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**Phase 1 Landfall Site Selection
Report**

**Round 3 Zone 2
Firth of Forth
Offshore Wind Farm Development**

RESTRICTED COMMERCIAL

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TABLE OF CONTENTS

1. PURPOSE OF REPORT 4

2. INTRODUCTION 4

 2.1.1 LANDFALL SCREENING CRITERIA AND INITIAL LOCATIONS IDENTIFIED 6

3. ASSESSMENT METHODOLOGY 8

 3.1 STAGE 1: DESKTOP REVIEW AND SITE VISIT 8

 3.2 STAGE 2: OFFSHORE SURVEY AND CONSTRUCTION FEASIBILITY ASSESSMENT..... 8

4. BACKGROUND: CABLE INSTALLATION TECHNIQUES..... 9

5. ASSESSMENT STAGE 1- DESKTOP STUDIES AND SITE INVESTIGATION 14

5.1 EAST HAVEN 14

 5.1.1 AREA FOR TRANSITION PIT..... 16

 5.1.2 IMPACTS ON DWELLINGS AND OTHER BUILDINGS..... 16

 5.1.3 IMPACTS ON RECREATIONAL USERS 17

 5.1.4 IMPACTS ON PRIME QUALITY AGRICULTURAL LAND 17

 5.1.5 ACCESS AND CONSTRUCTION INSTALLATION ONSHORE..... 17

 5.1.6 ACCESS AND CONSTRUCTION INSTALLATION OFFSHORE..... 18

 5.1.7 ENVIRONMENTAL CONSTRAINTS 19

 5.1.8 EAST HAVEN SUMMARY 20

5.2 CARNOUSTIE 22

 5.2.1 WORKING AREA AND TRANSITION PIT LOCATION 24

 5.2.2 IMPACTS ON DWELLINGS AND OTHER BUILDINGS 24

 5.2.3 IMPACTS ON RECREATIONAL USERS 24

 5.2.4 IMPACTS ON PRIME QUALITY AGRICULTURAL LAND 25

 5.2.5 CONSTRUCTION INSTALLATION ONSHORE 25

 5.2.6 ONSHORE ACCESS..... 26

 5.2.7 ACCESS AND CONSTRUCTION INSTALLATION OFFSHORE..... 26

 5.2.8 ENVIRONMENTAL CONSTRAINTS 27

 5.2.9 CARNOUSTIE SUMMARY 28

5.3 ARBROATH..... 30

 5.3.1 WORKING AREA AND TRANSITION PIT LOCATION 32

 5.3.2 IMPACTS ON RECREATIONAL USERS 32

 5.3.3 IMPACTS ON DWELLINGS AND OTHER BUILDINGS..... 32

 5.3.4 ACCESS AND CONSTRUCTION INSTALLATION ONSHORE..... 32

 5.3.5 ACCESS AND CONSTRUCTION INSTALLATION OFFSHORE..... 33

 5.3.6 ENVIRONMENTAL CONSTRAINTS 34

 5.3.7 ARBROATH SUMMARY 34

5.4 MONIFIETH 37

 5.4.1 AREA FOR TRANSITION PIT..... 39

 5.4.2 IMPACTS ON DWELLINGS AND OTHER BUILDINGS..... 39

 5.4.3 IMPACTS ON RECREATIONAL USERS 39

 5.4.4 IMPACTS ON PRIME QUALITY AGRICULTURAL LAND 39

 5.4.5 ACCESS AND CONSTRUCTION INSTALLATION ONSHORE..... 39

 5.4.6 ACCESS AND CONSTRUCTION INSTALLATION OFFSHORE..... 40

5.4.7	ENVIRONMENTAL CONSTRAINTS	40
5.4.8	MONIFIETH SUMMARY	41
5.5	CONCLUSION OF STAGE 1 LANDFALL OPTION ASSESSMENTS	43
6.	STAGE 2 – FURTHER ASSESSMENT	45
6.1	CARNOUSTIE	45
6.1.1	LANDFALL ENGINEERING FEASIBILITY - HDD	45
6.1.2	ACCESS AND CONSTRUCTION INSTALLATION OFFSHORE	46
6.1.3	VESSEL ACCESS.....	46
6.1.4	ENVIRONMENTAL SURVEY RESULTS	46
6.2	ARBROATH.....	46
6.2.1	CONSTRUCTION INSTALLATION OFFSHORE	46
6.2.2	VESSEL ACCESS.....	47
6.2.3	FISHING ACTIVITY	47
6.2.4	INSTALLATION ONSHORE	48
6.2.5	CORSE HILL WINDFARM.....	48
6.2.6	ENVIRONMENTAL SURVEY RESULTS	48
7.	CONCLUSION.....	49

APPENDICES

Appendix A	Landfall Locations and Environmental Designations
Appendix B	Landfall Locations and Surface Rock

1. PURPOSE OF REPORT

This report documents the decision making process which has been followed by Seagreen in the selection of the preferred landfall location for its Phase 1 project power export cables. The report focuses on the selection of the landfall point only and does not discuss the cable route either onshore or offshore of the landfall point.

The report sets out the engineering and environmental parameters and constraints which have informed decisions and discusses them on a site specific basis for each of the landfall locations considered.

2. INTRODUCTION

Seagreen has accepted a grid connection offer from National Grid Electricity Transmission (NGET) for its Phase 1 offshore wind farms, Alpha and Bravo. The connection offer identifies the onshore grid connection location as the Scottish Hydro Electric Transmission Limited (SHETL) substation at Tealing near Dundee.

It is proposed to connect the Phase 1 offshore wind farms to the national electrical transmission grid via power export cables running from an offshore substation/converter station to a landfall point on the Angus Coastline between Arbroath and Monifieth and thence across country to Tealing. The cables will be buried underground both onshore and offshore.

The coastal area of search for a landfall point was directly determined by the requirement to connect to the grid at Tealing in accordance with the grid connection offer made by NGET. This led directly to the consideration of a number of options for landfall locations between Arbroath and Monifieth. The landfall search area which was considered is shown in Figure 1.

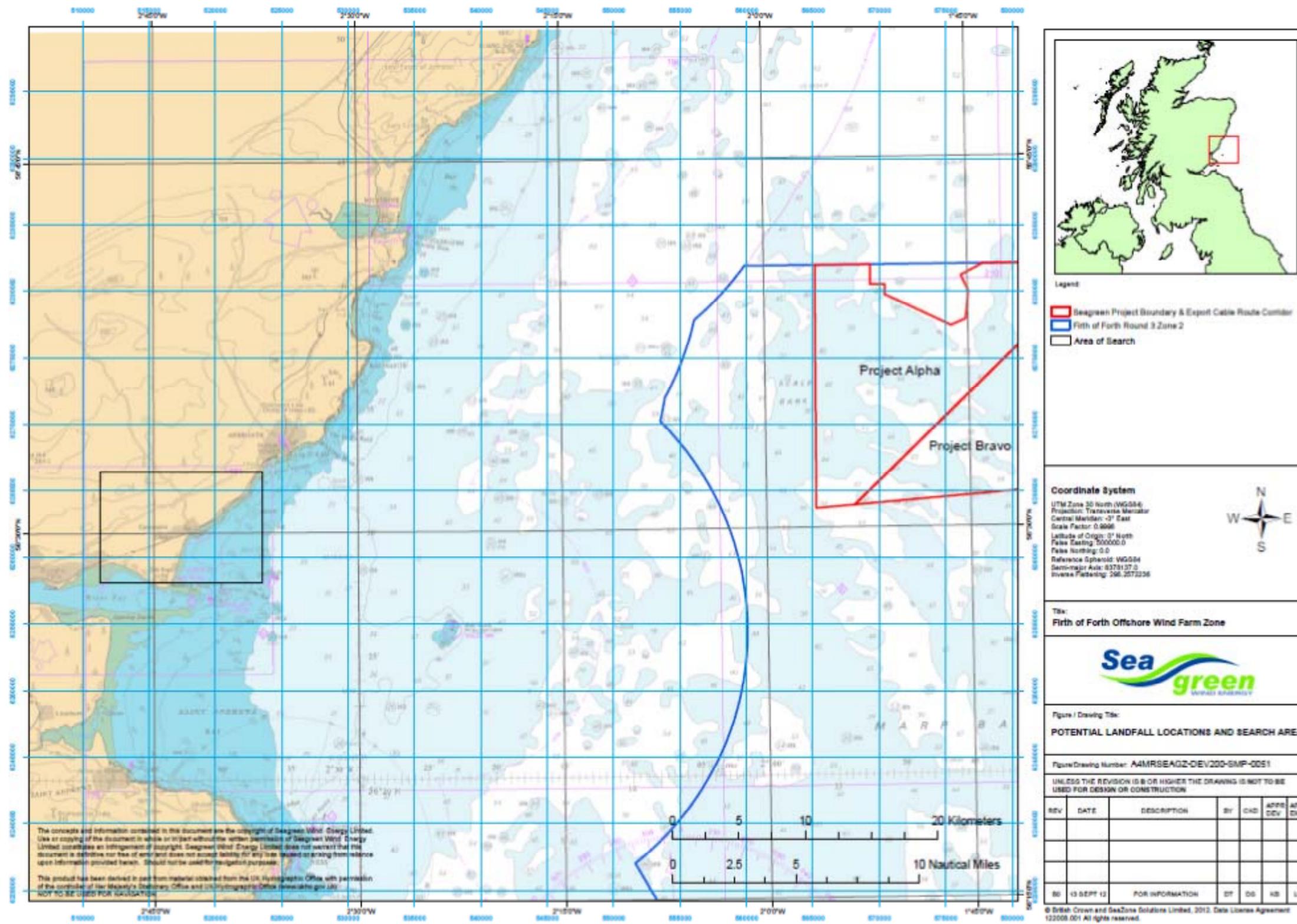


Figure 1. Landfall Location Search Area

2.1.1 Landfall Screening Criteria and Initial Locations Identified

The list below provides the criteria to against which potential locations were screened. As far as is practicable, the export cable landfall should;

- Avoid environmentally sensitive/designated sites;
- Avoid underground or subsea rock/solid substrates;
- Minimise disruption to existing users of adjacent coastal waters;
- Provide sufficient space for a working area for construction and a suitable land area behind the beach for location of a cable transition joint pit
- Ensure construction feasibility;
- Ideally be situation on gently sloping sandy beach
- Provide suitable cable protection within the foreshore and intertidal area. (Ideally by means of cable burial)
- Ensure access for installation vehicles and construction equipment onshore.
- Ensure access for construction vessels and installation equipment offshore
- Minimise the crossing of linear natural features and infrastructure, e.g. watercourses, rail lines, roads and utilities;
- Avoid areas of tree cover, standing water or undesignated areas likely to have nature conservation interest;
- Minimise take of Prime Quality Agricultural Land;
- Avoid existing dwellings;
- Avoid important recreation areas;
- Avoid steep gradients/banked verges.

Installation and operation of offshore export cables is significantly influenced by seabed conditions. Soft sediments and muds are strongly preferred to hard, rocky substrates for both ease of installation and protection. The Angus coastline between Monifieth and Arbroath is predominantly rocky and hence the initial identification of potential landfall locations was strongly steered by apparent absence of rocky foreshores.

Five potential landfall locations were identified based upon the site and desk-based reviews of the above criteria. These are listed below and shown in Figure 2.

