BERWICK BANK WIND FARM
ONSHORE ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Chapter 4: Site Selection and Consideration of Alternatives

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CONTENTS

TABLES

FIGURES

4. SITE SELECTION AND CONSIDERATION OF ALTERNATIVES

4.1. INTRODUCTION

1. This chapter of the Onshore Environmental Impact Assessment Report (EIA Report) provides an overview of the site selection process and the reasonable alternatives studied for the Berwick Bank Wind Farm onshore transmission works (OnTW) (the Proposed Development).

2. The Applicant has three signed grid connection agreements with the network operator (National Grid Electricity System Operator (NGESO)). Two agreements are for connection at a point close to the existing Branxton cable sealing end compound, around 8 km south west of Dunbar on the East Lothian coast (the Branxton connection), with a third additional connection at Blyth, Northumberland.

3. This chapter presents the site selection that has been undertaken at the Branxton connection near to Scottish Power Energy Network (SPEN's) existing Branxton Sealing End Compound. There is a strong technical and environmental preference to bring the power generated by the offshore wind farm to landfall as close as possible to the onshore grid connection.

4. The export cables and landfall infrastructure for the third connection at Blyth, Northumberland are being consented separately.

5. Alternatives have been considered in relation to the following infrastructure components of the Proposed Development:

   - Landfall;
   - Onshore cable route; and
   - Onshore substation location

6. Once the preferred cable landfall, cable corridor and onshore substation locations were established, further design work was undertaken to minimise, as far as possible, the impact on the environment.

4.2. PROJECT EVOLUTION

7. The Firth of Forth Zone was awarded to SSE Renewables Ltd (SSER) and Fluor in 2010 as part of The Crown Estate (TCE) 3rd Offshore Wind Leasing Round (Round 3). Following zone award, SSER commenced a number of studies as part of the Zonal Appraisal and Planning (ZAP) process to identify areas within the zone to be taken forward for development. Development of the areas would be completed in three phases:

   - phase 1: Northern Area;
   - phase 2: South-eastern Area; and
   - phase 3: South-western Area.

8. Phase 1, the Northern Area was subsequently taken forward for development as Seagreen as Alpha Offshore Wind Farm (Project Alpha) and Project Bravo Offshore Wind Farm (Project Bravo) projects. Although consented by the Scottish Ministers in 2014, the consents were subject to legal challenge, which upheld the grant of the consents in November 2017. In 2018 these projects were combined into one project (Seagreen 1). In 2019, amendments were made to the Seagreen 1 project boundary creating the projects now referred to as Seagreen 1 and Seagreen 1a.

9. Having received consent for Project Alpha and Project Bravo in October 2014, a decision was taken by SSER to undertake further studies (technical and environmental) as part of an internal Project Identification and Approval process to determine the potential for developing the remaining two areas within the Firth of Forth Zone. At the time (2014) these areas were referred to as Seagreen Charlie (South-eastern Area) and Seagreen Delta (South-western Area). In 2018, following the creation of Seagreen 1 1, these remaining areas were renamed Seagreen 2 and Seagreen 3 respectively. The PIA process concluded that both remaining areas should be taken forward for development. The areas were renamed again, with accompanying boundary modification in 2020 from Seagreen 2 and 3 to Berwick Bank and Marr Bank respectively. Full details on the offshore site selection process can be found in the Berwick Bank Wind Farm, Offshore EIA Report, Volume 1, Chapter 4.

10. The Branxton grid connections were first secured in 2011 and an updated grid connection agreement for the same location was signed in 2020. Subsequently, the identification and selection of the Proposed Development site have been guided by the grid connection agreement.

11. The third additional connection agreement in Blyth, Northumberland (Cambois connection) was confirmed in June 2022 following NGESO's Holistic Network Review (results published July 2022). The Cambois connection provides an earlier connection date than a third connection location in the Branxton area, therefore enabling the Project to reach full generating capacity (4.1 GW) by early 2030's.

Table 4.1: Project Evolution

Date	Project Stage
2008-2010	Firth of Forth Zone Identification and Award
2011	Branxton Grid Connections First Secured
2017-2020	Project appraisal and site selection process
2020	Branxton grid connection for 2.3GW signed
2020	EIA Onshore Scoping Report Submitted
2020	Scoping Opinion received
2020-2022	Proposed Development maximum design parameters identified, and EIA carried out
2022	EIA Report and Application submitted to East Lothian Council

4.3. LEGISLATION AND POLICY

12. A detailed assessment of the Proposed Development in relation to current and future policy is presented in the Planning Statement. Policy considerations are also outlined in Volume 1, Chapter 3.

13. The requirement to consider viable alternatives is contained within Schedule 4 (2) of the EIA Regulations 2017. This states that: '*A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects'.*

14. The information provided in this chapter sets out the approach taken to meet the requirements of the above regulations.

4.4. SITE SELECTION OVERVIEW

15. The Applicant considered several landfall and substation options within the vicinity of Branxton. These were evaluated from an engineering, consents (planning and environment), commercial and land use perspective. A two-stage process was undertaken and is summarised in Table 4.2 below.

Table 4.2: Stages of Site Selection

Stages	Scope of Work
Stage 1: Identification and screening of site options	▪ Identification of multiple landfall and substation options, based on proximity to the grid connection at Branxton. ▪ Consideration of each landfall and substation option based on technical, consents, land use and cost perspectives.
Stage 2: Further assessment of short-listed options to determine the 'preferred' options	▪ Further consideration of options shortlisted at Stage 1. ▪ Consideration of potential alternatives raised during consultation. ▪ Identification and refinement of preferred landfall, substation location and evaluation of the cable corridor to connect both, and onward to the grid connection at Branxton.

16. The site selection process utilised technical reports provided by specialist consultants which covered engineering feasibility, land use (current and historical) and consents constraints.

