FOREWIND

DOGGER BANK
TEESSIDE A & B

March
2014

Environmental Statement Chapter 6 Appendix G Onshore Site Selection: Part 3

Application Reference: 6.6.7

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

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Dogger Bank Teesside
Onshore Site Selection: Part 3

Forewind

July 2012
Draft Report
9W7904

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HASKONING UK LTD.
INDUSTRY AND ENERGY

4 Dean's Yard
Westminster
London SW1P 3NL
United Kingdom
+44 (0)20 7222 2115 Telephone
020 7222 2659 Fax
info@london.royalhaskoning.com E-mail
www.royalhaskoning.com Internet

Document title	Dogger Bank Teesside Onshore Site Selection
Document short title	Site Selection Report: Part 3
Status	Draft Report
Date	July 2012
Project name	Dogger Bank Teesside
Project number	9W7904
Client	Forewind
Reference	9W7904/304141/Lond

Drafted by	Michael Gough and David Morgan
Checked by	Rufus Howard
Date/initials check	July 2012

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CONTENTS

1 INTRODUCTION

The purpose of this report is to identify a preferred cable route from the preferred landfall between Redcar and Markse-by-the-Sea to the potential converter stations sites within the Wilton Complex. This report identifies potential cable route options taking into account the environmental, social and physical considerations within the study area (See **Figure 1.1**).

1.1 Background

The preferred onshore cable route identified in this report is for the Dogger Bank Teesside projects A and B and is recommended to be taken forward for consultation, further survey work and assessment to aid the identification of a final project design and layout. The onshore cable route site selection has been undertaken in three parts:

Part 1 – Onshore Study Area Characterisation
Part 1 sought to characterise the study area drawing on a variety of development considerations. The considerations identified were used as the starting point for further surveying, consultation and assessment to aid the identification of a cable route.

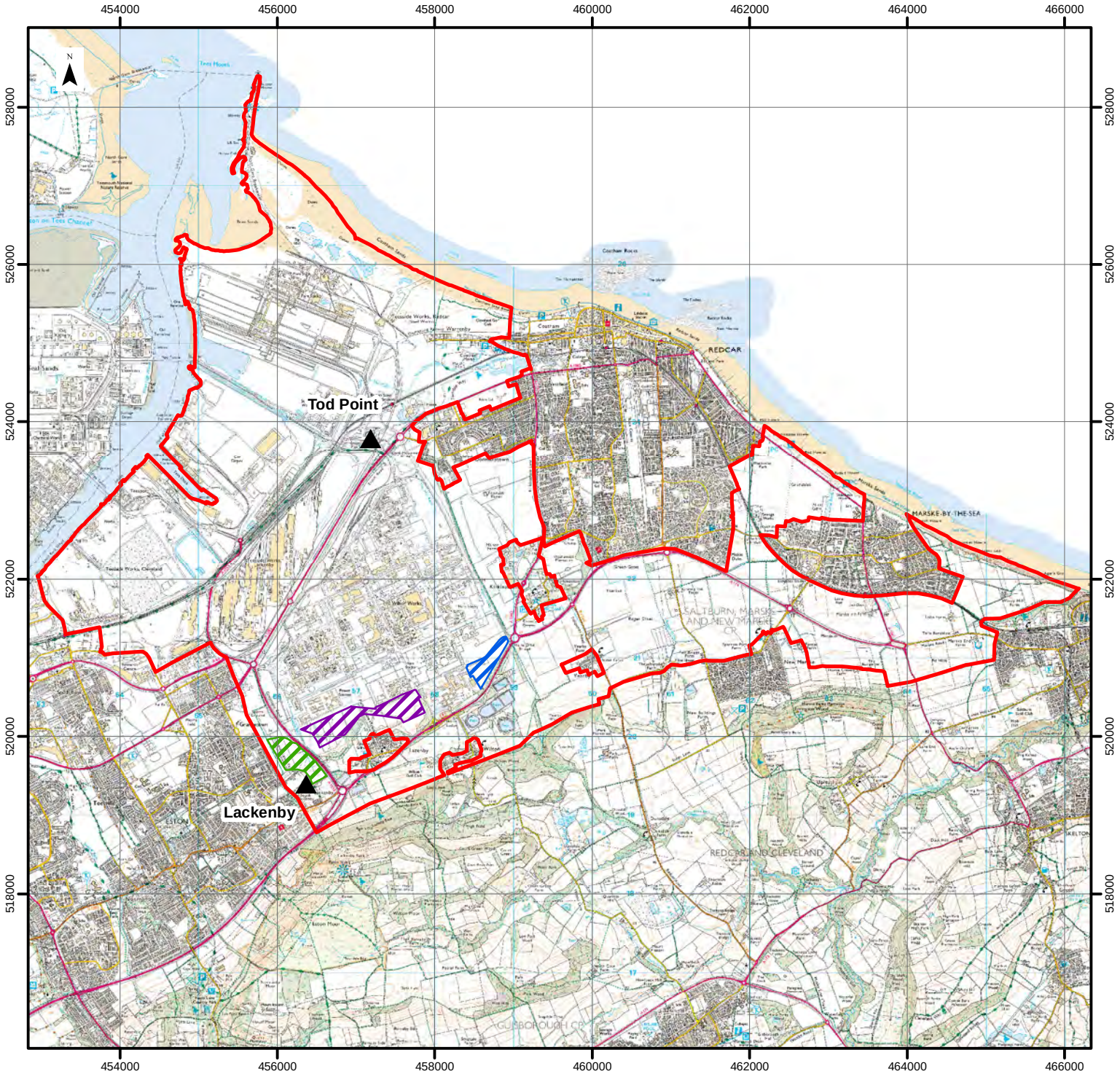
Part 2 - The Identification of Onshore Cable Corridors
Part 2 sets out the results from a desk based study to identify potential cable corridors for Dogger Bank Teesside (Projects A, B, C and D). The identified corridors were all routed between the three potential landfall locations, provided by Forewind, and the eight potential converter station locations. A review of available desk based information identified forty nine potential cable routes to the potential converter station sites. A constraint matrix was completed to provide an overview of the consenting risks associated with each route.

