DOGGER BANK
TEESSIDE A & B

March
2014

Environmental Statement Chapter 24 Appendix B Flood Risk Assessment

Application Reference: 6.24.2

Cover photograph: Indicative image showing installation of meteorological mast within the Dogger Bank Zone

Dogger Bank – Teesside A & B

Flood Risk Assessment

Forewind Ltd

15 January 2014

Final Report

9W7904

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Date/initials approval	

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1 INTRODUCTION

1.1 Background

1.1.1 Royal HaskoningDHV has been commissioned by Forewind to carry out an Environmental Impact Assessment (EIA) for both the offshore and onshore elements of Dogger Bank Teesside A & B. As part of the onshore EIA a Flood Risk Assessment (FRA) is required; this will also accompany the Development Consent Order (DCO).

1.1.2 Dogger Bank Teesside A & B is Forewind's second stage of development of the Dogger Bank Zone. Dogger Bank Teesside A & B will each have a maximum installed capacity of 1.2GW. The onshore element comprises all infrastructure landward of the Mean High Water Mark (MHWM) including:

- A preferred landfall location between Redcar and Marske-by-the-Sea (shown in **Appendix A** Figure 1);
- Two buried High Voltage Direct Current (HVDC) cable systems (each cable system contains a pair of main cables and communications within a single trench) (shown in **Appendix A** Figure 2);
- Two converter stations and associated development (shown in **Appendix A** Figure 3); and
- Two buried High Voltage Alternating Current (HVAC) cable systems (one per project) connecting the converter stations to the existing National Grid substation at Lackenby (shown in **Appendix A** Figure 3).

1.1.3 The onshore cable corridor begins at the landfall between the town of Redcar and the village of Marske-by-the-Sea (**Appendix A**, where the export cables come ashore. The two main cable construction techniques proposed are trenching and horizontal direction drill (HDD). Trenching will be used along the majority of the route, while HDD will be used to cross significant obstacles such as watercourses, rail lines and major roads where trenching cannot be achieved (6 no. HDD crossings are detailed in **Appendix A** Figure 2). During HDD tunnels are bored under the structure and the cables pulled through the underlying geology.

1.1.4 The project area this FRA covers is:

1. The underground onshore High Voltage Direct Current (HVDC) cable route from landfall to the converter stations site;
2. The converter stations site;
3. The High Voltage Alternating Current (HVAC) cable route between the converter stations site and the existing National Grid substation at Lackenby; and
4. The National Grid enabling works at the existing National Grid Electricity Transmission (NGET) Lackenby Substation (National Grid to consent separately if required).

1.1.5 This FRA has been produced in accordance with the National Planning Policy Framework (NPPF) and associated Technical Guidance, published in March 2012. The flood risk principles within the NPPF are to avoid inappropriate development in areas at risk of flooding and, wherever possible, to direct development away from areas of highest risk. Local authorities should steer development to Flood Zone 1 (low risk), and only consider development in, sequentially, Flood Zones 2 and 3 if there is no appropriate and available site in an area of lower flood risk.

1.1.6 All works for the onshore development of Dogger Bank Teesside A & B are within Flood Zone 1 and as such are complying with the NPPF requirement to avoid development in areas at risk of flooding.

1.1.7 During the development of the FRA, pre-planning consultation has been carried out with the Environment Agency (EA), Redcar & Cleveland Borough Council (RCBC) and Northumbrian Water to discuss the risks of flooding to and from the development which have been assessed and determined through the work completed.

1.2 Site Location

1.2.1 The preferred location for the converter stations site is shown in Figure 3 of **Appendix A**. One key factor in selecting this as the preferred site is its location in Flood Zone 1 (therefore passing the flood risk sequential test).

1.2.2 Other additional factors assessed at the site selection phase were favourable to select this site, such as; reasonable site access, proximity to the National Grid site; a receptive landowner in Wilton International, excellent site capacity (34Ha) for development and also a preferable cable route option to this site.

2 DEVELOPMENT AND FLOOD RISK

2.1 Type of Development and Location

Converter Stations Site

2.1.1 The chosen location for the converter stations site is within the Wilton Complex, a privately developed industrial site.

2.1.2 The operational footprint of each converter station is approximately 2 hectares (shown in **Appendix A** Figure 3). The development will comprise two converter stations which will convert direct current (DC) export power to 400kV alternating current (AC) prior to connection to the existing NGET substation at Lackenby.

HVDC & HVAC Cable Routes

2.1.3 The onshore High Voltage Direct Current (HVDC) cable route starts between Redcar and Marske-by-the-Sea on the East Yorkshire coast, and extends in a westerly direction prior to reaching the converter stations site in the Wilton Complex just east of Lackenby, the High Voltage Alternating Current (HVAC) cable route then extends from the converter stations site to the substation at Lackenby. Figures showing the HVDC and HVAC cable route are included as **Appendix A**; the cable routes will cross the A174 in two locations and the A1053 (Greystone Road) as well as crossing 7 no. minor roads (including private roads), 2 notable watercourses and a railway line. The cables will be buried for the entire length of the route from landfall to the converter stations site, and will be installed using both conventional open trench and HDD techniques for construction.

National Grid Enabling Works

2.1.4 The existing Lackenby substation is located approximately 1.5km to the south east of the converter stations site and can be seen on Figure 3 in **Appendix A**.

2.1.5 National Grid has confirmed that the enabling works proposed for their site are to be contained within the building extensions on the existing site. As the existing site is entirely within Flood Zone 1 there is no further consideration required as part of this Flood Risk Assessment.

2.1.6 However, confirmation of this is to be acquired by National Grid separately to this assessment. The National Grid Flood Mitigation Policy (**Appendix E**) states that early consultation should be carried out with the EA and RCBC irrespective of whether planning permission will be required.

2.2 Vulnerability Classification

2.2.1 In terms of flood risk and vulnerability, Table 2 of the NPPF Technical Guidance classifies all the components of the development; converter stations site, buried cable systems and works at the existing NGET substation at Lackenby as 'Essential Infrastructure'. Table 3 of the Guidance indicates that developments of this flood type are considered to be appropriate in Flood Zones 1 and 2 but are permitted in Flood

Zones 3 if the 'Exception Test' can provide further justification for locating them there. The application of the Sequential Test should guide development to Flood Zone 1 first, then Flood Zone 2 and finally Flood Zone 3.

2.2.2 The following section of this report identifies how the flood risk along the HVDC & HVAC cable routes and at the converter stations site has been assessed, and confirms that the flood risk Sequential Test has been appropriately applied. This exercise has not yet been undertaken for any potential enabling works at the existing NGET substation at Lackenby.

2.2.3 The report also details and confirms that all of the works areas are within Flood Zone 1.

3 DEFINITION OF FLOOD HAZARD

3.1 Data used for the FRA

3.1.1 The following data has been collected and used for the FRA:

- Overall onshore layout details (**Appendix A** Figures);
- Site photos (**Appendix B**); and
- Consultation with Northumbrian Water, EA and RCBC (**Appendix C**).

3.2 Site Visit

A site visit was carried out on 28 November 2012 by a number of the EIA team including the technical expert responsible for the FRA. A selection of site photos from the visit can be found in **Appendix B**. The site visit was relevant to better understand the works, to ascertain the site layout and topography and the existing drainage features in the vicinity of the converter stations site.

3.3 Consultation and Local Development Documents

Strategic Flood Risk Assessment

3.3.1 In March 2010, RCBC published a Level 1 Strategic Flood Risk Assessment (SFRA) in which provides baseline information on flood risk in the authority area. The SFRA is a tool which plays an important role in delivering sustainable development; it is the starting place from which the sequential test can be applied in order to direct development towards Flood Zone 1.

3.3.2 The SFRA identified that there is a risk of flooding to numerous areas within RCBC, predominantly tidal flood risk in the coastal areas to the east of the Borough. The SFRA indicates that the entirety of the cable route from the landfall and the converter stations site is within Flood Zone 1 and is therefore considered to have a low risk of fluvial flooding; less than a 1 in 1000 annual probability.

3.3.3 The SFRA recommends that runoff for developments in all flood zones should be reduced through the implementation of Sustainable Drainage Systems (SuDS). The SFRA also states that development on greenfield sites will be expected to restrict runoff to the greenfield runoff rate whilst brownfield sites will be expected to reduce existing runoff rates by a minimum of 30%.

Local Development Documents

3.3.4 RCBC have commenced work on the preparation of a new Local Plan that will eventually replace the Local Development Framework (LDF) as the statutory development plan for the borough. These changes are being made in response to the Government's National Planning Policy Framework, which was published in March 2012.

3.3.5 The LDF which is currently in place with RCBC is being phased out as part of the Local Development Scheme between 2012 and 2015, with the proposed adoption of the Local

Plan in August 2014. The LDF comprises a suite of documents, including a core strategy, development plan documents and associated supplementary planning documents.

3.3.6 The key policies within the current RCBC LDF Core Strategy (adopted July 2007) relevant to the Flood Risk Assessment are:

3.3.7 CS1 – Securing a Better Quality of Life – Cross linked to Policy 2 of the Borough's Regional Spatial Strategy (RSS), the principle of Sustainable Development underpins the policies and proposals for the use and development of land in the LDF. Specific to the FRA process, this includes controlling development in areas at risk of flooding.

Consultation

3.3.8 The EA, RCBC and Northumbrian Water have been consulted to gain information for the FRA (copies of all emailed consultation responses are included in **Appendix C**), and all this information has been taken into account when developing this report.

3.3.9 The EA has responded confirming there are no historic flooding issues in the vicinity of the converter stations site.

3.3.10 RCBC responded confirming that that the proposed route of the works is within Flood Zone 1. They have also referred to the RCBC Strategic Flood Risk Assessment to confirm that the works will not be affected by surface water flooding. Finally, RCBC confirmed they hold no records of flooding in the areas highlighted.

3.3.11 For information, RCBC states in the response that the proposed route will cross a number of watercourses and any works, on, in or near a watercourse will require their consent.

3.3.12 Northumbrian Water has responded to our consultation, again confirming there is no sewer flooding incidents recorded in the vicinity of the converter stations site or the wider cable route area.

3.4 Potential Sources of Flooding to the Converter Stations Site

3.4.1 The Technical Guidance that supports the NPPF states that there are a number of sources of flooding which need to be considered within any FRA. The potential sources of flooding to the converter stations site are discussed in the sections below.

Flooding from Rivers

3.4.2 The nearest main river watercourse to the converter stations site is the River Tees, approximately 4km north west of the site. This watercourse is a major river in the north east of England which passes through the town of Middlesbrough before discharging into the North Sea. There is no flood risk to the site from this watercourse or any other in the vicinity of the site.

3.4.3 The EA have confirmed there is no historic record of flooding in the area.

Flooding from the Sea (Tidal or Coastal)

3.4.4 There is no tidal flood risk to the converter stations site.

Pluvial Flooding

3.4.5 Volume II of the RCBC Level 1 SFRA (March 2010) confirms there are no historic flooding locations shown near the site and this is confirmed by the consultation response by RCBC noted in section 3.3.10.

3.4.6 Therefore, the requirement for the development of the site is to ensure that the converter stations site does not increase risk elsewhere.

Sewer Flooding

3.4.7 The sewer layout around the converter stations site has been reviewed. This review has shown that there are no foul or combined sewers in the immediate vicinity of the site. Therefore sewer flooding is not considered an issue.

3.4.8 This has been confirmed through consultation with Northumbrian Water who also confirms there is no historical flooding evident in the vicinity of the site.

Groundwater

3.4.9 Groundwater flooding can occur when water stored beneath the ground reaches the surface and is generally associated with porous rocks, e.g. sands and gravels. The Level 1 SFRA (Vol II) refers back to the Draft Tees Catchment Flood Management Plan (CFMP) which states that there is little documented evidence of groundwater flooding in the Tees catchment.

Climate Change Impacts

3.4.10 The NPPF Technical Guidance outlines that an increase of 20% and 30% should be given to peak river flows and rainfall intensities respectively. This allowance is recommended as a sensitivity check for assessment. This is not relevant to this FRA as the application of climate change sensitivity allowance to the existing flooding outlines will not affect any of the works area.

3.5 Potential Sources of Flooding to the HVDC and HVAC Cable Routes

Flooding from Rivers

3.5.1 A screening of the proposed HVDC and HVAC cable routes from landfall to the converter stations site and from the converter stations site to the existing NGET substation at Lackenby was carried out to understand any significant flood risk issues. The focus of the screening was on the construction stage alone (and not on the permanent works), as on completion of construction the entire cable route will be underground. The screening process identified that the cable route does not cross any areas within Flood Zones 2 and 3 and is therefore considered to be at low risk.

Table 3.1 Cable route screening summary

Crossing ref.	Watercourse type and name (if any)	Flood Zone of crossing point	Construction method to be used	Assumed source of flood risk (if any)	At Risk Nearby (within c. 50m) / adjacent properties and type (if any)
1	Assumed land drain adjacent to Cat Flatt lane	1	Open cut with overpumping if required	None	None
2	land drain along field boundary close to Grewgrass Farm	1	Open cut with overpumping if required	None	None
3	Roger Dike	1	To be crossed using HDD - no residual risk during construction	None	None
4	Land drain running north - south, parallel with Fishponds Road	1	To be crossed using HDD - no residual risk during construction	None	None
5	Mains Dike (close to Mains Dike Bridge on the A174)	1	To be crossed using HDD - no residual risk during construction	None	None
6	South Avenue surface water drain	1	To be crossed using HDD - no residual risk during construction	None	None
7	Kettle Beck adjacent to the A1053 (Greystone Road)	1	To be crossed using HDD - no residual risk during construction	None	None
8	Drain from Kettle Beck adjacent to the A1053 (Greystone Road)	1	Haul road crossing with temporary bridge and culvert	Channel restriction	None

3.5.3 The following reasons account for this conclusion:

- The cable route has already been selected to avoid developed areas where possible. It is generally undeveloped and so watercourse crossings do not coincide with built up areas. Therefore there is limited potential for flood risk impacts to properties associated with crossing watercourses during the construction phase;

- The only watercourses of any significance (Roger Dike & Mains Dike) are being dealt with by crossing them using HDD in order to reduce the potential impact (including flood risk); and
- The other watercourses identified are minor drainage ditches and therefore any flood risk issues are likely to be localised to the crossing point rather than have any wider impacts. Crossing these ditches by cutting through and overpumping (for example) is unlikely to cause any significant increase in flood risk.

