	COMMENT	RESPONSE
SEPA	The submission must include: a) A detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)) with all the built elements (including peat storage areas) overlain to demonstrate how the development avoids areas of deep peat and other sensitive receptors such as Groundwater Dependent Terrestrial Ecosystems. b) A table which details the quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement. Details of the proposed widths and depths of peat to be re-used and how it will be kept wet permanently must be included.	Peat depth and peat management (including storage and re-use proposals) are assessed in OMP3: Outline PMP. Peat depth mapping is provided in Figure 8-8. Details on the quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement will be provided once a design is finalised, as part of an updated PMP. It should be noted that the current Application is for PPP and therefore at the current time the detail required to inform final peat management isn't available. It will become available during detailed design (post-consent).
SEPA	To avoid delay and potential objection proposals must be in accordance with Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste and our Developments on Peat and Off-Site uses of Waste Peat.	Peat management is discussed in OMP3: Outline PMP. Specific details will be provided once the design is finalised as part of an updated PMP.
SEPA	Dependent upon the volumes of peat likely to be encountered and the scale of the development, applicants must consider whether a full Peat Management Plan (as detailed in the above guidance) is required or whether the above information would be best submitted as part of the schedule of mitigation. Any excavated peat should be reused in peat restoration rather than 'landscaping' and compensatory peatland restoration should be included as a mitigation measure.	Peat management is discussed in OMP3: Outline PMP. Specific details will be provided once the design is finalised as part of an updated PMP.
SEPA	Please note we do not validate carbon balance assessments except where requested to by Scottish Government in exceptional circumstances. Our advice on the minimisation of peat disturbance and peatland restoration may need to be taken into account when you consider such assessments.	The potential for carbon loss from disturbance or loss of peat is assessed in SS1: Climate and Carbon Assessment.

CONSULTEE	COMMENT	RESPONSE
SEPA	GWDTE are protected under the Water Framework Directive and therefore the layout and design of the development must avoid impact on such areas. The following information must be included in the submission: a) A map demonstrating that all GWDTE are outwith a 100 m radius of all excavations shallower than 1 m and outwith 250 m of all excavations deeper than 1 m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the site boundary where the distances require it. b) If the minimum buffers above cannot be achieved, a detailed site-specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all GWDTE affected.	An overview of GWDTE and NVC mapping is provided in section 8.4.4.5.2. GWDTEs are assessed in further detail within SS2: GWDTE assessment. By design, avoidance of GWDTE is the first principle, as outlined in section 8.5.4. As the onshore export cable corridor route is yet to be finalised, details of site-specific risk assessment for affected GWDTE will be provided post-consent.
SEPA	Please refer to Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems for further advice and the minimum information we require to be submitted.	GWDTE are assessed in SS2: GWDTE assessment. SEPA guidance on assessing impacts to groundwater abstractions and GWDTEs have informed the assessment, as stated in section 8.2.
SEPA	Excavations and other construction works can disrupt groundwater flow and impact on existing groundwater abstractions. The submission must include: a) A map demonstrating that all existing groundwater abstractions are outwith a 100 m radius of all excavations shallower than 1 m and outwith 250 m of all excavations deeper than 1 m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the site boundary where the distances require it. b) If the minimum buffers above cannot be achieved, a detailed site-specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all existing groundwater abstractions affected.	No confirmed groundwater abstractions have been identified within the onshore Project area. Two PWS that may abstract groundwater have been identified and protection measures are set out in relation to these, should the confirmed cable route pass within 250 m of either source location.

CONSULTEE	COMMENT	RESPONSE
SEPA	We note there is no mention of the requirement for borrow pits in the Scoping Report. Should these be required, in accordance with Paragraphs 52 to 57 of Planning Advice Note 50 Controlling the Environmental Effects of Surface Mineral Workings (PAN 50), a Site Management Plan should be submitted in support of any application. The following information should also be submitted for each borrow pit: a) A map showing the location, size, depths and dimensions. b) A map showing any stocks of rock, overburden, soils and temporary and permanent infrastructure including tracks, buildings, oil storage, pipes and drainage, overlain with all lochs and watercourses to a distance of 250 metres. You need to demonstrate that a site-specific proportionate buffer can be achieved. On this map, a site-specific buffer must be drawn around each loch or watercourse proportionate to the depth of excavations and at least 10m from access tracks. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse, drawings of what is proposed in terms of engineering works. c) You need to provide a justification for the proposed location of borrow pits and evidence of the suitability of the material to be excavated for the proposed use, including any risk of pollution caused by degradation of the rock. d) A ground investigation report giving existing seasonally highest water table including sections showing the maximum area, depth and profile of working in relation to the water table. e) A site map showing cut-off drains, silt management devices and settlement lagoons to manage surface water and dewatering discharge. Cut-off drains must be installed to maximise diversion of water from entering quarry works. f) A site map showing proposed water abstractions with details of the volumes and timings of abstractions.	Borrow pits are no longer being considered for the onshore Project.

CONSULTEE	COMMENT	RESPONSE
	g) A site map showing the location of pollution prevention measures such as spill kits, oil interceptors, drainage associated with welfare facilities, recycling and bin storage and vehicle washing areas. The drawing notes should include a commitment to check these daily. h) A site map showing where soils and overburden will be stored including details of the heights and dimensions of each store, how long the material will be stored for and how soils will be kept fit for restoration purposes. Where the development will result in the disturbance of peat or other carbon rich soils then the submission must also include a detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)) with all the built elements and excavation areas overlain so it can clearly be seen how the development minimises disturbance of peat and the consequential release of CO2. i) Sections and plans detailing how restoration will be progressed including the phasing, profiles, depths, and types of material to be used. j) Details of how the rock will be processed to produce a grade of rock that will not cause siltation problems during its end use on tracks, trenches and other hardstanding.	
SEPA	One of our key interests in relation to developments is pollution prevention measures during the periods of construction, operation, maintenance, demolition, and restoration. A schedule of mitigation supported by the above site-specific maps and plans must be submitted. These must include reference to best practice pollution prevention and construction techniques (for example, limiting the maximum area to be stripped of soils at any one time) and regulatory requirements. They should set out the daily responsibilities of ECOWs, how site inspections will be recorded and acted upon and proposals for a planning monitoring enforcement officer. Please refer to Guidance for Pollution Prevention (GPPs).	Embedded mitigation measures have been outlined in section 8.5.4. this includes pollution prevention measures. Pollution prevention and control measures are further detailed within OMP1: Outline CEMP. A final Pollution Prevention Plan will be produced post-consent on drafting of the final CEMP in consideration of SEPA guidance. A schedule of mitigation for the onshore Project will be finalised within a Commitments Register at post-consent when conditions of the PPP are known. The proposed mitigation and monitoring measures for the onshore Project are also provided in chapter 19: Summary of mitigation and monitoring, within this Onshore EIA Report.

CONSULTEE	COMMENT	RESPONSE
NatureScot	The assessment should distinguish between peat - the material - and peatland, which refers to the ecosystems and vegetation that form peat. The peatland classification (Class 1, Class 2 etc.) relates to the condition of the vegetation and the system's ability to form peat or to be restored to active peat forming condition. At present both peat and peatland are referred to in the Geology and Hydrology section, but peatland impacts might be better considered under Non-Avian Terrestrial Ecology. Should any peatland be identified along the cable route we recommend that, as well as NVC survey, an assessment is made of its condition.	The Carbon and Peatland map has been used to assess indicative soil type, including the likely presence of carbon-rich soils, as part of the baseline on soils and peat (section 8.4.4.3). Peat depth, from a Phase 1 surveys, and peat management are assessed in OMP3: Outline PMP. Habitat and NVC survey assessment is detailed within chapter 10: Terrestrial non-avian ecology.
NatureScot	Table 3-3 (Designated Areas with Relevance to Geology and Hydrology) contains a number of errors and omissions: River Thurso SSSI is notified for its floodplain fen and vascular plant features, but the qualifying feature of the SAC is Atlantic salmon. In addition to blanket bog, Caithness and Sutherland Peatlands SAC is designated for several other habitat features relevant to geology and hydrology. It is also a Ramsar Site for blanket bog. Achanarras quarry SSSI is notified for Silurian-Devonian chordata (fossils) as well as non-marine Devonian geology. Broubster Leans is an SSSI, notified for its hydrological mire range as well as an SAC for transition mires and quaking bogs.	These errors are noted and have since been amended. All designations within the study area that have relevance to geology and hydrology are reported in section 8.4.4.10.

8.4 Baseline characterisation

This section outlines the current baseline for geology and hydrology within the geology and hydrology onshore study area. The baseline has been informed through a combination of desk-based and onshore Project site-specific surveys, further details are provided in sections 8.4.2 and 8.4.3.

8.4.1 Study area

The geology and hydrology onshore study area is defined as the onshore Project area within which the landfall options, onshore export cable corridor and onshore substation search area are located plus a buffer zone of 2 kilometre (km). The onshore study area is used to assess potential effects on geology, quarries and mines, and soils.

A 250 m buffer zone is used for assessing GWDTE, while potential effects on PWS and water resources are considered within a 5 km buffer.

The onshore study area and associated study area buffers are illustrated on Figure 8-1.

8.4.2 Data sources

The existing data sets and literature with relevant coverage to the onshore Project, which have been used to inform the baseline characterisation for geology and hydrology are outlined in Table 8-5.

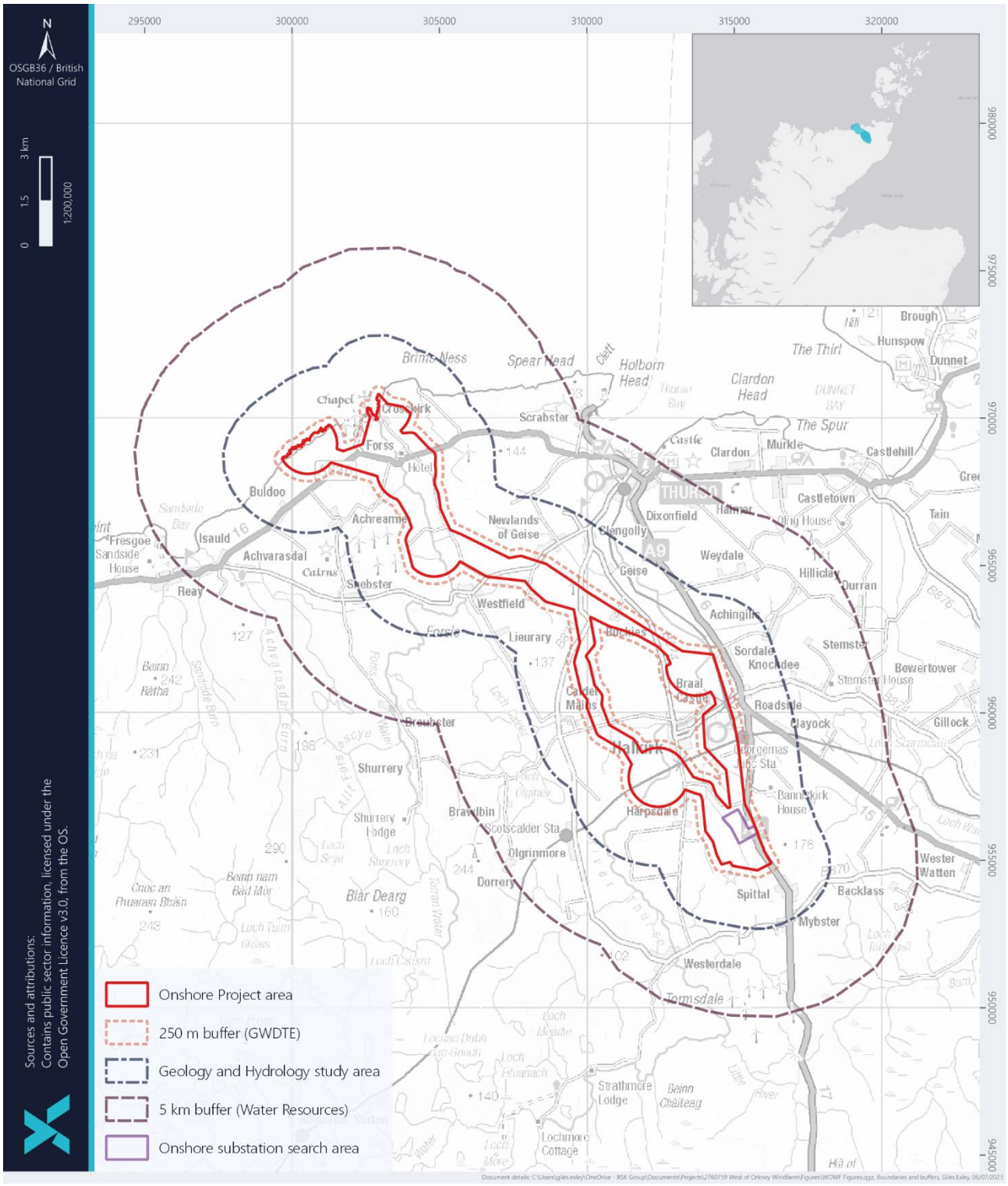

Figure 8-1 Onshore Project area and associated study area buffers for geology and hydrology

Table 8-5 Summary of key datasets and reports

TITLE	SOURCE	YEAR	AUTHOR
GeoIndex Onshore: geological mapping	https://mapapps2.bgs.ac.uk/geoindex/home.html	N/A	British Geological Survey (BGS)
BGS Maps Portal	https://webapps.bgs.ac.uk/data/maps/	N/A	BGS
National Soil Map of Scotland	https://soils.environment.gov.scot/maps/soil-maps/national-soil-map-of-scotland/	2023	James Hutton Institute (JHI)
Carbon and Peatland Map	https://soils.environment.gov.scot/maps/thematic-maps/carbon-and-peatland-2016-map/	2016	Scottish Natural Heritage (now NatureScot)
Coal Authority mining information portal	https://mapapps2.bgs.ac.uk/coalauthority/home.html	2023	Coal Authority
Water Environment and Water Classification Hubs	https://www.sepa.org.uk/data-visualisation/water-environment-hub/ and https://www.sepa.org.uk/data-visualisation/water-classification-hub/	Various	SEPA
Flood Mapping	https://www.sepa.org.uk/environment/water/flooding/flood-maps/	Various	SEPA
Flood Estimation Handbook Web Service	https://fehweb.ceh.ac.uk/	2022	UK Centre for Ecology and Hydrology (CEH)
The Geology of Scotland	The Geological Society of London (publisher)	2003	Trewin, N.H.
British Regional Geology: the Northern Highlands of Scotland	British Geological Survey (publisher)	1989	Johnstone and Mykura
Private Water Supply details	https://map-highland.opendata.arcgis.com/	N/A	THC Environmental Health Department
WFD095 A functional wetland typology for Scotland	https://www.sniffer.org.uk/wfd95-a-functional-wetland-typology-for-scotland	2009	SEPA

8.4.3 Project site-specific surveys

A reconnaissance survey was undertaken on the 9th and 10th of August 2022 across the onshore study area. The survey followed a standard 'reconnaissance level' walkover survey to obtain an overview of the conditions present within the onshore study area at the time of the visit. A reconnaissance level survey involves walking through and around an area to gather visual information concerning elements such as slope, rock outcrop, ground wetness and bogginess, nature and type of watercourses, and the presence or absence of groundwater seepages or spring points. No ground investigation was undertaken as part of this site visit.

Two further visits to conduct Phase 1 peat surveys were undertaken in September and October 2022. During these surveys, peat depth and condition were recorded at predetermined points across a 100 m grid, where access permitted. A peat probe was inserted vertically, with the depth of refusal recorded to indicate peat depth. Local hydrological conditions and photographs of the location were taken as required by the survey specification. Surveys covered all areas where peat was expected or considered possible as a result of ground conditions, plus a buffer zone around these areas. Further details of the surveys and results are provided in OMP3: Outline PMP.

8.4.4 Existing baseline

A review of literature and available data sources, augmented by consultation and the onshore Project site-specific surveys has been undertaken to describe the current baseline environment for geology and hydrology across the onshore study area.

8.4.4.1 Meteorology and climate

The onshore study area is situated within the UK Meteorological (Met) Office's Northern Scotland climate district (Met Office, 2016). Much of Northern Scotland constitutes high ground (i.e. more than 200 m above sea level), including the mountainous regions of the Grampians, Monadh Liath and the northern Highlands, and encompasses the highest point in the UK, Ben Nevis at 1,345 m. Northern Scotland has a climate strongly influenced by the rain-bearing westerly winds, particularly the Western Isles and the western coastal area which have an average annual rainfall of over 1,700 millimetres (mm).

As the onshore study area is located in the north-eastern part of the Northern Scotland climate district, it benefits from the rain shadow of the mountains in the northern Highlands and has a comparatively dry climate as a result. Rainfall is generally well-distributed throughout the year, but normally greatest in the autumn and winter. Further details are provided in SS1: Climate and carbon assessment.

8.4.4.1.1 Rainfall

The onshore study area is approximately 24 km west of the Wick John O'Groats Airport climate monitoring station and 15.7 km east of the Strathy East station (Met Office, 2023). Rainfall patterns are likely to be similar to those observed at the Wick John O'Groats Airport and Strathy East monitoring stations.

Average annual rainfall from 1991-2020 for the Wick John O'Groats Airport monitoring station is 792.7 mm and 984.6 mm at Strathy East, compared with 1,702.5 mm for the Northern Scotland climate district. Wick John O'Groats Airport monitoring station is located 36 m above mean sea level, with Strathy East at 68 m (Met Office, 2023).

Figure 8-2 shows the average monthly rainfall distribution for the Wick John O'Groats Airport and Strathy East monitoring stations and, to compare, the Northern Scotland climate district for the period 1991-2020.

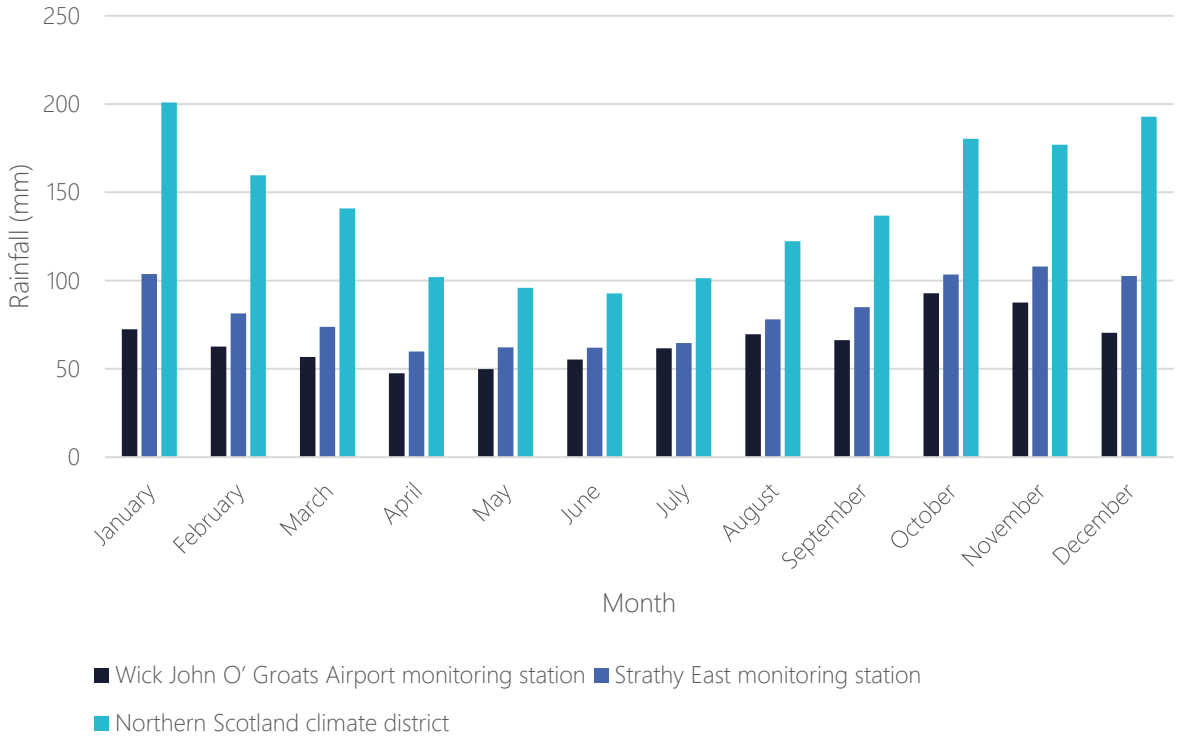

Figure 8-2 Monthly rainfall averages at Wick John O'Groats Airport and Strathy East monitoring stations and for the Northern Scotland climate district. Averages cover the period 1991-2020 (Met Office, 2023)

8.4.4.2 Geology

Geological information is derived from the BGS GeoIndex online geological mapping at 1:50,000 scale and the BGS Lexicon of Named Rock Units (BGS, 2023a; BGS, 2023b). Geological mapping is shown on Figure 8-3.

8.4.4.2.1 Bedrock geology

The onshore study area is underlain by bedrock of the Middle Old Red Sandstone group of Early-Middle Devonian age, part of the Old Red Sandstone Supergroup, as illustrated in Figure 8-3. Rocks from this Supergroup dominate the Caithness and Orkney areas of Scotland. Bedrock within the onshore study area varies in depth from 0 m (present at surface) to depths of 6 m or deeper. The Phase 1 peat surveys identified that the base of the soil was hard across much of the onshore Project area; this confirms that the rockhead may be shallow for much of the area.

Eight distinct formations have been identified within the onshore study area, all of which are characterised by interbedded sandstones and siltstones, with mudstones in some areas. The proportions of different rock types vary between the formations, but the main rock characteristics are similar throughout.

Of particular note is the Achanarras Fish Bed Member, which is present as a narrow rock unit, typically around 2 m in thickness, sub-parallel to the Achanarras Burn in the area between Halkirk and the onshore substation search area, as illustrated in Figure 8-3. This unit comprises interbedded limestone and mudstone / siltstone and includes fish fossils.

A number of faults are indicated within the onshore study area and illustrated in Figure 8-3. In the northern part of the corridor, the Bridge of Forss Fault Zone cuts across at Bridge of Forss with a north-east to south-west orientation. The Loch Calder Fault runs along the Forss Water valley and alongside Loch Calder, with a north-west to south-east orientation. A number of minor faults are indicated, particularly on the north-west side of the Bridge of Forss Fault Zone extending to the coast. These mainly have north-east to south-west or north-west to south-east orientations.

8.4.4.2.2 Superficial geology

The BGS GeoIndex indicates that superficial deposits are mainly Devensian till with some small areas of peat, notably in the southern part of the onshore study area, and areas of glaciofluvial deposits, alluvium and river terrace deposits within the River Thurso and Forss Water valleys. Till deposits are indicated across the majority of the study area. A small area of lacustrine deposits is noted near Lochan Buidhe. An area of Head, a mix of gravel, sand, silt and clay, is present within the eastern side of the Forss Water valley near Lythmore.

One area of unspecified artificial ground was identified within the onshore export cable corridor area, located between Lybster Smallholdings and the A836. A small number of additional areas of artificial ground are present outwith the onshore export cable area, around the Forss Business and Technology Park and associated with the various quarries in the onshore study area.

Areas of peat are mainly around Loch Lieurary, Moss of Geise and the Yellow Moss / Bloody Moss areas south of Halkirk. Peat is discussed in more detail in section 8.4.4.3. Superficial geology in the vicinity of the onshore study area is shown in Figure 8-4.

8.4.4.2.3 Mineral extraction

There are no active quarries within the onshore Project area, although there are 52 ceased quarries within the onshore Project area. However, these are not shown on Ordnance Survey (OS) 1:25,000 scale mapping and, since they are ceased, they are not considered to be of particular importance (BGS, 2023a).

There are a number of quarries within a 2 km buffer surrounding the onshore Project area, see Figure 8-5. Of these, nine ceased, one inactive and two active quarries are visible on OS 1:25,000 scale mapping and details of these are provided in Table 8-6. The remaining quarries are not identified on 1:25,000 scale mapping and, since they are ceased, they are not considered to be of importance (BGS, 2023a). It is likely that the quarries listed as 'Unknown' were sourcing flagstone or aggregate material. There is no known history of mining for coal or other materials within the onshore study area (BGS, 2023a; Coal Authority, 2023).