Part 3 – Identification of the Preferred Onshore Cable Route
Part 3, presented in this report, collates the information identified in the previous two reports and combines these with results from further key technical studies to identify a preferred cable route to be taken forward into the EIA phase of the project development process.

1.2 Assumptions

The report identifies potential routes from the landfall to the converter station sites at various capacities, including options. The routes identified are based on a number of engineering assumptions, agreed prior to commencement of the assessment, as defined below:

- The ‘Landfall Two’ option between Redcar and Marske-By-The-Sea, is the preferred landfall location;
- The minimum capacity of a single cable route will be 1GW;
- Cable routes accommodating a cable system of between 2GW (minimum) and 4GW (maximum) will be required to each of the three converter station sites within the Wilton Complex;



Legend

- Tod Point 275KV
- Lackenby 400KV
- Onshore Scoping Area

Converter Station Sites

- E
- G
- H

Source:
Ordnance Survey Digital Map Data © Crown copyright, All rights reserved. 2012 Licence number 0100031673

0 500 1,000
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
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Figure 1.1: Onshore Cable Study Area

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/1.1/00

SCALE	1:70,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

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- Each 1GW project will require a cable route construction width of 18m within agricultural land. (i.e. an 18m wide 1GW cable route, a 36m wide 2GW (2x18m wide) route or a 76m wide 4GW (4x18m wide) route); and
- The construction width can be reduced within road surfaces to 7.5m wide for 1GW, 13m wide for 2GW and 24m wide for 4GW.

1.3 Report Structure

The report is comprised of four Sections. Section 1 provides the introduction, background and methodology to the report. Section 2 presents the findings of the route options to connect the landfall to the Wilton Complex. Section 3 presents the route options within the Wilton Complex and between the potential converter station sites and the substations at Lackenby and Tod Point. Section 4 provides a summary and recommendations for further work.

1.4 Data Sources

The information used to inform the routing assessment has been sourced from a number of providers. All datasets have been received as or converted to spatially referenced GIS layers. **Table 1.1** contains all the datasets used and the data providers.

