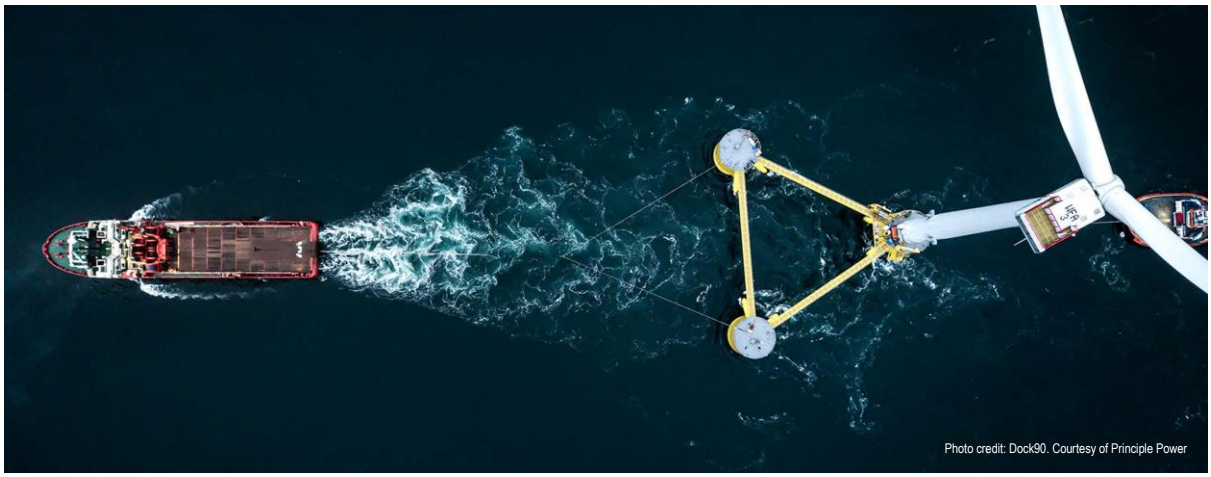

Project Erebus Environmental Statement
Chapter 19: Onshore Geology, Hydrology and Hydrogeology

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Acronyms

Term	Definition
AAA	Anti-Aircraft Ammunition
CEA	Cumulative Effects Assessment
CLV	Cable Lay Vessel
COLREGS	International Regulations for Preventing Collisions at Sea
DECC	Department of Energy and Climate Change
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESCA	European Subsea Cables Association
FLOW	Floating Offshore Wind
GIL	Greenlink Interconnector Limited
HE	High Explosive
IALA	International Association of Lighthouse Authorities
ICPC	International Cable Protection Committee
IMO	International Maritime Organisation
km	Kilometre
km^2	Square kilometre
LNG	Liquified Natural Gas
m	Meter
m^2	Square meter
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act
META	Marine Energy Test Area
MHPA	Milford Haven Port Authority
MMO	Marine Management Organisation

Term	Definition
MoD	Ministry of Defence
MPS	Marine Policy Statement
MW	Megawatt
nm	Nautical Mile
NPS	National Policy Statement
NRW	Natural Resources Wales
NtM	Notice to Mariners
O&M	Operation and Maintenance
OSEA3	Offshore Energy Strategic Environmental Assessment 3
PDE	Project Design Envelope
PDZ	Pembrokeshire Demonstration Zone
PEXA	Practice and Exercise Area
PINS	The Planning Inspectorate
PLG	Pre-Lay Grapnel
PLGR	Pre-Lay Grapnel Run
SAC	Special Area of Conservation
SBE	Simply Blue Energy
UKHO	United Kingdom Hydrographic Office
UXO	Unexploded Ordnance
WNMP	Welsh National Marine Plan
WTG	Wind Turbine Generator
WWI	World War One
WWII	World War Two

Chapter 19 Onshore Geology, Hydrology and Hydrogeology

19.1 Introduction

19.1.1.1 This chapter assesses the potential impacts of the Proposed Development on onshore geology, hydrogeology and hydrology. This includes detailed consideration of potential impacts on surface watercourses, groundwater and the local geology in and around the Proposed Development and any potential impacts on flood risk in the local area. The effects on private water supplies (PWS), both surface water and groundwater sources are also assessed.

19.1.1.2 Desktop and site-based surveys, including a site walkover and PWS survey, have been carried out to inspect and identify potentially sensitive hydrogeological, hydrological and geological receptors.

19.1.1.3 A PWS Assessment has been undertaken to support this chapter and is included as Volume 3, Technical Appendix 19.1. The PWS Assessment provides a detailed overview of the findings from the PWS survey undertaken during the site walkover and establishes their sensitivity to the Proposed Development.

19.1.1.4 A Schedule of Watercourse Crossings has been undertaken to support this chapter and is included as Volume 3, Technical Appendix 19.2. This document provides details of observations at specific watercourses where the onshore export cable crossings are expected and recommends crossing types based on these observations.

19.1.1.5 A Flood Consequence Assessment (FCA) has been prepared detailing flood risk that may arise from the Proposed Development, during both construction and operational phases, and recommends mitigation measures to reduce any potential flood impact. The FCA is included as Volume 3, Technical Appendix 19.3.

19.1.1.6 An Outline Drainage Assessment has been prepared detailing surface and foul water drainage strategies, proposed Sustainable Drainage System (SuDS) features and hydraulic calculations, network sizing and treatment measure calculations. The Outline Drainage Assessment is included as Volume 3, Technical Appendix 19.4.

19.1.1.7 A Project Water Framework Directive Compliance Assessment has been undertaken by Marine Space Limited with input from ITPEnergised (ITPE). This assessment is relevant to this chapter.

19.1.1.8 Figures supporting this chapter are found in Volume 2 and comprise the following:

- Volume 2, Figure 19.1 Study Area
- Volume 2, Figure 19.2 Superficial Geology
- Volume 2, Figure 19.3 Bedrock Geology
- Volume 2, Figure 19.4 Chapter Relevant Designated Sites
- Volume 2, Figure 19.5 Hydrogeological Summary
- Volume 2, Figure 19.6 Hydrological Summary
- Volume 2, Figure 19.7 PWS

19.1.1.9 This assessment has been undertaken by ITPE. The Chapter has been authored by Katie Brydie (BSc Earth Science, MSc Hydrogeology) with support from Zak Ritchie (BEng Civil Engineering, MSc Hydrology and Water Resources, MCIWEM, C.WEM, CEng). Zak has over eight years' consultancy experience and is the Head of ITPE's Civil Engineering and Hydrology Team. His experience spans, civil engineering and water environment input to project design, flood risk assessments, surface water management plans, water quality monitoring and analysis, drainage and Sustainable Drainage Systems (SuDs) design, earthworks design and terrain modelling.

19.2 Legislation, Policy and Guidelines

19.2.1.1 The following section lists the relevant legislation, policy and guidelines that have been taken into consideration during the assessment of onshore geology, hydrogeology and hydrology effects.

19.2.2 Legislation

19.2.2.1 Relevant legislation and guidance documents have been reviewed and taken into account as part of this assessment. Of particular relevance are:

- The Water Framework Directive (WFD 2000/60/EC);
- Future Wales: The National Plan 2040 (2021);
- Groundwater (England and Wales) Regulations 2009;
- Flood and Water Management Act 2010;
- The Flood Risk Regulations 2009;
- Water Act 2014;
- Pollution Prevention and Control (England and Wales) Regulations 2000;
- Water Supply (Water Quality) Regulations 2018; and
- Private Water Supplies (Wales) Regulations 2017.

19.2.3 Policy

19.2.3.1 The following planning policy was reviewed and taken into account as part of this assessment:

- Pembrokeshire County Council LDP (2013 - currently undergoing review), Relevant Policies include GN.1 General Development Policy, GN.2 Sustainable Design which outline policies in regard to conversation of geological heritage and the water environment;
- Pembrokeshire Coast National Park LDP (2020);
- Pembrokeshire County Council Local Flood Risk Management Strategy (2015)
- Planning Policy Wales 11 (PPW) (2021) and accompanying Technical Advice Notes (TAN); and
- TAN15 'Development and Flood Risk' (2004).

19.2.4 Guidance

19.2.4.1 Recognisance has been taken of the following best practice guidelines / guidance:

- The SuDS Manual C753, (CIRIA, 2015);

- CIRIA C532: 'Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors' (CIRIA, 2001); and
- Pollution Prevention Guidance (PPGs) and the emerging replacement series of Guidance for Pollution Prevention (GPPs) provide guidance to Northern Ireland Scotland and Wales. This guidance has been produced by Natural Resources Wales (NRW), the Northern Ireland Environment Agency (NIEA) and the Scottish Environment Protection Agency (SEPA). The following PPGs and GPPs have been considered to be of particular relevance as part of this assessment:
    - GP 1: Understanding your environmental responsibilities – good environmental practices (2020);
    - PPG 3: Oil Interceptors and Surface Water Drainage (2006); and
    - GPP 5: Works and maintenance in or near water (2018).

19.3 Consultation and Scoping

19.3.1.1 An EIA Scoping Opinion was issued by NRW in January 2020 which confirmed the need for an EIA and included information on the extent and content (scope) of the assessment.

19.3.1.2 A Freedom of Information (FOI) data request was submitted to Pembrokeshire Country Council (email dated 27th April 2021) requesting any information Pembrokeshire County Council holds regarding PWS within 1km of the onshore cable corridor. A response was received (email dated 21st May 2021).

19.3.1.3 A summary of consultation is set out in Table 19.1.

19.3.1.4 Engagement with landowners is ongoing and landowner specific land drainage will be considered at detailed design stage. Public exhibitions have been attended and issues raised were taken into account in completing this Chapter and further detail are included within Volume 3 Technical Appendix 2.3 Consultation Report.

Table 19.1 – Summary of Consultation

Consultee	Response	Applicant Action
NRW EIA Scoping Opinion	You must include reference to the Water Framework Directive when identifying applicable policy / legislation in the submitted ES. Whilst this has not been identified within this section of the Scoping report, it is recognised that the WFD is referenced within the Water Quality chapter with specific reference to a WFD assessment in Section 5.5. We suggest that the WFD assessment should align with that of the wider EIA where there are topic areas/receptors of relevance to WFD within its geographical remit.	A WFD Compliance Assessment has been undertaken and included as Volume 3, Technical Appendix 7.1. This includes assessment of onshore WFD bodies. WFD bodies have also been considered in this chapter assessment.