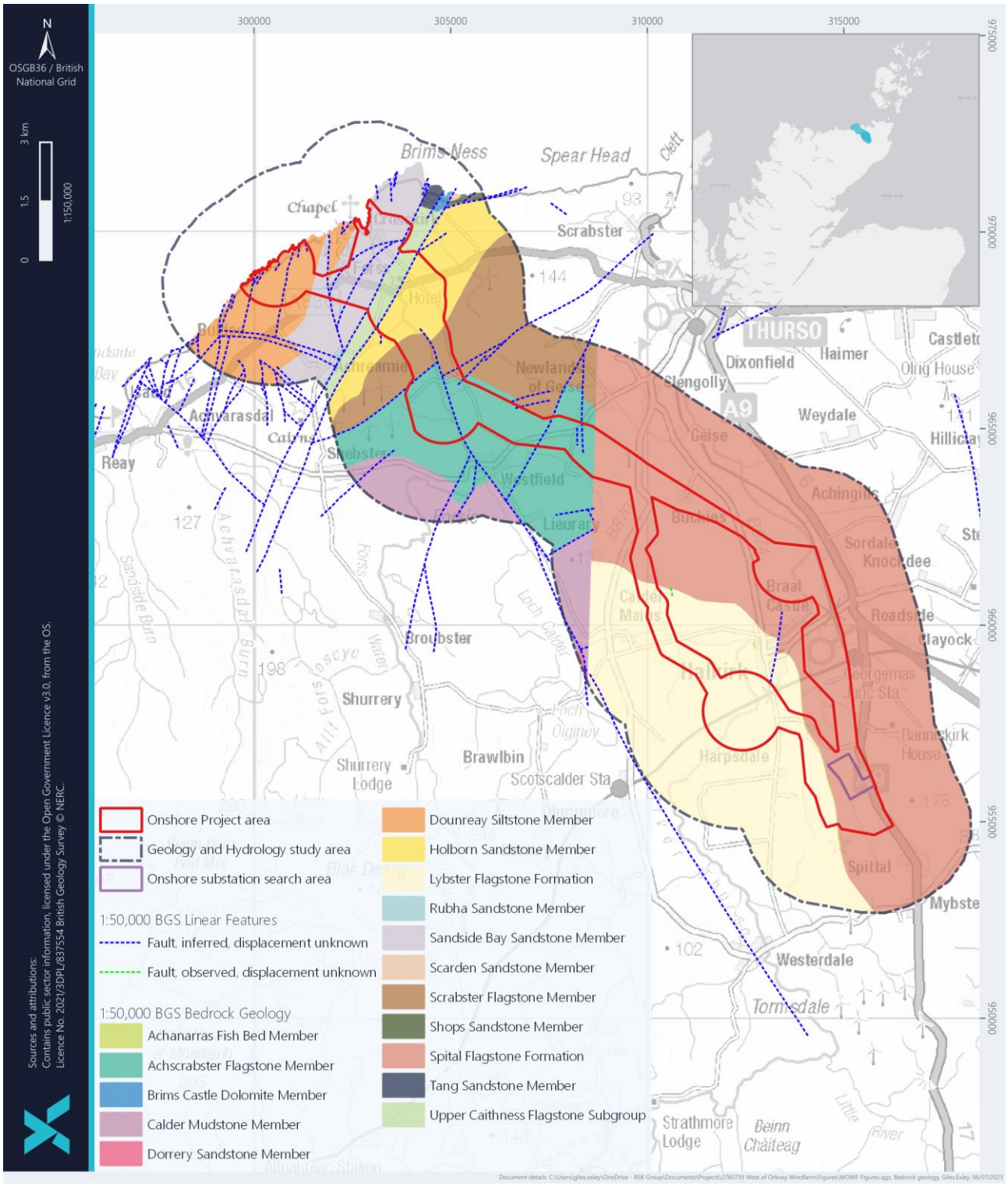

Figure 8-3 Terrestrial bedrock geology in the vicinity of the onshore study Project (BGS, 2023a). The distinctive line running north to south in the centre of the figure indicates the boundary of adjoining paper maps that have subsequently been digitised

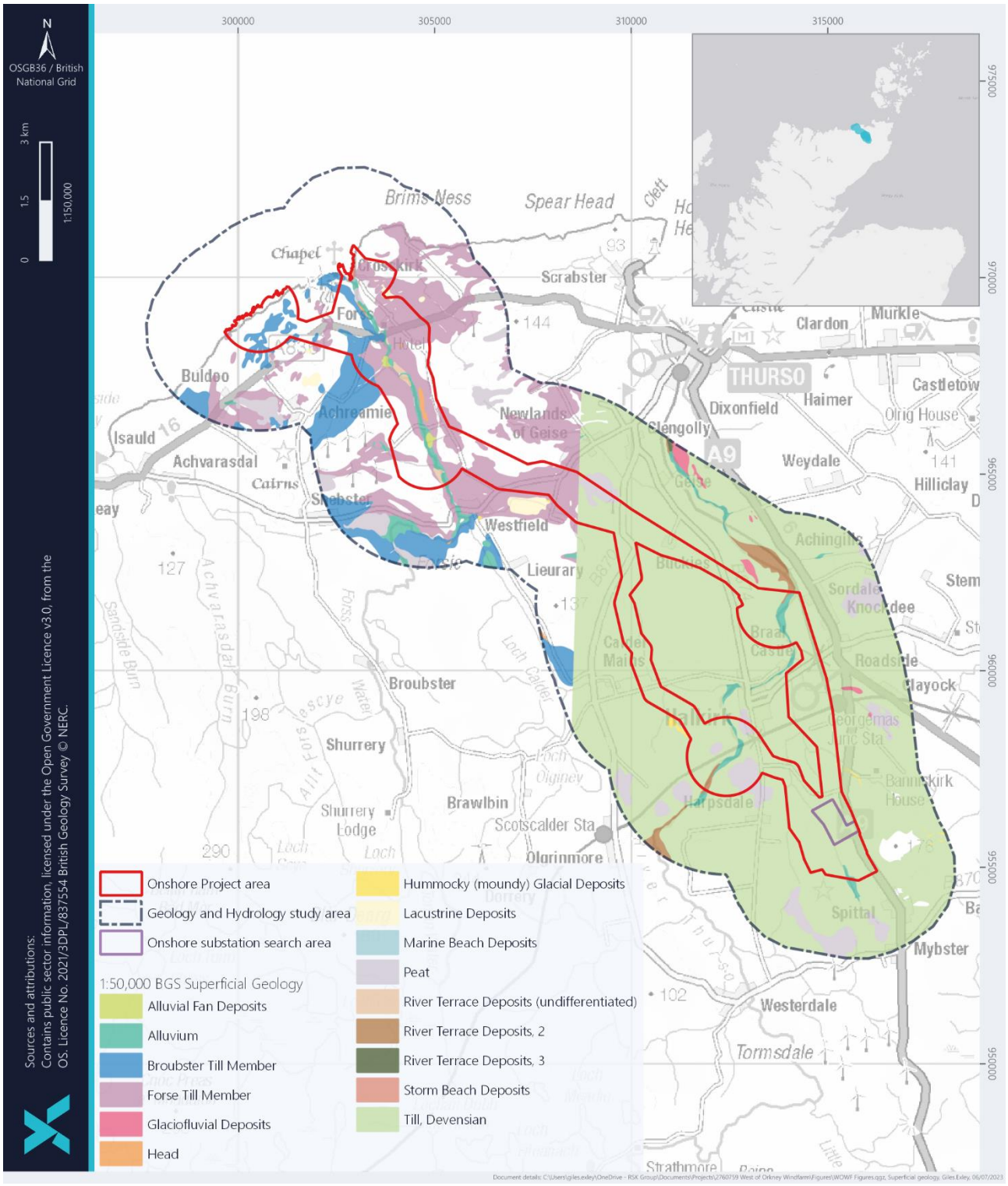

Figure 8-4 Superficial geology in the vicinity of the onshore Project area (BGS, 2023a). The distinctive line on the edge of the area of Devensian Till indicates the boundary of adjoining paper maps that have subsequently been digitised

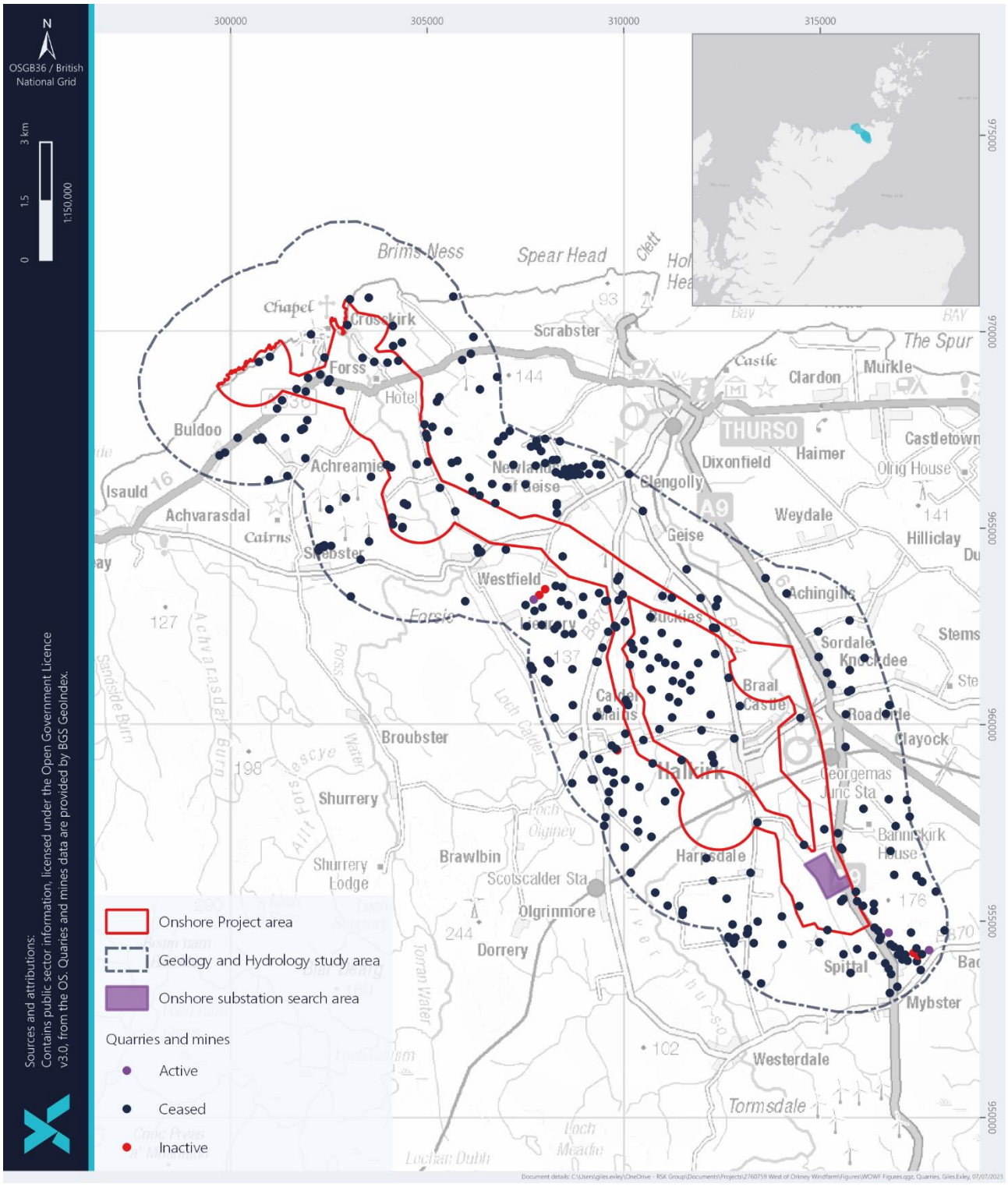

Figure 8-5 Quarries and mines within 2 km of the onshore study area based on BGS (2023a) data

Table 8-6 Quarries visible on OS 1:25,000 scale mapping within 2 km of the onshore Project area (BGS, 2023a)

NO	NAME	SOURCE LOCATION BRITISH NATIONAL GRID REFERENCE	COMMODITY	STATUS	DISTANCE AND DIRECTION FROM THE ONSHORE PROJECT AREA
1	Achnaharrass (Achanarras) Quarry	314971 954465	Slate	Ceased	0.3 km south
2	Achavrole	309804 959385	Flagstone	Inactive	0.3 km west
3	Achreamie Quarry	300779 967311	Unknown	Ceased	0.8 km south
4	Achscrabster Quarry	307851 963301	Flagstone	Active	0.9 km south-west
5	Quarry	316785 956789	Unknown	Ceased	1.2 km north-east
6	Spittal Quarries	317370 954195	Flagstone	Active	1.3 km south-east
7	Janetstown Quarries	308898 966371	Unknown	Ceased	1.3 km north-east
8	Banachmore	313153 954711	Unknown	Ceased	1.4 km west
9	Lieurary	308241 962439	Unknown	Ceased	1.5 km west
10	Hill of Forss Quarries	306945 967350	Unknown	Ceased	1.7 km north-east
11	Dale Croft	313116 953655	Unknown	Ceased	1.9 km south-west
12	Langland Quarries	307781 967229	Unknown	Ceased	1.9 km north

8.4.4.3 Soils and peat

The National Soils Map of Scotland identifies the predominant soil types of the onshore export cable corridor as noncalcareous gleys and brown soils of the Thurso Association (Soil Survey of Scotland, 1981). The onshore substation search area is identified to contain noncalcareous gleys of the Thurso Association. An area of alluvial soils is identified on the soils mapping along the River Thurso running north from Halkirk. Yellow Moss, to the south of Halkirk, is identified as being an area of blanket peat. Two areas of peaty gleys from the Thurso Association are present, one at Bloody Moss and the other between Georgemas Junction and Achlachan Moss.

Soils across the whole area are generally noted to be thin, rarely exceeding 0.3 m in thickness (Offshore Wind Power Limited (OWPL), *per comms*).

Further details on soils within the onshore Project area are provided in Table 8-7 and illustrated in Figure 8-6.

Table 8-7 Soil types within the onshore Project area (Soil Survey of Scotland, 1981)

SOIL ASSOC.	PARENT MATERIAL	COMPONENT SOILS	LANDFORMS	VEGETATION	% OF ONSHORE PROJECT AREA*
Thurso	Greyish brown drifts derived from Middle Old Red Sandstone flagstones and sandstones.	Noncalcareous gleys; some peaty gleys, brown forest soils and brown rankers.	Undulating lowlands with gentle slopes.	Arable and permanent pastures; Rush pastures and sedge mires; Acid bent-fescue grassland.	47.4
Thurso	Greyish brown drifts derived from Middle Old Red Sandstone flagstones and sandstones.	Brown forest soils, brown rankers; some noncalcareous gleys.	Undulating lowlands with gentle and strong slopes.	Arable and permanent pastures; Acid bent-fescue grassland; Rush pastures and sedge mires.	34.5
Thurso	Greyish brown drifts derived from Middle Old Red Sandstone flagstones and sandstones.	Noncalcareous gleys; some peaty gleys, brown forest soils and brown rankers.	Undulating lowlands and foothills with gentle and strong slopes: non-rocky.	Arable and permanent pastures; Rush pastures and sedge mires; Acid bent-fescue grassland.	7.9
Alluvial soils	Recent riverine and lacustrine alluvial deposits.	Alluvial soils.	Flood plains with river terraces and former lake beds.	Arable and permanent pastures; White bent grassland; Swamp, rush pastures and sedge mires.	3.9
Thurso	Greyish brown drifts derived from Middle Old Red Sandstone flagstones and sandstones.	Brown forest soils; some noncalcareous gleys, peaty gleys and peat.	Hummocky moraines.	Arable and permanent pastures; Rush pastures and sedge mires.	3.0
Organic soils	Organic deposits.	Blanket peat.	Uplands and northern lowlands with gentle and strong slopes.	Blanket and northern blanket bog; Upland and flying bent bog; Deer-grass bog; Sedge mires.	2.4

There are no data for a small portion (0.9%) of the onshore Project area so the % of onshore Project area does not total 100%.

NatureScot's Carbon and Peatland map has been consulted to understand the carbon-rich soils, deep peat and priority peatland habitat within the onshore study area (NatureScot, 2016). The map classifies soils into five carbon classes, as well as three classes for mineral soils, non-soil or unknown. Classes 1 and 2 are considered to be nationally important carbon-rich soils. Details of each peatland class and the associated areas are provided in Table 8-8 and illustrated in Figure 8-7.

Within the onshore study area, the soils are principally assigned Class 0 (mineral soils) (Figure 8-7). There is a small pocket of Class 1 soil on the western section of the onshore export cable corridor, just south of the River Thurso. No areas of Class 2 soil were identified. Smaller pockets of Class 3 (not priority peatland habitat) and Class 5 (no peatland habitat recorded) are present in the south-western sections of the onshore export cable corridor. A small area of Class 4 (unlikely to include carbon-rich soils) is present to the east of North Calder on the western section of the onshore export cable corridor, and in pockets of the onshore export cable corridor south of Halkirk.

Table 8-8 Carbon and peatland classes present within the onshore Project area (NatureScot, 2016)

PEATLAND CLASS	DESCRIPTION	% OF ONSHORE PROJECT AREA**
Class 0	Mineral soil – Peatland habitats are not typically found on such soils.	86.4
Class 3	Dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type. Occasional peatland habitats can be found. Most soils are carbon-rich soils, with some areas of deep peat.	4.7
Class 4	Area unlikely to be associated with peatland habitats or wet and acidic type. Area unlikely to include carbon-rich soils.	3.3
Class 5	Soil information takes precedence over vegetation data. No peatland habitat recorded. May also include areas of bare soil. Soils are carbon-rich and deep peat.	2.5
Class 1	Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas likely to be of high conservation value.	2.0
Class -2	Non-soil (e.g., loch, built up area, rock and scree).	0.2

There are no data for a small portion (0.9%) of the onshore Project area so the % of onshore Project area does not total 100%.

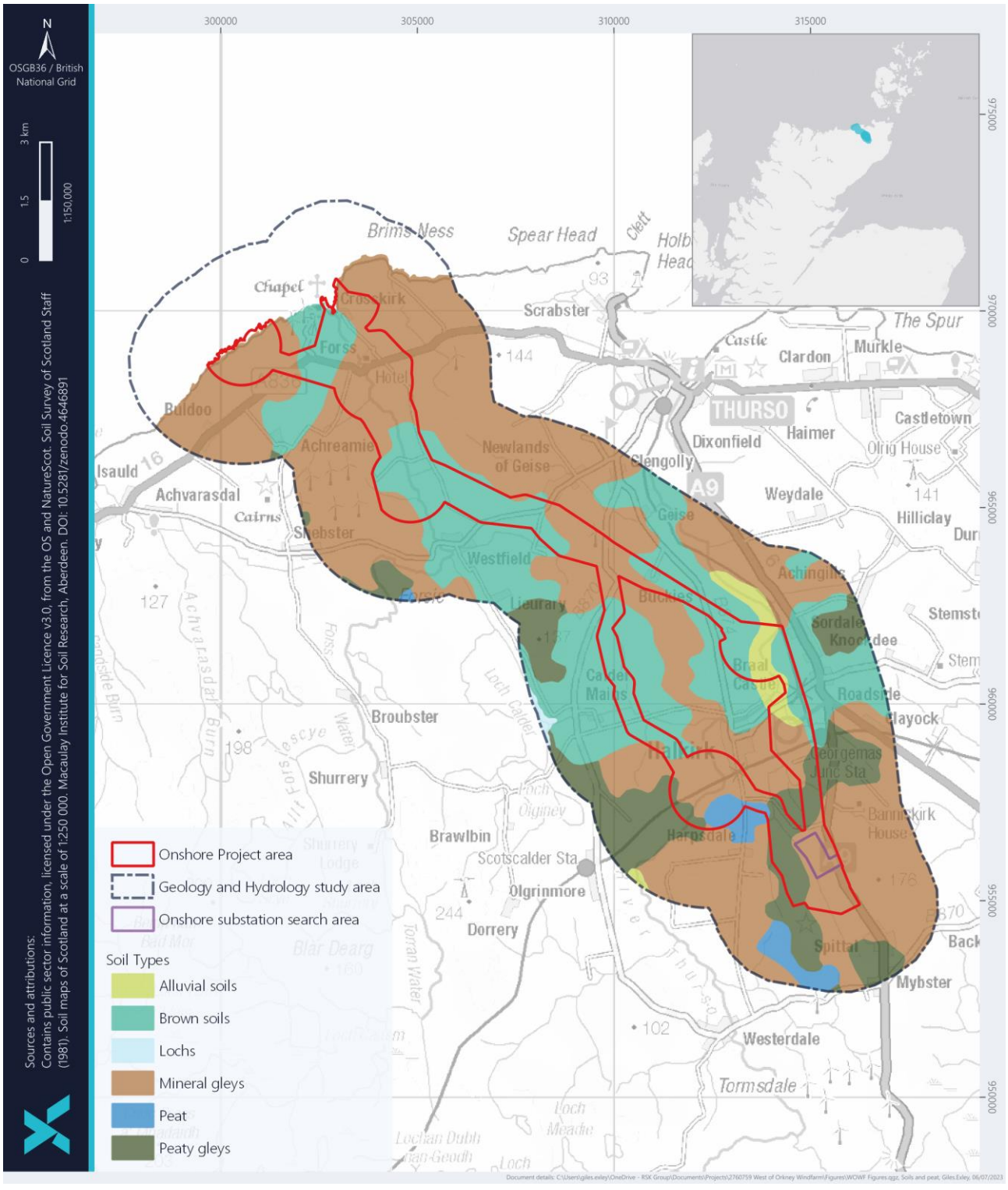

Figure 8-6 Soil types in the vicinity of the onshore study area (Soil Survey of Scotland, 1981)

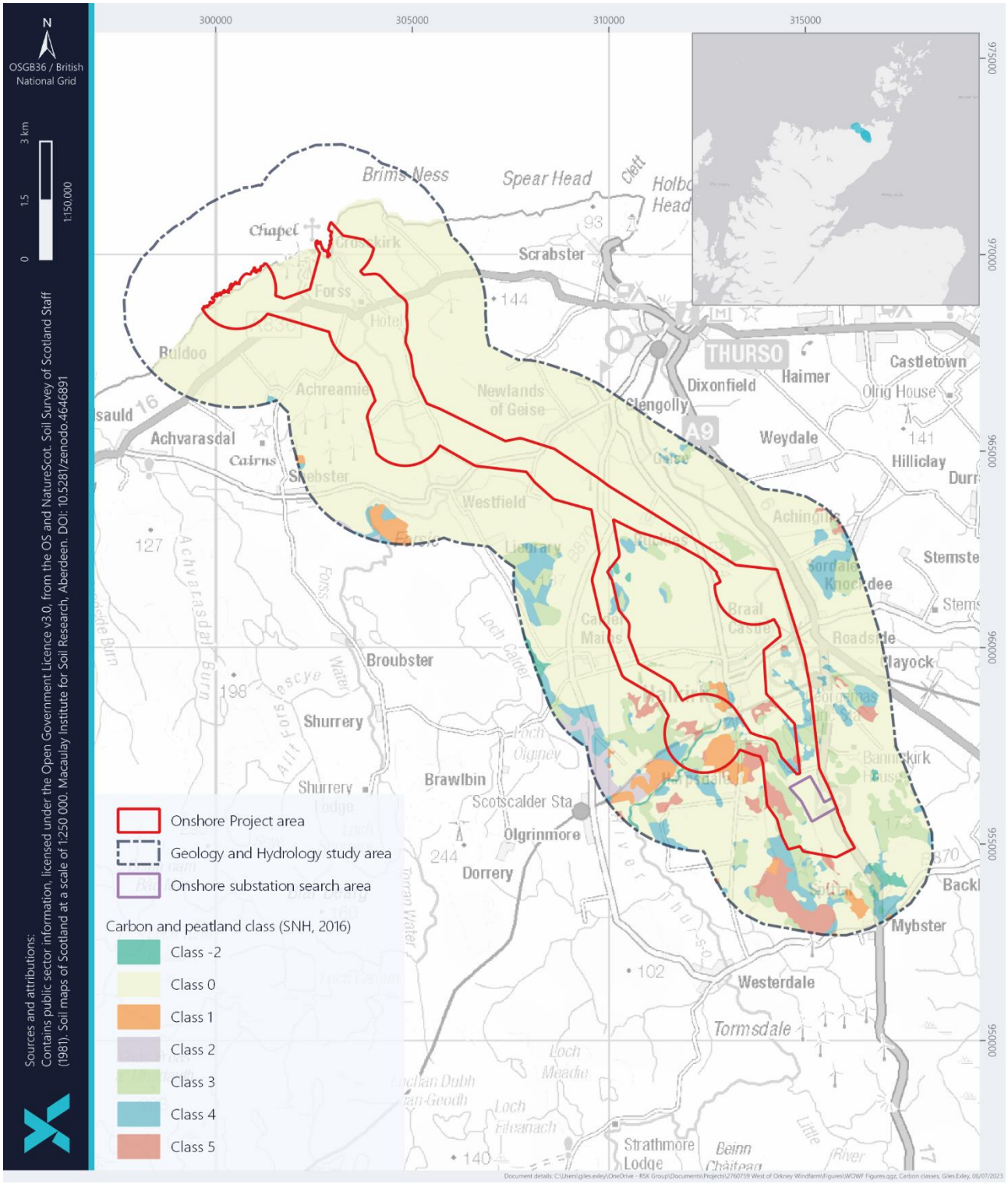

Figure 8-7 Carbon and peatland class of soils within the vicinity of the onshore study area (SNH, 2016)

The reconnaissance and Phase 1 peat surveys found that pockets of peat are present throughout the onshore Project area but are not extensive, as illustrated in Figure 8-8. The largest area of peat is located within the onshore export cable corridor to the east of Harpsdale, south of Halkirk and reaches a maximum depth of 4 m. Three other main areas of peat are present within the western onshore export cable corridor. These include:

- An area between Bardnaheigh and Houstry Mains with a maximum depth of 3.1 m;
- An area on Yellow Moss, with a maximum depth of 2.0 m; and
- An area north-west of the River Thurso and east of Drakerous with a maximum depth of 1.85 m.

Further small areas of peat were also identified at other locations within the onshore study area, notably:

- Along the Forss Water valley, mainly adjacent to the river;
- Along the south-western margin of the Moss of Geise;
- Adjacent to the River Thurso north-east of Halkirk; and
- Around the Calder Water east of Calder Mains.

Some additional minor pockets of peat identified were scattered throughout the onshore Project area, although these are mainly small and discontinuous. Peat is assessed in more detail in OMP3: Outline PMP.

8.4.4.4 Geomorphology

The onshore study area lies on relatively low ground, with elevations ranging from sea level to around 115 m Above Ordnance Datum (AOD).

The lowest point within the onshore study area is at the Crosskirk landfall near Crosskirk Bay, where the Forss Water meets the sea. The highest point within the onshore study area is to the west of Spittal Hill, at the southern extent of the onshore export cable corridor.

The topography of the onshore study area is characterised by 10-20 m high cliffs at the landfall(s) at the north of the onshore export cable corridor, with low-lying rolling hills and valleys inland. Steeper slopes are present within the Forss Water valley and in the eastern part of the onshore export cable corridor along the side of Buckies Hill. The southern part of the onshore export cable corridor, near and to the south of Halkirk, is nearly flat in nature.

The onshore indicative substation location (located within the substation area of search) ranges in elevation from approximately 65 m to 85 m AOD.