- Arbroath North
- Arbroath South
- East Haven
- Carnoustie
- Monifieth

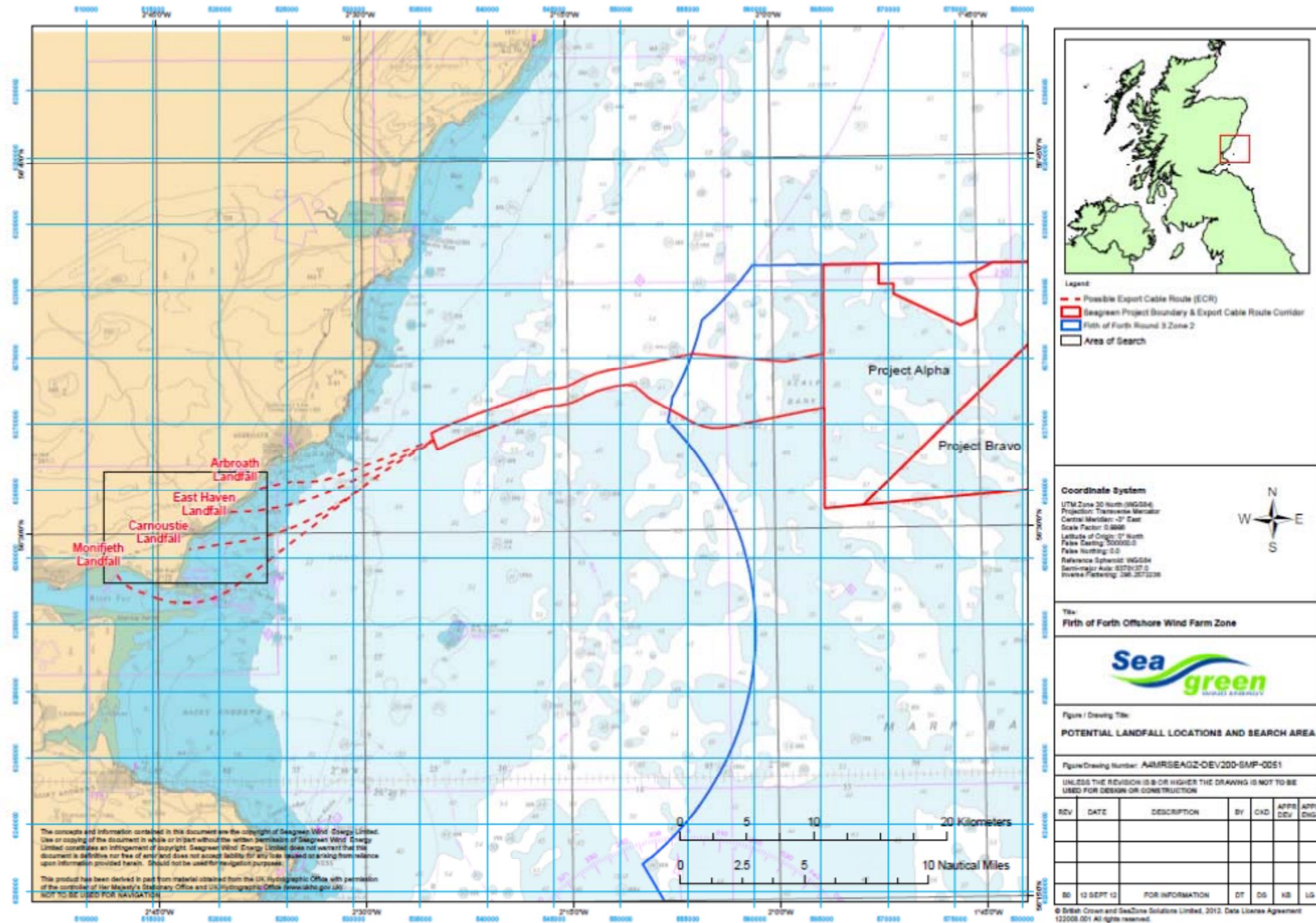


Figure 2: Initial Landfall Locations

3. ASSESSMENT METHODOLOGY

The landfall selection process was completed in two stages between January 2010 and August 2012;

Stage 1.

- Desktop reviews and site visits
- Shortlisting of two preferred alternatives.

Stage 2.

- Offshore survey and construction feasibility assessments
- Final selection

The selection process was informed by expert consultants in engineering, construction and environment including Xero Energy, Cathie Associates, Amec, Royal Haskoning, METOC and Osiris.

3.1 Stage 1: Desktop Review and Site Visit

The desktop review included a review of offshore geotechnical and metocean conditions, a review of offshore and onshore environmental constraints and designations, a review of access for construction on land and sea and preliminary site inspections using desktop based GIS mapping and photography tools (including aerial photography).

Site visits and walkover surveys were conducted to verify the findings of the desktop reviews and identify any new constraints and issues. Where more detailed ground information was deemed necessary limited intrusive investigations (penetration testing) took place.

The information gathered was reviewed by Seagreen and used to inform the decision on which of the landfall locations to shortlist and progress to Stage 2, and which to discard.

3.2 Stage 2: Offshore Survey and Construction Feasibility Assessment

Two locations were shortlisted for further works including offshore surveys and construction feasibility & cable burial assessments. The results from these assessments ultimately informed the final selection of landfall location.

The offshore surveys of the route options were completed in the summer of 2011 comprising;

- Side Scan Sonar
- Multi-beam swath bathymetry
- Sub-bottom profiling

-
- Magnetometer
 - Single beam echo-sounder
 - Seabed grab samples to verify seabed conditions.

Cable burial risk assessments were undertaken to assess the risks to damage of the cable for the route options. These assessments identified and ranked the risks to the cable from threats including fishing activity, seabed mobility, unexploded ordnance and vessel anchors. The study identified the required cable burial depths along the routes necessary to mitigate these risks to an acceptable level.

Cable burial studies for the route options were then undertaken to assess the feasibility of achieving the target cable burial depths from the cable burial risk assessments, for the ground conditions encountered in the geophysical survey. The study assessed ploughs, jetting and mechanical trenching burial techniques.

The offshore benthic survey was also completed in summer 2011. It consisted of three elements which were:

1. Grab sampling: targeting infaunal species (species within the sediment);
2. Beam trawl sampling: targeting epibenthic species (species living upon the seabed); and,
3. Drop down video sampling: targeting species which may be mobile enough to escape the beam trawling or species which may be damaged should the beam trawl be deployed.

Onshore Phase 1 habitat and ornithology surveys were completed in summer 2011 to provide a greater understanding of the onshore environmental constraints.

Using the results of the Stage 2 assessments a comparison of the landfall locations was made to inform a decision on the most suitable landfall selection.

4. BACKGROUND: CABLE INSTALLATION TECHNIQUES

Techniques available to install the cable offshore and provide protection from other users of the sea and the marine environment include open cut trenching, jetting tools, Ploughs, mechanical trenching and placement of rock or concrete mattresses. Horizontal Directional Drilling (HDD) is an additional technique suitable for installing the cable from landfall into the intertidal area and the sea.

HDD is a technique whereby ducting is installed in holes drilled from landfall out to the intertidal area or below the low water level. The cables are then pulled through the ducts into a Transition Pit where they are joined to the onshore cables. An advantage of this technique is that the cables are unobtrusive post installation. However the maximum length that can be drilled is limited to approximately 1000m depending on ground conditions.



Figure 3: Horizontal Directional Drill Rig.

Open cut trenching can be used on dry land, in the intertidal area and shallow water and consists of laying the cable into trenches previously dug into the ground. Cables can be laid with or without ducting. This technique is suitable where there is sufficient sediment cover and where the marine environment is relatively benign. It is also the preferred technique for onshore cable installation.



Figure 4: Open Cut Trench Cable Installation

Ploughs are the preferred method of installing subsea cables in stiff clay, sand, dense sand and gravel. The cable is installed into a trench that is simultaneously ploughed and back-filled in a single operation.

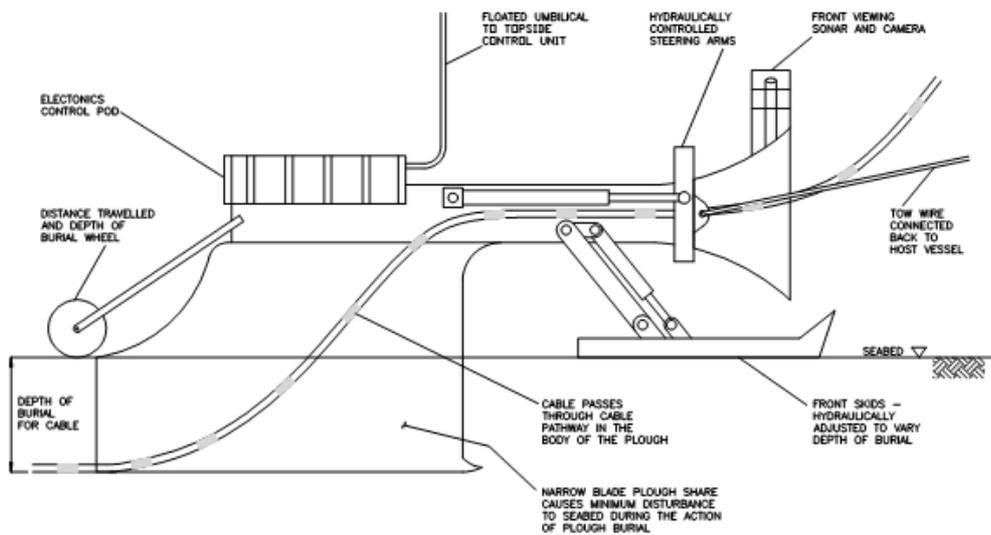


Figure 5: Plough Cable Installation

Jetting tools can be used to install subsea cables in soft sediment. The cable is laid on the surface of the seabed and then a tool travels along the cable route which

impinges a jet of water onto the seabed such that it fluidises the sediment and the cable sinks into it under it's own weight.

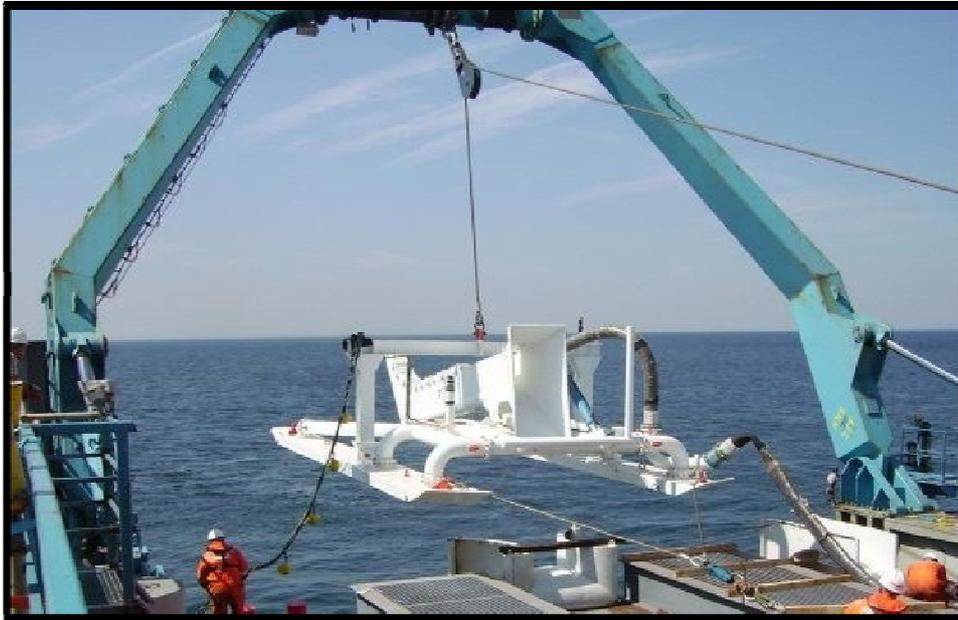


Figure 6: Jetting Tool Cable Installation

Mechanical trenching tools can be used where there is insufficient sediment cover to bury the cable. They are generally pecking tools or saws which can cut channels into the underlying rock. The cables are then laid in the channels so that they are not proud of the seabed and are protected. As the tools rely on mechanical wear to function they are generally only suitable for soft rock and are often relatively unreliable and subject to failure. Due to the complexity and risk of the marine installation they are the least preferred cable protection technique.

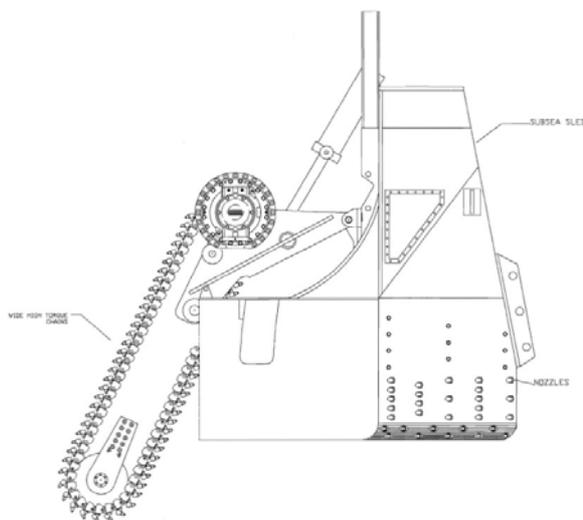


Figure 7: Mechanical Trenching Tool

Mattresses, rock nets and rock placement can all be used to protect a cable without burying it below the surface of the seabed. They rely on laying material on top of the cable to prevent it from moving and protect it from anchors, fishing activity etc.

