Bloch Wind Farm

Technical Appendix 9.6: Watercourse Assessment

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Renewable Energy Systems Limited

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Contents

1. Introduction

This document provides an overview and assessment of the watercourses and artificial drainage networks at Bloch Wind Farm (proposed development) as part of Chapter 9: Hydrology, Hydrogeology, Geology and Soils of the Environmental Impact Assessment Report (EIA Report). The purpose of this document is to provide consultees with further information on the distribution of natural and artificial hydrological networks and how these have been considered in the siting of the infrastructure associated with the proposed development.

Details of the hydrological regime and associated flood risk affecting the proposed development is presented in Chapter 9 of the EIA Report. Further information on watercourse crossings is presented in Technical Appendix 9.1: Schedule of Watercourse Crossings.

This technical appendix is supported by the following figures provided in Volume 2a of the EIA Report;

- Figure 9.1: Hydrology Overview;
- Figure 9.2: Flow Accumulation; and
- Figure 9.13: Natural & Artificial Drainage Networks.

1.1. Background

The proposed development comprises the construction of up to 21 wind turbines and associated infrastructure. As outlined in Chapter 9, Section 9.7, of the EIA Report, the proposed development has generally avoided sensitive hydrological receptors (including watercourses) through embedding set back distances (or buffers) in the design.

The identification of hydrological receptors such as watercourses is based primarily on Ordnance Survey (OS) mapping subsequently verified through field surveys. During the mapping exercise and subsequent surveys, it was noted that some of the minor watercourses shown on 1:10,000 scale OS maps were artificial drainage ditches. These artificial ditches varied in condition from being recently cleared out with minor but continuous flow, to being barely discernible and stagnant.

Artificial drainage ditches (or “grips”) are part of the upland hydrological network installed by current or former land users with the specific purpose of encouraging land drainage and other associated effects. Artificial ditches are commonplace in upland environments such as peatlands and are characterised by being typically shallow, and narrow and extending into the upper 0.5 to 1.0m of the surface superficial cover. Artificial ditches are characterised by their regular form, structure, and distribution. The density of the artificial drainage ditch network within the proposed development is such that total avoidance of these features is not possible.

Whist none of the proposed development infrastructure is within 50m of any watercourse mapped on the 1:25,000 scale OS or 1:50,000 scale OS (apart from watercourse crossings on access tracks), the following proposed infrastructure locations are within 50m artificial drainage ditches which are only shown on the 1:10,000 scale OS map;

- T3 and crane hardstand;
- T5 and crane hardstand;
- T17 and crane hardstand; and
- T18 and crane hardstand.

In all cases further investigation and assessment provided later in this appendix has determined that despite being mapped drainage channels on the OS mapping, these features are confirmed to be artificial drainage ditches. As these ditches are heavily modified and contribute to the degradation of the surrounding habitat through continual drainage, during the construction it is proposed these ditches would be blocked around the infrastructure location.

As well as habitat restoration, blocking the ditches would contribute to reducing peak flows by slowing the flow of water entering the natural drainage network. This assessment provides reassurance to Regulators and stakeholders that natural or sensitive hydrological features will not be affected by construction and operation of the proposed development. Further information available in Technical Appendix 7.6: Outline Habitat Management Plan.

2. Methodology

2.1. Desk Study

The desk study consisted of an examination of the infrastructure layout and the identification of watercourses, including those marked on the 1:10,000, 1:25,000 and 1:50,000 scale OS maps. Additional information collated as part of Chapter 9 of the EIA Report, as well as the supporting figures and technical appendices.

Information of watercourses and artificial ditches were also obtained using a combination of aerial imagery and LiDAR data obtained from the Scottish Remote Sensing Portal[1].

2.2. Site Survey

Following the completion of the desk study, a walkover survey was undertaken by an experienced hydrologist to verify the distribution and accuracy of the identification of natural watercourses and artificial ditches.

2.3. Identification & Assessment

The information obtained during the desk study and site walkover survey will be used to map the extent of natural watercourses and artificial ditch networks at the proposed development.

The assessment will comprise an assessment which demonstrates that blocking and managing these artificial features would not result in any adverse significant effects and would instead provide environmental betterment.

3. Results

3.1. Desk Study

The results of the desktop study confirmed the presence of natural watercourses networks as well as artificial drainage ditches which are clearly identifiable on the LiDAR and aerial imagery (Figure 3.1).