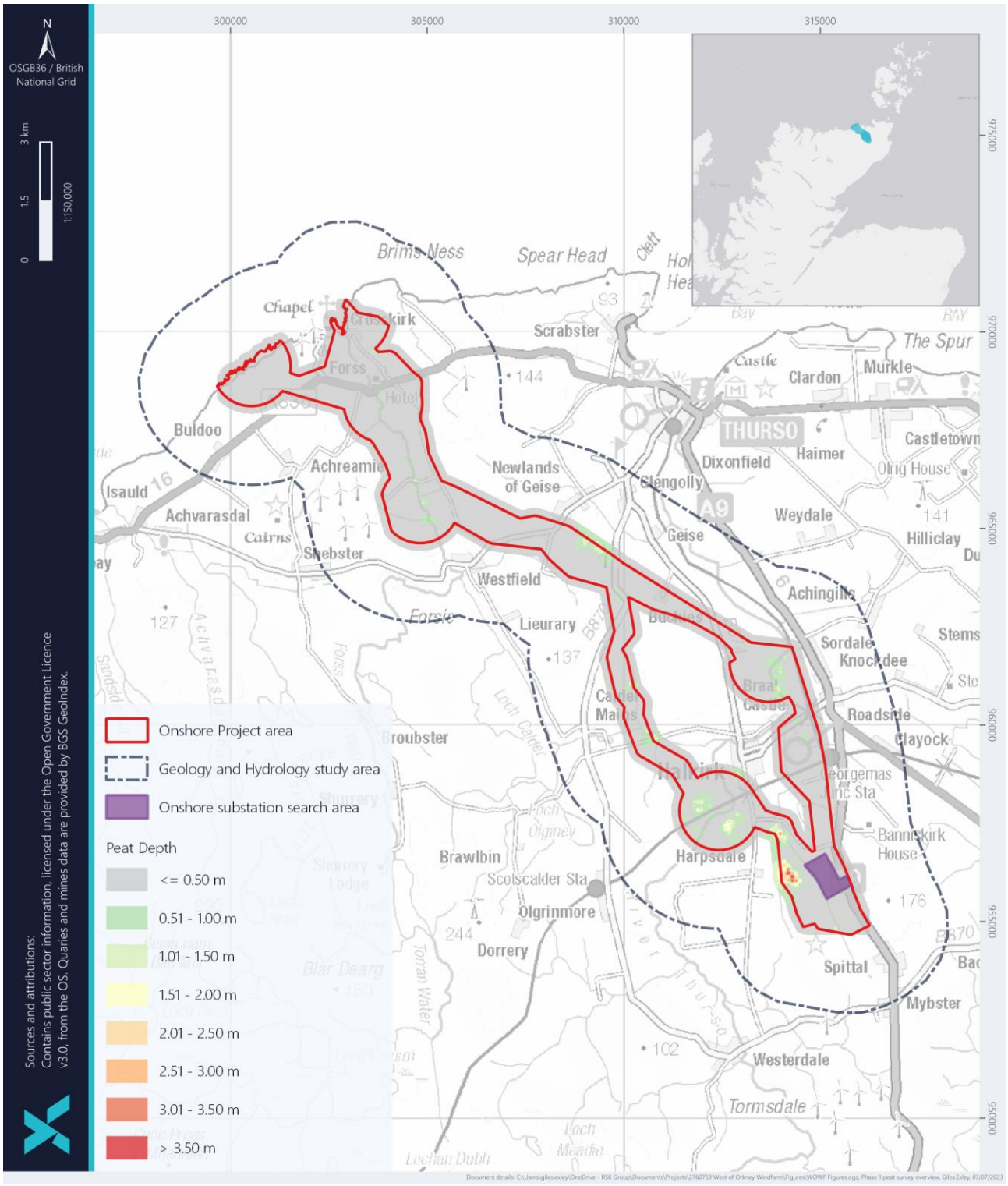

Figure 8-8 Peat depths measured across the onshore Project area during Phase 1 peat surveys

8.4.4.5 Hydrogeology

The onshore study area is underlain by Middle Old Red Sandstone bedrock forming a moderately productive aquifer (BGS, 2023a). The aquifer comprises sandstones (in places flaggy) with siltstones, mudstones and conglomerates, and interbedded lavas, locally yielding small amounts of groundwater confined to a shallow zone of weathered rock. Groundwater flow is predominantly through fissures and other discontinuities.

Depth to groundwater is variable, with records from boreholes in the area giving figures of 0.65 m below ground level near the coast, in areas without cliffs, to 2.0 m and deeper in locations further inland (BGS, 2023a). Groundwater depth also varies seasonally, with highest water table levels usually present in late winter and early spring (February-April). There are two groundwater bodies associated with the onshore study area: the Caithness groundwater body, which lies beneath the majority of the onshore study area, and the Dounreay groundwater body, which lies beneath a small section in the north-west of the onshore study area at Dounreay. Both are in good condition (SEPA, 2021a).

The superficial deposits covering the onshore study area have a range of potential permeabilities, and their productivity will depend on their composition and connectivity locally, with pockets of sand and gravel having high permeability and clay and silt having low permeability. The peat bodies will also hold some groundwater, although peaty gleys are known to have poorly drained characteristics (JHI, 2023). Flow within peat is known to be extremely slow, although it can contribute some limited baseflow to local burns; with the extent of peat being limited, the significance of groundwater in peat is very low.

Regional groundwater flow would tend to mimic the topography, flowing north towards the coast.

8.4.4.5.1 Groundwater vulnerability

Groundwater vulnerability is "the tendency and likelihood for general contaminants to move vertically through the unsaturated zone and reach the water table after introduction at the ground surface" (Dochartaigh *et al.*, 2011). Groundwater vulnerability classes are shown in Table 8-9.

Table 8-9 Groundwater vulnerability classes (Dochartaigh et al., 2011)

VULNERABILITY CLASS	DESCRIPTION
Class 0	Not sufficient data to classify vulnerability.
Class 1	Only vulnerable to conservative pollutants in the long term when continuously and widely discharged / leached.
Class 2	Vulnerable to some pollutants, but only when they are continuously discharged / leached.
Class 3	Vulnerable to some pollutants; many others significantly attenuated.
Class 4a	Vulnerable to those pollutants not readily adsorbed or transformed. May have low permeability soil; less likely to have clay present in superficial deposits.
Class 4b	Vulnerable to those pollutants not readily adsorbed or transformed. More likely to have clay present in superficial deposits.
Class 5	Vulnerable to most pollutants, with rapid impact in many scenarios.

Groundwater vulnerability mapping has identified that most of the groundwater within the onshore export cable corridor is considered to have a vulnerability class of 4a (Dochartaigh *et al.*, 2011). Minor areas on the Greeny Geo landfall are classed as 1 and 5. Part of the onshore export cable corridor and the onshore substation search area are predominantly class 3.

8.4.4.5.2 Groundwater-dependent terrestrial ecosystems

A habitat mapping exercise was completed as part of the ecology baseline assessment, which was used to identify potential GWDTE within the onshore study area. The results of the habitat mapping exercise are discussed in chapter 10: Terrestrial non-avian ecology. GWDTE are defined by the UK Technical Advisory Group (UKTAG) (2004) as:

"A terrestrial ecosystem of importance at Member State level that is directly dependent on the water level in or flow of water from a groundwater body (that is, in or from the saturated zone). Such an ecosystem may also be dependent on the concentrations of substances (and potentially pollutants) within that groundwater body, but there must be a direct hydraulic connection with the groundwater body."

In line with the guidance provided by UKTAG (2004), a dual approach to identifying GWDTE has been used. This involves detailed study of vegetation communities in order to determine the potential level of groundwater dependency, combined with detailed hydrogeological study in order to identify locations where groundwater reaches the surface and is therefore able to provide a source of water to the associated habitats. The detailed assessment of the potentially GWDTEs within the onshore study area is provided in SS2: GWDTE assessment.

NVC communities identified by SEPA as potentially highly or moderately groundwater-dependent, depending on the hydrogeological setting, are listed in SEPA's publication 'Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems' (SEPA, 2017). Within the onshore study area potentially groundwater-dependent NVC communities identified are:

- M15: *Scirpus cespitosus – Erica tetralix* wet heath;
- M16: *Erica tetralix – Sphagnum compactum* wet heath;
- M25: *Molinia caerulea – Potentilla erecta* mire;
- M27: *Filipendula ulmaria* – Angelica sylvestris mire;
- M28: *Iris pseudacorus – Filipendula ulmaria* mire;
- MG8: *Cynosurus cristatus – Caltha palustris* lowland neutral grassland;
- MG9: *Holcus lanatus – Deschampsia cespitosa* grassland;
- MG10: *Holcus lanatus – Juncus effusus* rush-pasture;
- S27: *Carex rostrata – Potentilla palustris* tall-herb fen;
- U4: *Festuca ovina – Agrostis capillaris – Galium saxatile* grassland; and
- W6: *Alnus glutinosa – Urtica dioica* woodland.

An overview of potentially groundwater-dependant habitats in the vicinity of the onshore study area is shown below in Figure 8-9. NVC mapping, as determined through survey works, for the onshore study area is shown in Figure 8-10 and Figure 8-11.

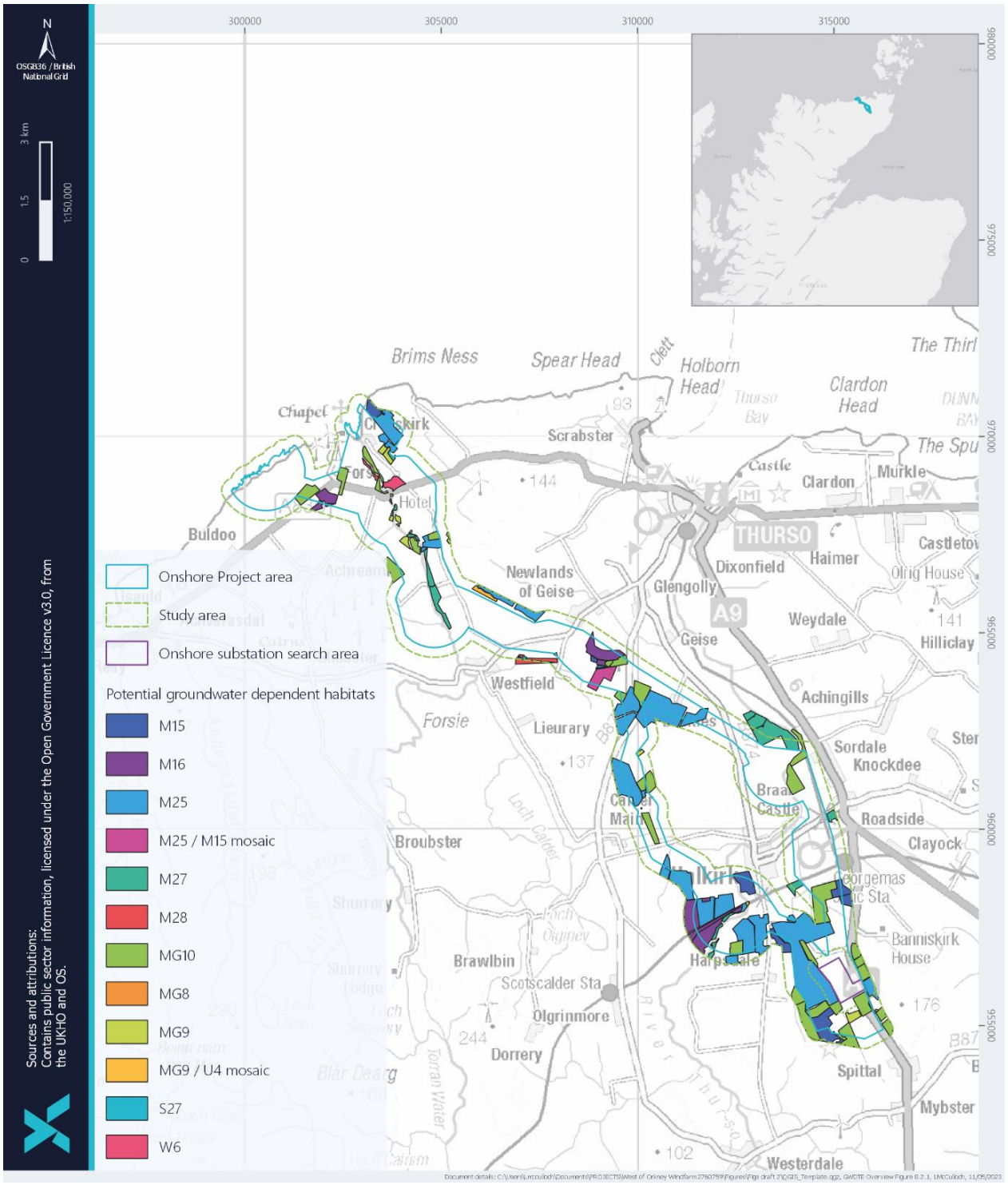

Figure 8-9 Overview of potentially groundwater-dependent communities in the vicinity of the onshore study area

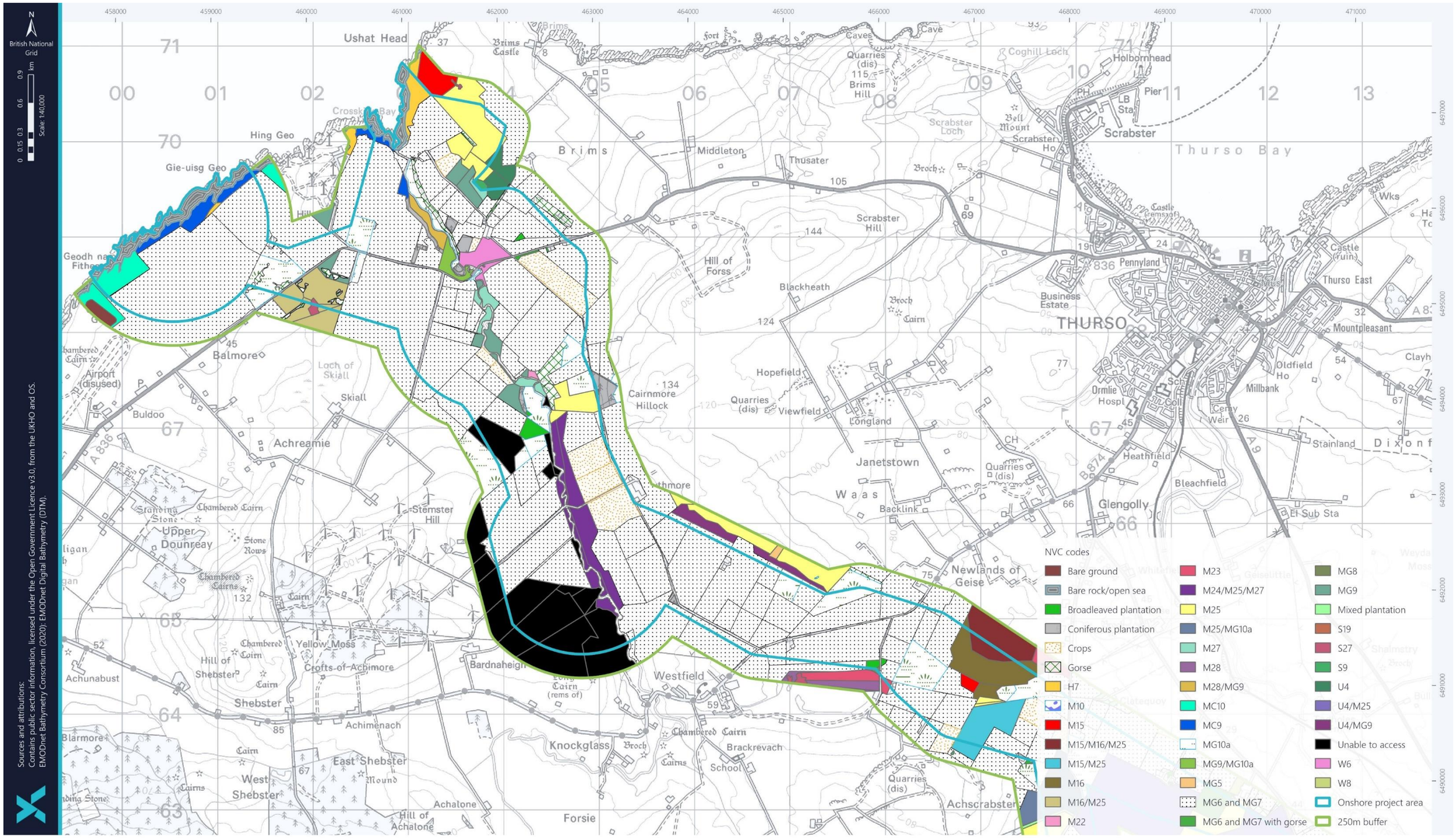

Figure 8-10 NVC habitats recorded within the northern section of the onshore study area

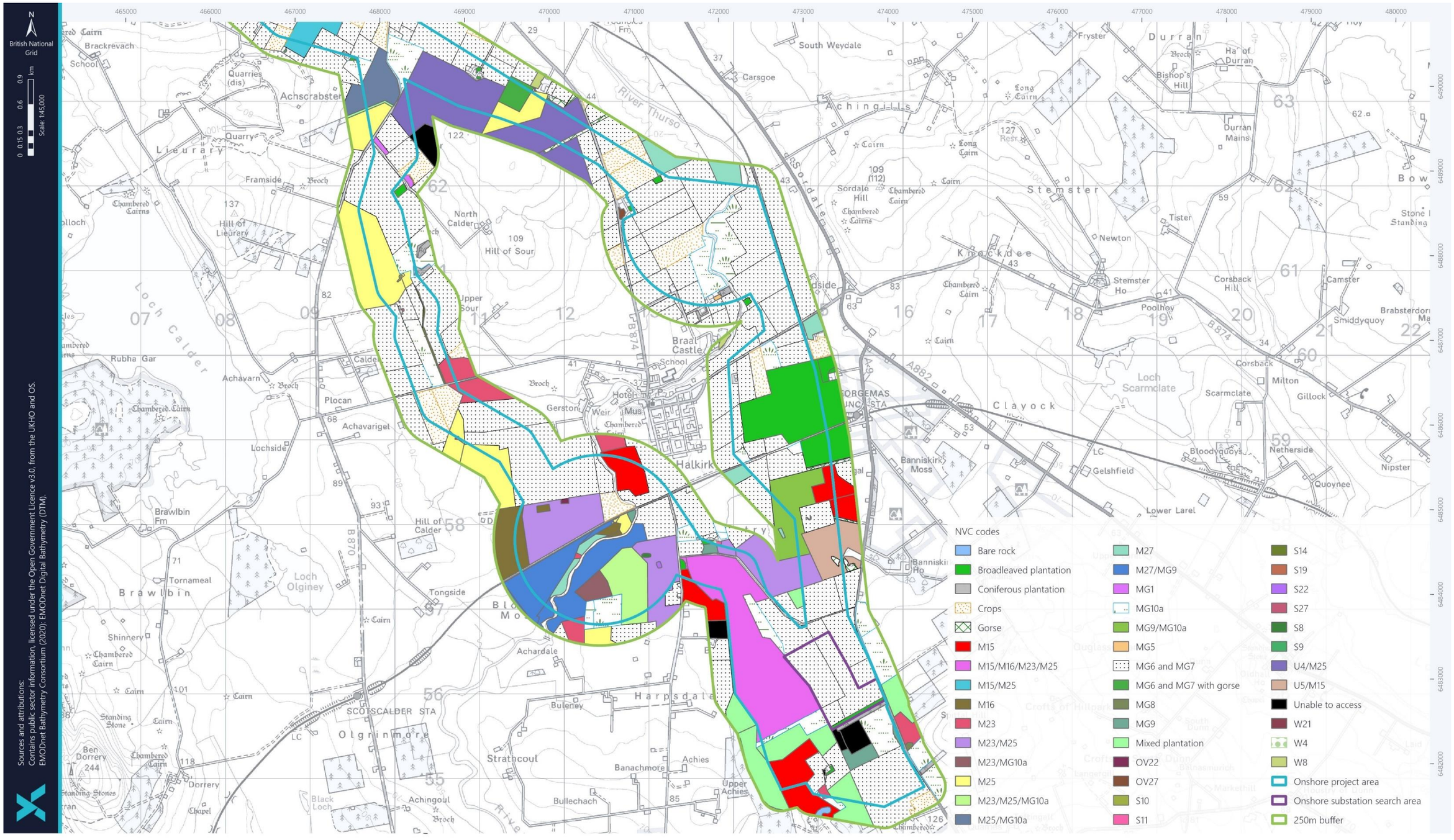

Figure 8-11 NVC habitats recorded within the southern section of the onshore study area

8.4.4.6 Hydrology

The onshore study area is located across five hydrological catchment areas: the River Thurso, Forss Water, Burn of Brims, Thurso Coastal between Forss Water and Dounreay Burn, and Thurso Coastal between Burnside Burn and Forss Water. The catchments are shown on Figure 8-12. Just over half of the land within the onshore study area lies within the River Thurso catchment, including the southern extent of the onshore export cable corridor and the onshore substation search area. The north of the onshore export cable corridor lies mainly within the Forss Water catchment, with a small area near the Crosskirk landfall within the Burn of Brims catchment. The Greeny Geo landfall lies in the Thurso Coastal between the Forss Water and Dounreay Burn catchment. At the Crosskirk landfall, to the west of Crosskirk Bay the area lies in the Thurso Coastal between Forss Water and Dounreay Burn catchment. To the east, the area lies in the Thurso Coastal between Burnside Burn and Forss Water catchment.

The catchment wetness index (the Proportion of Time Soils are Wet (PROPWET)) for all the catchment areas ranges from 0.50 to 0.56, indicating that soils within the onshore study area are wet for 50-56% of the time. The area has a Baseflow Index (BFI)[7] of between 0.32 and 0.34, indicating a moderate to low input of groundwater baseflow to surface watercourses. The Standard Percentage Runoff (SPR) Hydrology of Soil Types (HOST) (SPR HOST) is 39-53%, indicating that this percentage of rainfall on-site is converted into surface runoff from rainfall events; this represents a high runoff risk where soils have a limited capacity to store rainfall and/or a slow infiltration rate and will quickly saturate, leading to rapid runoff, and more 'flashy' watercourses. Catchment statistics derived from the Flood Estimation Handbook Web Service are provided in Table 8-10 (CEH, 2022). Catchment statistics are provided for the main catchments within the onshore study area.

8.4.4.6.1 Watercourses

River Thurso

The River Thurso drains 53.5% of the land within the onshore study area (CEH, 2022). The River Thurso catchment is located in the part of the onshore study area that is south-east of Moss of Geise and includes the onshore substation search area. Several smaller watercourses drain into the River Thurso through the onshore study area, including:

- Burn of Achanarras, flowing approximately north-westerly from the B870 to the confluence with the Burn of Halkirk south of Little Houstry. The Burn of Achanarras is adjacent to the onshore substation search area;
- Burn of Halkirk, flowing approximately north-westerly from Banniskirk House to the confluence with the River Thurso east of Braal Castle;
- Burn of Geise, approximately 0.6 km north-east of the onshore export cable corridor, flowing in a south-easterly to easterly direction from Newlands of Geise to the confluence with the River Thurso at Geise;
- Burn of Carnavagry, flowing approximately south-easterly from the B870 to the north of Carnavagry and then in a southerly direction through the onshore export cable corridor to the confluence with Calder Burn; and
- Calder Burn, flowing approximately easterly from Loch Calder to the confluence with the River Thurso at Comlifoot.

[7] *Estimate of the BFI based on the Hydrology of Soil Types (HOST) classification (BFI HOST19), provides a measures of catchment responsiveness.*

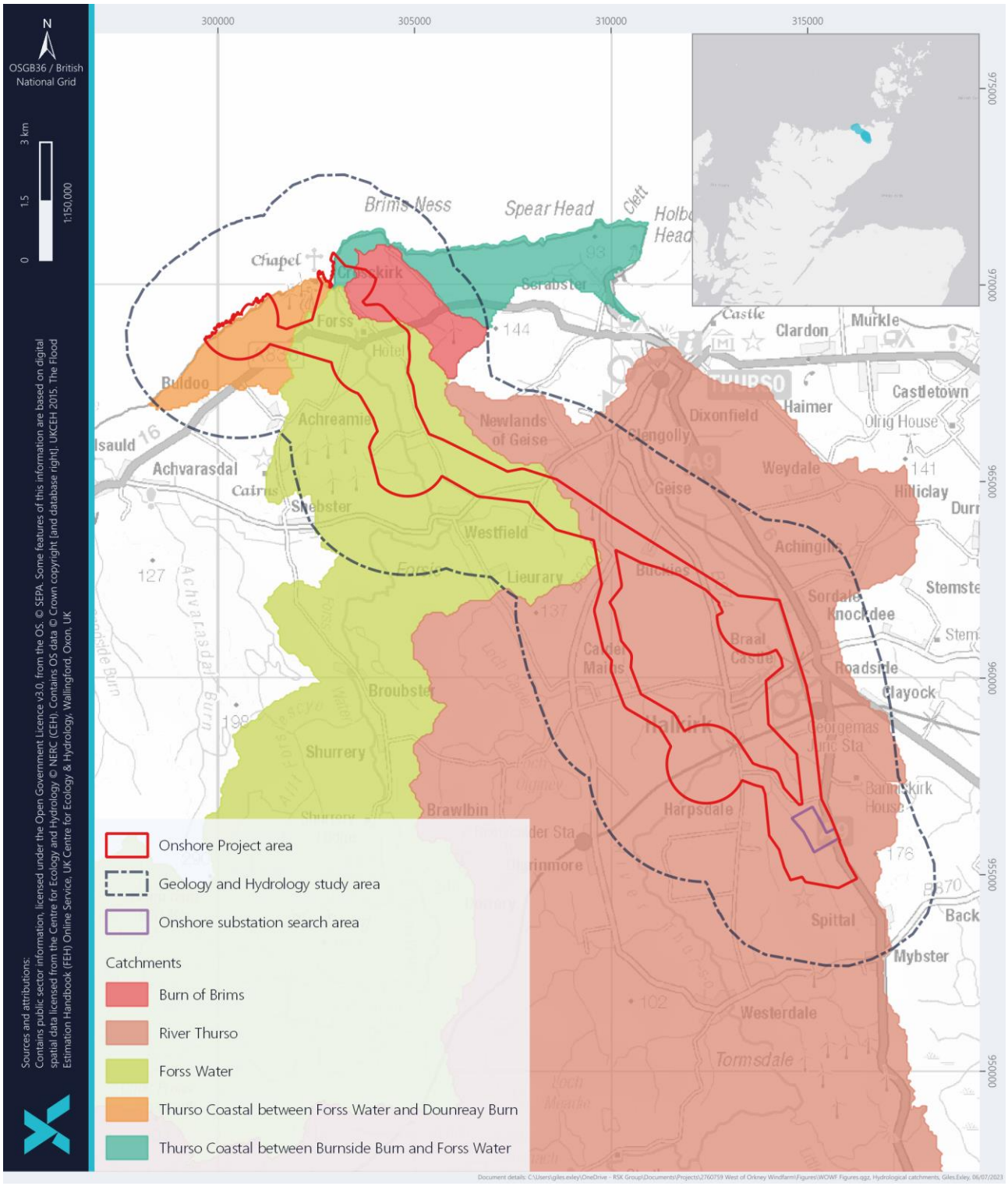

Figure 8-12 Hydrological catchments in the vicinity of the onshore study area (CEH, 2022)

Several unnamed watercourses (based on OS 1:25,000 mapping) drain into the River Thurso within the onshore study area to the west of Houstry, south of Aimster and north-east of Clatequoy. The River Thurso is designated as a Special Area of Conservation (SAC). Additional detail on the River Thurso SAC can be found in section 8.4.4.10.