Table 1.1: Data Providers and Datasets Utilised

Data Provider	Datasets utilised
Forewind (Via ZoC Process)	Existing substations, grid connections, national grid gas pipes, overhead cables, agricultural land classification, airfields, ancient woodlands, Areas of Outstanding Natural Beauty (AONB), battlefields, urban areas, country parks, national parks, Special Sites of Scientific Interest (SSSI), listed buildings, Heritage Coasts, Lakes, Local Nature Reserves (LNR), Local Planning Policies, National Nature Reserves (NNR), Registered Parks and Gardens, Ramsar sites, Royal Society for the Protection of Birds (RSPB) reserves, Special Area of Conservation (SAC), Scheduled Ancient Monuments (SAM), Source Protection Zones, Special Protection Area (SPA), World Heritage Sites, Roads, Schools, rivers, woodland, Hospitals, railways 1:25,000 and 1:100,000 Ordnance Survey (OS) mapping.
Environment Agency	Water abstractions, flood risk zones, detailed river line, nodes and offline drainage, Active Landfills.
Ordnance Survey	1:10,000 OS colour raster mapping.
British Geological Society	Bedrock Geology 1:50,000, Artificial Geology 1:50,000, Superficial deposits 1:50, 0000.
Tees Archaeology	Redcar and Cleveland Historic Environment Record, Historical Investigations Record.
Ecological Records Information Centre North East	Local Wildlife Sites, Biodiversity Action Plan (BAP) habitat and additional habitat layers, Teesside Species Records, Redcar and Cleveland Local Wildlife Sites (LWS).
Find Maps	Active landfills, Detailed River Network, Environmental Permitting Regulations (EPR) Waste licenced sites, Geology 1:50,000, Water Abstraction Licences, Groundwater Vulnerability maps.

Data Provider	Datasets utilised
Envirocheck	Active and historic landfill locations and contaminated land point data.
Natural England	Green Infrastructure Project Areas
Redcar and Cleveland Council	Local Plan policies, Strategic Flood Risk Assessment.
Other Sources digitised by Royal Haskoning	Historic Landfills, Golf courses, Public Rights of Way, Potash gas pipeline, Marske Sewage outfall pipe, other overhead power lines, other large infrastructure projects, Strategic Flood Risk Assessment (SFRA) allocations, Built up areas, Wilton Complex available sites, Wildlife Trust Reserves, Other Woodland Data Sets

2 CABLE ROUTE ASSESSMENT: HVDC ROUTES FROM THE LANDFALL TO THE WILTON COMPLEX

2.1 Methodology

For the purposes of assessment and reporting, the land between the landfall and the Wilton Complex was divided into sections. A brief description of the three sections (see **Figure 2.1**) is provided below:

Section A: This section includes the landfall, the corridor between the towns of Redcar and Marske-by-the-Sea, the sewage works, railway line and the agricultural land and woodland up to the A174.

Section B: This section includes the agricultural land south of the A174 to the village of New Marske and Longbeck Lane. This section also includes the village of Yearby and continues to the A174 roundabout with the A1042 at the south east corner of the Wilton Complex.