Flooding from the Sea (Tidal or Coastal)

3.5.4 The EA flood map indicates that there is tidal flood risk to the foreshore in the vicinity of the landfall site. However, the area of foreshore is significantly lower than the hinterland. Therefore there is no tidal flood risk inland of this point.

3.5.5 The River Tyne to Flamborough Head Shoreline Management Plan 2 (February 2007) states that the policy for the Management Area of the coast associated with the landfall site (MA15.1) is 'No Active Intervention'. This policy will have no implications on flood risk going forward when considering the cable routes and landfall.

4 IMPACT ON LOCAL FLOODING REGIME

4.1 Converter Stations Site

4.1.1 The converter stations site is not within a fluvial floodplain and therefore they will not reduce flood storage or affect fluvial flow routes.

4.1.2 Approximately two-thirds of each converter station operational area will be roofed (valve hall and control building). The remainder of the area includes the external AC yard and access roads. All of this area will be impermeable, whereas the current land use is agricultural grassland. The converter stations site will therefore result in an increase in impermeable area compared to current use at the site; any consequent increase in runoff will have to be mitigated to ensure no increase in flood risk elsewhere.

4.2 HVDC Cable Route

4.2.1 The cable route will cross only two watercourses of note (Roger Dike and Mains Dike), as well as some smaller land drainage ditches. On completion of the works the cable will be fully underground. HDD will be used to lay the cables under Roger Dike and Mains Dike which will ensure no impact to the watercourses. It is currently being proposed that the cable will be cut through any smaller watercourses which it is required to cross. However, as the route runs through predominantly undeveloped areas it is unlikely that cutting through watercourses will cause increased flood risk to residential property, especially when the limited amount of time for which the cutting will be in place during construction is considered.

4.2.2 After completion the cable will be fully underground and watercourses will be reinstated; there will therefore be no residual flood risk issues.

5 FLOOD RISK MANAGEMENT MEASURES

5.1.1 In order to manage the surface water run-off from the converter stations site, an adequate drainage system is required. When developed in detail the surface water drainage system for the stations should consider operation and maintenance issues. The system should be robust, prevent blockages and allow ease of maintenance and reduce long term maintenance costs.

5.2 Converter Stations Site Drainage

5.2.1 Ramboll are contracted civil engineers working on behalf of Forewind. Ramboll has produced an Initial Drainage Assessment (**Appendix D**) which has outlined the calculated volumes of runoff which need to be managed. The surface water attenuation will be sized for at least the 1 in 100 storm event plus an allowance of 30% for climate change. Storage of the surface water either above or below ground through attenuation is required prior to discharge at a restricted rate. An allowable discharge rate of 16.2 litres/second (l/s) is proposed based on greenfield runoff rates using the Institute of Hydrology Report 124 methodology. This will be confirmed through consultation with the EA and RCBC.

5.2.2 Based on the proposed allowable discharge rate of 16.2 l/s for the site and the impermeable area of the converter stations site, Ramboll has calculated the following surface water storage which will be required to achieve greenfield run off rates (until the detailed design is finalised ranges of potential attenuation volume requirements are given at this stage; the final figure will depend on drainage design and configuration):

- 1 in 30 year – between 550m³ and 800m³;
- 1 in 100 year – between 750m³ and 1100m³; and
- 1 in 100 year + 30% CC – between 1050m³ and 1550m³.

5.3 Identified SuDS Solutions

5.3.1 In order to provide sufficient attenuation of runoff in order to achieve the equivalent greenfield site runoff rate, SuDS will be required. Ramboll has carried out a surface water assessment and has proposed a number of potential options to attenuate the flow. These attenuation options are discussed in detail in the initial drainage assessment report in **Appendix D**, with a summary of the options below.

5.3.2 *Permeable or porous surfaces* – This will be feasible for use on access roads and in parking areas.

5.3.3 *Swales* – These grassland depressions will be lined and will convey surface water runoff to a storage system. This option is feasible for the collection of water from the access roads around the perimeter of each converter station. As infiltration is deemed undesirable for the site, these features will need to be lined.

5.3.4 *Above ground storage, detention basins or ponds* – these features provide attenuation of surface water run-off in storm conditions but can require considerable land take.

5.3.5 *Underground Storage* – An underground system could be fitted to the drainage system to provide large storage volumes in a small area. This could be a feasible option and placed under the car parking area, roads or soft landscaped areas.

5.3.6 Consultation with the site owner confirmed there is suitable private surface water drainage available in the vicinity which discharges to an open drainage ditch on Southway (shown in the site photos in **Appendix B**) which flows into Mains Dike. This system is considered sufficient to accept the additional surface water runoff from the converter stations site.

5.3.7 The Initial Drainage Assessment states that swales and a detention basin are the most viable methods for conveying and attenuating the surface water runoff from the areas of hardstanding prior to discharge into the adjacent drainage ditches. This is both because the receiving drainage ditch itself is relatively shallow, and therefore surface drainage systems are preferable, and also because the swale and detention basin can provide additional ecological habitat.

5.4 Residual Risk Management

5.4.1 Relevant measures from the above list will be included in the final design to ensure that on completion of construction there will be a low residual risk to the converter stations site. As there is no residual risk of flooding associated with the development, only standard measures are suggested.

6 CONCLUSIONS AND RECOMMENDATIONS

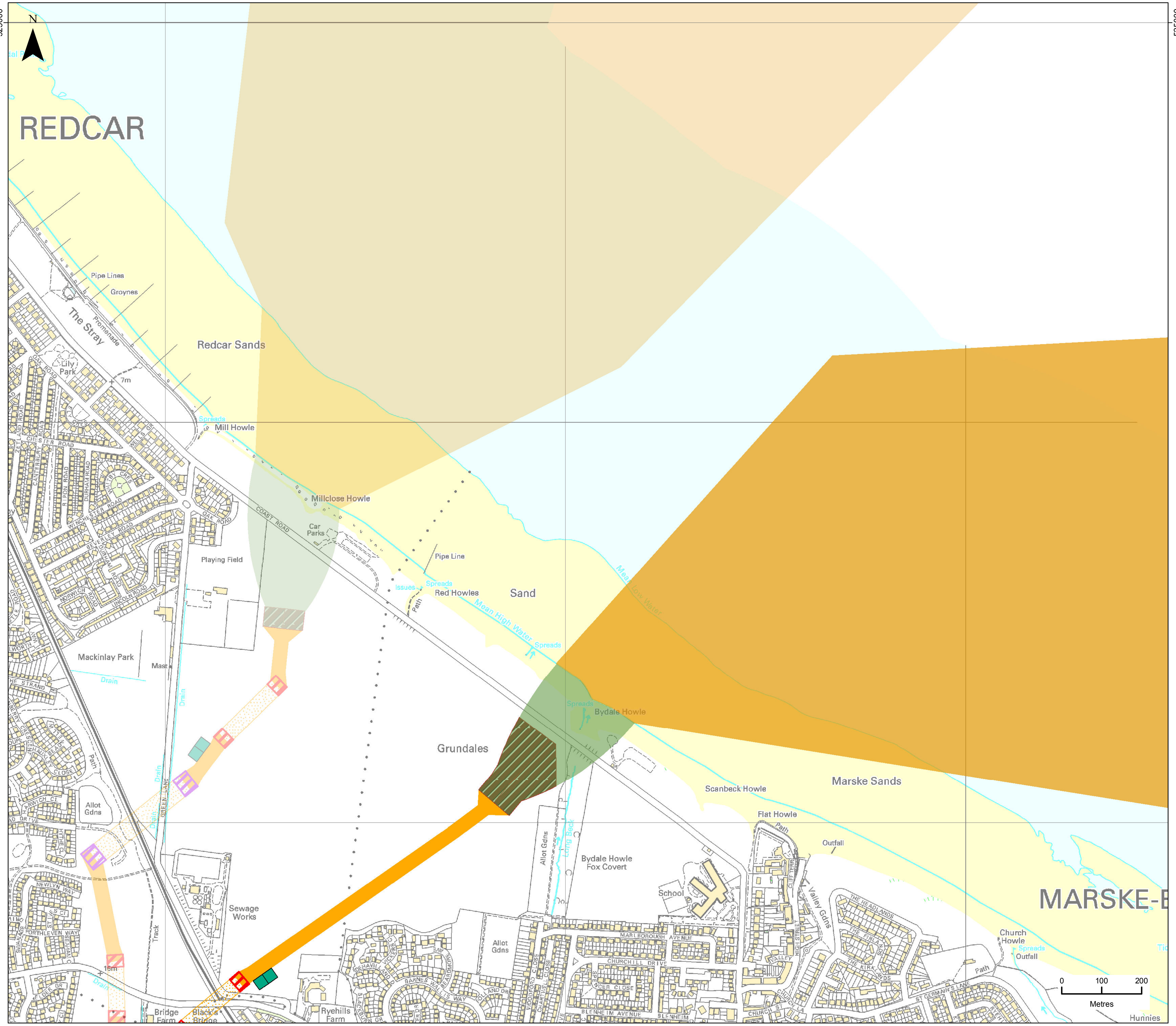
6.1.1 Flood risk issues at the converter stations site have been assessed for both flood risk to the site and also any potential flood risk issues that their construction could cause. The key conclusions from the FRA are:

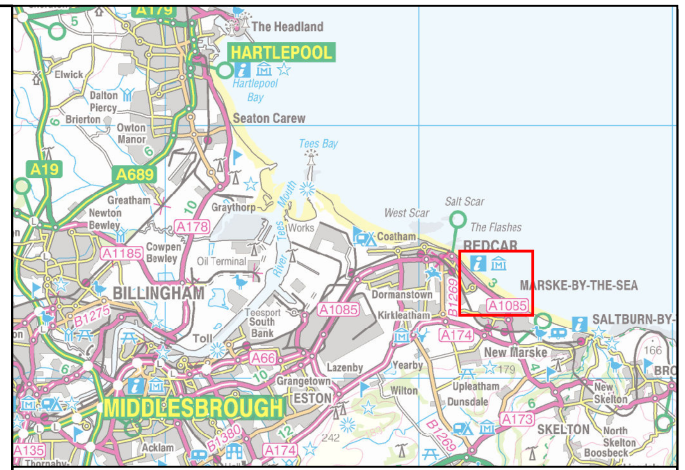
- Consultation has been carried out with the EA, RCBC and Northumbrian Water;
- The converter stations site is within Flood Zone 1 demonstrating it is not at risk from fluvial sources;
- Solutions are proposed within the design to reduce the rate of surface water runoff from the converter stations site; and
- The enabling works at the existing NGET substation at Lackenby are to be carried out within the existing site which is entirely within Flood Zone 1.

6.1.2 The cable route between the landfall and the site of the converter stations site has also been assessed for flood risk only during construction. Once operational it will be underground. There are no significant flood risk issues identified with the associated watercourse crossings as the location of the cable route was selected to avoid developed areas where possible. It is generally rural and so watercourse crossings do not coincide with built up areas. HDD will be used to cross the significant watercourses to ensure there is no disruption to watercourse flow. Smaller watercourses and ditches are likely to be open cut trenching, however this is still to be confirmed through further consultation.

6.1.3 Based on the information gathered and the proposed mitigation measures, in line with the technical guidance provided by the NPPF, it is considered that the construction of converter stations on the site are appropriate in terms of flood risk and, further, meet key consultees requirements.

Appendix A - Figures





LEGEND

Teesside A & B

- Teesside A&B export cable
- Teesside A&B cable landfall
- Teesside A&B landfall construction
- Teesside A&B HVDC, Open
- Teesside A&B HVDC,
- Teesside A&B minor horizontal directional drill entry or exit locations (1,200m²)
- Teesside A&B intermediate construction compound

Teesside C & D

- Teesside C&D export cable route
- Teesside C&D cable landfall envelope
- Teesside C&D landfall construction envelope
- Teesside C&D HVDC, Open trench
- Teesside C&D HVDC, HDD
- Teesside C&D major horizontal directional drill entry or exit locations (2,000m²)
- Teesside C&D minor horizontal directional drill entry or exit locations (1,200m²)
- Teesside C&D intermediate construction compound (784m²)