Consultee	Response	Applicant Action
	The submitted ES must ensure that the full range of data available to you is used when reviewing the baseline for the WFD. Potential data sources include the Lle data portal for spatial data and the Water Watch Wales website for biological and chemical data.	
Pembrokeshire County Council FOI Response to PWS locations (email dated 21st May 2021)	A search of our records has not shown there to be any Regulation 9 or 10 supplies in this area as defined under the Private Waters Supply (Wales) Regulations 2017. No Single Domestic Supplies are showing but since the changes to Water Regulations some years ago we cannot be certain of our existing records for such smaller supplies and therefore cannot say that there are no supplies of this type within your prescribed area.	Due to the rural nature of the Proposed Development and location of properties from utilities, it was suspected that there would be PWS's in the area. A PWS Survey was carried out. The results of the PWS survey (Volume 3, Technical Appendix 19.1) and PWS's identified to be at a potential risk have been considered in this chapter.

19.4 Assessment Methodology and Significance Criteria

19.4.1 The assessment has been undertaken using qualitative and quantitative analyses and is based on professional judgement and statutory and general guidance. Relevant legislation, policies and best practice guidance is used in the assessment and development of mitigation measures.

19.4.2 Study Area

19.4.2.1 The focus of the assessment is the land within the onshore cable corridor, however a wider Study Area has been defined based on a 500 m buffer for geology and a 1 km buffer for hydrological and hydrogeological receptors around the site (refer to Volume 2, Figure 19.1).

19.4.3 Desk Study

19.4.3.1 Data has been collected from the following sources in order to establish the catchment characteristics and baseline geological, hydrogeological and hydrological conditions beneath the site:

- British Geological Survey (BGS) geological and hydrogeological online mapping of the area;
- Current Ordnance Survey 1:25,000 and 1:50,000 scale mapping;

- Available aerial and topographical mapping;
- British Geological Survey 1:50,000 scale geological maps (Scotland Bedrock and Superficial Deposits) to understand hydrogeological conditions;
- Online Hydrogeological Map of Scotland (British Geological Survey);
- Lle data portal for spatial data (NRW);
- Cleddau and Pembrokeshire Coastal Rivers Management Catchment Summary (NRW, 2016);
- Water Watch Wales (NRW);
- Review of water supply assets to establish potential PWS to inform PWS survey; and
- UK Centre for Ecology and Hydrology. (2021). Flood Estimation Handbook (FEH) Web Service.

19.4.4 Site Visit / Surveys

19.4.4.1 ITPE undertook a hydrological site reconnaissance survey of the Proposed Development to inform this Chapter and provide feedback on the proposed alignment with respect to hydrological setting on-site. The site walkover was undertaken by two experienced ITPE Hydrologist / Civil Engineers between the 10th and 13th May 2021. The proposed onshore export cable route was surveyed and key hydrological features of note, potential watercourse crossings and existing crossings were recorded and surveyed.

19.4.4.2 Although no PWS were identified by Pembrokeshire County Council in response to the FOI request, due to the rural setting of the Proposed Development and following review of water supply assets, it was suspected that PWS would be present at or around the Proposed Development. Any properties within 1km of the onshore export cable route that did not have a water supply asset to the property were visited by the surveyors during the hydrological site reconnaissance survey and issued with a PWS questionnaire. Properties identified as PWS have been assessed in Volume 3, Technical Appendix 19.1 and are discussed in this Chapter.

19.4.5 Assessment of Potential Effect Significance

Sensitivity

19.4.5.1 The sensitivity of onshore geological, hydrological and hydrogeological receptors has been guided by the matrix presented in Table 19.2 which provides indicative criteria.

19.4.5.2 The criteria for sensitivity have been developed based on a hierarchy of factors relating to quality of the aquatic and geological environment including international and national designations, water and soil quality information, waterbody status, consultations, site visits, and the professional judgement of the assessment team.

Table 19.2 – Sensitivity Levels for Receptors (Onshore Geology, Hydrogeology and Geology)

Sensitivity	Description
High	Areas containing geomorphological or hydrological features considered to be of national interest, for example Aquatic Natura 2000 sites, SACs, SSSIs, RAMSARs, SPAs Highly permeable superficial deposits allowing free transport of contaminants to groundwater and surrounding surface waters. Wetland/watercourse of High or Good Ecological Potential, as per the WFD classifications. Raised or blanket bog. High risk of flooding. Remote PWS source within 250 m of any development. Highly sensitive or vulnerable receptors to contaminants.
Medium	Moderately permeable superficial deposits allowing some limited transport of contaminants to groundwater and surrounding surface waters. Wetland/watercourse of Moderate Ecological Potential, as per the WFD classifications. Moderate risk of flooding. Remote PWS source within 500 m of any development. Sensitive or vulnerable receptors to contaminants.
Low	Low permeability superficial deposits likely to inhibit the transport of contaminants. Wetland/watercourse of Poor or Bad Ecological Potential as per the WFD classifications or no WFD classification. Low risk of flooding. Remote PWS source within 1000m of any development. No sensitive receptors vulnerable to contaminants.
Negligible	No appreciable effect on geology, hydrology or hydrogeology

Magnitude

19.4.5.3 The prediction and assessment of effects on geology, hydrology and hydrogeology has been undertaken using a series of tables to document the various potential impacts from aspects of the construction and operational phases of the Proposed Development. Impacts have been predicted based on the guidance criteria for the magnitude of change set out in Table 19.3.

Table 19.3 – Sensitivity Levels for Receptors

Sensitivity	Description
High	Total loss of, or alteration to, key features of the baseline resource such that post development characteristics or quality would be fundamentally

Sensitivity	Description
	and irreversibly changed e.g. development resulting in increased flood risk, PWS source pollution (during and post construction), groundwater or surface water quality or permanent changes to local surface and groundwater flow regimes.
Medium	Loss of, or alteration to, key features of the baseline resource such that post development characteristics or quality would be partially changed e.g. instream permanent bridge supports, temporary or non-material changes to local surface / groundwater flow regime, increased pollution potential / alteration of source volumes to remote PWS during construction only and localised change in groundwater or surface water quality.
Low	Small changes to the baseline resource, which are detectable but the underlying characteristics or quality of the baseline situation would be similar to pre-development conditions e.g. culverting of very small (unmapped) watercourses / drains, temporary and / or very localised change in local surface / groundwater flow regime, very localised and temporary change in groundwater and surface water quality and. Possible although very remote potential for change in PWS source quality / quantity.
Negligible	A very slight change from baseline conditions, which is barely distinguishable, and approximates to the 'no-change' situation e.g. new site drainage discharge from developed SuDS scheme to receiving watercourse, new land drainage measures to maintain hydraulic continuity between upgradient and downgradient of the Proposed Development and no / negligible development in PWS source catchment.

Significance of Effect

19.4.5.4 The significance of the effect upon onshore geology, hydrogeology and hydrology is determined by correlating the magnitude of the impact and the sensitivity of the receptor, as presented in Table 19.4. On this basis potential impacts are assessed as of negligible, minor, moderate and major significance (definitions are provided in Chapter 2: Overview of EIA Methodology).

19.4.5.5 For the purposes of this assessment, any effects with a significance level of major and/or moderate have been deemed significant in EIA terms, while those of minor or negligible are deemed non-significant.

Table 19.4 – Effect Significant Matrix

		Sensitivity			
		High	**Medium**	**Low**	**Negligible**
Magnitude	**High**	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Minor
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Minor	Minor	Negligible	Negligible

19.4.6 Standard Mitigation

19.4.6.1 A range of standard mitigation measures has already been applied to the Project as part of the over-arching site selection and iterative design process (see below and Chapter 3: Site Selection and Alternatives). These have been introduced in order to minimise potential impacts of the Project on any affected receptors.

19.4.6.2 Standard mitigation measures which the Project has already implemented, or is committed to in the future, in order to minimise potential impacts on onshore geology, hydrogeology and hydrology are listed below.

- The proposed foul and surface water drainage strategy outlined in the Outline Drainage Assessment – see Volume 3, Technical Appendix 19.4. The drainage design detailed the Project drainage design mitigating increased discharge rates and flood risk, as well meeting the water quality criteria set in the SuDS Manual. A summary of the drainage design is outlined below in paragraphs 19.4.6.15 to 19.4.6.21.
- A schedule of pre-development, construction and post-development groundwater sampling and monitoring will be developed and agreed with NRW should planning consent be granted
- A Construction Environmental Management Plan (CEMP) will be in place to control potentially polluting activities to prevent adverse impact to downstream persons, properties and environment during the construction phase. An outline CEMP is provided in Volume 3 Appendix Technical Appendix 4.1 of this ES. The purpose of this document is to provide an overview of how the site preparation and construction process will be undertaken to afford protection to the environment and the residents and businesses within the surrounding area. It should be noted that the outline CEMP is a “live” document and will be subject to periodic review and updating. Relevant mitigation measures to be implemented during construction to control water quality impacts as part of the outline CEMP are given below in paragraphs 19.5.6.3 to 19.5.6.10.
- All earthmoving works or similar operations would be carried out in accordance with BSI Code of Practice for Earth Works BS6031:2009.
- Site discharges and temporary water abstraction would be regulated in line with NRW guidance for discharges to surface water and groundwater. All necessary permits would be sought from NRW prior to the commencement of operations on-site.

- Where a Horizontal Directional Drilling (HDD) method is used to cross watercourses the depth of HDDs at crossings will be such that the riverbed is undisturbed. Where an open cut method is used to cross smaller watercourses and drainage ditches crossing locations with be isolated using temporary dams that span the width of the channel. Water will be extracted and diverted downstream by over pumping methods or using temporary "flume" pipes installed in the bed of the watercourse. Full details of both methods are provided in Volume 3, Technical Appendix 19.2. This document also provides the recommended crossing required based on watercourse specific observations. The Watercourse Crossings will be subject to authorisation and Ordinary Watercourse consent from Pembrokeshire County Council.

CEMP

19.4.6.3 Outlined below are recommendations for mitigation measures to be implemented during construction to control water quality impacts. These mitigation measures take due cognisance of the relevant policy, legislation and guidance outlined in Section 19.2 previously.

19.4.6.4 Good practice measures set out in the relevant Pollution Prevention Guidance (PPGs) or Guidance for Pollution Prevention (GPPs) have been followed. A review plan for Pollution Prevention Guidance documents (PPGs) is currently underway by, NRW, the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment Agency (NIEA), replacing them with a new series of guidance: Guidance for Pollution Prevention (GPPs). GPPs provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Wales, Scotland and Northern Ireland. The relevant guidance includes:

- GPP1: General guide to preventing pollution (October 2020);
- GPP2: Above ground oil storage tanks (January 2018);
- GPP5: Works and maintenance in or near water (February 2018);
- PPG6: Working at construction and demolition sites (2012); and
- GPP21: Pollution incidence response planning (June 2021).

19.4.6.5 General Mitigation:

- Undertake a pollution risk assessment of the site and the proposed activities;
- Identify all Controlled Waters that may be affected by the works and temporary discharge points to the on-site drainage ditches and the marine environment;
- Implement a pollution control system during earthworks and construction; and
- Monitor construction procedures to ensure management of risk is maintained.

