# 12 Hydrology, Flood Risk, Water Resources and Surface Water Quality

## 12.1 Introduction

1 This chapter considers the potential effects of the proposed Onshore Works on surface water hydrology, flood risk, water resources and water quality.

2 It details the current baseline conditions within the area potentially affected by the Onshore Works, focussing on key streams and catchments crossed by the proposed Cable Corridor; flood risk at the onshore landing point, substation site and stream crossings; existing water resources along the Cable Corridor and the quality of stream flows in watercourses within and adjacent to the Application Boundary.

3 This chapter assesses the effect of the development on surface water quantity and quality during construction and operation including flood risk to third parties and on any water resources close to the proposed Onshore Works. Key issues related to this development are effects on surface runoff rates, the effect of stream crossings on flood risk and potential releases of sediment and other contaminants during construction, operation and maintenance.

4 The assessment presented in this chapter was undertaken by Kaya Consulting Limited. The chapter is accompanied by four appendices, which include a Flood Risk Assessment prepared for the Cable Landfall, a Flood Risk Statement for the Substation and an Outline Drainage Strategy Plan for the entire route (all prepared by Kaya Consulting). The chapter is also supported by an Outline Surface Water Drainage Strategy for the Proposed Substation prepared by Natural Power.

## 12.2 Effects Assessed in Full

5 The following potential effects of the construction and operation of the proposed Onshore Works were assessed.

### *12.2.1.1 Surface Water Hydrology*

- Modifications to natural drainage patterns during construction and operation of the Onshore Works, including effects on streams, hillslope runoff, wetlands, marshes and peat bogs. This will include changes to channel form and stream geomorphology.
- Changes to runoff rates and volumes during construction and operation of the Onshore Works.

### *12.2.1.2 Flood Risk*

- Increases in flood risk due to increased runoff from compacted or disturbed ground.
- Increase in flood risk due to transfer of surface water along excavated trenches.
- Increases in flood risk due to potential for blockages of existing culverts and bridges from land/bank erosion as a result of tree removal and construction of the Onshore Works.
- Increases in flood risk, risk of localised flooding and/or bank erosion due to impediments to flow within channels due to debris from land/bank erosion during tree removal and construction of the Onshore Works, particularly in conditions of high discharge.
- Increase in flood risk due to encroachment of development on natural floodplains of streams and channels and changes to flood storage within floodplain areas.

### *12.2.1.3 Water Resources (Drinking Water Supply)*

- Changes in surface runoff rates that could affect water resources.
- Pollution of public/private drinking water supplies caused by releases of sediment to watercourses from excavated/stockpiled material during construction, or as a result of stream crossings or works near streams.
- Pollution of public/private drinking water supplies, through operation of machinery (e.g. spillage of fuels, oils etc.) during site preparation and construction of the Onshore Works.

### *12.2.1.4 Water Quality*

- Pollution of surface waters caused by releases of sediment to watercourses from excavated/stockpiled material during construction or as a result of stream crossings or works near streams.
- Pollution of surface and groundwater through operation of machinery (e.g. spillage of fuels, oils etc.) during site preparation and construction of the Onshore Works.
- Damage to river banks resulting in erosion and sediment discharge to channels due to the operation of machinery during construction of the Onshore Works.

6 For all potential effects, an assessment has also been made of the cumulative effects with other development proposals anticipated to be constructed or operated during the same period.

## 12.3 Effects Scoped Out

7 The following potential effects have been scoped out:

- Pollution of surface water and groundwater as a result of maintenance activities associated with the operation of the Onshore Works (e.g., spillage of fuels, oils etc.).
- Reductions in natural flows arising from any temporary or permanent abstractions, This effect, identified in the Scoping report has subsequently been scoped out of the assessment as no abstractions are proposed during construction or operation.

## 12.4 Guidance and Legislation

8 The assessment has been undertaken in line with the following guidance and legislation:

- Scottish Environment Protection Agency (SEPA) Pollution Prevention Guidelines;
- SEPA Regulatory Position Statement – Developments on Peat (SEPA, 2010a);
- Planning Advice Note (PAN) 51: Planning, Environmental Protection and Regulation (Scottish Government, 2006a);
- Scottish Planning Policy, (Scottish Government, 2010);
- PAN 69 Planning and Building Standards Advice on Flooding (Scottish Government, 2004);
- Technical Flood Risk Guidance for Stakeholders (SEPA, 2010b);
- Technical Flood Risk Guidance Revision Note 1 = Estimation of Coastal Sea Levels (SEPA, March 2011);
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011;
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011: A Practical Guide (SEPA, 2011);
- Additional SEPA guidance;
- The Flood Risk Management (Scotland) Act 2009;
- Technical Note on Protecting the Environment during Mechanised Harvesting Operations (Forestry Commission, 2005);
- Control of Water Pollution from Linear Construction Projects. Technical Guidance and Site Guide. (CIRIA, 2006a and 2006b);
- SUDS Manual (CIRIA, 2007);
- Directive 2000/60/EC establishing a framework for Community action in the field of water policy (Water Framework Directive);
- Directive 2006/7/EC concerning the management of bathing water quality (Bathing Water Directive) transposed into domestic law by the Bathing Water (Scotland) Regulations 2008;
- Forests and Water Guidelines (Forestry Commission, 2003);
- Technical Note on Protecting the Environment during Mechanised Harvesting Operations (Forestry Commission, 2005); and
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011.

## 12.5 Data Sources

9 The following sources of information have been referred to in this chapter of the EIA:

- Ordnance Survey mapping at 1:10,000, 1:25,000 and 1:50,000 scales;
- A field walkover survey of the proposed Onshore Works undertaken on 15 July 2011;
- Consultation with statutory and non-statutory organisations;
- The Flood Estimation Handbook (FEH), CD-Rom Version 3;

- SEPA's Indicative River and Coastal Flood Map;
- SEPA River Basin Management Plan Interactive Map (http://213.120.228.231/rbmp/);
- The UK Hydrological Register;
- Scottish Natural Heritage (SNH) Interactive Map (http://www.snh.gov.uk/publications-data-and-research/environmental-data/map/);
- Forth River Basin Management Plan and results of water quality monitoring (http://www.sepa.org.uk/water/river_basin_planning/area_advisory_groups/forth.aspx).
- **Appendix 12.:, Flood Risk Assessment for Cable Landfall Point**;
- **Appendix 12.2: Flood Risk Statement for Substation Site**;
- **Appendix 12.3: Outline Surface Water Drainage Strategy for Proposed Substation**; and
- **Appendix 12.4: Drainage Strategy Plan**.

## 12.6 Engagement

10 Consultation responses with respect to surface water hydrology, flood risk, water resources and water quality are outlined in **Table 12.1**.

| Consultee | Scoping/other Consultation | Issue Raised | Response/Action Taken |
|---|---|---|---|
| SEPA | Scoping response | <u>Wetlands and peatlands</u><br>EIA needs to demonstrate how the layout and the design of the development avoid effects on wetlands and peatlands. | The effect on wetlands (including any Groundwater Dependent Ecosystems) is considered in **Chapter 8: Terrestrial and Inter-tidal Ecology and Ornithology**. The effect on Peatlands is considered in **Chapter 11: Geology, Ground Conditions, Groundwater** and **Coastal Processes**. |
| | | <u>Existing private water supplies</u><br>Any private water supplies within 1 km of the proposed Cable Corridor should be identified on a map. | SEPA, Scottish Water and East Lothian Council were consulted with respect to any relevant information held by them related to private water supplies. One licensed drinking water abstraction site at Woodhall Farm (369004, 672566) and a private water supply at Weatherly (367828, 671727) were identified by SEPA close to the Cable Corridor. |
| | | <u>Engineering activities in the water environment</u> | Footprint of development has been selected to limit disturbance as far as possible. Crossings of a number of watercourses will be undertaken using trenchless techniques. |
| | | Evidence on efforts to leave the water environment in its natural state should be provided. | |
| | | Flood risk assessment required of any proposed engineering of watercourses. | Flood risk for watercourses is considered in **Table 12.6.** A detailed Flood Risk Assessment of the Cable Landfall point is provided in **Appendix 12.1**, with a flood statement for the Substation Site in **Appendix 12.2**. |
| | | A site survey should be undertaken of existing water features and a map of proposed engineering activities in the water environment provided. A table giving justification for the activity and details of mitigation measures should be included, including a photograph of the affected water bodies. | A site survey was undertaken by hydrologists. Details of engineering activities are provided in **Chapter 5: Project Description**. |
| | | <u>Pollution prevention and environmental management</u><br>Prevention and mitigation measures during construction, operation, maintenance, demolition and restoration should be identified. | Mitigation measures for activities in the surface water environment are provided in this chapter. Photographs of water bodies are provided in **Figures 12.6a-c**. |
| | | <u>Flood Risk</u><br>Built development on the flood plain should be avoided. Any built development proposed for a functional flood plain should be shown in the ES.<br>SEPA welcomes the stand-alone Flood Risk Assessment (FRA) proposed to be undertaken for key infrastructure and recommend that the proposed FRA considers all watercourse crossings to ensure that proposed culverting does not increase flood risk to nearby areas. Consideration should be given to any cable | The footprint of the development is not predicted to lie within the floodplain of any watercourse, except where the Cable Corridor crosses the watercourse. The footprint of the development has been selected to limit. disturbance as far as |

| Consultee | Scoping/other Consultation | Issue Raised | Response/Action Taken |
|---|---|---|---|
| | | crossings to ensure they would not exacerbate flooding by increasing the potential for channel blockage. | possible. Land will be returned to its natural state as far as possible on completion of construction. As a result, development is not predicted to increase downstream flood risk to others.<br>The cable landfall lies within the 200 year coastal floodplain. A stand-alone flood risk assessment has been prepared for the cable landfall (**Appendix 12.1**). Flood risk for all watercourse crossings is assessed in the main effects assessment section, **Table 12.7**. **Appendices 12.2-12.4** providing further supporting information. |
| | | <u>Removal of trees</u><br>The removal of trees could have varying degrees of associated hydrological effects. Careful consideration should be given in the ES to the extent of deforestation and flood risk mitigation measures. | Minor tree felling will be required but the majority of trees/woodland areas will be avoided by the route completely or passed via trenchless crossing methods. |
| | | <u>Water Framework Directive</u><br>● Developments should be designed to avoid engineering activities in the water environment wherever possible and it should be demonstrated that every effort has been made to leave the water environment in its natural state.<br>● Engineering activities such as culverts, watercourse diversions, bank modifications or dams should be avoided unless there is no practicable alternative.<br>● Where a watercourse crossing cannot be avoided, bridging solutions or bottomless or arched culverts which do not affect the bed and banks of the watercourse should be used.<br><br>A site survey of existing water features and a map of the location of all proposed engineering activities in the water environment should be included in the ES. | The proposed Onshore Work contains a cable corridor, such that crossings of some watercourses cannot be avoided.<br>A site survey of existing water features has been undertaken and a map of proposed crossings is provided as **Figure 12.4 Stream Crossings**.<br><br>Effects on stream crossings and crossing types are summarised in **Table 12.4**. |
| SNH | Scoping Response | There is the potential for impacts upon Woodhall Dean Site of Special Scientific Interest (SSSI) as it lies partly within the route corridor. There is a risk that the natural heritage value of this SSSI could be affected via run-off or other impacts during the construction phase of the proposal. SNH advises the applicant to provide clear and detailed plans to avoid impacts upon this SSSI during construction. | Potential effects of construction activities on stream flow rates and water quality at Woodhall Dean SSSI are considered in Section 12.12 with mitigation measures outlined in the drainage strategy in **Appendix 12.4**. |
| East Lothian Council (ELC) | Scoping Response | ***Water/(Landscape)***<br>Where felling may be considered as mitigation for potentially significant effects on hydrology, the requirements of the Scottish Government's Policy on Control of Woodland Removal should be referred to, in particular, the requirement for replacement planting. | Minimal tree felling is required and is not predicted to have a significant effect on the hydrological environment. |
| | | A systematic table detailing the justification for each engineering activity in the water environment and how any adverse effect will be mitigated should be included, accompanied by a photograph of each affected water body along with its dimensions. | Justification of engineering activities in water environment with respect to stream crossings is provided in **Table 12.5**. |
| | | SEPA encourages applicants to seek opportunities to avoid or offset environmental effects in the water environment. Any such proposed mitigation should be shown. | At four stream crossings the cable will be installed by trenchless methods that will not disturb the stream channel. |
| SEPA | Consultation response | SEPA was asked for relevant information related to the study area; as well as data on any known flood risks in the study area.<br>SEPA responded by providing the following data:<br>● Recorded flow data for Dry Burn<br>● Stream water quality classification data<br>● Licensed water abstraction sites within a 5 km radius.<br>One licensed drinking water abstraction site at Woodhall Farm (369004, 672566) and a private | SEPA data was used in the baseline studies. |

| Consultee | Scoping/other Consultation | Issue Raised | Response/Action Taken |
|---|---|---|---|
| | | water supply at Weatherly (367828, 671727) were identified.<br><br>SEPA referenced their indicative flood maps but did not identify any historical flooding instances. | |
| Scottish Water | Consultation response | Scottish Water was asked for information on their public water supply network within the study area. They were also asked if they had information on private water supplies in the study area.<br>Scottish Water responded by providing plans of public water infrastructure. They did not identify any private water supplies. | The plans were analysed against the layout of the development. No sources of public water supply were identified at the site. However, the construction corridor crosses public water infrastructure at:<br><br>● A1 at co-ordinates (374699, 674361)<br>● Access Road to Station House at (374600, 674377)<br><br>The construction corridor is parallel to a 400 mm trunk main adjacent to the A1. |
| ELC | Consultation response | ELC was asked for information on historical flood risk in the study area and for information on private water supplies. | ELC indicated that they have no records of private drinking water supplies in the area. The council also did not indicate any known flooding issues in the study area. |

Table 12.1: Consultation Responses

## 12.7 Assessment Methodology

11 The sensitivity of catchments, streams and crossing locations to change have been determined based on the criteria presented in **Table 12.2**.

