Offshore Wind Power Limited

West of Orkney Windfarm Onshore EIA Report

Volume 2, Supporting Study 2: Groundwater-Dependent Terrestrial Ecosystems (GWDTE) Assessment

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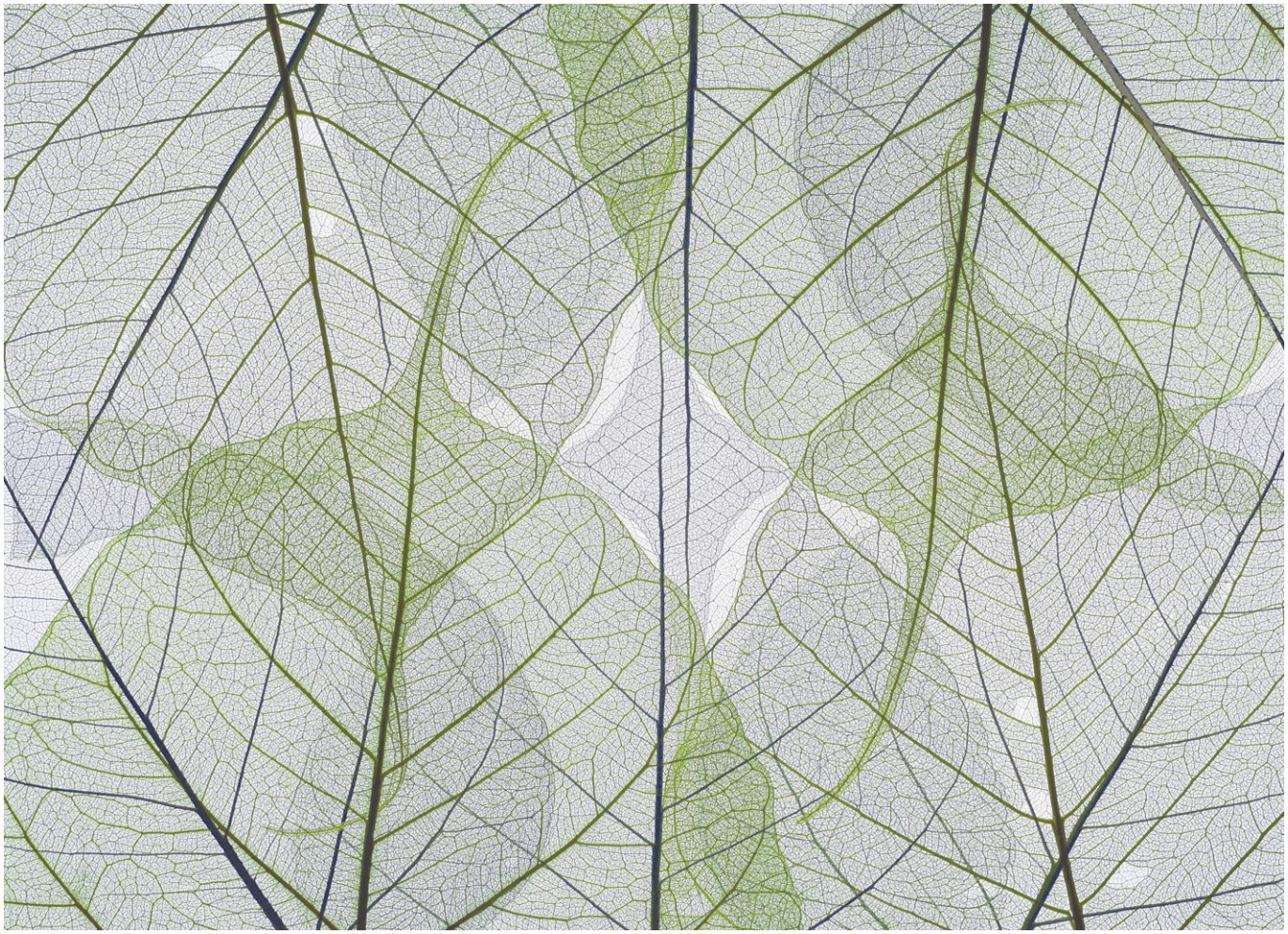
West of Orkney Windfarm



Offshore Wind Power Limited

West of Orkney Windfarm: Groundwater-Dependent Terrestrial Ecosystems (GWDTE) Assessment

Supporting Study 2

2760759-P8.2 (04)

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RSK GENERAL NOTES

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1 INTRODUCTION

1.1 This report provides a Groundwater-Dependent Terrestrial Ecosystem (GWDTE) Assessment for West of Orkney Windfarm and associated onshore development infrastructure (hereafter referred to as the onshore Project).

1.2 The report forms a supporting study to the Onshore Environmental Impact Assessment (EIA) Report for the onshore Project and should be read in conjunction with this document. It has been produced in response to concerns over development in areas with, or that have potential to affect, sensitive groundwater-dependent habitats raised by the Scottish Environment Protection Agency (SEPA) and The Highland Council (THC). The report focuses on the onshore study area, defined as the land within the onshore Project area and onshore substation search area plus a 250 m buffer (Figure 2.1).

1.3 GWDTE are protected under the Water Framework Directive and are potentially sensitive receptors to the impacts of development. This report identifies the potentially groundwater-dependent habitats present within the onshore Project area and identifies and assesses the potential impacts of the onshore Project on these habitats. Design and mitigation methods to avoid or minimise these risks are set out, along with good construction practices that would be employed during all onshore Project works.

1.4 As detailed in Figure 2.1, buffers around the onshore Project area appropriate to individual effects are used to assess impact. The onshore study area for geology and hydrology is the onshore Project area plus a buffer zone of 2 km (Figure 2.1). The onshore study area for GWDTE is the onshore Project area plus a buffer zone of 250 m (Figure 2.1). The onshore study area for considering potential effects on water resources, including Private Water Supplies (PWS) and waterbodies is the onshore Project area plus a buffer zone of 5 km (Figure 2.1).

Site location

1.5 The onshore Project area is situated within Caithness, in the far north-eastern part of the Scottish Highlands (Figure 2.1). The onshore Project area extends from two landfall options, the western landfall at Greeny Geo and the eastern landfall at east of the bay at Crosskirk. The onshore Project area follows a generally south-easterly direction, branching into two corridor options south-east of the Moss of Geise, with one passing to the east and one to the west of Halkirk. These corridors merge just north of the onshore substation search area at Achalone.

1.6 The onshore Project area lies within a Farmed Lowland Plain Landscape Character Area, which is described as a ‘generally open, low-lying plain, gently undulating to form shallow broad valleys, which are often filled with lochs and mosses, and subtle low ridges’ (Scottish Natural Heritage, 2019).

1.7 Current land use within the onshore Project area involves arable farming, livestock pasture, rough grazing, areas of unproductive ground and the local road and rail networks.

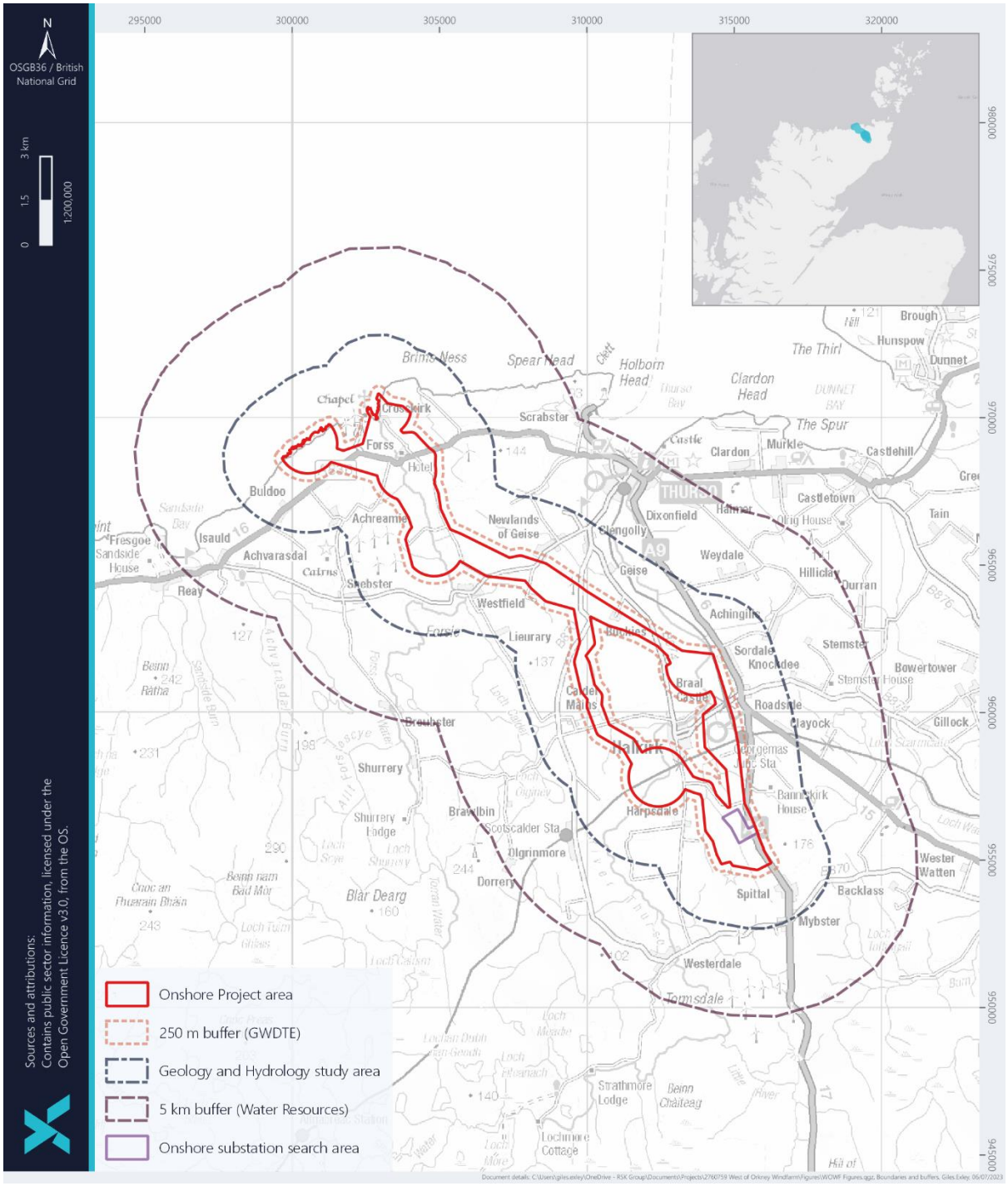

Figure 2.1 Onshore Project area and buffers for study areas

Development proposals

1.8 The onshore Project includes:

- Landfalls – the locations at Greeny Geo and Crosskirk where the offshore export cables will be brought ashore. One or both options may be utilised. The temporary working area for the construction compound at each landfall is expected to be 22,500 m^2.

- Onshore export cables – five onshore export cables will be buried underground in separate trenches, with each onshore export cable comprising of three separate power cables and a one fibre optic communications cable. Each onshore export cable will be up to 33 km across a working corridor width of up to 100 m. The total working corridor area is 3,300,000 m^2. Temporary laydown compounds of 100 m x 100 m will be placed along the route every 2 km.
- Onshore substation – contains the electrical components for transforming the power supplied from the Project via the export cables to meet the export requirements. The full size of development area (including substation screening, Sustainable Drainage Systems (SuDS) and bunding) is 239,200 m^2. During construction, the temporary construction compound (22,500 m^2), site office and car park (40,000 m^2) will total 62,500 m^2.
- Temporary access tracks (not including haul roads) up to 3,300 m in length at the landfall, the entry and exit points of the horizontal directional drilling (HDD) points and the onshore substation. Lengths are indicative only.
- It is anticipated that up to six new permanent access tracks will be required for HDD sites and one permanent access track will be required at the onshore substation This consists of 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.

1.9 Full details of the Project description are provided in chapter 5 of the Onshore EIA Report.

1.10 The final cable route and onshore substation location will be defined during the detailed design stage, post-consent.

Aims

1.11 This report reviews relevant baseline information, including all habitat and vegetation data and hydrogeological details, in order to provide an assessment of the risk to groundwater-dependent habitats. Recommendations are made for mitigation measures and construction methods that should be implemented to minimise the risk of disturbance or damage to sensitive habitats during construction works and ongoing development operations.

Assessment method

1.12 This assessment has involved the following stages:

- Desk study;
- Site reconnaissance;
- Vegetation mapping;
- Hydrogeological assessment;
- Detailed assessment of sensitive habitats; and
- Identification of protection and mitigation measures.

2 DESK STUDY

Information sources

2.1 The desk study involved a review of available relevant information sources on the ground conditions at the onshore Project area. Information sources included:

- Ordnance Survey (OS) topographical mapping at 1:50,000 and 1:25,000 scale;
- British Geological Survey (BGS) geological mapping, superficial and bedrock;
- Centre for Ecology and Hydrology (CEH) Flood Estimation Handbook (FEH) Web Service;
- Data provided by the applicant, including the onshore export cable corridor and onshore substation search area boundaries;
- THC PWS records;
- Scotland's Soils mapping, 1:250,000 scale; CL
- SEPA's *A functional wetland typology for Scotland*; and
- Caledonian Conservation's Phase 1 habitat and National Vegetation Classification (NVC) survey results (Supporting Study (SS) 6: West of Orkney Windfarm: Terrestrial Non-Avian Ecology Technical Survey Report).