Artificial ditches are typically arranged in a logical and organised manner tending to be linear, with pronounced geometry associated with unnatural changes in flow direction. Artificial ditches lack sinuosity, and their shape is not usually reflected in the surrounding topography. Artificial ditches also spanned entire catchments and, in some instances, between separate catchments. In some, the excavated material is also visible on one side of the ditch.

As well as a discrete network of variably sized and orientated artificial ditches, small areas of the site boundary have been subject to more intense and regularised ploughing, with ditches parallel to one another with spacing varying from 25m to 10m.

[1] Scottish Remote Sensing Portal. 2022. Available at https://remotesensingdata.gov.scot/ (accessed 27/09/2022).

Source: Remote Sensing Portal / Bing Maps

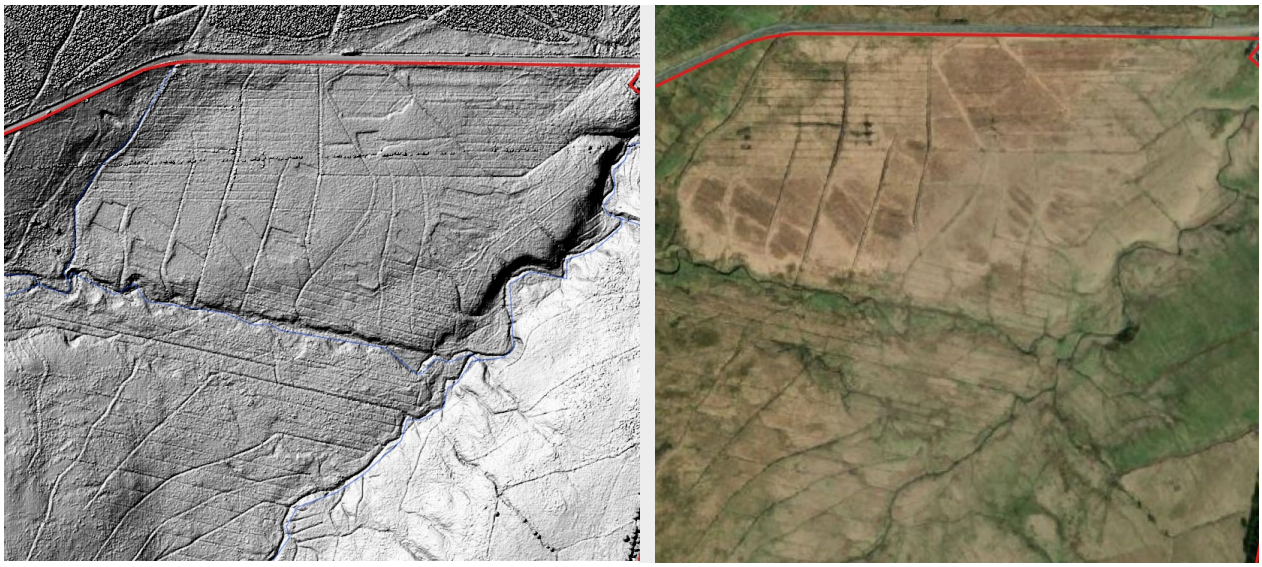


Figure Insert 3.1: **LiDAR imagery (left) and aerial imagery (right) illustrating the presence of artificial drainage networks present within the site boundary (image of west of Collin Burn)**

Natural watercourse channels were also identifiable on the LiDAR and aerial imagery (Figure Insert 3.2) and were mapped concomitant to features shown on the 1:25,000 scale OS and 1:50,000 scale OS. Watercourses were typically sinuous in lower reaches and more linear through steeper terrain. The topography surrounding the watercourse was also often reflective of its geometry, occupying re-entrant type features with nearby slopes also reflecting any associated sinuosity.