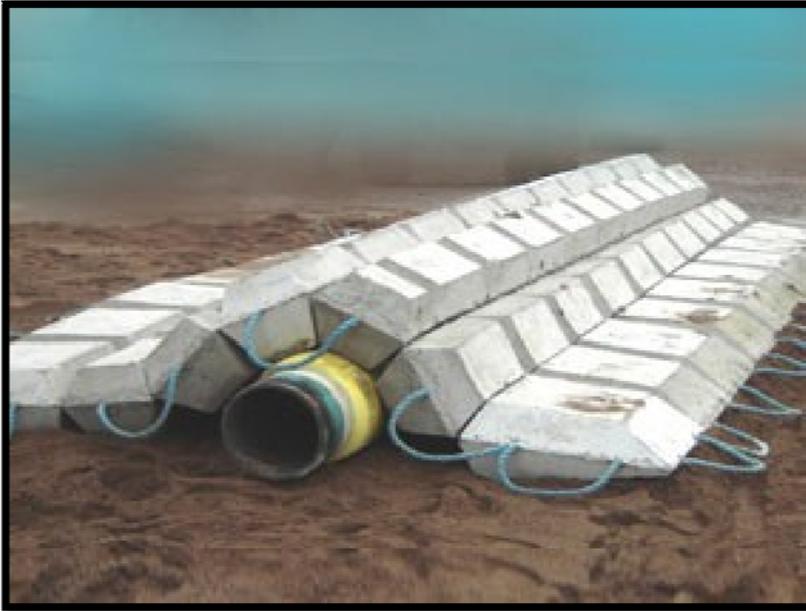


Figure 8: Concrete Mattress Cable Protection



Figure 9: Rock Bag Cable Protection

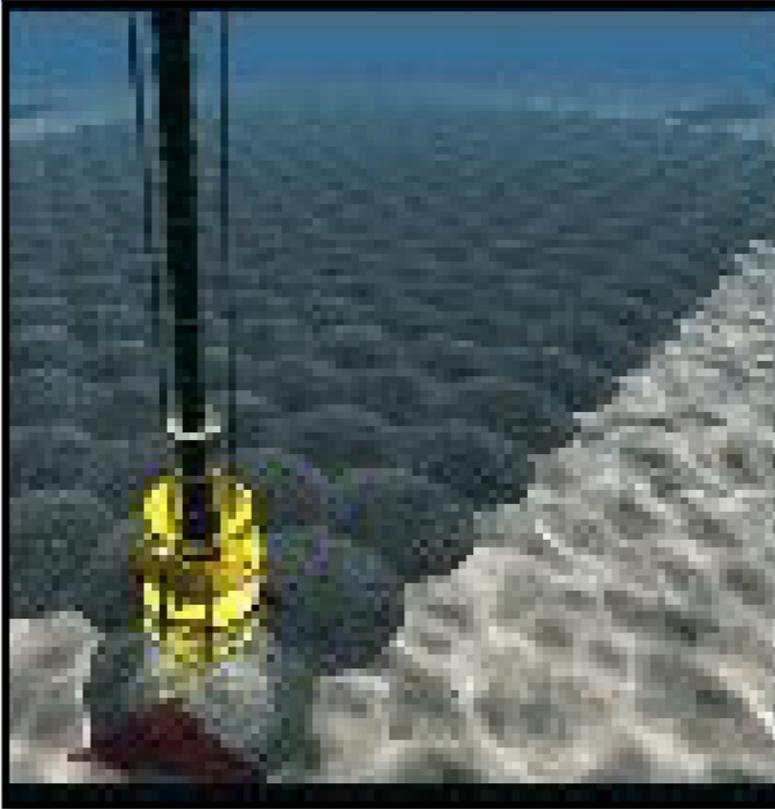


Figure 10: Rock Placement Cable Protection

5. ASSESSMENT STAGE 1- DESKTOP STUDIES AND SITE INVESTIGATION

5.1 East Haven

The landfall option is located in the village of East Haven which is located to the north of Carnoustie and southwest of Arbroath. The sandy beach at East Haven was identified as the only location available in East Haven which would meet the cable protection requirements. The landfall location is shown in Figure 11.

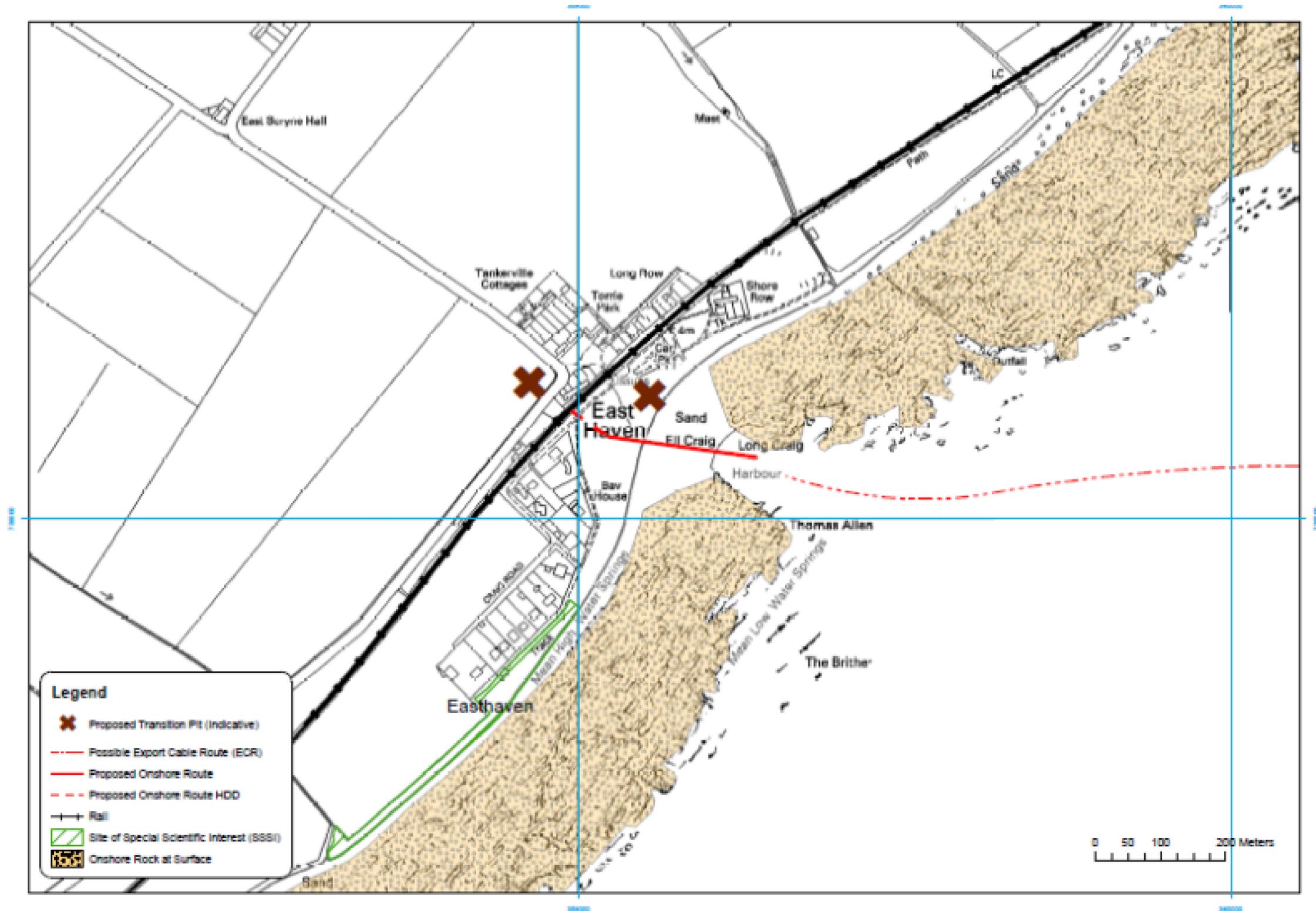


Figure 11: East Haven Landfall Location

5.1.1 Area for Transition Pit

Two potential sites for a transition pit were identified at East Haven. One potential site was identified in a field located on the inland side of the railway, diagonally opposite the road from the entrance to the car park and railway crossing. This site would be very visible to East Haven residents and from the road as seen in Figure 12.



Figure 12. Potential transition pit location at East Haven.

An alternative transition pit site was identified in the grassland behind the beach next to a recreation area. While there is adequate space for the transition pit in this area it is also very visible to shorefront residents and recreational users. The transition pit was not identified as a major concern.

5.1.2 Impacts on Dwellings and other buildings

It is considered that Horizontal Directional Drill (HDD) would be required to cross the road and railway. This would potentially be very close to or underneath residential properties representing an important construction risk. The residential properties in close proximity to the landfall location are considered to be potentially sensitive to construction noise and would have a high degree of visibility of construction works. In addition, construction works would cause access restrictions to properties adjacent to the cable installation works.

5.1.3 Impacts on Recreational Users

The beach is known to be well used for recreation purposes by residents and by visitors. As noted above, one of the potential transition pit locations is located next to a recreation area and would be very visible to shorefront residents and recreational users. Access to the village and beach is likely to be restricted during construction.

5.1.4 Impacts on Prime Quality Agricultural Land

One of the transition pit locations is within a field which was under crop at the time of assessment. The use of this area for a transition pit would result in temporary loss of prime quality (Class 1) agricultural land for the duration of the construction works but would be reinstated on completion for its original use.

5.1.5 Access and Construction Installation Onshore

The proposed landfall location comprises of a 150m long beach made of sand with rock shelves extending offshore either side of the beach. Although the rock shelves at either end restrict the landfall location to the beach area it was initially assessed as potentially suitable for cable landing and construction activity.

There is a single point of public access to the beach across the main east coast railway line which comprises of an underpass with a restriction of 2m height and 3m width, see Figure 13. The dimensions of the underpass make it is severely restricted for access purposes being only suitable for cars and small vans. It is unsuitable for large construction vehicles such as field excavators or similar.



Figure 13. East Haven Construction Beach Access.

There is a locked, private level crossing to the west of the village, located on the main East Haven to Carnoustie road which provides alternative access across the railway line for emergency vehicles to the houses on the south side of the railway line. The level crossing provides access across an agricultural field to a narrow single track road approximately 500m to the south which runs to the rear of a row of residential properties at Craig Road. The level of movements which would be required across the private level crossing presents significant health and safety concerns. Network Rail strongly discourages use of private level crossings and it is considered that the necessary agreement is unlikely to be provided by Network Rail. More than 80 trains per day travel along the route between Dundee and Aberdeen at speeds of between 60 and 100mph (Hansard, November 2003). The access to the landfall location after the private level crossing is also restricted further south towards the beach. There is little land between the dwellings and the railway to route the access track for construction vehicles. Further south it is restricted by East Haven SSSI.

Construction feasibility is considered a major constraint to development at East Haven due to the absence of a suitable access for construction vehicles across the east coast railway line.

5.1.6 Access and Construction Installation Offshore

The visible beach area at East Haven initially appeared to provide potentially acceptable conditions for cable installation and protection. During site survey however a large (5m wide) bedrock formation was observed in the centre of the beach in the low tide zone, see Figure 14. As a result of this penetration testing was carried out at 5m intervals along the full width of the beach at low tide mark. The results confirmed a shallow depth of sand cover across the entire length of the beach not suitable for cable protection. The presence of rock and the shallow depth of sand cover confirmed that it was not feasible to achieve cable protection by conventional methods, meaning that significant offshore works would be required to cut channels into the rock to protect the cable.



Figure 14. Rock at East Haven Beach

The potential for vessel access appears to be feasible but could be limited by the presence of rock in the waters near to the landing point.

5.1.7 Environmental Constraints

The cable route is adjacent to the Firth of Tay and Eden Estuary Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar. The Firth of Tay and Eden Estuary SAC supports a number of habitats and species for which the site has been designated including;

- estuaries
- sandbanks slightly covered by seawater all the time
- mudflats and sand flats not covered by seawater at low tide
- common seal

The Firth of Tay and Eden Estuary SPA and Ramsar also supports a number of Annex I birds and regularly occurring migratory birds not listed on Annex I including;

- breeding populations of little tern and marsh harrier
- over winter aggregations of bar-tailed godwit, greylag goose, pink-footed goose and redshank
- overwinter assemblages of waterfowl

SNH has provided advice in respect of the potential impacts on the protected sites and confirmed that a Habitats Regulations Appraisal (HRA) will be required for Barry links SAC and Firth of Tay and Eden Estuary SAC and SPA. Onshore, the cable route is adjacent to the northern boundary of East Haven SSSI designated for presence the greater yellow-rattle.