4.5. LANDFALL SITE SELECTION

4.5.1. STAGE 1 – IDENTIFICATION AND SCREENING OF LANDFALL OPTIONS

17. Branxton was identified as the preferred grid connection location following the Connection and Infrastructure Options Note (CION) process. During the CION process the transmission operator carries out an optioneering process on a range of onshore connections points to identify the most economic and efficient connection point. Initial options for the landfall location were driven by NGESO's grid connection offer at Branxton and the requirement to screen options within the vicinity of this.

18. The findings of various technical reports were used to appraise and identify potential landfall locations, as part of the site selection process. The potential landfall sites were numbered Landfall 1 (LF1), LF2, LF3, LF4, LF5, LF6 and LF7a/b. The location of each landfall option is shown on Volume 2, Figure 4.1.

19. Stage 1 considered a range of factors such as intertidal and onshore infrastructure requirements, engineering, and environmental constraints, including (but not limited to):

- Geology;
- Thermal;
- Land use;
- Nature designations (e.g., Barns Ness Coast Site of Special Scientific Interest [SSSI]);
- Scheduled Monuments;
- Ancient woodland;
- Battlefield sites;
- Former coal working areas; and
- Human receptors.

20. The key outcome of the Stage 1 screening process was to shortlist landfalls that were preferred from an engineering, environmental and land use perspective. Initially, landfalls taken forward for further evaluation were LF2, LF3, LF5 and LF7a/b. Stage 1 concluded with LF3 (also referred to as Skateraw Landfall) and LF5 (also referred to as Thorntonloch Landfall) being taken forward as the preferred options. A summary is set out in Table 4.2 below.

Table 4.2: Stage 1 - Screening of Landfall Site Options

Site Name	Key Evaluation	Stage 1 Conclusion
LF1	Bypasses Barns Ness Coast Site of Special Scientific Interest (SSSI). However, it has a long onshore cable route with a challenging landform and would have to negotiate multiple obstacles including the cement works, reclaimed quarry, landfill site, A1 trunk road (A1 (T)), East Coast Main Line Railway (ECML), Skateraw Burn, Thornton Burn and NNG onshore route. Additionally, there is a buried 132kV route from Torness power station, running west, emerging to overhead transmission 200m south of Thurston Manor Caravan Park as well as the site's proximity to the settlement of Dunbar.	Not preferred
LF2	Intersects with Barns Ness Coast SSSI. Intersects Tarmac's operational quarry and would therefore sterilise this land. The onshore cable route would have to negotiate multiple obstacles including Skateraw Burn, the A1 (T), ECML, Neart na Gaoithe (NNG) onshore route and Thornton Burn	Not preferred
LF3 (Skateraw Landfall)	Intersects with Barns Ness Coast SSSI. However, during the evaluation process it was anticipated that there was potential for a trenchless technique for cable landfall which would avoid direct impacts on the SSSI. Short cable route in comparison to the other options. Permanent infrastructure located close to residential properties (i.e., around 250 m to nearest).	**Shortlisted for Stage 2**
LF4	Landfall would be within the boundary of the Torness Power Station licenced area. and as such, incompatible with nuclear licence control measures.	Not preferred
LF5 (Thorntonloch Landfall)	Located close to residential properties (i.e., around 75 m to nearest). Compact site with limited space, given NnG landfall is installed in the same area.	**Shortlisted for Stage 2**
LF 6	A trenched solution may be feasible but would require extensive earthworks to remove cliff face if an open trench technique was deployed, resulting in an adverse impact on sand dune habitat. A trenchless solution would only be possible for a lower capacity of cable than being considered. Short cable route in comparison to the other options. Located close to residential properties (i.e., around 110 m to nearest).	Not preferred
LF7a/b	Due to elevation of the cliffs the landfall cable would require to be at significant depth (~30 m) with high potential for thermal issues, such as overheating.	Not preferred

4.5.2. STAGE 2 – LANDFALL SHORTLISTED SITES

21. The shortlisted landfall sites, LF3 (Skateraw Landfall) and LF5 (Thorntonloch Landfall) were considered further. A summary of the key constraints and opportunities for each, is presented in Table 4.3 below and in Volume 2, Figure 4.2.

Table 4.3: Stage 2 – Shortlisted Landfalls Options

Landfall	Opportunities	Constraints
LF3 (Skateraw Landfall)	**Technical** Technically feasible with trenchless technique below the Barns Ness Coast SSSI, which also has limited inland extent. **Consents** A trenchless technique for cable installation will be out with the Barns Ness Coast SSSI and UK Biodiversity Action Plan (UKBAP) sand dune habitat present along the coast. This landfall location would require a short route to the onshore Substation 8.	**Technical** The cable route would need to account for the westward extent of the Torness Nuclear Licensed Site, the ECML, A1 (T), Thorntonloch Burn, NnG cables and potentially the buried 400 kV cables leading southward from Torness Power Station. **Consents** Potential issues around access and disruption to the nearby Skateraw village during construction. However, this would be temporary and would be controlled with a Construction Environmental Management Plan (CEMP). The presence of the Barns Ness Coast SSSI, but trenchless technique would mitigate impacts. There are several known Historic Environment Records (HER) in the surrounding area, a Scheduled Monument (SM4040) and two Grade B Listed Buildings, Skateraw Limekiln and Skateraw House within the vicinity. The landfall is located within ~190 m of a residential property. Potential to intersect with the John Muir Link coastal path.
LF5 (Thorntonloch Landfall)	**Technical** This is a compact site at Thorntonloch beach; however, it has the potential to offer a good landing point. **Consents** This landfall location would require a short route to Substation 3.	**Technical** Limited availability of space at Thorntonloch Beach due to NnG Offshore Wind Farm's cable route reaching landfall in the same area. A viable engineering solution could not be established for either trench or trenchless solutions due to the nature of the superficial and bedrock geology and space constraints due to the proximity of NnG's cable route, detail provided in Section 4.6.1 below. **Consents** Located within 50 m of a watercourse. Potential impact on the UKBAP sand dune habitat present along the coast. Located within 100 m of residential property and sensitive receptors including users of Thorntonloch beach and caravan park. Intersects with the John Muir Link coastal path. Bathing water designation (Bathing Water Directive, SEPA) and the impact on locals and tourists using the beach.