Source: Remote Sensing Portal / Bing Maps

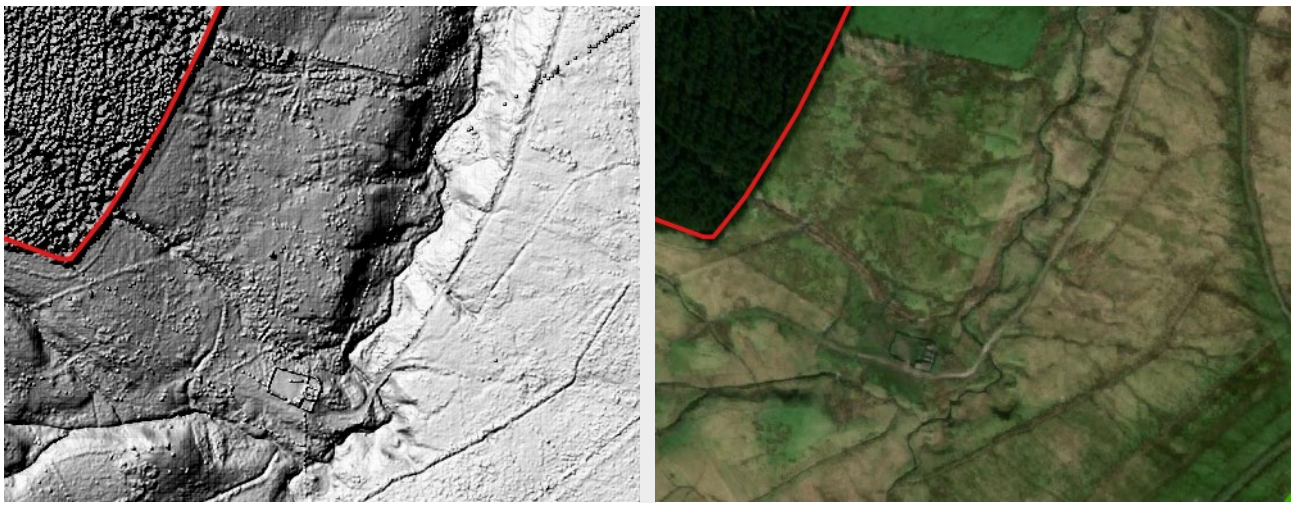


Figure Insert 3.2: **LiDAR imagery (left) and aerial imagery (right) illustrating watercourse features (image of Back Burn)**

Information relating to each of the hydrological catchment areas including extent, watercourse names, River Basin Management Plan (RBMP) status etc, can be found in Chapter 9, Section 9.5, of the EIA Report.

3.2. Site Survey

Site walkovers were undertaken on the 20 July and 9 August 2022 by a Hydrologist to survey the hydrology of the proposed development. Specific hydrological assessments were undertaken within all the main catchment areas and also at proposed infrastructure locations, including T5 and crane hardstand, T3 and crane hardstand, T17 and crane hardstand; and T18 and crane hardstand.

The survey results provided ground truthing for artificial drainage networks identified using aerial imagery and LiDAR data. These are identified in Figure 9.12: Natural & Artificial Drainage Networks.

Further details are provided in the sections below.

3.2.1. Artificial Drainage Networks

Artificial drainage networks were evident across the site. The majority of artificial ditches were dry or stagnant, apart from where these occurred on steeper slopes where they were slightly scoured, and some flow was evident. The bed of the artificial ditches was generally vegetation, but occasionally exposed subsoil or peat was identified.

Anecdotal information indicates that a small number of the ditches are regularly cleared as part of the baseline land use for agriculture, with more recently excavated sections also demonstrating a very low level of flow. Figure insert 3.3 illustrates ditches surveyed during the hydrological walkover.

Source: Natural Power

Figure Insert 3.3: Photographs of an artificial ditch recently cleared for land use (left) and of a heavily vegetated ditch which was dry / stagnant

The site walkover indicated that surveyed artificial drainage ditches correlated well with those identified on LiDAR and aerial imagery. Further comparison of the position of artificial drainage ditches in relation to the flow accumulation model presented in Figure 9.2 in Volume 2 of the EIA Report demonstrates divergence from the model, with zones of expected flow not containing any flow due to redirection from artificial ditches. This further highlights the effect that such features impart in modifying the hydrological regime within the site boundary.

Specific surveys were also undertaken at the aforementioned infrastructure locations. Photographs as well as assessment notes are presented for these in Appendix A.

3.2.2. Unmodified Watercourses

Hydrologically, the proposed development lies in the watershed of the River Esk which discharges into the Solway Firth and therefore falls within the Solway-Tweed River Basin District which is jointly managed by SEPA and the Environment Agency.

Watercourses or their tributary catchments within the site, which are sub-catchments to the River Esk are the Collin Burn, Back Burn, Cow Sike, Bloch Burn, Hall Burn and Kerr Burn.

Apart from artificial drainage ditch tributary confluences and the effects of heavy grazing in riparian zones, the form of mapped watercourses was generally unmodified. Typically, these watercourses were incised into the subsoil with the bed being sub-soil or more commonly bedrock and gravel.