Forss Water

The Forss Water drains 36.3% of the land within the onshore study area (CEH, 2022), to the north-west of Achscrabster to the coast at Crosskirk Bay. Several smaller tributaries drain into the Forss Water through the onshore study area, including:

- Burn of Baillie, flowing approximately easterly from coniferous woodland at Stemster Smallholdings to the confluence with Forss Water at Baillie;
- Burn of Brimside, flowing westerly from outwith the onshore export cable corridor at Cairnmore to the confluence at Forss Water to the west of Brimside Tulloch; and
- Craigan Well, flowing in a northerly direction south-west of Crosskirk.

Burn of Brims

The Burn of Brims drains 2.4% of the onshore study area (CEH, 2022), located north of Forss, near the Crosskirk landfall for the onshore export cable corridor.

Coastal areas

The two landfall options are drained by minor watercourses. The Greeny Geo landfall lies in the Thurso Coastal between Forss Water and Dounreay Burn catchment (SEPA, 2021a). In total this catchment drains 6.8% of the onshore Project area. At the Crosskirk landfall, to the east of Crosskirk Bay the area lies in the Thurso Coastal between Burnside Burn and Forss Water catchment, draining 1.0% of the onshore Project area.

Table 8-10 Onshore Project area catchment statistics (CEH, 2022)

CATCHMENT NAME	PROPWET	BFI HOST19	SPR HOST	% OF ONSHORE PROJECT AREA
River Thurso	0.56	0.317	52.85%	53.5
Forss Water	0.54	0.319	51.46%	36.3
Burn of Brims	0.50	0.339	39.21%	2.4
Thurso Coastal between Forss Water and Dounreay Burn	Not available*			6.8
Thurso Coastal between Burnside Burn and Forss Water	Not available*			1.0

This information is not publicly available because the watercourses are too small to model with sufficient accuracy for the data to be useful.

8.4.4.7 Water quality

8.4.4.7.1 Surface waterbodies

SEPA's Water Classification and Water Environment Hubs have been consulted to determine the existing baseline water quality for the main watercourses and waterbodies within the onshore study area (SEPA, 2021a, b). Details were not available for some of the smaller tributaries, including the Burn of Achanarras, Burn of Geise, Burn of Carnavagry, Calder Burn, Burn of Baillie, Burn of Brimside and Craigan Well. The details, where available, are summarised in Table 8-11.

Table 8-11 Baseline surface water quality status, summarised (SEPA, 2021a; SEPA, 2021b)

WATERBODY NAME AND ID	STATUS		PRESSURES
Forss Water – Allt Forsiescye to sea (ID: 20633)	Condition[7] in 2014	Overall: Good Water flows and levels: High Physical condition: Good Water quality: Good	None
	Classification[8] in 2020	Overall: Good Biology (fish): Good Hydromorphology: Good Water quality: Good	
Calder Water – downstream of Loch Calder (ID: 20643)	Condition[8] in 2014	Overall: Poor ecological potential* Water flows and levels: Good Physical condition: Moderate Water quality: Good	None
	Classification[9] in 2020	Overall: Poor ecological potential* Biology (fish): Poor Hydromorphology: Bad Water quality: Good	

[8] *Condition refers to the initial assessment of the waterbody status.*

[9] *Classification refers to the assessed status of the waterbody for a given year.*

WATERBODY NAME AND ID	STATUS		PRESSURES
Halkirk Burn (ID: 20642)	Condition[7] in 2014	Overall: Moderate ecological potential* Water flows and levels: High Physical condition: Moderate Water quality: Good	None
	Classification[8] in 2020	Overall: Moderate ecological potential* Biology (fish): Moderate Hydromorphology: Bad Water quality: High	
River Thurso – Loch More to sea (ID: 20637)	Condition[7] in 2014	Overall: Good Water flows and levels: High Physical condition: Good Water quality: Good	None
	Classification[8] in 2020	Overall: Good Biology (fish): Good Hydromorphology: Good Water quality: Good	

Waterbodies identified as having 'ecological potential' have been designated as heavily modified waterbodies on account of physical alterations that cannot be addressed without a significant impact on water storage for public drinking water.

8.4.4.7.2 Receiving waterbodies

SEPA's Water Classification and Water Environment Hubs have also been consulted to determine the existing baseline water quality for receiving waterbodies (SEPA, 2021a, b). The onshore study area west of the Moss of Geise drains in a north-westerly direction, via the Forss Water, into the Strathy Point to Dunnet Head coastal waterbody. The onshore study area to the east of the Moss of Geise drains in a northerly direction to Thurso Bay, via the River Thurso. The details are summarised in Table 8-12.

Table 8-12 Receiving waterbody quality status, summarised (SEPA, 2021a; SEPA, 2021b)

WATERBODY NAME AND ID	STATUS		PRESSURES
Strathy Point to Dunnet Head (ID: 200224)	Condition[10] in 2014	Overall: Good Physical condition: High Water quality: Good	None
	Classification[11] in 2020	Overall: Good Biological elements: Good Water quality: Good	
Thurso Bay (ID: 200218)	Condition[9] in 2014	Overall: Good Physical condition: Good Water quality: Good	None
	Classification[10] in 2020	Overall: Good Biological elements: Good Water quality: Good	

8.4.4.7.3 Groundwater

SEPA's Water Environment Hub was also consulted for groundwater quality information (SEPA, 2021b). The Caithness groundwater body, covering most of the onshore study area, is classified as having 'Good' overall status. The Dounreay groundwater body, underlying the Greeny Geo landfall, is classified as having 'Good' overall status. The details are summarised in Table 8-13.

Table 8-13 Groundwater bodies quality status, summarised (SEPA, 2021a; SEPA, 2021b)

WATERBODY NAME AND ID	STATUS		PRESSURES
Caithness (ID: 150692)	Condition[9] in 2014	Overall: Good Water flows and levels: Good Water quality: Good	None
	Classification[10] in 2020	Overall: Good Chemical status: Good Water quality: Good	

[10] *Condition refers to the initial assessment of the waterbody status.*

[11] *Classification refers to the assessed status of the waterbody for a given year.*

WATERBODY NAME AND ID	STATUS		PRESSURES
Dounreay (ID: 150487)	Condition[9] in 2014	Overall: Good Water flows and levels: Good Water quality: Good	None
	Classification[10] in 2020	Overall: Good Chemical status: Good Water quality: Good	

8.4.4.8 Water resources

8.4.4.8.1 Drinking water protected areas

The onshore Project area passes through a surface water DWPA, which comprises part of the catchment of the River Thurso and the river itself.

A small area of both Loch Calder and the Loch Calder catchment surface water DWPAs are in the onshore study area, however, these protected areas are located upstream from the onshore Project area and would be unaffected by the development. The surface water DWPAs which overlap and are within the vicinity of the onshore Project area are shown in Figure 8-13.

The onshore study area is primarily located in the Caithness groundwater DWPA, except for the landfall at Greeny Geo, which is located in the Dounreay groundwater DWPA, as shown on Figure 8-14.

8.4.4.8.2 PWS

A number of PWS have been identified within and surrounding the onshore study area. Information in this section has been provided by THC; their records confirm that there are two PWS within the onshore Project area (Table 8-14) and 12 registered PWS within 5 km of the onshore Project area (Table 8-15). A figure showing the PWS identified within the onshore study area are shown in Figure 8-15. Consultation with landowners has confirmed that the supplies of Achnabrae and Knockglass Farm are present within the onshore Project area at the locations identified, and that there is associated pipework with these supplies.

OS mapping identified two springs and 16 wells within the onshore Project area. Details of these springs and wells are shown in Table 8-16. A further 15 springs and 113 wells were identified on OS mapping in the remainder of the onshore study area (Figure 8-16). According to the BGS GeoIndex there are no boreholes within the onshore study area (BGS, 2023a). Although information was requested from landowners, no evidence has been identified that any of these wells are in active use for any purpose.

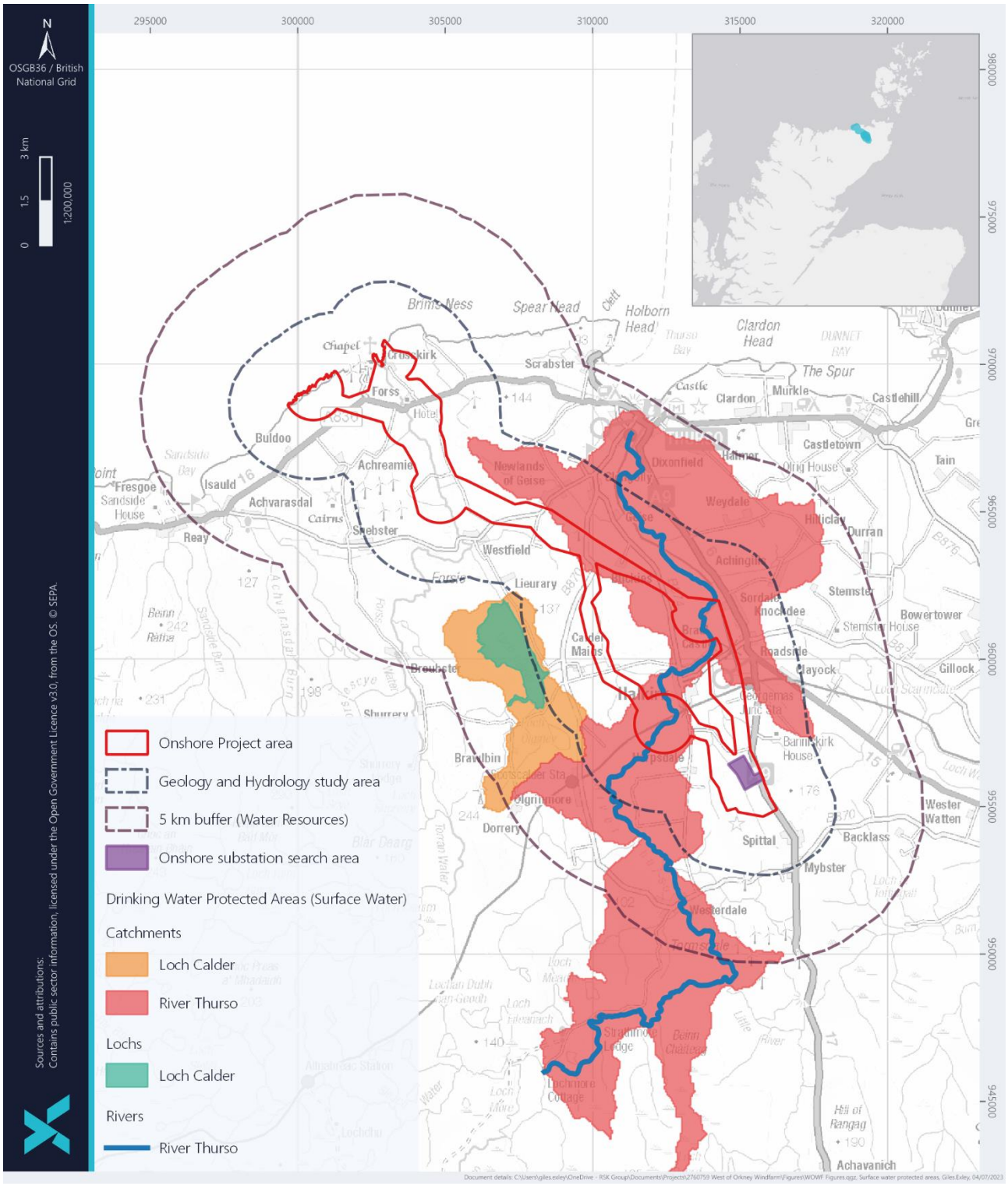

Figure 8-13 Surface water drinking water protected areas in the vicinity of the onshore study area (Scottish Government, 2014)

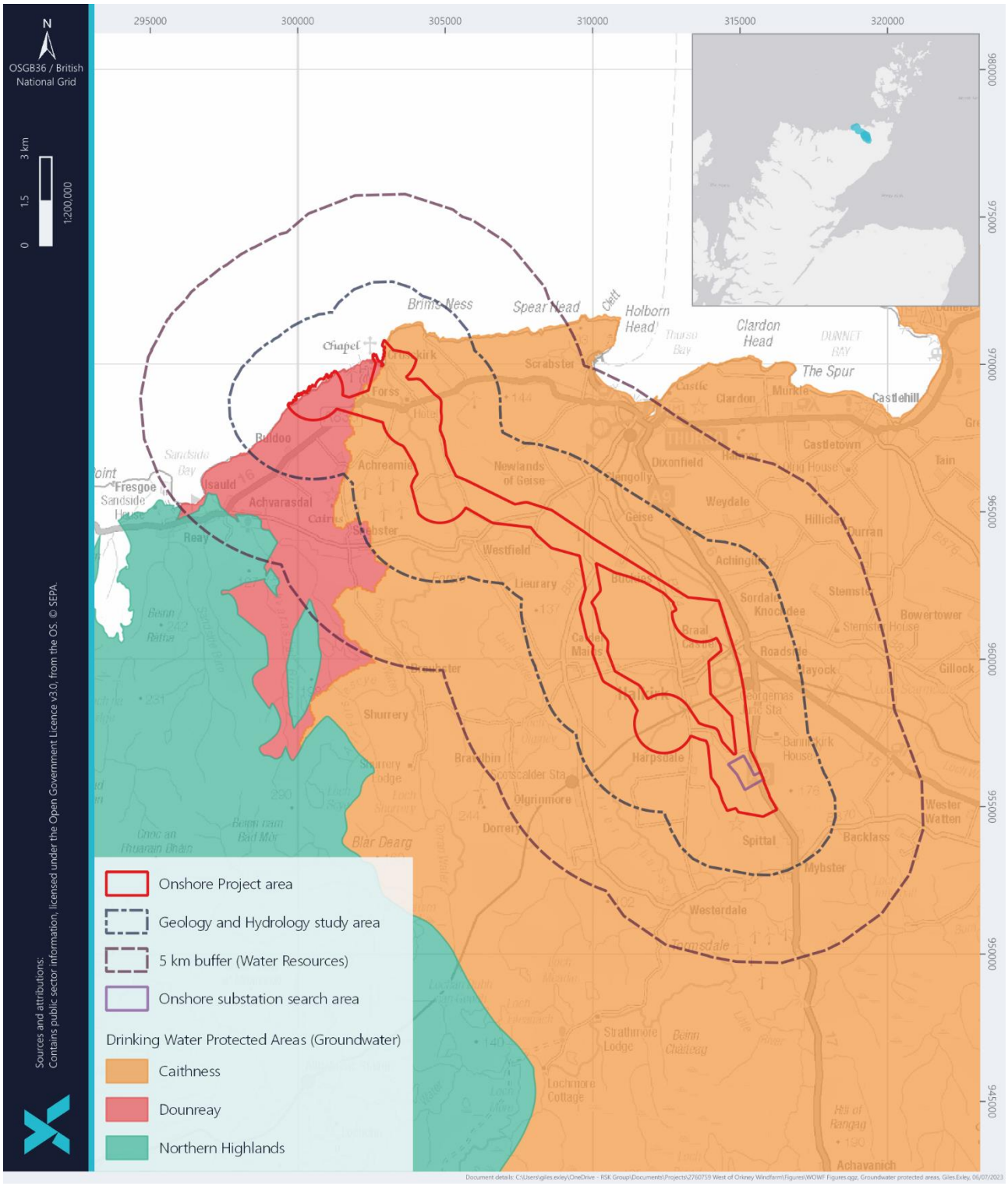

Figure 8-14 Groundwater water drinking water protected areas in the vicinity of the onshore study area (Scottish Government, 2014)

Table 8-14 Private water supplies within the onshore Project area (THC, 2023)

PWS NAME	SOURCE LOCATION NATIONAL GRID REFERENCE	SOURCE TYPE	DISTANCE TO ONSHORE PROJECT AREA	LINKAGE
Achnabrae	306100, 965200	N/A	N/A	Within onshore export cable corridor.
Knockglass Farm	305200, 965300	N/A	N/A	Within onshore export cable corridor.

Table 8-15 Private water supplies within 5 km of the onshore Project area (THC, 2023)

PWS NAME	SOURCE LOCATION NATIONAL GRID REFERENCE	SOURCE TYPE	DISTANCE FROM ONSHORE PROJECT AREA	LINKAGE
Holding No 11 Forss	305400 969100	N/A	0.6 km east	No linkage; located upstream from the onshore study area.
Lieurary	307200 962900	N/A	1.6 km south-west	No linkage; located upstream from the onshore Project area.
Lower Toftingall	317721 954004	N/A	1.7 km south-east	No linkage; located in separate catchment to onshore Project area.
Cathel Shieling	307800 960900	N/A	1.9 km west	No linkage; located upstream from the onshore Project area.
Achnabraeskaill	301411 965180	Spring	2.5 km west	No linkage; located upstream from the onshore Project area.
Bannerman's Well	309592 954975	Spring	3.0 km south-west	No linkage; located upstream from the onshore Project area.
Brawlbin	307100 957900	N/A	3.5 km west	No linkage; located upstream from the onshore Project area.
Tor-na-Mea	307200 957400	N/A	3.7 km west	No linkage; located upstream from the onshore Project area.
Wolfburn	310036 968558	Stream	3.8 km north-west	No linkage; located upstream from the onshore Project area.
Loanscorriebest	298549 964016	Groundwater – Spring	4.5 km south-west	No linkage; located in separate catchment to onshore Project area.
Shepherds Cottage	303673 959785	Groundwater – Spring	5.0 km south	No linkage; located upstream from the onshore Project area.
Torigil	303655 959786	Borehole	5.0 km west	No linkage; located upstream from the onshore Project area.

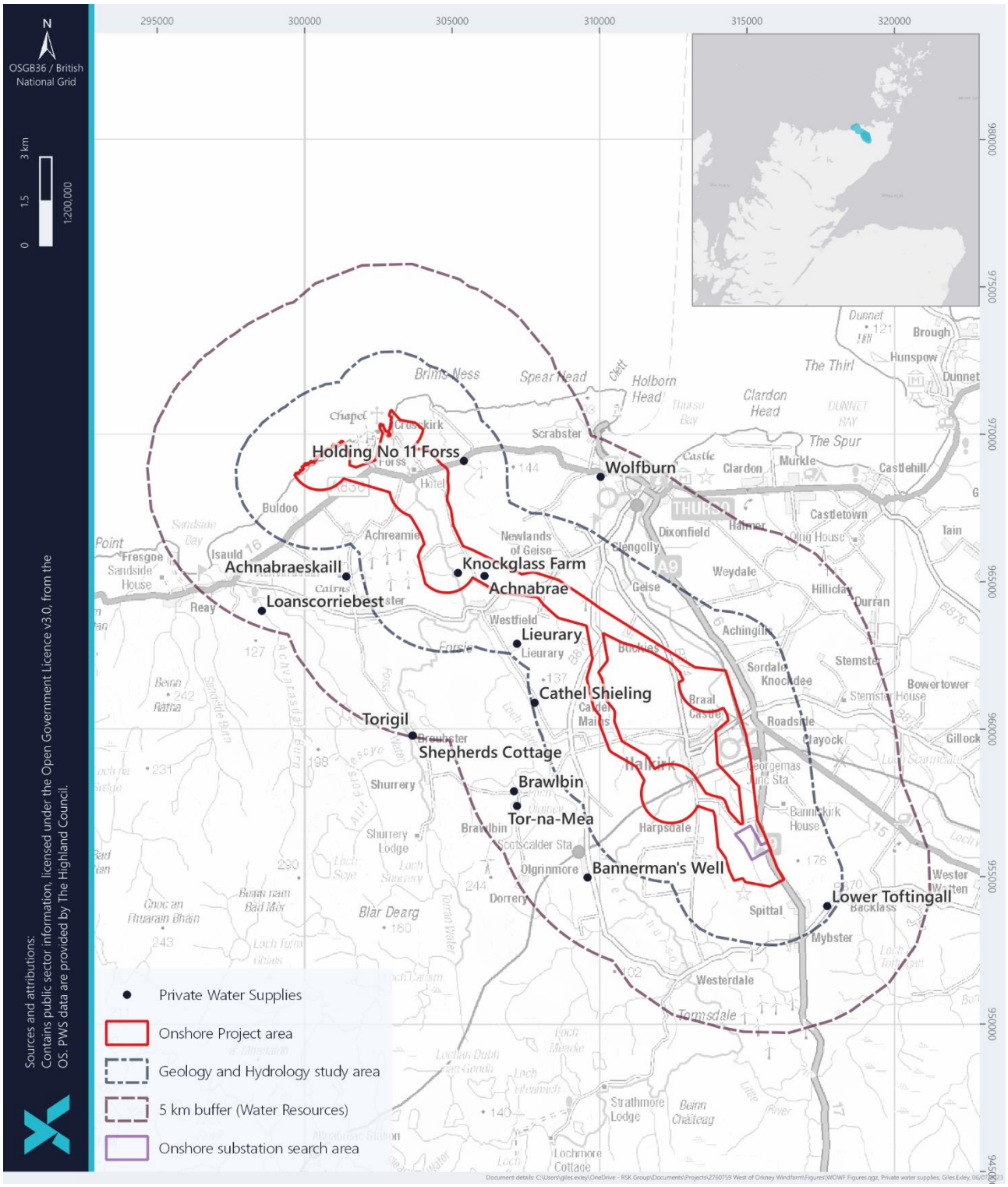

Figure 8-15 Private water supplies in the vicinity of onshore study area (THC, 2023)

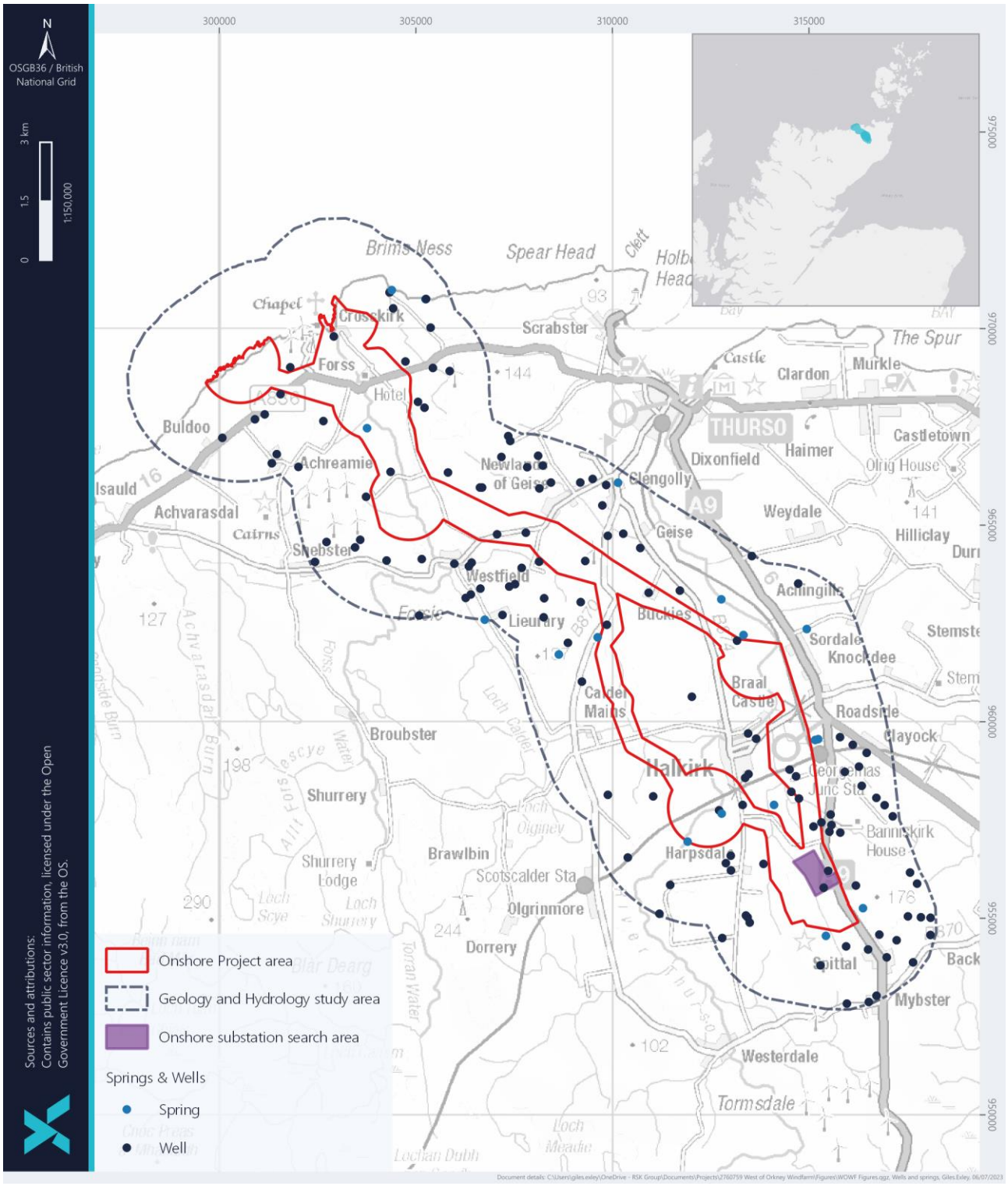

Figure 8-16 Springs and wells identified within the onshore study area (BGS, 2023a)

Table 8-16 Wells and springs identified within the onshore Project area (OS 1:25,000 scale mapping)

ID	SOURCE LOCATION NGR	LOCATION DESCRIPTION
Spring 1	303758 967469	North-east of Hallam Smallholdings.
Spring 2	312778 957666	North-east of Blackpark.
Well 1	302913 969802	Craigan Well, located south of Crosskirk.
Well 2	304357 966358	North-west of Lythmore Strath.
Well 3	307066 964770	Located at Bardnaclavan Farm.
Well 4	307798 964810	East of Bardnaclavan Farm.
Well 5	309307 964091	South of Moss of Geise.
Well 6	309858 962469	Located at West Calder.
Well 7	312712 957748	North-east of Blackpark.
Well 8	313311 957887	West of Houstry.
Well 9	315373 955781	South of Achcomhairle, in the onshore substation search area.
Well 10	315488 956210	North of Achcomhairle.
Well 11	315113 957337	North-west of North Achalone.
Well 12	314743 958050	West of Sibster Burn Farm.
Well 13	314669 958614	Located at Sibsterburn.
Well 14	314505 958785	Located at Sibsterburn, adjacent to the railway line.
Well 15	313168 962065	Located at St Thomas's Chapel (remains of).
Well 16	310921 963283	Located at Buckies.