19.4.6.6 Proposed Mitigation for Excavations:

- Take relevant precautions to ensure no services are struck during excavations. Ensure relevant emergency response and contacts are in place in the event services are stuck which could impact the water environment, e.g. oil line, water main, sewer. An Emergency Response Plan will be in place as part of the outline CEMP to ensure appropriate action is taken should this occur;
- Scan excavation areas for potential unrecorded culverts/field drains. De-watering measures to be present in the event of a leak;
- Existing culverts/field drains to be protected to prevent potentially polluted site run-off discharging to them prior to treatment;

- Plan and design dewatering activities to maintain the hydrology of identified sensitive habitats;
- The requirement for dewatering will be minimised in all locations by timely and efficient excavation of the cable trench, any foundation voids and subsequent concrete pouring and backfilling. Unnecessary dewatering will be avoided, and an appropriate dewatering pumping rate will be used to ensure minimal changes to groundwater flow out with construction area.
- Prevent site run-off entering excavations and regular de-water to prevent infiltration to groundwater. Ensure that dewatering of excavations is directed away from drainage ditches and the marine environment; and
- Any deep excavations (e.g. boreholes, piled foundations) must be protected to prevent infiltration of site run-off and a direct pathway to groundwater.

19.4.6.7 Proposed Mitigation for Concrete Works:

- If concrete is brought to site, provide dedicated concrete washout skip/basin to prevent any uncontrolled spilling of material in-site or nearby public roads;
- Concrete washout facilities to be regularly maintained and solids to be disposed of safely and in accordance with relevant waste management legislation;
- If on-site concrete batching is needed, ensure necessary containment measures are in place and suitable disposal and cleaning methods;
- Robust emergency response in place for any concrete spillage on-site;
- Correct disposal of any waste or surplus concrete in agreed suitable locations both on-site and off-site;
- Where applicable, shuttered pours should be used to prevent concrete losses to ground;
- Ensure excavations are sufficiently dewatered before concreting begins and that dewatering continues while concrete sets; and
- Cover freshly poured concrete surfaces to prevent any polluted run-off attributed with wet weather.

19.4.6.8 Fuel and Chemical Storage Measures:

- Follow measures set out in the ‘Outline Pollution Prevention Management Plan’ in the outline CEMP;
- Maintain oil booms and absorbent pads within all work areas;
- Fuel and oil deliveries to take place on an impermeable transfer area with a bunding facility capable of handling a major spill;
- Assign designated refuelling areas where appropriate and site them as far as practicably possible and at least 20 m from adjacent field drains and public sewers; and
- Install operational drainage as early as possible with the inclusion of oil separators.

19.4.6.9 Proposed Mitigation for Sediment Management:

- Control and divert surface water entering site from surrounding land (via cut-off drains) to reduce potential impacted water volumes;
- Minimise use of stockpiles and/or cover and contain stockpiles and provide sediment interception measures at their bases, e.g. silt fencing or cut-off drains and check dams;

- If topsoil is to be stored, avoid constructing stockpiles more than 2 m high. This will ensure anaerobic conditions do not occur and that the soil will remain fertile and capable of being re-seeded. It will also be less susceptible to erosion;
- Temporary drainage measures to be installed which provide filtration (filter drains or filter strips) and settlement (ponds/basins) to collect sediments prior to off-site discharge;
- Avoid mass overburden stripping on the site, expose parts of the site only when essential for operation;
- Temporary drainage measures and silt fencing to be installed around large areas of exposed soils;
- Ensure a robust site traffic management plan is in place to reduce sediment run-off risks. Good practices include; minimise turning of tracked vehicles where possible and manage dedicated turning areas appropriately (hard surfacing, silt fencing etc.), avoid unnecessary turning of large site plant and minimise overall routes on-site to better manage sediment run-off;
- Prevent/reduce off-site sediment impacts to public roads. Good practices include; wheel was facilities, site-road sweeping, vehicles only permitted on-site not to use public roads, formally surfaced site car park and separate access points for cars and plant/deliveries;
- Bowsers to be used to keep exposed earth and soils damp preventing dust generation reaching nearby watercourses (sediment build-up can be managed on-site); and
- Dedicated plant washing areas to control sediment run-off.

19.4.6.10 Contingency Planning and Emergency Procedures:

- All pollution prevention consumables and plant to be made readily available at all times. Keep spill kits in all vehicles to enable a rapid and effective response to any accidental spillage or discharge; and
- Train all construction staff in the effective use of spill kits and raise awareness of all preventative measures for water pollution.

Construction Phase Flood Risk Mitigation

19.4.6.11 Construction Phase Fluvial Flood Risk Mitigations

- Watercourse crossings will take place during periods of normal to low flow to avoid conveyance related flood risk effects.
- All mobile equipment when not required to facilitate scheduled works will not be stored within areas of identified fluvial flood risk.
- Where open cut trench methodology is used watercourse sections will be isolated using barriers that span the width of the channel. Water will be extracted and diverted downstream by over pumping methods before treatment to remove silt prior to downstream discharge.
- Where an HDD method is used to cross watercourses, the depth of HDDs at crossings will be such that the riverbed is undisturbed and pressurised bentonite in the drill hole does not leak into watercourses. The HDD compounds will be placed in an appropriate location, as far from flood potential as reasonably possible within the requirements of the HDD design to reduce the potential for impacts if flooding does occur.

- Given the relatively low presence of fluvial flood risk across the site it is considered highly unlikely that any HDD compounds will be located within the flood risk zone. If the floodplain cannot be avoided, to minimise impacts on natural drainage within the functional floodplain the following measures will be incorporated:
    1. Access tracks will not be elevated. Where this is not possible cross drainage will be installed to allow natural drainage;
    2. Soil storage alongside the cable trenches will not be continuous but will incorporate breaks of 3-4 m at regular intervals;
    3. Pre-construction drainage measures will be installed within the working corridor to minimise disruption to natural drainage pathways.
- Where an access track necessitates a temporary watercourse crossing, appropriate design will ensure flood flow conveyance and sediment transfer conditions are commensurate with existing conditions. Temporary bridges or culverts will be removed within 12 months following construction of the onshore infrastructure.

19.4.6.12 Construction Phase Tidal Flood Risk Mitigations:

- The preferred option for landfall is HDD as this will reduce the footprint of impact on shallow sub-tidal and intertidal marine habitats. However, without information from detailed HDD feasibility studies, and further geotechnical site investigation works scheduled to be undertaken post-submission (2022), risk remains that HDD may not be technically feasible. Therefore, open cut trenching is also considered as a contingency option.
- Where an HDD method is used, HDD compounds will be placed in an appropriate location, as far from coastal flood potential as reasonably possible within the requirements of the HDD design to reduce the potential for impacts if flooding does occur.
- All mobile equipment when not required to facilitate scheduled works at the HDD locations will not be stored within areas of identified tidal flood risk.
- Should the HDD feasibility study conclude that this option is not feasible, open cut trench methodology would be used. In the West Angle Bay Landfall location this would require the temporary breakout of existing coastal defences at West Angle Bay. Sheet piling will be installed to provide trench shuttering to minimise the extent of the excavation works and provide safe trench support from the seaward side. Temporary demountable defences would be installed on the landward side for the duration of the cable installation phase and reinstatement of the flood defences to ensure no decrease in the level of flood protection.
- For work within the coastal flood boundary, a site-specific Flood Action Plan will be developed in partnership with the appointed contractor. This will include details of safe systems of work, access and egress routes, a detailed response plan to a flood risk event and the roles and responsibilities of those onsite in the event of a flood.
- Full details of potential impacts and proposed mitigation for both open cut trench and HDD methodologies on the coastal and intertidal areas is given in Chapter 6 Marine and Coastal Processes Section 6.6.

19.4.6.13 Construction Phase Surface Water Flood Risk Mitigations:

- Works will be planned and programmed, where possible, to be completed during periods of low rainfall which will limit the potential for impacts.
- All mobile equipment when not required to facilitate scheduled works will not be stored within areas of identified surface water flood risk.

- Prior to construction, cleaning of existing field ditches and culverts will be undertaken to alleviate drainage blockages or restrictions.
- Mitigation measures to maintain surface water flow during cable installation should be put in place to prevent direct impacts on the hydrology and geomorphology of surface water courses. Standard settlement management measures should also be used, if appropriate, e.g., settlement ponds, covering stockpiles to prevent run off, silt curtains in water courses etc.

19.4.6.14 Construction Phase Groundwater Flood Risk Mitigations:

- In order to minimise the impacts of groundwater inundation on the construction process, prior to excavations, temporary cut-off drains will be installed parallel to proposed trench lines to prevent soil and groundwater entering the trenches.
- Where groundwater is higher than the excavation depth dewatering of excavations will be undertaken in order to provide sound working conditions for the construction phase.
- The proposed substation SUDs pond will be lined to prevent risk of groundwater intrusion compromising the capacity of the surface water drainage system.

Surface Water Drainage at the onshore substation

19.4.6.15 The proposed SUDS approach is for surface water runoff from the impervious areas of the development to be conveyed by a piped network to a proposed SUDS wetland. Surface water runoff will be suitably attenuated (up to 0.1% AEP) within the wetland prior to discharging to the existing spring adjacent to the site (as indicated in Volume 2, Figure 19.6) at greenfield runoff rates.

19.4.6.16 Drawing 002 and 003 of Volume 3, Technical Appendix 19.4 provide an overview of the proposed drainage strategy.

19.4.6.17 Discharge to the existing spring will be controlled via a hydrobrake. As an added precaution, a high level overflow pipe will be installed into the hydrobrake chamber to provide continuity in the extremely unlikely event the hydrobrake becomes blocked.

19.4.6.18 Full details can be found in Volume 3, Technical Appendix 19.4.

Water Quality Mitigation at the onshore substation

19.4.6.19 In accordance with CIRIA Report C753 it is necessary to undertake a 'Water Quality Risk Management' assessment to determine the suitability of SuDS methods from a water quality perspective. Based on the application of a wetland the SuDS Mitigation Index offered by the proposed SuDS is ≥ Pollution Hazard Index therefore the water quality assessment criteria is considered to be satisfied. Full details of the water quality design criteria can be found in Volume 3, Technical Appendix 19.4.

Foul Water Management at Substation

19.4.6.20 The proposed foul water drainage strategy is to collect foul flows from the proposed facilities via conventional piped drainage and collectively passed through a packaged treatment plant providing a secondary level of treatment. The flow will then be discharged to the existing spring which flows into a larger watercourse

19.4.6.21 In order to achieve appropriate dilution rates, the installation of a commercial Klargester BioDisc (or similar proprietary system) is proposed, sized appropriately to manage the foul water from the substation. Full details can be found in Volume 3, Technical Appendix 19.4.