12 The magnitude of change has been assessed based on the criteria presented in **Table 12.3**.

13 The predicted significance of effects was determined through a standard method of assessment based on professional judgement, considering both sensitivity and magnitude of change as per **Table 12.4**.

14 Major and moderate effects are considered significant in the context of the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 (EIA Regulations).

| Sensitivity | Surface Water Hydrology including Flooding | Water Quality including Water Resources |
|---|---|---|
| High | A watercourse with:<br>i) important sensitive and protected ecosystems;<br>ii) critical economic and social uses (e.g., water supply, navigation, recreation, amenity etc.);<br>iii) known risk of flooding of properties (or land of great value);<br>iv) large floodplains and other hydrological features providing critical flood alleviation benefits;<br>vi) adjacent sites with international and European nature conservation designations due to water features;<br>vii) a range of morphological features such as pools and riffles; and/or<br>viii) evidence showing channel migration and other morphological changes such as bar evolution. | i) Large (>100 km$^2$) or medium (10-100 km$^2$) watercourse with 'Good' water quality under the Water Framework Directive. Natural or semi-natural ecosystem with sensitive habitats and sustainable fish population;<br>ii) International and European nature conservation sites designated due to water dependent ecosystems e.g. Special Protection Area and European Commission designated freshwater fisheries. Includes all nature conservation sites of national and regional importance designated by statute including Sites of Special Scientific Interest, National Nature Reserves and Natural Areas (part of a Regional Biodiversity Action Plan);<br>iii) Watercourse supports a range of species and habitats sensitive to a change in suspended sediment concentrations and turbidity, such as migratory salmon or freshwater pearl mussels.<br>iv) Major water supply that provides water to multiple >10 households. |
| Medium | A watercourse with limited/few:<br>i) sensitive or protected ecosystems;<br>ii) economic and social uses (e.g., water supply, navigation, recreation, amenity etc.);<br>iii) risk of flooding of property (or land of value);<br>iv) floodplains and other hydrological features which provide some flood alleviation benefits;<br>v) morphological features such as pools and riffles; and/or<br>vi) risk of being vulnerable to changes in fluvial processes (e.g., increased bank or channel erosion). | i) Large (>100 km$^2$) or medium (10-100 km$^2$) watercourse with a measurable degradation in its water quality as a result of anthropogenic factors (e.g., 'Medium' or 'Poor' water quality designation under the Water Framework Directive). Ecosystem modified resulting in effects on the species diversity of flora and fauna in the watercourse. Moderately sensitive habitats.<br>ii) Medium (10-100 km$^2$) or small (1-10 km$^2$) watercourse of 'Good' water quality under the Water Framework Directive that lies upstream of a larger watercourse with 'Good' water quality, where flows in smaller watercourse are minor compared to the larger stream.<br>iii) Includes non-statutory sites of regional or local importance designated for water dependent ecosystems.<br>iv) Watercourse supports a species |

| Sensitivity | Surface Water Hydrology including Flooding | Water Quality including Water Resources |
|---|---|---|
| | | sensitive to change in suspended sediment concentrations or turbidity including non-statutory sites of regional or local importance designated for water dependent ecosystems.<br>v) Water supply that provides water to multiple (>1) households. |
| Low | A watercourse with minimal hydrological importance to:<br>i) sensitive or protected ecosystems;<br>ii) economic and social uses (e.g. water supply, navigation, recreation, amenity etc.);<br>iii) the flooding of property (or land of value);<br>and which;<br>iv) provides minimal flood alleviation benefits; and/or<br>v) shows no evidence of active fluvial processes and exhibits no morphological diversity. | ii) Large (>100 $km^2$), medium (10-100 $km^2$) or small (1-10 $km^2$) watercourse with 'Poor' water quality designation under the Water Framework Directive', resulting from anthropogenic factors.<br>ii) Minor (<1 $km^2$) watercourse or man-made drainage channel with 'Good' water quality designation under Water Framework Directive, upstream of larger watercourse with 'Good' water quality, where flows in smaller watercourse are minor compared to larger stream.<br>iii) Major change in the species diversity of flora and fauna due to the significant water quality degradation. Fish sporadically present.<br>iv) Low sensitivity ecosystem of local and less than local importance. Does not support any significant species sensitive to changes to suspended sediment concentrations or turbidity.<br>v) Water supply that provides water to single household. |

Table 12.2: Criteria to Assess Sensitivity of Water Features

| Sensitivity | Surface Water Hydrology including Flooding | Water Quality including Water Resources |
|---|---|---|
| Major | • Major shift away from baseline conditions and/or major changes to the flow regime.<br>• Considered as >10% change in average flows, >25% decrease in low flows or >10% change in peak flows<br>• Increased number of properties at risk of flooding and extent of "high risk" areas [classified by the Risk Framework contained in Scottish Planning Policy (SPP)] will be significantly increased.<br>• Major effects on channel morphology resulting in change in channel form or loss of morphological diversity.<br>• Major interruption to fluvial processes such as channel plan form evolution or erosion and deposition. | • A major effect will be considered when there is a low dilution available in the watercourse and there is a major potential for accidental spillage of fuel and concrete, the watercourse is a designated fisheries river or has an environmental protection status (e.g. Special Area of Conservation (SAC), Special Site of Scientific Interest (SSSI)); there is water abstraction downstream or the flow pattern is such that sediment may accumulate to significant levels.<br>• Any change that downgrades a site from Good status as this does not comply with the Water Framework Directive.<br>• Major effects to the river bed due to deposition or erosion. Major effects to sensitive species or habitats as a result of changes to suspended sediment load or turbidity.<br>• A change that results in a permanent or long-lasting (months) effect on the quality or quantity of a water supply that renders it unusable. |
| Moderate | • Moderate shift away from baseline conditions and/or major changes to the flow regime. Considered as >5% change in average flows, >10% decrease in low flows or >5% change in peak flows<br>• Moderate increase in extent of "high risk" areas [classified by the Risk Framework contained in Scottish Planning Policy (SPP)].<br>• Moderate effects on channel morphology resulting in change in channel form or loss of morphological diversity.<br>• Moderate interruption to fluvial processes such as channel plan form evolution or erosion and deposition. | • A moderate effect will be classed when there is Moderate dilution potential in the watercourse and medium potential for accidental spillage of fuel and concrete. Additionally, the watercourse is considered of regional ecological value (e.g. supports habitats of county or district importance, District Wildlife Sites (DWS) and Sites of Interest for Nature Conservation (SINS) or the flow pattern is such that sediment may accumulate to moderate levels.<br>• Effects that result in a change in the ecological status of the watercourse.<br>• Changes to suspended sediment load or turbidity resulting in a moderate effect on sensitive habitats or species.<br>• A change that results in an effect on quality or quantity of water supply that renders it unusable for days or weeks, with no alternative source provided. |
| Minor | • Minor shift away from baseline conditions and/or major changes to the flow regime. Considered as >1% change in average flows, >5% decrease in low flows or >1% change in peak flows<br>• Any change to the extent of "high risk" areas [classified by the Risk Framework contained in SPP] will be within the errors of method used to estimate the flood extent, e.g., for SEPA flood maps uncertainties in water levels might be of the order of 0.2 m or more. | • A minor effect will be classed when there is reasonable potential of dilution and low potential for accidental spillage of fuel and concrete, the watercourse is a considered of local ecological value (e.g. habitats of local value) or the flow pattern is such that sediment may accumulate to low levels.<br>• Minor changes to sediment transport resulting in minimal effects on species or habitats as a result of changes to suspended sediment concentration or turbidity.<br>• Minor effects to sediment patterns over this area due to either erosion or deposition.<br>• A change that results in an effect on quality or quantity of water supply that renders it unusable for a short period (days) and where the potential for |

| Sensitivity | Surface Water Hydrology including Flooding | Water Quality including Water Resources |
|---|---|---|
| | | effect has been communicated in advance, or where water is unusable for a longer period but where an alternative has been put in place. |
| Negligible | • Very slight shift away from baseline conditions and negligible changes to the flow regime (i.e. changes that are within the monitoring and prediction errors). Considered as <1% change in average flows, <5% decrease in low flows or <1% change in peak flows | • A Negligible effect is anticipated when the proposed engineering works are beside the watercourse and there is only an indirect potential effect from accidental spillage of fuel and concrete. Additionally, the watercourse might be slightly affected through low levels of sediment release, it has great potential for dilution, the flow pattern is such that sediment may not accumulate significantly or it is considered of less than local ecological value (e.g. habitats of limited ecological value).<br>• Very slight change from the baseline conditions such that no discernible effect upon the watercourse's ecology results. No change in water quality classification.<br>• Negligible changes to sediment transport No discernible effect to sediment patterns and behaviour over the development area due to either erosion or deposition.<br>• No effect on quality or quantity of water supply or change that results in short-term (days) effect where an alternative has been put in place |

Table 12.3: Criteria to assess magnitude of predicted effect on water features

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

Table 12.4: Significance criteria, based on combination of magnitude of effect and sensitivity of receptor

## 12.8 Existing Conditions

15 The study area included all catchments within which the Onshore Works are located. The assessment focussed on the Landfall Point, Cable Corridor and Substation Site. However, the assessment considered downstream effects of the development in terms of runoff and flow rates, water quality and flood risk.

16 The key issues to be considered within the baseline assessment with respect to hydrology, flood risk, water resources and water quality were identified as:

- the hydrology of key stream and watercourse crossings along the route, defined as streams marked on Ordnance Survey 1:10,000, 1:25,000 and/or 1:50,000 scale maps;
- the hydrology of sections of cable corridor between crossings, e.g., hillslope sections;
- existing flood risk along the Cable Corridor;
- water usage (as a resource) within the study area and
- water quality.

### 12.8.1 Overview of Surface Water Hydrology

17 East Lothian is one of the driest areas in Scotland with annual rainfall of around 600 mm at Dunbar, rising to above 1000 mm in the Lammermuir Hills, based on data from FEH CD-Rom Version 3. The mean annual temperature is around 8 – 10 $^{o}$C along the coast falling to 6 – 7$^{o}$C in the hills, based on Met Office regional climate normal for the East Lothian area.

18 The general topography of the study area is shown in **Figure 12.1**. A long profile of the proposed Cable Corridor is also shown in **Figure 12.1**. From the coast, there is a low lying coastal plain, with elevations around 0-20 m AOD. Ground levels rise steadily to the west into the Lammermuir Hills. The highest point along the Onshore Works is at 320 m AOD within the existing Crystal Rig Wind Farm site at Bransly Hill in the Lammermuir Hills.

19 The Onshore Works lie primarily within the catchment of the Dry Burn (which is formed by Boonslie Burn, Weatherly Burn and Woodhall Burn in its upper catchment), although they also cross the catchments of Thornton Burn near to the coast and Tay Burn (located in the headwaters of Bothwell Water) near to the proposed substation in the Lammermuir Hills, see **Figure 12.2**. Dry Burn drains east while Bothwell Water drains south.

20 Catchments in the study area have low runoff rates compared to other catchments in Scotland. Based on data from the Flood Estimation Handbook (FEH) CD-Rom Version 3, the percentage runoff for the Dry Burn and Thornton Burn catchment near the coast is around 30% (SPRHOST = 30-30.4). A similar figure is found for Weatherly Burn catchment in the east facing Lammermuir Hill (SPRHOST = 31.6). At the headwater of the Dry Burn, percentage runoff increases to about 40%. At the headwaters of Bothwell Burn which faces west, the percentage runoff is about 45%. These figures indicate that typically around 30% of the rainfall falling on a catchment becomes river and stream flow. The rest is lost to infiltration to groundwater, soil water storage, evaporation or is used by vegetation.