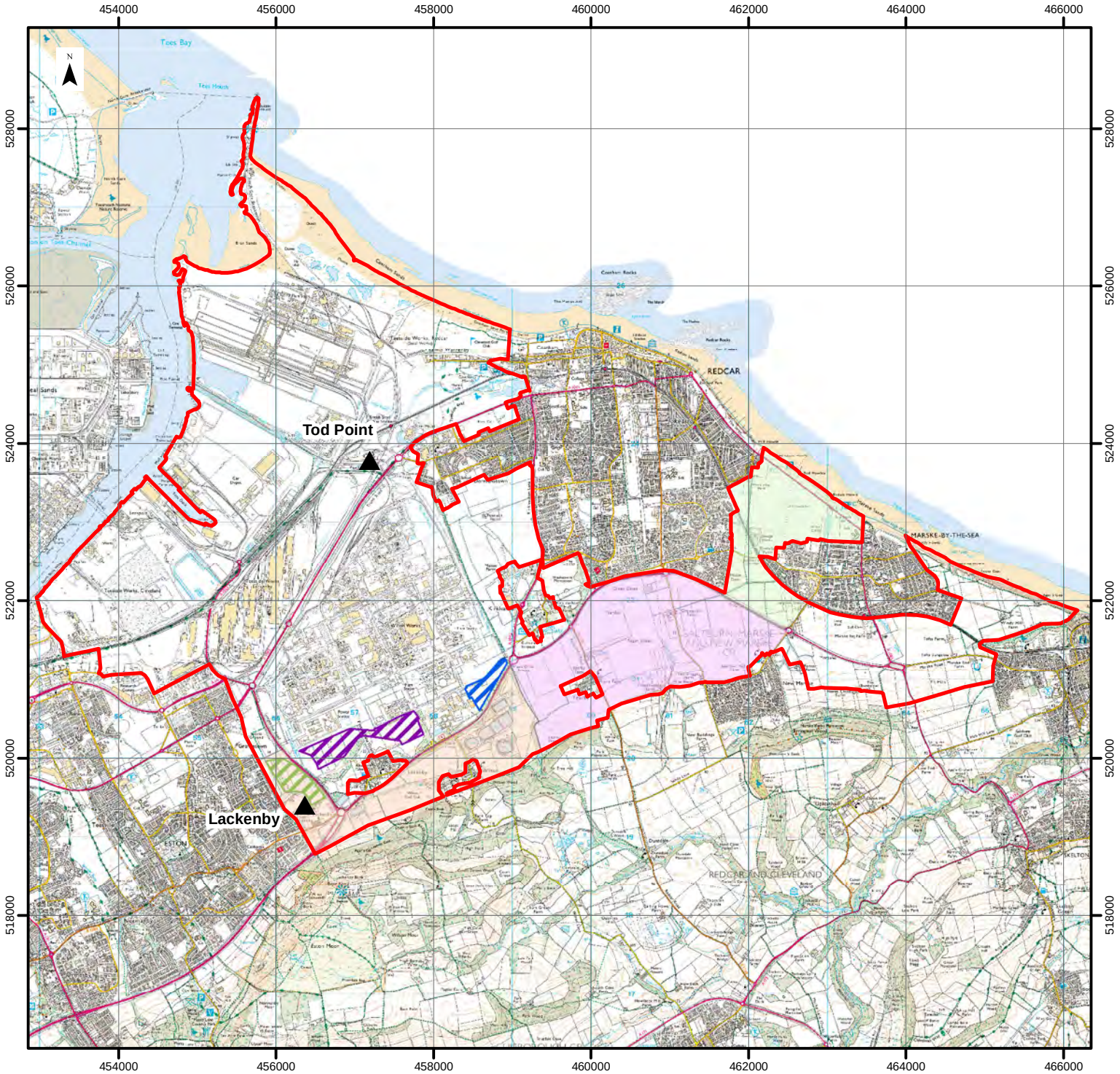
Section C: This section includes the land directly south of the Wilton Complex adjacent to the A174. The area includes reservoirs, Wilton Golf Club and several areas of woodland and individual mature trees. Along the southern border are Neptune Wood and Wilton Wood. It also includes the land surrounding the Lackenby substation and offers an alternative route (avoiding the Wilton Complex) to the westernmost converter station Site H.

In addition to exploring the route options within each these sections, this report also explores the potential to site the cable underneath the existing highway infrastructure.

The assessment of each section is detailed in the report below, within each section the key consenting risks have been detailed and summarised within a table for comparison. A figure has also been produced showing the identified routes for each section.

The methodology of this report focused on identifying a preferred cable route that minimised consenting risk. The following assumptions were adopted where practicable to further minimise environmental impact:

- Avoid designated sites and areas (i.e. heritage and biodiversity sites);
- Follow existing field boundaries (where practical);



Legend

- Tod Point 275KV
- Lackenby 400KV
- Onshore Scoping Area
- Section A
- Section B
- Section C

Converter Station Sites

- E
- G
- H

Source:
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0 500 1,000
Metres

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Teesside

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Figure 2.1: Onshore Cable Study Area with Sections A to C

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/2.1/00

SCALE	1:70,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

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- Minimise the number of hedgerow crossings;
- Utilise existing gaps in field boundaries;
- Avoid rendering parcels of agricultural land inaccessible during construction;
- Avoid areas of important habitat, trees, ponds and agricultural ditches;
- Minimise impacts on agricultural practices and access; and
- Reduce proximity to residential dwellings.