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PROJECT TITLE

DOGGER BANK R3 DEVELOPMENT

DRAWING TITLE

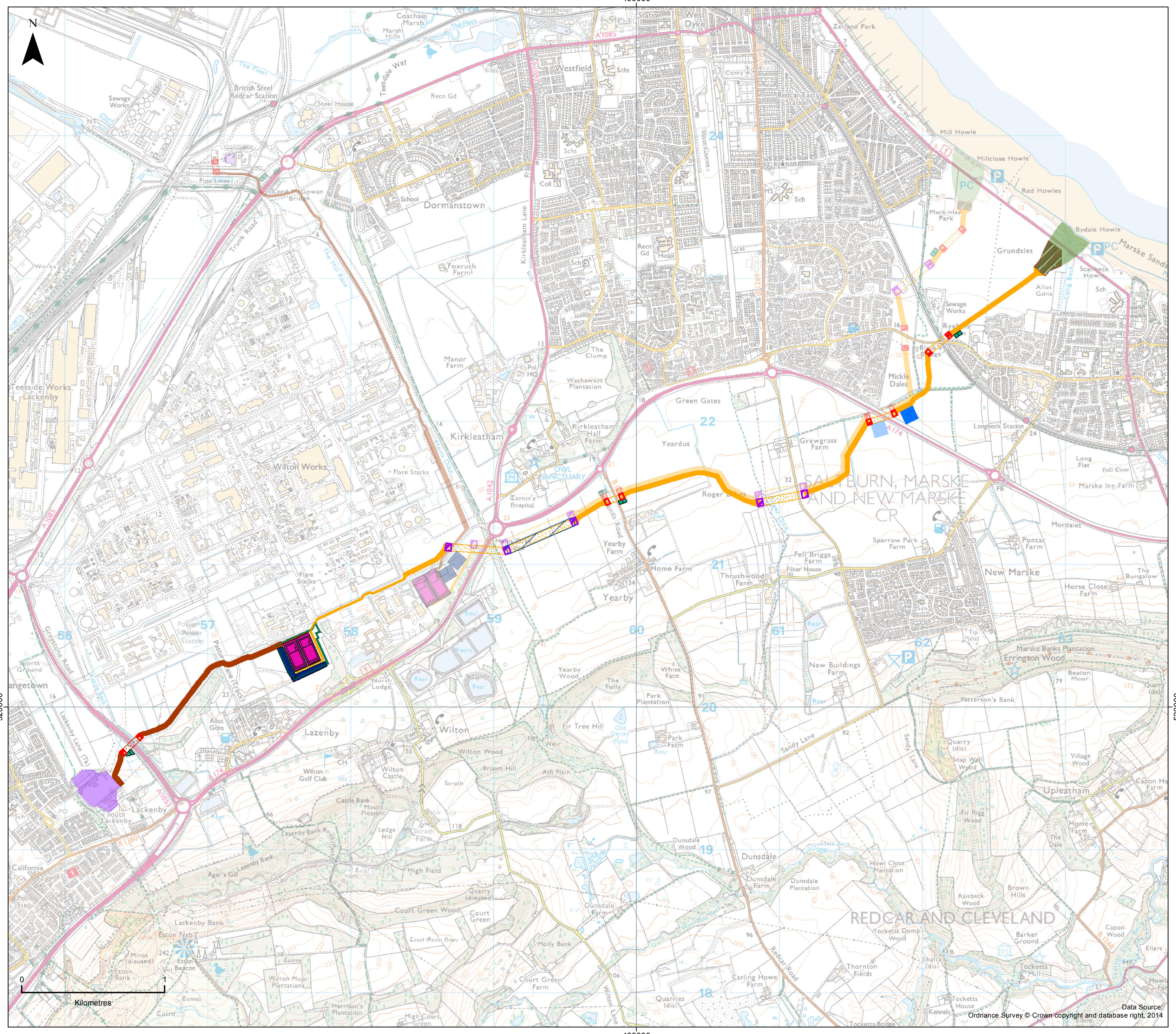
Figure 1: Dogger Bank Teesside A & B - Landfall

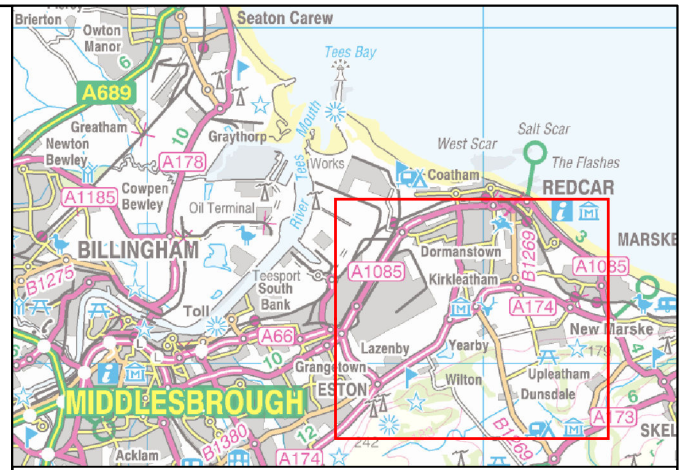
VER	DATE	REMARKS	Drawn	Checked
1	05/02/2014	CPD v6.1	SW	DW
2	11/02/2014	Pre-DCO submission review	LW	DW
3	19/02/2014	Pre-DCO submission review	SW	DW

DRAWING NUMBER: **T-DES-0149-01**

SCALE	1:10,000	PLOT SIZE	A3	DATUM	OSGB	PROJECTION	BNG

FOREWIND





LEGEND

- Teesside A&B cable landfall envelope
- Teesside C&D cable landfall envelope
- Teesside A&B landfall construction envelope
- Teesside C&D landfall construction envelope
- Teesside A&B HVDC, Open trench
- Teesside A&B HVDC, HDD
- Teesside A&B HVAC, Open trench
- Teesside A&B HVAC, HDD
- Teesside C&D HVDC, Open trench
- Teesside C&D HVDC, HDD
- Teesside C&D HVAC, Open trench
- Teesside C&D HVAC, HDD
- Teesside A&B major horizontal directional drill entry or exit locations (2,000m²)
- Teesside A&B minor horizontal directional drill entry or exit locations (1,200m²)
- Teesside C&D major horizontal directional drill entry or exit locations (2,000m²)
- Teesside C&D minor horizontal directional drill entry or exit locations (1,200m²)
- HDD or open trench to be confirmed
- Teesside A&B cable route primary construction compound (10,000m²)
- Teesside C&D cable route primary construction compound (10,000m²)
- Teesside A&B intermediate construction compound (784m²)
- Teesside C&D intermediate construction compound (784m²)
- Teesside A&B converter stations
- Teesside C&D converter stations
- Teesside A&B converter stations construction compounds (10,000m² per project)
- Teesside C&D converter stations construction compounds (10,000m² per project)
- Lackenby 400kV substation
- Tod Point 400kV substation
- Teesside A&B converter station site
- Teesside C&D converter station site

PROJECT TITLE

DOGGER BANK R3 DEVELOPMENT

DRAWING TITLE

Figure 2: Dogger Bank Teesside A & B – Indicative Onshore Cable Route and Infrastructure

VER	DATE	REMARKS	Drawn	Checked
1	05/02/2014	CPD v6.1	SW	DW
2	11/02/2014	Pre-DCO submission review	LW	DW
3	19/02/2014	Pre-DCO submission review	LW	DW

DRAWING NUMBER:

T-DES-0160-01

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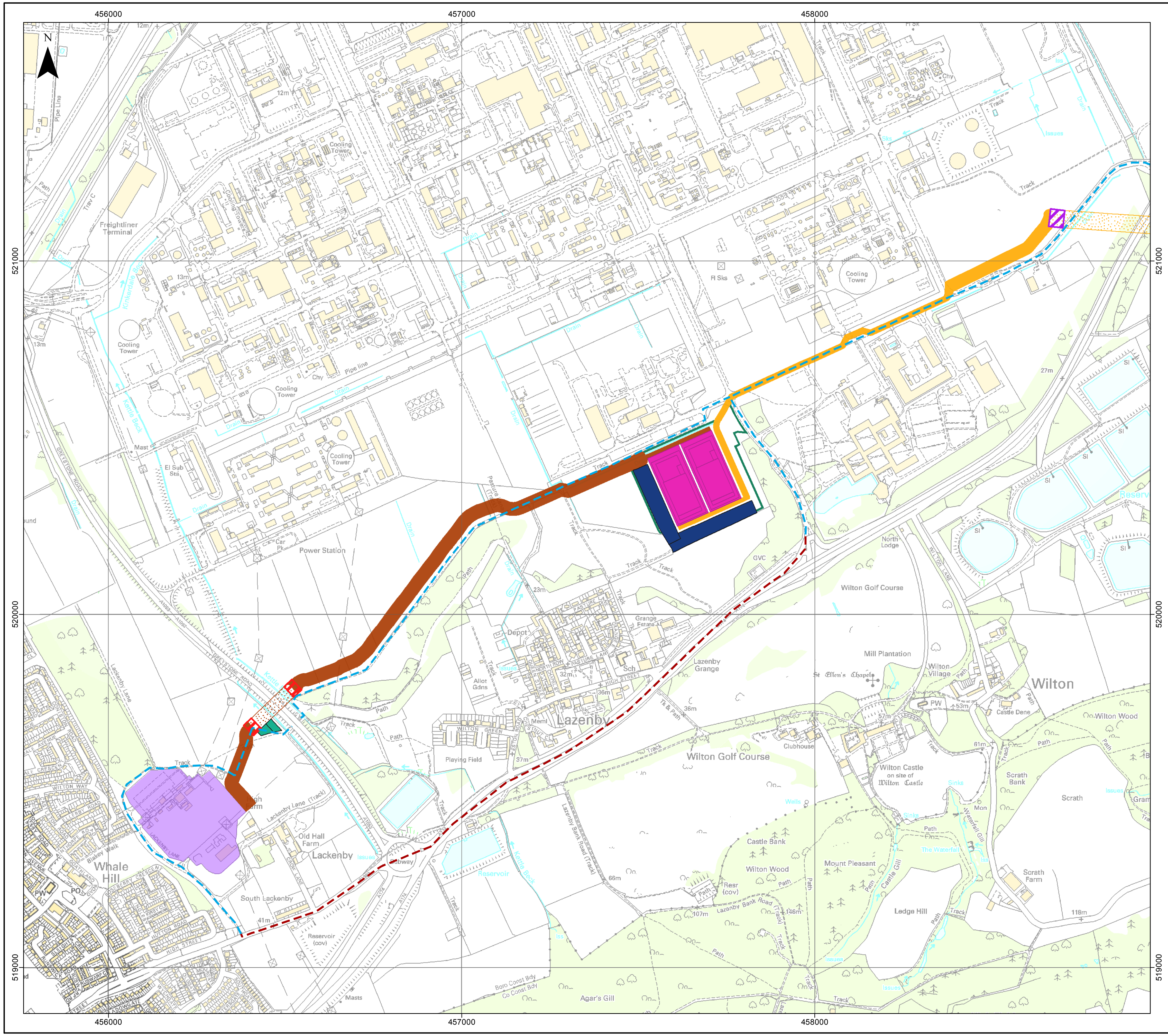
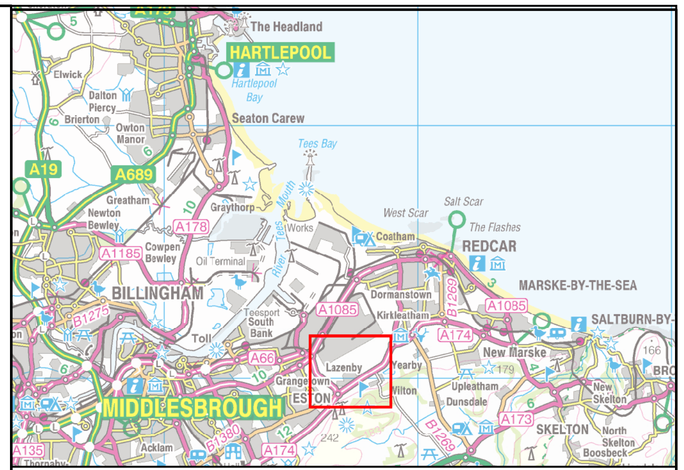
FOREWIND





LEGEND

- Teesside A&B HVDC, Open trench
- Teesside A&B HVDC, HDD
- Teesside A&B HVAC, Open trench
- Teesside A&B HVAC, HDD
- Teesside A&B major horizontal directional drill entry or exit locations (2,000m²)
- Teesside A&B minor horizontal directional drill entry or exit locations (1,200m²)
- Teesside A&B intermediate construction compound (784m²)
- Teesside A&B converter stations
- Teesside A&B converter stations construction compounds (10,000m² per project)
- Lackenby 400kV substation
- Teesside A&B converter station site

Construction access roads

- Public Road
- Private Road / Track

0 250 500
Metres

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DOGGER BANK TEESSIDE A & B

DRAWING TITLE

Figure 3: Dogger Bank Teesside A & B – Wilton Complex Infrastructure

VER	DATE	REMARKS	Drawn	Checked
1	05/02/2014	CPD v6.1	SW	DW
2	11/02/2014	Pre-DCO submission review	LW	DW
4	07/03/2014	Pre-DCO submission review	LW	DW

DRAWING NUMBER: **T-DES-0145-01**

SCALE	PLOT SIZE	DATUM	PROJECTION
1:11,000	A3	OSGB	BNG

FOREWIND

Appendix B – Site Photos

East of the proposed converter stations site, looking from the Wilton Complex Access Road (Queens Avenue East)		Looking East from the west side of the proposed site.	
Looking North along Queens Ave East. The boundary fence on the left is the East boundary of the proposed site.		Existing Drainage ditch running west to east along Southway within the Wilton Complex.	

Site of the landfall between Marske-by-the-Sea and Redcar		Roger Dike at Longbeck Lane	

Appendix C – Stakeholder Consultation Responses

Graham, S.J. (Steve)

From: Daniel Woodward <Daniel.Woodward@nwl.co.uk>
Sent: 05 February 2013 10:33
To: Graham, S.J. (Steve)
Subject: RE: email 1 of 2 - Pre-planning enquiry for proposed development: Onshore Elements of the Dogger Bank Offshore Windfarm (Teesside Projects A & B)
Attachments: Wilton Works Flooding History Map.pdf; Mickle Dales Flooding History Map.pdf; Teesside A & B Development Flood History Map.pdf

Hi Steve

I have attached a copy of our sewer flooding records for the site. I have focused on the 2 construction areas labelled on your plan as well as attached a copy of the whole area and cable route.
As you can see there's no historic flooding that will affect your development only floods in nearby villages that we have records of. Please note this does not include any private drains & sewer flooding.

In relation to discharge rates unfortunately I am unable to help with this. To get this information I would advise you to contact our pre development enquiry team on 0191 419 6646. You may have to submit a pre development enquiry in order for NWL to model sewers in the vicinity to advise of any likely discharge rate restrictions & discharge points.

I hope this information is useful and if you have any questions please feel free to contact me.

Thanks

Daniel Woodward
New Development
Northumbrian Water
Tel: 0191 419 6731

From: Graham, S.J. (Steve) [mailto:steve.graham@rhdhv.com]
Sent: 04 February 2013 16:41
To: Daniel Woodward
Subject: RE: email 1 of 2 - Pre-planning enquiry for proposed development: Onshore Elements of the Dogger Bank Offshore Windfarm (Teesside Projects A & B)

Hi Daniel,

The Teesside A&B sites detailed at the Wilton Complex are the main onshore development sites in terms of actual installation construction so yes, this is the main focus of the FRA. However, I would certainly advocate 'the more the better' so if there is any known flood history in the general vicinity of the site that may have influenced the site in the past or likewise, along the cable route show on the plans, it would be greatly appreciated to inform the FRA.

