

Norfolk Vanguard Offshore Wind Farm

Intrusive Site Investigations – what can you expect?

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VATTENFALL

1. What are the Investigations?

The work we have undertaken to date – desk-based studies of existing data, site visits by engineers and other specialists, early phase site investigations, aerial photography and geophysical surveys – has highlighted where it will be beneficial to look more closely at ground conditions and what we will encounter under the surface.

We also now have more detailed proposals, following consultations and reaching common ground with stakeholders during the examination process, and this too helps us focus our next phase of site investigations to inform detailed design in relation to duct installation, cable design, and trenchless techniques such as horizontal directional drilling (HDD). Over the coming months we will focus on the main crossing points along the proposed cable route (e.g. road or river crossings), the area around the proposed onshore project substation and near landfall.

The purpose of these investigations is to understand more about the geology, ground conditions and drainage, investigate any potential contamination issues, and thermal resistivity of the ground at specific locations. We also need to check places where previous geophysical survey work has indicated we may encounter buried archaeological remains, as well as where the data showed nothing of interest – as a checking exercise.

Below, we provide more information on each technique we will be deploying locally.

Individual landowner plans have been produced to accompany the intrusive licences which show the precise number and locations of the engineering site investigation intrusive works relevant to each land holding. These plans will be issued to all relevant interested parties.

Borehole Drilling

We are borehole drilling at some of the main crossing points of interests along the proposed cable route, and at the onshore project substation.

An image of a borehole drilling rig is provided in Figure 1. At each location, the borehole drilling typically involves four surveyors (additional surveyors such as an archaeologist may be present as required) with a trailer mounted cable percussion drilling rig from a 4x4 vehicle. A supporting vehicle with welfare facilities may also be deployed.

The cable percussion drilling rig will bore a vertical hole of approximately 6" diameter to a depth of up to 30m and recover soil samples for laboratory testing. The bore will then be backfilled with inert materials, such as bentonite (clay) pellets. Each borehole is typically completed within a single day.

Some boreholes may have groundwater / gas monitoring wells installed for a period of up to 8 weeks during which time up to 4 gas/groundwater monitoring visits may be conducted. Wells have the borehole sealed at ground level with a raised lockable cover and fenced off (see photo of an example of Ground Water and Gas monitoring at Figure 2). Following the monitoring period the borehole will be backfilled.

Window Sampling

We shall be window sampling at the onshore project substation, to gain more information relevant to foundation design.

Window samples are similar to boreholes but typically utilise a smaller trailer mounted hydraulic hammer rig from a 4x4 vehicle (see photo of an example window sample rig at Figure 3). Typically two surveyors (additional surveyors such as an archaeologist may be present as required) and a supporting vehicle will be deployed, as well as welfare facilities.

The hydraulic hammer drilling rig will drive a sample tube (typically up to 3" diameter) into the ground to the depth required, typically no deeper than approximately 5m. The sample tubes include a broad slot, or window, cut down one side which allows the soil strata to be identified when the sample is extracted once the required depth is achieved. The soil samples may then be sent for laboratory testing.

The bore will then be backfilled with inert materials, such as bentonite (clay) pellets. Each window sample is typically completed in half a day.

Some window samples may have groundwater / gas monitoring wells installed for a period of up to 8 weeks during which time up to 4 gas/groundwater monitoring visits may be conducted. Wells have the borehole sealed at ground level with a raised lockable cover and fenced off (see photo of an example of Ground Water and Gas monitoring at Figure 2). Following the monitoring period, the borehole will be backfilled.

Trial Pits

Trail pits are dug to provide information about the thermal resistivity of the ground (and changing geology), particularly at locations where the geology is anticipated to change along the route, and other physical properties of the ground, such as its natural drainage capacity.

Trial pit ground investigation involves 2-4 surveyors (additional surveyors such as an archaeologist will be present) with a trailer mounted mini digger from a 4x4 vehicle. The mini digger will excavate a small trial pit approximately 2m³ and probes inserted into the exposed soil layers to measure soil resistivity or filled with water to monitor infiltration or a ground bearing plate and assessment conducted to understand the ground bearing capacity of the subsoil. The trial pit will then be reinstated with the excavated soils (subsoil followed by topsoil). Each trial pit is typically completed within a few hours.

Archaeological trial trenching

The main objectives of the archaeological trial trenches are to identify the presence/absence, nature, date, possible extent and significance of any buried archaeological remains. Undertaking trial trenching investigations early in the development process will help decide whether further archaeological investigations will be required later on, and assists with programming and planning. Further work may include e.g. larger set-piece excavations and/or strip, map and sample excavations and monitoring (watching briefs) – these are undertaken within the pre-construction programme or alongside the construction programme, respectively (ensuring that programme extensions are minimised wherever possible and land is reinstated as soon as appropriate).

Trial trenches will be excavated using a 360° mechanical excavator, JCB (or similar) – fitted with a toothless ditching bucket, under constant archaeological supervision to the top of the natural geology, or until archaeological features are encountered

Each of the archaeological trial trenches will generally be c. 30m in length by c. 2m wide. There may also be instances where trenches are 50m in length. Spoil storage either side of the trenches will increase the width on the field surface.

There are anticipated to be up to 600 trial trenches along the approximately 60 km onshore cable corridor. Final numbers, locations and positioning are subject to agreement with Norfolk County Council Historic Environment Service. In terms of the number of trenches specific to each landowner/occupier, this is still to be finalised, and will be informed further by the geophysical surveys that are being undertaken during the 2020 Spring – Summer season. An indication of high-level approximate numbers of archaeological trial trenches can be provided to individual landowners on a case-by-case basis, upon request.