4.5.3. LF5 (THORNTONLOCH LANDFALL)

22. As shown in the table above, LF5 (Thorntonloch Landfall) presented a series of challenges in terms of the engineering solution for landfall. The Applicant considered and assessed

the viability of bringing ashore the export cables using three trenchless techniques: Horizontal Directional Drilling (HDD), direct pipe and open trench methods. The key points on each are summarised below.

Horizontal Directional Drilling

23. With HDD it was considered extremely challenging from an engineering perspective to bring ashore the required number of export cables at this landfall. The underlying geology was the key constraint which prevented the development of a viable HDD solution which would not lead to unacceptable impacts on key features of the location, such as residents and tourists use of the beach, the bathing water designation, coastal landscape/seascape and the John Muir Link Coastal Path.

Direct Pipe

24. In consideration of the direct pipe method it was concluded that whilst the technology is relatively unproven in terms of industry use, the engineering studies performed to date suggest it could be a potentially technically feasible option. However, given the lengths of the direct pipe, (exacerbated by the need to commence these operations west of the A1(T) due to inadequate space requirements) are in the region of 1.2 km, and a nominal diameter of the pipe is 1.2 m (any greater would mean additional thrusting machines and a subsequent lack of space), HSE (UK Health and Safety Executive) guidance indicates this should be considered “not acceptable” from an HSE perspective as human entry is required down the pipe. The direct pipe option was therefore discounted.

Open Trench

25. A review of an open trench methodology was also considered as part of the site selection process. Based on available ground investigation information and site observations the nature of the expected excavated material was assessed. The bedrock is known to be both lithologically and structurally very variable. Instances of sandstones and calcareous sandstones have been identified and these would present a significant challenge owing to their hard nature. The equipment required to break rock of this nature is very specialised with significant noise related issues over protracted periods of time. As such, the process of forming the open trench is considered a significant engineering and consenting risk with greater potential adverse effects on the environment. This was supported by field observations which indicated that the process of forming the open trench is likely to be ‘hard’ and ‘requiring blasting’ depending on the geological formation encountered. It was therefore concluded that due to the high variability and significant engineering works for removal that this would affect the direct viability of the implementation of this methodology for the Project.

26. As well as the engineering challenges, LF5 has restricted available beach space due to the NnG offshore cables reaching landfall at the same location. The Project would have a greater number of cables and resultantly a wider cable corridor coming onshore in this area and therefore the landfall location studied needed to be outwith the NnG corridor and further south near the sand dunes. The works could result in significant effects on the sand dune habitat in that location along the coast. The potential impact on the bathing water designated area was also a consideration. The landfall works could impact the nearby residential properties, as well as the caravan park, although this could be minimised by implementation of a CEMP.

4.5.4. LF3 (SKATERAW LANDFALL)

27. LF3 (Skateraw Landfall) has reasonable access and available space to achieve landfall if some of the potential constraints can be avoided or managed effectively during landfall construction.

28. The engineering evaluation considered the option for trenched and trenchless solutions to connect to the offshore export cables. A trenched solution was not considered possible due to the constraint presented by the Barn Ness Coast SSSI which is designated for coastal geology and habitats. A trenched solution would likely result in significant effects on the SSSI and so was deemed not to be a viable engineering or environmentally sustainable solution. Through the scoping opinion response it was advised that an open cut trenching scenario through the SSSI would be likely to result in an objection on the grounds of causing significant damage to the geodiversity feature.

29. A trenchless technique (e.g., HDD) that would pass at depth under the Barns Ness Coast SSSI, was considered feasible, as it would avoid direct impacts on this designated feature. This solution would also avoid a direct impact on the John Muir Links Coastal Path, which runs along the coastline. This landfall also offered sufficient space to avoid other environmental constraints, such as archaeological sites and it was considered that impacts on nearby residents could be minimised using good practice construction techniques set out in a CEMP.

4.5.5. CONCLUSION

30. The Stage 2 assessment compared the remaining two landfall options to determine a preferred option. Based on an evaluation of the engineering and consents requirements LF3 (Skateraw Landfall) presented the most feasible option and was therefore deemed the preferred option. This was based on the following key aspects:

- A viable engineering solution;
- Direct impacts on nature conservation and cultural heritage designation could be avoided; and
- Measures could be applied, during construction, to minimise disruption to residents and their amenity.

31. The proposed landfall infrastructure is shown on Volume 2, Figure 4.3.

4.6. SUBSTATION SITE SELECTION

4.6.1. STAGE 1 – IDENTIFICATION AND SCREENING OF SUBSTATION OPTIONS

32. Initial options for the substation location were driven by the landfall options taken forward for further evaluation, as well as the following considerations:

- the landscape and visual context;
- presence of man-made structures in the local environment;
- key engineering and design constraints;
- availability and size of land parcels; and
- proximity to the grid connection in Branxton, to limit the extent of onshore cable route required.

33. Six potential substation sites were considered initially (Substations 1 to 6). Three further possible sites (Substations 7 to 9) were subsequently assessed. The substation site options are shown on Volume 2, Figure 4.3.

34. Some of these substation locations were only deemed suitable for specific landfalls (i.e., where constraints along potential onshore cable corridors limited/prevented connection to

other landfall locations). Therefore, when a landfall was deselected the corresponding substation location was also deselected on the basis that no alternative onshore cable route options linking to alternative landfall locations were available.