19.4.7 Assessment for Residual Effect Significance

19.4.7.1 The impact assessments and conclusions on significance of effect presented in Section 19.6 assume that the standard mitigation measures listed above have been successfully implemented. Where significant environmental impacts remain even after these standard measures have been factored in, then project-specific mitigation measures are detailed and the residual significance of effect presented.

19.4.8 Limitations to Assessment

19.4.8.1 The FEH Web service, used for determining catchment characteristics, only analyses catchments greater than 0.5 km^2 and does not account for any in-channel artificial modifications to watercourses (i.e. culverting, weirs etc).

19.4.8.2 A formal PWS survey was not issued to one property, known to be service by a PWS, referred to in this assessment as Broomhill Farm. This is because at the time of the hydrological walkover survey there were ongoing access limitations. However, a follow up visit was carried out by Blue Gem Wind which noted the specific location of the primary PWS source and a backup source.

19.4.8.3 At the time of assessment, the completed Ground Investigation Interim Factual Report was not available. As such, a preliminary version of the report has been used to inform this assessment. The preliminary report gives detailed accounts of conditions onsite and contains complete trail pit and borehole records, therefore this limitation will not materially change the assessment.

19.5 Baseline Conditions

19.5.1 Geology

Superficial

19.5.1.1 Review of the British Geological Survey (BGS) online geology maps indicate that the majority of the onshore export cable route is not situated along any underlying superficial deposits with few exceptions. The landfall location at West Angle Bay is classified as marine beach deposits of sand. There is an extent of Brown Sand which intercepts the middle section of the route for a 2.22 km of routing from Middlehill to Neath. A more discrete section is underlain by Tidal Flat Deposits, consisting of sand silt and clay. This is confined to a small area under the third compound and surrounding area. Refer to Volume 2, Figure 19.2.

Bedrock

19.5.1.2 Reference to the BGS online geology maps indicates that the bedrock geology underlying the onshore cable corridor is almost exclusively part of the Milford Haven Group, consisting of argillaceous rocks and sandstone.

19.5.1.3 At landfall, the underlying bedrock is Black Rock Subgroup and Gully Oolite Formation consisting of limestone. This changes when the onshore cable corridor turns south towards Angle Road, the route crosses a multitude of bedrock classifications along its initial 1 km rise, including, the Avon Group, consisting of limestone and mudstone, the Skrinkle Sandstone Formation, the Ridgeway Conglomerate Formation and the Milford Haven Group. The onshore export cable remains underlain by the final profile from Hubberton to the onshore substation, briefly cutting though Cosheston Group by Hoplass Solar farm. Refer to Volume 2, Figure 19.3.

Designated Geological Sites

19.5.1.4 There are two designated Geological Conservation Review (GCR) sites located in proximity to the proposed option for landfall locations; West Angle Bay and West Angle Bay (North). At the proposed northern landfall location, where the breaching landfall will be undertaken either by open trenching or HDD, the proposed cable route passes between the two GCR sites in close proximity however not within the designation boundaries. The southern landfall location is located approximately 300 m southeast of both GCR sites, where landfall will be undertaken by HDD.

19.5.1.5 Both landfall locations are located within Arfordir Penrhyn Angle / Angle Peninsula Coast SSSI. This SSSI is located along the southern and western edge of the peninsula.

19.5.1.6 Recently, a new species of fossil crinoid (*Hylodecrinus cymrus*), was described from the Pembroke Limestone Group (Mississippian, Tournaisian, Courceyan) of West Angle Bay (Howells and Kammer, 2014). This specimen represents the first report of this genus from Europe, which most probably migrated from North America.

19.5.1.7 Freshwater West (North) GCR site is located 380 m south of the onshore cable boundary. No disruption is expected to this site.

Regionally Important Geodiversity Sites

19.5.1.8 West Angle Bay is identified in the Pembrokeshire Coast National Park LDP as a Regionally Important Geodiversity Site. The majority of this site is located within Arfordir Penrhyn Angle / Angle Peninsula Coast SSSI.

19.5.1.9 East Pickard Bay is also identified as a Regionally Important Geodiversity Site and is included within Arfordir Penrhyn Angle / Angle Peninsula Coast SSSI. East Pickard Bay is located approximately 350 m south of the onshore cable boundary. No disruption is expected to this site.

19.5.1.10 Angle Bay is also identified as a Regionally Important Geodiversity Site and is located north of the onshore cable boundary, approximately distanced 670 m at its closest point. No disruption is expected to this site.

Review of Ground Investigation Results

19.5.1.11 The results of the site investigation broadly concur with the published geology from BGS. Blown sand was encountered to extend to one exploratory location where BGS records no superficial deposits. This exploratory location is located where the onshore cable route passes southwest of the property at Neath.

19.5.1.12 The BGS mapping does not identify superficial deposits across the majority of the site. However, soils deposits were encountered at every exploratory location across the site which have been identified as weathered bedrock.

19.5.1.13 Topsoil was encountered in the majority of exploratory hole locations and Made Ground was encountered across 18 out of the 55 exploratory locations.

19.5.2 Hydrogeology

19.5.2.1 The majority of the Proposed Development is underlain by low productivity bedrock aquifers, with the exception of the landfall location and the onshore export cable between the onshore substation and the grid connection, which are partially underlain by a moderately productive aquifer described as a "*massive karstic limestone aquifer with rapid response to rainfall. Yields highly variable from dry to 40 L/s".*

19.5.2.2 Review of BGS Geoindex Onshore interactive mapping indicates areas of this moderately productive aquifer is designated as a Principal bedrock aquifer. The majority of the site however is underlain by designated as a Secondary A bedrock aquifer. The mapped superficial deposits are classed as a Secondary A superficial aquifer.

19.5.2.3 The WFD groundwater body Pembrokeshire Carboniferous Limestone underlies the entire site. This groundwater body currently has good status for qualitative, chemical and overall status.

19.5.2.4 Site-specific ground investigations along the onshore cable corridor have been reviewed. Trial pits and borehole logs identified instances of a groundwater table in 15 of the 55 exploratory locations at depths between 0.55 m below ground level (bgl) to 10 m bgl.

Landfall Area

19.5.2.5 This section is underlain by the following described units moving north to south through the section;

- Massive karstic limestone aquifer with rapid response to rainfall. Yields highly variable from dry to 40 L/s.
- Indurated multi-layered aquifer with small local yields from secondary fractures.
- Local sandstone and conglomerate aquifers yield small supplies.
- Highly indurated sandstone and conglomerate with small amounts of groundwater in near surface weathered zone and secondary fractures.

South Studdock to Wogaston

19.5.2.6 The Proposed Development through these areas is underlain by highly indurated sandstone and conglomerate with small amounts of groundwater in near surface weathered zone and secondary fractures.

Wogaston to Onshore Substation

19.5.2.7 The Proposed Development is underlain by highly indurated sandstone and conglomerate with small amounts of groundwater in near surface weathered zone and secondary fractures along the majority of the route with local sandstone and conglomerate aquifers yielding small supplies underlying the route at Wallaston Cross and the substation.

Onshore Substation and 132 kV route to grid connection

19.5.2.8 This section is underlain by the following described units moving south to north along the route;

- Local sandstone and conglomerate aquifers yield small supplies.
- Indurated multi-layered aquifer with small local yields from secondary fractures.
- Massive karstic limestone aquifer with rapid response to rainfall. Yields highly variable from dry to 40 L/s.

19.5.2.9 Refer to Volume 2, Figure 19.6 for a hydrogeological summary of the area.

19.5.3 Hydrology

19.5.3.1 The closest WFD surface water body to the onshore cable corridor is the Castlemartin Corse (GB110061025000) - headwaters to tidal limit which is not located within the Proposed Development. Review of Water Watch Wales (NRW) indicates Castlemartin Corse waterbody has an overall classification of Moderate. Its ecological classification is Moderate, and its chemical classification is Good.

19.5.3.2 The area is coastal and watercourses within the vicinity of the onshore export cable are generally fed by springs. The area is subdivided into numerous small surface water catchments which discharge directly to tidal headwaters.

19.5.3.3 A summary of the hydrology in the Study Area is provided in Volume 2, Figure 19.5.

19.5.4 Flood Risk

19.5.4.1 ITPE has undertaken a detailed FCA for the onshore components of the Proposed Development. The purpose of this report is to outline any potential flood risks to the site, the impact of the Proposed Development on flood risk elsewhere, and the proposed measures which could be incorporated to mitigate the identified flood risk.

19.5.4.2 All potential sources of flooding to the site have been considered. The finished cable route will be installed with a minimum cover of 1.1 m from the top of the cables to finished ground level and the cable ducting will be designed to prevent water ingress. The transition joint bay at landfall will be located inland within Flood Zone 1 for rivers and sea. Where possible detailed design will ensure that joint bays, the transition joint bay and link boxes will be sited away from areas of surface water risk, however if it is necessary to locate infrastructure such as joint bays within areas of surface water flood risk these will be designed to prevent water ingress.

19.5.4.3 Therefore, it is confirmed that once operational, no material flood risk sources have been identified that will impact the Proposed Development. For full details refer to Volume 3, Technical Appendix 19.3 FCA.

19.5.4.4 During the construction phase the Proposed Development will be vulnerable to several types of flooding. Table 19.5 presents a summary of the flood risk assessment outcomes for the construction phase of the Proposed Development.

19.5.4.5 However, for the purpose of this assessment the overall sensitivity of the Proposed Development with respect to all flooding is considered to be **negligible** to **low** when taking account of the standard mitigation measures set out in Section 19.4.6.11 to Section 19.4.6.14 included to reduce flood risk during the operation phase and therefore flood risk is not considered further.

Table 19.5 – Construction Flood Risk prior to Standard Mitigation Measures

Potential Flood Source (not considering standard mitigation)	Screening Assessment of Flood Risk at Site	Justification
Fluvial flooding	Medium	As part of the export cable installation a number of watercourses and drainage ditches must be crossed. While there are no main rivers within the watercourse crossing schedule and no areas of fluvial flood risk identified on the NRW flood risk mapping, there remains a level of risk associated with construction within or near to watercourses.
Tidal flooding	Medium	Construction works at the landfall site will require complex operations within an area of coastal flood risk and mitigation measures are required.
Flooding from land	Low	Review of NRW Flood Map indicate some isolated areas of surface water flood risk along the cable route.
Groundwater flooding	Low	Review of site-specific ground investigations reveals there are instances where the ground water level encountered is higher that the proposed depth of excavations, therefore further consideration of this flood source is required.
Flooding from sewers / artificial drains	Low	There is considered a very low risk of flooding from sewers or artificial drains due to the rural setting of development. Only the area at the landfall site was observed to be serviced by an existing sewer network.
Flooding due to infrastructure failure / blockage	Low	Review of the Carmarthenshire & Pembrokeshire Stage 1 Strategic Flood Consequence Assessment (SFCA) indicates that the site is not located in or near to any canals or reservoirs and that there are no records of breaching or overtopping in the area. The SFCA is a broad scale assessment on the nature of flood risk which assesses available information in order to evaluate the cause and extent of potential flooding across Carmarthenshire and Pembrokeshire. It is anticipated that buried services and land drainage will be encountered during cable installationhere is no other significant infrastructure i.e. culverts, pumping stations, aqueducts etc located upstream or in hydraulic continuity / proximity to the site which may pose a flood risk during a failure scenario.