Many thanks,
Steve

Steve Graham
Senior Consultant / Project Manager
Coastal & Rivers UK - Leeds
T +44 (0)113 388 4889 | **M** +44 (0)7855 450148 | **E** steve.graham@rhdhv.com | **W** www.royalhaskoningdhv.com

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From: Daniel Woodward [mailto:Daniel.Woodward@nwl.co.uk]
Sent: 04 February 2013 14:15
To: Graham, S.J. (Steve)

Subject: RE: email 1 of 2 - Pre-planning enquiry for proposed development: Onshore Elements of the Dogger Bank Offshore Windfarm (Teesside Projects A & B)

Hi Steve

Just reviewing the plans now.

What sites are you looking for the flood history for? Am I correct to say it is the 2 sites labelled "Teesside A & B"? Or do you need the history for more than this?

Thanks

Daniel Woodward
New Development
Northumbrian Water
Tel: 0191 419 6731

From: Graham, S.J. (Steve) [mailto:steve.graham@rhdhv.com]
Sent: 04 February 2013 11:45
To: Daniel Woodward
Cc: Henderson, R. (Ruth); Chris Gibbs (Chris.Gibbs@forewind.co.uk)
Subject: email 1 of 2 - Pre-planning enquiry for proposed development: Onshore Elements of the Dogger Bank Offshore Windfarm (Teesside Projects A & B)
Importance: High

Dear Daniel,

Following recent contact with one of your colleagues it was confirmed to me that you are the appropriate point of contact for this planning consultation. Please find attached a formal letter of consultation for the Onshore Elements of the Dogger Bank Offshore Windfarm (Teesside Projects A & B) and associated site information for your review (please note there is a second email to follow, keeping the email sizes below 10Mb).

I will attempt to give you a telephone call early this week to confirm the receipt of this consultation and discuss potential timescales for response. I do not intend to issue these in hardcopy format, however if you wish me to I will be happy to print and post, please let me know if this is desirable.

Many thanks in advance for your input,

Kind Regards,
Steve Graham

Steve Graham
Senior Consultant
Coastal & Rivers UK - Leeds

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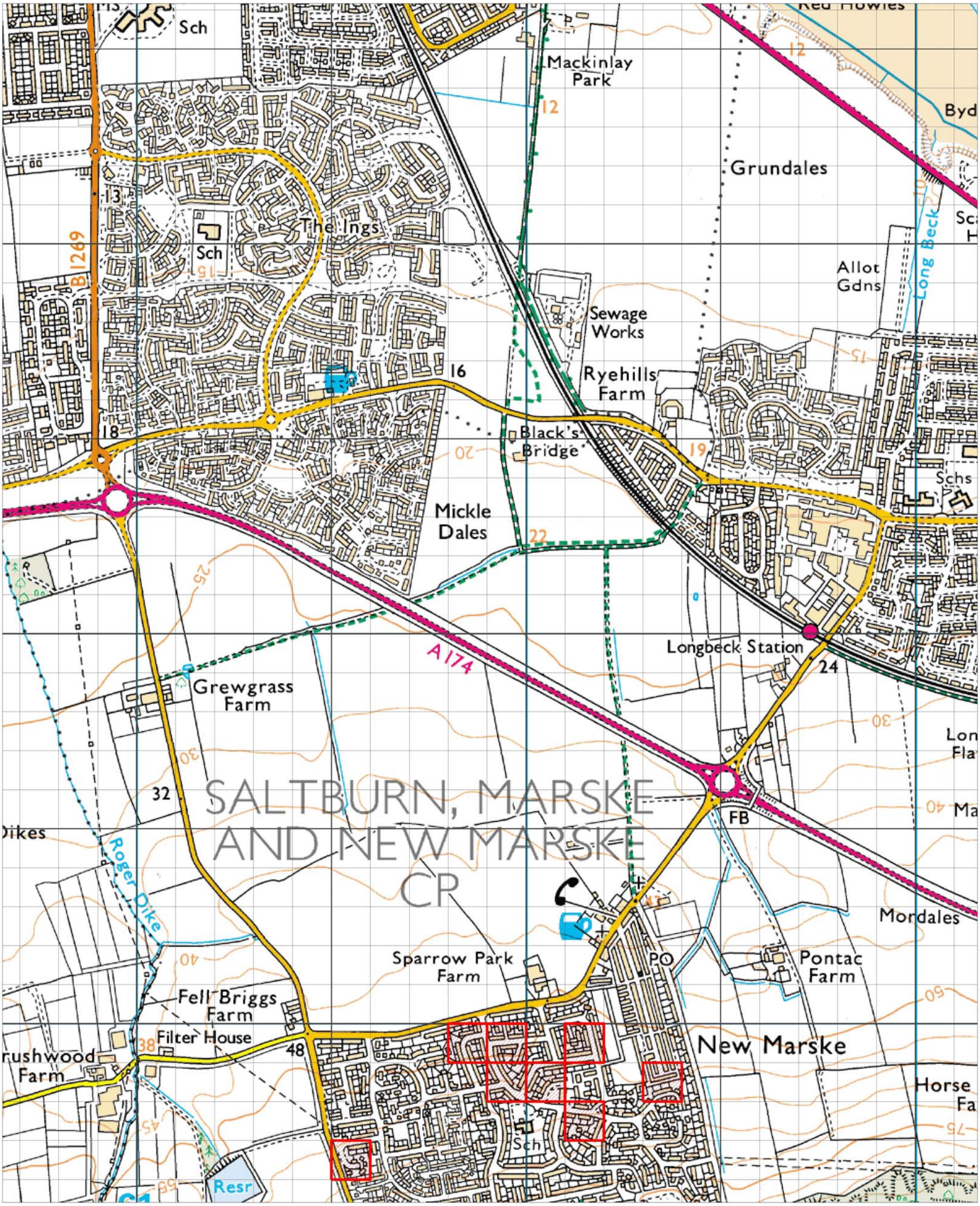
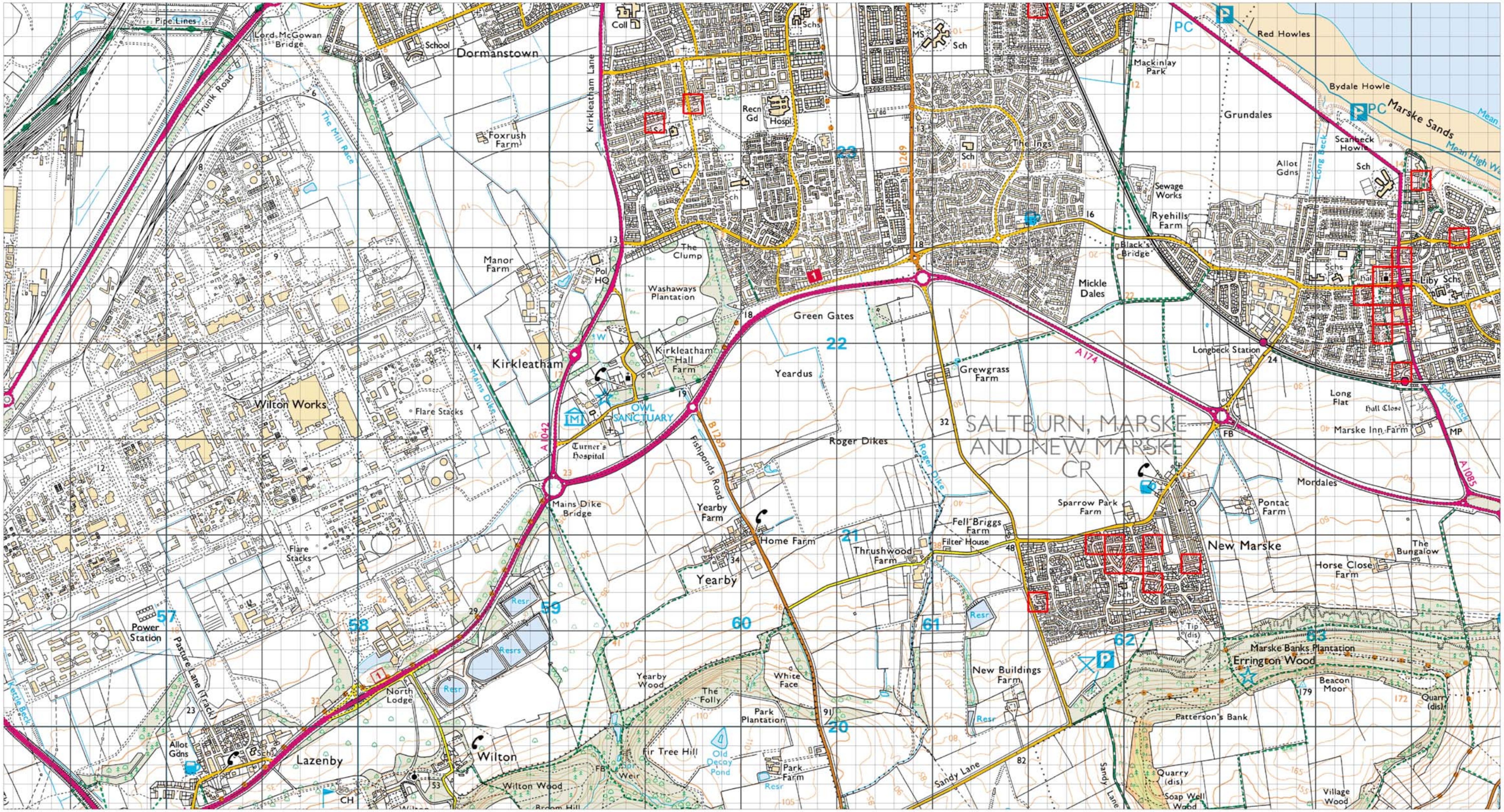


100m grid square where there has been reported sewer flooding.

100m grid square where there has been reported sewer flooding in an extreme event.

Author : CAPEL	Date : 05-02-2013
Title :	Sheet: NZ6122
Centre Point : 461907,522079	Scale : 1:4600

NORTHUMBRIAN WATER



(blue square)	100m grid square where there has been reported sewer flooding
(red square)	100m grid square where there has been reported sewer flooding in an extreme event.

Author : CAPEL

Title :

Centre Point : 460058,521673

Date : 05-02-2013

Sheet : NZ6021

Scale : 1:7000

NORTHUMBRIAN WATER

100m grid square where there has been reported sewer flooding.

100m grid square where there has been reported sewer flooding in an extreme event.

Author	: CAPEL	Date	: 05-02-2013
Title	:	Sheet:	NZ5720
Centre Point	: 457598,520295	Scale	: 1:4600

NORTHUMBRIAN WATER

Graham, S.J. (Steve)

From: Pearce, Sarah <sarah.pearce@environment-agency.gov.uk>
Sent: 21 February 2013 14:35
To: Graham, S.J. (Steve)
Subject: RE: Pre-planning enquiry for proposed development: Onshore Elements of the Dogger Bank Offshore Windfarm (Teesside Projects A&B)
Attachments: Copyright Statement and Disclaimer 2011.pdf

Our Ref: NC13-086

Dear Steve

INFORMATION REQUEST: Historical flooding, Onshore Elements of the Dogger Bank Offshore Windfarm (Teesside Projects A&B)

Thank you for your request for information, forwarded to me by Lucy Mo on 21 February 2013. We have no records of historic flooding at the above site. This does not mean that the area has never flooded, only that we currently don't have any records. Currently we can only supply flood risk information relating to main rivers. You may want to check with the Local Authority and/or Water Company to see if they have any records of flooding from other sources, such as surface water. In addition, the Environment Agency is not aware of any relevant environmentally sensitive receptors.

I attach our Copyright Statement and Disclaimer which sets out the various uses to which Environment Agency information and data can be put.

If you require any further assistance on this or any other environmental matter please contact me at the address or telephone number below.

Kind regards

Sarah Pearce
Customers and Engagement

Tel: 0191 203 4138 (Internal 728 4138)
Email: sarah.pearce@environment-agency.gov.uk

Environment Agency
Tyneside House
Skinnerburn Road
Newcastle Business Park
Newcastle upon Tyne
NE4 7AR

Part of the Environment Agency's Yorkshire and North East Region

Graham, S.J. (Steve)

From: Pedlow, David <David.Pedlow@redcar-cleveland.gov.uk>
Sent: 14 March 2013 10:04
To: Graham, S.J. (Steve)
Cc: 'Chris.Gibbs@forewind.co.uk'; Chris Nunn (chris.nunn@forewind.co.uk)

Good morning

Please find below the comments from the Councils drainage engineer with regard to the information received.

The consultants are correct that the proposed route of these works are within a Flood Zone 1, I have studied our Strategic Flood Risk Assessment with regards to flooding of the proposed route of the High Voltage Cables and can confirm that the works will not be affected by surface water flooding and I am also satisfied that these works will not increase the flood risk to the area. I can also confirm that we hold no records of flooding in the areas highlighted, however the Converter Station sites is within the boundaries of Wilton Complex and I am unable to advise on any flooding issues within the Wilton site.

The only other comment I would make is, the proposed route will cross a number of water course and any works, on, in or near a watercourse will require our consent.