21 Although there is generally low runoff within the catchments affected by the Onshore Works, there is a high degree of variability in soil conditions. The coastal strip has sandy and very well drained soils which tend to produce limited runoff in response to rainfall (Winter Rain Acceptance Potential (WRAP) Soil Class 1). The farmlands between Lammermiur Hills and coast also have well-drained sandy soils (WRAP Soil Class 2), with more silty and poorer drained soils within the lower slopes of the Lammermuir Hills (WRAP Soil Class 3). There is only a small area of very poorly drained peaty soils within the headwaters near the Crystal Rig Wind Farm (WRAP Soil Classes 4 and 5).

22 There are no operational stream flow monitoring stations on any of the watercourses potentially affected by the Onshore Works. Stream flows have been gauged on Thornton Burn at Thornton Mill (SEPA Gauge No. 20804, NT741741) and Woodhall Burn at Woodhall (SEPA Gauge No. 20807, NT686734). However, at both sites the period of record is short (<10 years) and at both sites gauging stopped in the 1970's. As a result, data from these gauges were not considered in this assessment. The closest SEPA flow gauge, with a reasonable length of record and recent flow data, is on Biel Water at Barton House (Gauge No. 20006, NT645768) near to Dunbar. This gauge operated for 26 years from 1973 – 1998. The catchment is 51.8 km$^2$ in size, which is larger, but of a similar order of magnitude in size, to the two main rivers close to the Onshore Works (Dry Burn, 19.1 km$^2$ and Thornton Burn, 14.8 km$^2$). Average annual flows (1971 – 2000 averages) at this gauge are shown in **Figure 12.3**. At the gauge the average annual flow is around 0.6 m$^3$/s (11.6 L/s/km$^2$), with the flow hydrograph showing a rapid response to rainfall. Such a flashy response would be expected for such a relatively small and steep catchment. It is notable that high flow events can occur throughout the year, but generally higher flows occur in the period, September to December. A similar rapid response and annual pattern of flows would be expected in Dry Burn and Thornton Burn.

23 Dry Burn is reported to run dry in its lower reaches in summer months (RPS 2007). It is thought that the low summer flows may reflect infiltration into the channel bed in the lower reaches in areas with sandy, well drained soils.

### 12.8.2 Hydrology of Watercourses and Stream Crossings

24 The Onshore Works will extend from the coast to the existing Crystal Rig Wind Farm in the Lammermuir Hills, refer to **Figure 12.1**.

25 At the coast, the Landfall for the offshore cable will be on the beach near Thorntonloch. The connection will then head inland paralleling the line of Thornton Burn, before crossing Thornton Burn, downstream of the A1 road. The cable corridor crosses the A1 and trends to the north following the line of the road, but passing through fields to the west of the road. The corridor crosses an unnamed small watercourse (termed Innerwick Burn in this report) before turning south to follow a C-Class road inland. The corridor does not cross the main channel of Dry Burn, although it crosses small tributaries in its headwaters.

26 The corridor then follows the C-Class road trending inland and upslope towards the gate and access to the Crystal Rig Wind Farm. For much of this section of the route the corridor parallels the road, although it leaves the road near the village of Innerwick, where the corridor crosses farmland and an upland reach of Innerwick Burn. Along the road the corridor passes through agricultural land crossing a number of small streams and field drains, which are tributaries of Dry Burn. As the cable corridor enters the Crystal Rig site, the catchments change from agricultural to heath, open moorland and hillslopes. The corridor follows the main access road to the existing wind farm, crossing a number of small, upland streams and one larger watercourse (Weatherly Burn forming the headwaters of Dry Burn). The corridor climbs to the headwaters of Dry Burn, crossing Thorter Cleugh and passing parallel to Boonslie Burn, before crossing the divide into the catchment of Tay Burn (Bothwell Water) in the last hundred metres of the route as it reaches the site of the new substation adjacent to Crystal Rig Wind Farm. The headwaters of the two catchments lie in a relatively flat plateau with blanket peat.

27 Key hydrological features along the proposed route of the Onshore Works are illustrated in Photos 1 to 6 (refer to **Figure 12.6a-b**).

28 The proposed cable corridor crosses eleven watercourses identified on 1:10,000 scale Ordnance Survey maps and confirmed during a walkover site visit on 15 June 2011. Locations of the crossings are shown in **Figure 12.4**.

29 Each stream crossing was assessed against sensitivity criteria for hydrology outlined in **Table 12.2**, with results provided in **Table 12.5**. All the stream crossings were assessed to be of 'Low' sensitivity, with the exception of Thornton Burn, which was assessed to be of 'Medium' sensitivity due to evidence of bank erosion and an active channel and as it is considered as a 'Listed Wildlife Site' by the local council and Weatherly Burn, which was assessed to be of 'Medium' sensitivity due to its proximity to Woodhall Dean SSSI.

30 There may be other small culverted field drains, small field ditches, roadside drains or drainage associated with the East Coast Main Line railway that are crossed by the Cable Corridor and which are not listed in **Table 12.5**. These features not visible on 1:10,000 scale mapping may be culverted or may be small man-made surface features. These features will be of minor importance, with hydrological connections (culverts or surface ditches) either able to be bypassed during construction or replaceable with negligible effect on flow paths or flow rates.

31 The proposed substation is located in the headwaters of Bothwell Water at the western end of the cable corridor. The proposed site is adjacent to an existing substation and the access road to the Crystal Rig site. It is located in an upland area with evidence of peat. A drainage channel parallels the access road and crosses the access road to the east of proposed substation. The channel is a headwater stream of Tay Burn and is visible on 1:10,000 scale Ordnance Survey mapping. This channel may follow the line of a natural drainage feature, but is now a man-made channel constructed parallel to the access road. The channel lies within the Application Boundary for the Onshore Works, but will not be affected by the Cable Corridor. Hence, it is not listed as a crossing in **Table 12.5**, but the effects of the Onshore Works on Tay Burn will be considered within this assessment.

| No. | Name | Upstream catchment area ($km^2$) | Channel width (m) | Comment and justification for crossing | Proposed crossing type | Sensitivity for hydrology | Sensitivity for water quality |
|---|---|---|---|---|---|---|---|
| 1 | Thornton Burn | 14.9 | 3 | No existing crossing. Medium gradient stream with gravel and cobble bed. Vegetated banks along most of reach although some evidence of bank erosion in sections close to crossing.<br>Stream is along proposed Cable Corridor and cannot be avoided. However, trenchless construction measures to be used. | Trenchless, temporary crossing with single span bridge during construction. | Medium as Thornton Burn is a 'Listed Wildlife Site' by local council. | Medium, due to evidence of bank erosion and as Thornton Burn is a 'Listed Wildlife Site' by local council. |
| 2 | Unnamed Innerwick downstream | 1.8 | <1 | No existing crossing. Small anthropogenically modified channel that follows field boundaries. Heavily vegetated banks close to crossing.<br>Stream is along proposed Cable Corridor and cannot be avoided. However, trenchless construction measures to be used. | Trenchless, during construction stream will be crossed using existing culvert/ field access. | Low | Low |
| 3 | Unnamed Innerwick upstream | 0.74 | 1.5 | Existing field access crossing (approx. 400 mm diameter culvert under wooden bridge). Small, natural channel draining farmland. Vegetated banks and channel lies in broad hollow.<br>Stream is along proposed Cable Corridor and cannot be avoided. | Trench, temporary crossing with single span bridge (or temporary culvert) used during construction. | Low | Low |
| 4 | Unnamed Farmland 1 (Birky Bog) | 0.16 | 0.5 | Small field drain culverted under C-class road. Channels overgrown with vegetation.<br>Stream is along proposed Cable Corridor and cannot be avoided. However, trenchless construction measures to be used. | Trenchless, existing road and crossing to be used for access during construction. | Low | Low |
| 5 and 6 | Unnamed Farmland 2 and 3 | 0.15 | 0.5 | Two small field drains culverted under C-class road. Channels overgrown with vegetation.<br>Stream is along proposed Cable Corridor and cannot be avoided. However, trenchless construction measures to be used. | Trenchless, existing road and crossing to be used for access during construction. | Low | Low |
| 7 | Unnamed Woodhall | 0.86 | 0.5 | Existing crossing over culverted section of channel (250 mm diameter culvert). Channel is culverted upstream of crossing. Upstream and downstream of crossing, channel has been straightened to follow field boundaries.<br>Stream is along proposed Cable Corridor and cannot be avoided. However, stream is minor field drain. | Trench, temporary culvert will be installed to allow access during construction. | Low | Low |
| 8 | Unnamed Upland 1 | 0.10 | 0.5 | Hillslope runoff captured by road drainage and culverted under access road to Crystal Rig. Channel not well defined either side of road.<br>Stream is along proposed Cable Corridor and cannot be avoided. However, stream is minor drainage feature. | Trench, existing crossing to be used for access during construction. | Low | Low |
| 9 | Unnamed Upland 2 | 0.090 | 0.5 | Hillslope runoff culverted under the access road to Crystal Rig (one 400 mm diameter culvert). Channel not well defined either side of road. Water drains to wetland area to north of access road.<br>Stream is along proposed Cable Corridor and | Trench, existing crossing to be used for access during construction. | Low | Low |

| No. | Name | Upstream catchment area ($km^2$) | Channel width (m) | Comment and justification for crossing | Proposed crossing type | Sensitivity for hydrology | Sensitivity for water quality |
|---|---|---|---|---|---|---|---|
| | | | | cannot be avoided. However, stream is minor drainage feature. | | | |
| 10 | Weatherly Burn | 0.94 | 2.5 | Existing crossing for access road to Crystal Rig (two 1.1 m diameter culverts). Crossing at low gradient section of upland stream draining small catchment in Lammermuir Hills. Cobble and gravel channel with banks damaged by livestock. Crossing lies upstream of Woodhall Dean SSSI. Stream is along proposed Cable Corridor and cannot be avoided. However, crossing is proposed close to existing road crossing. | Trench, existing crossing to be used for access during construction. | Medium, due to proximity to Woodhall Dean SSSI. | High, due to existing bank erosion and proximity to Woodhall Dean SSSI. |
| 11 | Thorter Cleugh | 0.25 | 1.5 | Existing crossing for access road to Crystal Rig (400 mm diameter culvert). Small steep hillside stream. Stream is along proposed Cable Corridor and cannot be avoided. However, crossing is proposed at existing road crossing and cable will pass above channel. | Cable will pass above stream channel at similar level to existing access track. The cable will be installed in a trench adjacent to the existing access road and there may be a need to widen the road to accommodate the trench. Existing crossing to be used for access during construction. | Low | Low |

Table 12.5: Baseline Assessment for Key Stream Crossings

Note: This table lists crossings of main watercourses identified as streams that are visible on 1:50,000, 1:25,000 and/or 1:10,000 scale Ordnance Survey mapping.

NGR Co-ordinates indicating the locations of each crossing are shown on **Figure 12.4 Stream Crossings** which accompanies this chapter.

### 12.8.3 Hydrology of Hillslope Sections

32 Remote from stream crossings, the proposed Onshore Works will cross surface and shallow surface runoff flow pathways on hillslopes along the proposed Cable Corridor.

33 From the coast to the entrance to the access to the Crystal Rig Wind Farm, the Onshore Works pass through farmland with relatively gentle hillslopes (1 - 5 %), (refer to **Figure 12.5**). The farmland is well drained with sandy and silty soils, field drains and a number of small watercourses. For much of the route, the cable will follow the line of a C-Class road, which is likely to provide an existing impediment to surface and shallow subsurface flows.

34 From the entrance to the access to the Crystal Rig Wind Farm to the headwaters of Dry Burn, the Cable Corridor follows the access road to the existing wind farm. The route passes across steeper (5 - 20 %) hilllslopes in the Lammermuir Hills. The access road will provide an existing impediment to surface and shallow subsurface flows. There are existing road side swales and ditches that divert unchannelised flow towards stream channels and which focus surface flows through the road at key crossings identified above. Soils within the hills have a higher runoff potential than those found further east.

35 Within the headwaters of Dry Burn and Bothwell Burn at the western end of the cable corridor, hillslopes flatten out and the proposed substation will be constructed in an upland area with evidence of peat (further detail is provided in **Chapter 11: Geology, Ground Conditions, Groundwater and Coastal Processes** and the supporting Appendix).

36 Based on the criteria in **Table 12.2**, the sensitivity of all the hillslope sections are considered to be 'Low'.

### 12.8.4 Flood Risk

#### *12.8.4.1 Coastal*

37 Extreme sea levels along the Scottish coast are predicted in Environment Agency (2011a and b). Return period extreme sea levels for the proposed onshore landing point are shown in **Table 12.6**. Ground levels adjacent to the Thorntonloch Caravan Park and between the A1 and the shore fall from around 3 - 10 m AOD, which would indicate that land around the onshore landing point is at risk of coastal flooding. These extreme sea level estimates are a result of high astronomical tides and storm surges. Defra (2006) estimates that sea level rise due to climate change by 2080 is likely to be of the order of 0.5 m, with SNIFFER (2008) producing estimates of around 0.3 – 0.4 m.

38 The onshore landing point will also be affected by waves, which are considered in more detail within a site specific flood risk assessment for the landing point in **Appendix 12.1**.