19.5.5 Private Water Supplies

19.5.5.1 A PWS Survey was undertaken, as described in Section 19.4.4. The results of the PWS Survey are fully detailed in Volume 3, Technical Appendix 19.1. A source-pathway-receptor assessment has been carried out as part of the PWS Assessment. A summary of the findings is set out below in Table 19.6. The locations of the PWS's are shown in Volume 2 Figure 19.7 and in Figures 19.1.1 – 19.1.5 of Volume 3, Technical Appendix 19.1.

Table 19.6 – Private Water Supply Assessment Summary

PWS ID	Name	PWS Source	Notes	Potential Complete Source-Pathway-Receptor Linkage?
PWS01	South Studdock	Borehole	Review of the FEH catchment shows the supply catchment of South Studdock Farm is located adjacent to the proposed cable route alignment. Depth of the borehole is unconfirmed therefore the assessment is based on the worst-case scenario that the PWS is sourced by shallow groundwater and is therefore in hydraulic continuity with the construction zone. Further investigation of risks to the PWS is merited.	Yes
PWS02	Chapel Bay	Spring	Source location is on the far side of a cliff to the north, some 500 m from the proposed cable route. The PWS is not in any hydrological continuity with Proposed Development.	No
PWS03a	Broomhill	Borehole/ well	The borehole location is shown to be just beyond 250 m of the proposed export cable works, and downstream. Depth of the borehole is unconfirmed therefore the assessment is based on the worst-case scenario that the PWS is sourced by shallow groundwater and is therefore in hydraulic continuity with the construction zone. Further investigation of risks to the PWS is merited.	Yes
PWS03b	Broomhill	Well	The well is located within 30 m of the onshore cable corridor. Depth of the well is unconfirmed therefore the assessment is based on the worst-case scenario that the PWS is sourced by shallow groundwater and is therefore in hydraulic continuity with the construction zone. Further investigation of risks to the PWS is merited.	Yes

PWS ID	Name	PWS Source	Notes	Potential Complete Source-Pathway-Receptor Linkage?
PWS04	Cheveralton	Unconfirmed	The property is located a minimum 1.3km from proposed excavation works and is hydrologically separated from the development by 2 surface water catchments.	No
PWS05	Corseside Nursery	Spring	The source location of the supply is just beyond 250m of the construction boundary however the construction barrier and location of excavations are beyond the surface water catchment of the PWS which drains south away from the development area.	No
PWS06	Moreston Farmhouse	Spring	The property is located a minimum 500m from proposed excavation works and is hydrologically separated from the development by the Goldborough Pill.	No
PWS07	Moreston Farm, Land	Borehole	The property is located a minimum 800m from proposed excavation works and is hydrologically separated from the development by the Goldborough Pill.	No
PWS08	Moreston Cottage	Borehole	The property is located a minimum 500m from proposed excavation works and is hydrologically separated from the development by the Goldborough Pill.	No
PWS09	Goldborough	Spring	The property is located a minimum 600m from proposed excavation works and is hydrologically separated from the development by the Goldborough Pill.	No

19.5.5.2 The following private water supplies are identified as having potential for the Proposed Development to affect the yield or quality of a PWS source:

- PWS01 South Studdock Farm
- PWS03a Broomhill Farm Borehole
- PWS03b Broomhill Farm Well

19.5.5.3 The risk to the supply is considered to be temporary for the duration of the construction of the onshore export cable while within the 250 m buffer of the PWS source location.

19.5.6 Other Designated Sites

19.5.6.1 As well as the geological designated sites identified in Section 19.5.1 (West Angle Bay GCR, West Angle Bay (North) GCR, Freshwater West (North) GCR and Arfordir Penrhyn Angle / Angle Peninsula Coast SSSI) additional designated site within the Study Area are listed below.

- Limestone Coast of South West Wales / Arfordir Calchfaen De Orllewin Cymru SAC extends to Freshwater West and the surrounding dunes and is located 70 m from the onshore cable corridor. This site is designated as an SAC primarily for its vegetated sea cliffs and fixed coastal dunes.
- Pembrokeshire Marine / Sir Benfro Forol SAC is located around the peninsula and extends above the mean low water spring line. This site is designated as an SAC for its various coastal habitats and multiple Annex II species.
- West Wales Marine / Gorllewin Cymru Forol SAC landward boundary generally follows the mean low water mark. This site is designated for its Harbour porpoise.
- Milford Haven Waterway SSSI is located 270 m east of the site at its closest point and is located around the northern edge of the peninsula. It is of special interest for its geology and ecology. Relevant to geology, the cliffs and foreshore at Little Castle Head provide exposures of two air-fall tuff horizons within the Sandy Haven Formation. Fossils have also been preserved. No impacts on the geology are anticipated from the Proposed Development.
- Broomhill Burrows SSSI is a large dune system with extensive and diverse dune slack vegetation. Species-rich dune grassland overlying Old Red Sandstone is also especially well represented. Numerous notable plants and insects also occur. Vestigial strandline vegetation occurs on the narrow shingle ridge. The site is located 60m from the onshore consent boundary.
- Castlemartin SSSI is located over 800 m from the onshore consent boundary. This site is of special interest primarily for its swamp and fen Meadow habitats. No impacts relating to geology, hydrogeology or hydrology are anticipated.
- Castlemartin Coast SPA is located south of the site, 170 m from the onshore consent boundary at its closest point. This site is designated for supporting *Pyrrhocorax pyrrhocorax* during the breeding season.
- Gweunydd Somerton Meadows SSSI is located 475 m from the onshore consent boundary and is designated for its biology. Review of FEH website indicates that a minor section (appropriately 300 m) of the cable route is located within the same catchment of the SSSI and upstream of the SSSI site.

19.5.6.2 Table 19.7 provides a summary for the identified designated sites within the Study Area and those considered for further assessment. Designated sites within the Study Area are shown in Volume 2, Figure 19.4. Designated sites at the landfall are shown in Volume 2, Figure 19.8.

Table 19.7 – Designated Sites within Study Area Summary

Designated Sites	Reason for designation	Notes	Further Assessed?	Reason
Limestone Coast of South West Wales / Arfordir Calchfaen De Orllewin Cymru SAC	Vegetated sea cliffs and fixed coastal dunes.	Located 70 m from the onshore cable boundary	No	No construction footprint is proposed on this site and therefore it is considered unlikely of any direct impacts on the dune system. SSSI site is downgradient from onshore export cable location however potential pollution impacts are likely to be highly localised and the risk reduced through standard mitigation measures.
Pembrokeshire Marine / Sir Benfro Forol SAC	Various coastal habitats and multiple Annex II species.	Located around the peninsula and extends above the mean low water spring line	No	Potential pollution impacts are likely to be highly localised and the risk reduced through standard mitigation measures. Considering this and the large volume of receiving waters within the SAC providing high capacity for dilution and receiving. As such no significant effects are anticipated
West Wales Marine / Gorllewin Cymru Forol SAC	Harbour porpoise	Landward boundary generally follows the mean low water mark	No	Potential pollution impacts are likely to be highly localised and the risk reduced through standard mitigation measures. Considering this and the large volume of receiving waters within the SAC providing high capacity for dilution and receiving. As such no significant effects are anticipated
Arfordir Penrhyn Angle / Angle Peninsula Coast SSSI	Designated for its geology and its wide range of intertidal rock, sand and gravel habitats and communities.	Located along the southern and western edge of the peninsula and includes the coast at West Angle Bay, at the landfall.	Yes, high sensitivity receptor	Potential impact anticipated
Milford Haven Waterway SSSI	Geology and ecology. The cliffs and foreshore at	Located 270 m east of the site at its closest point	No	No construction footprint is proposed on this site and therefore it is considered

Designated Sites	Reason for designation	Notes	Further Assessed?	Reason
	Little Castle Head provide exposures of two air-fall tuff horizons within the Sandy Haven Formation. Fossils have also been preserved.	and is located around the northern edge of the peninsula		unlikely that any impacts on the geology. Potential pollution impacts are likely to be highly localised and the risk reduced through standard mitigation measures. Considering this and the large volume of receiving waters within the SAC providing high capacity for dilution and receiving. As such no significant effects are anticipated
Broomhill Burrows SSSI	Large dune system with extensive and diverse dune slack vegetation. Numerous notable plants and insects also occur.	Located 60 m from the onshore consent boundary.	No	No construction footprint is proposed on this site and therefore it is considered unlikely of any direct impacts on the dune system. SSSI site is downgradient from onshore export cable location however potential pollution impacts are likely to be localised and the risk reduced through standard mitigation measures.
Castlemartin SSSI	Swamp and fen Meadow habitats	Located over 800 m from the onshore consent boundary and within the catchment for Castlemartin Corse	No	No construction footprint is proposed within the boundary of the SSSI or the surface water catchment the SSSI site is located within. Considering the standard mitigation measures in place no effects relating to this chapter are anticipated.
Castlemartin Coast SPA	Designated for supporting Pyrrhocorax pyrrhocorax during the breeding season.	located south of the site, 170 m from the onshore consent boundary at its closest point.	No	No construction footprint is proposed on this site and therefore it is considered unlikely of any direct impacts on the dune system. SSSI site is downgradient from onshore export cable location however potential pollution impacts are likely to be localised and the risk reduced through standard mitigation measures.

Designated Sites	Reason for designation	Notes	Further Assessed?	Reason
Gweunydd Somerton Meadows SSSI	Designated for its biology	Located 475 m from the onshore consent boundary	No	No direct impacts are anticipated. A minor section (appropriately 300 m) of the cable route is located within the catchment of this SSSI site therefore there is the potential for effects from the upgradient construction. However, considering standard mitigation measures, no significant effects are anticipated
West Angle Bay (North) GCR	Lower Carboniferous rocks that are exposed within the Angle Syncline. Other geological features noted	Located in close proximity to landfall	No	No construction footprint is proposed on this site and therefore it is considered unlikely of any direct impacts to the site.
West Angle Bay GCR	Geology – Quaternary of Wales	Located in close proximity to landfall	No	No construction footprint is proposed on this site and therefore it is considered unlikely of any direct impacts to the site.
Freshwater West (North) GCR	Variscan structures of South Wales and the Mendips	380 m south of the onshore consent boundary	No	No disruption is expected to this site.