Climate and topography

2.2 The onshore Project area is approximately 20 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 (Met Office, 2023).

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

2.4 The two landfall locations are both characterised by rocky shorelines and low cliffs of around 10-20 m in height. Inland, the topography is characterised by low-lying rolling hills and valleys. Steeper slopes are present within the Forss Water valley, on both sides of the river, 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.

2.5 The onshore substation search area has an elevation that ranges from around 60 m to 95 m AOD. The elevation of the indicative substation location ranges from 65 m AOD to 85 m AOD.

Geology

2.6 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). Bedrock geology mapping is shown on Figure 2.2 and superficial geology is shown on Figure 2.3.

Bedrock geology

2.7 The onshore Project area is underlain by bedrock of the Middle Old Red Sandstone group of Early-Middle Devonian age, part of the Old Red Sandstone Supergroup. Rocks from this Supergroup dominate the Caithness and Orkney areas of Scotland.

2.8 Eight distinct formations have been identified within the onshore Project 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.

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

2.10 A number of faults are indicated within the onshore Project area. 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.

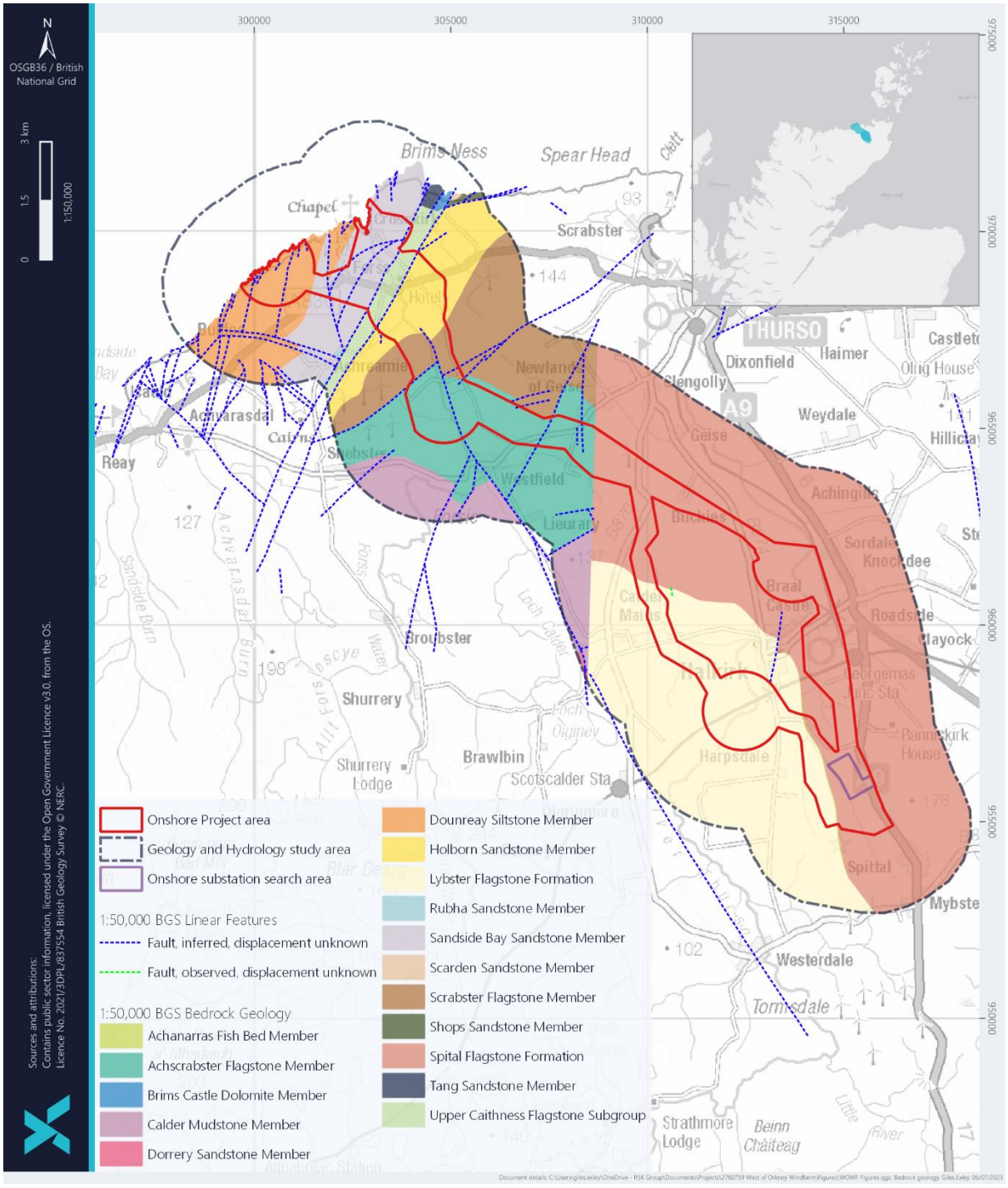

Figure 2.2 Terrestrial bedrock geology in the vicinity of the onshore Project area. The distinctive line running north to south in the centre of the figure indicates the boundary of adjoining paper maps that have subsequently been digitised (BGS, 2023a)

Superficial geology

2.11 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 Project area, and areas of glaciofluvial deposits, alluvium and river terrace deposits within the River Thurso and Forss Water valleys. A small area of lacustrine deposits is noted near Crosskirk and 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.

2.12 Areas of peat are mainly around Loch Lieurary, Moss of Geise and the Yellow Moss/Bloody Moss area south of Halkirk.

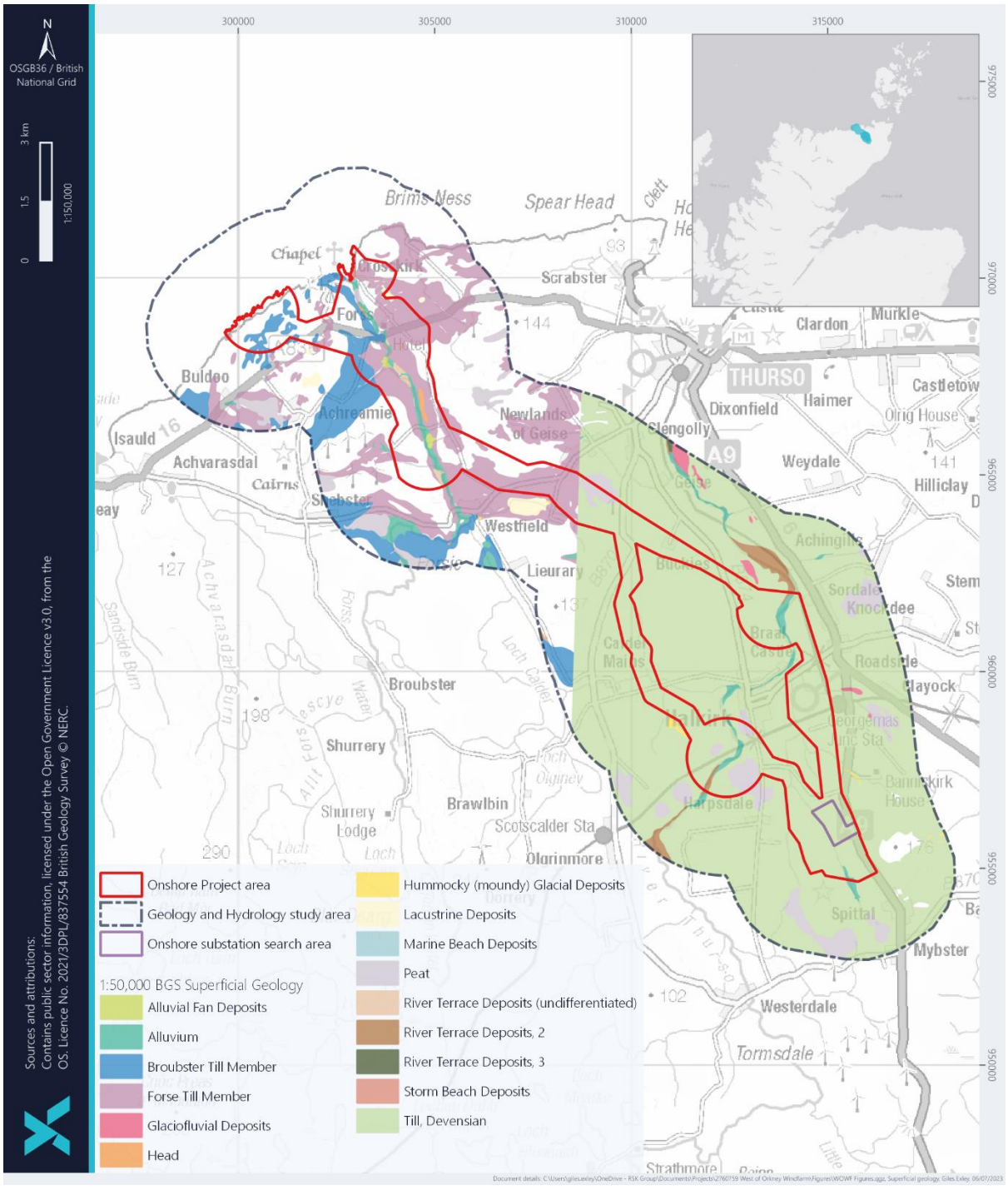

Figure 2.3 Superficial geology in the vicinity of the onshore Project area. The distinctive line on the edge of the area of Devensian Till indicates the boundary of adjoining paper maps that have subsequently been digitised (BGS, 2023a)

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

Soils and peat

2.14 The National Soils Map of Scotland identifies the predominant soil types of the onshore study area 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.

2.15 An area of aluvial soils is identified 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.

2.16 Peat depth surveys have been undertaken by RSK across the onshore Project area to confirm the extent of peat and peaty soils within the onshore Project area. Details are provided in Outline Management Plan (OMP) 3: West of Orkney Windfarm: Outline Peat Management Plan.

2.17 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.

2.18 Within the onshore study area, the soils are principally assigned Class 0 (mineral soils). There are two small pockets of Class 1 soil on the western section of the onshore export cable corridor, just south of Hlakirk. 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 study area. A small area of Class 4 (unlikely to include carbon-rich soils) is present near North Calder on the western section of the onshore study area, and in pockets of the onshore export cable corridor south of Halkirk.

Hydrogeology

2.19 According to the BGS, the onshore study area is underlain by Middle Old Red Sandstone bedrock forming a moderately productive aquifer (BGS, 2023a). The bedrock consists of sandstones, in places flaggy (a tendency to split or break into thin, flat layers or flags), 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.

2.20 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 to April).

2.21 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. Both are in good condition (SEPA, 2021).

2.22 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.

2.23 The peat bodies will also hold some groundwater, although peaty gleys are known to have poorly drained characteristics. Flow within peat is known to be extremely slow, although it can contribute some limited baseflow to local burns. As the extent of peat is limited, the significance of groundwater in peat will be very low.

2.24 Regional groundwater flow will tend to mimic the topography, generally flowing north towards the coast.

Hydrology

2.25 The onshore Project lies within five catchments: the River Thurso, the Forss Water, the Burn of Brims, Thurso Coastal between Forss Water and Dounreay Burn, and Thurso Coastal between Burnside Burn and Forss Water. Catchments are shown on Figure 2.4.

River Thurso

2.26 The River Thurso catchment has a total area of 487 km^2 and drains 53.5% of the land within the onshore Project area (CEH, 2022). The River Thurso catchment is located in the part of the onshore Project area that is south-east of the Moss of Geise, and includes the onshore substation search area.

2.27 Several smaller tributaries drain into the River Thurso through the onshore Project area, including the Burn of Achanarras/Halkirk Burn[1], Burn of Geise, Burn of Carnavagry and Calder Burn. Several unnamed tributaries drain into the River Thurso within the onshore Project area to the west of Houstry, south of Aimster and north-east of Clatequoy.

Forss Water

2.28 The Forss Water catchment has a total area of 139.5 km^2 and drains 36.2% of the land within the onshore Project area (CEH, 2022), from the north-west of Achscrabster to the coast at Crosskirk Bay.

2.29 Several smaller tributaries drain into the Forss Water through the onshore Project area, including the Burn of Baillie, Burn of Brimside and Craigan Well.

[1] The Burn of Achanarras is an important water feature with relevance to the onshore Project, but forms part of the Halkirk Burn catchment in SEPA's terminology. This document refers principally to the Burn of Achanarras.

Burn of Brims

2.30 The Burn of Brims catchment has a total area of 5 km^2 and drains 2.4% of the onshore Project area (CEH, 2022). This catchment is located to the north of Forss, near the eastern landfall for the onshore Project area.