8.4.4.9 Flood risk

SEPA's Indicative Flood Map was consulted to gain an overview of the likelihood of flooding within and downstream of the onshore study area (SEPA, 2022c). Flood risk within the onshore study area is shown to vary, with some localised regions of river (fluvial) and surface water (pluvial) flood risk.

River flooding has a high likelihood, defined as having a 10% chance of flooding in a given year, along the channels of the Forss Water, River Thurso, Burn of Achanarras, Halkirk Burn and Calder Burn and associated minor tributaries (Figure 8-17). The onshore substation search area is adjacent to the Burn of Achanarras, and the western edge of the area has a high likelihood of river flooding. The indicative substation location has been placed entirely outwith the high flood risk area as shown in Figure 8-18; however, parts of the cable route and/or construction activities will be required in areas of high flood risk in both corridors of the onshore Project area. There is also a high risk of river flooding in a small area of the onshore study area north of Loch Lieurary.

An area with high likelihood of surface water flooding is present in the main channel of the Forss Water between Forss and Crosskirk Bay (Figure 8-19). Small, isolated areas of high pluvial flood risk are present around the Moss of Halkirk, south of Houstry Mains, and in the Thurso River valley near Hoy and Braal Holdings. These areas are mainly associated with minor watercourses or ditches.

SEPA and THC consider there to be a high risk of coastal flooding adjacent to both the Greeny Geo and Crosskirk landfall locations (Figure 8-20). However, the cable landfall will be installed using HDD outside the area of coastal flood risk, situated at 10-15 m above sea level on the shoreline cliffs. Therefore, the risk of coastal flooding to landfall infrastructure is low for either location as all works would be undertaken set back from the cliffs.

Flood risk and drainage are considered in greater detail in SS3: Flood risk and drainage assessment.

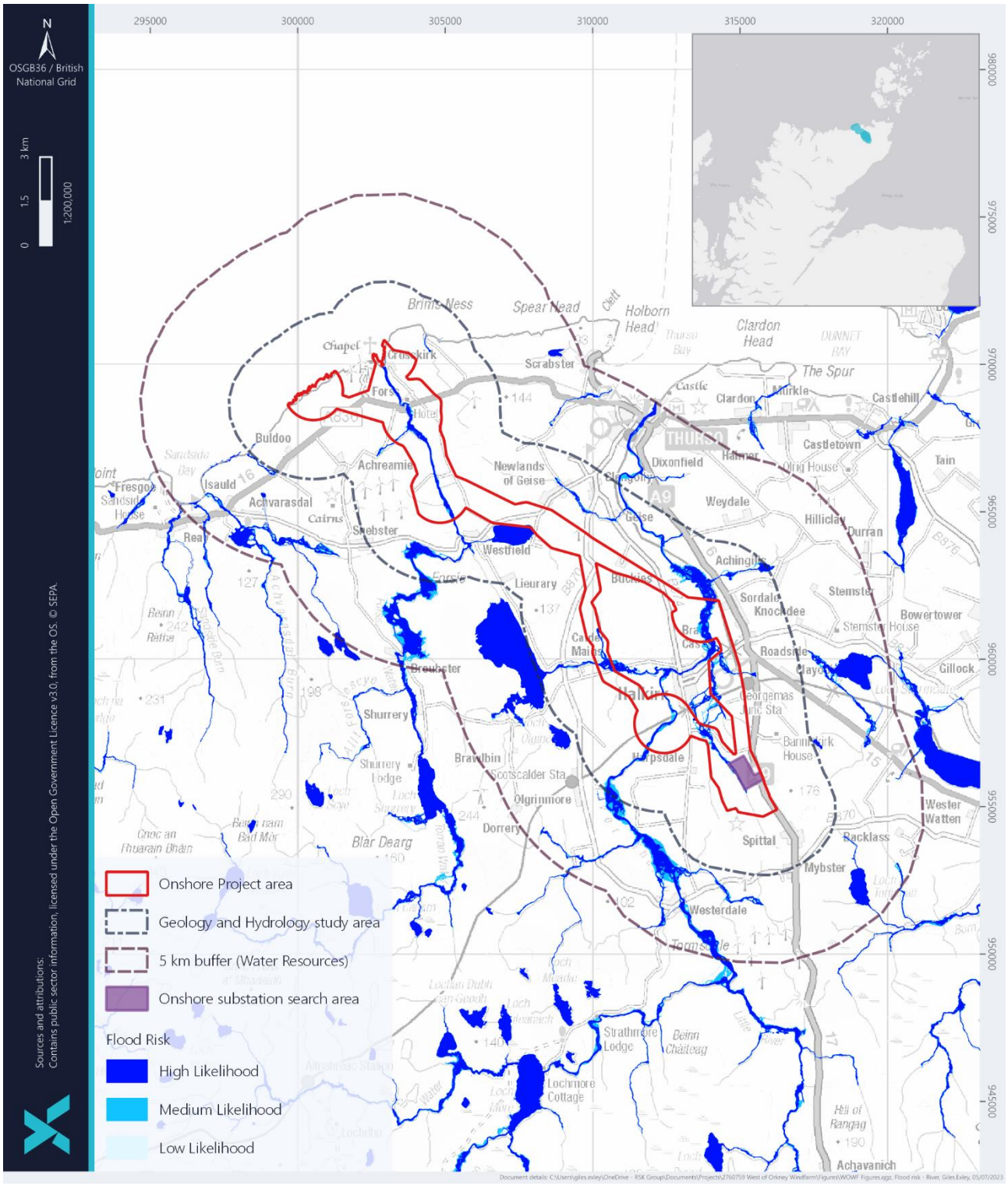

Figure 8-17 River flooding likelihood for the onshore study area (SEPA, 2022c)

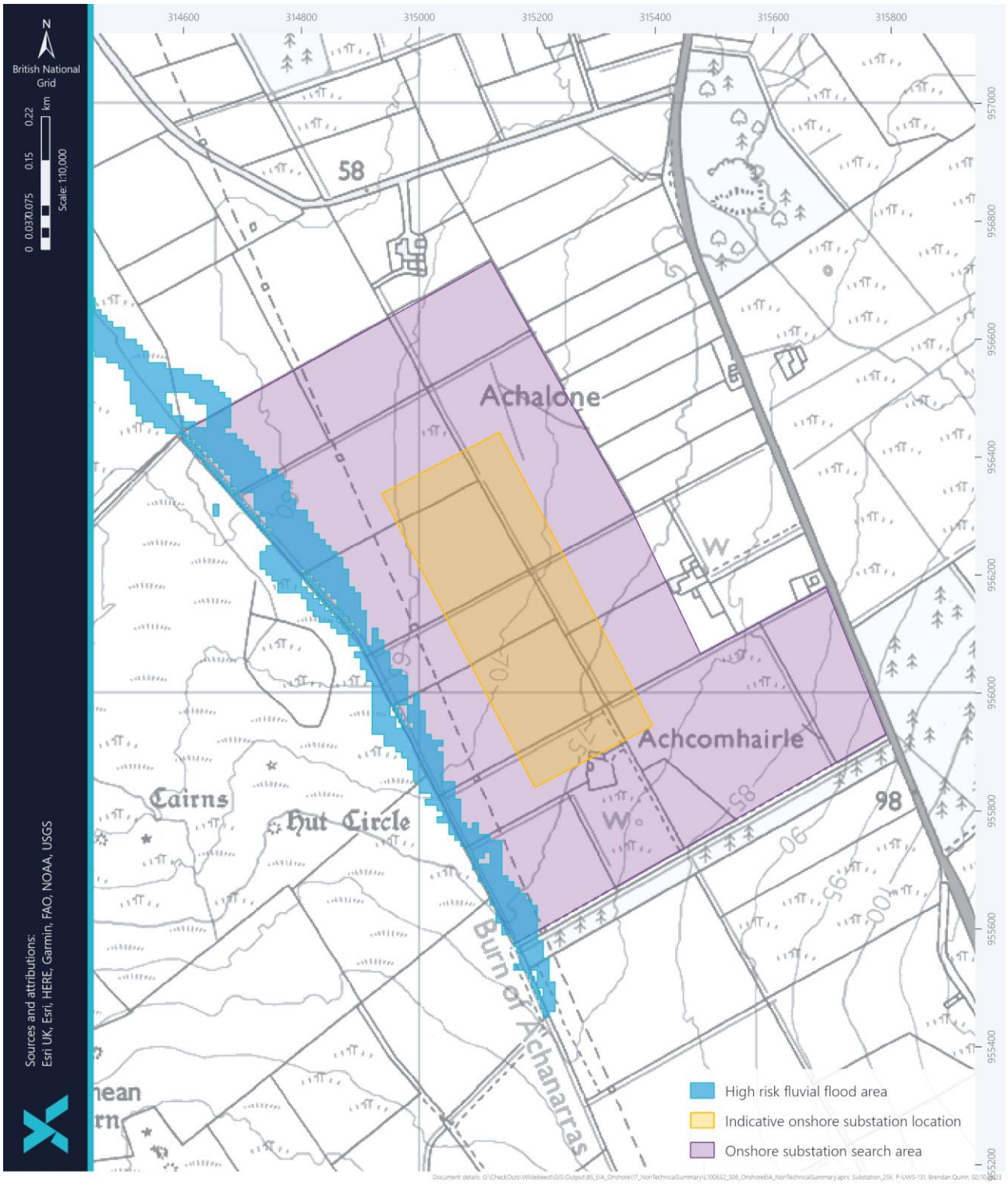

Figure 8-18 Fluvial flood risk at the onshore substation search area (SEPA, 2022c)

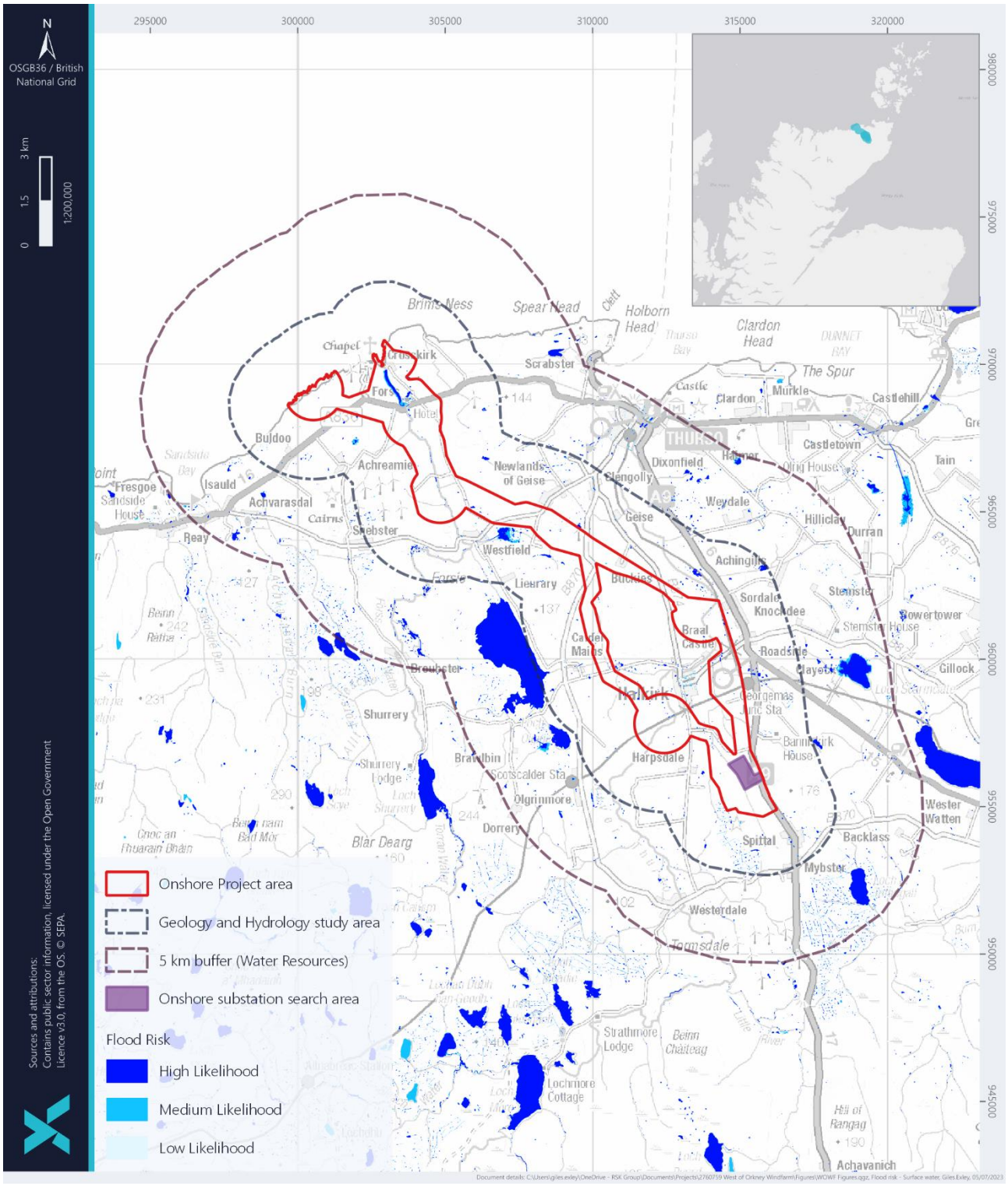

Figure 8-19 Surface water flooding likelihood for the onshore study area (SEPA, 2022c)

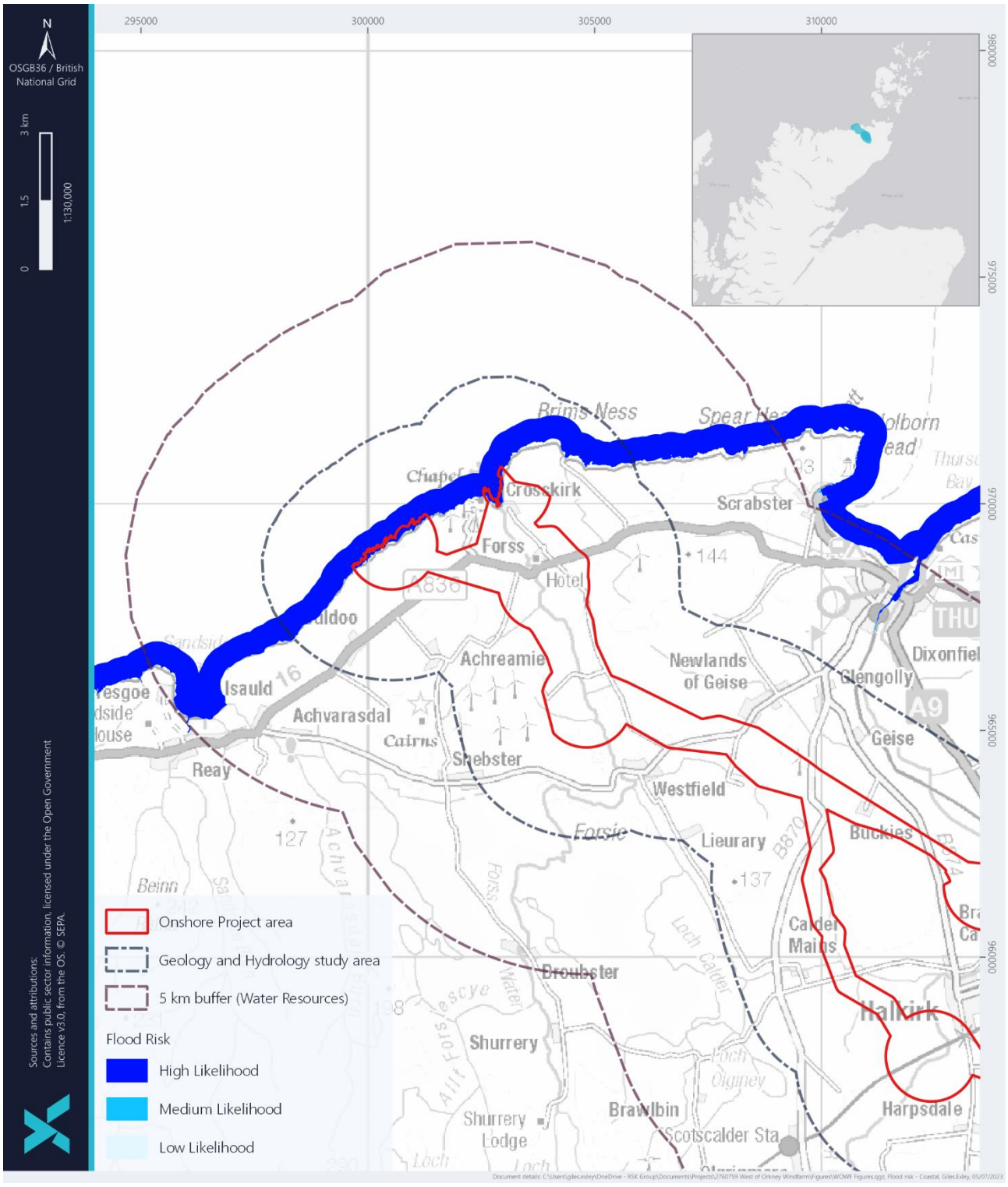

Figure 8-20 Coastal flooding likelihood for the onshore study area (SEPA, 2022c)

8.4.4.10 Designated sites

NatureScot data indicate that there are eight designated sites within 2 km of the onshore study area that have been designated for reasons associated with geology, hydrogeology, hydrology or peat (NatureScot, 2022). Three of these sites are also listed as Geological Conservation Review (GCR) sites; this is not a statutory designation but identifies sites of national importance for geological features. The River Thurso is designated as a SAC, and is the only designated site which overlaps with the onshore Project area. The River Thurso is also designated as a Site of Special Scientific Interest (SSSI), however the designation boundaries for the SSSI is downstream of and outwith the onshore study area. The details of designated sites are provided in Table 8-17 and Figure 8-21.

Table 8-17 Designated sites relevant to geology, hydrogeology, hydrology, and peat within of the onshore Project area (NatureScot, 2022)

SITE NAME	QUALIFYING FEATURES RELATING TO GEOLOGY, HYDROGEOLOGY, HYDROLOGY AND PEAT	DISTANCE FROM THE ONSHORE PROJECT AREA	LINKAGE
River Thurso SAC	SAC designated for populations of Atlantic salmon (*Salmo salar*).	Within onshore Project area.	Onshore export cable route will be HDD under the River Thurso. Additional linkage via watercourses flowing from the onshore study area into the River Thurso.
Achanarras Quarry. SSSI and GCR	Site of international importance due to the number and variety of well-preserved fossil fish that have been found. Silurian-Devonian Chordata GCR; Non-marine Devonian GCR.	0 km, adjacent to the onshore Project area boundary.	No linkage.
Ushat Head SSSI	Maritime cliff with particular importance for maritime heath.	0 km, adjacent to the onshore Project area boundary, east of Crosskirk landfall.	No linkage.
Loch Lieurary SSSI	Basin fen habitat and is one of the largest areas of this habitat in Caithness.	0.1 km south of the onshore Project area.	Watercourses flowing from the onshore study area into the SSSI.
Westfield Bridge SSSI	Nationally important fen meadow and calcareous grassland vegetation.	0.6 km south of the onshore Project area.	Watercourses flowing into the SSSI via Loch Lieurary – indirect linkage.

SITE NAME	QUALIFYING FEATURES RELATING TO GEOLOGY, HYDROGEOLOGY, HYDROLOGY AND PEAT	DISTANCE FROM THE ONSHORE PROJECT AREA	LINKAGE
Banniskirk Quarry SSSI and GCR	Designated because it has a layer of calcareous laminate rock that contains fossil fish. Silurian-Devonian Chordata GCR.	1 km east of the onshore Project area.	No linkage.
River Thurso SSSI	Nationally important flood-plain fen habitat and flowering plants that grow along the margins and banks of the river.	1.1 km north-east of the onshore Project area.	Watercourses flowing from the onshore study area into the SSSI.
Spittal Quarry SSSI and GCR	Designated for its fossil fish that date to the Middle Devonian period of geological time. Silurian-Devonian Chordata GCR.	1.2 km south-east of the onshore Project area.	No linkage.

The proposed Flow Country World Heritage Site is located outwith the onshore study area, to the south and west of the onshore Project (Figure 8-21).

8.4.4.11 Contaminated land

Potential for encountering contaminated land has been identified within the onshore study area, most notably in the area near the Dounreay Nuclear Power Establishment (DNPE) and associated Vulcan Naval Reactor Test Establishment (NRTE) (1.06 km from the onshore Project area). There are also potential contaminative activities around current and former quarries, farms and industrial buildings, the area of artificial ground near Lybster Smallholdings and all crossings of surfaced roads and the railway, relating to materials such as hydrocarbons in fuel, oils and bitumen, metal particles from vehicle movement and potentially for materials such as pesticides, herbicides and fertilisers.

Contamination from anthropogenic radioactive material is possible in the areas around the Crosskirk and Greeny Geo landfall locations. Available documentation indicates that the principal radioactive material legacy is in the sea and nearby coastline. Beaches on either side of DNPE/Vulcan NRTE are monitored routinely using radiation detection equipment and any identified particles are removed for safe disposal. A list of finds is published by the UK Government (2022a) and updated annually.

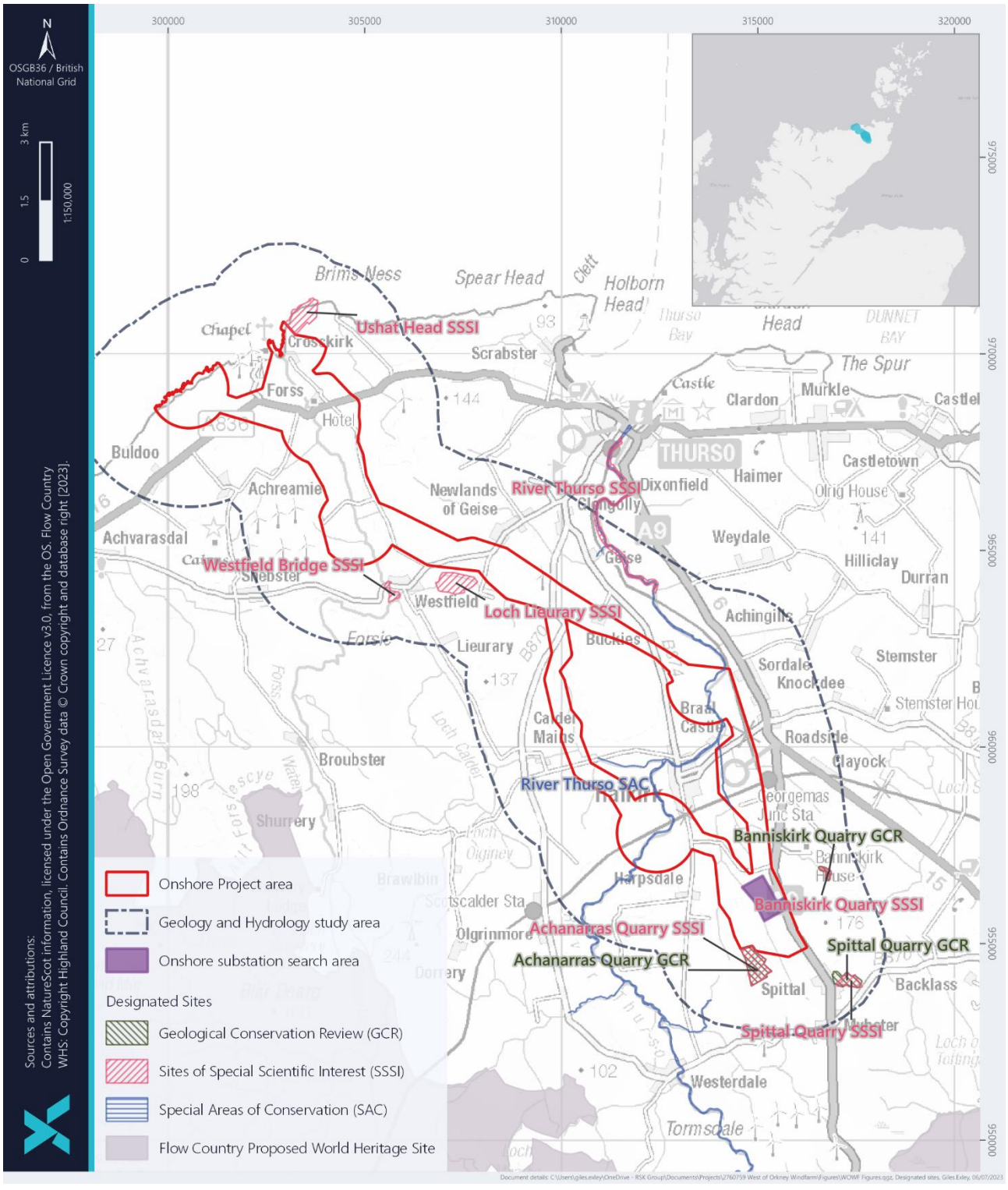

Figure 8-21 Designated sites within the vicinity of the onshore study area

There is a possibility of contamination associated with airfields that were used within World War II (WWII). Two airfields have been identified in the area, Dounreay Airfield and Brims Mains Airfield. The historic Dounreay Airfield is located approximately 250 m south-west of the onshore Project area near the Greeny Geo landfall. It was built during WWII for Royal Air Force (RAF) Coastal Command but was never occupied. Following its completion in 1944 it was placed on care and maintenance and was not used for any activities during the war (Secret Scotland, 2014). It has only been used as a means of transporting materials to the DNPE. A former airfield was established at Brims Ness, although no formal runway was established, and no visible remains are present. The airfield was located on the headland a short distance inland from Brims Ness, approximately 0.5-1 km north-east of the onshore Project area near Crosskirk (Airfields of Britain Conservation Trust (ABCT), 2023; Forgotten Airfields, 2011). Little information is available as to its usage during the war, although it was established in 1940 and abandoned in 1945 (Forgotten Airfields, 2011). It is unlikely to have experienced significant use; however, it remains possible that some radioactive material, notably Radium-226 and its daughter products, may be present around Brims Ness.

Potential contaminated land associated with artificial ground, quarry workings and farms are localised and usually small in footprint. These areas have mainly been avoided by the onshore Project area to minimise the potential risk. Crossings of surfaced roads and the single-track Network Rail Scotland railway line are likely to encounter some localised contaminated land although presence of volatile materials is not expected.

8.4.5 Future baseline

It is possible that the existing baseline described above may be subject to change in the future due to future developments within or proximate to the onshore Project. Any developments which have the potential to interact with the onshore Project, and which have not already been included as part of the geology and hydrology baseline, are discussed in section 8.7.