19.6 Potential Environmental Effects

19.6.1.1 The following receptors are being brought forward for assessment

- Hydrogeology (groundwater) considered to have a sensitivity of high considering the overall Good status of the Pembrokeshire Carboniferous Limestone groundwater body.
- Hydrology (surface water) is considered to have a sensitivity of low considering the watercourses local to the development have no WFD classification.
- PWS01 considered to have a sensitivity of high due to its proximity to the onshore export cable, within 250 m.
- PWS03 considered to have a sensitivity of medium as it is within 500 m of development and the back up source is within 250 m of development.

19.6.1.2 Arfordir Penrhyn Angle / Angle Peninsula Coast SSSI is considered to have a sensitivity of high given its designation. Further details are discussed in Table 19.7. However, potential impacts and proposed mitigation for both open cut trench and HDD methodologies on the coastal and intertidal areas is given in Chapter 6 Marine and Coastal Processes Section 6.6. As such, no further assessment in made in this chapter.

19.6.1.3 The following receptors have been scoped out for further assessment:

- PWS02, PWS04, PWS05, PWS06, PWS07, PWS08, and PWS09, all considered to be hydrologically separate from the Proposed Development and are no assessed further.
- Castlemartin Corse WFD surface water body, considering that the area of the onshore cable corridor encroaches onto is <0.05% of the WFD catchment and as such significant effects are not anticipated

19.6.1.4 Table 19.8 presents the key parameters (from the main project design envelope) that have been used to inform each impact assessment in this Chapter.

Table 19.8 - Project Design Envelope Parameters Relevant to Onshore Geology, Hydrogeology and Hydrology

Potential Pathway Change / Impact	Realistic Worst Case Scenario	Justification
Construction		
Damage or disturbance of geological features of interest (including national and regional designated sites).	Both open-cut trench and HDD are currently options under consideration for the cable landing at West Angle Bay.	Excavation into the underlying geology is expected at the landfall West Angle Bay. This is assessed in Chapter 6 Marine and Coastal Processes Section 6.6
Damage or removal of geomorphological (topographical) and / or soil features.	Maximum length of cable route is 14.5 km Maximum trench width of 2500 mm Maximum depth of cable (agriculture) is 1800 mm. Maximum depth of cover (road) is 1200 mm. Approximately 600 mm of CBS (Cement Bound Sand) with a worst case of 1750 mm. Remaining subsoil and topsoil replaced.	This presents the maximum soil disturbance for the cable route.
Changes to hydrology	Open cut method is used to cross smaller watercourses and drainage ditches crossing. Locations will be isolated using temporary dams that span the width of the channel	HDD to be used for major watercourse crossings. The depth of HDDs at crossings will be such that the riverbed is undisturbed. Open cut method will require temporary disturbance, though methods and mitigation will be used to keep this to a minimum

Potential Pathway Change / Impact	Realistic Worst Case Scenario	Justification
Sediment suspended as a result of construction or decommissioning activities may enter surface water bodies.	All onshore construction activities including HDD, open cut trench and onshore substation construction	All construction activities have the potential to cause sedimentation and cause pollution to surface water and groundwater if not properly mitigated.
Release of contaminants to surface waters and groundwater.	All onshore construction activities including HDD, open cut trench and onshore substation construction	All construction activities have the potential to cause contamination to surface water and groundwater if not properly mitigated.
Alteration to flood risk as a result of onshore works.	Construction of cable route at West Angle bay disrupting existing coastal flood defences	Disruption of coastal flood defence has the potential to increase coastal flood risk
Operation and Maintenance		
Alteration to flood risk as a result of onshore works.	Onshore substation footprint maximum 11328 m^2	Increase in impermeable areas may lead to increase in run off if drainage not appropriately designed

19.6.2 Construction

Compaction and degradation of soils.

19.6.2.1 There is potential for movement of construction vehicles and plant to result in soil compaction, reducing the ability of water to permeate the ground and increasing the potential for contaminated or sediment-laden surface run-off. Reduced permeability in soils also reduces the site's flood storage capacity, which could increase the potential for localised flooding incidents. The installation of the onshore export cable may result in local degradation of soils.

19.6.2.2 Taking account of embedded mitigation set out Section 19.4, and the lack of superficial deposits at the Site with the exception of Blown Sand the magnitude of change prior to any additional, specific mitigation is negligible. The sensitivity of the on-site and adjacent watercourses is low, therefore there is potential for an indirect, temporary, short-term effect of **negligible**, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

19.6.2.3 None of effects identified above are major or moderate adverse (significant in EIA terms). Therefore, no additional mitigation is required to reduce the significance to non-significant in EIA terms and the significance of residual effects remain as detailed above.

Pollution Impact from Sediment Run-off/Transport or Chemical Contaminated Run-off

19.6.2.4 Surface run-off containing silt and other sediments, particularly during and after rainfall events, has the potential to enter the watercourses and drains on and adjacent to the Proposed Development. Silt and sediment laden surface water run-off are predicted to arise from excavations, exposed ground and any temporary stockpiles. This has the potential to temporarily impact on the water quality and hydrological and ecological function of the receiving watercourse at and downstream of the works in the absence of any mitigation. Additionally, pollutants such as oils, fuel and cement may be mobilised through mechanical leaks or spillage and carried in surface drainage.

19.6.2.5 As noted in Section 19.4, standard construction practice measures would be set out in a CEMP and fully implemented to minimise the risk of pollution to surface watercourses.

19.6.2.6 The magnitude of change regarding surface water receptors, prior to any additional mitigation, is considered to be negligible, on a low sensitivity receptor. Therefore, there is potential for a direct, temporary, short-term effect of **negligible** which is not significant in EIA terms, prior to the implementation of any additional mitigation measures.

19.6.2.7 Regarding the groundwater receptor, the magnitude of change, prior to any additional mitigation, is considered to be negligible, on a high sensitivity receptor. Therefore, there is potential for a direct, temporary, short-term effect of **minor adverse**, which is not significant in EIA terms, prior to the implementation of any additional mitigation measures.

19.6.2.8 PWS01 is considered to be in hydraulic continuity with the construction zone with a complete source pathways receptor linkage between source location and Proposed Development. Whilst the CEMP measures set out in Section 19.4 are expected to limit pollution impact from sediment run-off/transport or chemical contaminated run-off, due to close proximity of the PWS to the construction zone the magnitude of change prior to any additional mitigation is considered to be medium on a high sensitivity receptor. Therefore, there is potential for a direct, temporary, short-term effect of **major adverse** and significant in EIA terms, prior to the implementation of any additional mitigation measures.

19.6.2.9 PWS03a is a borehole that was identified to be in close proximity to the Proposed Development therefore possibly at risk of being affected. It has been confirmed that where excavations are closest to the PWS they are located approximately 270 m from the source therefore beyond the 250m buffer. It is noted that at this location land and run-off falls to the northeast, away from the PWS. The closest excavations upstream are 450 m from PWS source. Furthermore, the CEMP measures set out in Section 19.4 are expected to limit pollution impact from sediment run-off/transport or chemical contaminated run-off. Therefore, the magnitude of change prior to any additional mitigation is considered to be low on a medium sensitivity receptor. Therefore, there is potential for a direct, temporary, short-term effect of **minor adverse**, which is not significant in EIA terms, prior to the implementation of any additional mitigation measures.

19.6.2.10 PWS03b is a well that is 30 m from the proposed onshore cable corridor therefore considered to be in hydraulic continuity with the construction zone with a complete source pathways receptor linkage between source location and Proposed Development. The PWS is not in regular use and impacts are considered temporary for duration of construction within PWS buffer zone. Furthermore, the CEMP measures set out in Section 19.4 are expected to limit pollution impact from sediment run-off/transport or chemical contaminated run-off. Therefore, the magnitude of change prior to any additional mitigation is considered to be low on a medium sensitivity receptor. Therefore, there is potential for a direct, temporary, short-term effect of **minor adverse** which is not significant in EIA terms, prior to the implementation of any additional mitigation measures.

Additional Mitigation and Residual Effect

19.6.2.11 Due to the predicated major adverse (significant) effect of pollution of South Studdock PWS01, additional, project specific mitigation will need to be applied.

19.6.2.12 The following mitigation measures will be implemented to minimise the likelihood and consequence of any impacts.

- The final onshore export cable installation route (and thus enabling works) to be microsited as far away from PWS source as possible;
- Enabling works for onshore export cable installation in vicinity of 250 m PWS buffer to be overseen full time by a suitably qualified environmental engineer
- No plant, vehicles, chemicals, fuels or pollutants to be located or stationary within the PWS 250 m buffer zone;
- An appropriate Water Quality Monitoring Plan (WQMP) will be designed for the PWSs identified as being at risk of water quality deterioration to include a comprehensive sampling programme;
- Frequent communication and liaison with PWS property owner while the onshore export cable installation is within the 250 m buffer. The Contractor will provide a nominated person as point of contact;
- In the event that a PWS is affected by activities associated with the onshore export cable installation works, contingency supply arrangements will be ready for implementation under these circumstances. This will include ensuring that alternative sources of drinking water and water or general use will be provided should it be required;
- Enhanced sampling frequency of PWS source extraction point while the onshore export cable installation is within the 250 m PWS buffer. This will involve daily sampling and will include insitu testing via multiparameter probes which provides ‘instantaneous’ results. The sampling results and insitu probe results will be monitored daily to ensure any deterioration of the PWS is identified quickly and ensure contingency supply arrangements are implemented if required; and
- Should a temporary alternative supply be provided, the existing supply would be reinstated following the construction and a water quality and quantity monitoring programme will be employed to ensure the water supply is reinstated to baseline conditions.

19.6.2.13 In addition to the specific mitigations in place at those PWS locations deemed to be at risk, standard good practice measures to be outlined within the Pollution Prevention Plan will be in place and will limit effects on private water supply.

19.6.2.14 Taking into account the additional mitigation measures set out above the magnitude of change prior to any additional mitigation is considered to be negligible on a high sensitivity receptor. Therefore, there is potential for a direct, temporary, short-term residual effect of **minor adverse** which is not significant in EIA terms on PWS01.

Impact on the integrity of banking / geomorphological changes to watercourses

19.6.2.15 Construction activities on or close to the sides of watercourses can detrimentally affect the structural integrity of the banks, either through direct damage to bankside material or indirect loosening of soil structure thus impacting on the localised morphology and water quality of the watercourse through erosion or even collapse of the banking.

19.6.2.16 Multiple watercourses were identified to require crossing during the hydrological walkover survey. Appropriate crossing types have been recommended based on observations made during this survey. Full details are provided in Volume 3, Technical Appendix 19.2. A total of 16 watercourse crossings are required, and includes 14 crossings via open cut trench methodology, with over pumping if required, and three crossings via HDD.