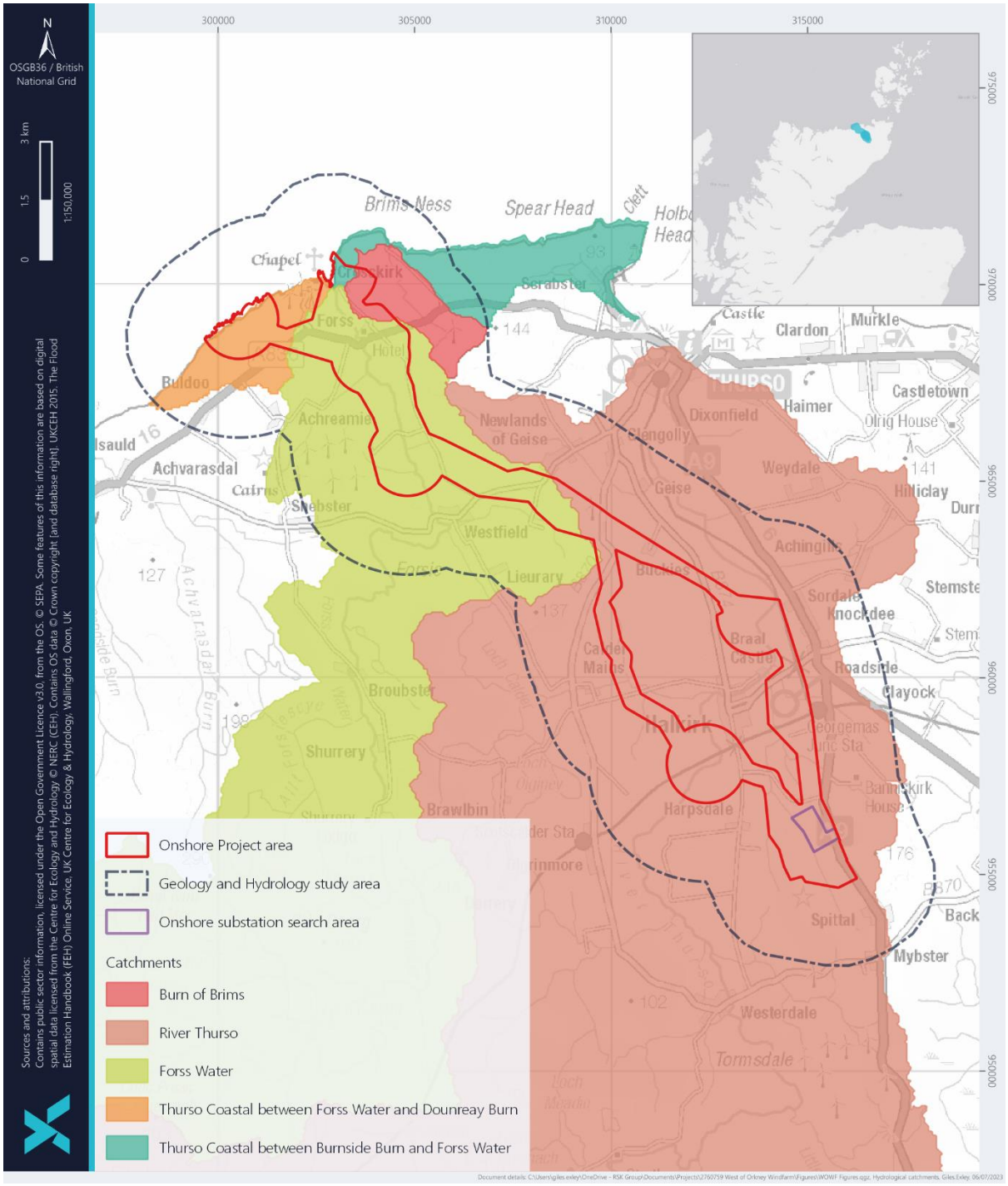

Figure 2.4 Hydrological catchments in the vicinity of the onshore Project area (CEH, 2022)

Coastal areas

2.31 The two landfalls of the onshore cable export corridor are drained by minor watercourses. The Greeny Geo landfall of the onshore study area lies in the Thurso Coastal between Forss Water and Dounreay Burn catchment (SEPA, 2022). In total this catchment drains 6.8% of the onshore Project area.

2.32 To the east, the landfall area at Crosskirk, to the east of Crosskirk Bay, lies in the Thurso Coastal between Burnside Burn and Forss Water catchment, draining 1.0% of the onshore Project area (SEPA, 2022).

Catchment statistics

2.33 Catchment statistics are derived from the FEH Web Service (CEH, 2022). The catchment wetness index, 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 to 56% of the time. The area has a baseflow index (BFI HOST19) of between 0.32 and 0.34, indicating a moderate to low input of groundwater baseflow to surface watercourses. The standard percentage runoff (SPR HOST) is 39 to 53%, indicating that this percentage of rainfall 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.

2.34 Catchment statistics derived from the FEH Web Service are provided in Table 2.1 (CEH, 2022). Catchment statistics are provided for the main catchments in the onshore Project area.

Table 2.1 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	N/A[2]			6.8
Thurso Coastal between Burnside Burn and Forss Water	N/A[3]			1.0

[2] This information is not publicly available because the watercourse is too small to model with sufficient accuracy for the data to be useful.

[3] *Ibid*

Water resources

Drinking water protected areas

2.35 The onshore Project area passes through a surface water Drinking Water Protected Area (DWPA), which comprises part of the catchment of the River Thurso and the river itself (Figure 2.5).

2.36 A small area of both Loch Calder and the Loch Calder catchment surface water DWPA 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 (Figure 2.5).

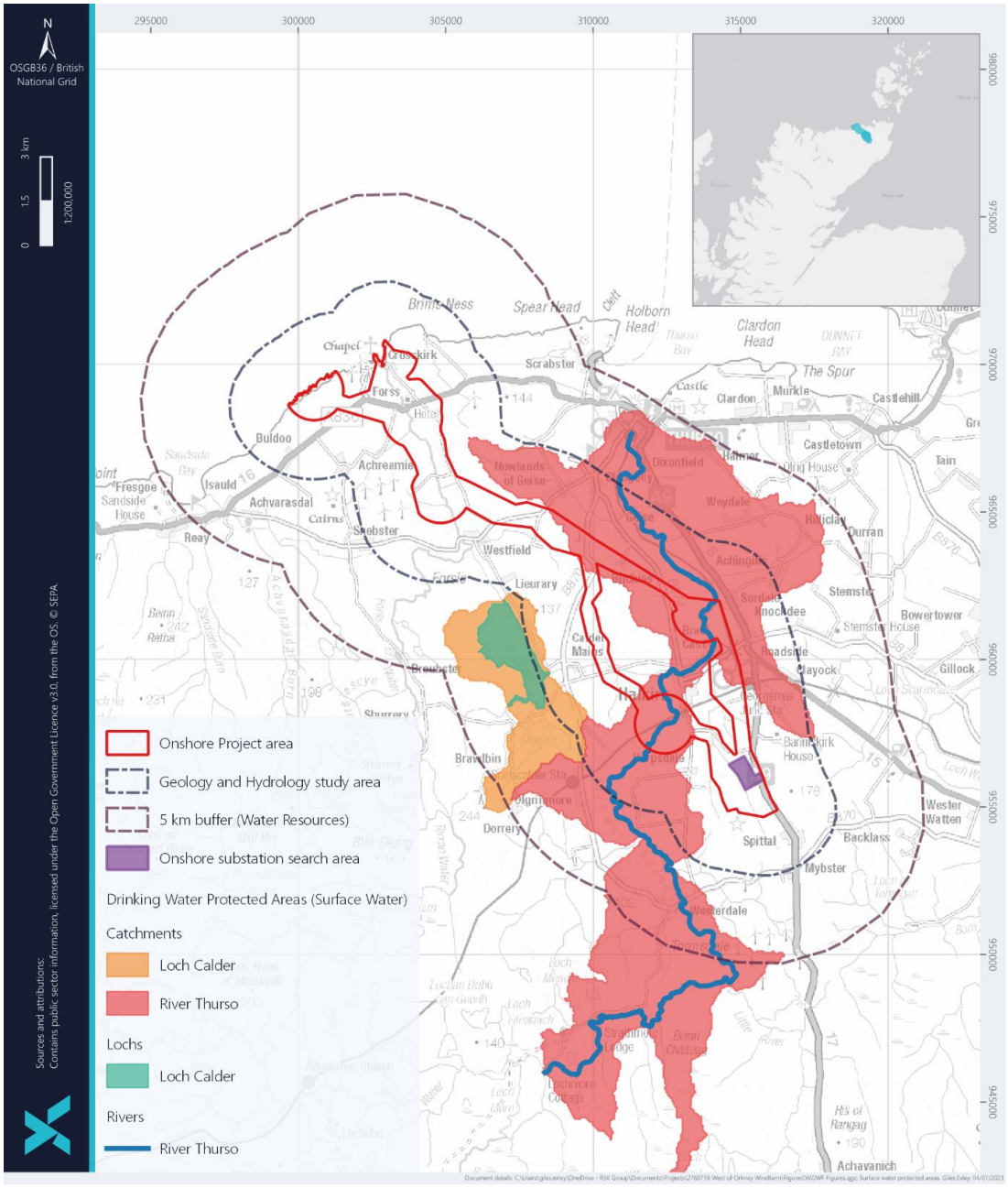

Figure 2.5 Surface water drinking water protected areas in the vicinity of the onshore study area (Scottish Government, 2014)

2.37 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 (Figure 2.6).

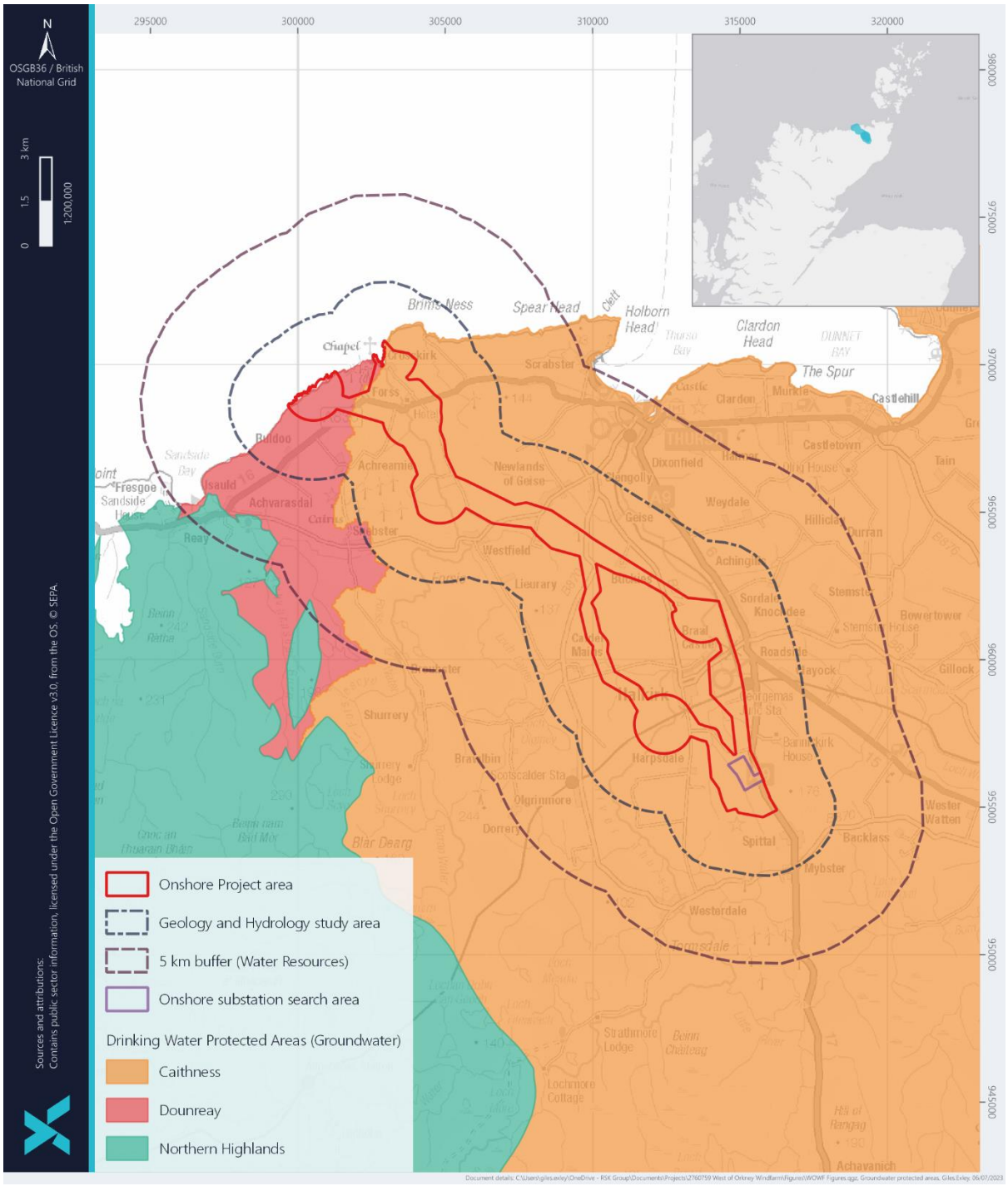

Figure 2.6 Groundwater water drinking water protected areas in the vicinity of the onshore study area (Scottish Government, 2014)

PWS

2.38 A number of PWS have been identified within and surrounding the onshore Project area. Information in this section has been provided by THC; their records confirm that there are two PWS within the onshore Project area and 12 registered PWS within 5 km of the onshore Project area.