5.1.8 East Haven Summary

The summary Table 1 presents the results from the desk studies and sites visits. The presence of near surface rock at the beach landfall point and the lack of any viable access for large construction vehicles across the railway have been identified as major constraints to landfall at East Haven.

Table 1. East Haven Stage 1 Landfall Constraints

Landfall Option	Transition pit location behind beach	Beach location, gently sloping (avoid steep banks)	Offshore vessel access.	Proximity to recreation, dwellings or prime agricultural land.	Onshore landfall access for construction and installation vehicles	Cable installation to Transition Pit	Onshore Ecology	Cable Installation Offshore/ cable protection	Offshore Landfall Access (beach access)	Offshore Ecology	Other issues
East Haven	Area good – but highly visible	Small beach without steep bank.	Natural harbour with rock close by.	Close to houses, agricultural land. No golf course.	No viable access for construction vehicles across the east coast railway line	HDD required close to/under houses	Nearby SSSI	Near surface rock - conditions not suitable for burial	Not assessed	Adjacent to SPA/SAC and Ramsar	N/A

5.2 Carnoustie

The Carnoustie landfall option is located at the south east end of Carnoustie beach and golf links, to the south of the outfall of the Buddon Burn. It is immediately north of the MoD firing range at Barry Buddon. A rock armour sea defence backs onto the beach which extends to the north and south of the landfall location. The location is shown in Figure 15.

Barry Buddon is a well established MoD training area which covers 930 hectares of coastal plain and dune between Carnoustie and Monifieth. The Practice and Exercise Areas (PEXAs) are considered to be of high sensitivity due to the nature of the use and their strategic importance to the military. PEXA D604 at Barry Buddon has been used for military training purposes since the mid 19th century and is currently primarily used as an infantry training area with firing of small arms, light and medium mortars and anti tank weapons. The site has full bore live firing ranges including the existing Barry North Range which is located close to the northern boundary of the site adjacent to Carnoustie golf links. Public access within Barry Buddon is restricted to roads and beaches due to risks from unexploded ordnance within the site and the ranges and danger areas are closed to public access during periods of live firing.

Three separate golf courses make up the links at Carnoustie including the Championship Course, the Burnside Course and the Buddon Course. The onshore cable corridor identified by Seagreen uses the track which runs parallel with the MoD boundary and areas on the south east edge of the Buddon Course. Recently permitted extended playing areas of the Buddon Course are currently under construction.

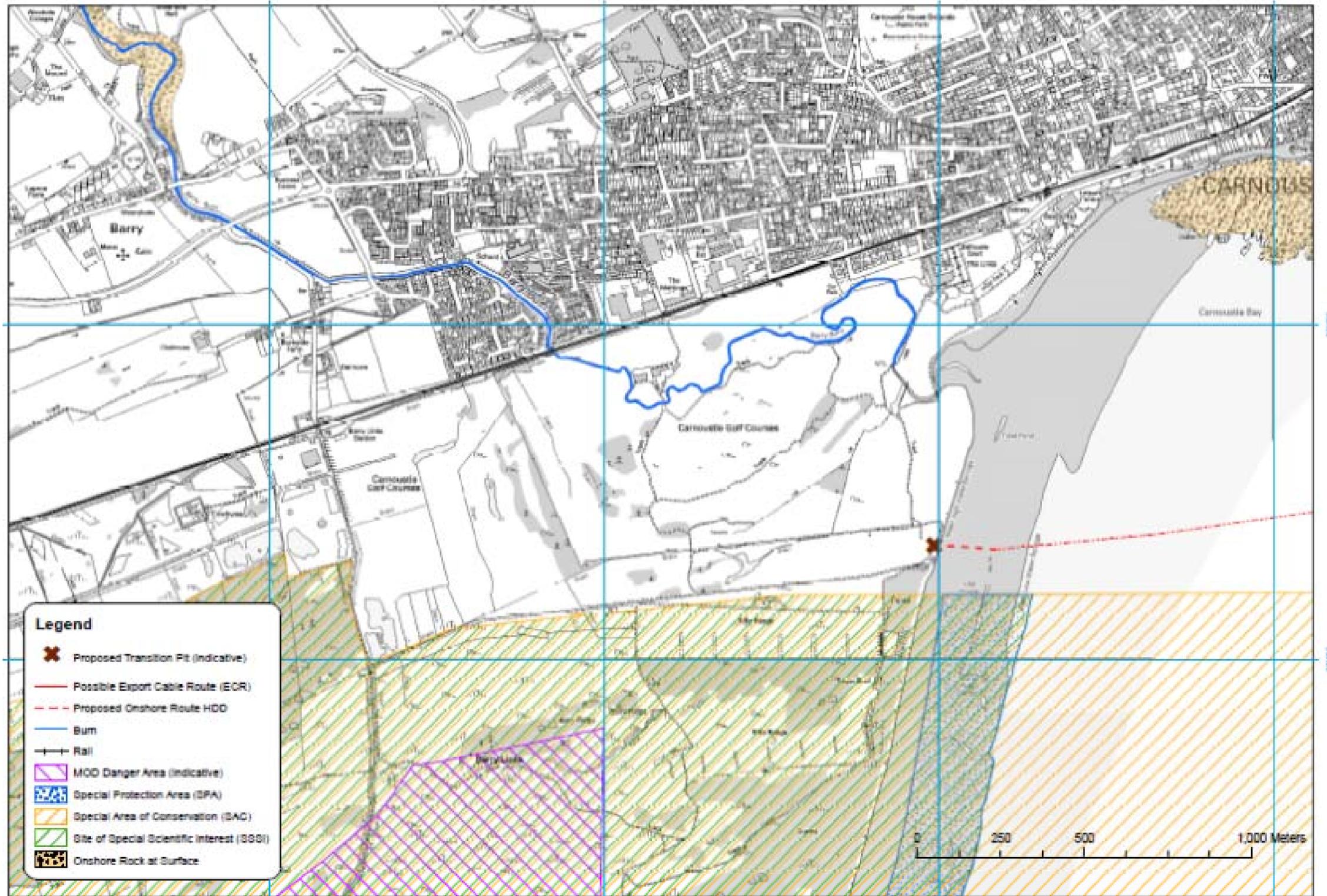


Figure 15: Carnoustie Landfall

5.2.1 Working Area and Transition Pit Location

Space for a transition pit and a landfall location was identified using land on the south east edge of the golf links and a narrow section of track adjacent to the MoD boundary. The location enables landfall works to avoid all MoD land forming part of any active firing ranges or training areas, which have been confirmed by the MoD to be unusable, while also minimizing encroachment on playing areas forming part of the golf links. The exact working area locations and space available for landfall works and transition pit would require further assessment and consultation.

5.2.2 Impacts on Dwellings and other Buildings

The location of the landfall works is remote from any residential properties. The nearest residential property is the Carnoustie Golf Hotel and other dwellings are separated from the landfall point by the golf links. Activities associated with the landfall works will be visible in the vicinity of the works during construction resulting in potential visual impacts. However any impacts will be temporary for the duration of construction works at the landfall only and are not considered to represent a significant constraint.

5.2.3 Impacts on Recreational Users

As noted above Carnoustie golf links directly adjoins the MoD land at Barry Buddon with the boundary defined by a fence. A narrow track approximately 3m in width runs parallel to the boundary and is made up of part hard core, part dirt surface. A photograph of the track is shown in Figure 16 below.



Figure 16 – Track running along southern boundary of Buddon Golf Course

While the area between the boundary of Barry Buddon and the golf course is narrow it is considered that use of appropriate installation techniques and reinstatement

together with micrositing of the cable can mitigate any potential impact on the golf links.

The area of the links at Carnoustie is defined in the Angus Local Plan Review as an area of Protected Open Space and is a popular location for walking for members of the public as well as for golfers with a core path also crossing the links. The beach is also a popular area for recreational usage. Construction works may result in a temporary restriction to a section of the beach and to existing access routes used by members of the public and alternative access provision may require to be provided for the duration of works. It is considered that alternative access provision can be achieved and is therefore not a significant constraint.

5.2.4 Impacts on Prime Quality Agricultural Land

The cable landfall at Carnoustie avoids any requirement to use prime quality agricultural land.

5.2.5 Construction Installation Onshore

The proposed landfall location comprises of a narrow section of beach backing onto coastal sea defences. Although narrow, the beach is approximately 1km long and the walkover site survey confirmed that the beach and foreshore comprised of relatively compacted sand with no evidence of rock present near the surface. The beach also has a relatively gentle gradient and as such the ground conditions in the beach area were considered to present potentially favourable conditions for cable installation and protection.

Between the beach and the golf course is a sea defence constructed of large dumped rocks which is designed to prevent coastal erosion. The sea defence is approximately 15-30m wide and 10-15m high on a steep embankment with a revetment slope of 1 (vertical) to 3 (horizontal). A photograph of the sea defence is shown in Figure 17.



Figure 17 - Sea defences at Carnoustie at the proposed landfall location

To the rear of the sea defence is an area comprising of up to 4m high manmade dunes extending approximately 60m to the west and 100m to the north.

As there is no existing path through the rock armour it is considered that the use of HDD under the sea defence would be required. The revetment slope of 1 (vertical) to 3 (horizontal) of the rock armour can be overcome by drilling from an appropriately set back position.

5.2.6 Onshore Access

Access to the beach landfall from the north would be through the town of Carnoustie itself. There is an automatically controlled public level crossing approximately 7-8m wide at Station Road in Carnoustie which is suitable for construction traffic to access the beach side of the railway line.

From here the beach can be directly accessed via a 3m wide paved ramp from the car park close to Carnoustie golf links, 650m north of the landfall location. Access across the beach to the landfall location is constrained by the presence of the Barry Burn outflow and would be periodically restricted by high tides. Further investigation of the method of crossing the outflow to access to the landfall location will be required to determine limiting vehicle sizes. However, this does not present a significant constraint to access across the beach.

There are two options for accessing the landward side of the landfall location. The first is to cross the existing bridge over the Barry Burn and along track parallel to the sea defences. The bridge could be reinforced if necessary and a ramp across the sea defence for tracked vehicles constructed in order to provide an access closer to the landfall.

Alternative access to the landward side is also possible from public roads across the public level crossing at Barry Links and using existing roads and tracks through MoD land and across the golf links. The first 300m of the access route is on a paved track through MoD land with the remainder though Carnoustie golf links likely to require to be improved.

5.2.7 Access and Construction Installation Offshore

Consideration of metocean data and observation during walkover site survey suggested that limited beach exposure at low tide would restrict the working area available at landfall and would require working within tidal water. Although it was considered that this would potentially restrict the timing of any construction and installation works within the intertidal area it was not considered to be a significant constraint to the overall feasibility of landfall at Carnoustie.

The absence of any visible rock and good sand cover across the whole length of the beach at Carnoustie which was confirmed during a site walkover survey suggested that standard cable installation methods would be able to be used for installation of cables at Carnoustie. Survey of the intertidal and immediate offshore area was identified as an important requirement to establish this.

Marine hazards are known to be present within the offshore area comprising a spoil ground and a dangerous wreck however it is considered that these can be mitigated against and do not present significant risks in relation to either cost or practicability. There is also potential for unexploded ordnance (UXO) in the area as a result of the historic use of the land by the Ministry of Defence (MoD) which requires to be determined by separate survey. If UXO are identified during survey it is considered that this will be capable of being dealt with and will not pose a significant constraint to the proposed cable route and achieving landfall in this area.

5.2.8 Environmental Constraints

Onshore, the cable route runs in close proximity to the boundary of the Barry Links SAC/SSSI which is designated for its embryonic dune habitats including;

- shifting dunes
- shifting dunes along the shoreline
- fixed dunes with herbaceous vegetation
- Atlantic decalcified fixed dunes and humid dune slacks

The presence of designated interests along the cable route at Barry Links gives rise to concern over potential for temporary damage to some of the designated habitats (sand dunes) by the cable installation and longer term from the presence of the cable via ground water hydrology. Micrositing of the cable and use of HDD are both considered to have potential to mitigate impacts on these habitats.