It is assumed the shortest practicable, and technically and environmentally acceptable route, is preferable to minimise disturbance to local residents, landowners and environmental features such as soils, watercourses and hedgerows.

For more detail on the wider environmental and social consenting risks within the Teesside Scoping Area, please refer to Part 1 of the onshore cable route site selection process, report titled 'The Dogger Bank Teesside – Onshore Study Area Characterisation', produced by Royal Haskoning in April 2012.

In the summary table for each section we have noted the number of road crossings, from the information currently available it is anticipated that Horizontal Directional Drilling (HDD) techniques are likely to be required to cross A and B roads and potentially minor roads. This will be confirmed at a later stage through discussion with the highway authorities and advice from the EIA traffic and transport specialists.

2.2 Landfall to Wilton: Section A

As described above Section A of the cable route assessment covers the area between the preferred landfall and the A174 (see **Figure 2.1**).

2.2.1 Key consenting considerations

Table 2.1 below provides the key environmental, technical and social considerations for this section of the cable route.

Table 2.1 Section A – Summary of Constraints

Environmental	Technical	Social
Residential zones of Redcar and Marske-by-the-Sea	Marske Sewerage Treatment Works	Bydales School, located on the north western edge of Marske-by-the-Sea
Woodland, grassland and hedgerow habitats	Buried sewage outfall pipe that runs across the agricultural land to the coast (shown on **Figure 2.2**)	The allotments adjacent to Marske-by-the-Sea
Areas of historic landfill	Railway line	Redcar Rugby Union Club, this is also the home for a new annual summer festival 'Redcar Rocks'
Soils and agriculture	A174 and Redcar Road	Community parkland

2.2.2 Identified Routes

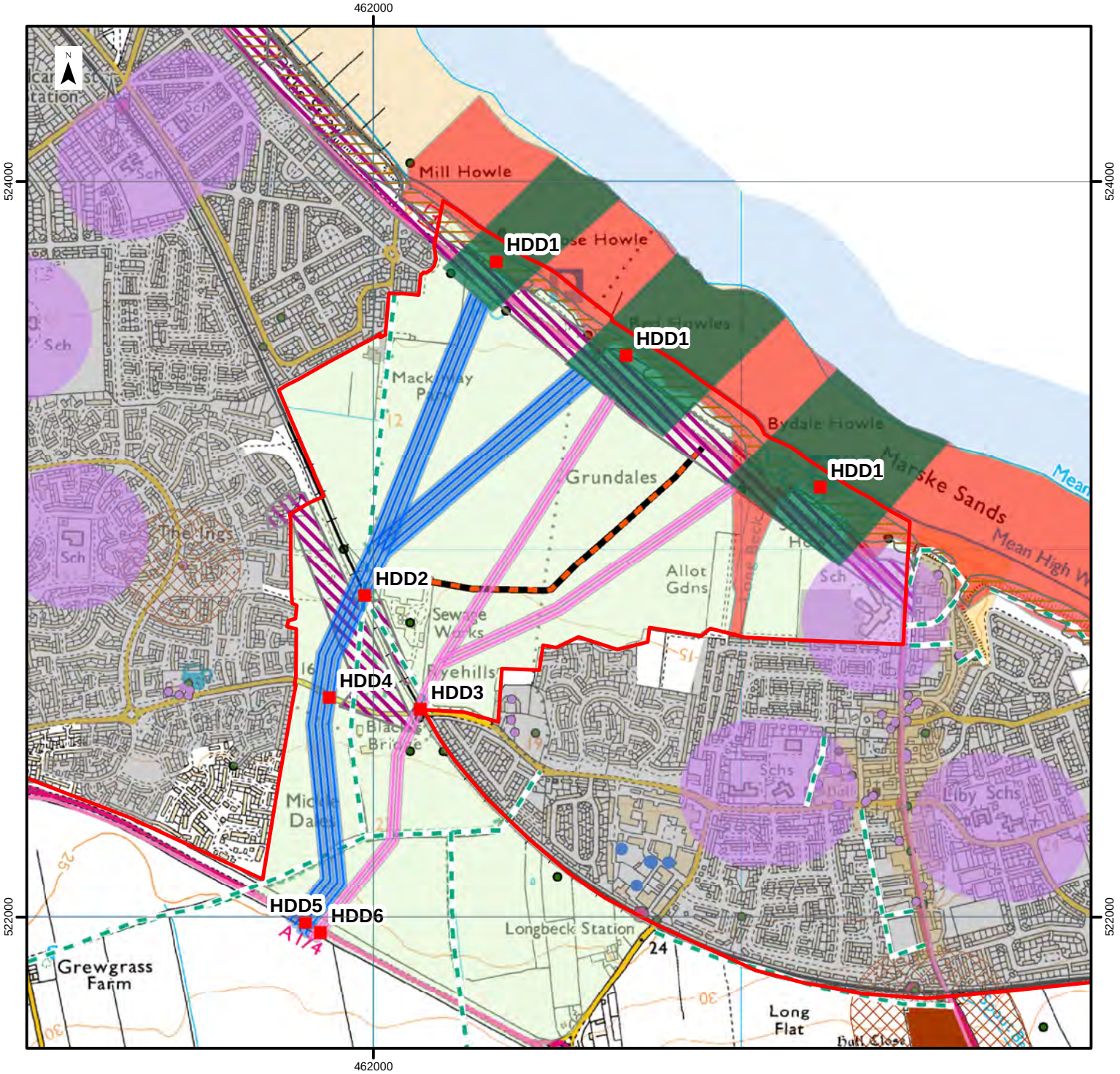
There are two primary route options identified within Section A. The key constraints for this section have been detailed in **Table 2.1** above as well as displayed in **Figure 2.2**. Below is a brief description of each route option and the main consenting risks identified. **Table 2.2** below provides a summary and comparison of the two alternative route options within this section. Recommendations are provided for the preferred route options at this stage and further assessments that could aid further route definition are highlighted. The identified route options discussed below are displayed in **Figure 2.2**.