39 At present, there are sea defences along the front at Thorntonloch, north of the Landfall area. These are ad-hoc defences which would appear to be in variable condition and constructed to protect the shoreline from erosion along the front of the caravan park at Thorntonloch.

| Return Period (years) | Extreme Sea Level (m AOD) |
|---|---|
| 2 | 3.31 |
| 5 | 3.40 |
| 10 | 3.47 |
| 50 | 3.66 |
| 100 | 3.74 |
| 200 | 3.83 |
| 500 | 3.95 |

Table 12.6: Return Period Extreme Sea Levels at Thorntonloch for Present Day

#### *12.8.4.2 Stream Crossings*

40 The SEPA Indicative Flood Map for Scotland considers watercourses with upstream catchments >3 $km^2$. As a result, the only stream crossing considered within the SEPA map is at Thornton Burn where the Cable Corridor crosses the burn and passes through its floodplain. Other streams crossed by the Cable Corridor are too small to be considered within the SEPA map. An assessment of flood risk for each crossing is provided in **Table 12.7**.

41 SEPA and ELC were consulted with respect to flood risk in the study area and no evidence of historical flooding along the route was identified.

42 The Cable Corridor will also cross other minor water features (i.e., not identified on 1:10,000 scale mapping) such as culverted field drains, minor field ditches, road drains and potentially drains associated with the East Coast Main Line. As outlined above, SEPA and ELC did not identify any known flood risk associated with minor drainage features. However, discussions with local land owners undertaken by the developer identified flooding at Skateraw Gate, close to the East Coast Main Line. This flooding is associated with a blockage or under-capacity of a minor field drainage ditch located parallel to the rail line and has a local scale effect only. The Cable Corridor lies downslope of the property at Skateraw Gate and, as a result, the Onshore Works are thought unlikely to result in any increase in flood risk at this location. If other minor drainage features are identified during construction work, any flooding risks associated with these features will be localised.

43 **Table 12.7** also provides an assessment of erosion risk at the crossing locations based on field observations of the channel morphology. As the Cable Corridor will pass under the channel bed at some locations, the potential for bed erosion (incising) and bank erosion (migration of channel) will need to be considered.

44 Flood risk at all crossings along the route is considered low. Flood risk at the substation is also considered to be low (refer to **Appendix 12.2**). The main flood risk is along the coast where the onshore landing point for the cable will lie within the 200 year coastal floodplain in an area with a potential risk of coastal erosion. Due to the higher flood risk at the coast, a stand-alone flood risk assessment has been prepared for works in the coastal area, **Appendix 12.1**.

| Location / Crossing | Catchment Area ($km^2$) | Current Flood Risk | Erosion Risk | Need for Detailed Flood Assessment | Sensitivity |
|---|---|---|---|---|---|
| Cable landing point at coastline | - | Landing point likely within coastal floodplain. | Evidence of coastal erosion along beach front likely due to wave action. Coastal defences are present to protect mouth of Thornton Burn and Thortonloch caravan park from erosion. | Yes (refer to **Appendix 12.1**) | High |
| Thornton Burn | 14.8 | Crossing lies within floodplain of the burn. However, no properties lie within SEPA Indicative Flood Map downstream of crossing. | Some bank erosion in vicinity of crossing, but channel is not incising into bed. | No | Low |
| Innerwick Burn downstream (Skateraw) | 2.6 | Crossing distant from any properties. Crossing upstream of culvert which could | Small vegetated channel, no visible erosion of banks or bed. | No | Low |

| Location / Crossing | Catchment Area ($km^2$) | Current Flood Risk | Erosion Risk | Need for Detailed Flood Assessment | Sensitivity |
|---|---|---|---|---|---|
| | | provide restriction to flow. Risk of flooding of crossing point in event of blockage of culvert. | | | |
| Innerwick Burn upstream (Temple Mains) | 0.68 | Crossing distant from any properties. Located at existing crossing. If crossing is blocked, flood waters would overtop crossing and re-enter stream down slope with no risk to properties. | Small vegetated channel, no visible erosion of banks or bed. | No | Low |
| Unnamed Farmland 1 | 0.19 | Crossing distant from any properties. Crossing upstream of culvert which could provide restriction to flow. If crossing is blocked, flood waters would overtop crossing and re-enter stream down slope with no risk to properties. | Small vegetated channel, no visible erosion of banks or bed. | No | Low |
| Unnamed Farmland 2 and 3 | 0.17 | Crossing distant from any properties. Crossing upstream of culvert which could provide restriction to flow. If crossing is blocked, flood waters would overtop crossing and re-enter stream down slope with no risk to properties. | Small vegetated channel, no visible erosion of banks or bed. | No | Low |
| Unnamed Woodhall | 0.82 | Crossing within fields downstream of culverted section of watercourse. No flood risk. | Vegetated, man-influenced channel, no evidence of erosion of banks or bed. | No | Low |
| Unnamed Upland 1 | 0.085 | Crossing in remote location. Crossing upstream of culvert which could provide restriction to flow. If crossing is blocked, flood waters would overtop crossing and re-enter stream down slope with no flooding risk. | Poorly defined channel. | No | Low |
| Unnamed Upland 2 | 0.085 | Crossing in remote location. Crossing upstream of culvert which could provide restriction to flow. If crossing is blocked, flood waters would overtop crossing and re-enter stream down slope with no flooding risk. | Poorly defined channel. | No | Low |
| Weatherly Burn | 0.86 | Crossing in remote location. Crossing at existing culvert which could provide restriction to flow. If crossing is blocked, flood waters would overtop crossing and re-enter stream down slope with no flooding risk. | Vegetated channel in low gradient section, no evidence of erosion of channel bed. | No | Low |
| Thorter Cleugh | 0.16 | Crossing in remote location. Crossing at existing culvert which could provide restriction to flow. The road is high (3 m) above culvert invert. If crossing is blocked, flood waters would pond upstream before overtopping crossing and re-enter stream | Steep hillside channel. Evidence of incising bed within channel. | No | Low |

| Location / Crossing | Catchment Area (km$^2$) | Current Flood Risk | Erosion Risk | Need for Detailed Flood Assessment | Sensitivity |
|---|---|---|---|---|---|
| | | down slope with no flooding risk. | | | |
| Substation | - | Substation Site is located in headwaters of Bothwell Burn, bounded to the north by higher ground. There is a minor risk of surface water runoff entering the site from the north, but existing peat provides attenuation and storage for downstream flows. | Site located on land with low gradient, no well-defined channels. | No, however flood risk statement has been provided in **Appendix 12.2** and the site drainage system will be designed to attenuate surface runoff from the site to greenfield runoff rates, as per **Appendix 12.3**. | Low |

Table 12.7: Assessment of Flood and Erosion Risk for Crossings, Cable Landing Point and Substation

### 12.8.5 Water Resources

45 The Cable Corridor does not pass near any major water bodies or lochs. It does pass close to two small ponds at Woodhall Farm (NT 368900 672550). Further afield, there is a pond approximately 600 m north of the route associated with a quarry near Dryburn Bridge and a pond north of Thurston Manor, approximately 350 m from the Application Boundary. None of these ponds are used for potable water supply.

46 There is a small wetland area lying downstream of the corridor near Weatherly within the Lammermuir Hills. The wetlands lie in a small perched valley which receives runoff from the High Wood area and two streams crossed by the Cable Corridor (Unnamed Upland 1 and 2). There are other areas of wetter ground identified as 'drainage' in **Figure 9.2** which accompanies **Chapter 9: Cultural Heritage**, but these appear to be minor local features.

47 Scottish Water was contacted and did not identify any sources of public water supply in the study area. However, plans of local public water infrastructure were provided and indicated that the construction corridor crosses public water infrastructure at:

- the A1 road (374699, 674361); and
- water mains on access road to Station House (374600, 674377).

48 The construction corridor will run parallel to a 400 mm diameter trunk main adjacent to the A1.

49 SEPA provided a list of private water supplies and licensed abstractions close to the study area. One private drinking water supply was identified by SEPA at Woodhall Farm (369004, 672566). There is a private water supply at Weatherly (367828, 671727).

50 East Lothian Council was contacted but did not have records of private drinking water supplies in the area.

### 12.8.6 Water Quality

51 SEPA's Water Body Classification for the Water Framework Directive (2009 results) indicates that Dry Burn has 'Good' water quality while Thornton Burn has 'Poor' quality. The Forth Area Management Plan aims to have water quality in Thornton Burn reaching a 'Good' standard by 2015. The headwater reaches of Bothwell Burn within the study area are unclassified; however, downstream of the study area, Bothwell Burn and tributaries are considered as being of 'Good' quality.

52 The SEPA Groundwater Classification indicates that the study area is located within an area of 'Good' quality groundwater.

53 Woodhall Dean is a SSSI and lies downstream of the Cable Corridor at Weatherly Burn. Woodhall Dean is a SSSI managed by the Scottish Wildlife Trust and is significant due to its woodland habitat and associated wildlife.

54 Thornton Burn is considered as a 'Listed Wildlife Site' by the local council.

55 Dry Burn and Thornton Burn are not considered as salmon bearing rivers. However, the Bothwell Burn (downstream of study area) is salmon bearing.

56 The beach at Thorntonloch is a water quality sampling location used by SEPA to assess compliance against the Bathing Water Directive (Sampling Site No. UKS7616059). Sampling has been undertaken at the site since 1988 and the results show that the beach has consistently passed the Bathing Water Directive's Guideline Standards for bathing waters.

57 Each stream crossing was assessed against the sensitivity criteria for water quality outlined in **Table 12.2**, with results provided in **Table 12.5**. Crossings over minor streams were assessed to be of 'Low' sensitivity, with the crossing over Thornton Burn assessed as being of 'Medium' sensitivity due to the size of the Thornton catchment. The crossing of the Weatherly Burn was assessed to be of 'High' sensitivity due to its proximity to Woodhall Dean SSSI. The proposed works at the shoreline at Thorntonloch are also considered as being of 'High' sensitivity in terms of water quality as Thorntonloch beach is designated as 'Bathing Water'.

## 12.9 The Do Nothing Scenario

58 If the Onshore Works were not developed, it is expected that current land use practices would continue as present. This may include further wind farm development in the study area and within the existing Crystal Rig site. The eastern part of the proposed cable corridor passes through agricultural land where any changes in farming practices would have an effect on water quantity and quality within the study area. There is limited forested land within the study area with changes in forestry practices unlikely to significantly change water flows or water quality. The surface water hydrology, water quality and flood risk within the study area would be expected to remain as at present in the 'Do Nothing Scenario', although the ongoing effects of climate change will produce changes in the seasonal patterns of rainfall and stream flow and have implications for flood flows.

## 12.10 Routeing and Design Considerations

59 Two key routeing and design decisions have been made with the aim of limiting effects to surface water hydrology, flood risk, water resources and water quality;

- trenchless installation methods will be used for selected stream crossings, including Thornton Burn in preference to open trenching across the channels; and
- the crossing at Thorter Cleugh has been designed to pass above the stream channel either utilising the existing crossing of the burn, or through the widening of the existing road.

## 12.11 Assessment of Effects

60 The assessment of effects is based upon the description of the Onshore Works as outlined in **Chapter 5: Project Description** and is structured as follows:

- Construction effects;
- Operational effects;
- Decommissioning effects
- In combination effects
- Cumulative effects.

61 As with any surface water assessment (hydrology, flood risk and water quality), key locations within the potentially affected catchments have to be selected to provide a focus for the assessment. The key locations assessed for this study are outlined in **Table 12.8**. These locations were selected based on the results of the baseline studies presented above. Locations were selected on the three main streams affected by the development at points located downstream of the Onshore Works (i.e., Thornton Burn downstream of A1, Dry Burn at A1 and Tay Burn at confluence with Bothwell Water). Two locations were selected at, and upstream of the Woodhall Dean SSSI, which

was identified as being a location sensitive to changes in surface water hydrology and water quality. Other reasons for selection of the key locations are outlined in **Table 12.8**.

62 Effects of the Onshore Works on water quality within the sea at Thorntonloch are also considered.

63 For the assessment of effects on water resources, the assessment focuses on locations where the Onshore Works cross Scottish Water infrastructure (see **Section 12.8.5**) and the two private water supplies identified at Weatherly and Woodhall Farm.

| Location | Catchment or crossing | Co-ordinates | Reason for selection |
|---|---|---|---|
| Thornton Burn downstream of A1 | Catchment and crossing point | 375016, 674187 | Evidence of bank erosion, proximity to designated bathing waters. Large upstream catchment. Thornton Burn considered as 'Listed Wildlife Site' by the local council. |
| Dry Burn at A1 | Catchment | 371748, 675111 | Mouth of catchment that contains majority of development footprint |
| Dry Burn at SSSI | Catchment | 368553, 673338 | Catchment flowing to Woodhall Dean SSSI |
| Weatherly Burn at Weatherly | Catchment and crossing point | 367709 671572 | Evidence of bank erosion at crossing. Crossing lies upstream of property. Catchment lies upstream of SSSI. |
| Tay Burn at confluence with Bothwell Water | Catchment | 365876, 667377 | Sub-catchment that contains substation at confluence with salmon bearing Bothwell Water |

Table 12.8: Key Locations for Hydrology, Flood Risk and Surface Water Quality Assessment

## 12.12 Construction Effects of the Onshore Works

64 An assessment of the effect of construction of the Onshore Works on surface water hydrology, flood risk, water resources and water quality is provided below.