Kind Regards

David Pedlow
Planning Officer
Development Management

Tel: 01287 612546
Email: david.pedlow@redcar-cleveland.gov.uk

NOT PROTECTIVELY MARKED/IMPACT LEVEL 0

Appendix D – Initial Drainage Assessment - Converter Stations

Intended for
Forewind Limited

Project no.
61030548

Date
29 November 2012

DOGGER BANK TEESSIDE

INITIAL DRAINAGE ASSESSMENT – CONVERTER STATIONS

DOGGER BANK TEESSIDE
INITIAL DRAINAGE ASSESSMENT – CONVERTER STATIONS

Revision History

Revision	Date	Purpose / Status	Document Ref.	Comments
-	28.09.12	First draft issue	61030348-WP4-R01	
A	29.11.12	Final Issue	61030348-WP4-R01A	

Prepared By	Reviewed By	Approved By
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DOGGER BANK TEESSIDE
INITIAL DRAINAGE ASSESSMENT – CONVERTER STATIONS

CONTENTS

FIGURES

APPENDICES

RAMBOLL

DOGGER BANK TEESSIDE
INITIAL DRAINAGE ASSESSMENT – CONVERTER STATIONS

1. INTRODUCTION

1.1. General

1.1.1. In 2010, Forewind, a consortium of four leading energy companies, was awarded the exclusive right to develop wind farms in the Dogger Bank Round 3 Offshore Wind Farm Zone. The Dogger Bank Wind Farm Zone is located in the North Sea off the east coast of Yorkshire. Electricity generated offshore will be transmitted via High Voltage Direct Current (HVDC) submarine cables and underground terrestrial cables to onshore converter stations where the current will be converted to alternating current so that it can be connected into the National Grid. The second project to be developed is called Dogger Bank Teesside and will connect to the national grid at the Tod Point and Lackenby Substations near Redcar in Teesside. It will generate around 4GW of power.

1.1.2. It is proposed that two sets of onshore converter stations (four in total) are constructed which will be located within the Wilton Complex, close to both substations. Appendix A includes a plan which indicates the proposed location of the converter station sites. The site locations were selected by Forewind taking account of a broad range of factors.

1.1.3. Each converter station has an area of around 2.0ha, based on the preliminary designs received from Forewind.

1.1.4. This report is based on the following information:

- Typical arrangement of onshore converter station, as provided by Forewind;
- Environment Agency Flood Risk maps;
- Redcar and Cleveland Borough Council Level 1 Strategic Flood Risk Assessment (JBA, 2010);
- Northumbrian Water sewer records (not available at the time of writing);
- National Planning Policy Framework.

1.2. Limitations

1.2.1. This report has been prepared for Forewind and shall not be relied upon by any third party unless that party has been granted a contractual right to rely on this report for the purpose for which it was prepared.

1.2.2. The findings and opinions in this report are based upon information derived from a variety of information sources. Ramboll cannot accept any liability for the accuracy or completeness of any information derived from third party sources; however, reasonable measures have been taken to confirm the accuracy of third party data where it is used.

1.2.3. This report has been prepared on the basis of the proposed size and function of the converter stations as defined by the Client. If this is amended then it may be necessary to review the findings of this report.

1.2.4. It should be noted that some of the aspects considered in this study are subject to change with time. Therefore, if the development is delayed or postponed for a significant period then it should be reviewed to confirm that no changes have taken place, either at the site or within relevant legislation.

1.3. Scope and Objectives

1.3.1. This report will cover the following:

- Options available for the collection and disposal of foul and surface water drainage from the converter stations;
- Indicative volume of surface water storage (attenuation) required;
- Sustainable drainage solutions for attenuation prior to discharge off site; and
- Consultations that will be required with external statutory bodies.

2. SURFACE WATER RUNOFF

2.1. General Surface Water Strategy

2.1.1. The National Planning Policy Framework promotes sustainable management of surface water run-off from any new development and the use of Sustainable Drainage Systems (SuDS) is recommended.

2.1.2. The Level 1 Strategic Flood Risk Assessment for Redcar and Cleveland Borough Council (produced by JBA in 2010), states that "for Greenfield developments, the aim is not to increase runoff from the undeveloped situation and for Brownfield re-developments, to reduce existing runoff rates". The converter stations will be located upon Greenfield land.

2.1.3. Given the location of the converter station sites on the Wilton complex with the site history and potential for contaminated soils, infiltration measures may not be appropriate or desirable for drainage. Notwithstanding this, the bedrock geology is Mudstones and drift deposits are Glacial Till, therefore infiltration techniques may not be feasible. The bedrock geology beneath the site is classified as a Secondary B aquifer. It is therefore likely that discharge of surface water from the sites will need to be to a surface watercourse. Consultation with Sembcorp, Redcar and Cleveland Council, and potentially Northumbrian Water and the Environment Agency will be required to agree the locations for discharge – although there are drainage ditches adjacent to both converter station sites.

2.1.4. The collection of surface water from each converter station site should ideally be split into two underground networks, one to collect clean water from the roof drainage and one to collect external hardstanding and possible landscape drainage.

2.1.5. The Water Framework Directive and planning policy guidance requires that water quality is assessed in the design. Further consultation will be required regarding water quality discharge with the Environment Agency; however, it is likely that water from external hardstanding areas will be required to pass through a water quality treatment system. This will need to remove silt, debris and other possible sources of contamination from the water prior to it leaving site for discharge.

2.1.6. Different forms of sustainable drainage techniques (SuDS) can be used to treat runoff, including permeable paving, swales and detention basins. These are discussed later in this report.

2.1.7. Where SuDS options are not possible then the inclusion of a proprietary treatment system may be required within the underground drainage network. The inclusion of an oil separator within the external hardstanding drainage could be used to remove any hydrocarbons from water off parking areas and access roads. The design of oil separation will need to comply with the Environment Agency's Pollution Prevention Guidelines (PPG 3) and Building Regulations, Approved Document H (Drainage and Waste Disposal).

2.1.8. If additional treatment is required then a proprietary filtration system can be installed within the underground drainage system. This will remove any heavy particles, silt and heavy metals such as copper, zinc and cadmium. The installation of silt trap manholes can also be incorporated within the scheme to collect larger silt and debris particles. A typical separator tank/filtration system is shown in Figure 1.

2.1.9. Water arising from any hardstanding areas where permeable paving is not possible will need to be collected prior to the treatment system. This will be either via traditional road gullies and/or drainage channels. Where proposed external levels are flat combined kerb drainage can be used as indicated in Figure 2.

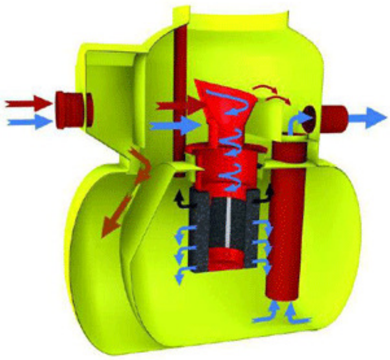


Figure 2 - Typical oil separator tank

Figure 1 - Combined kerb drainage

2.1.10. The collection of roof drainage can either be by traditional rainwater guttering and downpipes or via a syphonic system. A syphonic system collects the water from the roof at high level within the building and discharges it at a minimal number of locations to the below ground system. The reduction in the number of downpipes in such a system would reduce the depth of the underground pipework and make it easier to route the water to any attenuation or rainwater harvesting.

2.1.11. An indicative schematic of both traditional and syphonic drainage is given in Figure 3 below.

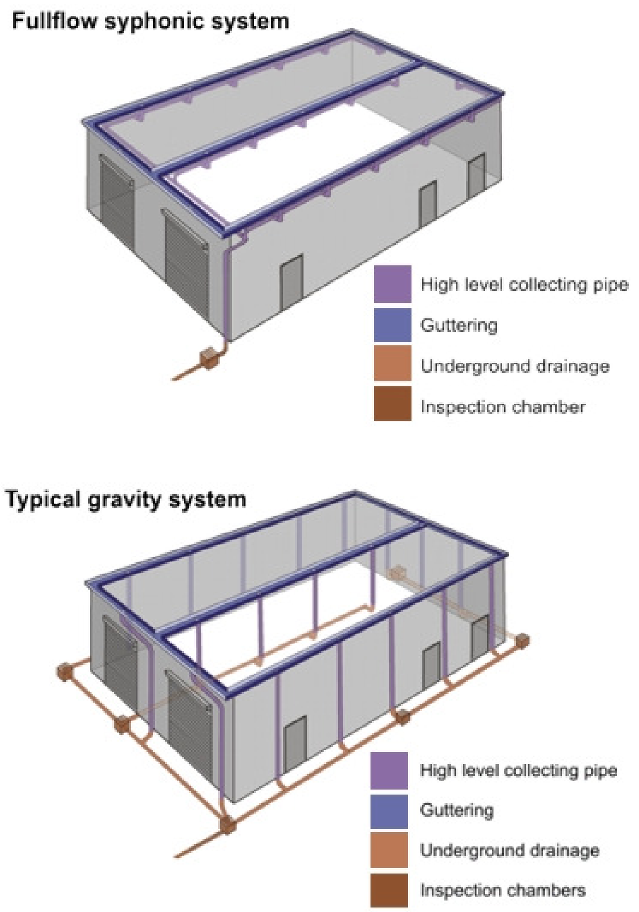


Figure 3 - Roof drainage system

Image provided by FullFlow (supplier of Syphonic Drainage)

2.2. Surface Water Runoff Rates

2.2.1. Based on the plans provided by Forewind, each converter station will have a total plan area of 2.02ha, of which some 1.26ha is likely to be impermeable. Therefore for both proposed converter stations, surface water runoff from a total of some 2.52ha of roof and hardstanding area will need to be collected and discharged off site.

2.2.2. It is proposed that the surface water attenuation will be sized for the 1 in 100 year storm event plus an allowance of 30% for climate change. Attenuation is the storage of surface water above or below ground on the site prior to discharge at a restricted rate.

2.2.3. Greenfield runoff rates have been calculated for both converter stations (using the Institute of Hydrology Report 124 methodology) as 16.2l/s (See Appendix B).

2.2.4. Although this figure is considered to be appropriate and has been calculated in line with current best practice and EA requirements, consultation with Sembcorp, Northumbrian Water and potentially the EA and Redcar and Cleveland Council will be required at the detailed design stage to confirm that this is acceptable discharge rate and the exact point of discharge.

2.3. Surface Water Storage Volumes

2.3.1. Based on this allowable discharge rate of 16.2l/s and combined impermeable area of 2.52ha per converter station site (ie for two converter stations), surface water storage volumes have been calculated per site (See Appendix B). Volume ranges are given at this stage until the detailed design of the system can be undertaken.

1 in 30 year	-	between 550m^3 and 800m^3
1 in 100 year	-	between 750m^3 and 1100m^3
1 in 100 year + 30%	-	between 1050m^3 and 1550m^3

2.3.2. The chosen location of the converter station has a bearing on which types of attenuation storage features are appropriate, for instance due to its topography, ground conditions and proximity to nearby watercourses for discharge. An assessment of different SuDS options available is made in the next section of this report, from which the most appropriate features have then been chosen for the concept drainage strategy.

3. SURFACE WATER ATTENUATION ASSESSMENT

3.1. Assessment of Attenuation Options

3.1.1. Permeable or porous surfaces: Permeable paving systems can take the form of either a block paving system which consists of interlocking paving blocks or alternatively a porous asphalt concrete surface that allows water to infiltrate through to an underlying open-graded sub-base or attenuation crate system (see Figure 4 below for a typical cross-section). The thickness of the underlying sub-base or crates is designed to accommodate the required amount of attenuation storage. From the sub-system, the water can either infiltrate directly into the ground, or where this not appropriate, can be collected and discharged elsewhere.

3.1.2. As noted in paragraph 2.1.3 above in the case of the converter stations infiltration is unlikely to be desirable or practicable therefore if a permeable/porous paving system was chosen it would need to take the form of a tanked system with a restricted discharge rate. This option could be feasible in any car parking and access road areas of the site. Since permeable or porous paving provides a degree of treatment to the runoff which passes through it, should this attenuation option be chosen, it would negate the need for an oil separator.

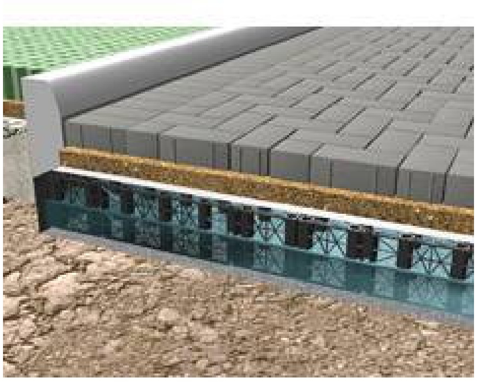


Figure 4 - Section through permeable paving solution indicating storage within a crate system

3.1.3. Swales: A swale is a grassland depression usually shallower and wider than a conventional ditch (see Figure 5 below for a typical example). Swales generally convey surface water run-off from a drained surface into a storage or infiltration system although they can also provide a storage function if necessary.

3.1.4. Again, as infiltration is unlikely to be desirable or practicable (paragraph 2.1.3 refers) at the converter stations site, if a swale was chosen within the drainage design it would need to be lined, and potentially contain a throttle to restrict the discharge. Swales are a relatively low-cost solution but can require a large land-take however this option could be feasible for collection of water from the access roads around the perimeter of the converter station, either receiving direct runoff from the roads into the swale or from road gullies or combined kerb drainage. This option can also be used to provide a degree of water treatment, depending on the length of the swale.

Figure 5 - Swale adjacent to a footpath/road, following a storm event

3.1.5. Detention Basins: These are above ground storage basins which generally remain dry under normal conditions but which provide attenuation of surface water run-off in storm conditions (typical example shown in Figure 6 below). Like swales, basins can require a large land take and can provide a degree of water treatment. Their maintenance is relatively easy since they are predominantly grassed, however they can incorporate more diverse planting (to enhance biodiversity for instance) as long as their storage volume is maintained and plants not susceptible to being in water are planted. For the converter stations, a detention basin could be a feasible option for the drainage strategy.

Figure 6 - Detention basin

3.1.6. Ponds: these are permanent water features which are designed with additional water storage above their usual water levels to attenuate runoff in storm conditions (typical example shown in Figure 7 below). Ponds can require a large land take although they can have steeper sides than detention basins as they are a defined water feature. Then maintenance and safety implications of a pond would need to be reviewed, and it is unlikely that there would be sufficient rainfall runoff to ensure that they were permanently wetted all year round. Furthermore, the drainage ditches in the area which would be the chosen discharge location for the runoff from the converter stations are relatively shallow, therefore ponds are less likely to be a viable attenuation option in this instance.