Within the intertidal area the cable route is adjacent to the Firth of Tay and Eden Estuary Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar. The Firth of Tay and Eden Estuary SAC supports a number of habitats and species for which the site has been designated including;

- estuaries
- sandbanks slightly covered by seawater all the time
- mudflats and sand flats not covered by seawater at low tide
- common seal

The Firth of Tay and Eden Estuary SPA and Ramsar also supports a number of Annex I birds and regularly occurring migratory birds not listed on Annex I including;

- breeding populations of little tern and marsh harrier
- over winter aggregations of bar-tailed godwit, greylag goose, pink-footed goose and redshank
- overwinter assemblages of waterfowl

In addition to the potential for direct impacts on the dune habitats onshore forming part of the SAC there is also potential for effects on bird species within the intertidal area of the SPA which immediately adjoins the SAC. Bird surveys were recommended in order to ensure sufficient data to inform any detailed assessments.

SNH has provided advice in respect of the potential impacts on the above sites and confirmed that a Habitats Regulations Appraisal (HRA) will be required for Barry Links SAC and Firth of Tay and Eden Estuary SAC and SPA.

5.2.9 Carnoustie Summary

Table 2 below provides a summary of the constraints at Carnoustie. Installation of the cable at the Carnoustie landfall did not appear to be constrained by ground conditions and accordingly seemed suitable for standard installation methods to achieve cable burial up to the area of the sea defence. HDD was considered to be a potentially suitable method of landfall under the sea defence although a detailed assessment of the feasibility of HDD required to be carried out to confirm this.

Multiple designated interests along the cable route will require careful consideration and management in order to avoid or mitigate potential effects, particularly in relation to EU habitats regulations. Consultation with SNH has suggested that the need for Appropriate Assessment will depend partly on whether the final route chosen crosses any of the sites.

Working space between MoD firing ranges at Barry Buddon and the Buddon Golf Course at Carnoustie links is limited however it is considered to be sufficient for the required cable corridor and for location of transition pit. Subject to appropriate working practices during construction and reinstatement of all works to an agreed standard it is considered that there will be no unacceptable impacts on adjacent users.

The proximity of MoD PEXA D604 at Barry Buddon raises the risk of encountering UXO which would require to be confirmed by additional surveys.

Table 2. Carnoustie Stage 1 Identified Landfall Constraints

Landfall Option	Transition pit location behind beach	Beach location, gently sloping (avoid steep banks)	Offshore vessel access.	Proximity to recreation, dwellings or prime agricultural land.	Onshore landfall access for construction and installation vehicles	Cable installation to Transition Pit	Onshore Ecology	Cable Installation Offshore/ cable protection	Offshore Landfall Access (beach access)	Offshore Ecology	Other issues
Carnoustie	Area acceptable but may be restricted	Beach with costal defence-needs further investigation	Vessel access appears to be good – no visible rock	Passes over golf links and adjacent to MOD ranges. No close housing or agriculture	Good – some upgrading may be required to tracks	Potentially difficult HDD due to sea defences	Adjacent to Barry Links SAC/SSSI and golf course	Potentially suitable for standard cable burial methods	Exposed, tidal working may be required	Adjacent to SPA/SAC and Ramsar	MoD Danger Area and Potential for UXO offshore

5.3 Arbroath

Two landfall options have been considered at Arbroath, both of which are located within a 2 km long strip of beach which extends south from Arbroath at Elliot. These options (North and South) are located on either side of the Dowrie Burn outflow. The outflow comprises of a concrete culvert which is protected by sea defences extending 100m to the north and 75m to the south of the culvert.

The North Arbroath landfall option is located approximately 100m to the north of the Dowrie Burn culvert to the north of the end of the sea defences. The South Arbroath landfall is located approximately 230m southwest of the culvert and 115m southwest of the end of the sea defence. The north and south landfall locations are separated by 400m. Each option includes consideration of a separate transition pit inland. The location of the north and south landfall options and the transition pit locations are shown in Figure 18.

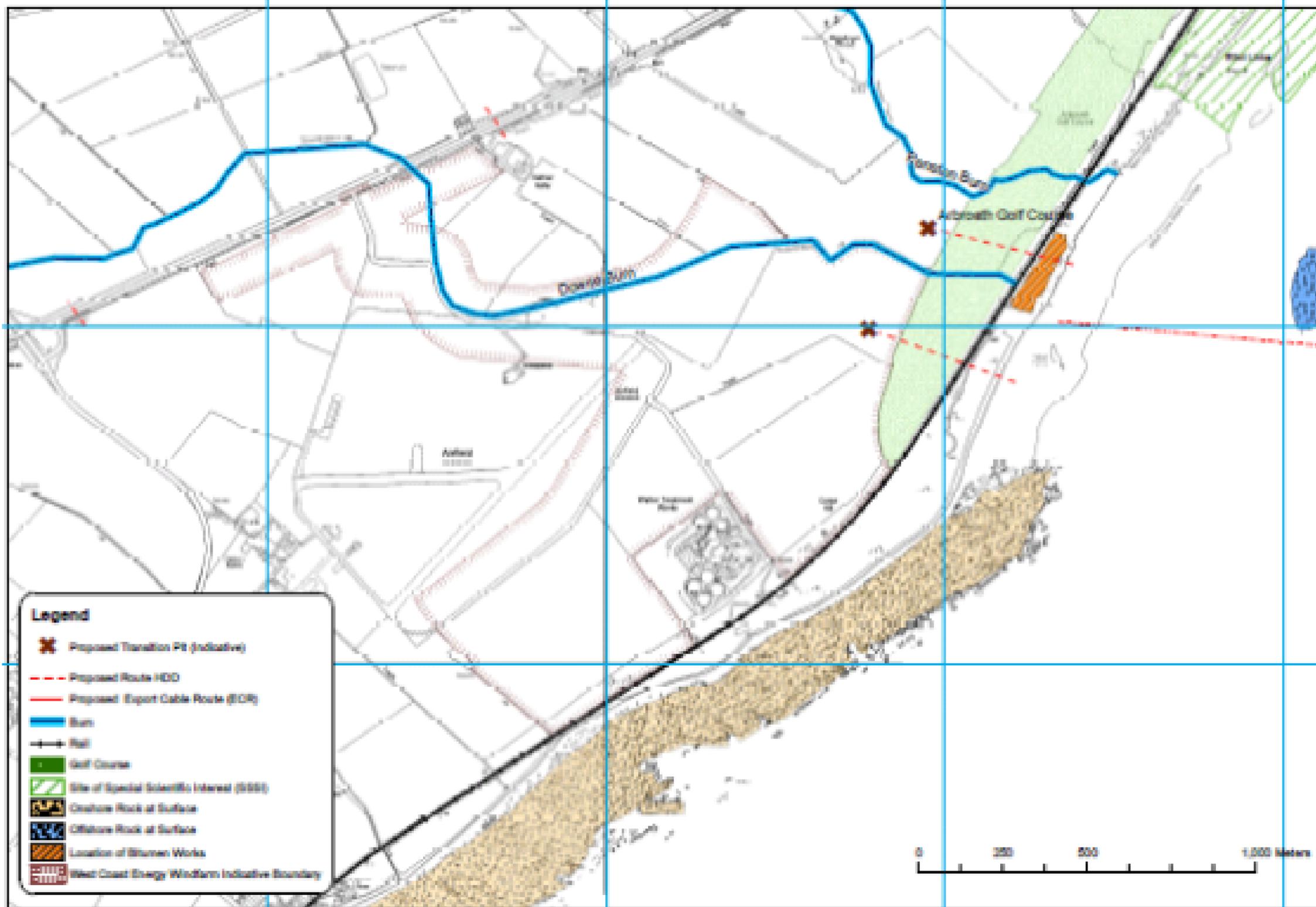


Figure 18: Arbroath Landfall Locations

It was quickly decided to rule out further consideration of the North Arbroath landfall and to take forward the southern route option for further consideration. This decision was based on the following;

- avoidance of potential contamination issues at a disused bitumen works extending through the northern route
- provision of a shorter and more direct onshore route
- avoidance of water crossing of Dowrie Burn
- lesser recreational usage of the dunes and beach area to the south

5.3.1 Working Area and Transition Pit Location

Proposed transition pit sites were identified approximately 450-550m northwest of the landfall location in an area of crop land north of the west end of the golf course and east of the water treatment works. The locations had sufficient space for the transition pit and for siting the HDD rig. HDD would be required to drill underneath golf course, the railway line and the dunes to link to the landfall on the beach.

5.3.2 Impacts on Recreational Users

The southern area of the beach and dunes is less well used and less visible to recreational users of the beach and golf course. Construction works may result in a temporary restriction to a section of the beach however such a restriction is not considered to be a significant constraint given the temporary duration of works and alternative access provision which would be available.

5.3.3 Impacts on Dwellings and Other Buildings

The location of the landfall works is remote from any residential properties. The nearest building to the landfall point is Hatton Waste Water Treatment Works (WWTW). It is not considered that the proposed landfall at Arbroath would have any potential impact on the existing WWTW. Activities associated with the landfall works will be visible in the vicinity of WWTW resulting in potential visual impacts. However any impacts will be temporary for the duration of construction works at the landfall only and are not considered to represent a significant constraint.

5.3.4 Access and Construction Installation Onshore

The proposed landfall at Arbroath comprises of a gently sloping beach with thinly scattered pebbles and small cobbles. The presence of localised rock outcrops between the sand dunes backing onto the beach and the low tide level was confirmed during the geotechnical site walkover.

Construction access to the landfall area on the beach is restricted to two private level crossings over the east coast railway line; one to the north and one to the south of the landfall location. The level of construction vehicle movements which would be required across the private level crossing presents significant health and safety concerns. Network Rail strongly discourages use of private level crossings and it is considered that the necessary agreement is unlikely to be provided by Network Rail.

More than 80 trains per day travel along the route between Dundee and Aberdeen at speeds of between 60 and 100 mph (Hansard, November 2003).

The dunes, grassland, and beach are all seaward of the railway line and present further access issues as follows.

The northern access uses a hardcore track between Arbroath Golf Club car park and a private level crossing. A surfaced track runs parallel to the railway to the south which is separated from the beach by approximately 100m wide sand dunes. Works would be required to the track and railway crossing to enable use by construction vehicles and to create a ramped access from the track to the beach. Several water crossings would also be required either by small bridge on the track or across the sand on the beach. This access would be highly visible and is well used for recreational purposes.

To the south, access across the railway is via a narrow track alongside the Water Treatment Works then across fields to a private level crossing. This gives access to the flat grassland area behind the steeper dunes at this end of the beach. The current track is very poor and there are severe slopes and restricted turning areas available. Civil works would be required to provide suitable access to this area. Access to the beach itself is also problematic and would require modification to the dunes.

To avoid these issues it was considered feasible to locate transition pit for HDD on agricultural land inland from the north of the railway. The HDD would run from the transition pit to the beach underneath the dunes, railway and golf course. In passing from the north side of the railway all the way to the beach, the required access to the beach for construction vehicles would be limited and potentially reduce issues for Network Rail.

5.3.5 Access and Construction Installation Offshore

The proposed landfall location comprises of a gently sloping beach with thinly scattered pebbles and small cobbles. The desktop study initially suggested a sufficient depth of sand cover for cable installation at the landfall. Localised rock outcrops were observed between the sand dunes backing onto the beach and the low tide level during a geotechnical walkover assessment at low tide. While sand depth was unknown it was expected to be sufficient and the initial assessment suggested that cable installation to offshore from the beach would be by plough, jetting tool, or trenching in soft sediments. Geophysical survey of the offshore area would be required to confirm the installation conditions.

The intertidal zone was identified as extending to approximately 40-50m with a higher predominantly dry area which would be adequate for landing the cables. During the walkover survey there was no evidence of movement of the sand on the beach during low tide although a south to north sand transport direction (due to sea currents) was known to exist.

Notwithstanding the exposed nature of the landfall location to weather and sea conditions no significant constraint to vessel access was noted as a result of the site walkover survey.

There are no known spoil grounds, significant (dangerous) wrecks, undue risks of unexploded ordnance, or cable or pipeline crossings present.

Fishing by vessels relying on static gear, primarily targeting lobster and crab, is known to be an important and established activity in the near shore area around Arbroath. Further consultation would be required with the fishermen regarding cable installation and protection methods in respect of potential impacts on fishing activities.

5.3.6 Environmental Constraints

There is an extensive area of dunes backing onto the beach at Arbroath which reach a height of around 3-5m at the southern end of the beach. The dunes present a grassland habitat which, although not subject of any statutory protection are considered to be environmentally sensitive.

There are several water courses in the area including the Dowrie Burn and the Penston Burn, which are environmentally sensitive and are understood to require a 10m clearance and no in-water works if crossed. Other water courses also run off through the golf course and by the Water Treatment Works to the south.