### 12.12.1 Surface Water Hydrology

#### *12.12.1.1 Potential Effects*

65 The construction works have the potential to effect natural drainage patterns and runoff rates. The primary effect is likely to be an increase in runoff rates due to hard standing areas or compacted/disturbed ground during construction. A further issue is the potential for the works to act to divert existing flow pathways, either through runoff entering the cable trench or water being diverted by ditches or spoil on the upstream side of the trench. There is the potential for excess surface runoff to be retained within the trench short-term.

66 During construction, the construction corridor will typically have a maximum width of 30 m (although it is wider in certain locations). The working corridor will be 20 m comprising 2 m wide trench, 5 m heavy vehicle access, 5 m for equipment laydown and spoil, 3 m small vehicle access track, 2 m buffer between trench and roads and 3 m for fencing, parking and turning.

67 The footprint of the Onshore Works during construction is summarised in **Table 12.9**, divided into a series of catchments defined at key points of interest. For the purpose of this assessment, the following conservative methodology has been used to assess the risk of additional surface water runoff:

- In terms of total runoff volumes during an event, data from FEH CD-Rom Version 3 suggests that around 30% of the precipitation falling on a catchment reports to streams as runoff. In the worst case that 100% of the precipitation landing on compacted or disturbed ground converts to runoff, a 1% increase in impermeable area in a catchment would increase runoff volumes by around 2.3%. Assuming a doubling of runoff from compacted ground (i.e., 60% runoff), a 1% increase in impermeable area in a catchment would increase runoff by around 1%.
- For flood flows, the standard Rational Method of estimating peak flows on ungauged catchments, provides a simple and conservative method of calculating peak flows from a catchment. Based on appropriate variables for the study area, the Rational Method would suggest that an increase of 1% of the catchment area in impermeable hardstanding would result in a 23% increase in peak flows from the catchment. An increase of 1% of compacted ground with 80% runoff under high flow conditions would result in approximately 1.5-2% increase in peak flows from the catchment.
- For the construction corridor, access roads for small vehicles and heavy plant and laydown areas could be considered as compacted ground with increased surface runoff. Laydown areas and substation are also considered as compacted ground. In the assessment, it is considered that compaction will double runoff volumes and increase runoff coefficients for flood flows to 80%, with resultant increases in runoff rates and flows as outlined above. This assumes no mitigation for excess surface runoff such as SuDS.
- Loss of trees is likely to increase surface water runoff. However, the route has been designed to avoid loss of trees and as a result there will be very limited tree loss along the construction corridor. Increases in runoff due to tree loss are considered within calculations considering compacted ground within the construction corridor, i.e., the areas of tree loss along the cable line are considered as having been converted to impermeable ground.

68 Potential effects on surface runoff rates within key catchments are summarised in **Table 12.10**. The results presented in the table are conservative as they do not take into account mitigation measures and consider the full construction footprint occurring at the same time. The results indicate that the magnitude of the effect of development on pre-mitigation surface runoff rates, are expected to be minor to negligible for all locations.

#### *12.12.1.2 Proposed Mitigation*

69 Standard runoff mitigation measures will be employed (such as SuDS) which will attenuate surface runoff during development to greenfield conditions. These are outlined in the Onshore Works Drainage Strategy Plan (**Appendix 12.4**) and the Outline Drainage Strategy for the Substation (**Appendix 12.2**).

70 Over most of its route, the construction works will be through open, grazing and arable fields (land to the east of the access to Crystal Rig Wind Farm) and open moorland. Minor tree felling will be required around Thornton Burn but the majority will be avoided by the route completely or passed via trenchless crossing methods. Access tracks will be constructed of compacted ground and gravel, with the exception of the road near Thornton Burn. The roads will not be fully impermeable to precipitation and surface runoff (apart from sections close to Thornton Burn where non-gravel roads will be used to limit cultural heritage effects as outlined in **Chapter 9: Cultural Heritage**), and runoff from the roads will be higher than for the pre-development surface. However, Sustainable Drainage Systems (SuDS) features will be installed along access roads, such as ditches alongside channel with check dams, laydowns (filter trenches and/or attenuation ponds) and Substation Site construction areas with the aim of controlling surface runoff rates, **Appendix 12.4**.

71 Following construction, the construction plant, temporary buildings and access roads will be removed and ground returned to its original state. Construction of the Cable Corridor will be in a phased manner and remediation works will start following completion of construction, so construction works will not affect the full route at the same time. In addition, as the construction corridor will contain permeable spoil and a trench it will depend on local conditions as to whether the construction corridor would result in an increase in runoff (if runoff from access roads and other compacted ground flows away from the trench) or a decrease (if the trench is located downslope of the compacted ground it may act as a sink for runoff, with excess water infiltrating into the ground within the trench).

72 Local drainage features installed during construction (e.g., ditches parallel to access roads and the trench) could act to divert surface water and shallow surface water from their natural flow pathways. However, drainage features required for construction will be temporary features. In addition, temporary pipes and/or culverts will be provided to allow surface runoff from upslope of the workings to pass over the trench without allowing flows to be maintained to existing streams. Any effects on flow pathways would be expected to be negligible.

73 With mitigation, the magnitude of effects on surface runoff rates is expected to be negligible.

74 The transition pit is located close to the sea and there are no properties between the transition pit and the sea. Hence, any increase in runoff from the transition pit works will have no downstream effect.

### *12.12.1.3 Summary of Effects and Residual Effects*

75 A summary of the effects assessment for surface runoff are provided in **Table 12.11**. Without mitigation, all effects are considered to be minor or negligible. However, with mitigation measures, the effects at all locations are expected to be **negligible**.

| Main Catchment | [a]Construction Corridor ($m^2$) | [b]Compound Areas ($m^2$) | Substation ($m^2$) | Tree Felling ($m^2$) | [b]Additional Access Road ($m^2$) | Total ($m^2$) |
|---|---|---|---|---|---|---|
| Thornton Burn downstream of A1 | 31,000 | - | - | - | - | 31,000 |
| Dry Burn at A1 | 86,000 | 5,500 | - | - | 13,000 | 104,500 |
| Dry Burn at SSSI | 18,000 | - | - | - | 6,500 | 24,500 |
| Weatherly Burn at Weatherly | 15,000 | - | - | - | 6,500 | 21.500 |
| Tay Burn at confluence with Bothwell Water | - | 10,600 | 134,400 | - | - | 145,000 |

Table 12.9: Development Footprint within Key Catchments

*a Based on length of construction corridor multiplied by average width of access road that will result in increased runoff, i.e., 13 m = 5 m heavy vehicle road, 5 m equipment laydown and spoil and 3 m small vehicle access road*

*b Based on area within Application Boundary*

| Main Catchment | Catchment Area (ha) | Area Disturbed during Develop-ment (ha) | Percentage of Catchment Affected | Possible Maximum Increase in Annual Runoff (no mitigation) | Possible Maximum Increase in Flood Flows (no mitigation) | Magnitude of Effect, (pre-mitigation) | Residual Effect (with mitigation) |
|---|---|---|---|---|---|---|---|
| Thornton Burn downstream of A1 | 1480 | 3.0 | 0.2% | 0.2% | 0.3% | Negligible increase | **Negligible** |
| Dry Burn at A1 | 1290 | 10.4 | 0.8% | 0.8% | 1.2% | Minor to negligible. | **Negligible** |
| Dry Burn at SSSI | 567 | 2.5 | 0.4% | 0.4% | 0.6% | Negligible increase | **Negligible** |
| Weatherly Burn at Weatherly | 103 | 2.2 | 2.7% | 2.7% | 4.0% | Minor increase | **Negligible** |
| Tay Burn at confluence with Bothwell Water | 886 | 14.5 | 1.6% | 1.6% | 2.4% | Minor increase | **Negligible** |

Table 12.10: Maximum Effect of Development on Surface Runoff and Flood Flows for Key Catchments

| Receptor | Sensitivity of Receptor | Magnitude of Effect | Significance of Effect | Likelihood of Effect Occurring | Mitigation Measures Proposed | Residual Effects |
|---|---|---|---|---|---|---|
| Thornton Burn downstream of A1 | Medium | Negligible | Negligible | Unlikely given mitigation measures | Drainage ditches, SuDS measures etc. to control surface water runoff rates | **Negligible** |
| Dry Burn at A1 | Low | Minor to Negligible | Negligible | Unlikely given mitigation measures | As above | **Negligible** |
| Dry Burn at SSSI | High | Negligible | Minor | Unlikely given mitigation measures | As above | **Negligible** |
| Weatherly Burn at Weatherly | Medium | Minor | Minor | Unlikely given mitigation measures | As above | **Negligible** |
| Tay Burn at confluence with Bothwell Water | Low | Minor | Negligible | Unlikely given mitigation measures | As above | **Negligible** |

Table 12.11: Effect Assessment during Construction for Surface Water Runoff

## 12.12.2 Flood Risk

### *12.12.2.1 Potential Effects*

76 Increased runoff during construction has the potential to increase flood risk elsewhere (properties and land of value). There is potential for construction debris (vegetation, sediment) to enter streams and cause blockage or restrictions to channels and existing stream crossings. Construction will require temporary crossing of watercourses as well as works to allow the cable to pass under watercourses. Construction work or ground movement on floodplains of watercourses has the potential to decrease flood storage and increase flood risk downstream.

77 The baseline assessment identified limited flood risk associated with proposed stream crossings. The crossings are generally located remote from existing properties and any backwatering upstream of the crossings would not place any properties at risk of flooding. Based on SEPA Indicative Flood Maps, the construction corridor does not lie within the floodplain of any major stream, apart from where it crosses Thornton Burn near the coast. If a flood event occurs while construction works are ongoing in this area, effects will be localised (flood flows could overtop or bypass works without affecting any properties) and as this crossing is located close to the sea there are not expected to be any downstream effects.

78 Four of the cable crossings of watercourses will be through trenchless methods, and at Thorter Cleugh the crossing will be above the stream channel either associated with the existing crossing or the widening of the existing crossing. For these crossings there will be no need for trenching or excavation of the channels that could affect channel capacity during construction. Temporary single span bridges will be placed over larger streams (Thornton Burn and unnamed Innerwick upstream) to allow movement of heavy machinery. Single span bridges limit the risk of blockage that could occur with culverted crossings. At Thorter Cleugh, any changes to the existing crossing will not decrease the culvert capacity or provide any additional restriction to flow.

79 Trenched crossings will be located on streams with Low sensitivity for flood risk. Any flooding risks at these sites will be local to the crossing point.

80 A flood risk assessment for the cable landing point is provided in **Appendix 12.1**. Effects on these components of the Onshore Works are considered negligible.

81 A flood risk statement for the substation is provided in **Appendix 12.2**. Existing flood risk and effects of the development on downstream flood risk are considered negligible.

82 Predictions of the potential increase in flood flows during construction as a result of compacted ground are outlined in **Table 12.10**. The results presented in the table are conservative as they do not take into account mitigation measures and consider the full construction footprint occurring at the same time. The results indicate that the magnitude of the effect of development on pre-mitigation surface runoff rates, are expected to be minor to negligible for all locations.

### *12.12.2.2 Proposed Mitigation*

83 Mitigation measures such as SuDS and drainage features will attenuate surface runoff during development to greenfield conditions. These are outlined in **Appendix 12.3 Outline Surface Water Drainage Strategy for Proposed Substation** and **Appendix 12.4 Drainage Strategy Plan**.

84 Blockages of channels causing localised flooding will be minimised by use of existing access roads for the construction of the cable trench at most crossings (**Table 12.5**). However, temporary crossings will be required for some streams; with a single span bridge installed at Thornton Burn and unnamed Innerwick upstream and temporary culverts at other crossings. Temporary culverts will be designed to allow passage of the 30 year flow at least (considered suitable for short-lived crossings).

85 There may be culverted field drains, field ditches and other minor drains (not visible on 1:10,000 scale mapping) crossed by the Cable Corridor, such as the field drain close to Skateraw Gate identified in the baseline assessment. At these locations, construction would not be expected to increase flood risk, but existing flow pathways (or alternatives) will be maintained during construction (e.g., temporary culverts, pumps or bypass channel), so as not to increase flood risk to properties. The open trench should not provide an alternative flood flow pathway that would flood adjacent land, properties or public roads. At Skateraw Gate, there is an existing flood risk to properties, although the Onshore Works are downslope of the properties. However, the need for channel diversions and other measures to minimise flood risk during construction will be considered at detailed design stage or during construction in response to local conditions. Minor field drains and ditches intercepted during construction will be secured in advance through the installation of cut-off drains and all drainage will be reinstated following cable installation.