2.39 Information provided by local landowners confirms that two PWS are present within the onshore Project area; Achnabrae at National Grid Reference (NGR) 306100 965200 and Knockglass Farm at NGR 305200 965300.

3 VEGETATION AND GROUNDWATER DEPENDENCY

3.1 GWDTE are defined by the United Kingdom 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 potential pollutants) within that groundwater body, but there must be a direct hydraulic connection with the groundwater body."*

3.2 In line with the guidance provided in UKTAG (2004), a dual ecological and hydrogeological approach to identifying GWDTE has been used. This involves a detailed study of vegetation communities in order to determine the potential level of groundwater dependency, combined with a detailed hydrogeological study in order to identify locations where groundwater reaches the surface and is therefore able to provide a source of water to terrestrial ecosystems.

3.3 Determining groundwater dependency is complex as most water-dependent terrestrial ecosystems rely on a combination of groundwater, surface water and rainwater, and many vegetation communities will use whatever source of water is available. In some topographical and hydrogeological conditions, a particular ecosystem can be groundwater-dependent whereas in others the same ecosystem is surface water-dependent. Seasonal patterns of water availability influence water use, providing an additional level of complexity; groundwater reliance is typically greater in the summer when rainfall and surface water are less available (Isherwood, 2013).

Vegetation mapping

3.4 Vegetation within the onshore study area has been surveyed using a combined Phase 1 habitat and NVC survey method and is reported in full in chapter 10: Terrestrial non-avian ecology of the Onshore EIA Report, with mapping provided in Figure 2.7 and Figure 2.8 below. The key findings relating to groundwater dependency are summarised below

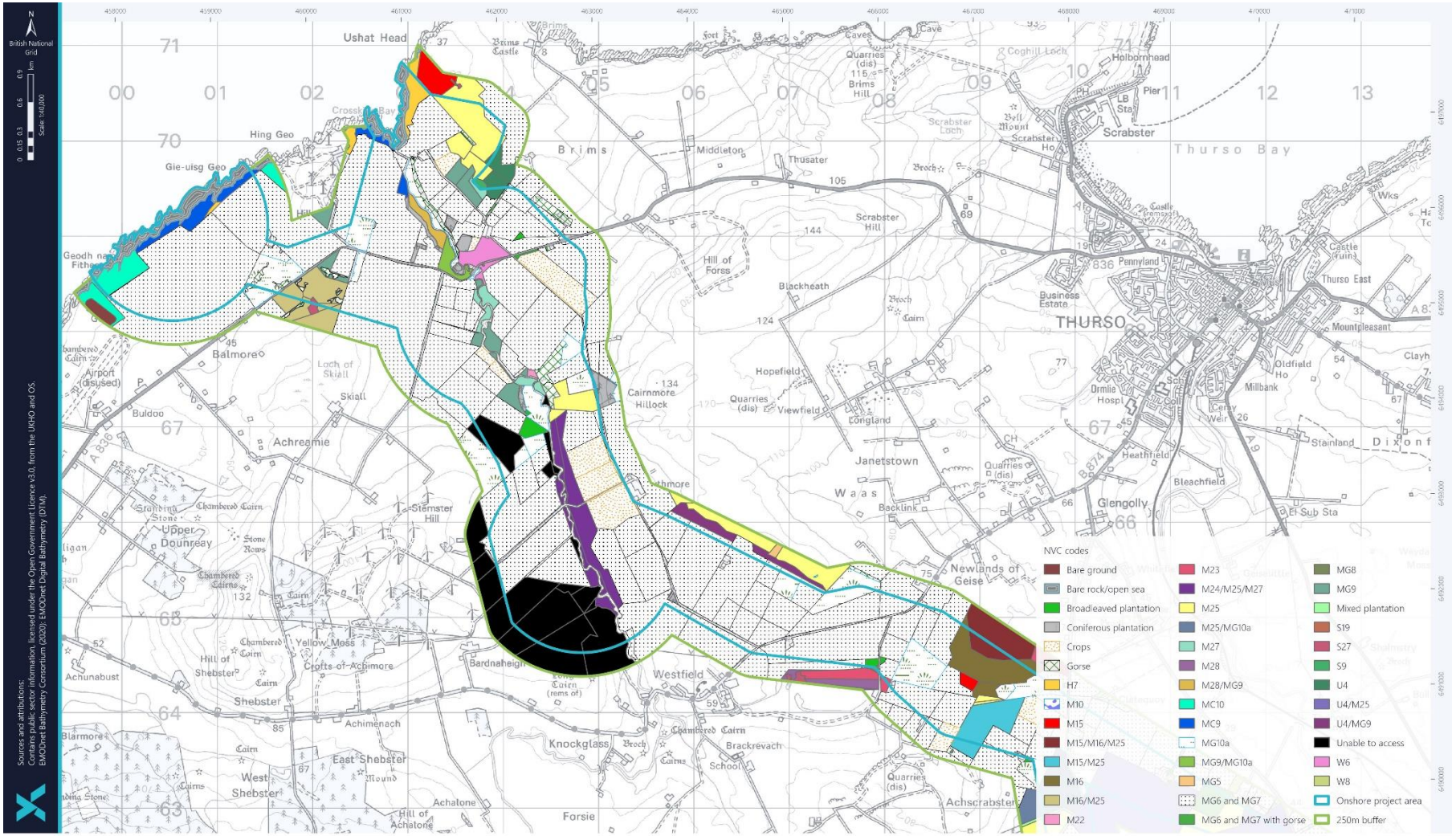

Figure 2.7 NVC habitats recorded within the northern section of the GWDTE study area

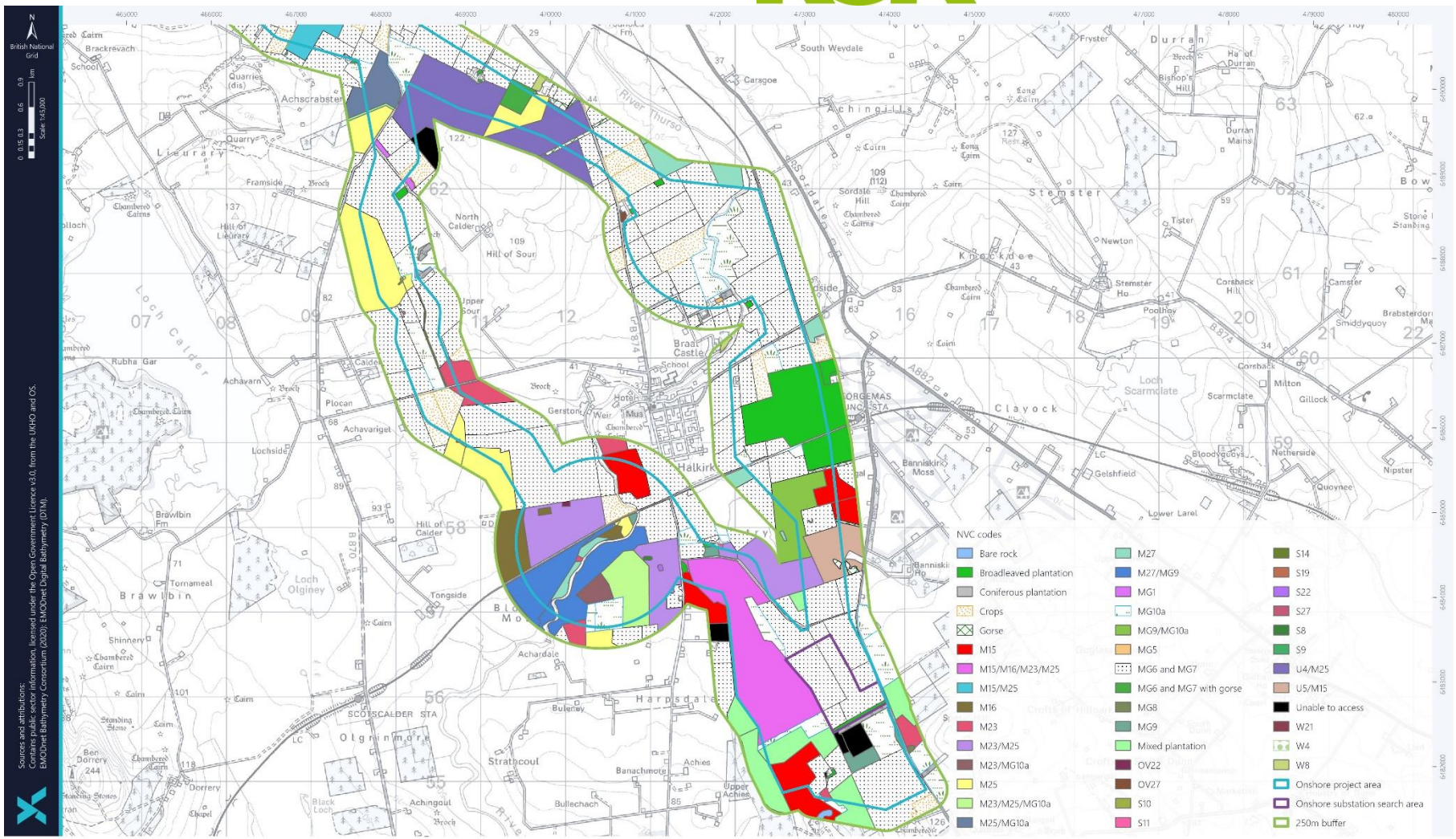

Figure 2.8 NVC habitats recorded within the southern section of the GWDTE study area

3.5 NVC communities identified by SEPA as likely to be highly or moderately groundwater-dependent, depending on the hydrogeological setting, are listed in SEPA's publications "Planning advice on on-shore windfarm developments" (SEPA, 2017a) and "Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems" (SEPA, 2017b).

3.6 The UKTAG Annex 1 table (UKTAG, 2009) differentiates communities by class, where Class 1 is potential high groundwater dependency, Class 2 is potential moderate groundwater dependency and Class 3 is potential low groundwater dependency.

3.7 The majority of the onshore study area consists of agricultural land used for crops or livestock grazing. The NVC mapping indicates that there are very few areas of potentially highly groundwater-dependent habitats within the onshore study area. These are located in the north-west, north-east and south-west of the onshore study area. A number of potentially moderately groundwater-dependent habitats are present, plus some potentially low groundwater dependency habitats.

3.8 Key areas of interest are alongside the Forss Water for most of its length within the onshore study area, alongside parts of the River Thurso, and in the areas near Moss of Geise, Moss of Halkirk and Yellow Moss.

3.9 The potentially groundwater-dependent NVC communities identified within the site and their groundwater dependency classifications can be found in Table 2.2.

Table 2.2 Potential groundwater dependency classifications of identified NVC communities within the onshore study area: classification are sourced from SEPA (2017b) and UKTAG (2009)

SEPA (2017b) Groundwater Dependency Classification	NVC Community	UKTAG (2009) Groundwater Dependency Classification
Highly groundwater-dependent	M16 *Erica tetralix - Sphagnum compactum* wet heath	2 (Moderate)*
Moderately groundwater-dependent	M15 *Scirpus cespitosus - Erica tetralix* wet heath	2
	M27 *Filipendula ulmaria - Angelica sylvestris* mire	2
	M28 *Iris pseudacorus - Filipendula ulmaria* mire	2
	MG8 *Cynosurus cristatus - Caltha palustris* lowland neutral grassland	2
	MG9 *Holcus lanatus - Deschampsia cespitosa* grassland	2
	MG10 *Holcus lanatus - Juncus effusus* rush pasture	2
	W6 *Alnus glutinosa - Urtica dioica* woodland	2
	M25 *Molinia caerulea - Potentilla erecta* mire	3 (Low)
	S27 *Carex rostrata - Potentilla palustris* tall-herb fen	3
	U4 *Festuca ovina - Agrostis capillaris – Galium saxatile* grassland	3
* UKTAG (2009) data refer specifically to the NVC habitat classifications in Scottish settings.		

4 DETAILED ASSESSMENT

4.1 Within this section of the supporting study, 'study area' refers to the onshore Project area plus a buffer zone of 250 m around this. The study area has been reviewed to identify locations with NVC habitats that require assessment.

4.2 Detailed consideration is required for sensitive habitats that lie within 100 m of areas likely to be excavated to less than 1 m in depth, or within 250 m of excavations deeper than 1 m (SEPA, 2017b). For the purposes of this assessment, it is assumed that construction within the onshore export cable corridor would require excavating to greater than 1 m depth and therefore a buffer zone of 250 m has been put around sensitive habitats within the onshore Project area for the purposes of this assessment. It is also assumed that the foundations for the onshore substation would be excavated to greater than 1 m depth. Thus, in this area a buffer of 250 m has been used. An overview map of the onshore study area, showing locations with potentially groundwater-dependent communities, is provided in Figure 2.9.