Figure 7 - Pond

3.1.7. Underground Cellular/Tubular Storage: This is an underground storage system involving the installation of either large diameter tubular pipework or square plastic crates (Figure 8 below shows a typical crate system under installation, and Figure 9 a typical tubular system). These can be used to provide large volumes of storage and have the advantage of having a 95-97% void ratio allowing them to attenuate significantly larger volumes in a smaller area compared to granular storage systems (which typically have only a 30% voids ratio). Underground storage is best situated below lightly trafficked areas and soft landscaping for ease of maintenance. This could be a feasible option and could be provided beneath the roads, car parking or soft landscaped areas, although it would need to be kept shallow to enable gravity discharge into the adjacent watercourses.

Figure 8 - Underground crate system

Figure 9 - Circular underground pipe tank system

3.1.8. Green Roofs: A Green roof or sedum roof is a planted roof area which can provide a degree of rainfall attenuation for small return period storms (see Figure 10 below for an example). Well maintained green roofs are able to decrease the volume of surface water runoff by up to 40% in low return period storms. For large storm events sheet runoff is still likely to occur. The roof area of the converter stations, although large would not be enough to store all the receiving rainwater and therefore additional below ground attenuation would still be required if green roofs were chosen. However, they remain a sustainable option and can also provide biodiversity and aesthetic benefits in addition to their attenuation properties.

Figure 10 - Established Green Roof

3.1.9. Rainwater Harvesting: The use of rainwater harvesting to provide a supply for grey-water use within the converter station buildings could decrease the volume and rate of surface water runoff from the roof areas. This will reduce the roof runoff in low return period events; however for larger storms the design has to assume that the rainwater tank is full (and therefore overflowing). Therefore, whilst we promote the use of rainwater harvesting tanks, their volume can't be accounted for when designing the attenuation storage – i.e. other forms of attenuation would still be required in the design. The water which is collected within the harvesting tank can be used for irrigation, flushing of toilets or washdown areas. As the converter stations are likely to have minimal operational requirements, it's possible that stagnation could occur within a rainwater harvesting tank therefore this option may not be appropriate in this case.

3.2. Concept Drainage Strategy

3.2.1. Taking account of the above review of the various SuDS that could be utilised, the concept surface water drainage strategy for each of the converter station sites is included in Appendix C. This will need to be developed at the detailed design stage, in conjunction with any specific requirements from Sembcorp, Northumbrian Water, Redcar and Cleveland Borough Council and the EA.

3.2.2. For both sites, swales and a detention basin are the most viable methods for conveying and attenuating the surface water runoff from the areas of hardstanding prior to discharge into the adjacent drainage ditches. This is both because the receiving drainage ditch itself is relatively shallow, and therefore surface drainage systems are preferable, and also because the swale and detention basin can provide additional ecological habitat.

4. FOUL WATER DISCHARGE

4.1. General

4.1.1. There are a number of options for discharge of the proposed foul drainage from the converter station sites and these are discussed below. The final solution will be influenced by the site location, topography, ground conditions and consultation with the Sembcorp, EA, Redcar and Cleveland Council and Northumbrian Water.

4.1.2. Foul flows from the converter stations are expected to be minimal due to their minimal operational requirements in terms of site staff.

4.2. Discharge Options

4.2.1. Direct discharge to public sewer: At the time of writing, public sewer records are not available. However, given the development on the Wilton complex it is likely that foul drainage is present in the vicinity – either private or public. Further discussions with Sembcorp and Northumbrian Water will be needed upon review of sewer records and at the detailed design stage to confirm whether direct sewer connection will be a viable solution.

4.2.2. Wastewater treatment system with discharge to watercourse: As an alternative it would be possible to treat foul drainage on site and then discharge it to watercourse. The primary wastewater treatment system could be a septic tank or proprietary wastewater treatment plant together with a secondary treatment if required located within the site prior to discharge to the nearest watercourse.

4.3. Primary Treatments

4.3.1. Septic tanks: Septic tanks provide suitable conditions for settlement, storage and partial decomposition of solids and therefore are located at the head of the treatment system (typical example shown in Figure 11 below). Septic tanks need to be emptied at regular intervals by a specialist drainage company to remove any solids collected. The discharge water can still fail to meet the relevant water quality criteria and therefore some form of secondary treatment is normally required. Septic tanks may not be acceptable to the EA above an aquifer.

Figure 11 - Typical underground septic tank

4.3.2. Proprietary package treatment plant: Package treatment plants are fitted within the underground drainage system and can be used as a primary form of treatment without the need for a secondary treatment as water can be treated to very high quality standards. Maintenance is dependent on the type of plant used although can be checked and regulated more easily than any other system. Due to the low flow rates which are expected from the converter station operatives this may be a suitable solution.

4.4. Secondary treatments:

4.4.1. Drainage fields: Drainage fields typically consist of a system of sub-surface irrigation pipes which allow effluent to percolate into the surrounding soils where biological treatment takes place in the natural aerated layers of the soil (see Figure 12 below). Drainage fields will need a relatively large land take and can only be used where the subsoil is sufficiently free draining and therefore may not be suitable for the converter station site. Furthermore, they may not be acceptable to the EA above an aquifer. If maintenance of the primary treatment is not undertaken regularly then solids can be passed onto the secondary treatment causing the requirement for early replacement. This will often mean the provision of a new location for the secondary system.

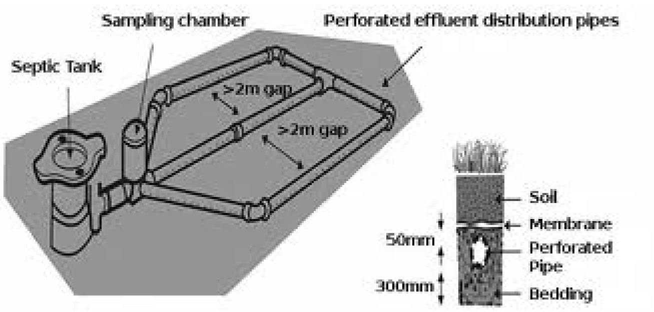


Figure 12 - Typical Schematic of a Drainage Field

4.4.2. Constructed wetlands: Reed beds are man made systems which use the natural treatment capacity of certain wetland plants combined with a gravel bed to purify wastewater by removing the organic matter, oxidising ammonia and reducing nitrate (see Figure 13 below). The area required for construction of a reed bed is dependent on the water quality levels that need to be achieved although they do not normally require as much land as a drainage field. Some maintenance is required over the life of the reed bed with reeds requiring replacing at specific intervals. Due to the low foul flows from the converter stations, reed beds could be a suitable foul drainage solution.

Figure 13 - Reed Bed

4.4.3. Any discharge to watercourse will potentially require consent (depending on ownership) from either the EA, Northumbrian Water, Redcar and Cleveland Council, or Sembcorp (in the case of riparian ownership). Therefore further consultation will be required at the detailed design stage.

4.4.4. Cesspools: A cesspool is normally used when no other form of treatment is possible. It is a watertight tank which is installed underground at the end of the foul network to store sewerage. No treatment is involved in this process and the effluent will need taking away on a regular basis by a specialist drainage company. On the basis that the converter stations would be largely unmanned, storage of foul effluent for long periods of time (until the tank is full) may not be acceptable due to the likelihood of septicity occuring.

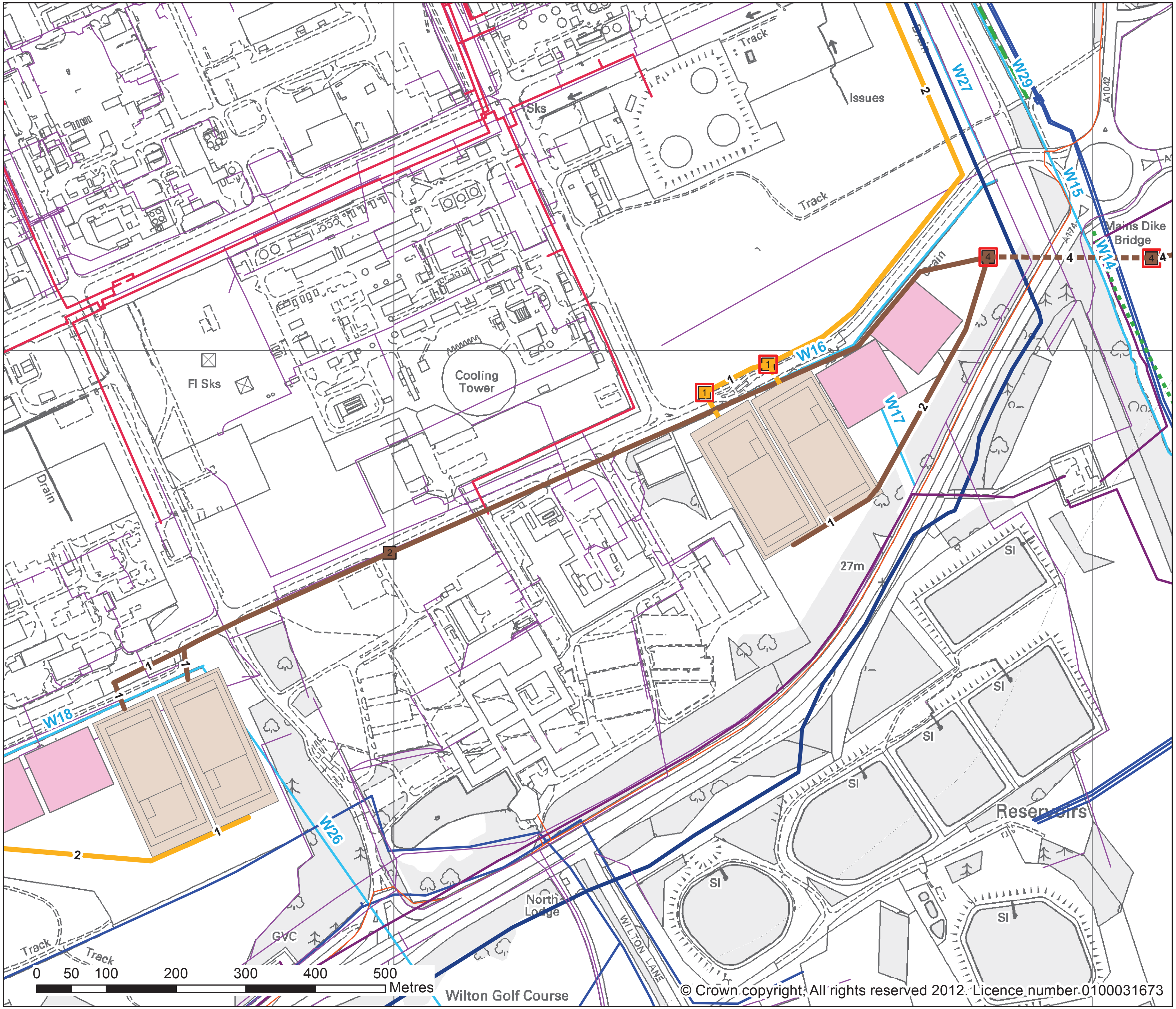
5. CONCLUSION

5.1.1. This report has been written to give initial options for the discharge of foul and surface water drainage from each of the converter station sites.

5.1.2. There are viable foul and surface water drainage solutions that could be implemented at each site, and in particular the surface water concept strategy focuses on the use of swales and a detention basin prior to discharge into an adjacent drainage ditch. Not only are these preferred to keep the system shallow, they can also incorporate ecological habitat.

5.1.3. As the detailed design progresses, consultation with the Environment Agency, Northumbrian Water, Sembcorp, and Redcar and Cleveland Borough Council will be required to confirm their acceptance of the preferred discharge locations and rates.

APPENDIX A - SITE LOCATION PLAN



Legend

Jointing Bay

- HVAC
- HVDC
- HDD Launch/Recieve Points

Cable Route Sections

- HVAC, Open trench
- HVAC, HDD
- HVDC, Open trench
- HVDC, HDD
- Large Construction Compound 100m x 90m
- Small Construction Compounds 30m x 30m
- Converter Stations
- Watercourse
- Bridleway
- Footpath
- Long Distance Path
- BOC Gas
- Northern Gas
- BT Infrastructure
- Cable and Wireless Network
- Virgin Media Network
- National Grid
- Northern Power Grid
- Overhead Power Lines Other
- TPEP
- Northumbrian Water
- Rail
- Landfill

N

Client

FOREWIND

Project Title

Dogger Bank Teesside

Project Number

61030548

Figure Title

Cable Route Layout

RAMBOLL

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Date	Prepared By
23/11/2012	CB
Figure No.	Revision
Figure 3.5	-

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DOGGER BANK TEESSIDE
INITIAL DRAINAGE ASSESSMENT – CONVERTER STATIONS

APPENDIX B - INITIAL SURFACE WATER CALCULATIONS

Appendix B – Outline Surface Water Calculations

Greenfield Runoff Rates

These have been calculated using the Institute of Hydrology Report 124 methodology in WinDes. Note that this methodology is aimed at sites over 50ha in area, therefore in line with best practice Greenfield rates have been calculated for 50ha and then divided accordingly to reflect the smaller site area (4.032ha for two converter stations, therefore each of the two converter station sites).