86 For all locations, the risk of flooding will be minimised by the remediation of the construction corridor as the works progress, limiting the time that bare ground is exposed or streams are being crossed. Much will depend on weather conditions during construction, with a risk of flooding only if construction activities coincide with heavy rainfall. Daily weather reports for the construction sites should be made available with further mitigation measures put in place if extreme weather conditions are forecast. These measures would include the removal of temporary crossings and stoppage of work in advance of extreme rainfall.

87 With mitigation, the magnitude of effects on surface runoff rates are expected to be negligible for all key locations apart from Weatherly Burn where the magnitude of effects could be minor to negligible.

88 Authorisation for construction activities within or close to watercourses is managed by SEPA under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (termed CAR). Different levels of authorisation are required for river crossings depending on watercourse conditions and the type/purpose of crossing. In respect of the Onshore Works it is assumed that no CAR licences will be required. However, this will be agreed with SEPA in advance of construction. The following registrations are considered likely:

- Trenchless stream crossings at Thornton Burn and Unnamed Innerwick downstream (streams numbered 1 and 2 in **Table 12.5**) will be covered by General Binding Rules (GBR) and specifically GBR7;
- Trenched crossings, assuming crossings will be isolated open cuts (i.e., dry workings with over-pumping or diversion of stream flows) at Unnamed Innerwick upstream, Unnamed Upland 2 and Weatherly Burn (streams numbered 3, 9 and 10 in **Table 12.5**), will require Registration under CAR only;
- Temporary bridge crossings during construction at Thornton Burn and Unnamed Innerwick upstream (streams numbered 1 and3 in **Table 12.5**) will be covered by General Binding Rules (GBR) and specifically GBR6;
- Any temporary culvert crossings during construction are likely to be covered by Registration only, but this will be confirmed with SEPA during detailed design;
- The permanent widening of the culvert crossing at Thorter Cleugh may be covered by Registration only, but this will be confirmed with SEPA during detailed design; and
- Any sediment control measures related to channel banks during construction of trenched crossings will be minor and <10 m in length and will be covered by General Binding Rules (GBR) and specifically GBR8.
- No engineering works are currently proposed within the headwater tributary of Tay Burn near the substation. However, it is noted that this water course, although man-influenced, is shown on 1:50,000 scale Ordnance Survey mapping and engineering works are proposed close to the stream. Hence, requirements under CAR will need to be discussed with SEPA once detailed design drawings are available.
- It is assumed that works at or close to stream crossings at Unnamed Farmland 1, 2 and 3, Unnamed Woodhall and Unnamed Upland 1 (streams numbered 4 to 8 in **Table 12.5**) are not likely to require authorisations as they are crossings of minor streams (defined by SEPA (2001). In addition, authorisations will not be required for any minor field drains not currently listed in **Table 12.5** or shown on 1:50,000 scale mapping.

### *12.12.2.3 Summary of Effects and Residual Effects*

89 A summary of the assessment with respect to flood risk is provided in **Table 12.12**. Prior to mitigation the predicted effects of the Onshore Works on flood risk is considered minor or negligible for all locations. However, following mitigation, the effects are considered negligible for all locations. The key issues with respect to flood risk relate to localised risks of damage to construction works in the case of a flood event in a watercourse, heavy precipitation event or extreme sea levels, with risk due to sea levels outlined in **Appendix 12.1**.

| Receptor | Sensitivity of Receptor | Magnitude of Effect | Significance of Effect | Likelihood of Effect Occurring | Mitigation Measures proposed | Residual Effects |
|---|---|---|---|---|---|---|
| Thornton Burn downstream of A1 | Medium | Negligible | Negligible | Unlikely given mitigation measures | Drainage ditches, SuDS measures etc. to control surface water runoff rates | **Negligible** |
| Dry Burn at A1 | Low | Minor | Negligible | Unlikely given mitigation measures | As above | **Negligible** |
| Dry Burn at SSSI | Medium | Negligible | Negligible | Unlikely given mitigation measures | As above | **Negligible** |
| Weatherly Burn at Weatherly | Medium | Minor | Minor | Unlikely given mitigation measures | As above | **Negligible** |
| Tay Burn at confluence with Bothwell Water | Low | Negligible | Negligible | Unlikely given mitigation measures | As above | **Negligible** |

Table 12.12: Effect Assessment during Construction for increase in Flood Risk

## 12.12.3 Water Resources

### *12.12.3.1 Potential Effects*

90 No public water supplies (reservoirs, ponds boreholes) were identified close to or down slope of the Onshore Works.

91 Two private water supplies were identified down slope of the Onshore Works at Weatherly and Woodhall Farm. Disruption to private water supplies could arise from: pollution of surface waters, increased suspended sediment concentrations in surface waters, or pollution of shallow groundwater though pollution of surface waters infiltrating to depth, or damage to the Scottish Water system either during excavation or due to damage from heavy machinery driving over the pipeline. Disruption of water supply at Weatherly could occur during construction of the crossing of Weatherly Burn, upstream of the property. Disruption of the water supply at Woodhall Farm could occur during construction of the section of Onshore Works that parallels the unnamed stream flowing to Woodhall Farm, close to the entrance to the existing Crystal Rig Wind Farm.

92 It is noted that the public water supply (Scottish Water) crosses the construction corridor at a number of locations and is parallel to the construction corridor close to the A1 road. These crossing points have been identified (**Section 12.8.5**); however, there may be a risk of damage to the public water supply (or sewerage) during construction.

93 The risk of damage or pollution to the Scottish Water system is considered negligible. However, the risk of short-term effects on water supplies at Weatherly and Woodhall Farm are considered to be moderate and minor respectively, with a higher effect at Weatherly because the Onshore Works will cross the Weatherly Burn upstream of the site, resulting in a greater risk of sediment release to the watercourse.

### *12.12.3.2 Proposed Mitigation*

94 Mitigation measures for sediment control and other pollutants will be outlined in more detail in the following section on water quality.

95 Scottish Water supply pipes and sewers were identified at the A1 Road and on the access road to Station House (Section 12.8.5). Appropriate care will be taken to ensure there is no damage to the public utilities during construction. Contractors will also need to undertake an assessment of the risk of damaging the pipeline based on the depth of pipe and type of machinery likely to cross the infrastructure pipes. Locations of Scottish Water infrastructure should be formally identified in the field prior to commencement of construction activities.

96 Prior to construction, the owners of the private water supplies at Weatherly and Woodhall Farms will be notified as to when construction activities will be taking place upstream of their water supplies. Monitoring of sediment content within streams feeding the water supplies will be undertaken when there are construction activities within the streams upstream of the supplies.

### *12.12.3.3 Summary of Effects and Residual Effects*

97 Prior to mitigation, the effects of the Onshore Works on the Scottish Water supply are considered negligible. However, the potential effect on private water supplies at Weatherly and Woodhall Farm were considered to be negligible and minor respectively. However, with mitigation the residual effects related to water resources are considered **negligible** for all locations, apart from Weatherly where they are considered to be **minor**. A summary of the effect assessment is provided in **Table 12.13**.

| Receptor | Sensitivity of Receptor | Magnitude of Effect | Significance of Effect | Likelihood of Effect Occurring | Mitigation Measures Proposed | Residual Effects |
|---|---|---|---|---|---|---|
| Scottish Water Infrastructure | High | Negligible | Minor | Unlikely | Standard sediment control measures for linear construction projects. Providing contractors with the location of infrastructure prior to works commencing and assessment of risk of damage to pipeline. | **Negligible** |
| Private Water Supply at Weatherly | Low | Moderate | Minor | Likely | Standard sediment and pollution control measures for linear construction projects | **Minor** |
| Private Water Supply at Woodhall Farm | Low | Minor | Negligible | Likely | Standard sediment and pollution control measures for linear construction projects | **Negligible** |

Table 12.13: Effect Assessment during Construction for Water Resources

## 12.12.4 Water Quality

### *12.12.4.1 Potential Effects*

98 The key risk to surface water quality as a result of the construction works relates to an increase in suspended sediment concentrations. All construction activities that involve ground movement (e.g., opening of the trench, construction of access roads, laydowns etc., tree felling) have the potential to expose bare soil and to result in increased erosion and sedimentation. Sediment in runoff and drainage from construction areas and access tracks may give rise to unacceptable levels of suspended solids and turbidity in watercourses. Increased sediment load in streams can affect the ecology and health of a stream by smothering micro-invertebrates or by changing the oxygenation state of the stream bed.

99 Proximity of construction works to watercourses is a key risk factor. The construction corridor crosses eleven mostly small streams along its length. For the majority of the route, the corridor is located within relatively shallow sloping hillslopes in open grassed fields or upland hillslope. The shallow slopes mean that cuttings for road construction will be minor (i.e., exposed slopes on the upslope side of access roads) and surface runoff flow velocities will be low, limiting erosion potential. In open hillslope sections, the natural vegetation downstream of the construction corridor would act to attenuate flows and settled sediments. In upslope areas where there are steeper slopes, there is an existing access road for the Crystal Rig Wind Farm, which is utilised along much of its length limiting the need for additional road construction in this area.

100 At four stream crossings (i.e., Thornton Burn, unnamed Innerwick downstream, unnamed Farmland 1 (Birky Bog) and unnamed Farmland 2&3), the cable will be put in place through trenchless methods which will not disturb the channel or stream banks. At Thorter Cleugh, the cable will cross above the channel, utilising an existing stream crossing. However, it is noted that the crossing may need to be widened to accommodate the access road and cable and in this case there would be a need to extend the culverted section of the channel with in stream works required. At the other crossings, trenching of the channel is proposed. At most of these crossings, the channels are narrow and there was no evidence of existing bank erosion. However, at Weatherly Burn, there are existing eroding banks and care will need to be taken to ensure that no excess sediment is released to the environment at this location. It is noted that there will be downstream dilution of any sediment releases at proposed stream crossing points.

101 Tree felling in the vicinity of streams can be a major cause of erosion risk. However, only limited and localised tree felling is proposed along the construction corridor.

102 In addition to water quality effects due to suspended solids, pollution incidents may occur from spillage of fuels, oils or lubricants during the operation or refuelling of construction vehicles. There is also the risk of spillage of drilling muds at locations where HDD methods are proposed. Pollutants could enter watercourses through direct spills and

also overland flow if spilled adjacent to watercourses. Shallow groundwater could also be affected through longer term seepage through ground contaminated by pollution incident.

103 Temporary toilet facilities will be required for construction staff in the construction compounds at the centre of the route and at the site of the substation. Effluent will be retained within the toilets and disposed off-site.

104 The Thornton Burn flows to the sea downstream of the Cable Corridor crossing over the watercourse. In addition, there will construction activities on the shoreline at Thorntonloch where the cable from the offshore wind farm comes ashore. The beach at Thorntonloch is a water quality sampling location used by SEPA to assess compliance against the Bathing Water Directive (Sampling Site No. UKS7616059). Bathing water standards are assessed against parameters (e.g., total coliforms, faecal coliforms) which will not be produced during the construction of the Onshore Works, unless there is an uncontrolled discharge of sewage from toilets used by construction workers. It is noted that temporary toilet facilities are not proposed at the cable landing point. There is no evidence of contaminated beach sediments that could be released during construction activities; hence, as a result, localised increases in sediment along the shoreline are not expected to have any significant effects. Releases of oil, drill muds or other hydrocarbons during construction could locally affect water quality in the sea, but the overall magnitude of effects of construction of the Onshore Works on water quality at the shore would be expected to be negligible.

105 Effects on beach erosion and coastal processes are discussed in **Chapter 11: Geology, Ground Conditions, Groundwater** and **Coastal Processes.**

106 Prior to mitigation, the magnitude of the effects of the development of the Onshore Works on water quality are considered negligible apart from at Weatherly Burn where the magnitude of effects is considered to be minor.

### *12.12.4.2 Proposed Mitigation*

107 Standard sediment and pollution management measures to be put in place during construction will be set out in a Construction Method Statement and complemented through the CEMP. The Management Plan will comply with SEPA's Pollution Prevention Guidelines and will be informed by best practice from key publications for management of sediment and pollution in linear construction projects including documents listed in **Section 12.4**.

108 Sediment laden water will not be discharged directly to the water environment without treatment. Measures are outlined in the Onshore Works Drainage Strategy Plan (**Appendix 12.4**) and the Drainage Strategy for the Proposed Substation (**Appendix 12.3**). Sediment control measures along the cable corridor will include standard SuDS measures (e.g., filter trenches, swales with check dams), diversion and slope drains, check dams and sediment traps, straw bales, silt fencing and filter trenches, with appropriate levels of treatment as outlined in SUDS Manual (e.g., two levels of treatment for road runoff). Access tracks will be cambered to direct surface runoff into the SuDS features. Additional sediment control could also be achieved by discharging treated water onto natural surfaces (e.g., fields, hillslopes) in a controlled manner at a rate that would not cause erosion. Sediment control measures at the substation and construction compound sites will include a series of SuDS measures including settlement ponds, sumps or tanks designed to accommodate appropriate treatment volumes as required by the SuDS manual.