Intrusive Site Investigations Techniques at a Glance:

Method	When	Duration	What equipment	How many people	Dimension of borehole / trench/pit	Top-soil & subsoil protection measures in place
Borehole Drilling	From July	Each bore hole will take approximately 0.5 days (8am – 6pm) with up to 8 weeks of sealed groundwater/gas monitoring well	Trailer mounted drill rig, 4x4 vehicle, welfare facilities	2 - 4 surveyors (+/- archaeologists / other specialist)	6 inch diameter to a depth of up to 30m	N/A
Window Sampling	From July	Each window sample will take approximately 0.5 days (8am – 6pm) with up to 8 weeks of sealed groundwater/gas monitoring well	Trailer mounted hydraulic hammer rig, 4x4 vehicle, welfare facilities	2 - 4 surveyors (+/- archaeologists / other specialist)	3 inch diameter to a depth of up to 10m	N/A
Trial Pits	From July	Each trial pit will take approximately 0.5 days (8am – 6pm)	Trailer mounted mini digger, 4x4 vehicle	2 - 4 surveyors (+/- archaeologists / other specialist)	2m ³	✓
Archaeological trial trenching	From August / September	Typically 1 – 3 weeks within each land parcel / field depending on number of trenches	360° mechanical excavator, JCB (or similar), 4x4 vehicle / site van, welfare facilities	3 – 8 surveyors & archaeologists	Typically 30m x 2m. Some 50m x 2m (in larger areas), e.g. landfall and substation	✓

2. When will work begin and how long will it take?

Borehole drilling, window sampling and work on trial pits is expected to begin from July 2020 with the full programme of works likely to take approximately 2 months. Specific dates and times for each site investigation location will be identified on appointment of the site investigation contractor (due by June 2020) following detailed programming, with consideration for clustering of works and landowner preferences where possible. These detailed timings will be communicated once available and in accordance with the licence conditions.

Typical timings for each of the works proposed is provided in Section 1. Multiple site investigation rigs may operate in parallel to accelerate the programme of works.

The current programme of archaeological trial trenching will begin after the main summer harvest window 2020, from August/early - September onwards. As a whole, it is likely to run for several months. However, depending on the number of trenches and size of individual land parcels/fields, the archaeological trial trenching should only affect individual land parcels/fields for between 1 and 3 weeks, although there may be certain instances where trial trenching needs to continue for longer.

Topsoil will be stored on topsoil along one side of the trench; subsoil will be stored along the other side. Every effort will be made to ensure the mixing of topsoil and subsoil horizons does not occur. See also question 7. below.

All archaeological features will be hand excavated, sampled and recorded. Artefacts and ecofacts (including soil samples) will be collected and labelled with the unique site code and returned to the offices of the Archaeological Contractor for processing.

3. Where are the works?

Please refer to the individual marked up licence plans to view the locations of the planned engineering site investigations relevant to your land interest.

4. Will the works continue 24 hours a day?

No. Works will be between 8am and 6pm.

5. Will the work be noisy?

The noisiest element of the borehole drilling and window sampling is a small diesel motor that will run more or less continually during drilling. Right next to the rig the hammer is audible as an intermittent dull thud due to the hammer striking the casing. Beyond the field boundary in which work takes place, the noise should not be too intrusive.

The noisiest element of the trial pits will be the short term use of a mini digger with a diesel motor to excavate and reinstate the 2m³ trial pit. Beyond the field boundary in which work takes place, the noise should not be too intrusive.

6. Who is the contractor (and where are they from)?

The site investigation contractor has not yet been assigned and procurement is ongoing at this time. Once the contractor is assigned, we will inform you of those details. In addition to the site investigation contractor, GHD, who are supporting Vattenfall in the design of the onshore engineering part of the project, will have an overseeing presence during the site investigation works.

Environmental and archaeological experts will also be involved in these works, leading on the archaeological trenching, and having a watching brief presence as necessary, studying the samples and findings of the investigations as they emerge for other works. This aspect is managed by Royal Haskoning DHV, our principal environmental consultants. The archaeological contractor is also still to be appointed, but once the contractor is assigned, we will also inform you of those details.

7. Soil protection measures

Soil protection measures will be in relation to trial pits and archaeological trial trenching. Topsoil will be stored on topsoil along one side of the pit / trench; subsoil will be stored along the other side. Every effort will be made to ensure the mixing of topsoil and subsoil horizons does not occur.

All spoil heaps (soil storage) will be maintained at a safe distance and angle from the archaeological trenches during the works. Upon completion of trench investigations and at the end of each working day, time will be allowed to ensure that the spoil remains suitably stored and sealed (where necessary) e.g. to prevent any significant ingress of water. As a general rule the ends of each archaeological trial trench will be fenced off with high-visibility netting when left open over-night.

Any further specific spoil storage requirements would be established in consultation with the landowner/occupier. With respect to the archaeological trenching, spoil may be lightly compacted (bunded) once excavated for the duration of the archaeological investigations. Backfilling will comprise placing the excavated arisings back into the trench, subsoil first and topsoil on top. The backfilled material will then be lightly compacted with the machine bucket along the length of each trenched area to achieve a satisfactory level surface. Trenches will require sign-off from Norfolk County Council Historic Environment Service, prior to backfilling.



Fig 1. Picture of a borehole drill rig of the type that will be deployed locally.



Fig 2. Picture of a ground water and gas monitoring station



Fig 3. Window sample drilling rig



Fig 4. Pictures of machine opened archaeological trial trenches, prior to hand excavations