35. A summary of the Stage 1 screening process for the substation options is set out in Table 4.4 below.

Table 4.4: Stage 1 - Screening of Substation Site Options

Site Name	Key Evaluation	Stage 1 Conclusions
Substation 1 (suitable for LF7a/b)	Located on high ground with potential for significant visibility in the landscape, therefore the predicted visual impact would be much greater in comparison to other substation locations. There was considered to be slope stability issues and would require significant upgrades to roads to access.	Not preferred based evaluation of constraints and on deselection of LF7a/b.
Substation 2 (suitable for LF7a/b)	Long onshore cable route. Directly linked to LF7a/b and was deselected with this landfall option.	Not preferred based on deselection of LF7a/b.
Substation 3 (suitable for LF5)	Closely linked to LF5 (Thorntonloch Landfall) as this would be a shorter and more direct cable route than other landfall options. Therefore, this substation was dependant on viability of LF5 (Thortonloch Landfall). Sufficient space for the substation. Potential significant effects on a Scheduled Monument and the amenity of local residents. Residential properties within 50m. New 2.1km access road would be necessary. However, short onshore cable route.	**Shortlisted for Stage 2 as LF5 was preferred**
Substation 4 (suitable for LF5)	Limited availability of space. Deemed too close to the proposed SPEN Branxton substation and with potential impacts on a Scheduled Monument. Significant slope stability issues.	Not preferred
Substation 5 (suitable for LF5)	On high ground and the substation footprint does not fit without significant slope stability issues. Deemed too close to the proposed SPEN Branxton substation. Difficult for cable trenching as the route requires crossing the valley to Branxton and back up other side. Due to proximity to residential properties (~40m) there is potential for significant residential amenity and visual impacts.	Not preferred
Substation 6 (suitable for LF7a/7b)	On high ground with potential for significant visibility in the landscape, but also there would be a requirement to irreversibly alter the summit of Braid Law hill. Located near an area of shallow coal mining, would require significant upgrades to roads to access.	Not preferred based on evaluation of constraints and deselection of LF7a/b.
Substation 7 (suitable for LF5)	Significant infrastructure and engineering constraints including proximity to the railway, insufficient space for trenchless solution. A new 1.6 km access road would be necessary. Potential impact on badger sett and foraging territory.	Not preferred

Site Name	Key Evaluation	Stage 1 Conclusions
Substation 8 (suitable for LF3 and LF2)	Large area of relatively level ground and relatively lower potential for visual impacts. Feasible to engineer the substation at this location. A single property, Railway Cottage, is present within 50m, with no other properties within a 250m radius.	**Shortlisted for Stage 2 as LF3 was preferred**
Substation 9 (suitable for LF3)	Large area with level ground and lower potential for visual impacts. The nearest residential property is located 165 m from the site. Utilities are present directly under the site.	**Shortlisted for Stage 2 as LF3 was preferred**

4.6.2. STAGE 2 – SUBSTATION SHORTLISTED OPTIONS

36. Following the Stage 1 screening, three substations were shortlisted as viable options. These options were presented in the Berwick Bank Wind Farm Onshore Scoping Report (August 2020) as the preferred options at the time.

37. The shortlisted substations were:

- Substation 3 (also referred to as Thorntonloch Holdings Substation);
- Substation 8 (also referred to as Skateraw Substation); and
- Substation 9 (also referred to as Crowhill Substation).

38. Each was considered further, as part of the Stage 2 process. The outcome is summarised in Table 4.5. This details the key engineering, land use and consenting aspects considered for each substation option.

Table 4.5: Stage 2 - Shortlisted Substation Site Options

Name	Evaluation	Stage 2 Conclusion
Substation 3	**Engineering** Substation 3 was intrinsically linked with LF5 due to the short cable distance require. LF5 was discounted as discussed in Table 4.3 above. Substation 3 was also deselected at this time, as it's engineering benefits were only applicable for a short cable corridor connection from LF5. Furthermore, in order to facilitate the delivery of the substation transformers (abnormal loads) there would have been a requirement to install a new 2.1 km access track and road improvements along the existing road network. The required road improvements would have also required the dismantling of part of the Bilsdean bridge that crosses the ECML railway bridge. Following consultation with Network Rail it became apparent that this presented a significant engineering constraint to development of this site. Consenting Two properties in close proximity to this substation location, one which operates as a bed and breakfast, leading to increased visual impacts on local residents and businesses.	Not considered further
Substation 8	**Engineering** Site identified as being suitable for LF3. There is a suitable junction off the A1 (T) from which there would be a requirement to construct a short	**Deemed the preferred option**

Name	Evaluation	Stage 2 Conclusion
	(approximately 600 m) track to access the site for construction. Although there is an adjacent 11 kV overhead line, it was identified that this could potentially be relocated or buried (KDS, Feb 2020), removing this as a potential constraint. There is sufficient space for a laydown area and the uniform slope across the site allows for a more simplistic cut and fill during construction of the substation platform. **Consenting** A single property, Railway Cottage, is present within 250 m from the site. However, there are no other properties within a 250m radius. The site is located in an area of Grade 2 Agricultural land (high quality). However, any potential significant effects resulting from the permanent loss of this agricultural land were considered to be limited due to the extent of Grade 2 Agricultural land present across the wider area. The site is also located within a large area of relatively level ground and relatively low visibility, although there is potential for a substation on this site to be visible from the A1 (T) and some properties located in the nearby villages of Crowhill and Innerwick. Given that the entire site is in agricultural land, potential effects on local ecology were considered to be low. However, there is potential to impact on badger foraging territory.	
Substation 9	**Engineering** Site identified as being suitable for LF3. From an engineering perspective the location allows sufficient space for the substation footprint and laydown area. There is also a suitable junction along the A1 (T) to facilitate access for abnormal loads, although there would be a requirement to construct a new approximately 1 km access track to gain access to the site for construction. The key engineering constraint affects the site relates to the presence of a 132kV buried cable from Torness-Dunbar and several other electrical cables which cross the site and have servitude rights. It was unclear how this could be mitigated without significant construction works. **Consenting** The site is located in an area of Grade 2 Agricultural land (high quality). However, any potential significant effects resulting from the permanent loss of this agricultural land were considered to be limited due to the extent of Grade 2 Agricultural land present across the wider area. Land near the rail embankments was identified as being suitable habitat for badgers to establish setts. There are 15 properties within 250 m of the substation, 13 of which are located within Crowhill. There is a potential for these properties to be effects by visual and noise impacts.	Not considered further due to the constraint posed by existing electrical cables which bisect the site and proximity to residential properties and increased potential for visual impacts.