109 Where open trench methods are to be used for crossings, measures will be put in place to provide a dry working environment to avoid water contact with construction materials. The measures might include damming of watercourses and over-pumping of upstream flows, to limit the volume of natural runoff flowing over the construction sites. Silt fences or other suitable sediment control measures will be installed along watercourse banks to intercept any polluted runoff. Cognisance will be taken of the stream flow conditions and works will be avoided in watercourses during periods of abnormally high flow.

110 Construction work will be phased to limit the area of ground disturbed at any one time during construction. It will also limit the area of the trench exposed at the surface at any time. Temporary access roads and the construction corridor will be returned to pre-development conditions soon after construction is complete, limiting the period of exposure of open trenches and spoil.

111 Vehicle movements over exposed soil have the potential to increase sediment erosion and will be avoided where practical.

112 Spoil and stock will not be placed close to a watercourse and sediment control measures (e.g. silt fences or settlement ponds) will be provided downslope of stockpiles of material until vegetation has been established on the stockpiled ground. Stockpiles with clay or fine silt grade material will be covered to limit surface erosion. Stockpiles will not be placed on natural flow pathways or bunds will be provided on the upstream side of the stockpile to divert natural runoff around the edge of the stockpile.

113 All oil and fuel storage will comply with The Water Environment (Oil Storage) (Scotland) Regulations 2006 and no oil storage tanks will be located within 10 m of a watercourse or the sea. All machinery will be checked regularly to identify oil leakages. Actions to be undertaken in the case of spillage of oils will be clearly described in the site Construction Environmental Management Plan.

114 Effluent from temporary toilets will be retained within the toilets and disposed off-site.

115 Drilling mud will be recycled on site and upon completion, surplus drilling mud will either be taken off site and stored or disposed of to landfill by a licensed contractor.

116 Due to the reasonably flat hillslopes over much of the route, low precipitation, staged manner of construction, stream crossing methods, limited tree felling and presence of existing roads and infrastructure in uplands areas of the route, the construction activities are not considered as being very high risk in terms of suspended sediment pollution to watercourses. It is assessed that the risk of sediment generation is no more than would be experienced at similar construction projects and which can be dealt with through effective control measures outlined in a Construction Environmental Management Plan and good site supervision. The same conclusions are arrived at for risks associated with other pollutants.

### *12.12.4.3 Summary of Effects and Residual Effects*

117 Prior to mitigation, the effects of the Onshore Works on surface water quality are considered negligible at three of the key catchment locations considered in this assessment (Thornton Burn downstream of A1, Dry Burn at A1 and Tay Burn at confluence with Bothwell Water). The effects are considered minor at Dry Burn at the SSSI and moderate at Weatherly Burn at Weatherly. However, with mitigation the residual effects related to water quality are considered negligible for all locations apart from Weatherly Burn, where they are considered minor. A summary of the effect assessment is provided in **Table 12.14**.

| Receptor | Sensitivity of Receptor | Magnitude of Effect | Significance of Effect | Likelihood of Effect Occurring | Mitigation Measures Proposed | Residual Effects |
|---|---|---|---|---|---|---|
| Thornton Burn downstream of A1 | Medium | Negligible | Negligible | Likely | Standard sediment and pollution control measures for linear construction projects | **Negligible** |
| Dry Burn at A1 | Low | Negligible | Negligible | Likely | As above | **Negligible** |
| Dry Burn at SSSI | High | Negligible | Minor | Likely | As above | **Negligible** |
| Weatherly Burn at Weatherly | High | Minor | Moderate | Likely | Consider bank stabilisation for eroding banks. | **Minor** |
| Tay Burn at confluence with Bothwell Water | Low | Negligible | Negligible | Likely | As above | **Negligible** |

Table 12.14: Effect Assessment during Construction for Water Quality

## 12.13 Effects of Onshore Works during Operation

118 An assessment of the effects of operation of the Onshore Works on surface water hydrology, flood risk, water quality and water resources are provided below.

119 Access tracks, laydowns and other areas required for construction will be returned to their natural state following construction works. Routine inspections will be undertaken on foot. Vehicle access to the cable and ground disturbances during operation will only occur if there is failure on the line. As discussed in **Chapter 5: Project Description**, cable failures are considered rare. The substation adjacent to the Crystal Rig Wind Farm will constitute the main development surface footprint during operation. The access to the substation from public roads will be by way of an existing access track for the Crystal Rig Wind Farm. The construction of the Onshore Works may require the widening of the existing access track and culvert at the crossing of Thorter Cleugh, but elsewhere along the access track there are expected to be no changes to the footprint of the access track as a result of the Onshore Works.

### 12.13.1 Surface Water

#### *12.13.1.1 Potential Effects*

120 Once land within the construction corridor has been reinstated, there is unlikely to be any significant effect on surface runoff rates during operation within the Thornton Burn and Dry Burn catchments. If sections of the cable need to be re-excavated for maintenance, the effects on surface runoff would be localised and temporary.

121 The substation base, located in the headwaters of Bothwell Burn, will be predominantly composed of crushed stone with some areas of impermeable hardstanding. Assuming no mitigation, the crushed stone and hardstanding areas will result in an increase in runoff rates to Bothwell Burn and its tributaries. However, with appropriate SuDS measures which attenuate site runoff to greenfield rates, surface water runoff rates are not predicted to exceed baseline conditions. The site drainage system for the substation will be designed to required standards, which will include SuDS measures to control the water quality of surface runoff from the site and surface water attenuation to greenfield rates. Runoff control measures for the substation are described in **Appendix 12.3**.

122 Within the Crystal Rig Wind Farm site, the existing permanent access road will be maintained for access to the substation. Effects of this access road will be similar to effects at present under baseline conditions.

123 In places, the cable trench may cut across natural flow pathways. Once land within the construction corridor has been reinstated, surface water flow paths should return to those seen pre-development. However, the infilled trench has the potential to alter shallow subsurface flow paths with shallow subsurface flow parallel to the trench through infill material that is less permeable than natural soils; however, this is likely to be limited as backfill material will be predominantly excavated material with the addition of some sand. Underground pipes and/or culverts will provide connections across the watercourse, especially in areas of wet ground (such as the small wetland area lying downstream of the corridor near Weatherly) fed by shallow groundwater flows (seepage or springs).

124 Pre-mitigation effects on surface water hydrology during operations of the Onshore Works are considered to be negligible.

#### *12.13.1.2 Proposed Mitigation*

125 No specific mitigation measures are proposed during operation. Runoff control measures along the permanent sections of the access road (giving access to existing Crystal Rig Wind Farm) that were installed during construction will be maintained during operation and will limit runoff rates. The site drainage system at the substation will be designed to required standards, which will include SuDS measures to control the water quality of surface runoff from the site and surface water attenuation to greenfield rates, **Appendix 12.3**.

#### *12.13.1.3 Summary of Effects and Residual Effects*

126 Effects on surface water hydrology during operation of the Onshore Works are considered to be **negligible**.

### 12.13.2 Flood Risk

#### *12.13.2.1 Potential Effects*

127 The effects of operation of the Onshore Works on flood risk will be similar to those for surface water hydrology, outlined above.

128 Flood risk of the onshore landing point will remain as during construction and as outlined in **Appendix 12.1**. The Landfall lies within the 200 year coastal floodplain. However, any changes in ground levels related to the Landfall will not increase flood risk to others, due to its proximity to the coast.

129 In addition, the structure constructed to house the connection between onshore and offshore cables will be unmanned and will not be affected by inundation during any large flood events.

130 SUDs measures installed during construction of the substation will be maintained during operation and will limit surface runoff from the site to greenfield rates. As a result, the operations of the substation would not be expected to increase flood risk to others.

131 Pre-mitigation effects on flood risk during operation of the Onshore Works are considered to be negligible.

#### *12.13.2.2 Proposed Mitigation*

132 Runoff control measures along the permanent sections of the access road (giving access to existing Crystal Rig Wind Farm) and at the substation that were installed during construction will be maintained during operation and will limit runoff rates.

#### *12.13.2.3 Summary of Effects and Residual Effects*

133 Effects on flood risk during operation of the Onshore Works are considered to be **negligible**.

### 12.13.3 Water Resources

#### *12.13.3.1 Potential Effects*

134 Once land within the construction corridor has been reinstated, there is unlikely to be any significant effect on water resources during operation. The existing access road to Crystal Rig Wind Farm lies upstream of the private water supplies for Weatherly and Woodhall Farm and no changes to this road are proposed during operation. There is the potential for leakages of oils or other hydrocarbons from vehicles accessing the substation and using the permanent access road within the existing Crystal Rig Wind Farm. However, the number of vehicles using the road specifically to access the new substation will be minimal (Refer to **Chapter 5: Project Description**) and these vehicles will use an existing road, so the significance of this effect is considered negligible. If sections of the cable need to be re-excavated for maintenance the effects on water resources would be localised and temporary.

135 Pre-mitigation effects on water resources during operation of the Onshore Works are considered to be negligible.

#### *12.13.3.2 Proposed Mitigation*

136 No specific mitigation measures are proposed during operation. Maintenance work during operation will follow the same Construction Environmental Management Plan (including sediment control and spill plans) as put in place for construction.

#### *12.13.3.3 Summary of Effects and Residual Effects*

137 Effects on water resources during operation of the Onshore Works are considered to be **negligible**.

### 12.13.4 Water Quality

#### *12.13.4.1 Potential Effects*

138 Once land within the construction corridor has been reinstated, there is unlikely to be any significant effect on stream water quality due to releases of sediment during operation within the Thornton Burn and Dry Burn catchments. If sections of the cable need to be re-excavated for maintenance, the effects on surface quality would be localised and temporary. There is the remote possibility of leakage of oils or other hydrocarbons from vehicles accessing the substation and using the permanent access road within the existing Crystal Rig Wind Farm. However, the number of vehicles using the road specifically to access the new substation will be minimal (Refer to **Chapter 5:**

**Project Description**) and these vehicles will use an existing road, so the significance of this effect is considered negligible.

139 Sewage generated by operators at the substation has the potential to affect surface water. Toilet and shower facilities within the control building will be connected to a full retention septic tank, buried and located outside the substation fence line. Due to the extremely low hydraulic loading (i.e. infrequent use by a very small number of personnel), this system will retain all effluent without discharging to a percolation area. The effluent will be emptied periodically by a licensed contractor and disposed of off-site. This emptying will take place at six monthly intervals, or more frequently if required. This will be confirmed prior to the commencement of works and will be based on the final specification of tank installed.

140 Pre-mitigation effects on water quality during operation of the Onshore Works are considered to be negligible.

#### *12.13.4.2 Proposed Mitigation*

141 No specific mitigation measures are proposed during operation. Maintenance work during operation will follow the same Construction Environmental Management Plan (including sediment control and spill plans) as put in place for construction.

#### *12.13.4.3 Summary of Effects and Residual Effects*

142 Effects on water quality during operation of the Onshore Works are considered to be **negligible**.

## 12.14 Monitoring

143 A strategy to monitor the water quality of watercourses potentially affected by construction activities will be agreed with SEPA before works commence. Monitoring will be undertaken by an Ecological Clerk of Works (or equivalent) to ensure that Construction Environmental Management Plans are implemented.

## 12.15 Assessment of Decommissioning

### 12.15.1 Decommissioning of the Cable, Transition Pits and Other Related Components

144 Potential effects during decommissioning of the cable, transition pits and other related components are likely to be similar to those predicted during construction (the significance of effects is not anticipated to be any greater than at construction). Effects anticipated include:

#### *12.15.1.1 Surface Water Hydrology*

- Potential for decommissioning to affect natural drainage patterns and runoff rates through compacted/disturbed ground during decommissioning.
- Potential for the re-excavated trenches to act as conduits for water or potential for water to be diverted by ditches or spoil on the upstream side of the trench.
- Potential for debris from decommissioning activities (vegetation, sediment) to enter streams and cause blockages or restrictions to channels and existing stream crossings.

#### *12.15.1.2 Flood Risk*

- Potential for increased runoff increasing flood risk elsewhere (e.g. downstream properties etc).

#### *12.15.1.3 Water Resources*

- Potential disruption to private water supplies through pollution of surface or groundwater.
- Potential damage to the Scottish Water supply system either during re-excavation of trenches or due to damage from heavy machinery during decommissioning.

#### *12.15.1.4 Water Quality*

- Potential for pollution of nearby watercourses (and/or the sea at Thorntonloch Beach) due to sources of pollution such as increased suspended solids, spillage of fuels, oils or lubricants.

145 Mitigation would be similar to that put forward during construction and would include:

#### *12.15.1.5 Surface Water Hydrology*

- Use of standard runoff mitigation measures such as SuDs to attenuate surface runoff.
- Use of drainage features (e.g. pipes across workings) to maintain existing flow pathways. Natural flow pathways would be returned once the trench has been infilled.