Additional to future developments, the effects of climate change may elicit changes to the existing baseline of the onshore study area, these are discussed in detail in SS1: Climate and carbon assessment. Given the potential for changes in precipitation patterns and seasonality, temperature, sea level and extreme weather events, there may be a variety of impacts on the geology and hydrology receptors of the area, including:

- Erosion: increased precipitation and extreme weather events can lead to increased erosion of soils and rock, potentially leading to landslides and other geological hazards, particularly along the coastline;
- Sea level: current climate change predictions indicate that mean sea level is expected to rise in the future and that storm frequency and intensity are also expected to increase. The combined effect of these aspects would be to increase the likelihood and severity of coastal flooding, leading to changes in coastal geomorphology. Rising sea levels can also lead to saltwater intrusion into freshwater aquifers; this could have impacts on the availability of water for human consumption and natural systems;
- Temperature changes: air temperature changes can lead to changes in the rate of weathering of rocks and soils, as well as changes in the distribution of plants and animals that can impact erosion and sedimentation patterns. SS1: Climate and carbon assessment, indicates that under the high emission scenario (Representative Concentration Pathway 8.5), the 10% and 90% probability levels for warmer temperatures are estimated to be between 0.7°C – 4.2°C warmer in winter, and 0.9°C to 5.4°C in summer, by 2070 compared to 1981 to 2000 mean;

- Changes in precipitation patterns: changes in precipitation patterns can lead to changes in the availability of water resources, as well as changes in surface water flow and groundwater recharge. SS1: Climate and carbon assessment, indicates precipitation levels are expected to increase in winter but decrease in summer by 2070, under the high emission scenario (RCP 8.5). Therefore, fluvial and pluvial flooding events may increase in frequency and severity, particularly during winter, although effects could be highly localised; and

- Changes in vegetation: changes in vegetation can impact erosion and sedimentation patterns. This may particularly affect wetland habitats if the availability of water decreases and ambient temperatures increase, raising evaporation rates.

Climate change also poses a threat to peat within the onshore study area; potential impacts include:

- Extreme drying: peat soils are typically wet, but with increasing temperatures and changing rainfall patterns, they can dry out and become more susceptible to wildfires and erosion;

- Carbon emissions: peat soils store considerable amounts of carbon, and increased drying would cause this carbon to be released into the atmosphere as carbon dioxide, contributing to climate change as well as loss of an active carbon sink; and

- Loss of biodiversity: drying peat soils can lead to loss of biodiversity, impacting species and habitats that are rare and only found in areas of peat soils.

An assessment of nationally and internationally important geoheritage sites in Scottish SSSIs identified that the three GCR sites (Achanarras Quarry, Spittal Quary and Banniskirk Quarry) adjacent to the onshore study area are likely to be 'fairly robust' to future climate change and are therefore designated as medium to low risk (Wignall *et al.*, 2018).

It is important to note that the future baseline is a projection, with a range of possible future conditions, and it is subject to uncertainty associated with the available projections. Across the lifetime of the Project, it is considered highly likely that the future baseline will be broadly comparable to the existing baseline described above.

8.4.6 Summary and key issues

The key sensitive receptors and key issues for the geology and hydrology onshore study area are provided below in Table 8-18.

Table 8-18 Summary and key issues for geology and hydrology

SUMMARY AND KEY ISSUES	ONSHORE STUDY AREA
	The key sensitive receptors are: • Soils and peat - dominant superficial deposits are Devensian till, which blankets much of the onshore study area. Alluvium and river terrace deposits are present along the channels of the River Thurso and Forss Water, with minor areas of head and lacustrine deposits. Peat deposits are indicated in parts of the southern onshore study area; • Groundwater - two groundwater bodies within the onshore Project area, both are classified as having 'Good' overall status; • Water supplies - two PWS are located within the onshore Project area, 12 PWS within 5 km of the onshore study area and the onshore Project are overlaps the River Thurso DWPA; • GWDTE – presence of potentially groundwater-dependent NVC communities: M16, M15, M27, M28, MG10, MG8, MG9, W6, M25, S27; • Designated sites relevant to geology, hydrogeology, hydrology and peat: – River Thurso SAC; – Achanarras Quarry SSSI and GCR; – Ushat Head SSSI; – Loch Lieurary SSSI; – Westfield Bridge SSSI; – Banniskirk Quarry SSSI and GCR; – River Thurso SSSI; and – Spittal Quarry SSSI and GCR. • Flood risk within discrete areas of the onshore Project area; and • Contaminated land potentially present in localise areas of the onshore Project area.

8.4.7 Data limitations and uncertainties

There were no desk-based study data gaps, but some potential limitations on the field surveys, as discussed below.

The site visit followed a standard 'reconnaissance level' walkover survey to obtain an overview of the conditions present within the onshore study area at the time of the visit. A reconnaissance level survey involves walking through and around an area to gather visual information concerning elements such as slope, rock outcrop, ground wetness and bogginess, nature and type of watercourses, and the presence or absence of groundwater seepages or spring points. No ground investigation was undertaken as part of the site visit. As a result, information is limited to detail that can be gathered from a visual survey of this kind. Uncertainties may arise as a result of preceding weather conditions; the weather throughout the walkover survey was hot and sunny, so may cause an under-estimation of the watercourse nature or ground bogginess than would be considered 'normal' for the area.

The information gathered has been combined with information derived from surveys to map peat depths, as well as details from other disciplines including vegetation and archaeological surveys, and photography to give as full a picture of conditions within the onshore study area as possible. Where information was unable to be provided through survey works, this has been supplemented where possible with publicly available information such as BGS maps and data from SEPA and NatureScot. All reasonable attempts were made to ensure that good coverage of the land within the onshore Project and study areas as appropriate. The information collected is appropriate to inform a robust impact assessment.

8.5 Impact assessment methodology

8.5.1 Impacts requiring assessment

The impacts identified as requiring consideration for geology and hydrology are listed in Table 8-19. Information on the nature of impact (i.e. direct or indirect) is also described.

Table 8-19 Impacts requiring assessment for geology and hydrology

POTENTIAL IMPACT	NATURE OF IMPACT
Construction and decommissioning*	
Groundwater flows and levels	Direct
Soil compaction and erosion	Direct
Changes to soil and groundwater quality	Direct
Changes in flow to and/or contamination of vulnerable receptors	Direct
Contamination of surface watercourses or waterbodies	Direct
Changes to surface water runoff	Direct
Risk of flooding to the development and increased risk of flooding in areas downstream	Direct
Interactions with contaminated land	Direct
Operation and maintenance	
Changes to soil and groundwater quality	Direct

POTENTIAL IMPACT	NATURE OF IMPACT
Changes in flow to and/or contamination of vulnerable receptors	Direct
Contamination of surface watercourses or waterbodies	Direct
Risk of flooding to the development and increased risk of flooding in areas downstream	Direct

** In the absence of detailed information regarding decommissioning works, and unless otherwise stated, the impacts during the decommissioning of the onshore Project are considered comparable with, or likely less than, those of the construction stage as detailed in section 8.6.3.*

8.5.2 Impacts scoped out of the assessment

The impacts scoped out of the assessment during EIA scoping, and the justification for this, are listed in Table 8-20. None of the potential impacts were scoped out of the assessment for the construction stage, as it is considered that all impacts have the potential to be significant and therefore, they require assessment.

Table 8-20 Impacts scoped out for geology and hydrology

IMPACT SCOPED OUT	JUSTIFICATION
Construction and decommissioning	
None	N/A
Operation and maintenance	
Groundwater flows and levels; Soil compaction and erosion; Changes to surface water runoff; and Interactions with contaminated land.	There will be no activity that has potential to lead to any of these impacts.

8.5.3 Assessment methodology

An assessment of potential impacts is provided separately for the construction, operation and maintenance and decommissioning stages.

The assessment for geology and hydrology is undertaken following the principles set out in chapter 7: EIA methodology. The sensitivity of the receptor is combined with the magnitude to determine the impact significance. Topic-specific sensitivity and magnitude criteria, as described in Table 8-21 and Table 8-22, are assigned based on professional judgement.

Table 8-21 Sensitivity criteria

SENSITIVITY OF RECEPTOR	DEFINITION
High	The receptor has very limited ability to absorb change without fundamentally altering its present character, is of very high environmental value and/or is of international importance e.g. SAC, Ramsar sites, world heritage sites.
Medium	The receptor has limited ability to absorb change without significantly altering its present character, is of high environmental value and/or is of national importance e.g., National Nature Reserves (NNR), SSSI.
Low	The receptor has moderate capacity to absorb change without significantly altering its present character, has moderate environmental value and/or is of regional importance e.g. GCR sites.
Negligible	The receptor is tolerant of change without detriment to its present character, is of low environmental value and/or of local importance e.g. Local Nature Reserves, Local Geodiversity Sites.

Table 8-22 Magnitude criteria

MAGNITUDE CRITERIA	DEFINITION
High	Substantial changes, over a significant area, to key characteristics or to the geological / hydrogeological / peatland classification or status for more than 2 years.
Medium	Noticeable but not substantial changes for more than 2 years or substantial changes for more than 6 months but less than 2 years, over a substantial area, to key characteristics or to the geological / hydrogeological / peatland classification or status.
Low	Noticeable changes for less than 2 years, substantial changes for less than 6 months, or barely discernible changes for any length of time.
Negligible	Any change would be negligible, unnoticeable or there are no predicted changes.

The consequence and significance of effect is then determined using the matrix provided in chapter 7: EIA methodology.

8.5.4 Embedded mitigation

As described in chapter 7: EIA methodology, certain measures have been adopted as part of the onshore Project development process in order to reduce the potential for impacts to the environment, as presented in Table 8-23. These have been accounted for in the assessment presented below. The requirement for additional mitigation measures (secondary mitigation) will be dependent on the significance of the effects on geology and hydrology receptors.

In accordance with the onshore PPP Application, the embedded mitigations listed below have been attributed to particular Development Zones within the onshore Project area. These are detailed in Table 8-23 and the Development Zones are shown on Figure 8-22.

8.5.5 Worst case scenario

As detailed in chapter 7: EIA methodology, this assessment considers the worst case scenario for the onshore Project parameters which are predicted to result in the greatest environmental impact, known as the 'worst case scenario'. The worst case scenario represents, for any given receptor and potential impact, the design option (or combinations of options) that would result in the greatest potential for change.

Given that the worst case scenario is based on the design option (or combination of options) that represents the greatest potential for change, the development of any alternative options within the design parameters will give rise to no worse effects than assessed in this impact assessment. Table 8-24 presents the worst case scenario for potential impacts on geology and hydrology during construction, operation and maintenance and decommissioning.

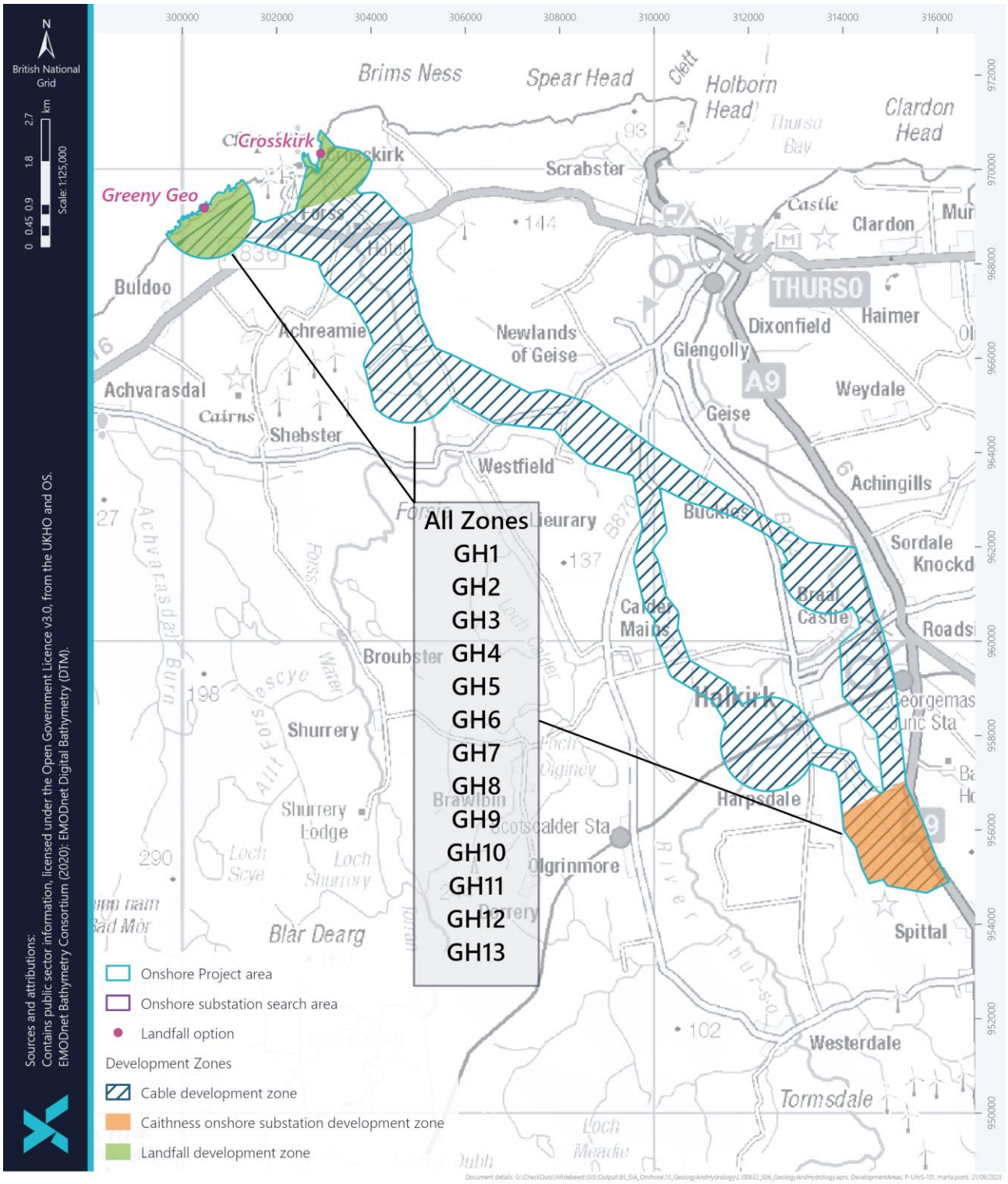

Figure 8-22 Development Zones for the onshore PPP Application

Table 8-23 Embedded mitigation measures relevant to geology and hydrology

ID	MITIGATION MEASURE	TYPE	DESCRIPTION	HOW MITIGATION WILL BE SECURED	DEVELOPMENT ZONE
GH1	Onshore cable routeing and avoidance of sensitive areas	Primary	The boundary of the onshore Project has been developed to avoid sensitive areas (peatland, potential GWDTE, designated areas, PWS) wherever possible. Where impacts cannot be avoided, these will be minimised. Further mitigation details are provided below on sensitive receptors, including GWDTE's and PWS. Consideration of geology and hydrology sensitivities, including contaminated land as part of the constraints mapping exercise to inform final cable routes and associated construction infrastructure.	Established within the design principles (secured through Construction Method Statements (CMSs).	All zones.
GH2	Minimisation of watercourse crossing and route adjacent to watercourses	Primary	Minimisation of watercourse crossing where possible (i.e. reduce the number of crossings and the impact of each crossing through the implementation of appropriate techniques such as cased auger boring and HDD). Avoidance, where possible, of cable routes close to (within 100 m) and parallel to watercourses for distances greater than 500 m.	Established within design principles (secured through CMSs) and as per OMP1: Outline CEMP, these measures will also be established within the Pollution Prevention and Control Plan which will be appended to the final CEMP. The CEMP will be secured through a condition attached to the PPP.	All zones.
GH3	Ecological Clerk of Works (ECoWs)	Primary	Ensure appropriately qualified ECoW(s) presence at wetland locations.	The requirement for an ECoW will be secured through a condition attached to the PPP.	All zones

ID	MITIGATION MEASURE	TYPE	DESCRIPTION	HOW MITIGATION WILL BE SECURED	DEVELOPMENT ZONE
GH4	CEMP	Tertiary	The CEMP will outline how the onshore Project will ensure the suitable implementation and control of the mitigation measures during construction. The CEMP will also include detailed information on good practice working methods relating to soils, peat and sediment; geology and contaminated land; drainage, groundwater and pollution prevention. An outline CEMP (OMP 1: Outline CEMP) is provided alongside the Application for PPP.	As per OMP1: Outline CEMP, the final CEMP will be provided at post-consent. The CEMP will be secured through a condition attached to the PPP.	All zones.
GH5	Soil and sediment management	Tertiary	In order to ensure proper soil and sediment handling, good practice procedures will be followed throughout construction of the onshore Project. These measures include protocols for soil stripping, soil storage (including soils bund specifications), reinstatement of soils, dampening sprays during dry weather, use of particular vehicles on unstripped ground, drainage systems, and dust mitigations. Further details are provided in OMP 1: Outline CEMP, submitted alongside the Application for PPP.	As per OMP 1: Outline CEMP, these measures will be established within the Soil Resource Management Plan (SRMP) which will be appended to the final CEMP. The CEMP will be secured through a condition attached to the PPP.	All zones.
GH6	Control of diffuse and point source pollution	Tertiary	A Pollution Prevention and Control Plan will be established for the onshore Project. Pollution prevention and control measures will be implemented by this plan in accordance with the latest legislation and guidance from SEPA. This includes utilisation of best practice sediment management techniques and employment of best practice pollution prevention techniques for dealing with groundwater, surface water and soil pollution risk.	As per OMP 1: Outline CEMP, these measures will be established within the Pollution Prevention and Control Plan which will be appended to the final CEMP. The CEMP will be secured through a condition attached to the PPP. These measures will also be secured through conditions of CAR authorisations, if required.	All zones.

ID	MITIGATION MEASURE	TYPE	DESCRIPTION	HOW MITIGATION WILL BE SECURED	DEVELOPMENT ZONE
GH7	Contamination management	Tertiary	Management of potentially contaminated materials that could be associated with road and rail crossings.	As per OMP1: Outline CEMP, contamination management protocols will be provided in the final CEMP. The CEMP will be secured through a condition attached to the PPP.	All zones.
GH8	Peat Management Plan (PMP)	Tertiary	An outline PMP is provided as part of the onshore Application and details the proposed mitigations for the management of peat within the onshore Project area, see OMP3: Outline PMP. The outline PMP will be updated once the onshore Project design is finalised post-consent.	As per OMP1: Outline CEMP, these measures will be established within the final PMP which will be appended to the final CEMP. The CEMP will be secured through a condition attached to the PPP.	All zones.
GH9	Drainage Strategy	Tertiary	A Drainage Strategy will detail site runoff within the natural catchment areas, and detail how drainage will be maintained following treatment and attenuation in order to mimic natural flow as closely as possible. An outline Drainage Strategy is provided alongside the onshore Application, see SS3: Flood Risk and Drainage Assessment. A final Drainage and Flood Risk Plan will be developed at post-consent once the final design of the onshore Project is known. In summary, to mitigate impacts on vulnerable receptors the following measures will be employed: • Installation of a soil bund downslope of excavation works to capture and divert runoff away from PWS; • At least two lines of silt fencing downslope of the bund, to ensure that runoff from the bund does not lead to sediment transfer towards PWS;	As per OMP1: Outline CEMP, these measures will be established within the Drainage and Flood Risk Plan which will be appended to the final CEMP. The CEMP will be secured through a condition attached to the PPP. These measures will also be secured through conditions of CAR authorisations, if required.	All zones.

ID	MITIGATION MEASURE	TYPE	DESCRIPTION	HOW MITIGATION WILL BE SECURED	DEVELOPMENT ZONE
			• Regular monitoring of the PWS source for the duration of construction works upslope of source. As requested by SEPA, monitoring will begin 6 months prior to construction works taking place within 250 m of the PWS and will continue throughout period of groundworks in this area. Monitoring of the source will be undertaken daily while construction works are active within 250 m of the source; • Monitoring upstream and downstream of any proposed major watercourse crossings will take place for a minimum of 6 months prior to commencement of works in order to establish a baseline and will continue for duration of groundworks in these areas; and • Placement of clay bunds or alternative impermeable barrier periodically within the cable trench, to minimise in-trench groundwater flow.		
GH10	GWDTE	Tertiary	As per SS2: GWDTE assessment, the following good practice construction methods are to be followed for the development on or adjacent to GWDTEs: • In areas of wet or marshy ground, and where the onshore export cable corridor route crosses up or down notable slopes, placement of clay bunds or alternative impermeable material will be included for every 0.5 m change in elevation along the length of the cable trench, to minimise in-trench groundwater flow; • It is good practice for long-distance cable routes to include impermeable barriers at regular intervals even where no significant slope is present, to prevent the trench being used as a preferential flow path. Selected intervals will be identified on site by the site manager in consultation with the ECoW(s) and based on local ground conditions;	As per OMP1: Outline CEMP, these measures will be established within the Pollution Prevention and Control Plan and the final Drainage and Flood Risk Plan which will be appended to the final CEMP. The CEMP will be secured through a condition attached to the PPP. The measures will also be established within the Habitat Management Plan (HMP) which will be secured through a condition attached to the PPP. These measures will also be secured through conditions of CAR authorisations, if required.	All zones.

ID	MITIGATION MEASURE	TYPE	DESCRIPTION	HOW MITIGATION WILL BE SECURED	DEVELOPMENT ZONE
			• Removing protective layers of soil and superficial deposits makes groundwater vulnerable to pollution from leaks or spills from vehicles or equipment used during construction. Earthworks will be kept to a practical minimum within these areas to reduce the area of wetland affected by the construction works; • Water collecting in excavations for the onshore export cables and onshore substation will be removed into settlement ponds or equivalent alternative to allow for the removal of suspended sediment. Treated water will not be discharged directly upslope of identified sensitive habitat areas, to minimise the potential for water and nutrient flushing in these areas; • Water from settlement ponds will not be discharged directly into watercourses. Additional protection, in terms of sediment traps using silt fencing, straw bales or excavated sumps or settlement ponds, will be put in place between the water discharge location and watercourses. Sediment trap installation and monitoring will be overseen by the ECoW(s); and • Site-specific mitigation, including drainage segregation to avoid 'flushing' from excavation works and micrositing to avoid specific higher sensitivity areas, will be identified and established where appropriate. For the onshore Project area particular care will be required for works in areas within 250 m of any mapped areas of M16 habitat (*Ericetum tetralicis wet heath*), as this is the most sensitive potentially groundwater-dependent habitat within the study area. Also, all works within 250 m or upslope of Loch Lieurary will require particular care as habitats in this area are likely to be groundwater-dependent.		

ID	MITIGATION MEASURE	TYPE	DESCRIPTION	HOW MITIGATION WILL BE SECURED	DEVELOPMENT ZONE
GH11	Construction Traffic Management Plan (CTMP)	Tertiary	The management of construction traffic within the onshore Project area is detailed within OMP2: Outline CTMP, provided alongside the Application for PPP. The final CEMP will be updated at post-consent. Specifically for geology and hydrology, the CTMP will ensure that traffic routes clearly demarcated, and vehicles will not be permitted access outwith these areas. Only tracked or low ground pressure vehicles will be permitted access to unstripped ground. Further details of the CTMP are provided in chapter 16: Access, traffic and transport.	As per OMP2: Outline CTMP, these measures will be established within the final CTMP provided at post-consent. The CTMP will be secured through a condition attached to the PPP.	All zones.
GH12	Risk management system	Tertiary	A risk management system (e.g. geotechnical risk register) will be compiled and maintained at all stages of the Project and developed as part of post-consent detailed design works and will be updated as new information becomes available. Identified risks will inform the CEMP as appropriate.	Employment of best practice construction methods and as per OMP 1: Outline CEMP, these measures will also be established within the final CEMP. The CEMP will be secured through a condition attached to the PPP.	All zones.
GH13	Decommissioning, Restoration and Aftercare Plan	Tertiary	A Decommissioning, Restoration and Aftercare Plan will be prepared for the onshore Project and agreed with THC prior to decommissioning works being undertaken. The plan will include any measures required to protect geology and hydrology features during decommissioning which are likely to be similar to those proposed within the CEMP.	Established within the design principles (secured through CMSs) and the Decommissioning, Restoration and Aftercare Plan which will be secured through a condition attached to the PPP.	All zones.