Route option: A1
Route option A1 passes to the north side of the Marske Sewerage Treatment Works across the green belt (agricultural use) from the landfall location. The route then crosses the passenger railway line that runs between Middlesbrough and Saltburn-by-the-Sea followed by two unclassified residential roads, Redcar Road and Green Lane at separate locations. These are both likely to require an HDD as they represent major transport infrastructure. The route then curves south across community parkland and Redcar Road and into the agricultural field surrounded by Mickle Dales woodland between Simmons Nurseries and the town of Redcar, before reaching the A174. Prior to reaching the A174 there is public footpath that runs along the south side of the woodland. HDD may be required to cross the woodland to reduce impact on this habitat. The second HDD will need to travel under the woodland and the A174.

The proximity to Redcar residential areas has potential to restrict the project in terms methodology and timing of construction and represents and risk to consent. The woodland may also potentially represent constraints to works, given their (potential) ecological interest and their use by members of the local community. There is the potential to locate up to 4GWs of export cable within this route option, in any combination from 1x1GW, 2x1GW or 4x1GW. 4GW is considered the least viable option at this location due to the constraints identified, in particular the lack of available space for the HHD to the north of the Marske Sewerage Treatment Works.

Route option: A2
The route option passes across the agricultural land to the south of the Marske Sewerage Treatment Works followed by the passenger railway line that runs from Middlesbrough to Saltburn-by-the-Sea. The route also crosses Green Lane a byway followed by Redcar Road and a small copse of woodland in close succession. In order to cross these multiple constraints it is likely that a single long HDD could be employed. The route then continues down to the A174, crossing Cat Flatt Lane (a small service track and also public footpath to the Simmons nurseries). The route then crosses the A174, most likely by HDD, into the adjacent agricultural field. There is the potential to locate up to 2GWs of export cable within this route option either as 1x1GW or 2x1GW. 4x1GW is considered unlikely to be viable at this location due to the constraints identified, in particular the lack of available space for the HHD to the south of the Marske Sewerage Treatment Works.

Route Recommendation
At this stage route option A2 is considered to be preferential over route option A1, due the reduced HDD requirements, the proximity to fewer residential properties and the reduced disruption to community facilities. However, as route option is only viable for 2x1GW it is likely that route option A1 is also likely to be required for the second 2x1GW.