4.6.3. ALTERNATIVE SUBSTATION OPTIONS

39. Once the preferred site selection options were established (LF3 (Skateraw Landfall) and SS8) a summary of the site selection process was provided to representatives from East Lothian Council (ELC) planning department. Two meetings were held with ELC on the 9 December 2020 and on the 2 March 2021. During these meetings representatives from ELC raised concerns about the location of the substation and requested that further consideration was given to potential locations north of the A1 (T). As a result, three further substations options were considered (refer to Volume 2, Figure 4.5). These were:

- On land at the Tarmac Quarry Area, northwest of Skateraw landfall;
- On a brownfield site, near the Cement Works in Dunbar, referred to as the Oxwellmains Site; and
- On land west of Torness Power Station, referred to as the EDF Option.

40. Based on a preliminary assessment the Tarmac Quarry Area was discounted from further detailed consideration due to there being insufficient land available to accommodate the substation and length of cable corridor required.

Oxwellmains site

41. ELC requested that the brownfield site near the Cement Works in Dunbar, owned by Viridor Waste Management Limited and named Oxwellmains, be investigated as a potential site for the substation. The same request was made to SPEN for their proposed converter station, as part of the Eastern Link Project. This location had the advantage of being a brownfield site with industrial land adjacent. However, the site was constrained by lack of available space in which to accommodate the full requirements of the substation including SUDS pond, landscaping and access roads. In addition, the cable route would be longer in comparison to other options and potentially result in a greater environmental impact.

42. During the Applicant's review of this option, SPEN confirmed that they would be taking this site forward for the proposed Eastern Link Project convertor station. As a result, and given the constraints identified, this location was deselected from the site selection process. As no additional space was available.

EDF option

43. Following discussions with ELC, the Applicant engaged with EDF to determine whether any of the land within their ownership could be made available. During the screening stage, it was understood that nuclear licence restrictions would present a hard constraint to development in and around Torness Power Station. Initial discussions concluded that the land could be made available subject to further considerations. Given the request from ELC and the potential availability of the land, it was considered a reasonable alternative to be considered as part of the site selection process.

44. To consider the 'EDF option', the proposed substation footprint was presented to EDF to demonstrate an approximate land take. EDF requested that the substation should be located as far to the west of the land in their ownership as possible. This was reviewed in conjunction with technical consultants who highlighted potential impacts on the residents of Skateraw to the west. On this basis, in the interest of protecting residential amenity, the location of the substation was moved further east, closer to Torness Power Station and with an approximate 300m buffer between the western edge of the substation and Skateraw as shown on Volume 2, Figure 4.6. The buffer was advised by the Project landscape and visual consultant (OPEN) who, based on professional judgment, considered it a reasonable precaution to reduce the impact on the residents of Skateraw from the change in their immediate landscape and the associated visual impact. The buffer also reduced the potential impacts from noise and dust during construction and operation of the substation.

This revised location was used in the site selection analysis to identify potential engineering, land use and consents constraints presented by the EDF option.

45. Historical records indicate former landfill sites in the north-west of the EDF land. According to available records (ELC and SEPA) the landfill sites are within the former Skateraw Quarry. The first record of a landfill dates to 1981 and is noted as having no known restrictions on the source of waste, with construction waste specifically authorised. It appears the landfill was expanded and operated by ELC. It is recorded as receiving inert waste until closure in 1993. These landfills were operated prior to the introduction of regulations focused on the control of waste entering landfills (e.g. Landfill Scotland Regulations 2003). The material contained within the landfill and its current condition cannot be reliably predicted. It is possible that the landfill will contain residual hazardous substances and explosive gases (such as methane). The latter would originate from the decomposition of biodegradable waste deposited in the landfill. It is also possible that hazardous substances such as asbestos could be present. The Applicant's engineers consider development within a former landfill area to be a considerable risk. An acceptance of the potential liabilities associated with the purchase of the land would also need to be secured. Extensive contamination remediation may be required to make the site suitable for the onshore substation. There could be a requirement to dispose of hazardous waste material at a suitably licenced facility. The presence of landfill material is likely to require an advanced geotechnical solution, such as piling to bedrock, as the landfill material will be unsuitable for load bearing. Piling introduces further concerns in relation to noise and vibration. On the latter, discussions with EDF have highlighted that vibration could be problematic for the Torness Power Station.

46. This site also presented concerns due to its proximity to Barns Ness Coast SSSI, including the risk of slope instability associated with the former landfills which border the SSSI. The landfill material could be unstable and any engineering within, or above, could result in a landslip toward the Barns Ness Coast SSSI. This could impact on the key botanical and geological features which are the basis of the SSSI designation. Furthermore, the landslip could facilitate the release of hazardous material which could pollute the marine environment. It is possible that an engineering solution could be applied but this would require additional studies to determine the engineering approach and mitigation necessary to manage the risk. It is likely, given the uncertainty around the nature of the landfill material, that some residual risk would remain.

47. Although the substation would be set against the backdrop of Torness Power Station, it would be a noticeably different structure and would bring the extent of industrial activity closer to Skateraw, whereas the current agricultural fields provide a degree of separation from Torness Power Station.

48. An initial assessment has shown that, based on the known constraints there is limited space available for the substation, including the necessary earthworks, drainage, landscaping, access roads and construction compound. This leaves little or no flexibility for addressing any unforeseen constraints, such as unsuitable ground conditions identified following consent.