#### *12.15.1.6 Flood Risk*

- Use of temporary pipes or culverts to allow surface water runoff upslope of the workings to pass over the re-excavated trench.
- Remediation of the corridor as decommissioning works progress, limiting the time that bare ground is exposed or streams crossed.
- Avoidance/stopping of works during periods of extreme rainfall.

#### *12.15.1.7 Water Resources*

- Identification of public and private water supplies prior to commencement of decommissioning works to avoid accidental damage.
- Monitoring of sediment content within streams feeding the water supplies where there are decommissioning activities within the streams upstream of the supplies.

#### *12.15.1.8 Water Quality*

- Use of standard sediment and pollution management measures (e.g. SuDs such as filter trenches, swales with check dams etc).
- Additional sediment control measures e.g. discharging treated water onto natural surfaces such as fields, and hillslopes in a controlled manner.
- Phasing of decommissioning activities to limit the area of ground disturbed at any one time and returning re-excavated trenches to pre-development conditions as soon as work is complete in a local area.
- Locating spoil and stock away from watercourses as far as is practicable.
- Locating sediment control measures (e.g. silt fences or settlement ponds) downslope of stockpiled material.

### 12.15.2 Decommissioning of Substation Site

#### *12.15.2.1 Surface Water Hydrology*

146 During decommissioning of the substation, the above ground infrastructure and impermeable hardstanding will be removed and the site reinstated to its former condition.

147 The substation is located within the catchment of Tay Burn that flows in the Bothwell Water. Hence the surface water effects during decommissioning of the substation will not affect the Dry Burn and Thornton Burn catchments to the east.

148 During decommissioning, the above ground infrastructure and impermeable hardstanding will be removed and the site re-profiled close to its former condition. During decommissioning, the area of hardstanding within the substation site is not expected to increase compared to the area of hardstanding during the operational phase. As decommissioning progresses, the area of hardstanding will decrease as the ground surface is returned to near natural conditions. Runoff control measures (SuDS ponds and diversion channels, refer to **Appendix 12.3**) constructed for the operational phase will be retained during the decommissioning phase, only removed at the end of decommissioning.

149 Once completed, decommissioning would be expected to return surface runoff conditions within the substation site close to natural conditions.

150 As the area of hardstanding within the substation site is not expected to increase during decommissioning and runoff management measures constructed for the operational phase will be in place during the decommissioning period, the pre-mitigation effects on surface water runoff during decommissioning of the substation are considered to be negligible.

151 Drainage control measures installed for the operational phase (refer to **Appendix 12.3**) will be in place at the beginning of decommissioning. These measures will not be removed until the end of decommissioning. The measures will have been designed to limit runoff to greenfield conditions.

152 Following mitigation, effects on surface water runoff during decommissioning of the substation are considered to be **negligible**.

#### *12.15.2.2 Flood Risk*

153 Effects of decommissioning of the Substation Site on flood risk will be similar to those outlined in **Section 12.15.2.1** related to surface water runoff.

154 Effects on flood risk during decommissioning of the substation are considered to be **negligible**.

#### *12.15.2.3 Water Resources*

155 No water resources, including private water supplies were identified close to the substation. As a result, there will be no effect of decommissioning of the substation on water resources.

#### *12.15.2.4 Water Quality*

156 The substation site is located within the catchment of Tay Burn that flows in the Bothwell Water. Hence the water quality effects during decommissioning of the substation will not affect the Dry Burn and Thornton Burn catchments to the east.

157 During decommissioning, the above ground infrastructure and impermeable hardstanding will be removed and the site re-profiled close to its former condition. Potential effects of decommissioning on surface water quality include increases in sediment erosion due to ground movements and contamination due to spillage of fuels, oils or lubricants during the operation or refuelling of decommissioning vehicles. There is also the risk of remobilisation of any contaminants (e.g., oils) spilled onto the gravel surface of the substation during operation (during the removal of the hardstanding areas).

158 Temporary toilet facilities will be required for staff involved in the decommissioning activities, although pollution from this source is unlikely as effluent will be retained within the toilets and disposed off-site.

159 Overall, potential effects of decommissioning on surface water quality are likely to be similar to those outlined for the construction phase. However, effects would be expected to be localised at the substation site and limited by SuDS measures that will already be in place for the operational phase (refer to **Appendix 12.3**).

160 Pre-mitigation effects on surface water runoff during decommissioning of the substation are considered to be minor.

161 SuDS measures installed for the operational phase (refer to **Appendix 12.3**) will be in place at the beginning of decommissioning. These measures will not be removed until the end of decommissioning. Additional sediment and pollution control measures will be put in place at the substation, to a similar level as provided during the construction period (refer to **Appendix 12.4**). Furthermore, decommissioned material will be reused or recycled where possible, with remaining material disposed off-site to a licensed waste disposal site.

162 A Decommissioning Method Statement and Environmental Management Plan will be developed and put in place prior to the onset of decommissioning works. Mitigation measures during decommissioning will be consistent with measures to be implemented during construction of the Onshore Works.

163 Following mitigation, effects on surface water quality during decommissioning of the substation are considered to be **negligible**.

## 12.16 Assessment of In Combination Effects

164 No in combination effects of the Onshore and Offshore components of 'The Project' are predicted for surface water, flood risk, water resources and water quality.

## 12.17 Assessment of Cumulative Effects

165 At present, there are no other known schemes within the route corridor that are at the planning stage and scheduled to be constructed at the same time as the Onshore Works. However, there are three known nearby planned developments where substation infrastructure will be required in the vicinity of the Neart na Gaoithe substation considered in this ES. These are:

- Aikengall II Wind Farm and substation;
- Crystal Rig III Wind Farm extension; and
- The SPT NnG Scheme.

#### *12.17.1.1 Potential Effects*

166 Potential cumulative effects of the proposed projects are anticipated to be similar to the effects of the construction and operation of the Onshore Works. For example, construction activities have the potential to result in releases of suspended solids to watercourses and hardstanding areas will increase surface runoff rates to streams. However, for there to be a cumulative effect on surface water hydrology, flood risk, water quality or water resources within the study area considered in this assessment, proposed developments will need to lie within the same catchments affected by the Onshore Works. As outlined below, very limited areas of the proposed developments lie within the same catchments as those affected by the Onshore Works.

167 The effects assessment for the Onshore Works highlighted that the main effects of the project for surface water hydrology, flood risk, water quality or water resources would occur during construction, with no significant effects during operation. Given the nature of the three other projects highlighted above the same temporal pattern of effects would be expected, with greater effects during construction. Hence, construction activities would have to occur at the same time as construction of the Onshore Works to have significant cumulative effects.

168 Aikengall II Wind Farm is not located within the same catchments as the Onshore Works and as a result no cumulative effects are anticipated. However, the proposed substation for the Aikengall II Wind Farm will lie to the south of the existing Crystal Rig Wind Farm substation within the headwaters of Tay Burn (Bothwell Water).

169 The Crystal Rig III Wind Farm extension will lie within catchments potentially affected by the Onshore Works. A single turbine and a construction compound will lie in the catchment of Thorter Cleugh, which is upstream of Dry Burn. The rest of the footprint of the development will be in the catchment of Tay Burn (Bothwell Water) and Dunglass Burn that flows to the south of the site.

170 The SPT NnG Scheme will be located close to the Substation Site for the Onshore Works, to the south and within the catchment of Tay Burn (Bothwell Water).

171 The effects assessment for surface water hydrology, flood risk, water quality and water resources for the Onshore Works presented above indicated negligible effects on Tay Burn (Bothwell Water), as a result of the small footprint of the Onshore Works within this catchment. Assuming that appropriate sediment and runoff control measures for the Aikengall II Wind Farm and SPT Scheme are in place, the cumulative effects on this catchment are considered negligible.

172 The effects assessment for surface water hydrology, flood risk, water quality and water resources for the Onshore Works presented above indicated negligible effects on Dry Burn and Woodhall Dean SSSI. The footprint of the Crystal Rig III Wind Farm that lies within the catchment of Dry Burn is minor and as a result the cumulative effects on this catchment are considered negligible.

173 None of the other developments considered in this assessment lie within the Thornton Burn catchment.

174 The relative timings of the construction of the developments are not fixed at this stage. As noted above, the key effects on surface water hydrology, flood risk, water quality and water resources will occur during construction and cumulative effects would only be expected if the construction activities happened at the same time. However, as noted above even if the construction activities were to occur at the same time the cumulative effects would be expected to be negligible.

175 Pre-mitigation cumulative effects of the development on surface water hydrology, flood risk, water quality or water resources are considered to be negligible.

#### *12.17.1.2 Proposed Mitigation*

176 No additional mitigation for the Onshore Works is proposed to address potential cumulative effects.

### 12.17.1.3 Summary of Effects and Residual Effects

177 Cumulative effects of the development on surface water hydrology, flood risk, water resources or water quality are considered to be **negligible**.

## 12.18 Summary

178 **Table 12.15** summarises the predicted effects of the development on surface water hydrology, water quality, water resources and flood risk.

| Predicted Effects | Significance | Mitigation | Significance of Residual Effects |
|---|---|---|---|
| **Construction** | | | |
| **Effects on surface water run-off** | | | |
| Thornton Burn downstream of A1 | Negligible | Drainage ditches, SuDS measures etc. to control surface water runoff rates | **Negligible** |
| Dry Burn at A1 | Negligible | As above | **Negligible** |
| Dry Burn at SSSI | Minor | As above | **Negligible** |
| Weatherly Burn at Weatherly | Minor | As above | **Negligible** |
| Tay Burn at confluence with Bothwell Water | Negligible | As above | **Negligible** |
| **Effects on flood risk** | | | |
| Thornton Burn downstream of A1 | Negligible | Drainage ditches, SuDS measures etc. to control surface water runoff rates | **Negligible** |
| Dry Burn at A1 | Negligible | As above | **Negligible** |
| Dry Burn at SSSI | Negligible | As above | **Negligible** |
| Weatherly Burn at Weatherly | Minor | As above | **Negligible** |
| Tay Burn at confluence with Bothwell Water | Negligible | As above | **Negligible** |
| **Effects on water resources** | | | |
| Scottish Water Infrastructure | Minor | Standard sediment control measures for linear construction projects. Providing contractor's with the location of infrastructure prior to works commencing and assessment of risk of damage to pipeline. | **Negligible** |
| Private Water Supply at Weatherly | Minor | Standard sediment and pollution control measures for linear construction projects | **Minor** |
| Private Water Supply at Woodhall Farm | Negligible | Standard sediment and pollution control measures for linear construction projects | **Negligible** |
| **Effects on water quality** | | | |
| Thornton Burn downstream of A1 | Negligible | Standard sediment and pollution control measures for linear construction projects | **Negligible** |
| Dry Burn at A1 | Negligible | As above | **Negligible** |
| Dry Burn at SSSI | Minor | As above | **Negligible** |
| Weatherly Burn at Weatherly | Moderate | Consider bank stabilisation for eroding banks. | **Minor** |
| Tay Burn at confluence with Bothwell Water | Negligible | As above | **Negligible** |
| **Operation** | | | |
| Effects on surface water run-off | Negligible | Runoff control measures which were installed during construction will be maintained. | **Negligible** |
| Effects on flood risk | Negligible | Runoff control measures which were installed during construction will be maintained. | **Negligible** |
| Effects on water resources | Negligible | Maintenance work during operation will follow the Construction Environmental Management Plan (including sediment control and spill plans) as put in place for construction. | **Negligible** |
| Effects on water quality | Negligible | Maintenance work during operation will follow the Construction Environmental Management Plan (including sediment control and spill plans) as | **Negligible** |

| Predicted Effects | Significance | Mitigation | Significance of Residual Effects |
|---|---|---|---|
| | | put in place for construction. | |
| **Decommissioning** | | | |
| Potential effects during decommissioning of the cable, transition pits and other related components are likely to be similar to those predicted during construction (the significance of effects is not anticipated to be any greater than at construction | | | |
| Effects of decommissioning the substation on surface water run-off | Negligible | Drainage control measures installed for the operational phase will be in place at the beginning of decommissioning and will not be removed until the end of decommissioning. | **Negligible** |
| Effects of decommissioning the substation on flood risk | Negligible | Drainage control measures installed for the operational phase will be in place at the beginning of decommissioning and will not be removed until the end of decommissioning. | **Negligible** |
| No effects identified during the decommissioning of the substation on water resources. | | | |
| Effects of decommissioning the substation on water quality | Minor | SuDS measures installed for the operational phase will be in place at the beginning of decommissioning and will not be removed until the end of decommissioning.<br><br>Additional sediment and pollution control measures will be put in place at the substation.<br><br>Decommissioning Method Statement and Environmental Management Plan will be developed prior to the onset of decommissioning works.<br><br>Mitigation measures during decommissioning will be consistent with measures implemented during the construction phase. | **Negligible** |
| **In combination effects** | | | |
| No in combination effects are predicted. | | | |
| **Cumulative Effects** | | | |
| Effects on surface water hydrology; water quality; water resources and flood risk | Negligible | None | **Negligible** |

Table 12.15: Summary of Predicted Effects

## 12.19 References


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