Table 8-24 Worst case scenario specific to geology and hydrology receptor impact assessment

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Construction and decommissioning		
Groundwater flows and levels	• Deeper groundworks relating to HDD, to facilitate landfall and for crossings including the River Thurso, Forss Water (if required) and single-track Network Rail Scotland railway line, may exceed 1.8 m below the ground surface; • Total working corridor width: 100 m; • Total maximum length of onshore export cables: 198 km (33 km per cable plus a 20% contingency); • Maximum number of trenches: 5; • Maximum depth of onshore export cable trenches (excluding HDD): 1.8 m; • Maximum cable working corridor: 3,300,000 m^2; • Maximum combined temporary working area: 215,000 m^2; • Maximum excavated material for all onshore cables: 975,150 m^3; • The full size of development area (including substation screening, Sustainable Drainage Systems (SuDS) and bunding) of approximately 23.9 hectares (ha); excavation depth to be confirmed at detailed design; and • HDD construction compound(s) will be required at the landfall sites of 7,500 m^2; excavation depth to be confirmed at detailed design. The maximum working area for the crossings will be 100 m long x 30 m wide.	There are likely to be several sections along the onshore export cable route where the burial depth will need to be increased to cross existing utilities such as railways, roads, or large natural features such a river crossing. The depth over short lengths at these locations may exceed 1.8m (e.g. at major crossing with HDD). HDD under watercourses is likely to interact with groundwater in hydraulic continuity with surface water. Continuous trenching provides a preferential groundwater flow path through both bedrock and superficial deposits. Excavations for HDD compounds and the onshore substation may exceed 1 m in depth and may interact with shallow groundwater. Hard construction in these areas would alter groundwater flow paths.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Soil compaction and erosion	• Maximum excavated material for all onshore cables: 975,150 m^3; • Maximum access road excavated material: 650,000 m^3; • The full size of development area (including substation screening, Sustainable Drainage Systems (SuDS) and bunding) of approximately 23.9 ha; • HDD construction compound(s) will be required at the landfall sites of 7,500 m^2. The maximum working area for the crossings will be 100 m long x 30 m wide; • Laydown areas (100 m x 100 m) located every 2 km along onshore export cable routes; • Stripping and stockpiling of soils, subsoils and peat; • Traffic for onshore export cables likely to be light vehicle traffic. At onshore substation, likely to be 4 x 4 or small van weekly; • Approximately 5 km in length of permanent access tracks. 24% (1.2 km) are existing tracks, 44% (2.21 km) are existing tracks that require improvements and 33% (1.67 km) will be newly installed tracks; • Temporary access tracks (not including haul roads) up to 3,300 m in length at the landfall, the entry and exit points of the HDD points and the onshore substation. Lengths are indicative only; and • Where possible, local infrastructure including road networks, farmer tracks and utility access roads will be utilised to minimise the construction of new infrastructure. Temporary bridges/spanning structure will be considered for appropriate locations for haul roads.	Plant movements will act to compact soils through movements over unstripped ground and under temporary and permanent tracks. Turf, soils, subsoils and peat will need to be removed to permit excavation of the cable trenches.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Changes to soil and groundwater quality	• Onshore export cable trenches are routed through peat; • Onshore export cable trenches are routed through or within 250 m of potential GWDTE; • Total working corridor: 3,300,000 m^2; and • Pollutants such as fuel or oils and concrete can cause reduction in soil and groundwater quality.	If it is not possible to avoid peat or GWDTE through design, it may be necessary to route the onshore export cable trenches through these receptors. Plant and vehicles require fuel and oils to operate. Concrete will be required in some areas as part of the construction method.
Changes in flow to and/or contamination of vulnerable receptors	• Onshore cable trenches are routed within 250 m of an active PWS; • Onshore cable trenches are routed through, or within 250 m of, GWDTE; • Break-out of drilling fluid during HDD operations relating to the river crossing of the River Thurso or crossing of the Forss Water (if required); • Pollutants such as fuel or oils and concrete can cause reduction in groundwater quality and significant damage to watercourses and waterbodies; and • Release of loose sediment can cause significant damage to watercourses and waterbodies.	If it is not technically possible to route the onshore export cable trenches outwith 250 m from an active PWS. If it is not possible to avoid GWDTE through design, it may be necessary to route the onshore cable trenches through or close to these receptors. HDD is much lower risk than open trenching across the river channel but break-out of drilling fluid remains a possibility. Plant and vehicles require fuel and oils to operate. Concrete will be required in some areas as part of the construction method. Excavation and soil stripping works require the presence of loose sediment and bare ground.
Contamination of surface watercourses or waterbodies	• Break-out of drilling fluid during HDD operations relating to the river crossing of the River Thurso or crossing of the Forss Water (if required); and • Release of loose sediment, specific pollutants such as fuel or oils, or spills of concrete or concrete wash-out water can cause significant damage to watercourses and waterbodies.	HDD is much lower risk than open trenching across the river channel but break-out of drilling fluid remains a possibility. Excavation and soil stripping works require the presence of loose sediment and bare ground. Plant and vehicles require fuel and oils to operate. Concrete will be required in some areas as part of the construction method.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Changes to surface water runoff	• Permanent diversion of water runoff paths affecting downstream receptors such as watercourses and areas of wetland habitat; and • Permanent changes to overland drainage patterns associated with excavations for cable trenches, onshore substation, construction of compounds and laydown areas, and soil stripping.	Some diversion of surface water is required to permit construction works to proceed safely.
Risk of flooding to the development and increased risk of flooding in areas downstream	• HDD platforms situated in flood risk areas beside watercourses; • Onshore substation works required in flood risk areas; and • Onshore export cable route works required in flood risk areas.	If it is not possible to locate the working areas for HDD works outside of flood risk areas beside watercourses (e.g., the River Thurso). The indicative onshore substation layout design avoids the flood risk zone, although it is possible the zone extends further from the channel than indicated by the SEPA flood maps (SEPA, 2022c). Sections of the cable route will be required to cross areas indicated to have high risk of flooding.
Interactions with contaminated land	• While most identified potentially contaminated ground will be avoided, it will be necessary for works to cross areas such as roads and the single-track Network Rail Scotland railway line; and • Some areas of potentially contaminated land may only be identified at a late stage in the design process, owing to a lack of available information.	It is not possible to avoid crossing all roads and the Far North railway and some interaction with contaminated land is therefore unavoidable. It is possible that lack of documentary evidence around other potentially contaminated sites may not be available and that such sites may be encountered.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Operation and maintenance		
Changes to soil and groundwater quality	• Fuel and oils will be present on site and spillages may occur.	It is not possible to avoid storage and use of fuel and oils for vehicles and for the onshore substation infrastructure.
Changes in flow to and/or contamination of vulnerable receptors	• The presence of cable trenches will lead to long-term changes in the subsurface flow patterns. • Fuel and oils will be present on site and spillages may occur, risking contamination of vulnerable receptors.	It is not possible to avoid trenching. It is not possible to avoid storage and use of fuel and oils for vehicles and for the onshore substation infrastructure. Proximity to vulnerable receptors depends on the final onshore export cable route.
Contamination of surface watercourses or waterbodies	• Fuel and oils will be present on site and spillages may occur.	It is not possible to avoid storage and use of fuel and oils for vehicles and for the onshore substation infrastructure.
Risk of flooding to the development and increased risk of flooding in areas downstream	• Delays to maintenance activities for onshore substation drainage infrastructure.	This may arise as a result of operational requirements or unforeseen weather events.

8.6 Assessment of potential effects

8.6.1 Potential effects during construction

8.6.1.1 Groundwater flows and levels

Physical changes to the shallow subsurface as a result of all excavation work of 2 m or deeper has potential to interrupt shallow groundwater flow paths. Physical changes to the deeper subsurface (>5 m below ground surface) has potential to interrupt deeper groundwater flow paths. In addition, installation of cables within a trench can provide a preferential flow pathway for shallow groundwater.

It is anticipated that the majority of the works will be no deeper than 1.5 m below ground surface and will therefore have limited impact on shallow groundwater.

Deeper groundworks relating to HDD, to facilitate landfall and for major crossings including the River Thurso, Forss Water (if required) and single-track Network Rail Scotland railway line, may exceed 1.8 m below the ground surface. These works will be very limited in area and any effects will therefore be highly localised.

The linear nature of the onshore Project indicates that the trench could form a preferential flow path for shallow groundwater, particularly in areas where the cable crosses up or down notable slopes. Embedded mitigation will be followed, including measures to protect GWDTEs (Table 8-23). This mitigation includes the placement of clay bunds or alternative impermeable barrier periodically within the trench, to minimise in-trench groundwater flow. Further details on the mitigation measures are provided in SS2: GWDTE assessment.

It should be noted that the onshore Project construction works will be staggered, and the entire onshore export cable route will not be worked on at a single point in time, but rather the cable installation and reinstatement works will occur on a rolling basis throughout the construction stage. As such, this will ensure that there will be no widespread or prolonged impacts throughout construction.

The bedrock and superficial deposits at the onshore study area are noted to be of moderate groundwater productivity. It is possible that groundwater flow is present within open fractures and fracture networks in the uppermost few metres.

The introduction of hard engineered surfaces at the onshore substation will have some effect on local rainfall recharge in the immediate area. Long-term drainage infrastructure within this area will take the form of shallow filter drains, in order to promote recharge to the bedrock around the infrastructure footprint.

The onshore study area groundwater receptor has limited ability to absorb change without significantly altering its present character. Therefore, the receptor is considered to be of medium sensitivity.

With appropriate design constraints and mitigation measures in place (Table 8-23), as described, any noticeable changes to the onshore study area groundwater will be barely discernible. Therefore, the magnitude of impact of the works is considered to be low.

Evaluation of significance

Taking the medium sensitivity of the groundwater and the low magnitude of the impact, the overall effect on groundwater flows and levels during construction is considered to be minor and not significant in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

8.6.1.2 Soil compaction and erosion

Construction activity, particularly plant and vehicle movements, soil stripping and stockpiling, will affect the nature of the onshore study area's soils. Plant movements will act to compact soils through movements over unstripped ground and under temporary tracks. All activity requiring removal, transport and stockpiling of soils will have potential to lead to soil erosion and loss of structure, resulting in overall soil degradation. Nonetheless, the onshore Project construction works involving the landfall, onshore export cables and onshore substation will not occur all at once and will be staggered throughout the construction stage. As such impacts to soil compaction and erosion will be managed accordingly to limit widespread impacts to reduce prolonged effects on these receptors.

In terms of peat, a PMP will be implemented as part of the embedded mitigation measures (Table 8-23). Further detail specific to the handling of peat is contained in OMP3: Outline PMP. The CEMP (Table 8-23) will provide measures to ensure traffic routes will be clearly demarcated and vehicles will not be permitted access outwith these areas. Only tracked or low ground pressure vehicles will be permitted access to unstripped ground.

The CEMP will also ensure that handling and management of soils will be undertaken with care and to best practice and will be restricted to as small a working area as practicable. Additionally, should prolonged periods of dry weather occur a damping spray will be employed to maintain surface moisture on the soil bunds. This is an embedded mitigation measure which will help to maintain vegetation growth in turves and to retain the soil structure. Further detail on these embedded measures is presented within OMP1: Outline CEMP.

The onshore study area soils receptor has limited ability to absorb change without significantly altering its present character. Therefore, the receptor is considered to be of medium sensitivity.

Any change to the onshore study area soils will be low. Therefore, the magnitude of impact of the works is considered to be low.

Evaluation of significance

Taking the medium sensitivity of the soils and the low magnitude of the impact, the overall effect on soil erosion and compaction during construction is considered to be **minor** and **not significant** in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

8.6.1.3 Changes to soil and groundwater quality

Spillage of fuels, oils or lubricants could have an adverse effect on soil and groundwater quality, and major spillages could have a potential influence on the onshore study area and the surrounding area's groundwater.

Where superficial deposits are thin or permeable, it is possible that any spillage or contamination at ground surface could percolate through into the groundwater below the onshore study area. Therefore, as per Table 8-23, pollution prevention measures will be put in place to mitigate any effects on groundwater quality. Pollution prevention measures are provided in the OMP1: Outline CEMP.

Soils and groundwater in the onshore study area have limited ability to absorb change without significantly altering the receptors present character and quality. Therefore, the receptor is considered to be of **medium sensitivity**.

Any change to the soils and groundwater in the onshore study area will be localised in accordance with the embedded mitigation, although a major incident could have a more widespread effect. Therefore, the magnitude of impact of the works is considered to be **low**.

Evaluation of significance

Taking the medium sensitivity of the onshore study area's soils and groundwater and the low magnitude of the impact, the overall effect on soils and groundwater quality during construction is considered to be **minor** and **not significant** in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

8.6.1.4 Changes in flow to and/or contamination of vulnerable receptors

Vulnerable receptors that have the potential to be affected by the onshore Project works have been identified. These include two PWS which are located within the onshore export cable corridor, two surface water DWPAs, two groundwater DWPAs and a number of potential GWDTE.

8.6.1.4.1 PWS

One PWS is located at Achnabrae, approximately 1 km north of Westfield. A second PWS is located at Knockglass Farm, approximately 450 m east of Baillie and 1.2 km north-west of Westfield, in the Forss Water valley (as shown in Figure 8-15). It has not been possible to confirm whether the Knockglass PWS is active and whether it supplies Knockglass or an alternative property. In the absence of confirmation, it is assumed that the PWS is active.

It is possible that the onshore cable trenches could be located within 250 m of both PWS or will be upslope; therefore there is a potential risk of contamination of the PWS via overland flow, shallow groundwater flow or spillage or pollution upslope. However, it should be noted that the final onshore export cable route is yet to be defined and there is the potential to avoid impacts to the PWS by careful routing.

PWS in the onshore Project area have very limited ability to absorb change without significantly altering their present character. Therefore, the receptor is considered to be of high sensitivity.

Embedded mitigation for the protection of PWS is provided in Table 8-23, with further details on the Drainage Strategy provided in SS3: Flood risk and drainage assessment. Any noticeable change to PWS in the onshore study area, with appropriate mitigation measures in place will occur for less than 2 years after construction.

Additionally, as discussed with SEPA, should any onshore construction works be required within 250 m of either PWS source location, monitoring of the source will be undertaken. This monitoring would be established at least 6 months prior to any works beginning within 500 m of the PWS source and would continue until all construction works within 500 m of the source is completed and fully reinstated. Therefore, the magnitude of impact of the works is considered to be low.

Evaluation of significance (PWS)

Taking the high sensitivity of the onshore study area's PWS and the low magnitude of the impact, the overall effect on PWS during construction is considered to be minor and not significant in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
High	Low	Minor

Impact significance - NOT SIGNIFICANT

8.6.1.4.2 DWPA

The onshore Project area passes through a surface water DWPA, which comprises part of the catchment of the River Thurso and the river itself.

A small area of both Loch Calder and the Loch Calder catchment surface water DWPAs are in the onshore study area, however, these protected areas are located upstream from the onshore Project area and would be unaffected by the development.

The onshore study area is primarily located in the Caithness groundwater DWPA, with the exception of the landfall at Greeny Geo, which is located in the Dounreay groundwater DWPA.

DWPAs in the onshore Project area have very limited ability to absorb change without significantly altering their present character. Therefore, the receptor is considered to be of high sensitivity.

Any change to the surface water DWPA in the onshore study area, with appropriate mitigation measures in place, as described in Table 8-23, will occur for less than 2 years after construction. These impacts will also be reduced when considering that onshore Project work will be staggered throughout the construction stage as described above to ensure, along with the embedded mitigations detailed above, that impacts to DWPAs will not be prolonged throughout this stage. Therefore, the magnitude of impact of the works is considered to be low.

Any change to the groundwater DWPA in the onshore study area will be localised as discussed above. Nonetheless, a major incident could have a more widespread effect. With appropriate mitigation measures in place, as described in Table 8-23, the magnitude of the impact of the works is considered to be low.

Therefore, the magnitude of the impact of the works for all DWPAs within the onshore study area is considered to be low.

Evaluation of significance (DWPA)

Taking the high sensitivity of the onshore study area's DWPAs and the low magnitude of the impact, the overall effect on DWPAs during construction is considered to be minor and not significant in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
High	Low	Minor

Impact significance - NOT SIGNIFICANT

8.6.1.4.3 GWDTE

Due to the presence of several potentially groundwater-dependent habitats in the onshore study area it is likely that the onshore cable trenches will be within 250 m of some of these habitats and therefore there is a potential risk to these sensitive areas. Embedded mitigation will be followed, including measures to protect GWDTEs (Table 8-23). An in-depth assessment of GWDTE habitats is provided in SS2: GWDTE assessment.

The potentially groundwater-dependent habitats have been assessed specifically within the context of the onshore Project taking into account the local bedrock and superficial geology, peat distribution and site observations. Most of the habitats have been assessed as relying on rainwater, surface water, surface runoff and/or shallow groundwater in direct association with surface watercourses through alluvial or river terrace deposits. The topographical setting of Loch Lieurary indicates that groundwater may be present in this area and that habitats in association with Loch Lieurary may be groundwater-dependent. It is recommended that a precautionary approach is taken in this area, to maximise separation of works by careful design. Additionally, it should be noted that the final onshore export cable route is yet to be defined and there is the potential to avoid or minimise impacts to GWDTE by careful routing.

GWDTE in the onshore study area have a limited capacity to absorb change without significantly altering their present character. Therefore, the receptor is considered to be of medium sensitivity.

The onshore Project works will be staggered throughout the construction stage, given the length of the onshore export cable route and as such this will ensure no prolonged impacts to GWDTEs during the construction stage. Any noticeable change to GWDTE in the onshore study area, with appropriate mitigation measures in place, as described in section 8.5.4 (Table 8-23), will occur for less than 2 years after construction. Therefore, the magnitude of impact for these works is considered to be low.

Evaluation of significance (GWDTE)

Taking the medium sensitivity of the onshore study area's GWDTE and the low magnitude of the impact, the overall effect on GWDTE during construction is considered to be minor and not significant in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

8.6.1.5 Contamination of surface watercourses or waterbodies

All development work involving earthmoving operations, such as onshore export cable trenches and HDD crossings, will generate loose sediment, which could potentially gain access to surface watercourses and waterbodies through entrainment in surface runoff. This could potentially have an adverse effect on downstream watercourses through water turbidity, damage to fish spawning habitat and changes to dissolved oxygen and nutrient levels.

Release of loose sediment, specific pollutants such as fuel or oils, or spills of concrete or concrete wash-out water can cause significant damage to watercourses and waterbodies. Foul drainage will be required for the site welfare facilities. It is anticipated that the welfare facilities will include a suitably sized holding tank for waste water, and removal by tanker for offsite disposal.

The final onshore export cable route is yet to be defined and it should be noted that careful routing and appropriate mitigation may avoid or minimise the impacts to surface watercourses and waterbodies. Additionally, the onshore export cable installation will be a staged process throughout the construction period, owing to the length of the onshore export cables, as such this will ensure there is no widespread impacts and no prolonged impacts to watercourses or waterbodies.

Surface watercourses and waterbodies in the onshore study area have very limited ability to absorb change without fundamentally altering their present character. In particular, the River Thurso SAC is of very high environmental value. Therefore, the receptor is considered to be of high sensitivity.

Any change to surface watercourses and waterbodies in the onshore study area, with appropriate mitigation measures in place, as described in Table 8-23, will occur for less than 2 years after construction. Therefore, the magnitude of impact of the works is considered to be low.

Evaluation of significance

Taking the high sensitivity of the onshore study area's surface watercourses and waterbodies and the low magnitude of the impact, the overall effect on surface watercourses and waterbodies contamination during construction is considered to be minor and not significant in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
High	Low	Minor

Impact significance - NOT SIGNIFICANT

8.6.1.6 Changes to surface water runoff

Changes to overland drainage patterns will arise principally from excavation associated with the cable trenches, the onshore substation, and construction of associated compounds and laydown areas.

Embedded mitigation will be followed in order to manage surface water runoff, as per Table 8-23. Temporary cut-off drains or bunds will be required along the upslope side of the working area to minimise the volume of runoff entering the stripped ground within the working corridor. It is likely that temporary water storage ponds will be required periodically along the working corridor, to store collected water. Water will be pumped out of the ponds for discharge on the downslope side of the working corridor as necessary.

Temporary cut-off drains will be required around the construction compounds to divert clean water away from the working areas.

Following installation of the cables, the working corridor and associated drainage infrastructure will be removed, and the ground reinstated to natural pre-development conditions. The onshore Project installation and restoration works will be staggered throughout the construction stage, and thus no widespread or prolonged impact to receptors are likely to occur.

Surface watercourses in the onshore study area have very limited ability to absorb change without fundamentally altering their present character. In particular, The River Thurso SAC is of very high environmental value. Therefore, the receptor is considered to be of high sensitivity.

Any change to surface watercourses in the onshore study area, with appropriate mitigation measures in place, as described in Table 8-23, will occur for less than 2 years after construction. Therefore, the magnitude of the works is considered to be of low magnitude.

Evaluation of significance

Taking the high sensitivity of the onshore study area's surface watercourses and the low magnitude of the impact, the overall effect on surface water runoff during construction is considered to be **minor** and **not significant** in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
High	Low	Minor

Impact significance - NOT SIGNIFICANT

8.6.1.7 Risk of flooding to the development and increased risk of flooding in areas downstream

The western edge of the onshore substation search area has a high likelihood of river flooding from the Burn of Achanarras. The indicative substation location has been placed outwith the high flood risk area to mitigate this risk (see Figure 8-18). However, it is possible the flood risk zone extends further from the channel than indicated by the SEPA flood maps (SEPA, 2022c). The onshore export cable corridor has a high likelihood of flooding along the Forss Water and River Thurso valleys. Flood risk is considered in more detail in SS3: Flood risk and drainage assessment. It should be noted that the final onshore export cable route is yet to be defined, therefore, by careful routing, onshore export cables may be able to avoid passing through or encroaching on areas of high flood risk where practicable.

The drainage infrastructure installed around long-term onshore Project infrastructure will be designed to minimise concentration of flows as per Table 8-23. This will be achieved by:

- Use of cut-off drains to divert runoff around necessary 'hard' infrastructure at the onshore substation and all temporary hardstanding areas, including construction compounds;
- Use of regular cross-drains underneath any long-term access tracks. These will be installed in line with the natural terrain, making use of natural low points where runoff will naturally be focused; and
- Use of a slight gradient on installed 'hard' infrastructure to encourage drainage into a filter drain, for infiltration into vegetated areas and as shallow through-flow.

Long-term drainage will be installed ahead of related construction works or excavations taking place, to ensure that site drainage can be controlled appropriately.

Any areas which have to be left unvegetated during the construction stage, such as the onshore export cable working corridor, the onshore substation search area and construction compounds, will have temporary settlement ponds put in place to attenuate flow until vegetation can be re-established at the end of the construction period. Settlement ponds at the onshore substation will be converted into SuDS ponds to provide long-term water treatment and attenuation while the onshore substation is in use.

In line with best practice guidance, site runoff will not be greater than natural pre-development runoff.

During construction, HDD platforms for the potential Forss Water and River Thurso crossings will be located outwith flood risk areas. If this is not possible, weather forecast management will be in operation, with the site manager or nominated deputy responsible for undertaking regular checks of the weather forecast and potential for future storms, and taking action to suspend works if heavy or prolonged rainfall is forecast. This will allow all staff and sensitive equipment to be removed from the flood risk area until the weather returns to normal.

Similar operations will be in place for the landfall locations, as storm surges and storm winds could affect the HDD platforms required for the landfall drilling operations although the potential areas are located outwith the coastal flood risk zone.

The receptors, infrastructure and property downstream of the onshore study area have very limited ability to cope with increased flood risk. Therefore, the receptor is considered to be of high sensitivity.

Any change to flood risk in the onshore study area, with appropriate embedded mitigation measures in place, as described Table 8-23, will be negligible. Therefore, the magnitude of impact is considered to be negligible.

Evaluation of significance

Taking the high sensitivity of the onshore study area to changes in flood risk and the negligible magnitude of the impact, the overall effect on flood risk during construction is considered to be negligible and not significant in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
High	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

8.6.1.8 Interactions with contaminated land

The proximity of the onshore study area to DNPE, Vulcan NRTE and the historic airfield raises the possibility that radioactivity levels may be a concern (1 km from the onshore Project area at the Greeny Geo landfall). Exposure to man-made radioactivity in the UK arises mainly from release from nuclear sites, and the Radioactivity in Food and the Environment (RIFE) programme undertakes regular monitoring of the environment and diet of people who live and work near nuclear sites (UK Government, 2022b). The report of the 2021 monitoring programme (the most recent available) concludes that the total dose to members of the public from DNPE and Vulcan NRTE from all pathways and sources of radiation was 0.026 millisieverts (mSv) per year, well within the legal limit of 1 mSv per year (UK Government, 2022b). It is advised that results of the RIFE programme are checked in advance of any construction work within the DNPE and Vulcan NRTE notification area.

Contaminated land is expected during crossings of surfaced public and private roads and may also be encountered during HDD operations under the single-track Network Rail Scotland railway line. Volatile materials are not likely to be present. As per the embedded mitigation set out in Table 8-23, any waste arisings will be handled in accordance with the rules set out in OMP1: Outline CEMP.

The receptors, site staff and nearby surface watercourses in the onshore study area have very limited ability to cope with exposure to contamination. Therefore, the receptor is considered to be of high sensitivity.

The very low levels of potential exposure, and the types of contamination likely to be encountered within the onshore study area, combined with appropriate mitigation measures in place as described in Table 8-23, indicate that the risk is very low. Therefore, the magnitude of the potential impact is considered to be negligible.

Evaluation of significance

Taking the high sensitivity of the potential receptors to interactions with contaminated land and the negligible magnitude of the impact, the overall effect of contaminated land during construction is considered to be negligible and not significant in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
High	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

8.6.2 Potential effects during operation and maintenance

8.6.2.1 Changes to soil and groundwater quality

The risk of soil or groundwater contamination from fuels or oils is considerably lower during operation than during construction as there are significantly decreased levels of activity at the onshore study area and most potential pollutants will have been removed. Vegetation management will be undertaken by physical cutting rather than use of herbicide, except if required for control of invasive species. There is the possibility of fuel usage and storage during the operation and maintenance stage.

The spillage and emergency procedures, as set out in the pollution prevention control measures within OMP1: Outline CEMP (Table 8-23), will remain in force throughout the operation and maintenance stage and will be secured within relevant management plans.

Soils and groundwater in the onshore study area have limited capacity to absorb change without significantly altering the receptors present character and quality. Therefore, the receptor is considered to be of medium sensitivity.

Any change to the soils and groundwater in the onshore study area will be negligible. Therefore, the magnitude of impact of the works is considered to be negligible.

Evaluation of significance

Taking the medium sensitivity of the onshore study area's soils and groundwater and the negligible magnitude of the impact, the overall effect on soils and groundwater quality during operation and maintenance is considered to be **negligible** and **not significant** in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
Medium	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

8.6.2.2 Changes in flow to and/or contamination of vulnerable receptors

No additional groundworks are anticipated to take place upstream of the two PWS or within 250 m of sensitive GWDTE during the operation and maintenance stage.

No additional changes to groundwater flow paths are anticipated in the operation and maintenance stage. However, the presence of onshore export cable trenches will lead to long-term changes in the subsurface flow patterns.

No vehicle or plant movements are anticipated within 250 m of either PWS during the operation and maintenance stage. Vehicle movement may take place in proximity to GWTDE during the operation and maintenance stage, given the distribution of GWDTE across the width of the onshore export cable corridor. However, as the onshore cable route is yet to be defined, the proximity of vehicle movement working within the cable corridor, to PWS or GWDTE is uncertain.

The risk to DWPAs is considerably lower during operation and maintenance than during construction as there are significantly decreased levels of activity at the onshore study area and most potential pollutants have been removed. Lubricants, oils, diesel generator and maintenance vehicle fuels will remain present in small quantities. The main operation and maintenance stage work will involve onshore substation operation and maintenance, and periodic inspections, maintenance and repair of the buried onshore export cables. The spillage and emergency procedures, as set out in pollution prevention control measures within OMP1: Outline CEMP (Table 8-23), will remain in force throughout the operation and maintenance stage and will be secured through relevant management plans.

Evaluation of significance (PWS)

Taking the high sensitivity of the onshore study area's PWS and the negligible magnitude of the impact, the overall effect on PWS during operation and maintenance is considered to be **negligible** and **not significant** in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
High	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

Evaluation of significance (DWPA)

Taking the high sensitivity of the onshore study area's GWDTE and the negligible magnitude of the impact, the overall effect on DWPA during operation and maintenance is considered to be **negligible** and **not significant** in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
High	Negligible	Negligible
Impact significance - NOT SIGNIFICANT		

Evaluation of significance (GWDTE)

Taking the medium sensitivity of the onshore study area's GWDTE and the negligible magnitude of the impact, the overall effect on GWDTE during operation and maintenance is considered to be **negligible** and **not significant** in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
Medium	Negligible	Negligible
Impact significance - NOT SIGNIFICANT		

8.6.2.3 Contamination of surface watercourses or waterbodies

The risk of water contamination from particulates, suspended solids, fuels, oils or foul drainage from operation and maintenance works is assessed to be considerably less than during the construction stage as works will be over a much smaller area and at lower intensity. The majority of potential pollutants will no longer be present on site. Lubricants, oils, diesel generator and maintenance vehicle fuels may remain present in small quantities.