Conceptual site model

4.3 Of the NVC communities identified in Table 2.2, SEPA (2017b) identifies M16 as *"… likely to be … highly groundwater dependent … depending on the hydrogeological setting"* and UKTAG (2009) identifies it as Class 2 (Moderate) in Scottish settings.

4.4 Of the NVC communities identified in Table 2.2, SEPA (2017b) identifies M25, S27 and U4 as *"… likely to be moderately groundwater dependent … depending on the hydrogeological setting"* and UKTAG (2009) identifies them as Class 3 (Low) in Scottish settings.

4.5 All other NVC communities identified in Table 2.2 are identified by both SEPA and UKTAG to be Class 2/moderately groundwater-dependent.

4.6 In summary, M16 is likely to have potential moderate to high groundwater dependency, M25 and S27 are likely to have potential moderate to low groundwater dependency, and all other specified vegetation communities are likely to have potential moderate groundwater dependency.

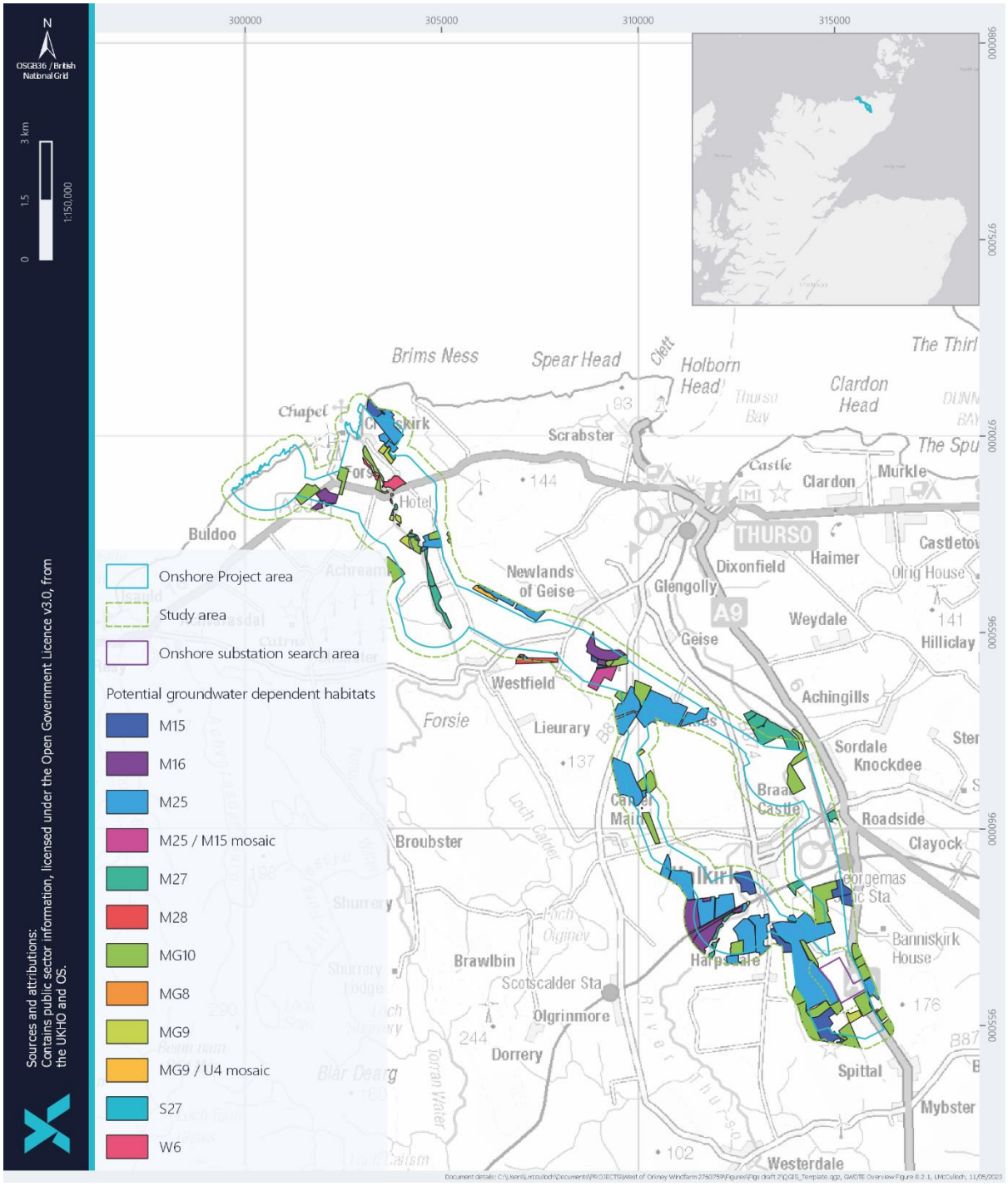

Figure 2.9 Overview of potentially groundwater-dependent communities in the vicinity of the onshore study area

Access to groundwater

4.7 Hydrogeological assessment of the onshore study area has identified the following key points in relation to groundwater availability at or near the surface:

- There are two PWS within the onshore Project area at Achnabrae (NGR 306100 965200) and Knockglass Farm (NGR 305200 965300);

- OS mapping indicates a number of springs and wells within the onshore study area;
- Bedrock present under the onshore study area is classed as a moderately productive aquifer with fracture flow;
- Superficial deposits within the onshore study area consist of glacial tills, alluvial and river terrace deposits and some peat. These deposits are all likely to have variable productivity depending on local variations in composition and are also very variable in thickness; and
- Soils across the whole area are generally noted to be thin, rarely exceeding 0.3 m in thickness (OWPL, *pers comm*).

4.8 A site reconnaissance survey was undertaken on the 9th and 10th of August 2022; accessible spring points were visited during the survey. None of these were found to be 'true' springs, but rather consisted of outlet pipes from field drains. No evidence of true springs or seepage lines were identified during site visits. However, the presence of a large number of mapped wells indicates that groundwater is accessible within the bedrock and that some unmapped spring or seepage points may be present.

4.9 While bedrock within the onshore study area is classified as a moderately productive aquifer, superficial deposits, particularly peat and glacial till, may act as barrier between the surface vegetation and the bedrock, preventing surface vegetation from being groundwater-dependent.

Habitats on peat

4.10 Some of the habitats identified as potentially groundwater-dependent are on areas of peat over 0.5 m in depth, as confirmed by the Phase 1 peat survey (see OMP3: West of Orkney Windfarm: Outline Peat Management Plan). The Phase 1 peat survey identified peat at 13.7% of the survey points in the onshore Project area. Blanket peat is generally considered to be ombrotrophic and receives all its nutrients from rainwater (JNCC, 2022). Areas of peat can act to insulate surface features from groundwater. Although peat bodies do contain water, and support some water flow, this is typically very slow except in areas with peat pipes or conduits to allow focused flow. Peat is usually considered to be effectively impermeable, thus insulating surface features from groundwater. It should be noted that peat coverage within the onshore study area is fairly restricted, limiting this insulation effect. Additionally, localised flushing can occur adjacent to watercourses, although this is rarely extensive away from the watercourse channel.

4.11 RSK visited the onshore study area twice during September and October 2022 to conduct Phase 1 peat surveys. The surveys found that peat present within the onshore study area has a wide range of depths (from 0-4 m). At a depth of at least 0.5 m below ground surface within areas of peat, it is unlikely that any groundwater present within the shallow bedrock is accessible to surface habitats.

4.12 It is therefore likely that the dominant water source within areas of peat, irrelevant of peat depth, is rainwater with shallow through-flow within the uppermost vegetated layer.

Habitats with no identified peat

4.13 Many of the habitats identified as potentially groundwater-dependent are located within areas with no identified peat. The Phase 1 peat survey identified no peat at 86.3% of the

survey points, see OMP3: West of Orkney Windfarm: Outline Peat Management Plan for further details. In these cases the nature of the underlying substrate requires assessment in order to draw conclusions regarding the groundwater dependency of habitats in these areas.

4.14 The Phase 1 peat survey 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. However, BGS mapping of the onshore study area indicates that there are widespread deposits of glacial till across the entire study area. Thus, it is likely that the hard rockhead is due to the presence of clay material within the superficial deposits in at least some parts of the study area.

4.15 Glacial till can form both an aquifer (source of water) and an aquitard (barrier to flow) as a result of its highly variable composition. Where glacial till deposits are clay-rich, they would act more to restrict groundwater movement and create an insulating effect similar to peat. However, glacial till composition is known to vary over very short distances, and it is therefore impossible to rule out groundwater presence in some areas. Fractures and discontinuities within clay-rich till can also lead to spring development.

4.16 Considering the characteristics of the study area, the availability of groundwater and the potential effects of peat and other superficial deposits, it is concluded that groundwater sources for vegetation communities within the onshore study area are likely to be localised, infrequent and potentially seasonal. It is unlikely that any habitats within the onshore study area have a reliable source of groundwater on which they can depend. These habitats are most likely to rely on a combination of rainfall and surface runoff, with some direct surface water in areas adjacent to watercourses and waterbodies.

4.17 Nevertheless, it remains possible that some groundwater dependency may be present within the vegetation communities identified within the study area. Additionally, these habitats are considered to be sensitive, and a level of protection is required to minimise and, if necessary, mitigate any impacts that may occur. Therefore, a detailed assessment of these communities is conducted below.

4.18 General mitigation measures applicable to all areas is provided in Section 5.

Area 1

4.19 Area 1 covers the northern part of the onshore study area, from the landfall locations to just south of the Burn of Baillie and Forss Water confluence (Figure 2.10).

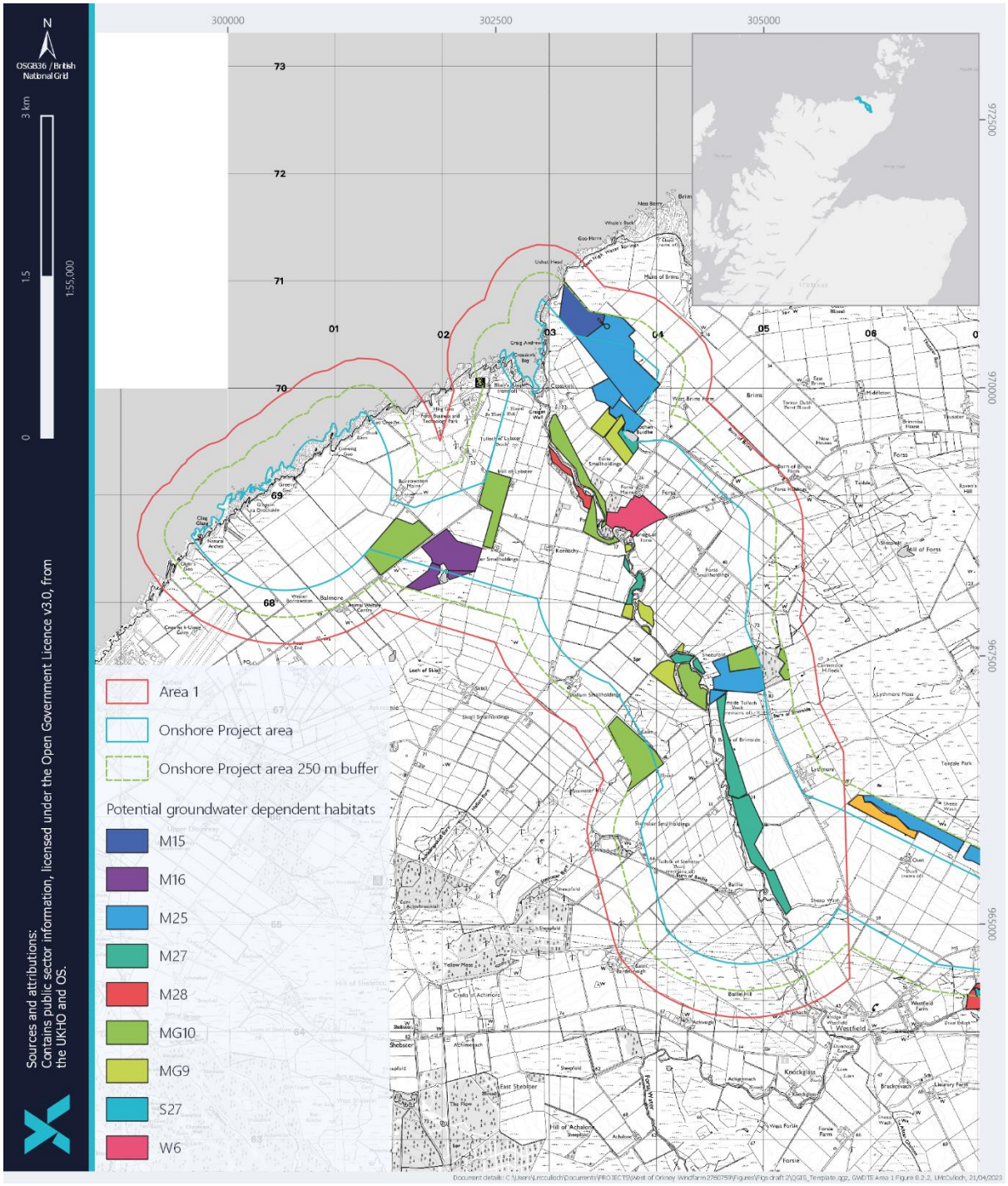

Figure 2.10 Potentially groundwater-dependent communities in Area 1

Habitats present

4.20 One area of M15 is present in the far north-east outwith the onshore Project area at Creagan Caol.

4.21 One area of M16 is present in the north-west at Lybster Smallholdings.

4.22 Two areas of M25 are present; one located in the north-east, north of Lochan Buidhe, the other located at the eastern edge of the onshore Project area just north of Brimside Tulloch Broch.