Legend

- Onshore Scoping Area
- Section A
- HDD Locations
- Cable Landfall Envelope
- A1 - 4 x 1GW 18m HVDC Cable Route
- A2 - 2 x 1GW 18m HVDC Cable Route
- Marske Sewerage Line

0 125 250
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

DRAWING TITLE
Figure 2.2: Section A Routes and Considerations

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/2.2/00

SCALE	1:15,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

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Land Use

- Converter Station Study Area
- Existing Creyke Beck Substation
- Overhead Power Lines
- Overhead Power Lines Buffer
- National Grid Gas Pipeline
- Pipeline Buffer 10m
- Water
- Gas
- Etheleyene Pipeline
- Electric
- Railways
- NG Gas Pipe
- Gas
- Properties
- Properties in Substation Area 200m Buffer
- Properties in Substation Area 300m Buffer
- Built Up Areas
- Bridleway
- Footpath
- National Trail

Land Quality

- Possible Landfills
- Landfills
- Environmental Permitting Regulation Site

Hydrology

1 in 1000 years + Climate Change Flood Depth

- 0 - 0
- 0 - 0.5
- 0.5 - 1
- 1.000000001 - 1.5
- 1.500000001 - 2
- 2.000000001 - 2.5
- Abstraction License
- Private Water Supplies
- Detailed River Network

Archaeology

- World Heritage Sites
- Scheduled Monuments
- Scheduled Monument Buffer - 150m
- Listed Buildings
- Parks and Gardens
- Local Sites and Monuments Record
- Previous Study or Reports

Nature Conservation Designations

- RAMSAR
- SPA
- SAC
- SSSI
- National Park
- AONB
- NNR
- RSPB Reserves
- Local Nature Reserves
- Country Parks
- Local Wildlife Sites
- Site of Nature Conservation Interest
- YWT Reserves
- Ancient Woodlands
- Woodland

Phase 1 Habitat Survey

- Amenity Grassland
- Arable
- Arable/Grass
- Awaiting Clarification
- Bare ground
- Broadleaved Woodland
- Building
- Coniferous Woodland
- Dry Pond
- Hardstanding
- Improved Grassland
- Inundation
- Manure Pile
- Neutral Grassland
- No Access
- Pond
- Rush Pasture
- Scrub
- Semi-Improved Grassland
- Semi-Improved Grassland with Scrub
- Semi-improved with Rush Pasture
- Swamp
- Tall Herb Community
- Tall Ruderal
- Water
- Woodland
- Tree
- Hedgerow
- Target Notes

Table 2.2 HVDC Cable Route Options in Section A – Comparison

Route ID	Comparative Consenting Risk	Length (m) from MHWM	No. of HDD	No. of Hedgerow Crossings	No. of road crossings	No. of Landowners	Potential GW	Key environmental, social and technical constraints
A1	High	1,980	4	0	4	8	4	• Historical landfill sites at the coast and the railway line • Redcar and Cleveland Rugby Club • Railway and road crossing • Crossing two PROWs • Woodland • Proximity to dwellings • Community Parkland
A2	Low	1,915	3	2	5	10	2	• Historical landfill sites at the coast and the railway line • Marske Sewerage Treatment Works • Sewage outfall pipe • Crossing one PROW • Railway and road crossing

2.3 Landfall to Wilton: Section B

Section B of the study area covers the agricultural land between the A174 and the roundabout at the south west corner of the Wilton Complex (see **Figure 2.1**).

2.3.1 Key consenting considerations

Table 2.3 below provides the key environmental, technical and social considerations for this section of the cable route.