49. An additional constraint is the degree of uncertainty regarding the nuclear safety case and the required separation distances, from the proposed substation infrastructure to Torness Power Station, to ensure nuclear safety. Discussions with EDF were unable to provide certainty on an appropriate safety distance.

50. Despite the constraints listed above the site analysis included a high-level risk assessment to compare the EDF option against Substation 8. The scoring was calculated based on the sensitivity of the receptor (e.g., designated site) multiplied by the magnitude of potential impact to determine an overall consent risk score for each criteria. The methodology used is shown on Table 4.6 below:

Table 4.6: Consent risk RAG scoring

Sensitivity	Magnitude of Impact: 3	2	1
1	3	2	1
2	6	4	2
3	9	6	3

51. The constraint/consent risk was rated from '1' as low to '3' as high. The sensitivity was based on the status of the receptor with '1' a receptor of low sensitivity to a '3' a receptor with higher sensitivity to the substation development. The resulting scoring was then classified as either a red, amber, or green (RAG) to reach an overall score for each element considered, with red a high risk, amber as moderate and green as low.

52. This enabled a comparison of substation 8 against the EDF option. The RAG assessment can be found in Volume 4, Appendix 4.1. As can be seen, the EDF option scored higher for several of the criteria considered, including the risk to national designations (i.e., the SSSI), risk from the former landfills, impact on historic environment, impact on the Special Landscape Area and the potential impact on the John Muir Link. The total RAG score for EDF was 80 whilst substation 8 scored 67.

53. A key differentiator is the presence of the historic landfill sites which lie adjacent to the Barns Ness Coast SSSI. As noted above, development within the landfill area carries significant environmental and geotechnical risk and in the event of a landslip could result in pollution of the adjacent SSSI, a nationally designated site.

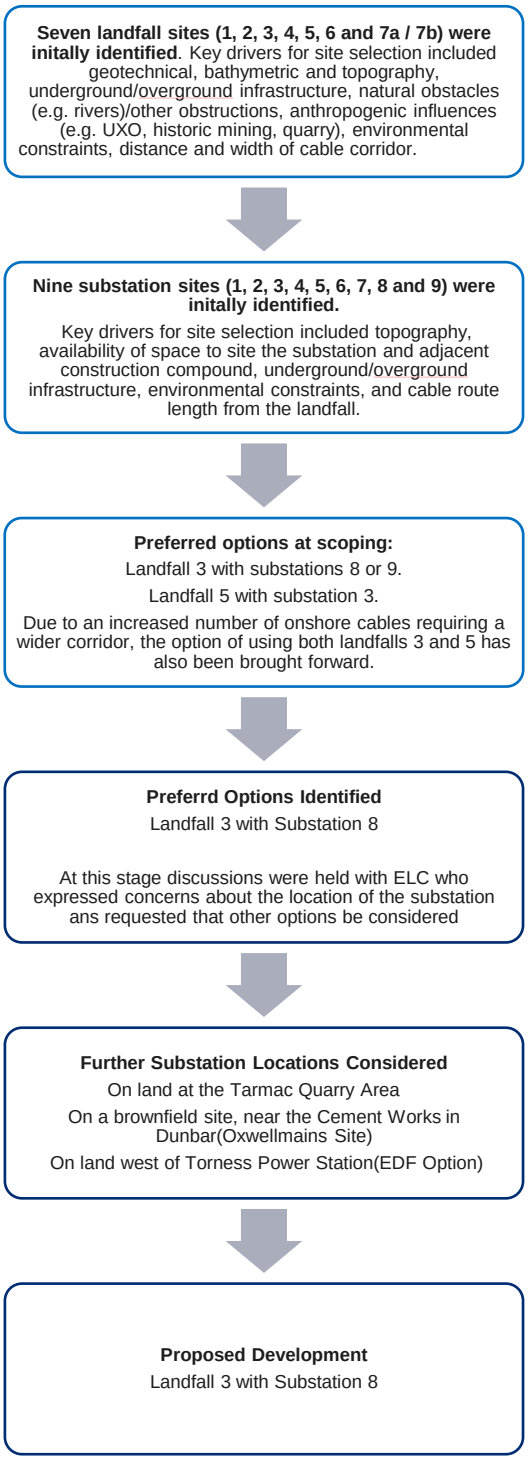
4.6.4. SUBSTATION SITE SELECTION CONCLUSION

54. At the request of ELC and in response to their concerns about the substation location, further site selection work was carried out to determine if another suitable location could be identified. Of the three areas available for consideration, none were deemed to be more suitable and less environmentally intrusive than Substation 8 which had previously been identified as the preferred location.

55. Given that Substation 8 and Substation 9 are in close proximity to one another and that both are on agricultural land, the constraints presented are broadly similar. The exception to this is the presence of at least three SPEN underground cables crossing the location of Substation 9. Re-routing of these cables was considered a significant constraint as it would mean that a trenchless technology (e.g. HDD) solution was not possible and as such this substation option was deselected.

56. On the basis of the site selection process detailed above and summarised below (refer to Diagram 4.1), Substation 8 remained the preferred option and has been taken forward as the Proposed Development. Further details of the onshore substation are provided in Volume 1, Chapter 5.

Diagram 4.1 Summary of Substation Site Selection



4.7. CABLE ROUTING

57. The landfall and substation site selection process took cognisance of the potential constraints in the wider environment in respect to the required cable routing. This work took place in parallel and contributed to the site selection process for the preferred options of LF3 (Skateraw Landfall) with Substation 8 (Skateraw Substation) and LF5 (Thorntonloch Landfall) with Substation 3 (Thorntonloch Holdings Substation). It should be noted that, although reference is made in the preceding sections to the subsequent deselection of LF5 and Substation 3 (Thorntonloch Holdings Substation) these decisions were informed by the outputs from the routing study described below.