4.23 Five areas of M27 are present along the banks of the Forss Water and one small area is present in the north-east at Lochan Buidhe.

4.24 One small area of M28 is present in the north of Area 1, along the western side of the Forss Water.

4.25 Eight areas of MG10 are present. Two are located in the north of Area 1, along the Forss Water. Two are located in the north-west near Lybster Smallholdings. One is located nearer the centre of Area 1 along the Forss Water, there are two areas east of this and one to the west, just south of Hallam Smallholdings.

4.26 Six areas of MG9 are present along the Forss Water and one larger area is located in the north-east at Lochan Buidhe.

4.27 One very small area of S27 is present in the far north-east outwith the onshore Project area near Creagan Caol.

4.28 One area of W6 is present in the northern-central region of Area 1 around Forss House, Forss Mains and Bridge of Forss.

Setting and infrastructure

4.29 From north to south the bedrock in Area 1 consists of interbedded sandstone and siltstone with mudstone in some areas.

4.30 The bedrock underlying the entire onshore study area is classed as a moderately productive aquifer which locally yields small amounts of groundwater. Flow is predominantly through fractures and other discontinuities (BGS, 2022).

4.31 Superficial deposits predominantly consist of diamicton till. Alluvium (consisting of clay, silt, sand and gravel), alluvial fan (consisting of sand, gravel and boulders), head (consisting of gravel, sand, silt and clay) and river terrace deposits (consisting of undifferentiated gravel, sand and silt) are associated with the Forss Water valley. At the eastern landfall there are small pockets of storm beach deposits and marine beach deposits consisting of boulders and sand respectively. Lacustrine deposits consisting of clay, silt and sand are found around Lochan Buidhe in the north-east.

4.32 Small localised areas of shallow peat are present along the Forss Water and in the north-east at Lochan Buidhe.

4.33 Infrastructure development in Area 1 includes the landfall and the onshore export cables and temporary construction compounds. HDD would be used for the landfall and for the crossing of any major rivers (such as Forss Water) should this be required. A temporary drilling compound would be required at the landfall area.

Assessment

4.34 It is anticipated that habitats adjacent to the Forss Water rely on surface water and connected groundwater within the alluvial deposits around the main watercourse channel. Within the small areas of peat along the watercourse channel there is likely to be some localised flushing. Habitats immediately adjacent to Lochan Buidhe in the north-east of

Area 1 are likely to be reliant on surface water and connected groundwater within the lacustrine deposits. This is likely to be the same for habitats directly adjacent to the small waterbody in the north-west at Lybster Smallholdings.

4.35 Across the rest of Area 1, where identified habitats are located within areas of diamicton till, the till is likely to act to insulate these habitats from groundwater in the bedrock below. However, mapped superficial deposits are somewhat sparse, particularly in the northern and southern parts of Area 1. Additionally, while the site reconnaissance visit did not find any evidence of flowing springs or seepage points within Area 1, many wells are indicated on OS mapping. Thus, some of the identified habitats in Area 1 may rely on groundwater as a water source. The area of most concern is the M16 habitat in the north-west near Lybster Smallholdings.

4.36 Due to the width of the onshore Project area it should be possible to avoid direct impacts to most of the sensitive habitats by careful design of the onshore export cable route. It is unlikely to be possible, however, to remain completely outwith the 250 m buffer zone throughout this area as the buffer zone extends across the entire corridor in some sections.

4.37 Where possible, the onshore export cable trenches should be located downslope of the identified sensitive habitats, as this would minimise any impacts on water supply to the habitats. This would form a protection for the area of M16 at Lybster Smallholdings and for other habitats within Area 1.

4.38 Direct impacts on identified sensitive habitats are anticipated at two locations from the onshore export cable trenches. These areas include the combined M16 and MG10 habitat near Lybster Smallholdings and the combined MG9-MG10-M27-M25 areas near Braes of Brimside Broch, in the Forss Water valley, if the landfall at Crosskirk is selected as the preferred option.

4.39 Direct impacts to habitats adjacent to the Forss Water could be avoided or minimised by HDD under the Forss Water channel and immediate flood plain, as the habitats in this area are mainly within close proximity to the river channel. Care would be required in siting of HDD compounds to avoid locating these within the M27/MG9/MG10 habitats if possible.

Area 2

4.40 Area 2 covers the section of the onshore study area from Lythmore to Howe Farm, south of Moss of Geise (Figure 2.11).

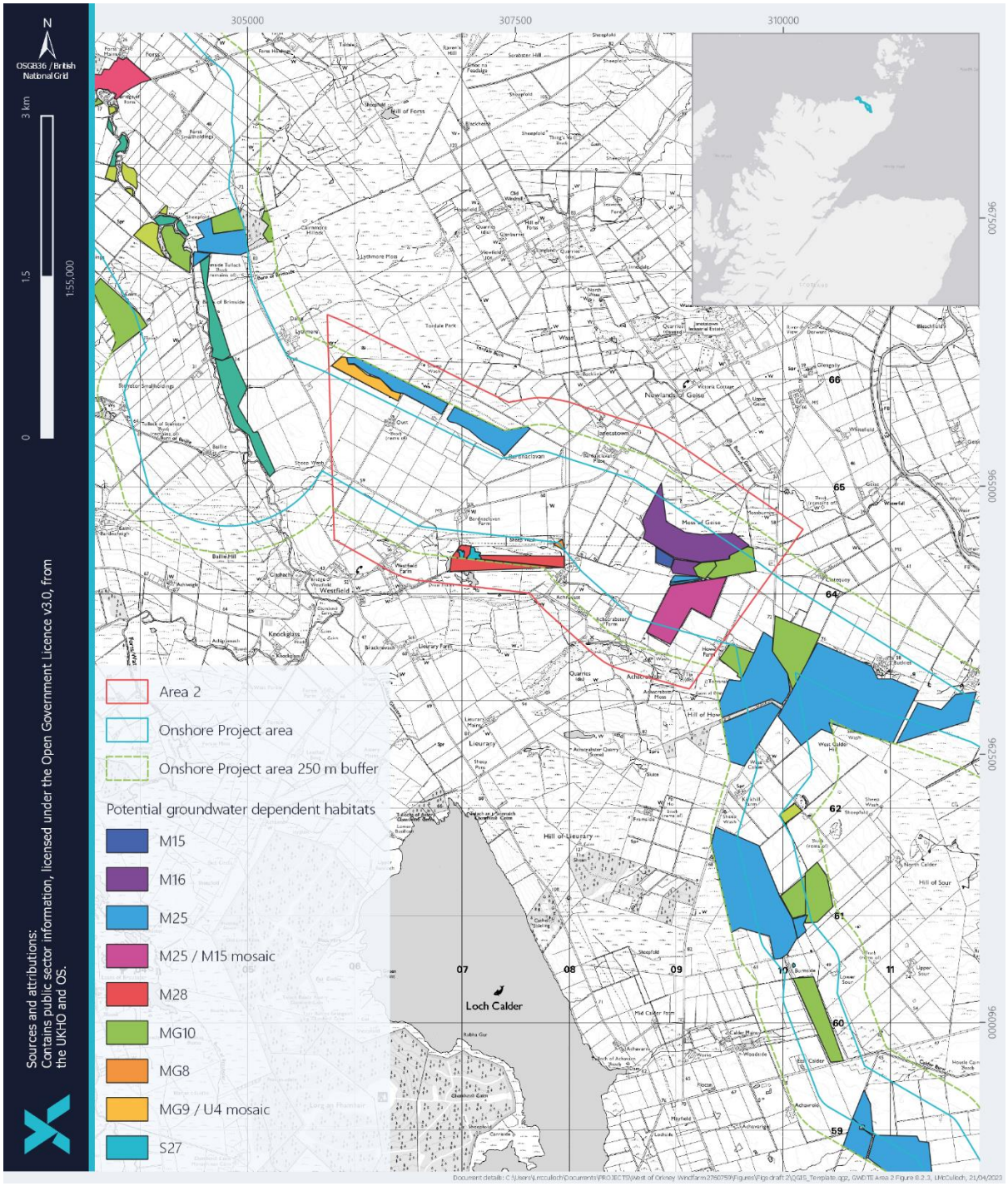

Figure 2.11 Potentially groundwater-dependent communities in Area 2

Habitats present

4.41 One area of M15, one area of M16 and one area of MG10 are present at Moss of Geise.

4.42 Three areas of M25 are present. Two of these are located in the north outwith the onshore project area between Lythmore and Bardnaclavan. One small area is located south of Moss of Geise.

4.43 One mosaic habitat of MG9 and U4 is present outwith the onshore Project area, between Oust and Lythmore.

4.44 One mosaic habitat of M25 and M15 is present just to the north of Howe Farm.

4.45 One area of M28 and two small areas of S27 are located outwith the onshore Project area at Loch Lieurary.

4.46 One very small area of MG8 is present on the edge of the onshore Project area, just north of Achnavast, at the eastern end of Loch Lieurary.

Setting and infrastructure

4.47 Bedrock in Area 2 consists of interbedded sandstone and siltstone with mudstone in some areas.

4.48 Superficial deposits predominantly consist of diamicton till. Lacustrine deposits, consisting of clay, silt and sand, are present in the south near Loch Lieurary, alongside two small pockets of hummocky glacial deposits of sand, gravel and boulders.

4.49 Peat is mapped in the north-east at Moss of Geise and Phase 1 peat surveys confirmed this to be the case with some peat, typically under 1 m depth but up to 1.3 m in places, being found here. See OMP3: West of Orkney Windfarm: Outline Peat Management Plan for further details.

4.50 Infrastructure development in Area 2 consists of the onshore export cables and potentially for temporary construction compounds.

Assessment

4.51 Loch Lieurary is an area of marshy ground and wetland with a few small, remnant open water areas in the western part. Its setting indicates that it may have a direct connection to groundwater. Superficial deposits consist of lacustrine clay, silt and sand; depending on the balance between the finer clay particles and coarser sand and silt, these deposits may hold sufficient groundwater to support groundwater-dependent habitats.

4.52 It is recommended that the S27, M28 and MG8 habitats within the Loch Lieurary area are considered to be groundwater-dependent and that this area is avoided as far as possible. The onshore export cables should be located upslope to the north; the separation from the Loch Lieurary area and habitats should be maintained at 250 m or more if possible.

4.53 The areas of M25 and MG9/U4 mosaic habitats between Lythmore and Bardnaclavan are located upslope of any potential cable trenches, so would not be affected by the works. These are considered to be lower-sensitivity habitats in any case.

4.54 It is considered unlikely that any of the habitats located adjacent to the Moss of Geise are groundwater-dependent due to the presence of peat in this area. Additionally, the superficial deposits adjacent to the area of peat are indicated to be diamicton till and are likely to act as a barrier between groundwater and surface vegetation in this area.

4.55 It would be preferable to route the cable trenches through the area of M25/M15 mosaic south of the Moss of Geise, as this is a lower-sensitivity habitat than the areas of M16, M15 and MG10 to the north. There would also be a lower likelihood of encountering peat in the southern part of the corridor. It would not be possible to avoid all the habitats in this area as they span the entire corridor, but direct impacts will be mitigated.

Area 3

4.56 Area 3 covers the western onshore study area south of Howe Farm and Buckies up to and including Bloody Moss, Yellow Moss and Moss of Halkirk, plus part of the eastern onshore study area between Howe Farm and Aimster (Figure 2.12).