19.6.2.17 Considering the watercourse crossing methods appropriate to each specific crossing outlined in Volume 3, Technical Appendix 19.2 and standard mitigation set out in Section 19.4, the magnitude of change, prior to any additional mitigation, is considered to be low, on a low sensitivity receptor. Therefore, there is potential for a direct, temporary, short-term effect of **minor adverse**, which is not significant in EIA terms, prior to the implementation of any additional mitigation measures.

Additional Mitigation and Residual Effect

19.6.2.18 None of effects identified above are major or moderate adverse (significant in EIA terms). Therefore, no additional mitigation is required to reduce the significance to non-significant in EIA terms and the significance of residual effects remain as detailed above.

Changes to Groundwater Flow

19.6.2.19 The potential dewatering during construction may cause variation in groundwater flow. As discussed in Section 19.5.2, the majority of the site is underlain by low productivity bedrock aquifers with the exception of the landfall location and the onshore export cable between the onshore substation and the grid connection, which are partially underlain by a moderately productive aquifer.

19.6.2.20 As outlined in Section 19.4.6.6 the requirement for dewatering will be minimised in all locations by timely and efficient excavation of the cable trench, any foundation voids and subsequent concrete pouring and backfilling. Unnecessary dewatering will be avoided, and an appropriate dewatering rate will be used to ensure minimal changes to groundwater flow. It is considered that any changes to groundwater flow would be highly localised and recover following completion of construction.

19.6.2.21 Considering the above, the magnitude of change, prior to any additional mitigation, is considered to be negligible, on a high sensitivity receptor. Therefore, there is potential for a direct, temporary, long-term effect of **minor adverse**, which is not significant in EIA terms, prior to the implementation of any additional mitigation measures.

Additional Mitigation and Residual Effect

19.6.2.22 The effect identified above is not major or moderate adverse (significant in EIA terms). Therefore, no additional mitigation is required to reduce the significance to non-significant in EIA terms and the significance of residual effects remain as detailed above.

19.6.3 Operation

Changes to hydrology

19.6.3.1 If new watercourse crossings are not designed properly to ensure continuous flows, this could potentially adversely affect the geomorphology of watercourses by reducing heterogeneity. However, as noted in Section 19.4.6 and described in Volume 3, Technical Appendix 19.2 the cable route will be installed using appropriate watercourse crossing methods. Considering the onshore export cable will be appropriately located beneath watercourses (as described in Section 19.4.6. and described in full in Volume 3, Technical Appendix 19.2) limited changes to the geomorphology of rivers is anticipated.

19.6.3.2 Considering the above, the magnitude of change, prior to any additional mitigation, is considered to be negligible, on a low sensitivity receptor. Therefore, there is potential for a direct, temporary, long-term effect of **negligible**, which is not significant in EIA terms. prior to the implementation of any additional mitigation measures.

Additional Mitigation and Residual Effect

19.6.3.3 None of effects identified above are major or moderate adverse (significant in EIA terms). Therefore, no additional mitigation is required to reduce the significance to non-significant in EIA terms and the significance of residual effects remain as detailed above.

Surface Water Drainage (Increased Rate of Surface Water Run-off) and Alteration to flood risk

19.6.3.4 The Proposed Development could result in an increased rate of surface water run-off from the onshore substation, increasing downstream flood risk and potentially resulting in soil erosion and silt-laden run-off, which could pollute watercourses, ditches and ponds. However, as set out in Section 19.4, the detailed drainage design ensures that run-off from hard surfaces would be appropriately controlled and limit the Proposed Development discharge to the required greenfield run-off rates.

19.6.3.5 The magnitude of change, prior to any additional mitigation, is therefore negligible, on a low sensitivity receptor (local watercourses). Therefore, there is potential for an indirect, long-term effect of **negligible**, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

19.6.3.6 None of effects identified above are major or moderate adverse (significant in EIA terms). Therefore, no additional mitigation is required to reduce the significance to non-significant in EIA terms and the significance of residual effects remain as detailed above.

Long-term Changes to Groundwater Flow Regime

19.6.3.7 The presence of building foundations has the potential to interrupt groundwater flow for example, impermeable foundations can act as barriers to flow. However, given the lack of superficial geology at the onshore substation location, groundwater is expected to be limited to localised near-surface soils. Upon completion of construction, upgradient groundwater would establish a natural pathway locally around the development formation / foundation and continue in the natural (pre-development) flow regime.

19.6.3.8 The magnitude of impact is therefore negligible on a high sensitivity receptor. Therefore, there is potential for an indirect, long-term effect of **minor adverse**, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

19.6.3.9 None of effects identified above are major or moderate adverse (significant in EIA terms). Therefore, no additional mitigation is required to reduce the significance to non-significant in EIA terms and the significance of residual effects remain as detailed above.

19.6.4 Decommissioning

19.6.4.1 Onshore export cables will likely be left in-situ as is industry standard. It is noted that onshore export cable removal may result in disturbance to the local environment similar to installation. Contingency plans will be developed to ensure that appropriate actions are taken should any of the residual onshore export cable become exposed. It is likely that onshore export cables would be removed from ducts and trenches and recycled with ducts left in place undisturbed.

19.6.4.2 At the end of the Project's operational life, the onshore substation may be retendered for continued use (if, for example, the Project site is repowered), or the site will likely be decommissioned. To decommission the onshore substation, all electric plant is removed from their foundations and transported to a facility for processing for reuse, recycling, or disposal. The foundations may be pulled out and disposed of and any holes refilled with earth, if required. The control building can be demolished, and all materials disposed of.

19.6.4.3 Prior to decommissioning, a Decommissioning Environmental Management Plan (DEMP) will be produced to reflect the current legislation and policy and will be agreed with the relevant statutory authorities

19.6.4.4 Should PWS01 and PWS03 still be serving as PWS's at the time of decommissioning the onshore export cable will be left in situ within 250m of the supply to minimise the risk to the PWS.

19.6.4.5 Potential effects of the decommissioning stage on onshore geology, hydrogeology and hydrology are fewer than those at construction and typically of a lesser magnitude in term of scale and effect. Considering the above, the effect of the decommissioning phase on onshore geology, hydrogeology and hydrology is considered unlikely to give rise to significant effects.

19.6.5 Effects on Human Health and Population

19.6.5.1 There will be no effects on population or human health in relation to onshore geology, hydrogeology and hydrology. The assessment has identified potential effects on PWS01 and PWS03 during the time construction works are within hydraulic connection to the source supply location, however as discussed in Section 19.7.2.14, additional mitigation measures will be in place to reduce the risk to these PWS. These include enhanced sampling frequency of PWS source extraction point for the duration of time onshore export cable installation is within the 250 m PWS buffer and insitu testing via multiparameter probes which provides 'instantaneous' results will ensure any variations in quality are identified quickly. There will be frequent communication and liaison with PWS property owner and contingency supply arrangements should this be necessary. Refer to Section 19.7.1.14 for full mitigation details.

19.7 Inter-Related Effects

19.7.1.1 The assessment of impacts arising from construction, operation and decommissioning of the Project indicates that impacts on receptors addressed in different aspects of the Project may potentially further contribute to the impacts assessed on onshore geology, hydrogeology and hydrology. The potential inter-related effects that could arise in relation to onshore geology, hydrogeology and hydrology are presented in Table 19.9. Such inter-related effects include both:

- Project lifetime effects: i.e. those arising throughout more than one phase of the project (construction, operation, and decommissioning) to interact to potentially create a more significant effect on a receptor than if just one phase were assessed in isolation; and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor (or group). Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

Table 19.9 - Inter-related effects assessment for Onshore Geology, Hydrogeology and Hydrology

Project phase(s)	Nature of inter-related effect	Assessment alone	Inter-related effects assessment
Project lifetime effects			
Construction and Operation	Pollution impact from sediment run-off/transport during construction and pollution impact from increased rate of surface water run-off at the onshore substation location	A negligible effect is predicted on surface water receptors during construction considering standard mitigation measures. A negligible effect is predicted on surface water receptors during operation considering the appropriate design drainage strategy	Considering the negligible effect at the construction and operational phases on local surface watercourses and the mitigation measures in place, it is considering that there is no potential for interrelated impacts on local watercourses to result in a more significant effect.
Receptor-led effects			
Local Hydrology	Pollution impact from sediment run-off/transport during construction and impact on the integrity of banking / geomorphological changes to watercourses combined may create inter-related effects during construction on local hydrology.	A potential negligible effect is predicted on surface water receptors during construction from pollution impact considering standard mitigation measures. There is the potential for a direct, temporary, short-term effect of minor significance from geomorphological changes during construction considering standard mitigation measures	Considering the predicted effects on local hydrology from the individual impact and the standard mitigation measures in place, it is considering that there is the potential for a direct, temporary short-term inter-related effect of minor significance from construction impact.

19.8 Cumulative Assessment

19.8.1.1 A Cumulative Effects Assessment (CEA) has been made based on existing and Proposed Developments in the Study Area (Chapter 30: Cumulative Effects Assessment). The approach to the CEA is described in Chapter 30: Cumulative Effects Assessment. Cumulative effects are defined as those effects on a receptor that may arise when the Proposed Development is considered together with other reasonably foreseeable projects.

19.8.1.2 Details for the potential of onshore geology, hydrology and hydrogeology cumulative effects arising between developments identified in Chapter 30: Cumulative Effects Assessment and the developments considered are listed in Table 19..

19.8.1.3 Of the developments identified in the CEA, no developments have been identified which may result in cumulative effects with the exception of the applications relating to Greenlink Interconnector (18/0899/SO, 20/0041/PA, 20/0044/PA and NP/20/0222/FUL) and the Marine Energy Testing Area (META) (18/1067/SO).

19.8.1.4 However, no significant effects have been identified in the Greenlink Environmental Statement on onshore geological, hydrogeological and hydrological receptors considering embedded design, mitigation and enhancement measures. The project will include the use of SuDS to mitigate flood risk at the converter station and treat run-off to an appropriate level prior to discharge. A CEMP will also be in place which will be submitted and approved by the local authority.

19.8.1.5 It is noted that Greenlink Environmental Statement did not access PWS, despite the cable route passing approximately 100 m from Broomhill Farm well, PWS03b. The PWS is not in regular use and in the unlikely event the construction of the Greenlink project were to be undertaken at the same time as the Proposed Development, impacts are considered temporary for duration of construction within PWS buffer zone. CEMP measures set out in Section 19.4 are expected to limit pollution impact from sediment run-off/transport or chemical contaminated run-off. Therefore, the magnitude of impact would not increase.