Watercourses occupied topographical re-entrant features ranging from shallow to more pronounced vee shape. Where watercourses were mapped as terminating on 1:25,000 scale OS or 1:50,000 scale OS, channels became more poorly defined and in some cases were connected to a network on drainage ditches which were often noted as dry. Flow within headwater channels appeared to be derived through diffusely emerging groundwater, drainage or seepage from upgradient areas of topographical convergence and occasionally drainage from recently cleared artificial ditches.

Photographs obtained during the surveys are presented below.

Source: Natural Power

Figure Insert 3.4: Photographs of the Back Burn (left) at E330962, N580234 and Bloch Burn (right) at E333282, N581957.

The site surveys confirmed the extent of these networks correlated well with watercourses identified on 1:25,000 scale OS and 1:50,000 scale OS.

3.3. Summary

The desktop assessed findings have been verified through an on-site survey and have demonstrated that there is a complex assemblage of both generally unmodified watercourses and an extensive network of artificial drainage ditches within the site.

The extent of generally unmodified watercourses aligns with watercourses mapped on the 1:25,000 scale OS and 1:50,000 scale OS. These watercourses will be allocated a 50m buffer and considered appropriately within Chapter 9 of the EIA Report.

Artificial drainage ditches aren't generally shown on any mapping, however some ditches are shown on the 1:10,000 scale OS. Artificial ditches (including those mapped on 1:10,000 scale OS) have not be allocated a set-back buffer but will still be considered appropriately within Chapter 9 of the EIA Report.

4. Good Practice Mitigation

In order to avoid and minimise any adverse effects on the hydrological environment, including watercourses and artificial drainage networks, good practice mitigation will be implemented during the construction of the proposed development.

Full details of the good practice construction management and mitigation measures to be implemented during the construction of the proposed development have been outlined Chapter 9, Section 9.7 and Technical Appendix 2.1: Outline Construction Environmental Management Plan (CEMP). These measures would be outlined again prior to construction in a CEMP, the details of which would be embedded within construction contractor working method statements.

4.1. Pollution Prevention

During the construction and operation of the proposed development, pollution prevention measures would be utilised to minimise any potentially adverse effects on hydrological receptors. This includes any resultant sedimentation or pollution of watercourse networks arising from constructing in areas that contain existing artificial drainage networks. These networks would potentially act a pathway for pollution and as such will require specific consideration in temporary and permanent drainage plans.

Standard good practice mitigation which would be outlined in the CEMP will include requirements to identify and manage artificial drainage networks prior to and during construction works. Robust mitigation including the use of separate clean water and construction runoff systems, cut-off drains and multiple water treatment steps would be form part of these measures.

Further details on pollution prevention can be found in the Technical Appendix 2.3: Outline Pollution Prevention Plan.

4.2. Ditch Blocking

It is proposed that the identified artificial ditch networks at T3 and crane hardstand, T5 and crane hardstand and T18 and crane hardstand would be blocked during the construction of the proposed development to protect downgradient / downstream receptors. No artificial ditch or other hydrological network could be identified at T17. The blocking of these ditches would be undertaken in accordance with good practice mitigation outlined in Section 9.7 Mitigation, detailed in Chapter 9 of the EIA Report. Further information including method statements and site-specific environment management plans would be provided in the CEMP prior to construction.

It is emphasised that this assessment has identified an extensive network or artificial drainage ditches present within the site boundary. Blocking ditches at the aforementioned proposed turbine locations, as well as wider proposal for ditch blocking incorporated into the habitat management plan would provide environmental betterment both through reducing the runoff rate from the site boundary and therefore alleviating flood risk but would also potentially discourage drawdown and drainage of peatland habitats. It is highlighted that ditch blocking in other areas would require consideration and assessment to avoid impacts on the baseline hydrology. Further details on ditch blocking and habitat restoration are provided in the Technical Appendix 7.6: Outline Habitat Management Plan.