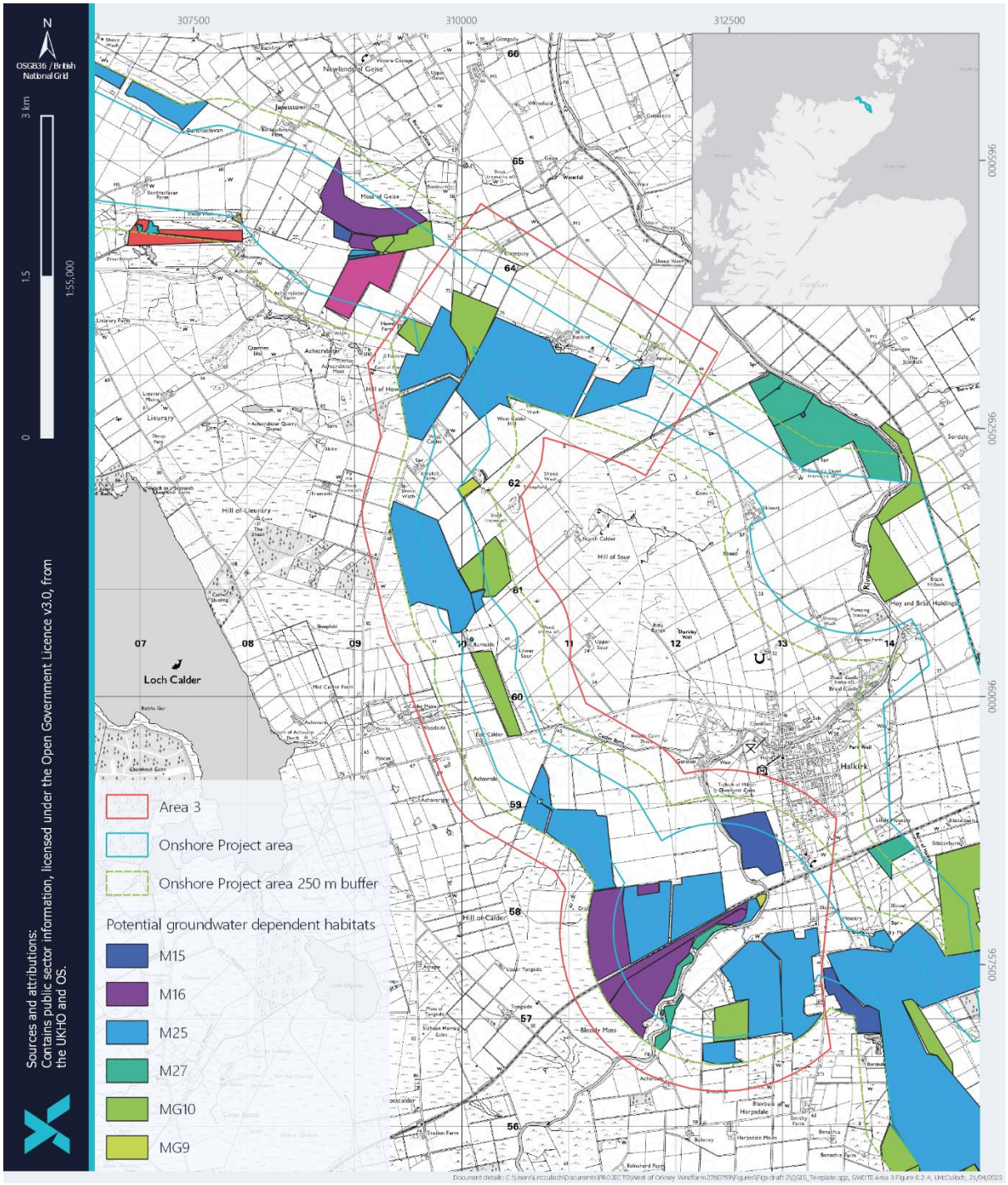

Figure 2.12 Potentially groundwater-dependent communities in Area 3

Habitats present

4.57 One area of M15 is present in the south at Moss of Halkirk.

4.58 Two areas of M16 are present to the north and south of the railway line at Bloody Moss, with a third small area 620 m east of Drakerous.

4.59 Four small areas of M27 are present along the River Thurso, south of the railway line.

4.60 Five areas of MG10 are present throughout Area 3. Two are present in the north, to the east of Howe Farm. Two are located in the centre of Area 3 near Carnavagry and Burnside. One is located south of the railway line at Torranshondall.

4.61 There are two small areas of MG9. One is located outwith the onshore Project area to the north-east of Carnavagry. The other is in the south of Area 3 between the railway line and the River Thurso.

4.62 A very small area of S27 is located in the centre of Area 3 at Burnside.

4.63 There are several large areas of M25 throughout Area 3. These are present in four main areas: in the north where the onshore Project area splits; in the centre of Area 3 at Carnavagry; to the south-east of Achavrole and north of Drakerous; and, on either side of the railway line at Bloody Moss and Yellow Moss.

Setting and infrastructure

4.64 Bedrock in Area 3 consists of interbedded sandstone and siltstone with mudstone in some areas.

4.65 Superficial deposits predominantly consist of diamicton till. In the south-west, approximately 1 km north-east of Hill of Calder, there is a small area of hummocky glacial deposits consisting of diamicton, sand and gravel. In the south of Area 3, alluvium (consisting of clay, silt, sand and gravel) and river terrace deposits (consisting of gravel sand, silt and clay) are present along the River Thurso.

4.66 Peat was identified during the Phase 1 peat survey in the southern region of Area 3 at Bloody Moss, Yellow Moss and Moss of Halkirk. Smaller areas of peat were also identified in the north and centre of Area 3. See OMP3: West of Orkney Windfarm: Outline Peat Management Plan for further details.

4.67 Infrastructure development in Area 3 would potentially consist of the onshore export cables if the western corridor were selected as the preferred route. HDD would be used for crossing the railway line and the River Thurso. HDD compounds would be required at either end of the HDD crossing.

Assessment

4.68 It is anticipated that habitats adjacent to the River Thurso are reliant on surface water and connected groundwater within the alluvial and river terrace deposits around the main watercourse channel. Habitats within areas of peat, in particular at Bloody Moss, Yellow Moss and Moss of Halkirk, are not likely to be groundwater-dependent.

4.69 In areas not on peat it is also unlikely that surface vegetation communities are groundwater-dependent due to the prevalence of glacial till deposits across the entire area, which would act to insulate the surface habitats from groundwater in the bedrock.

4.70 It would not be possible to avoid direct impacts to some areas of sensitive habitat as these cross the entire corridor in two areas – the section between Howe Farm, Buckies and Aimster in the northernmost part of Area 3, and at Carnavagry in the central section. In these areas it would be preferable to route the cable trenches through the areas of M25 habitat as it is less sensitive than the other habitat classes.

4.71 In other parts of Area 3, it would not be possible to maintain a 250 m buffer between excavations and the identified sensitive habitats as the areas are too constrained. This includes the area south of Carnavagry and all of the southernmost section including the River Thurso and railway crossings.

4.72 Additional care would be required for selecting the preferred location for the HDD crossing under the railway line and River Thurso. The preferred option would be to have one single HDD section, meaning that the areas of M16, M27, MG9 and M25 between the river and the railway would be unlikely to have a direct impact. Siting of the HDD compounds should avoid the higher-sensitivity habitats including if possible the areas of M16 and M15 to either side of the river and railway line in this area.

Area 4

4.73 Area 4 covers the eastern onshore study area south of Aimster to Sibster (Figure 2.13).

Habitats present

4.74 Two very small areas of M15 are present in the north of Area 4 on the western side of the River Thurso.

4.75 Two areas of M27 are present in Area 4. One large area is located in the north, on the western side the River Thurso, and one smaller area is found in the south, just outwith the onshore Project area at Sibster.

4.76 One area of MG10 is located in the centre of Area 4, east of the River Thurso.

Setting and infrastructure

4.77 Bedrock in Area 4 consists of interbedded sandstone and siltstone with mudstone in some areas.

4.78 Superficial deposits predominantly consist of diamicton till. Alluvium (clay, silt, sand and gravel) and river terrace deposits (gravel, sand, silt and clay) are found along the River Thurso valley. A small pocket of glaciofluvial deposits, consisting of gravel, sand and silt, is located to the west of the River Thurso in the north-western part of Area 4.

4.79 The Phase 1 peat survey identified some areas of peat along the banks of the River Thurso just north of Halkirk, and one small pocket in the south of Area 4 near Sibster. See OMP3: West of Orkney Windfarm: Outline Peat Management Plan for further details.

4.80 Infrastructure development in Area 4 would potentially consist of the onshore export cables if the eastern corridor were selected as the preferred route. HDD would be used for crossing the River Thurso and railway line.

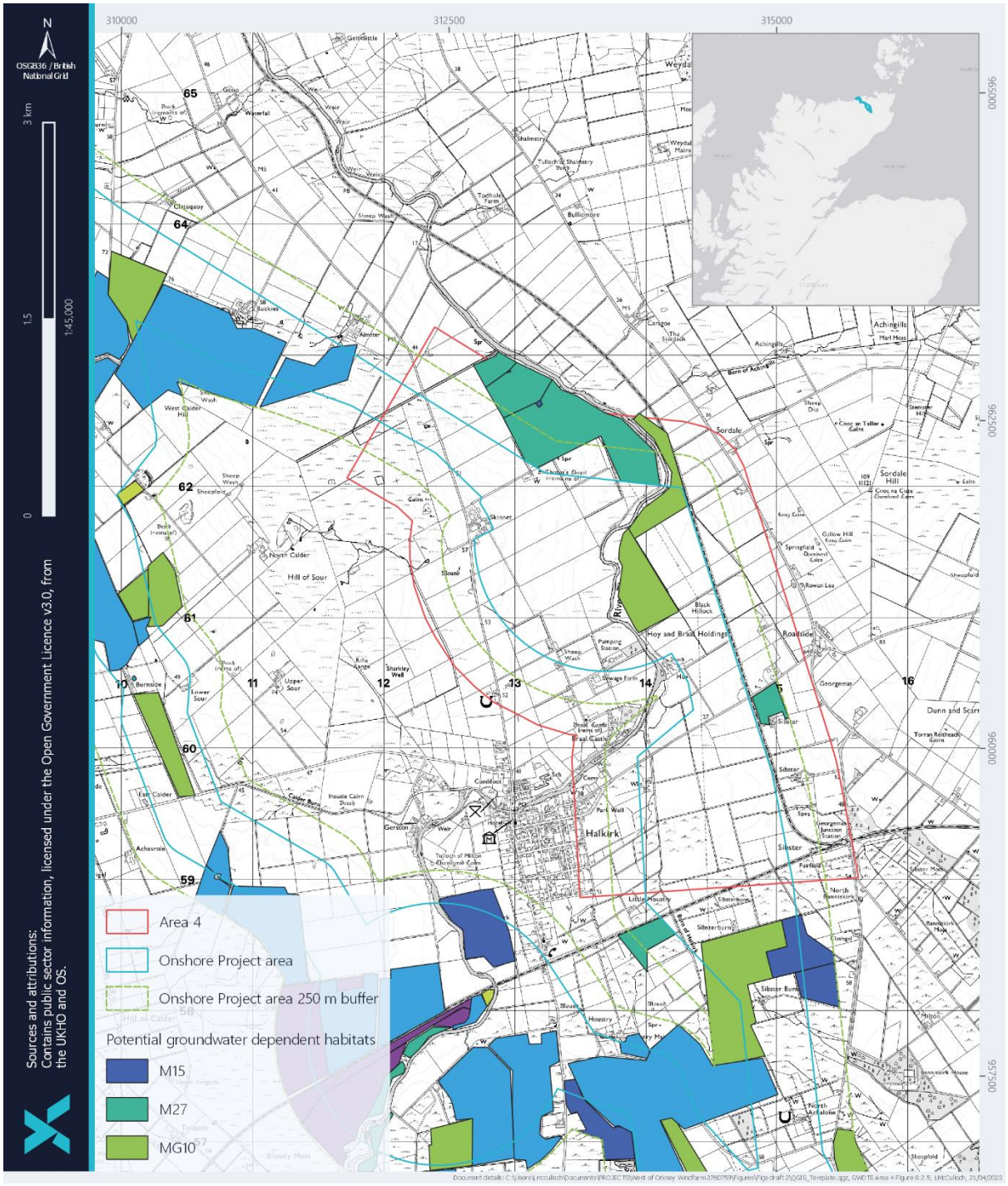

Figure 2.13 Potentially groundwater-dependent communities in Area 4

Assessment

4.81 It is anticipated that the habitats present around the River Thurso are reliant on surface water and connected groundwater within the alluvial and river terrace deposits around the main watercourse channel. Where peat is present along the watercourse there is likely to be localised flushing.

4.82 Other habitats in Area 4 are situated on diamicton till which is likely to insulate them from groundwater in the underlying rock. The spring identified on the map near Skinnet was discovered to be a field drain discharge rather than an actual spring.

4.83 With careful design it would be possible to avoid most of the sensitive habitats in Area 4. If the onshore export cables cross the River Thurso near Hoy and Braal Holdings the construction works would overlap with the 250 m buffer around the MG10 habitat, as this spans the full width of the onshore Project area at this point. Depending on the preferred route, there may be some limited direct impacts on the MG10 habitat in this area.

Area 5

4.84 Area 5 covers southernmost part of the onshore study area from the railway line at Sibster and east of Moss of Halkirk (Figure 2.14).

Habitats present

4.85 Three areas of M15 are present in the north-west, north-east and south-west of Area 5.

4.86 There are two main areas of M25 present. One very large area covers the majority of the western part of Area 5 from Houstry Mains to approximately 400 m north of Achanarras, and one small area in the south-east, just outwith the onshore Project area at Achcomhairle.