19.8.1.6 The META is currently at scoping stage (application 18/1067/SO). One of the proposed test sites is located south of the peninsula with cable route options coming into landfall at Freshwater Bay and at East Pickard Bay to various temporary control station options. The closest locations for potential temporary control stations and cable routes for META is approximately 100 m downgradient from the onshore consent boundary. Therefore, there is the potential for cumulative pollution effects to arise on the hydrology and hydrogeology receptors brought forward in this chapter's assessment should the onshore construction phases of the Proposed Development and META overlap. In their scoping response to 18/1067/SO, NRW advise that a CEMP is submitted to include construction method statements on the cable trenches and pollution prevention measures that will be employed to minimise the risk to controlled waters from the on-land construction activities. Considering no significant effects are anticipated in this chapter's assessment and a CEMP is in place to control pollution from the onshore works for META in line with NRW recommendations, no significant cumulative effects on the hydrology and hydrogeology are anticipated. The only PWS assessed in this chapter which is in proximity to the META onshore works is PWS03b. This PWS is located approximately 300 m from the META cable route and temporary control stations search area. PWS03b is located upstream from the search area and thus no pollution effects are expected. Therefore, no cumulative effects on PWS's are anticipated.

Table 19.10 – Cumulative Effects Assessment for Onshore Geology, Hydrogeology and Hydrology

Application Reference (refer to Chapter 31: Cumulative Effects for full details)	Potential for Cumulative Effects relating to Onshore Geology, Hydrology and Hydrogeology	Reasoning
12/0820/PA	No	Located opposite side of Milford Haven, no hydraulic connection
13/0824/PA	No	Located opposite side of Milford Haven, no hydraulic connection
14/0158/PA	No	Located opposite side of Milford Haven, no hydraulic connection
14/0901/PA	No	Located north of Pembroke, considered to be no hydraulic connection
14/1098/PA	No	Located in Pembroke Dock, considered to be no hydraulic connection
15/0144/PA	No	Located north of Pembroke, considered to be no hydraulic connection
15/0929/PA	No	Located at Pembroke Refinery, and located within a separate catchment to that of the Proposed Development
15/1266/PA	No	Located in Pembroke Dock, considered to be no hydraulic connection
18/0211/PA	No	Located opposite side of Milford Haven, no hydraulic connection
18/0274/PA	No	Located opposite side of Milford Haven, no hydraulic connection
18/0332/SO	No	Located in Pembroke Dock, considered to be no hydraulic connection
18/0899/SO	Yes	Located within proximity to the Proposed Development
18/1067/SO	Yes	Located, part of development located near Freshwater Bay
19/0577/PA	No	Located in Pembroke Dock, considered to be no hydraulic connection

Application Reference (refer to Chapter 31: Cumulative Effects for full details)	Potential for Cumulative Effects relating to Onshore Geology, Hydrology and Hydrogeology	Reasoning
19/0618/PA	No	Located at Pembroke Refinery, and located within a separate catchment to that of the Proposed Development
19/0928/PA	No	Located opposite side of Milford Haven, no hydraulic connection
20/0041/PA	Yes	Located within proximity to the Proposed Development
20/0044/PA	Yes	Located within proximity to the Proposed Development
NP/20/0222/FUL	Yes	Located within proximity to the Proposed Development

19.8.2 Construction

19.8.2.1 Considering the above no cumulative effects are anticipated during the operational phase of the development on onshore geology, hydrogeology and hydrology receptors.

19.8.3 Operation

19.8.3.1 Considering the above no cumulative effects are anticipated during the operational phase of the development on onshore geology, hydrogeology and hydrology receptors.

19.8.4 Decommissioning

19.8.4.1 It is not known whether there will be any other projects that could have onshore geological, hydrogeological impacts during the decommissioning phase for the Project. It is considered unlikely that there will be cumulative effects from noise and vibration in the decommissioning phase and any potential effects will be managed in accordance with guidelines and legislation applicable at the time of decommissioning.

19.9 Transboundary

19.9.1.1 There are no trans- boundary impacts predicted to result from the construction, operation and maintenance and decommissioning of the Project with respect to onshore geology, hydrogeology or hydrology.

19.10 Summary

19.10.1.1 The focus of the assessment is the land within the onshore consent boundary, with a wider Study Area including a 500 m buffer considered for geology and a 1 km buffer for hydrological and hydrogeological receptors around the site.

19.10.1.2 Review of the British Geological Survey (BGS) online geology maps indicate that the majority of the cable route is not situated along any underlying superficial deposits. There is an extent of Blown Sand which intercepts the middle section of the route for 2.22 km extents. A more discrete section is underlain by Tidal Flat Deposits, consisting of sand silt and clay is confined to a small area to the immediate east of the Blow Sand deposits. Topsoil was encountered in the majority of exploratory hole locations and Made Ground was encountered across 18 out of the 55 exploratory locations.

19.10.1.3 At landfall, the underlying bedrock is Black Rock Subgroup and Gully Oolite Formation consisting of limestone. This changes when the route turns south towards Angle Road, the route crosses a multitude of bedrock classifications along its initial 1km rise, including, the Avon Group, consisting of limestone and mudstone, the Skrinkle Sandstone Formation, the Ridgeway Conglomerate Formation and the Milford Haven Group. The cable remains underlain by the final profile from Hubberton to the substation, briefly cutting though Cosheston Group by Hoplass Solar farm. Both landfall locations are located within Arfordir Penrhyn Angle / Angle Peninsula Coast SSSI which is located along the southern and western edge of the peninsula.

19.10.1.4 The majority of the Proposed Development is underlain by low productivity bedrock aquifers, with the exception of the landfall location and the onshore export cable between the substation and the grid connection which is partially underlain by a moderately productive aquifer described as a massive karstic limestone aquifer with rapid response to rainfall.

19.10.1.5 The WFD groundwater body in the area is the Pembrokeshire Carboniferous Limestone. This groundwater body currently has good status for qualitative, chemical and overall status.

19.10.1.6 No WFD surface water bodies have been identified within the zone of effect for the onshore cabling activities. The closest WFD surface water body to the proposed route is the Castlemartin Corse (GB110061025000) which has an overall classification of Moderate. The area is coastal and watercourses within the vicinity of the onshore export cable are generally fed by springs. The area is subdivided into numerous small surface water catchments which discharge directly to tidal headwaters.

19.10.1.7 All potential sources of flooding to the site have been considered and it is confirmed that once operational, no material flood risk sources have been identified that will impact the Proposed Development.

19.10.1.8 During the construction phase the Proposed Development could be vulnerable to several types of flooding. However, taking into account of the standard mitigation measures detailed in the Flood Consequence Assessment (FCA) and the appropriate design of watercourse crossing detailed in the Watercourse Crossing Schedule, flood risk is considering to be **negligible** to **low** in terms of this assessment.

19.10.1.9 A range of standard mitigation measures have been applied to the Project in order to minimise potential impacts of the Project on onshore geology, hydrogeology and hydrology receptors. This includes a pre-development, construction and post-development groundwater sampling and monitoring schedule to be carried out with NRW. A Construction Environmental Management Plan (CEMP) will also be in place to control potentially polluting activities and to prevent adverse impact to downstream persons, properties and environment during the construction phase. An outline CEMP is provided in Volume 3 Technical Appendix 4.1. All earthmoving works or similar operations would be carried out in accordance with BSI Code of Practice for Earth Works BS6031:2009 and all necessary permits would be sought from NRW prior to the commencement of operations on-site.

19.10.1.10 The increased discharge rates and flood risk of the substation compound have been considered and mitigated through the Outline Drainage Assessment. This also details the proposed foul and surface water drainage strategy.

19.10.1.11 One PWS has been identified at risk from the Proposed Development; PWS01 South Studdock Farm is considered to be in hydraulic continuity with the construction zone. The potential effect on PWS has been assessed as major adverse and significant prior to the implementation of any additional mitigation measures. Additional mitigation measures are outlined in Section 19.7.2.13 and once implemented the residual effect is deemed **minor adverse** which is not significant in EIA terms.

19.10.1.12 The potential effects on watercourses during both construction and operation, considering standard mitigation measures, is assessed as **negligible** to **minor adverse** and not significant, prior to the implementation of any additional mitigation measures. The residual effect remains the same.

19.10.1.13 The potential effects on groundwater during both construction and operation, considering standard mitigation measures, is assessed as **minor adverse** and not significant, prior to the implementation of any additional mitigation measures. The residual effect remains the same.

19.10.1.14 At the end of the Project's operational life, the onshore substation will either be retendered for continued use or the site will be decommissioned. Prior to decommissioning, a Decommissioning Environmental Management Plan (DEMP) will be produced to reflect the current legislation and policy and will be agreed with the relevant statutory authorities. Should PWS01 and PWS03 still be serving as PWS's at the time of decommissioning the onshore export cable will be left in situ within 250 m of the supply to minimise the risk to the PWS.

Table 19.11 – Summary of Effects

Description of Effect	Significance of Potential Effect (assuming standard mitigation implemented)		Additional Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Compaction and degradation of soils	Negligible	Adverse	No additional mitigation	Minor	Adverse
Pollution Impact from Sediment Run-off/Transport or Chemical Contaminated Run-off on surface water	Negligible, considering standard mitigation measures (CEMP)	Adverse	No additional mitigation	Negligible	-
Pollution Impact from Sediment Run-off/Transport or Chemical Contaminated Run-off on groundwater receptors	Minor, considering standard mitigation measures (CEMP)	Adverse	No additional mitigation	Minor	Adverse
Pollution Impact from Sediment Run-off/Transport or Chemical Contaminated Run-off on PWS01	Major	Adverse	Additional mitigation specific to PWS01 has been set out in Section 19.6.2.	Minor	Adverse
Pollution Impact from Sediment Run-off/Transport or Chemical Contaminated	Minor	Adverse	No additional mitigation	Minor	Adverse

Description of Effect	Significance of Potential Effect (assuming standard mitigation implemented)		Additional Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Run-off on PWS03a and PWS03b					
Changes to groundwater flow	Minor	Adverse	No additional mitigation	Minor	Adverse
Impact on the integrity of banking / geomorphological changes to watercourses	Minor	Adverse	No additional mitigation	Minor	Adverse
Operation					
Changes to hydrology	Negligible, considering watercourse specific crossings identified in Volume 3, Technical Appendix 19.2	Adverse	No additional mitigation	Negligible	-
Surface Water Drainage (Increased Rate of Surface Water Run-off) and Alteration to flood risk	Negligible, considering appropriate drainage design set out in Volume 3, Technical Appendix 19.4	Adverse	No additional mitigation	Negligible	-
Long-term Changes to Groundwater Flow Regime	Minor	Adverse	No additional mitigation	Minor	Adverse

Description of Effect	Significance of Potential Effect (assuming standard mitigation implemented)		Additional Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Decommissioning					
Potential effects of the decommissioning stage on onshore geology, hydrogeology and hydrology are fewer than those at construction and typically of a lesser magnitude in term of scale and effect. The effect of the decommissioning phase on onshore geology, hydrogeology and hydrology is considered unlikely to give rise to significant effects, considering a DEMP will be in place and considering that the onshore export cable will be left in situ within 250m of the supply to minimise the risk to the PWS, should PWS01 and PWS03 still be serving as PWS's.					

19.11 References

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