5. Conclusion

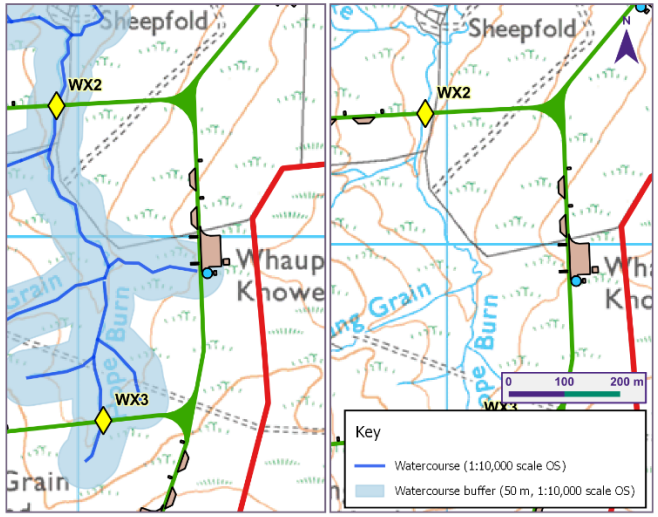
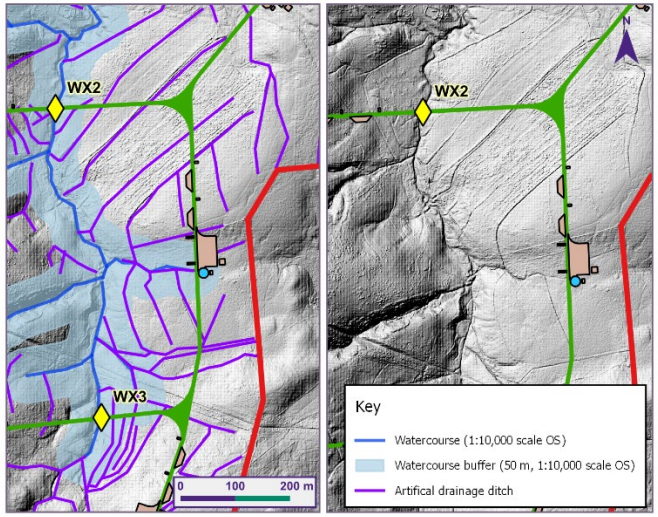
The purpose of this technical appendix was to provide further and more detailed information on the assemblage of watercourses and artificial drainage networks situated within the site boundary.

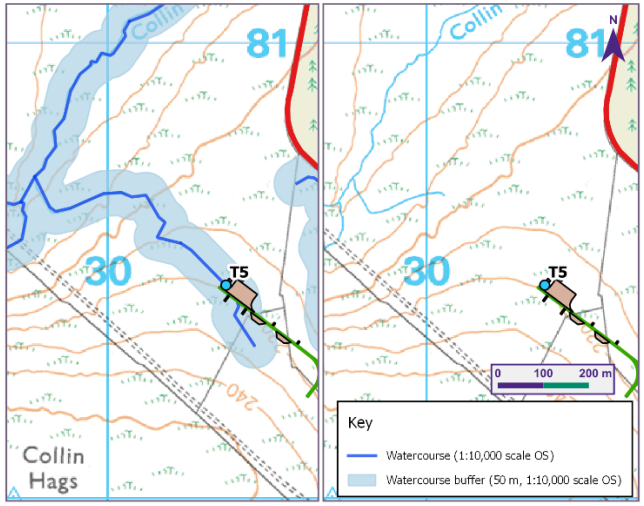
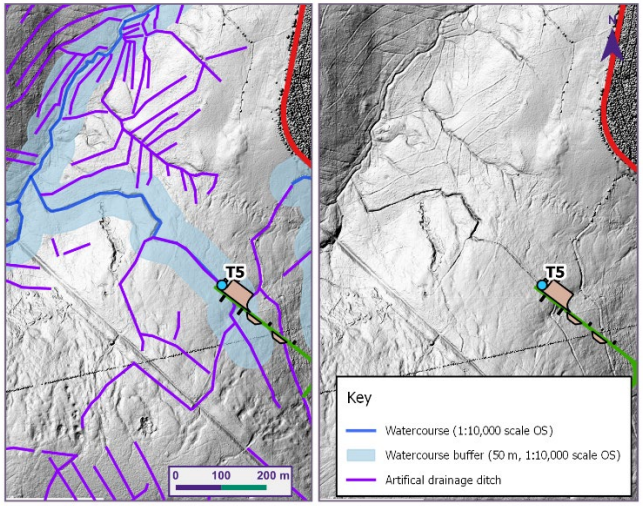
The assessment has identified that watercourses shown on the 1:25,000 scale OS and 1:50,000 scale OS closely represent the distribution of unmodified watercourse networks and that an extensive network of artificial drainage ditches to encourage land drainage are also present, with some of these also be shown on the 1:10,000 scale OS.