4.87 One area of M27 is present immediately south of the railway. It is located outwith the onshore Project area between the western and eastern sections of the onshore Project area.

4.88 Several areas of MG10 are present throughout Area 5, with the largest area in the southern part around Achanarras.

4.89 One very small area of MG8 is present just outwith the onshore Project area to the west of Spittal Hill.

4.90 Two areas of MG9 are present in the south of Area 5. One is located at Achanarras and the other to the east of Achanarras on the onshore Project area boundary.

Setting and infrastructure

4.91 Bedrock in Area 5 consists of interbedded sandstone and siltstone with mudstone in some areas. The Achanarras Fish Bed crosses the area, consisting of interbedded limestone and subequal/subordinate argillaceous rocks with fish fossils.

4.92 Superficial deposits in this area are almost entirely made up of diamicton till, with small pockets of hummocky glacial deposits (consisting of diamicton, sand and gravel) in the east near North Achalone. In the south there is a small area of alluvium (consisting of clay, silt, sand and gravel) to the south-east of Achanarras.

4.93 The Phase 1 peat survey found that areas of peat were present in this region, notably along the western margin between Houstry and Benachie. A few small pockets of peat are present in other areas. See OMP3: West of Orkney Windfarm: Outline Peat Management Plan for further details.

4.94 Infrastructure development in Area 5 would consist of the onshore export cables and the onshore substation, plus the HDD crossing of the railway and associated HDD compounds.

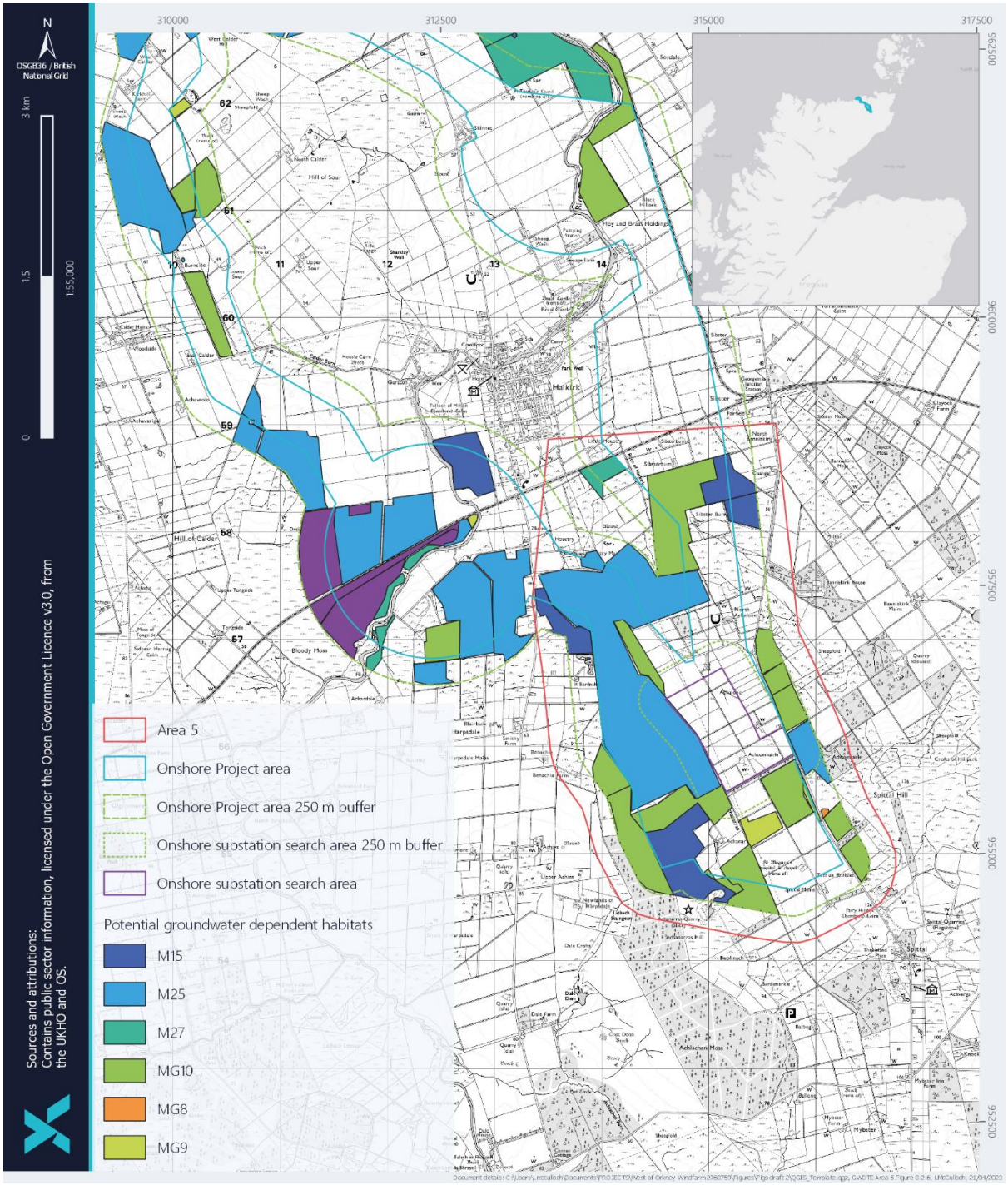

Figure 2.14 Potentially groundwater-dependent communities in Area 5

Assessment

4.95 It is unlikely that any of the habitats on the western half of Area 5 are groundwater-dependent due to the presence of deep peat (up to 4 m) in this area and the prevalence of clay-rich superficial deposits.

4.96 The Phase 1 peat surveys found little to no peat in the eastern half of Area 5, except for a few small and localised pockets. However, since this region also has significant deposits of diamicton till, it is unlikely that any of these habitats are truly groundwater-dependent.

4.97 Sensitive habitats cover the majority of Area 5 with the exception of the eastern onshore Project area between Sibster Burn and Achcomhairle. Therefore, there would be direct impacts to the identified habitats in this area. Careful route design would help to minimise direct impacts and avoid higher-sensitivity habitats where possible.

4.98 There are no sensitive habitats within the onshore substation search area. The 250 m buffer for this area overlaps areas of M25 and MG10 on all sides of the onshore substation search area, although the areas of overlap are relatively small in extent.

4.99 The area along the south-western margin is across the Achanarras Burn from the onshore substation search area and would therefore be hydraulically isolated from the works. The area along the north-eastern margin is across the A9 from the onshore substation area and is upslope of the onshore substation area; as a result it is unlikely to be affected.

4.100 The area to the south-east of the onshore substation search area is adjacent to the existing SHETL substation and shows no signs of impact from the excavations required for this development. It is unlikely that any effect would arise from a more distant excavation.

4.101 A small area of MG10 located to the north-west of the onshore substation search area has no proposed excavation works directly upslope and does not extend to the substation search area margin. It is therefore unlikely to be affected by any required groundworks for the onshore substation.

4.102 Careful design of the onshore substation infrastructure would avoid any direct impacts on these habitats.

5 PROTECTION AND MITIGATION

Design and mitigation

5.1 Sensitive habitats, as identified in this assessment, can easily be impacted by changes in their water supply, whether this is from groundwater, surface water or rainwater. With this in mind, the following good practice construction methods will be used for all development on or adjacent to sensitive habitats.

5.2 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.

5.3 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 Environmental Clerk of Works (ECoW), and based on local ground conditions.

5.4 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.

5.5 All works through and adjacent to wetland areas will be supervised by the ECoW.

5.6 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.

5.7 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.

5.8 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, 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.

5.9 There are several areas of concern where sensitive habitats are likely to be directly impacted by the proposed onshore export cables and substation. These are as follows:

- Area 1: MG10, MG9, M27 and W6 habitats are present in the north-east, around Forss Smallholdings. Development works will overlap with the 250 m buffer of some or all of these sensitive habitats. In some areas sensitive habitats cover the

entirety of the onshore Project area. This is the case for an area of MG10 (present at Lybster Smallholdings in the north-west) and for M25 and MG10 habitats located just north of Brimside Tulloch Broch in the centre-east of Area 1.

- Area 2: M15, M16, M25 and MG10 habitats as well as an M25/M15 mosaic habitat located in the east near the Moss of Geise have potential to be directly impacted as they span the full width of the onshore Project area at this location.
- Area 3: M25 habitats present in the north at West Calder; M25 and MG10 habitats present at Carnavagry. At both locations these sensitive habitats are present across the width of the cable corridor. In the south at Bloody Moss, Yellow Moss and Moss of Halkirk the onshore export cables will be required to cross the railway line and the River Thurso; there are several sensitive habitats present across the majority of the onshore Project area, including an area of M16.
- Area 4: the buffer for MG10 habitat spans the full width of the onshore Project area at Hoy and Braal Holdings and there is potential for the development works to overlap with this buffer should the onshore export cables cross the River Thurso and railway line at this point.
- Area 5: sensitive habitats cover the majority of Area 5 with the exception of the eastern onshore Project area between Sibster Burn and Achcomhairle. Therefore, it will not be possible to avoid direct impacts on sensitive habitats in this area.

Monitoring

5.10 Targeted monitoring will be put in place to provide a check on the identified sensitive habitats, and to ensure that mitigation and protection measures are in place and effective.

5.11 Surface water monitoring will be established within the existing watercourse network. Details are provided in SS3: West of Orkney Windfarm: Flood Risk and Drainage Assessment.

5.12 All areas of sensitive habitat will be visited and assessed by the ECoW prior to the commencement of any construction works. Assessment will include collection of representative photographs of the areas which are most likely to be affected by the works. Regular assessment visits will be undertaken throughout the construction period and for a minimum of 12 months after reinstatement to ensure that habitat protection is effective, and any restoration and recovery works become established. Areas of sensitive habitat will be monitored through the Habitat Management Plan (HMP), developed at post consent.

5.13 All proposed monitoring will begin at least 6 months prior to construction work and will continue throughout the construction period, and for at least 12 months following reinstatement.

6 CONCLUSIONS

6.1 A detailed assessment of the interaction between the proposed works for the onshore Project and any potentially GWDTE has been undertaken.

6.2 The potentially groundwater-dependent NVC communities identified within the onshore study area 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.

6.3 M16 has potentially moderate to high groundwater dependency. M15, M27, M28, MG10, MG8, MG9 and W6 have potentially moderate groundwater dependency. M25 and S27 have potentially moderate to low groundwater dependency.

6.4 Owing to the distribution of habitats within the onshore study area, habitats have been assessed in smaller sub-areas rather than across the onshore study area as a whole.

6.5 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. The superficial deposits, consisting largely of clay-rich diamicton till, are anticipated to act mainly to insulate the groundwater in the bedrock from the ground surface in areas where present, effectively preventing groundwater discharge at surface. Areas without significant superficial deposits are mainly found in the north of the onshore Project area (Areas 1 and 2), mainly forming ridges and hills of higher ground. Although a number of wells are mapped in this part of the study area, habitats are unlikely to be groundwater-dependent as a result of the location at or near the tops of hills and ridges.

6.6 The topographical setting of Loch Lieurary (Area 2), plus its lacustrine deposits, indicate that groundwater may be present in this area and that habitats in association with Loch Lieurary may be groundwater-dependent. No direct confirmation was apparent during site visits, but it is recommended that a precautionary approach is taken in this area.

6.7 No evidence of springs or seepage zones was identified during site visits, although several local PWS are noted to rely on spring sources. All the mapped springs visited were discharges from field drains rather than groundwater spring points.

6.8 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.

6.9 Impacts to identified sensitive habitats will be kept to a practical minimum through avoidance by careful design and the use of best practice construction and mitigation measures. Specific mitigation measures to avoid changes to the watercourse and wetland hydrochemistry through 'flushing' of excavated material in surface runoff have been set out and will be adhered to during all site works. Areas of sensitive habitat will be monitored through the Habitat Management Plan, developed at post-consent.

6.10 Areas of sensitive habitat or GWDTE would have visual monitoring established prior to construction work, throughout construction and for a minimum of 12 months post-reinstatement, all monitoring of sensitive habitats will be in accordance with the approved HMP, produced at post consent.

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8 ABBREVIATIONS AND ACRONYMS

Acronym	Definition
AOD	Above ordnance datum
BFI HOST19	Baseflow index derived from the Hydrology of Soil Types
BGS	British Geological Survey
CEH	Centre for Ecology and Hydrology
ECoW	Environmental Clerk of Works
DWPA	Drinking water protected area
EIA	Environmental impact assessment
FEH	Flood Estimation Handbook
GWDTE	Groundwater-dependent terrestrial ecosystem
HDD	Horizontal directional drilling
HMP	Habitat Management Plan
NGR	National grid reference
NVC	National vegetation classification
OMP	Outline Management Plan
OS	Ordnance Survey
PROPWET	Catchment wetness index
PWS	Private water supply
SEPA	Scottish Environment Protection Agency
SPR HOST	Standard percentage runoff derived from the Hydrology of Soil Types
SS	Supporting Study
SuDS	Sustainable Drainage Systems
THC	The Highland Council
UKTAG	United Kingdom Technical Advisory Group