The main operation and maintenance activities will involve periodic inspections, maintenance and repair of the buried onshore export cables. These works will be minor in scale (compared to the construction stage). The drainage network at the onshore substation will be subject to regular monitoring to ensure that it remains fully operational, as water build-up can cause considerable damage to track and hardstanding construction. Therefore, the likelihood of maintenance activities occurring near surface watercourses and waterbodies is uncertain, and it should be noted that careful routing may minimise or even avoid impacts to these sensitive receptors.

Surface watercourses and waterbodies in the onshore study area have very limited ability to absorb change without fundamentally altering their present character. In particular, the River Thurso SAC is of very high environmental value. Therefore, the receptor is considered to be of **high sensitivity**.

Any change to surface watercourses and waterbodies in the onshore study area, with appropriate mitigation measures in place, as described in Table 8-23, will be negligible. Therefore, the magnitude of the works is considered to be of **negligible magnitude**.

Evaluation of significance

Taking the high sensitivity of the onshore study area's surface watercourses and waterbodies and the negligible magnitude of the impact, the overall effect on surface watercourses and waterbodies contamination during operation and maintenance is considered to be **negligible** and **not significant** in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
High	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

8.6.2.4 Risk of flooding to the development and increased risk of flooding in areas downstream

Drainage will remain in place during the onshore Project's operation and maintenance stage around all long-term infrastructure such as the onshore substation and permanent access tracks. A regular monitoring and maintenance programme for the drainage infrastructure will be implemented to ensure that it remains fully operational and in good condition. Where practicable, routine maintenance will be undertaken during dry weather, to help ensure that drainage operation during wet weather is fully functional. During operation, the cables are considered to be flood resilient infrastructure.

Post-development runoff will be designed such that there is no change from natural pre-development runoff.

The receptors, infrastructure and property downstream of the onshore study area have limited ability to cope with increased flood risk. Therefore, the receptor is considered to be of **high sensitivity**.

Any change to flood risk in the onshore study area, with appropriate mitigation measures in place, as described in Table 8-23, will be **negligible**. Therefore, the magnitude of impact of the works is considered to be **negligible**.

Evaluation of significance

Taking the high sensitivity of the onshore study area to changes in flood risk and the negligible magnitude of the impact, the overall effect on flood risk during operation and maintenance is considered to be **negligible** and **not significant** in EIA terms.

SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE
High	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

8.6.3 Potential effects during decommissioning

In the absence of detailed information regarding decommissioning works, the impacts during the decommissioning of the onshore Project are considered analogous with, or likely less than, those of the construction stage.

Decommissioning operations will be based on strategies that minimise the environmental impact and maximise efforts to recycle materials where possible and will be developed in consultation with the local authorities. The preference will be to remove infrastructure where possible, however the impact of removal will be assessed against environmental impacts. Whilst the detail of the decommissioning strategy is yet to be established, this assessment is based on the decommissioning strategy proposed in Table 5-7 of chapter 5: Project description, which is as close to full removal as possible, whilst recognising that this is subject to assessments and consultation closer to the time of decommissioning. It is expected that decommissioning follows a reverse order of the installation activities with some infrastructure potentially left *in situ*, therefore lessening the impact on the land as there is no requirement for intrusive works. As the landscape bunds and proposed planting will be mature at the time of decommissioning, it is expected these will be retained.

For the onshore export cables, the impacts would be localised to the areas where cables are pulled and removed, and all aspects of the substation would be dismantled and removed, both resulting in very localised impacts that are broadly comparable with those identified for the construction stage.

Throughout the operation, maintenance and construction stages, new and forthcoming legislation and policies would be acknowledged and adhered to, supporting, and guiding the decommissioning process. A Decommissioning Restoration and Aftercare Plan will be prepared prior to decommissioning which will include a financial guarantee to secure decommissioning and site restoration. Decommissioning will be undertaken in accordance with applicable guidance at the relevant time. As per the embedded mitigation measures the Project will seek to maximise recycling where possible of components which are recovered to ensure sustainable decommissioning. As such, it would be expected that any potential impact would not be significant.

The overall impact on geology and hydrology during decommissioning is therefore considered to be, at worst, minor and not significant, in line with the impacts assessed for the construction stage.

8.6.4 Summary of potential effects

A summary of the outcomes of the assessment of potential effects from the construction, operation and maintenance and decommissioning of the onshore Project is provided in Table 8-25.

No significant effects on geology and hydrology receptors were identified. Therefore, mitigation measures in addition to the embedded mitigation measures listed in Table 8-23 are not considered necessary.

Table 8-25 Summary of potential effects

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction and decommissioning*						
Groundwater flows and levels	Groundwater	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Soil compaction and erosion	Soils	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Changes to soil and groundwater quality	Soils and groundwater	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Change in flow to and/or contamination of vulnerable receptors	PWS	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	DWPA	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
	GWDTE	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Contamination of surface watercourses or waterbodies	Surface watercourses and waterbodies	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Changes to surface water runoff	Surface watercourses	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Risk of flooding to the development and increased risk of flooding in areas downstream	Infrastructure and property	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Interactions with contaminated land	Site staff and surface watercourses	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Operation and maintenance						
Changes to soil and groundwater quality	Soils and groundwater	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	PWS	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Change in flow to and/or contamination of vulnerable receptors	DWPA	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	GWDTE	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Contamination of surface watercourses or waterbodies	Surface watercourses and waterbodies	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Risk of flooding to the development and increased risk of flooding in areas downstream	Infrastructure and property	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

** In the absence of detailed information regarding decommissioning works, and unless otherwise stated, the impacts during the decommissioning of the onshore Project are considered comparable with, or likely less than, those of the construction stage.*

8.7 Assessment of cumulative effects

8.7.1 Introduction

Potential impacts from the onshore Project have the potential to interact with those from other developments, plans and activities, resulting in cumulative impacts on geology and hydrology receptors. The approach to the cumulative effects assessment is detailed in chapter 7: EIA methodology (see Figure 7-4), detailing the developments considered in relation to the onshore Project area. A summary of the approach is provided below.

The list of relevant developments for inclusion within the cumulative effects assessment is outlined in Table 8-26. This has been informed by a screening exercise, undertaken to identify relevant developments for consideration within the cumulative effects assessments for each topic-specific, based on defined Zones of Influence (ZoI).

Developments which are located within 2 km from the onshore Project area have the potential to result in a cumulative effect for geology and hydrology receptors. Developments which are either in the operation or in the decommissioning stage are considered to be part of the baseline and are not considered within the assessment.

Table 8-26 List of developments considered for the geology and hydrology cumulative impact assessment

LOCATION	DEVELOPMENT TYPE	DEVELOPMENT NAME	DISTANCE FROM ONSHORE PROJECT AREA (KM)	DISTANCE FROM ONSHORE SUBSTATION SEARCH AREA (KM)	STATUS	CONFIDENCE[12]
Forss, Caithness	Onshore windfarm	Forss Windfarm Extension (20/04455/FUL)	0.51	18.21	Application	Low
Spittal, Caithness	Transmission infrastructure – substation plant	Electricity Supply Board (ESB) Asset Development Synchronous Compensator (20/05118/FUL)	0	0	Application	Low
Spittal, Caithness	Transmission infrastructure - cables	High Voltage underground Spittal Synchronous Compensator Grid Connection (22/00016/FUL)	0	0.24	Consented	Medium

[12] *Confidence ratings have been applied to each cumulative development where: 'Low' = pre-application or application, 'Medium' = consented and 'High' = under construction or operational.*

The following impacts have been taken forward for the cumulative effects assessment:

- Construction:
  - Groundwater flows and levels - Effects on groundwater can be transmitted over considerable distances, particularly when groundwater flow is mainly via fractures and discontinuities. There is the possibility of interaction of effects between nearby developments;
  - Soil compaction and erosion - Although effects are localised, multiple small effects can have a much larger detrimental effect over a wider area to elements such as peat condition, carbon storage and soil health. Effects of soil compaction and erosion should therefore be considered as a potential cumulative effect; and
  - Contamination of surface watercourses or waterbodies and associated designated areas - Effects on hydrology can be transmitted down watercourses for considerable distances. As a result, it is essential to consider point source and diffuse pollution effects on surface water and associated hydrological designations.

The following impacts have been scoped out of the cumulative effects assessment as these are either impacts that have a very localised context (e.g. removal of bedrock) or very limited potential for cumulative effects to occur as a result of the spatial distribution of the developments under consideration.

- Construction:
  - Changes to soil and groundwater quality;
  - Changes in flow to and/or contamination of vulnerable receptors;
  - Changes to surface water runoff;
  - Risk of flooding to the development and increased risk of flooding in areas downstream; and
  - Interactions with contaminated land.

All operation and maintenance impacts have also been scoped out due to the limited effects anticipated from the onshore Project alone (with all effects considered to be negligible and not significant as per section 8.6.2), and for the other developments considered during this stage.

- Operation and Maintenance:
  - Changes to soil and groundwater quality;
  - Changes in flow to and/or contamination of vulnerable receptors;
  - Contamination of surface watercourses or waterbodies; and
  - Risk of flooding to the development and increased risk of flooding in areas downstream.

8.7.2 Cumulative construction effects

8.7.2.1 Groundwater flows and levels

Effects on hydrogeology are confined to shallow groundwater found within the same hydrological catchment as the onshore Project. Developments within 2 km of the onshore Project area were assessed for cumulative effects.

Forss Windfarm Extension is located in the Thurso Coastal waterbody between Forss Water and Dounreay Burn catchment, 0.5 km from the onshore export cable corridor. Two developments (ESB Asset Development Synchronous Compensator, and Spittal Synchronous Compensator Grid Connection) are located adjacent to the onshore substation search area and are in the same hydrological catchment (the River Thurso).

There is potential for cumulative effects on shallow groundwater from concurrent excavation work of 2 m or deeper at the three nearby developments and the onshore Project when they are in the same hydrological catchment, combined with the moderate productivity classification of the bedrock. Spillage of fuels, oils or lubricants could have an adverse effect on soil and groundwater quality, and major spillages at nearby developments could have a potential influence on the onshore Project and the surrounding area's groundwater.

Assuming that best practice groundwater management is used at nearby developments, and any required CAR authorisations are put in place, the cumulative effects on hydrogeology are considered to be as follows.

The groundwater receptor has limited capacity to absorb cumulative change without significantly altering its present character. Therefore, the receptor is considered to be of medium sensitivity. With appropriate design constraints and mitigation measures in place at nearby developments, any noticeable changes to groundwater will be barely discernible. Therefore, the magnitude of the cumulative effect is considered to be low. Taking the medium sensitivity of the groundwater receptor and the low magnitude of the cumulative impact, the overall effect on groundwater flows and levels during construction is considered to be minor and not significant in EIA terms.

8.7.2.2 Soil compaction and erosion

Effects on soils are localised and these effects do not transmit over any noticeable distance. Soils can be affected by erosion and loss of quality. Developments within 1 km of the onshore Project area were assessed for cumulative effects. All three developments are within 1 km of the onshore Project (Forss Windfarm Extension, ESB Asset Development Synchronous Compensator, and Spittal Synchronous Compensator Grid Connection). The construction period for these developments is unknown, therefore temporal overlap may occur. Cumulative effects will depend on the magnitude of works at the three nearby developments.

Assuming that best practice construction methods (e.g. soil handling, management and prevention of erosion, and reinstatement) are used at the three developments within 1 km of the onshore Project area, the following can be assumed.

Soils in the onshore Project area have limited capacity to absorb cumulative change without significantly altering its present character. Therefore, the receptor is considered to be of medium sensitivity. Any cumulative change to soils will be negligible. Therefore, the magnitude of impact of the works is considered to be negligible. Taking the medium sensitivity of the soil receptor and the negligible magnitude of the impact, the overall cumulative effect on soil during construction is considered to be negligible and not significant in EIA terms.

8.7.2.3 Contamination of surface watercourses or waterbodies and associated designated areas

Cumulative effects on surface watercourses or waterbodies and associated designated areas with relevance to hydrology are generally confined to developments located within the same hydrological catchment as the onshore Project or that drain into the same receiving waterbodies. Cumulative effects in the form of water contamination from particulates, suspended solids, fuels, oils or foul drainage will be anticipated from construction works. However, it is assumed that best practice construction methods will be used for all developments.

Two developments (ESB Asset Development Synchronous Compensator, and Spittal Synchronous Compensator Grid Connection) are located adjacent to the onshore substation search area and are in the same hydrological catchment (the River Thurso). Surface water drainage from the two developments is via the Burn of Achanarras and received into the River Thurso. The River Thurso is designated as a SAC for Atlantic salmon (*Salmo salar*). Should construction work for these developments and the onshore Project occur in parallel, there is potential for cumulative effects on the River Thurso SAC from sediment pollution and contamination of surface waters, these are discussed further in chapter 9: Freshwater ecology.

Forss Windfarm Extension is located in the Thurso Coastal between Forss Water and Dounreay Burn catchment, 0.5 km from the onshore export cable corridor. The release of sediment from earthmoving works or contamination of surface water in parallel with the onshore Project could cause cumulative effects impacting the Strathy Point to Dunnet Head coastal waterbody. It is assumed that best practice construction methods will be used for all developments.

Surface watercourses and waterbody receptors, and those designated areas with relevance to hydrology have very limited ability to absorb cumulative change without fundamentally altering their present character. In particular, The River Thurso SAC is of very high environmental value. Therefore, the receptor is considered to be of high sensitivity. Any change to surface watercourses and waterbodies is likely to last for less than 2 years after construction owing to the embedded mitigations of the onshore Project and best practice methods and/or CAR authorisations required to be followed by the other identified developments. Therefore, the magnitude of the works is considered to be of low magnitude. Taking the high sensitivity of the surface watercourses and waterbodies and the low magnitude of the impact, the overall cumulative effect on surface watercourses, waterbodies and associated designated areas contamination during construction is considered to be minor and not significant in EIA terms.

8.7.3 Cumulative operation and maintenance effects

As detailed above in section 8.7.1, all operation and maintenance impacts have been scoped out of the cumulative assessment due to the limited effects anticipated from the onshore Project alone (with all effects considered to be negligible and not significant as per section 8.6.2), and for the other developments considered during this stage.

8.7.4 Cumulative decommissioning effects

As there is limited information on the decommissioning of the onshore Project and that of other developments, at present, a thorough assessment of decommissioning cumulative effects has not been undertaken. Nonetheless, it is expected that the cumulative effects are likely to be less than or equal to the construction stage, given the decommissioning will be a largely a reverse process to that of construction. Furthermore, decommissioning of multiple other developments are not expected to occur at the same time as the decommissioning stage of the onshore Project.

A Decommissioning, Restoration and Aftercare Plan will be developed and approved pre-construction to address the principal decommissioning measures for the onshore Project and will be written in accordance with applicable guidance. The Decommissioning Restoration and Aftercare Plan will detail the environmental management, and schedule for decommissioning and will be reviewed and updated throughout the lifetime of the onshore Project to account for changing best practices.

8.7.5 Summary of cumulative effects

A summary of the outcomes of the assessment of cumulative effects for the construction, operation and maintenance and decommissioning stages of the onshore Project is provided in Table 8-27.

Table 8-27 Summary of assessment of cumulative effects

POTENTIAL IMPACT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction and decommissioning*						
Groundwater flows and levels	Groundwater	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Soil compaction and erosion	Soils	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Contamination of surface watercourses or waterbodies and associated designated areas	Surface watercourses, waterbodies and designated areas	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

** In the absence of detailed information regarding decommissioning works, and unless otherwise stated, the impacts during the decommissioning of the onshore Project are considered comparable with, or likely less than, those of the construction stage.*

8.8 Inter-related effects

Inter-related effects are the potential effects of multiple impacts, affecting one receptor or a group of receptors. Inter-related effects include interactions between the impacts of the different stages of the onshore Project (i.e. interaction of impacts across construction, operation and maintenance and decommissioning), as well as the interaction between impacts on a receptor within an onshore Project stage. The potential inter-related effects for geology and hydrology receptors are described below.

8.8.1 Inter-related effects between onshore Project stages

The greatest risk for geology and hydrology receptors is contamination to surface watercourses and waterbodies, predicted to result from earth moving operations during the construction stage and a smaller risk from the use of fuels and oils, with minor and not significant effects predicted. This could potentially have adverse effects on downstream watercourses for example via increased water turbidity, damage to fish spawning habitat and changes to dissolved oxygen and nutrient levels. During operation, the risk of contamination to surface watercourses and waterbodies from lubricants, oils, diesel generator and maintenance vehicle fuels will remain present, although reduced (compared to during construction). The significance of effect is predicted to be not significant with the embedded mitigation measures to be adopted. Therefore, across the Project lifetime, the effects on surface watercourse and waterbodies receptors are not anticipated to interact in such a way as to result in combined effects (in relation to contamination) of greater significance than the assessments presented for each individual stage.

8.8.2 Inter-related effects within an onshore Project stage

There are no potential inter-related effects within an onshore Project stage predicted for geology and hydrology receptors.

8.9 Whole Project assessment

The offshore Project is summarised in chapter 5: Project description and a summary of the effects of the offshore Project is provided in chapter 18: Offshore EIA summary. These offshore aspects of the Project have been considered in relation to the impacts assessed in section 8.6. The findings are presented below.

Contamination of onshore Project surface watercourses and waterbodies may impact the downstream receiving coastal waterbodies, Thurso Bay and Strathy Point to Dunnet Head. The release of silty water into these coastal receiving waterbodies could impact water and sediment quality, impacting on benthic and intertidal ecology. However, with appropriate implementation of embedded mitigation measures in place as outlined in this Onshore EIA Report, negative impacts will be avoided, and effects are anticipated to be not significant in EIA terms.

8.10 Transboundary effects

There is no potential for transboundary impacts upon geology and hydrology receptors due to construction, operation and maintenance and decommissioning of the onshore Project. The potential impacts are localised and will not affect other European Economic Area (EEA) states. Therefore, transboundary effects for geology and hydrology receptors do not need to be considered further.

8.11 Summary of mitigation and monitoring

No secondary mitigation, over and above the embedded mitigation measures proposed in section 8.5.4, is either required or proposed in relation to the potential effects of the onshore Project on geology and hydrology receptors as no adverse significant impacts are predicted. This chapter has used the best available evidence to inform the assessment of potential effects on geology and hydrology. However, there are potential uncertainties in the knowledge base in relation to PWS and surface water quality.

A monitoring programme will be developed through consultation with relevant stakeholders. Details of the monitoring programme have not yet been confirmed as this will be undertaken once final design and cable route is known post-consent. Potential monitoring identified includes:

- Monitoring of PWS at Achnabrae and/or Knockglass (as appropriate) for 6 months prior to construction commencing to clearly establish baseline conditions (if the final cable route is located within 500 m of any PWSs);
- Monitoring of any PWS for the duration of all groundworks within 500 m of the PWS source (if required) to ensure that the PWS are not contaminated with silt runoff or fuel spillages from construction areas. Monitoring will occur twice daily while groundworks occur within 250 m of the source;
- Should areas of peat require excavation and reinstatement works, monitoring of the reinstated peat areas would be undertaken as required and agreed with consultees;
- Areas of sensitive habitat or GWDTE will be monitored as required through the HMP; and
- Long-term drainage infrastructure around onshore substation will have a monitoring and maintenance programme established, to include regular visual inspection of drainage infrastructure to check for blockages, debris or damage that may impede flow.

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8.13 Abbreviations

ACRONYM	DEFINITION
ABCT	Airfields of Britain Conservation Trust
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BFI	Base Flow Index
BGS	British Geological Survey
CAR	Water Environment (Controlled Activities) (Scotland) Regulations 2011
CaSPlan	Caithness and Sutherland Local Development Plan
CEH	Centre for Ecology and Hydrology
CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research and Information Association
CMS	Construction Method Statement
CTMP	Construction Traffic Management Plan
DEFRA	Department for Environment, Food and Rural Affairs
DNPE	Dounreay Nuclear Power Establishment
DWPA	Drinking Water Protected Area
ECoW	Ecological Clerk of Works
EEA	European Economic Area
EIA	Environmental Impact Assessment

ACRONYM	DEFINITION
ESB	Electricity Supply Board
EU	European Union
GCR	Geological Conservation Review
GPP	Guidance for Pollution Prevention
GWDTE	Groundwater-Dependent Terrestrial Ecosystems
ha	Hectares
HDD	Horizontal Directional Drilling
HMP	Habitat Management Plan
HOST	Hydrology of Soil Types
HwLDP	Highland-wide Local Development Plan
JHI	James Hutton Institute
km	Kilometres
m	Metres
mm	Millimetres
Met	Meteorological
MD-LOT	Marine Directorate - Licensing Operations Team
MS-LOT	Marine Scotland - Licensing Operations Team
mSv	Millisieverts
NIEA	Northern Ireland Environment Agency

ACRONYM	DEFINITION
NNR	National Nature Reserve
NPF4	National Planning Framework 4
NRTE	Naval Reactor Test Establishment
NRW	Natural Resource Wales
NVC	National Vegetation Classification
OIC	Orkney Islands Council
OMP	Outline Management Plan
OS	Ordnance Survey
OWPL	Offshore Wind Power Limited
PAN	Planning Advice Notes
PDE	Project Design Envelope
PMP	Peat Management Plan
PPP	Planning Permission in Principle
PROPWET	Proportion of Time Soils are Wet
PWS	Private Water Supply
RAF	Royal Air Force
RIFE	Radioactivity in Food and the Environment
SAC	Special Area of Conversation
SEPA	Scottish Environment Protection Agency

ACRONYM	DEFINITION
SPR	Standard Percentage Runoff
SRMP	Soil Resource Management Plan
SS	Supporting Study
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage System
THC	The Highland Council
UK	United Kingdom
UKTAG	UK Technical Advisory Group
USB	Universal Serial Bus
WFD	Water Framework Directive
WRC	Water Research Centre
WWII	World War II
ZOI	Zones of Influence

8.14 Glossary

TERM	DEFINITION
Alluvium	A deposit of clay, silt and sand left by flowing water in a river valley.
A narrow rock unit	A named rock unit with typical width of 5 m or less.
BFI HOST19	Estimate of the base flow index (BFI) based on the Hydrology of Soil Types (HOST) classification, BFIHOST, provides a measure of catchment responsiveness.
Catchment	Drainage/basin area within which precipitation drains into a river system and eventually into the sea.
Conglomerate	A coarse-grained sedimentary rock composed of rounded fragments embedded in a matrix of cementing material such as silica or clay.
Controlled Activities Regulations	The Water Environment (Controlled Activities) (Scotland) Regulations 2011, as amended, also known as the Controlled Activities Regulations or CAR, apply regulatory controls over activities which may affect Scotland's water environment. SEPA risk assesses the proposed activities before granting an authorisation if it is appropriate. The type of authorisation depends on the environmental risk, and could be General Binding Rules, registration, or a licence.
Devensian till	A highly variable, mixed sediment deposited by melting glaciers or ice sheets during the last glacial period, approximately 75,000-10,000 years ago. Formerly called boulder clay.
Early-Middle Devonian age	A geological period lasting from 419-382 million years ago.
Fault	A fracture in rock where there has been movement and displacement.
Fissure	A fracture or crack in rock along which there is a distinct separation but usually no, or very little, movement.
Flaggy	A characteristic of rocks or sediments that have a tendency to split or break into thin, flat layers or flags.
Fluvial	Relating to a river.
Glaciofluvial deposit	Coarse-grained sediments (i.e. sand and gravel) with some finer-grained layers (i.e. clay and silt) deposited by meltwater streams.

TERM	DEFINITION
Gley	A sticky clay soil or soil layer formed under the surface of some waterlogged soils.
Groundwater body	A defined body of groundwater within an aquifer or aquifers.
Group	A lithostratigraphic unit consisting of a series of related rock formations that have been classified together as a group.
Hydraulics	Processes and regimes of water flow (velocities, volumes, duration, frequency etc) in hydrological systems such as surface waters and groundwater.
Hydrodynamics	Mechanical properties of fluids, such as those concerned with flow.
Hydrogeology	Study of the distribution and movement of groundwater.
Lacustrine	Relating to lakes.
Lava	Term used to describe molten rock emerging above-ground from volcanoes; also used for the rock formed by this process.
Limestone	A sedimentary rock composed mainly of calcium carbonate.
Mean (high/low) water	Highest/lowest average level water reaches on an outgoing tide.
Middle Old Red Sandstone	A succession of rock strata consisting of fluvial, aeolian (wind-flown) and lacustrine sediments characterised by a red-brown colour. The Old Red Sandstone is mainly of Devonian age. The Middle Old Red Sandstone forms the central rock sequence and is distinct from the older Lower and younger Upper Old Red Sandstone.
Mudstone	A fine-grained sedimentary rock formed from consolidated mud.
Old Red Sandstone	A succession of rock strata consisting of fluvial, aeolian (wind-flown) and lacustrine sediments characterised by a red-brown colour. The Old Red Sandstone is mainly of Devonian age.
Pasture	Grassland maintained primarily for and by grazing, and on which grazing stock is kept for a large part of the year.
Pluvial	Relating to rainfall.
Ramsar	Areas designated by the UK Government under the International Ramsar Convention (the Convention on Wetlands of International Importance).

TERM	DEFINITION
Reaches	A continuous extent of water, usually in reference to rivers.
River terrace deposits	Alluvium which forms a series of level surfaces in a stream or river valley, produced as the dissected remnants of earlier abandoned floodplains.
Run-off	Precipitation that flows as surface water from a site, catchment or region waterbodies such as rivers and lakes and ultimately flows to the sea.
Sediment	Organic and inorganic material that has precipitated from water to accumulate on the floor of a waterbody, watercourse or trap.
Semi-natural	Habitat, ecosystem, community, vegetation type or landscape that has been modified by human activity but consists largely of native species and appears to have similar structure and functioning to a natural type.
Siltstone	A fine-grained sedimentary rock formed from consolidated silt.
Special Area of Conservation	International designation implemented under the Habitats Regulations for the protection of habitats and (non bird) species.
Supergroup	The largest geological unit of stratigraphy; usually covers a very wide time span.