58. A key driver for refining cable routing was to minimise the length of cable corridor where possible, thereby minimising the extent of potential environmental impacts. This was considered for the cable routing from landfall to the onshore substation and then on to the SPEN Branxton substation for connection into the grid.

59. Underground cables were considered the preferred option to overhead lines due to the potential for landscape and visual effects. As site selection progressed and cable routing was refined, a section of cable from the onshore substation to SPEN's Branxton substation was further considered to potentially require overhead lines due to the angle at which the cable turned. This would have required a cable sealing end compound to change from underground cable to overhead lines. Overhead lines for this section were not considered feasible due to a lack of available space as a result of constraints in the area and the potential for landscape and visual effects from the overhead lines and the sealing end compound. Therefore, underground cables were considered the preferred option for this section.

60. Cable routes were evaluated for:

- From LF3 (Skateraw Landfall) to Substation 8 (Skateraw Substation) and then onto grid connection at Branxton; and
- From LF5 (Thorntonloch Landfall) to Substation 3 (Thorntonloch Holdings Substation) and then onto grid connection at Branxton (this option was subsequently deselected as described in the preceding sections).

61. The routing studies and selection process undertaken for each of these options is detailed below

4.7.2. LANDFALL TO SUBSTATION

LF5 to Substation 3

62. The route from LF 5 was initially preferred, as it is shorter with less infrastructure crossings required. Therefore, work was initially focussed on trying to find a feasible solution for LF5 which was constrained in terms of the area of land available for the landfall infrastructure and due to the presence of extensive Glacio-fluvial superficial deposits (identified by ground investigation), which could lead to the collapse of boreholes, if drilled through unsupported. Despite exploring several trenchless and trenched solutions, a credible technically feasible option at LF 5 with proven industry application could not be found. This view was supported by specialist trenchless contractors and the SSE Civil & Geotech Technical Advisers. The crossing of the ECML and A1 (T) at this section near Thorntonloch on route 2 was also deemed to be very high risk from a technical perspective as 1) the same glacial deposits are in this location and 2) there is significant raised ground level to the south west of the railway corridor.

LF3 to Substation 8

63. LF 3 was considered to be the preferred option for the landfall, as it is a larger area (sufficient to accommodate required infrastructure) and the underlying rock has been identified as being suitable for trenchless technique (e.g. HDD). LF3 had available space north and south of Dry Burn to investigate further for the most feasible area to access the landfall. To avoid prohibiting or sterilising quarrying works at an active site located to the north of Dry Burn, land to the south of LF3 was taken forward as the preferred option for the onshore cable route. There is a surface geological SSSI in this area, but NatureScot have indicated that it is likely to be acceptable provided we use a trenchless technique (e.g. HDD) to go under this.

64. The route from LF3 to substation 8 also involves an ECML crossing. However, this crossing is considered to be much lower risk than LF5, as it is on a constructed embankment and therefore allows established trenchless technologies to be deployed. The A1 (T) is also on an embankment at the point of crossing but is concrete surfaced which decreases the settlement limits – however any future damage caused could be managed through a formal agreement made prior to construction. The substation 8 location is on flatter land than substation 3 for LF5. No unusual construction risks have been identified with the exception of the potential for a degree of rock removal to form the substation platform.

4.7.3. SUBSTATION TO BRANXTON GRID CONNECTION

65. There were two routes identified from substation 8 to the SPEN Branxton grid connection (see Volume 2, Figure 4.7).

Route 1

66. The eastern route involves crossing the two circuits of Torness 400kV underground cables at two locations. These are directly buried i.e., un-ducted at these locations, which has resulted in SPEN specifying that there can be 'no mechanical impact' on these cables. It is expected that this would only be possible to achieve if there is shallow rock present to drill through below the cable therefore reducing the risk of settlement of the cables above. The initial ground investigation campaign indicated shallow rock at the western side of the northern crossing. Rock has not been confirmed to the east. At the proposed southern crossing point, the nearest ground investigation available is approximately 100 m south of the position, which has not established rock at shallow depth. Therefore, based on the information available it was concluded that it would not be possible to develop a design solution that would meet the SPEN criteria for both the northern and southern crossings. In order to demonstrate whether there is a feasible solution, further ground investigations would be required to be undertaken adjacent to both sides of both crossings.

67. A number of environmental constraints were also identified in the area of Route 1 (the eastern route) including Scheduled Monuments, residential properties and Ancient Woodland. Due to the width of the cable corridor required, avoidance of these constraints resulted in a substantial increase in the overall length of the cable route and the route being less direct.

Route 1a

68. The western route between LF3 and the SPEN Branxton substation involves crossing a burn within a ravine. The preliminary design of a suitable culvert structure was undertaken for this crossing and a constructability review carried out. Part of the culvert and cable route leading to it run under existing 400kV overhead line. The position taken by the Applicant was that any works required under the 400kV overhead lines would need to be carried out during a simultaneous outage of both circuits of the 400kV overhead lines (a double

outage). Alternatively, it was concluded that trenchless technology (e.g. HDD) or other similar technology could be utilised to avoid the need to work under the live overhead line.

69. Route 1A also requires a trenchless solution (e.g. HDD) to avoid any potential effects on a Scheduled Monument (SM5849 – Castledene Enclosure) which is located along the route. Conversations with Historic Environment Scotland (HES) have indicated that an acceptable trenchless technology solution can be found. Route 1A also interacts with less residential properties, does not interact with any Ancient Woodland and is shorter and more direct than Route 1. Route 1A runs parallel to the SPEN Eastern Link cables in a relatively narrow corridor at one point.

70. The conclusion from the routing study was that Route 1A was the recommended options. This was on the basis that potential adverse effects on the Castledene Enclosure Scheduled Monument could be avoided by routing or utilising a trenchless solution, there are less environmental constraints present along the route and works can be completed safely under the 400 kV either via a simultaneous outage of both circuits of these 400kV overhead lines (double outage) or that trenchless technology.