The presence of a disused bitumen works located in the area of the Dowrie Burn outfall (within the discounted landfall route option for North Arbroath) became apparent through consultation with Angus Council. The former works presents significant potential for contaminated ground with unknown hazards which require to be avoided.

The Arbroath landfall is close to the Firth of Tay and Eden Estuary Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar. The common seal, which is part of The Firth of Tay and Eden Estuary SAC designation, frequently uses the area close to Arbroath and although it is unlikely to have a significant impact on this species the cable route will require careful consideration and management in order to avoid or mitigate potential effects.

Longshore sediment transport southwards along the Arbroath shoreline supplies sediment to active systems towards Buddon Ness and the Forth and Tay Estuary SAC and SPA and the cable route would also require further consideration in respect of potential for any likely significant effects on these sites.

5.3.7 Arbroath Summary

An early decision was made to take forward the South Arbroath landfall for further consideration in preference to the North Arbroath option. This was based on avoidance of the disused bitumen works, avoidance of the water crossing at the Dowrie Burn and a lesser recreational usage of the area.

Installation of the cable at the South Arbroath landfall did not appear to be constrained by ground conditions and accordingly seemed suitable for standard installation methods to achieve cable burial up to beach landfall. HDD was considered to be a potentially suitable method of landfall under the golf course, railway line and dunes from an appropriately set back area. It was noted that while the private level crossings presented a serious issue for construction access across the railway line this could be mitigated by the potential to site the HDD on the north side of the railway line.

Table 3. Arbroath Stage 1 Identified Landfall Constraints

Landfall Option	Transition pit location behind beach	Beach location, gently sloping (avoid steep banks)	Offshore vessel access.	Proximity to recreation, dwellings or prime agricultural land.	Onshore landfall access for construction and installation vehicles	Cable installation to Transition Pit	Onshore Ecology	Cable Installation Offshore/ cable protection	Offshore Landfall Access (beach access)	Offshore Ecology	Other issues
Arbroath	Area and location good	Beach with sand and small dunes	Vessel access appears to be good- no visible rock	Passes over golf course land and close to recreational land, no housing.	Upgrading/ civil works required and private level crossings	Good - HDD under rail line, golf course and dunes	Dunes backing beach of habitat value avoidable using HDD	Potentially suitable for standard cable burial methods	Exposed but good working area	Close to SAC / SPA and Ramsar to south	Contaminated land from disused bitumen works onshore. Fishing near shore.

5.4 Monifieth

The Monifieth option would make landfall at Monifieth Sands in the area to the east of Tayview Caravan Park and existing sports pitches at Monifieth links. The desktop study found that in Angus Council's Shoreline Management Plan the sand beach and high dunes which used to front much of the coast at Monifieth have been almost entirely eroded resulting in no beach being visible during high tides and only a small area of dunes remaining in front of Monifieth Caravan Park. The location of the landfall at Monifieth is shown below in Figure 19.

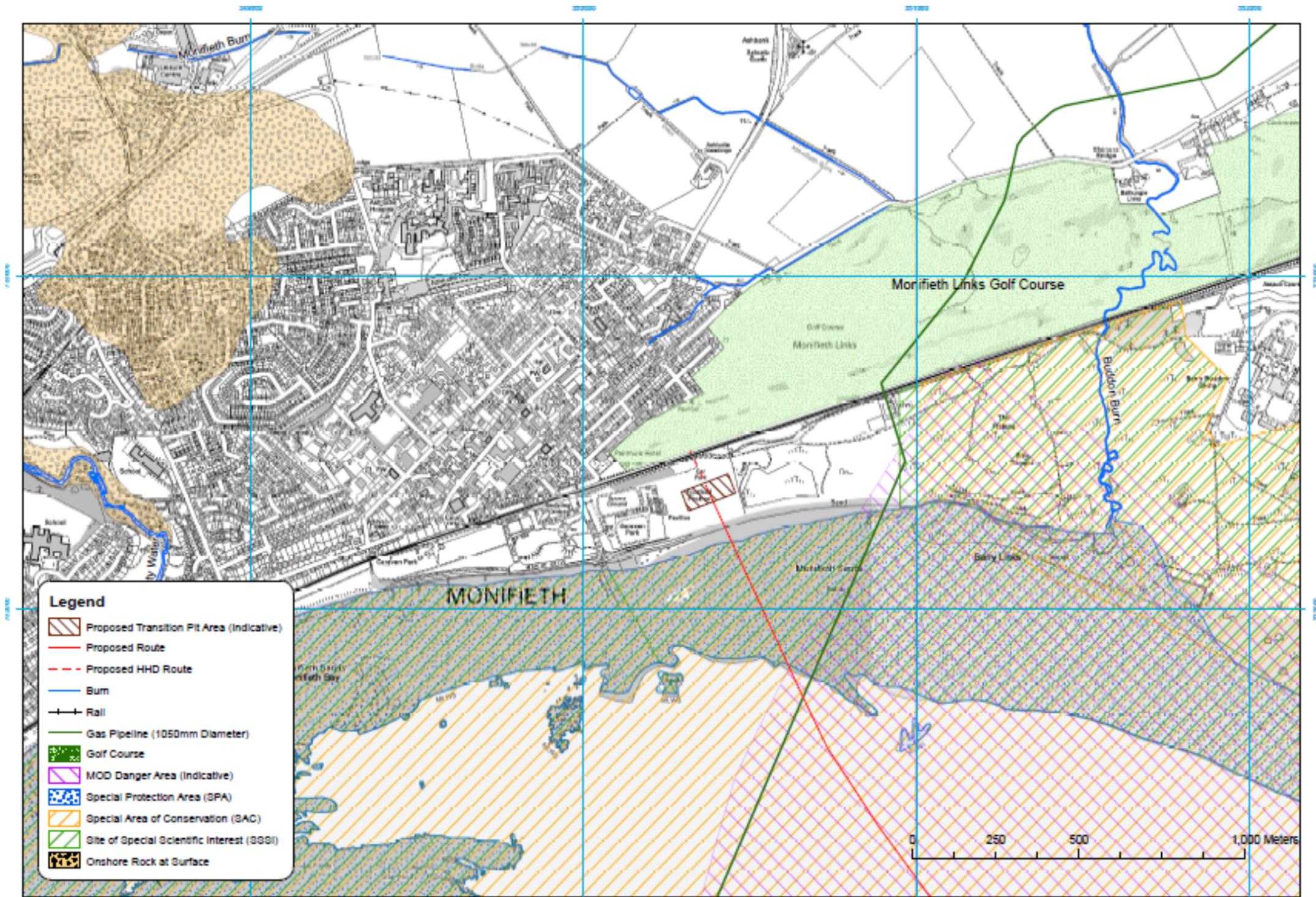


Figure 19: Monifieth Landfall Location

The Settlement Statement for Monifieth in the Angus Local Plan Review (ALPR) identifies the key issues affecting the town. The settlement statement confirms that the coastal setting provides Monifieth with much of its character and that the important beachfront area has recently been the subject of a major environmental improvement scheme. The beachfront improvements and links golf both compliment the town's attractions for residents and visitors. The ALPR Development Strategy for the town also includes improvement of coastal footpaths and cycleways as a priority for the area as well as the need to protect the existing open space within Monifieth including sports grounds, sand dunes and other recreation facilities.

5.4.1 Area for Transition Pit

The most suitable position for a transition pit is south of the railway line as shown in Figure 19.

The exact working area locations and space available for landfall works and transition pit require further assessment.

5.4.2 Impacts on Dwellings and Other Buildings

Properties within the built up area of Monifieth are separated from the landfall location by Monifieth Golf Course. Activities associated with the landfall works will be visible in the vicinity of the works resulting in potential visual impacts. However any impacts will be temporary for the duration of construction works at the landfall only and are not considered to represent a significant constraint.

5.4.3 Impacts on Recreational Users

As well as the beach where landfall is proposed there are a number of recreational facilities in the vicinity of the landfall including Tayview Caravan Park, football pitches and Monifieth Golf Course. There is potential for short term restriction of access during construction however any such restriction would be short term and is not considered to be a significant constraint.

5.4.4 Impacts on Prime Quality Agricultural Land

No prime quality agricultural land in the immediate vicinity of the landfall would be affected.

5.4.5 Access and Construction Installation Onshore

The railway line is located to the rear of the beach with Monifieth Golf Course located immediately to the north of the rail line. The most suitable method of crossing the railway line and golf course is likely to be HDD and a feasibility study for the use of HDD would be required.

Two access tracks require to be crossed within the recreational area close to the landfall point, one connecting the Tayview Caravan Park with the car parking

facilities adjacent to the golf course and the other providing direct access into the Gas Valve Compound (GVC) associated with the railway line. Access to the seaward side of the railway line at Monifieth is via two underpasses at South Street both of which have restricted height for vehicles. The lower underpass at South Street / Union Street has a maximum height restriction of 1.8m and the higher underpass has a maximum height restriction of 3.2m.

The presence of an active railway line will result in constraints during construction, operation and management of the cable. Agreements will need to be obtained from the railway operator in order to allow any cable crossing.

5.4.6 Access and Construction Installation Offshore

The highly dynamic nature of the wave, tidal and coastal processes in the area gives rise to potential for exposure of cable in the long term. If the cable becomes exposed it is a potential hazard to all users of the coastal waters and deemed an unacceptable risk. A greater understanding of the nature of the mobile sediment would require further investigation, though it is likely to be very difficult to install and maintain cable installation and protection and therefore is unlikely to be a suitable landfall location.

As previously discussed in section 5.2 (Carnoustie) the MoD 'Danger Area' PEXA D604 includes the coastal waters directly offshore of Barry Sands / Monifieth Sands. The location of the site raises the risk of encountering UXO which would require to be confirmed by additional surveys.

A British Gas National Pipeline is located offshore within 1km of the landfall location and would need to be crossed by the cable. Crossing the British Gas Pipeline offshore is considered high risk and not advised. The location of the pipeline is shown in Figure 19.

5.4.7 Environmental Constraints

The cable route passes through Monifieth Bay SSSI which is designated for non-breeding Sanderling and is close to Barry Links SSSI to the east which is designated for its geomorphology, coastlands (sand dunes), non-vascular plants (bryophyte assemblage) and its invertebrate assemblage.

The River Tay also supports numerous fish populations including protected species such as Atlantic salmon and brown / sea trout. The desktop study could not confirm the presence or absence of protected fish species within the watercourses included within the study area, however, there is the possibility that the Buddon and Monifieth Burns support populations of salmonids, European eel and lamprey.

The presence of numerous internationally and other designated sites within the intertidal and landfall areas are identified as key constraints to the Monifieth route.

These designations comprise:

-
- Firth of Tay and Eden Estuary SPA – supporting nationally important breeding populations and an internationally important wintering population of individual bird species; supporting an internationally important wintering population of waterfowl and waders.
 - Firth of Tay and Eden Estuary SAC – designated for its estuarine features, mudflats and sandflats not covered by seawater at low tide, sandbanks which are slightly covered by seawater all the time and the population of common seal.
 - Barry Links SAC – designated for its coastal dune heathland, shifting dunes, dune grassland and humid dune slacks.

The main potential issues relate to disturbance to the internationally and nationally important bird species assemblages which are known to occur within the study area and the surrounding habitats and also to the population of common seals. The coastal area and associated sand dunes are designated sites and it is likely that the species present could potentially use the onshore land within the study area for roosting and foraging during times of high tide, as well as the intertidal area for breeding and low tide feeding. Any disturbance of these species with a likely significant adverse effect requires a full Habitat Regulations Appraisal / Appropriate Assessment

5.4.8 Monifieth Summary

Table 4 provides a summary of the Monifieth landfall constraints. Three significant constraints have been identified. These are the potential risk of cable exposure due to mobility of sediments, the need to cross the offshore British Gas pipeline and the environmental constraints associated with European protected species (birds and common seals). Because of these the option was discarded.