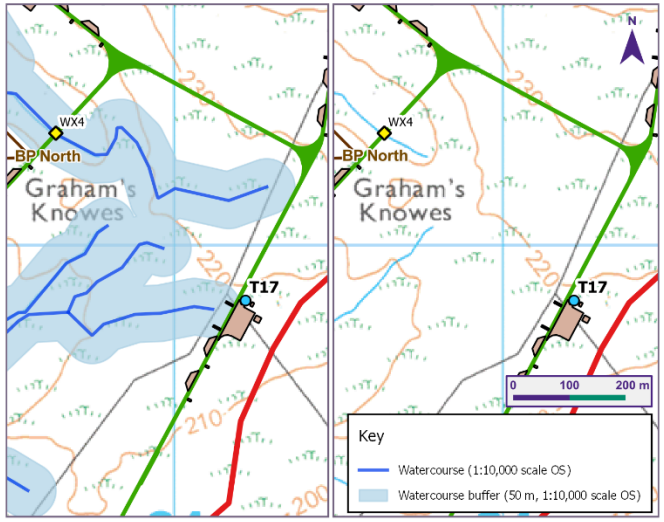
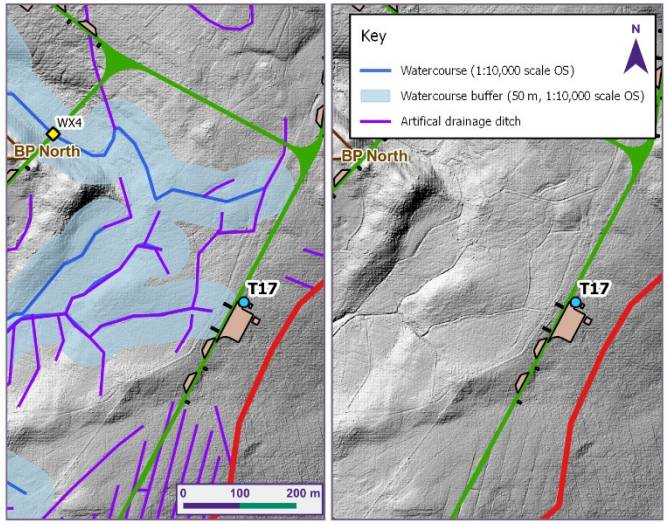
Due to the density of artificial drainage ditches, it has not been possible to completely avoid all artificial drainage features, including some of those shown on 1:10,000 scale OS. Where proposed infrastructure is positioned within 50m of these features, a site-specific assessment has been undertaken to confirm these features are artificial drainage ditches and not reflective of the natural watercourse network. Owing to these features being artificial ditches, it is proposed that as part of the construction of the proposed development these would be blocked to provide environmental betterment for flood risk and habitat restoration. During blocking activities robust pollution prevention measures would be implemented to ensure that downstream networks are not subject to any associated adverse effects. As the sensitivity of the artificial ditches is low on account of them being anthropogenically introduced features to encourage land drainage, and that during construction activities robust mitigation would be implemented in the form of pollution prevention which would minimising the magnitude of any associated effect to be negligible, the related significance of effect is therefore negligible and not significant.

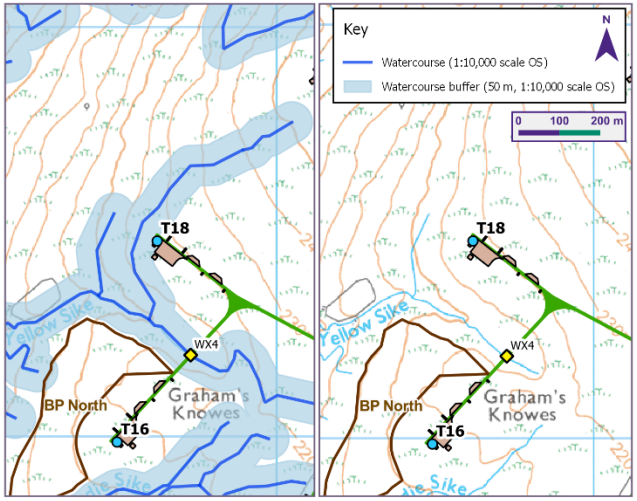
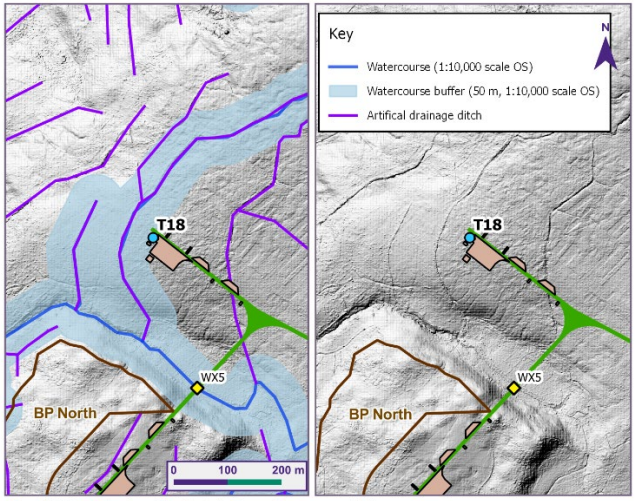
Appendices