71. Engagement with SPEN on their Eastern Link project footprint also influenced the final route of Route 1A as it was known that both developers are proposing to undertake works in the same area. Following discussion and review of the SPEN cable corridor search area, the Applicant identified the areas specifically around Castledene Scheduled Monument and the Thornton Burn as key areas of potential overlap. Therefore, the Applicant reviewed and amended the cable route which previously passed south of the Scheduled Monument to avoid the SPEN cable and amended the preferred crossing point at the Thornton Burn further east.

4.8. SITE SELECTION CONCLUSION

72. The Stage 2 assessment compared the remaining two landfall options to determine a preferred option. Based on an evaluation of the engineering and consents (planning and environment) constraints, LF3 (Skateraw Landfall) presented the most feasible option and was therefore deemed the preferred option. This was based on the following key aspects:

- A viable engineering solution;
- Direct impacts on nature conservation and cultural heritage designation could be avoided; and
- Measures could be applied, during construction, to minimise disruption to residents and their amenity.

73. The proposed landfall infrastructure is shown on Volume 2, Figure 4.8.

74. Given that Substation 8 and Substation 9 are in close proximity to one another and that both are on agricultural land, the constraints presented are broadly similar. The exception to this is the presence of at least three SPEN underground cables crossing the location of Substation 9. Re-routing of these cables was considered a significant constraint and as such this substation option was deselected.

75. On this basis of the site selection process summarised above, Substation 8 remained the preferred option. The preferred cable routing options following the site selection process was LF3 heading south to Substation 8 and 400kV cable route 1A to the Branxton gird connection.

4.9. FURTHER DESIGN CONSIDERATIONS

76. Once the preferred options for the landfall, cable routeing and substation were established, a further design exercise was undertaken to apply primary (design based) mitigation to minimise the potential impacts on the environment and residents. These designed in measures are summarised below.

Table 4.7: Consent risk RAG scoring

Final Preferred Option	Designed in Measures
Skateraw Landfall (LF3)	• Landfall area moved slightly to the southeast to avoid impacts on the Tarmac Quarry mineral rights. • Landfall area moved east to avoid direct impacts on the Dry Burn.
Cable route to Skateraw Substation (Substation 8)	• Temporary construction access proposed from the A1 (T) to reduce the need for heavy duty construction traffic and abnormal loads to pass the entrance to Skateraw village. This temporary access is located at an existing field access and will be limited to only Heavy Goods Vehicles (HGVs) accessing from the west. Large Goods Vehicles (LGVs) will access the construction area under the ECML.
Skateraw Substation (Substation 8)	• Substation moved approximately 20 metres to the east to reduce potential visual impact experienced from views from the west; and • Modification to drainage design to protect the local drainage network and to avoid any discharge to the minor unnamed watercourse north of the substation (during certain conditions). This followed consultation with a local resident who expressed concerns about the drainage around the proposed substation.
Cable Route to SPEN Branxton Substation	• Construction compound moved further from the property at Four Acres as a result of concerns raised in consultation with the resident; • In consultation with HES, proposed trenchless solution below the existing Scheduled Monument (SM5849) - Castledene Enclosure, close to the property at Castledene; • Change in approach to the trenchless solution under the Scheduled Monument to ensure any drilling would take place on the western compound, further away from the property at Castledene, thereby reducing the potential noise and vibration impacts; • Design of bottomless culvert cable bridge across the Thornton/Braidwood Burn to minimise the impact on this watercourse. Other options for the burn crossing were considered, however these are limited due to the existing overhead line and cumulative constraints with SPEN cables. Trenchless technology is also not possible due to the topography of the area.

4.10. CONSULTATION EVENTS

77. A virtual public exhibition along with online live question and answer sessions, was held in November 2020. For this, the following site selection information was presented:

- Preferred substation options: Skateraw Substation (Substation 8), Crowhill Substation (Substation 9) and Thorntonloch Holdings Substation (Substation 3); and
- Preferred landfall options: Skateraw Landfall (LF3) and Thorntonloch Landfall (LF5).

78. An informal in-person exhibition at the village hall and virtual public exhibition was then held in December 2021. For this, the Proposed Development had progressed the site selection phase and provided information on:

- the selected Skateraw Landfall (LF3);
- the selected onshore Skateraw Substation (Substation 8);

- the selected onshore cable route from landfall to the onshore substation; and the selected onshore cable route from the onshore substation to SPEN's proposed Branxton 400 kV Substation.

79. The formal public exhibition for the Project took place in March 2022. This exhibition was both in-person and virtual as detailed in the Pre-application Consultation Report (PAC Report). At this exhibition, details of the final stage of the site selection process, as assessed as part of the Onshore and Offshore EIA Reports were presented.

80. The PAC Report outlines various points raised by the public and where possible, how they have been considered by the Project team in the site selection process. This includes a suggestion from local residents to access the Landfall area during construction from the west of Skateraw as opposed to using the old A1. This has been reviewed and the following constraints identified as reasons why this has not been progressed at this time:

- the site would pass through the Tarmac Quarry Area which poses health and safety concerns;
- the access route would be outwith the Project's scoping boundary which has not been surveyed; and
- the route would be longer and require construction of new roads in comparison to using the existing farm tracks and accesses off the A1 (T) and old A1.

4.11. SUMMARY

81. The site selection process explained within this chapter has culminated in the Application for the Proposed Development. The Applicant has given serious consideration to the points raised by stakeholders during the onshore EIA scoping phase for the Proposed Development in relation to the site selection and/or design. Early, informal consultation events allowed the Proposed Development site selection options to be presented publicly for feedback, prior to the formal consultation event in March 2022.

4.12. REFERENCES

Cathie, 2019. Cable Landfall Feasibility Study.

Cathie, 2019. Landfall Feasibility Addendum.

Cathie, 2019. Onshore Geotechnical and Geo-environmental Desk Study.

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