Table 4. Monifieth Stage 1 Identified Landfall Constraints

Landfall Option	Transition pit location behind beach.	Beach location, gently sloping (avoid steep banks)	Offshore vessel access.	Proximity to recreation, dwellings or prime agricultural land.	Onshore landfall access for construction and installation vehicles	Cable installation to Transition Pit	Onshore Ecology	Cable Installation Offshore/ cable protection	Offshore Landfall Access (beach access)	Offshore Ecology	Other issues
Monifieth	Area to south of railway line -no specific location identified	Beach with small gradient banks	Relatively good access,	Passes over golf course, near by outskirts of town, but no agricultural land.	Restricted height through under-passes	HDD likely to be required	Route through Monifieth Bay SSSI	Risk of cable exposure due to mobility of sediments	Not assessed	Cable route through SAC, SPA and Ramsar	MoD Danger Area and Potential for UXO offshore. Crossing of gas pipeline offshore

5.5 Conclusion of Stage 1 Landfall Option Assessments

It was quickly identified that all of the cable routes are constrained in one way or another and that all of the selection criteria could not be met at any one location within the study area. The identified landfalls each have particular constraints but all share the common issue of crossing the main east coast railway line. Golf courses featured at four out of five of the locations identified.

Table 5 below summarises the potential constraints based on the initial Stage 1 assessments. Constraints are ranked at three levels for each of the locations with green used to signify minor or no concern, amber for moderate concern and red for an issue of major significance. Where an issue has not been assessed, for example where an issue of major significance has already been identified which makes the option unviable, the constraint is not coloured.

East Haven: Assessment identified that there is no viable access to the landfall for construction vehicles and equipment and that the near shore ground conditions are unsuitable for cable burial. These constraints were considered to make East Haven unviable for landfall and the option was discarded.

Monifieth: The potential risk of cable exposure due to mobility of sediments, the need to cross the British Gas pipeline together with environmental constraints associated with European protected species (birds and common seals) were considered significant issues and the option was discarded.

Carnoustie: Due to potentially favourable installation conditions and the lack of significant engineering and environmental constraints it was considered that Carnoustie landfall should be shortlisted for further investigation.

Arbroath: Due to potentially favourable installation conditions and the lack of significant environmental constraints it was considered that Arbroath South landfall should be shortlisted for further investigation. It is noted that the location of HDD would have to be set back north of the railway line due to access restrictions.

On this basis both of the Carnoustie and Arbroath landfall options were shortlisted for Stage 2 assessment.

Landfall Option	Transition pit location behind beach	Beach location, gently sloping (avoid steep banks)	Offshore vessel access.	Proximity to recreation, dwellings or prime agricultural land.	Onshore landfall access for construction and installation vehicles	Cable installation to Transition Pit	Onshore Ecology	Cable Installation Offshore/ cable protection	Offshore Landfall Access (beach access)	Offshore Ecology	Other issues
East Haven	Area good – but highly visible	Small beach without steep bank.	Natural harbour with rock close by.	Close to houses, agricultural land. No golf course.	No viable access for construction vehicles across the east coast railway line	HDD required close to/under houses	Nearby SSSI	Near surface rock - conditions not suitable for burial	Not assessed	Adjacent to SPA/SAC and Ramsar	N/A
Carnoustie	Area acceptable but may be restricted	Beach with costal defence- needs further investigation	Vessel access appears to be good – no visible rock	Passes over golf links and adjacent to MOD ranges. No close housing or agriculture	Good – some upgrading may be required to tracks	Potentially difficult HDD due to sea defences	Adjacent to Barry Links SAC/SSSI and golf course	Potentially suitable for standard cable burial methods	Exposed, tidal working may be required	Adjacent to SPA/SAC and Ramsar	MoD Danger Area and Potential for UXO offshore
Arbroath	Area and location good	Beach with sand and small dunes	Vessel access appears to be good- no visible rock	Passes over golf course land and close to recreational land, no housing.	Upgrading/ civil works required and private level crossings	Good - HDD under rail line, golf course and dunes	Dunes backing beach of habitat value avoidable using HDD	Potentially suitable for standard cable burial methods	Exposed but good working area	Close to SAC / SPA and Ramsar to south	Contaminated land from disused bitumen works onshore. Fishing near shore.
Monifieth	Area to south of railway line - no specific location identified	Beach with small gradient banks	Relatively good access.	Passes over golf course, near by outskirts of town, but no agricultural land.	Restricted height through under-passes	HDD likely to be required	Route through Moni-fieth Bay SSSI	Risk of cable exposure due to mobility of sediments	Not assessed	Cable route through SAC, SPA and Ramsar	MoD Danger Area and Potential for UXO offshore. Crossing of gas pipeline offshore

Table 5. Summary of Stage 1 Constraints at Landfall Options

6. STAGE 2 – FURTHER ASSESSMENT

Following the Stage 1 assessments and short-listing of Carnoustie and Arbroath, more detailed assessments were made to better understand the constraints at these locations. Further works were completed including offshore geophysical surveys and engineering installation assessments, onshore habitat surveys, ornithology surveys and offshore benthic surveys.

6.1 Carnoustie

6.1.1 Landfall Engineering Feasibility - HDD

An assessment was undertaken to confirm the feasibility of HDD at Carnoustie. The assessment examined the drilling angles that would be required to provide suitable clearance underneath the sea defences out into the intertidal area.

Completing the HDD from the landward of the sea defences is preferred as it would reduce the need for installation equipment at the seaward exit point of the bore hole and minimise potential construction difficulties arising from variable weather and sea conditions.

The preferred method would involve a pilot hole being drilled using a drill bit which would then be extracted, removed, and replaced with a reamer. The pilot hole would then be forward reamed to enlarge the pilot hole to the desired diameter. Cable ducts would then be fed forward into the bore hole with a hydraulically powered pipe pushing machine. This method is considered to be suitable at Carnoustie based on the geology at the landfall.

The HDD assessment confirmed that operations would need to be set-back between 100-200m from the high water mark based on a need to clear the bottom of the sea defences in the underlying sandstone by a minimum of 1m.

The operations would require a drill rig with dimensions of approximately 15m x 2.5m x 3.6m and with a weight of 30-35 tonnes. Some limited ground works may be required in the area which backs onto the golf course for placement of the rig together with some minor access upgrades to the hard core track around southern perimeter of the golf links to enable transportation. These works do not represent a significant constraint to engineering feasibility.

The working width which may be required has been considered in relation to the number of boreholes which may be necessary and the minimum separation required between drills at the entry point. The relatively narrow area of land which may be available between the golf course and the MoD does not present a significant constraint as bore holes could be separated vertically as well as horizontally if necessary.

Overall however the use of HDD for cable landfall is considered to be feasible and none of the works likely to be required represent a significant issue for construction.

6.1.2 Access and Construction Installation Offshore

The offshore geophysical survey results confirmed shallow water depths on the approach to the Carnoustie landfall with the 10m depth contour located approximately 3km offshore. The seabed has a smooth gradient and does not exhibit any notable features. The smooth gradients and presence of soft sediments and sands on the seabed mean the use of common burial tools such as a cable plough or jetting lance are suitable for installation to achieve cable burial with no need for additional protection of the cable. These conditions are suitable for cable installation.

6.1.3 Vessel Access

The HDD feasibility study at Carnoustie also considered the method for near shore cable installation as a result of the shallow bathymetry. In order to optimise installation it is noted that the cable could be split into two sections with the main offshore cable section installed using deep water dynamic positioning vessels. The shore end cable could be installed in parallel within the intertidal zone and out to 10m water depth using a shallow draught vessel equipped with a cable plough or jetting tool.

6.1.4 Environmental Survey Results

The onshore habitat surveys noted some botanical interest and potential for European Protected Species (EPS) within the Carnoustie golf links. Further consideration of botanical interest will be required including the need for reinstatement, translocation and habitat management measures in order to mitigate impacts on undesignated areas with nature conservation interest. Implementation of preconstruction surveys and best practice measures during construction should mitigate any potential impacts.

Neither the onshore bird surveys completed within the intertidal area nor the offshore benthic surveys found any significant issues.

6.2 Arbroath

6.2.1 Construction Installation Offshore

The offshore geophysical survey found that the final 3.6km approach to the Arbroath landfall has exposed rock strata with little or no sediment cover. The seabed is rough and of variable gradient including rock steps up to 2.5m high. A map showing the location of the surface rock along the offshore section of the cable route is attached at Appendix B.

The presence of surface rock precludes the use of conventional cable installation tools such as ploughs, jettors and mechanical excavators and make standard cable burial and protection techniques impractical over a large section of the approach to shore. Consequently, alternative means of cable protection are required for the

Arbroath landfall such as very long HDD, mechanical trenching, rock dumping and/or mattressesing.

Very Long HDD: Technical limitations of HDD and cable installation restrict working borehole lengths to around 800m. For this to be effective for the offshore section of the cable at Arbroath the HDD location would require to be set as near as possible to the beach, on the southern side of the railway line. This brings significant issues of access across the private level crossing (section 5.3.4) and, even if it were possible, the HDD will only mitigate a small portion of the exposed rock.

Mechanical trenching: - Mechanical trenching is a difficult and slow process. It is considered impracticable at Arbroath given the number of trenches that would be required, the distance to be covered and the particularly rough seabed conditions. In addition, there may be significant environmental issues due to impacts of underwater noise on nearby protected seal populations.

Rock Dumping/Mattressing: - These techniques are considered possible for installation but will have significant environmental and operational impacts.

The construction of rock armour berms across the shallow sub tidal rock shelf will impede and adversely affect the local longshore drift of sediment. The net drift is southwards along the Arbroath shoreline supplying sediment to active beach systems at Buddon Ness and the Forth and Tay Estuary SAC and SPA. To minimize impacts, studies indicate that any rock armour berms should start seaward of the 7m depth contour, 500m to 1km distance from MLWS..

From a long term operational perspective, rock dumping/mattressing is considered to be high risk. This is because of the dynamic conditions in the shallow water including tides, waves and surf which will directly affect the stability of rock berms and mattresses. These present significant operational risks to the protection of cables due to movement leading to persistent cable flexing, abrasion, and strikes with rocks increasing the risk of cable failure.

6.2.2 Vessel Access

The Arbroath landfall location is open, rocky, shallow, and particularly exposed to easterly winds which result in breaking waves and surf near to shore. Installation would require the use of shallow draft vessels which are vulnerable to these conditions. This is considered to be a particular constraint for installation in respect of available working time and safety management.

6.2.3 Fishing Activity

Fishing using static gear, primarily for lobster and crab, is known to be an important and established activity in the near shore area around Arbroath. The type of fishing vessels are typically small - less than 15m length and locally based. Surface cable laying and cable protection through rock placement or mattressesing gives rise to concerns for anchors and fishing gear to be snagged resulting in loss of gear,

damage to the cable and increased potential for safety incidents including vessel capsizing in extreme cases.

6.2.4 Installation Onshore

The offshore geophysical survey results have confirmed that standard installation methods offshore are impracticable and requires HDD entry and transition pit as close as practical to the beach to maximise the offshore drill length to safely protect the cables through the intertidal zone. It is considered that up to a maximum of 1km of the offshore 3.6km cable route approach to the Arbroath landfall would be feasible using HDD but this necessitates a location within the grassland and dunes which back on to the beach.

While there is considered to be sufficient space for HDD within this area works would result in significant disturbance to the dunes as well as high traffic volumes across the private level crossing of the rail line in order to facilitate access.

Under the Stage 1 assessment it was assumed that private level crossings could be avoided by a long HDD from the north of the railway line. However, the Stage 2 study indicates that HDD works close to the beach are inevitable with no mitigation to this significant constraint.

The extent of both temporary and permanent works which would be required in the dune/grassland area in order to facilitate HDD, access and cable transition raise concerns over potential environmental impacts on the dune habitats.

6.2.5 Corse Hill Windfarm

A planning application by West Coast Energy for an onshore wind farm on a site at Corse Hill adjacent to Hatton Waste Water Treatment Works was refused by Angus Council on 7 August 2012. No appeal has currently been submitted however it is relevant to note that the applicants have 3 months from the date of the decision to submit an appeal against refusal of this application.

The Seagreen onshore cable route crosses the proposed Corse Hill site at landfall and in the event that the Corse Hill project were to proceed then any related infrastructure (turbines, buildings, tracks, cabling etc) would need to be avoided.

Seagreen submitted a letter of representation to Angus Council in response to the application raising concerns over the potential for the development to adversely impact on its potential landfall and cable route at Arbroath.

6.2.6 Environmental survey results

Phase 1 habitat surveys, ornithology surveys, a physical processes assessment and offshore benthic surveys were completed for the Arbroath landfall.

Elliot Links SSSI is close by the cable landfall and should be avoided. There is sufficient space to the west of the SSSI and therefore this is not deemed a significant constraint. Penston Burn and Dowrie Burn were identified as important watercourses. The export cables should not run parallel to, or within 10m of the burns. Notable dune habitat exists along the coast east of the rail line. This is not designated but is a good example of a Biodiversity Action Plan (BAP) habitat. Disturbance of this area should be avoided.