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	50.000	Urban	0.000
SAAR (mm)	650	Region Number	Region 3

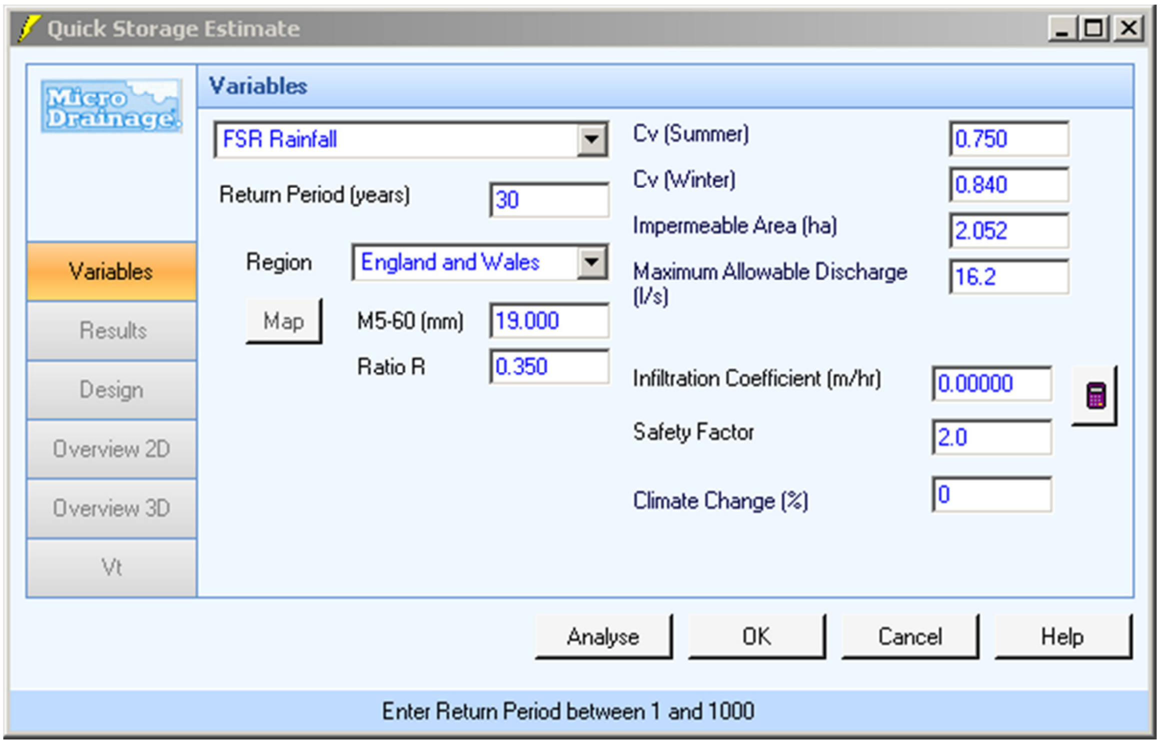
Results	**l/s**
QBAR Rural	201.4
QBAR Urban	201.4

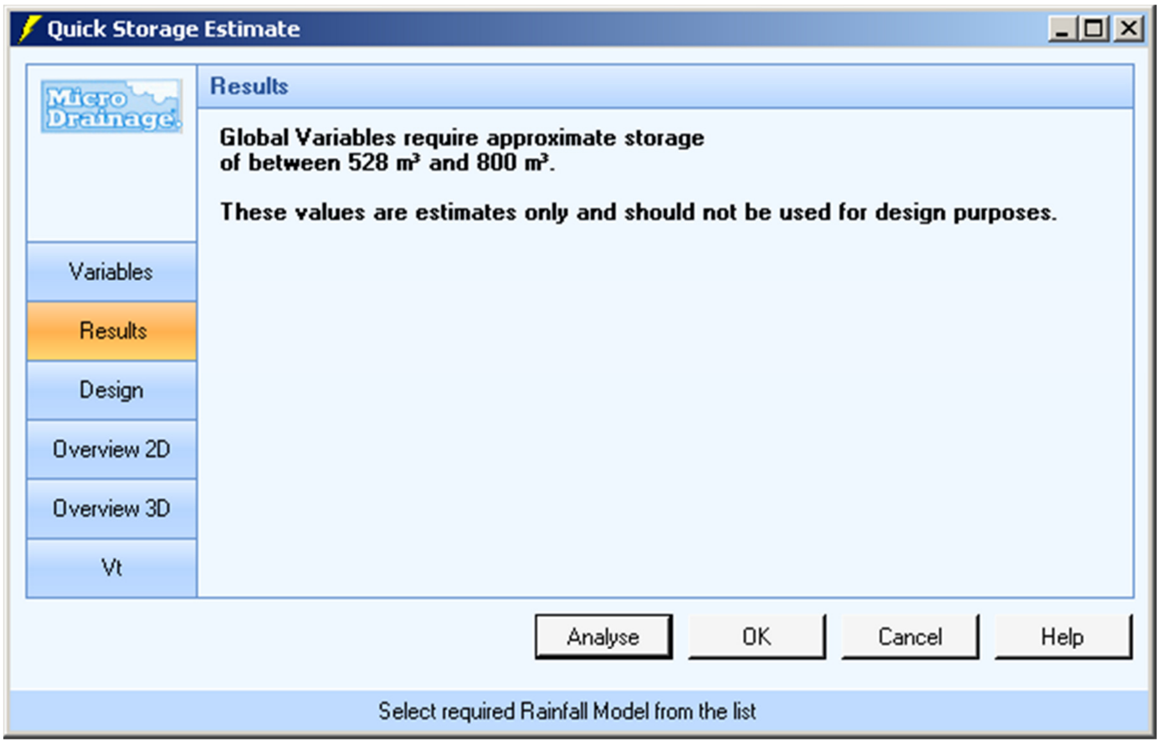
Qbar = 201.4l/s for 50ha, therefore Qbar = 16.2l/s for each of the converter station sites.

Initial Attenuation Sizing

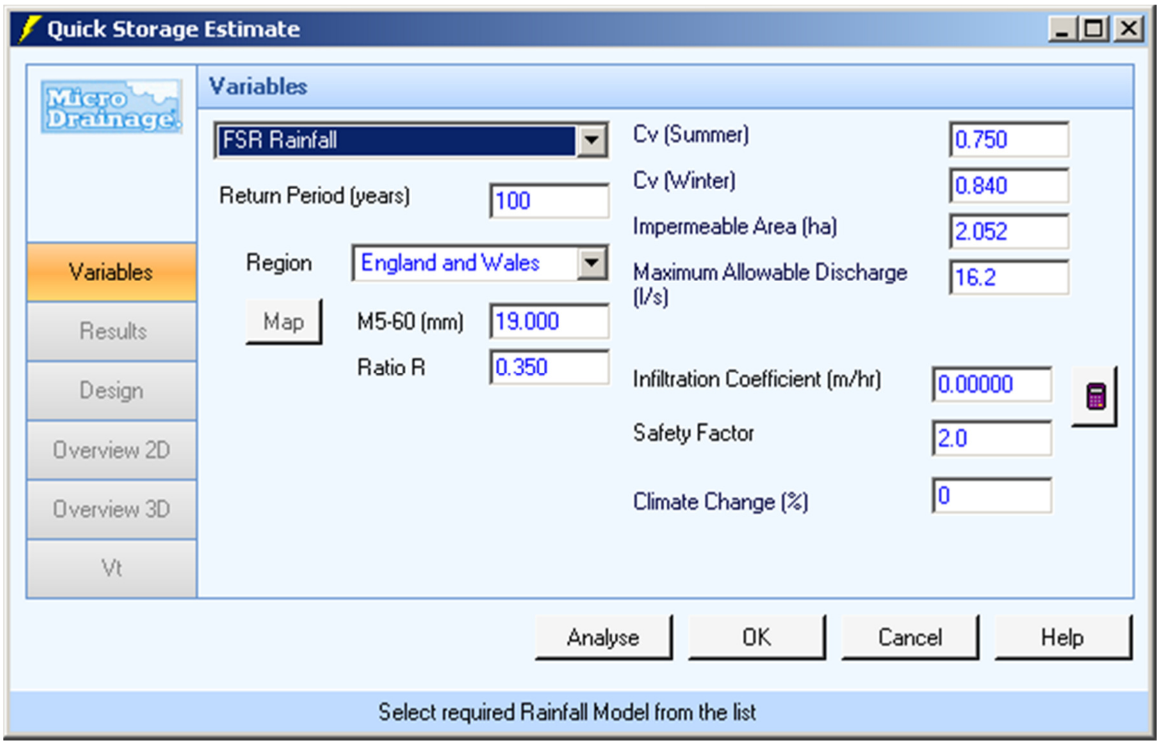
This has been calculated for the 1 in 30 year, 1 in 100 year and 1 in 100 year (+ climate change) return periods, based upon an allowable discharge rate of 7.35l/s. An increase in rainfall intensity of 30% has been allowed for the 1 in 100 year (+ climate change) scenario.

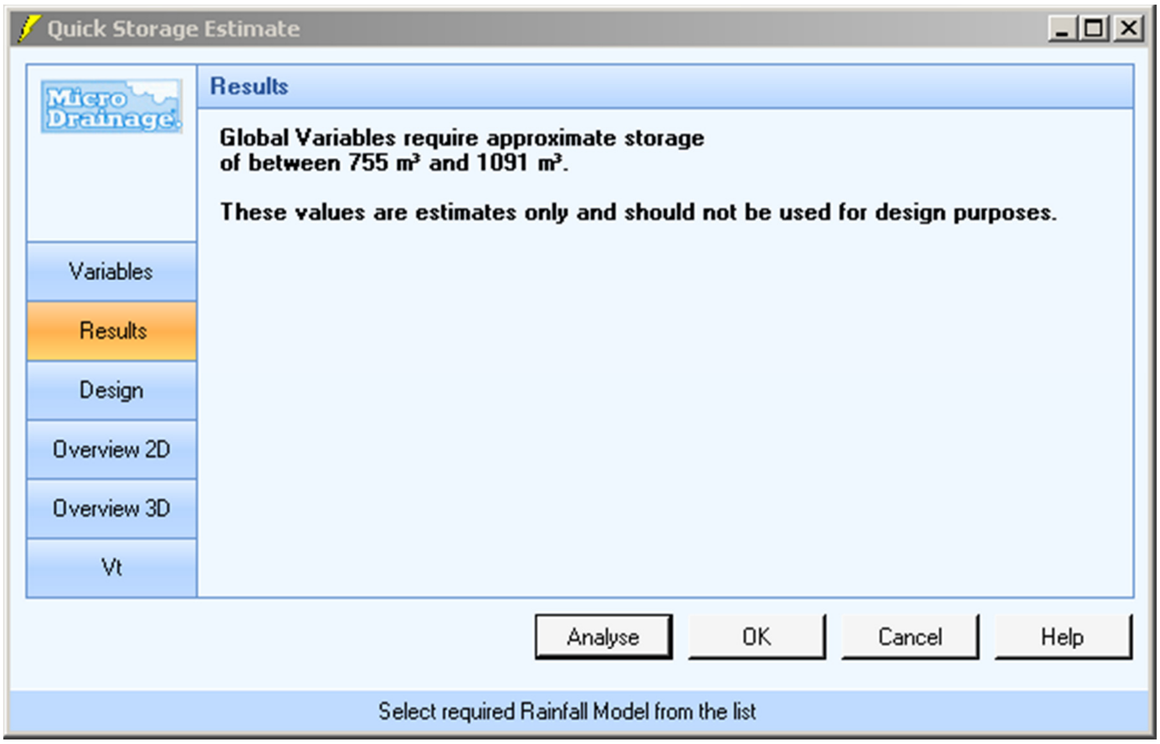
1 in 30 year scenario:



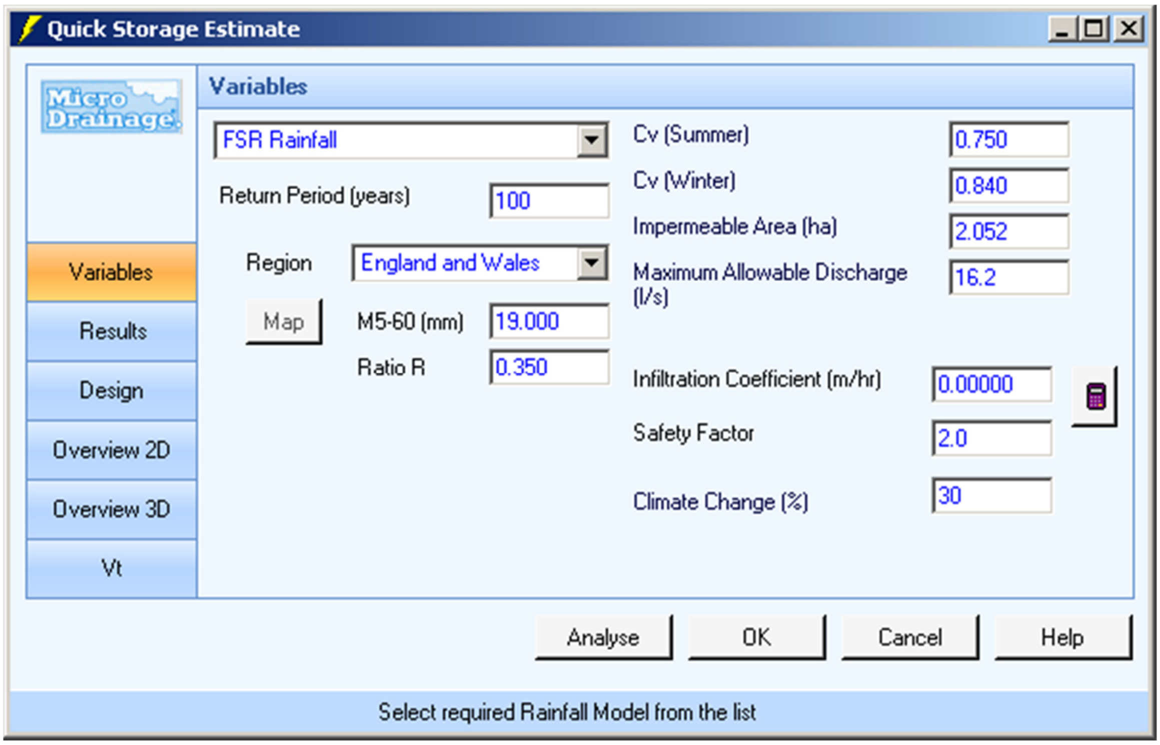


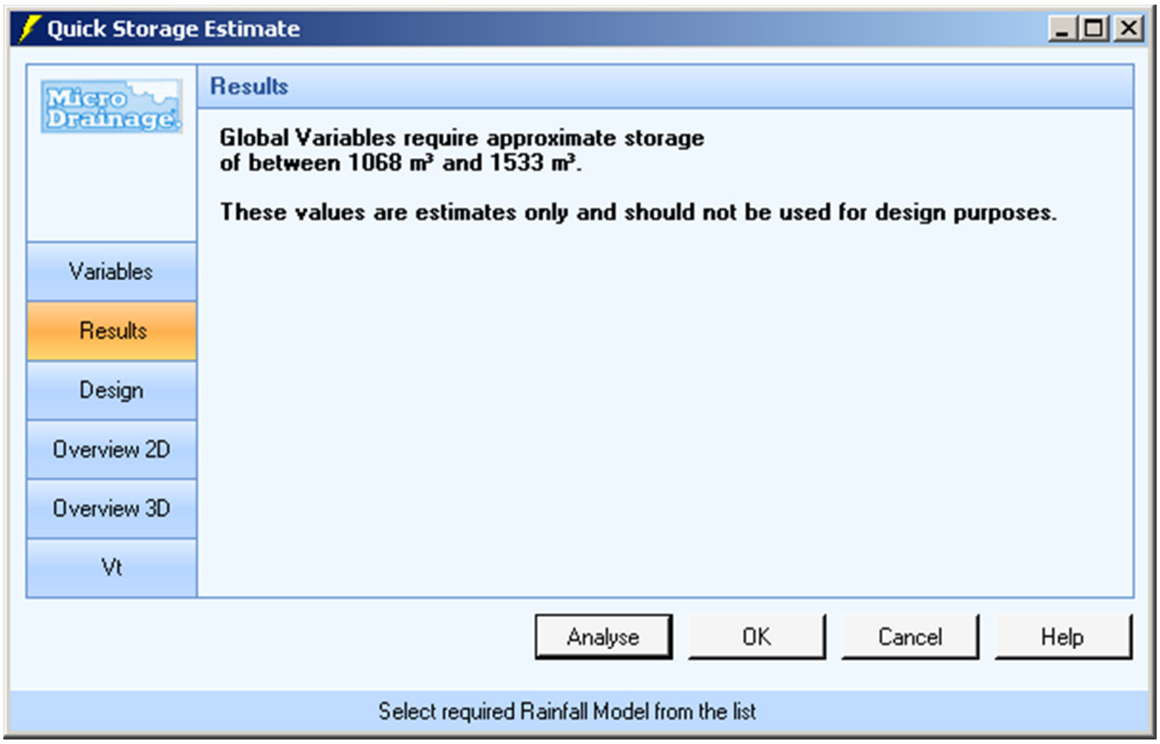
1 in 100 year scenario:





1 in 100 year (+ climate change) scenario:


Quick Storage Estimate
Micro Drainage
Variables
FSR Rainfall
Return Period (years)
100
Region
England and Wales
Map
M5-60 (mm)
19.000
Ratio R
0.350
Cv (Summer)
0.750
Cv (Winter)
0.840
Impermeable Area (ha)
2.052
Maximum Allowable Discharge (l/s)
16.2
Infiltration Coefficient (m/hr)
0.00000
Safety Factor
2.0
Climate Change (%)
30
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Select required Rainfall Model from the list


Quick Storage Estimate
Micro Drainage
Results
Global Variables require approximate storage
of between 1068 m³ and 1533 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Select required Rainfall Model from the list

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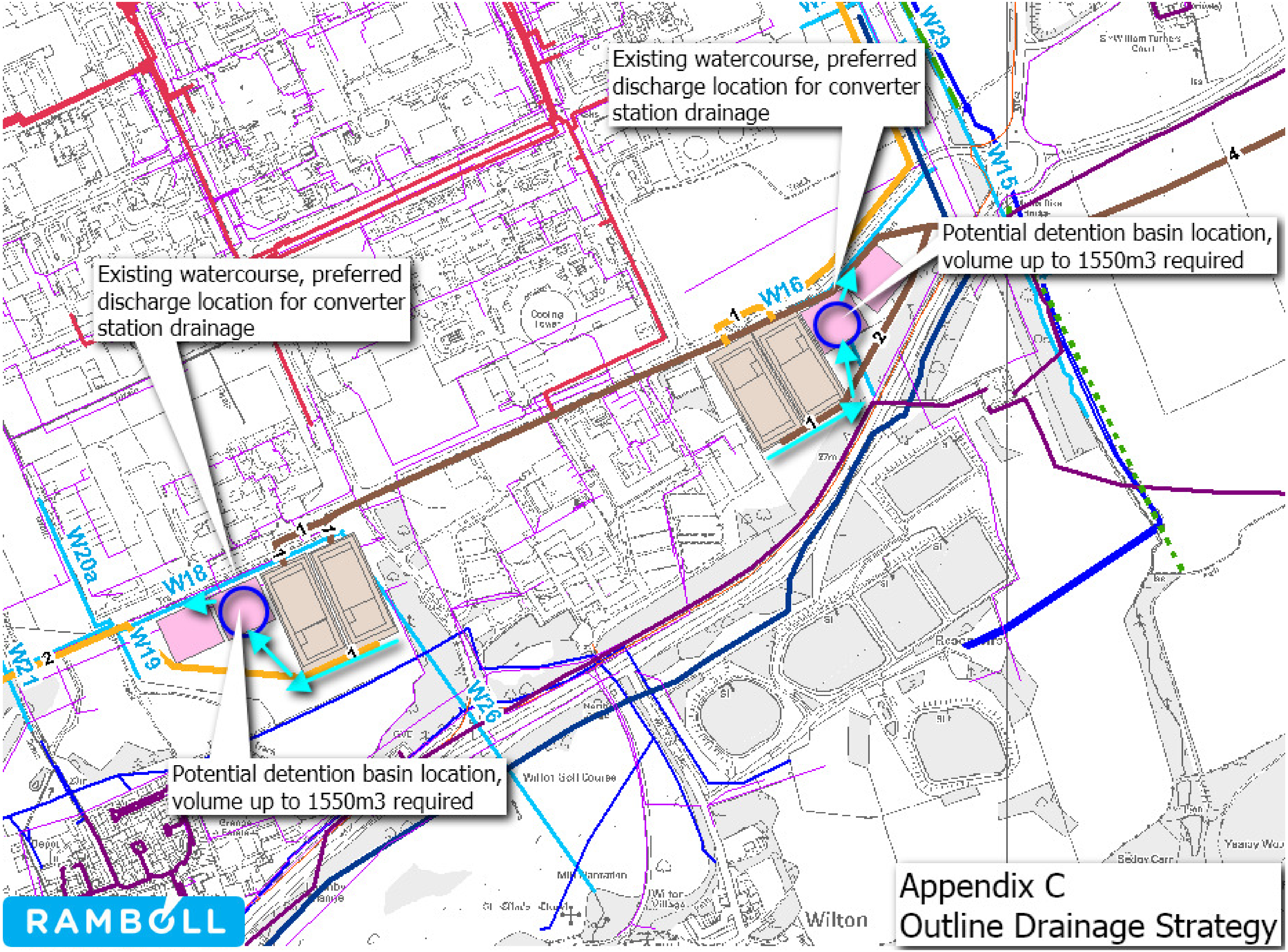
DOGGER BANK TEESSIDE
INITIAL DRAINAGE ASSESSMENT – CONVERTER STATIONS

APPENDIX C - CONCEPT SURFACE WATER DRAINAGE STRATEGY


Existing watercourse, preferred discharge location for converter station drainage
Existing watercourse, preferred discharge location for converter station drainage
Potential detention basin location, volume up to 1550m3 required
Potential detention basin location, volume up to 1550m3 required
W16
W18
W19
W20a
W21
W26
W29
W15
Cooling Tower
Wilton Golf Course
Wilton
RAMBOLL
Appendix C
Outline Drainage Strategy

Appendix E – National Grid Flood Mitigation Policy

FLOOD MITIGATION POLICY

TABLE OF CONTENTS

PURPOSE AND SCOPE

This policy document defines National Grid's declared target levels for flood defence / resilience that should be applied to existing transmission substations, all new build electricity transmission substations and at legacy substations subjected to an expansion or a major refurbishment programme.

Its aim is to ensure that flood risk is a material consideration at all stages of National Grid's capital planning process.

It draws guidance from the following documents:

- Communities and Local Government, Planning Policy Statement 25 (PPS25) - Development and Flood Risk
- Planning Policy Wales, Technical Advice Note 15 (TAN15) - Developments and Flood Risk
- The Energy Network Association Engineering Technical Report (ENA ETR138) – Resilience to Flooding of Grid and Primary Substations.
- UK Climate Change Projections 2009 (UKCP09)

PART 1 – POLICY

1 GENERAL POLICY

As defined in PPS25, TAN15, and ETR138, National Grid needs to ensure that new and existing sites (or key equipment located therein) meet declared flood resilience levels defined within this document.

In doing so, ensuring the site is safe and operational during flooding events with no loss of supply or risk to system stability.

2 FLOOD RISK ASSESMENTS

When looking to select a site for a new facility or during consultations with planning authorities for works on existing sites, early consultation with both the local authority and the Environment Agency is advised irrespective of whether planning permission is required. If flood risk is raised as a concern, a detailed Flood Risk Assessment (FRA) shall be undertaken to determine the level of risk. Failure to submit a FRA could result in a planning application being delayed or refused planning permission due to lack of information.

3 RESILIANCE LEVELS

If a risk is identified it shall be accurately assessed. If no other suitable location can be found then this will be recorded and submitted as part of undertaking a Sequential Test (see PPS25 Practice Guide).

The aim of the Sequential Test is to steer new development towards areas with the lowest probability of flooding (Zone 1). Where this is not possible it must be demonstrated to both the Local Planning Authority and the Environment Agency that there are no reasonably available sites for the type of development proposed in a lower risk category. Only where there are no reasonably available sites in Flood Zones 1 and 2, should sites within Flood Zone 3 be considered.

National Grid infrastructure should be located in a Low Probability Zone 1 (risk less than 1:1000). Where this is not possible the infrastructure shall be located in a medium probability Zone 2 (risk between 1:100 and 1:1000), and must be accompanied by a Flood Risk Assessment to demonstrate how flood risks from all sources of flooding to the development itself and flood risk to others will be managed. It will also be necessary to take account of climate change and errors in data when establishing a flood height for any mitigation measures.

3.1 New Sites

Target - 1:1000 flood resilience with suitable allowance for climate change;

- River, surface water, ground water and sewers flooding climate change – refer to PPS25 - 20% increased peak river flow or where unknown add 300mm (Environment Agency standard practice)
- Tidal flooding climate change – refer to PPS25

In addition to climate change add 300mm for errors in data if not already accounted for in information provided.

3.2 Existing sites and extensions to existing sites resilience level

Target - 1:1000 flood resilience with suitable allowance for climate change;

- River, surface water, ground water and sewers flooding - 20% increased peak river flow or where unknown add 300mm (Environment Agency standard practice)
- Tidal flooding risks for existing sites – Expansion beyond the boundary fence line tidal risk sites refer to PPS25 where practicable or add 433mm (UKCP09) if no accurate data can be obtained from the Environment Agency
- Expansion within the boundary fence line tidal risk sites refer to PPS25 where practicable or add 433mm (UKCP09) if no accurate data can be obtained from the Environment Agency and base solution on Design Justification Report (TP146.2)

In addition to climate change add 300mm for errors in data if not already accounted for in information provided.

In circumstances where the 1:1000 + Climate Change + 300mm is not practical due to cost or engineering constraints a lower level of resilience will be acceptable with a minimum standard of resilience to 1:200 + Climate Change + 300mm flooding.

Parameters which may permit a reduction in the target resilience include

- The projected lifespan of the site (< 10 years)
- Engineering constraints on site mean mitigation option cannot be practically accommodated
- Flood defence wall not exceeding 2.4m high
- The cost of the target resilience (1:1000 + CC + 300mm) exceeds the minimum defence option (1:200 +CC + 300mm) by £1m or 50% which ever figure is the greater amount
- The site can be switched out safely at any time and not impact supplies

A suitable cost benefit analysis shall be carried out detailing and recording the decision process.

3.3 Shared ownership sites and adjacent DNO / Generator sites

In accordance with ETR138 Appendix 6 the flood risk assessment and any necessary mitigation works shall ensure the resilience of the site and security of supply.

3.4 Off site 3rd Party Flood Defences

Where a site is shown to be at risk from flooding but benefits from defences off site (e.g. EA or local authority owned and maintained river or coastal defences) to the target resilience level there may still be a risk from surface water which may require flood mitigation work this will be established through the FRA.

Where the off site defence is to a lesser standard but above the minimum resilience level, consideration may be given to improving the defence through either on site protection or improving the off site protection.

Where the off site defence is to a lesser standard and below the minimum resilience level, the site defence shall be improved through either on site protection or improving the off site protection.

A suitable cost benefit analysis shall be carried out detailing and recording the decision process.

4 FORMS AND RECORDS

Not applicable.

PART 2 - DEFINITIONS AND DOCUMENT HISTORY

5 DEFINITIONS

Not applicable.

6 AMENDMENTS RECORD

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
1	January 2011	New document	Doug Dodds Asset Engineering	David Wright Electricity Network Investment Manager

7 IMPLEMENTATION

7.1 Audience Awareness

Audience	Purpose Compliance (C) / Awareness (A)	Notification Method Memo / letter / fax / e-mail / team brief / other (specify)
Asset Management, UK Construction, Network Operations, Alliances	C	E-mail

7.2 Training Requirements

Training Needs N/A / Informal / Workshop / Formal Course	Training Target Date	Implementation Manager
N/A	N/A	N/A

7.3 Compliance

Compliance will be ensured through the investment scheme process and internal audit.

7.4 Procedure Review Date

8 years from publication date.

PART 3 - GUIDANCE NOTES

8 REFERENCES

UKBP/TP 213 Substation flood risk assessment and flood risk monitoring

TGN(E) *** - Flood Mitigation Technical Guidance

PPS25 – Communities and Local Government, Planning Policy Statement – Development and Flood Risk

ETR138 – Energy Network Association Engineering Technical Report – Resilience to Flooding of Grid and Primary Substations

Planning Policy Wales, Technical Advice Note 15 (TAN15) - Developments and Flood Risk

UK Climate Change Projections 2009 (UKCP09)