A. Assessment Notes

T3 (331233, 579934)	
	• Survey undertaken to characterise watercourse tributary shown on 1:10,000 scale map and noted absent from 1:25,000 and 1:50,000 scale OS. • Desktop assessment using LiDAR and aerial imagery identified high number of artificial drainage ditches within the vicinity all draining into the Hope Burn (upper Back Burn). • Site walkover identified a vegetation filled artificial ditch that was dry with no evidence of flow. Artificial ditch appears to confluence with the Hope Burn ~200m to the west. Hope Burn is a natural watercourse channel and is outside the buffer. • As the mapped ditch is artificial and it is evidentially not a watercourse, the ditch would be blocked at the point of overlap during construction of T3. • Surrounding habitat noted as M25 (modified bog) and around ditch may benefit from ditch blocking.
 	 Scottish Remote Sensing Portal. Open Government License.

T5 (330260, 580468)	
	• Survey undertaken to characterise watercourse tributary shown on 1:10,000 scale map and noted absent from 1:25,000 and 1:50,000 scale OS. • Desktop assessment using LiDAR and aerial imagery identified high number of artificial drainage ditches within the vicinity all draining into the Collin Burn. • Site walkover identified a vegetation filled artificial ditch that was dry with no evidence of flow close to proposed turbine. Further down ditch had been recently excavated. Artificial ditch confluences with the Collin ~400m to the west. Collin Burn and the lower section of the confluence which the artificial ditch is connected to is a natural watercourse channel and is outside the buffer. • As the mapped ditch is artificial and it is evidentially not a watercourse, the ditch would be blocked at the point of overlap during construction of T5. • Surrounding habitat noted as M25 (modified bog) and may benefit from ditch blocking.
	

T17 (334128, 580901)	
	• Survey undertaken to characterise watercourse tributary shown on 1:10,000 scale map and noted absent from 1:25,000 and 1:50,000 scale OS. • Desktop assessment using LiDAR and aerial imagery identified high number of artificial drainage ditches all draining into a tributary of the Bigholm Sike. • The site walkover identified no drainage network at the proposed turbine location. Approximately 100m to the west the ditch became more pronounced. The artificial ditch confluences with a headwater tributary of the Bigholm Sike ~300m to the west. The Bigholm Sike is a natural watercourse channel and is outside the buffer. • As the mapped ditch is ~100m from the proposed turbine and is also artificial, no specific consideration is required. • Surrounding habitat noted as M25 (modified bog) and where the ditch becomes pronounced may benefit from ditch blocking.
 	

T18 (334128, 580901)	
	• Survey undertaken to characterise watercourse tributary shown on 1:10,000 scale map and noted absent from 1:25,000 and 1:50,000 scale OS. • Desktop assessment using LiDAR and aerial imagery identified high number of artificial drainage ditches all draining to a tributary of the Bigholm Sike. • Site walkover no drainage network at the proposed turbine location. Approximately 100m to the west the ditch became more pronounced. The artificial ditch confluences with a headwater tributary of the Bigholm Sike ~300m to the west. The Bigholm Sike is a natural watercourse channel and is outside the buffer. • As the mapped ditch is ~100m from the proposed turbine and is also artificial, no specific consideration is required. • Surrounding habitat noted as M25 (modified bog) and where the ditch becomes pronounced may benefit from ditch blocking.
 © Crown Copyright 2022. All rights reserved. Ordnance Survey Licence 0100031673.	 Scottish Remote Sensing Portal. Open Government License.

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