Neither the onshore bird surveys completed within the intertidal area nor the offshore benthic surveys found any significant issues.

Although there is a potential requirement for cable protection measures including the construction of rock armour berms at Arbroath it has been assumed that these works will not be visible and as such there will be no permanent above ground works proposed. On this basis it is considered that there is no potential for landscape and visual impacts as a result of the cable route in this location.

7. CONCLUSION

In contrast to Arbroath, no major constraints have been identified for the Carnoustie landfall. It is significantly less constrained from both an engineering and environmental perspective than all the other potential locations considered. Carnoustie is accordingly considered to be the best location and has been confirmed as the chosen landfall.

Table 6 updates the findings reported in Table 5 and which are summarised below.

Arbroath: Conventional cable burial and protection techniques are not feasible over a large section of the shore approach due to the rough and rocky seabed. Alternative installation techniques of long HDD, mechanical trenching, rock matressing have been reviewed but are also considered impractical from either environmental or engineering perspectives.

Carnoustie: Further assessment has confirmed that offshore conditions support standard cable burial methods and that HDD under the coastal defences is feasible. Although working within the intertidal area would be partly restricted by tidal conditions this is not considered to be a significant constraint and access is satisfactory onshore and offshore.

Residual issues that will require management for the Carnoustie landfall are:

Environmentally designated interests along the cable route will require careful consideration and management in order to avoid or mitigate potential effects, particularly in relation to HRA.

Impacts on adjacent users offshore and onshore, including the Buddon Golf Course, are manageable subject to reinstatement to agreed standards.

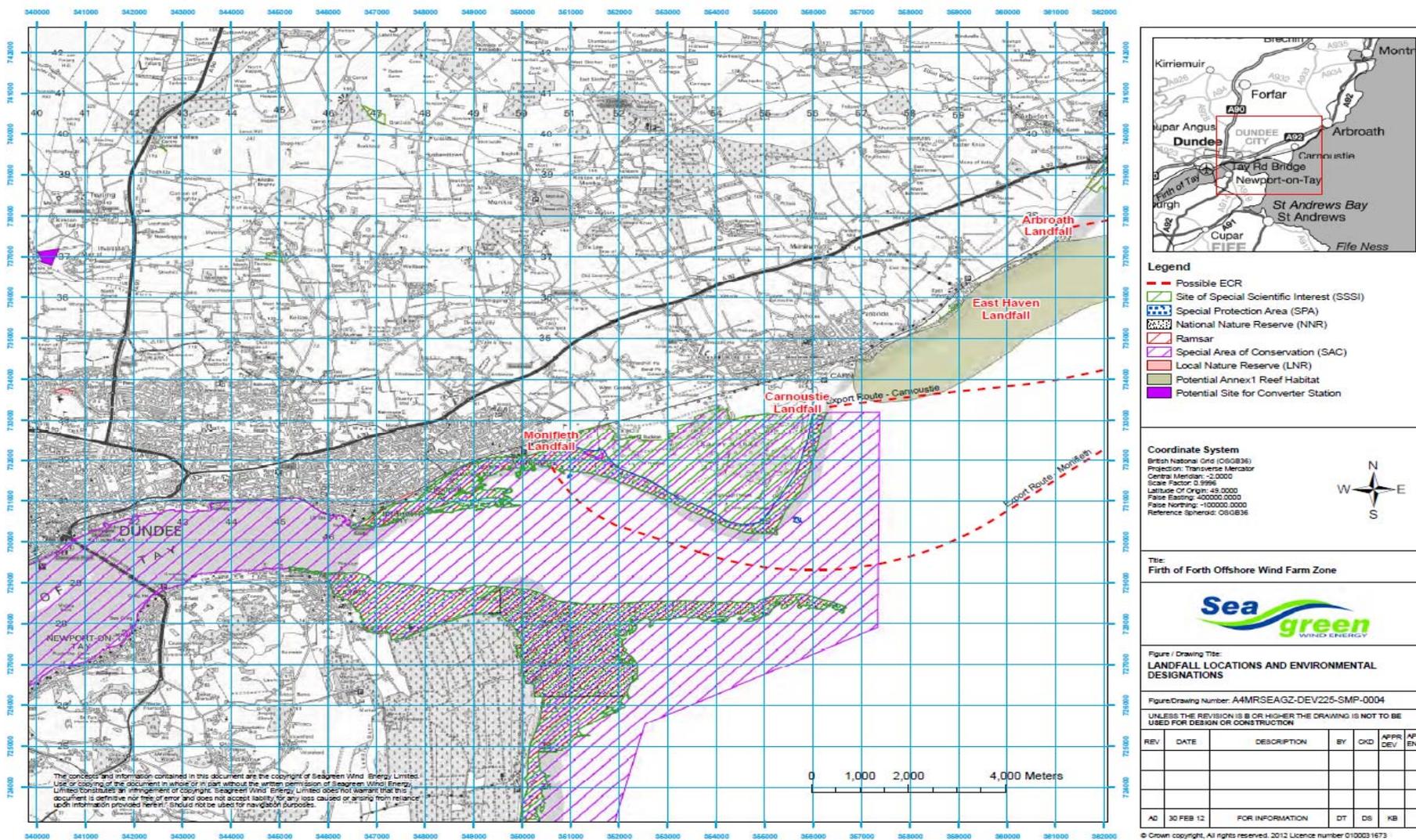
Landfall Option	Transition pit location behind beach	Beach location, gently sloping (avoid steep banks)	Offshore vessel access.	Proximity to recreation, dwellings or prime agricultural land.	Onshore landfall access for construction and installation vehicles	Cable installation to Transition Pit	Onshore Ecology	Cable Installation Offshore/ cable protection	Offshore Landfall Access (beach access)	Offshore Ecology	Other issues
Carnoustie	Area acceptable but may be restricted	Good smooth gradients and presence of soft sediments allow use of common burial tools.	Vessel access appears to be good – no rock	Passes over golf links and adjacent to MOD ranges. No close housing or agriculture.	Good – some upgrading may be required to tracks. Access to beach possible.	Sea defence is obstacle, but HDD under sea defences possible.	Adjacent to Barry Links SAC/SSSI and golf course	Suitable for standard cable burial methods	Exposed, tidal working may be required	Adjacent to SPA/SAC and Ramsar	MoD Danger Area and Potential for UXO offshore
Arbroath	Original location not feasible. Now located in grassland close to beach.	Beach with sand and small dunes	Vessel access assessed as difficult with rock in all of the shallow areas.	Passes over golf course land and close to recreational land, no housing.	Upgrading/ civil works required and private level crossings. Level of vehicle crossings not mitigated by HDD position (as previously assumed)	Beach transition pit not possible due to rock. Cable installation under dunes is possible.	Transition pit now not avoidable on dunes. Important habitat value	Unsuitable cable burial and protection due to rock.	Good working area, but limited to access across private level crossing only.	Close to SAC / SPA and Ramsar to south	Crab and Lobster Fishing activity and Corse Hill Wind Farm.

Table 6. Summary of Stage 2 Constraints at Landfall Options

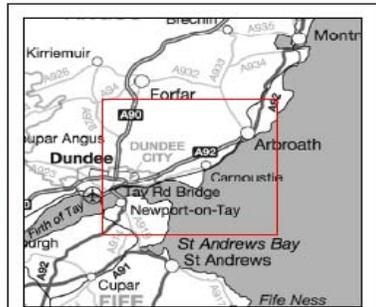
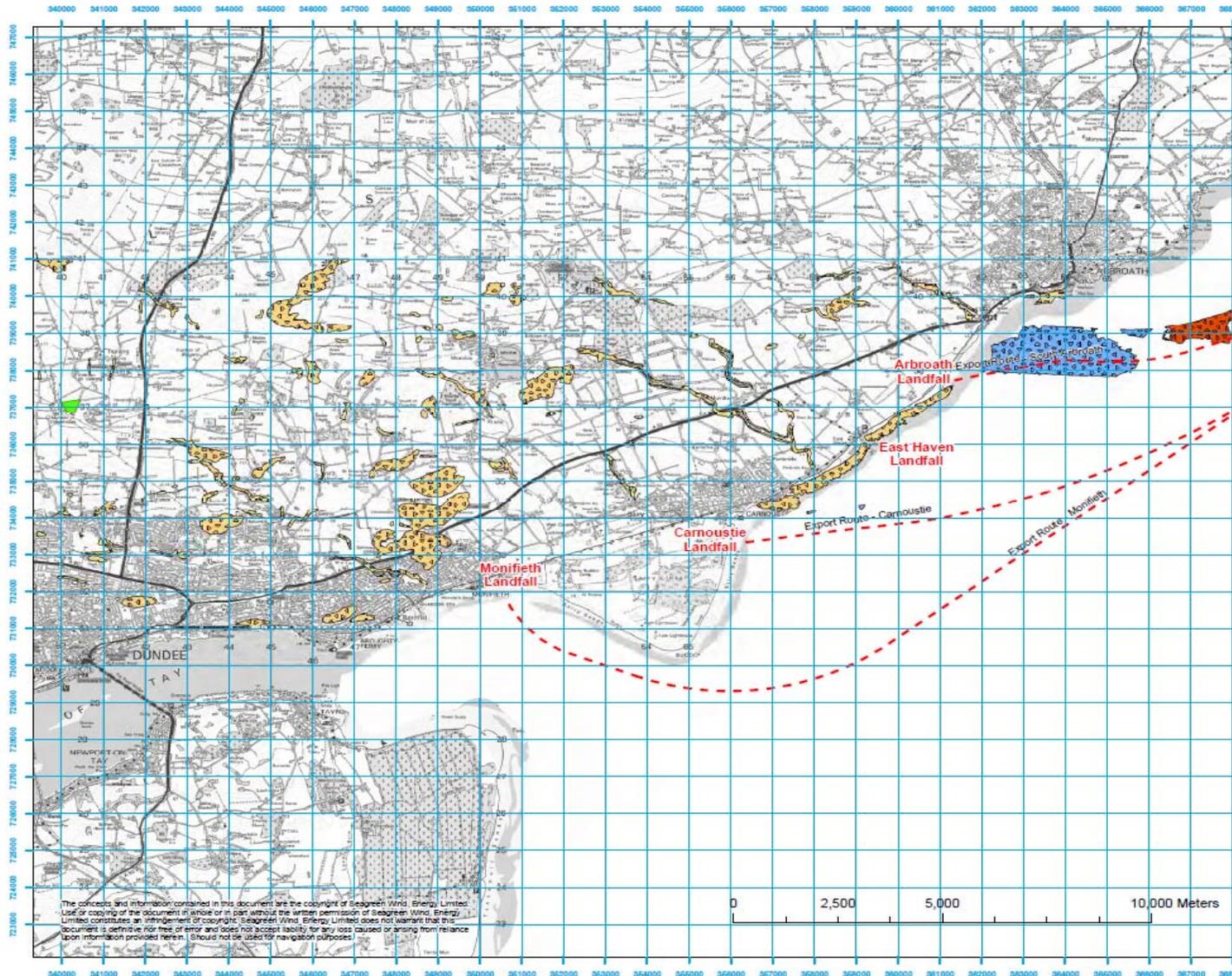
References

Hansard (November 2003) Unmanned level crossings, available from http://hansard.millbanksystems.com/westminster_hall/2003/nov/18/unmanned-level-crossings (accessed 12/09/12)

APPENDIX A



APPENDIX B



- Legend**
- - - Possible ECR
 - Onshore Rock at Surface
 - Offshore Rock at Surface
 - Offshore Rock at Surface with Veneer
 - Potential Site for Converter Station

Coordinate System
 British National Grid (OSGB36)
 Projection: Transverse Mercator
 Central Meridian: -2.0000
 Scale Factor: 0.9996
 Latitude Of Origin: 49.0000
 False Easting: 400000.0000
 False Northing: -100000.0000
 Reference Spheroid: OSGB36



Title:
 Firth of Forth Offshore Wind Farm Zone



Figure / Drawing Title:
 LANDFALL LOCATIONS AND SURFACE ROCK

Figure/Drawing Number: A4MRSEAGZ-DEV225-SMP-0005

UNLESS THE REVISION IS B OR HIGHER THE DRAWING IS NOT TO BE USED FOR DESIGN OR CONSTRUCTION

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A2	28 AUG 12	FOR INFORMATION	DT	DS	KB	LG