Table 2.3

Environmental	Technical	Social
Hedgerow crossings	Overhead power lines	Multiple landowners
Proximity to Yearby Conservation Area	Proposed York Potash gas pipeline	Proximity to residential dwellings
Soils and agriculture		Private micro light airstrip
Old mineral railway contaminated land potential		Crossing two local roads
		Crossing of Public Right of Way

2.3.2 Identified routes

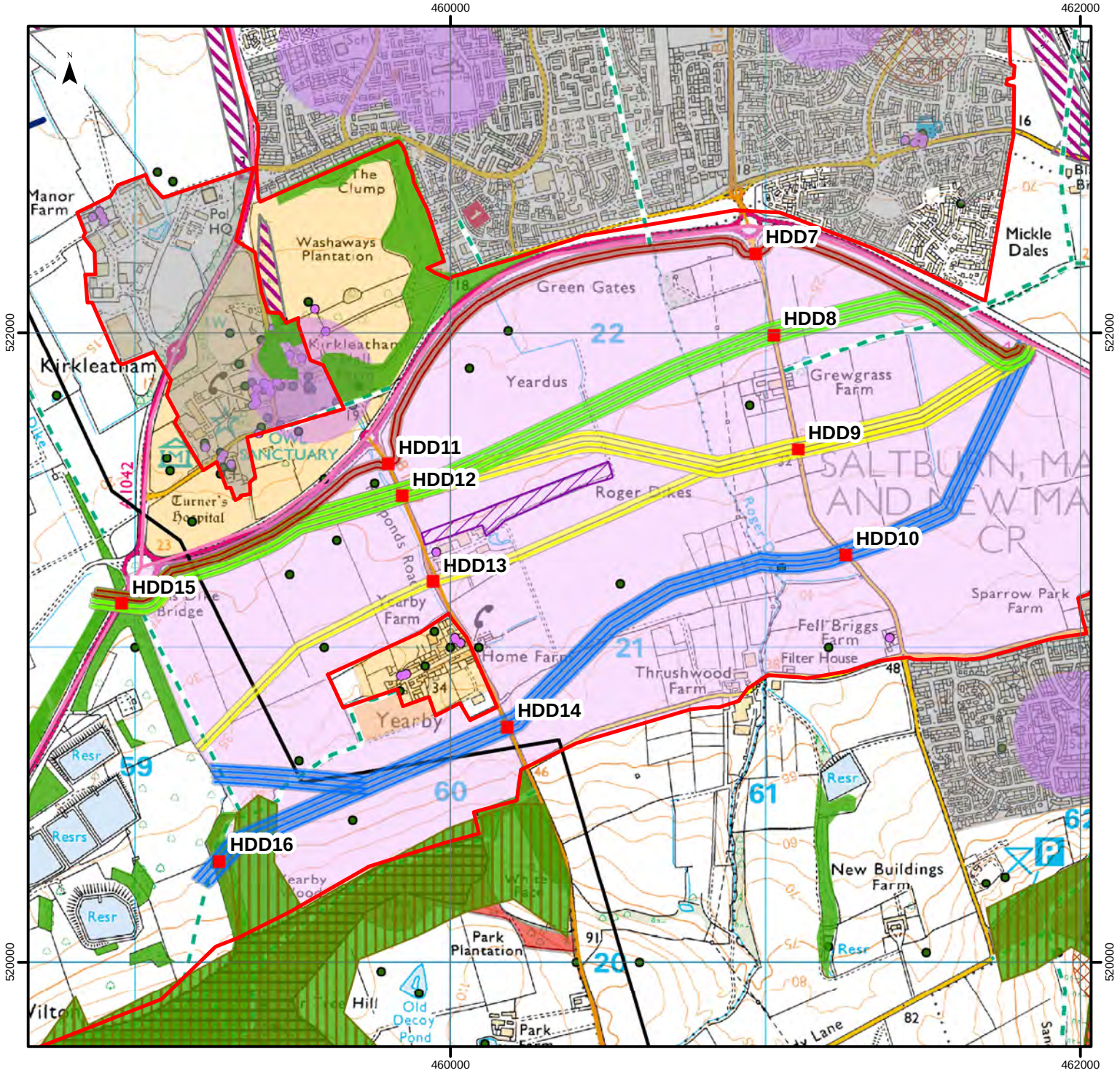
Due to the relatively large area of agricultural land within Section B, there are four primary route options identified within this part of the cable route study area. The key constraints for this section have been detailed in **Table 2.3** above as well as displayed in **Figure 2.3**. The figure demonstrates where there are options to travel between the identified routes, if sections of the route become unfeasible due to landowner negotiations or constraints unknown at this stage.

Below is a brief description of each route option and the main consenting risks identified. **Table 2.4** below provides a summary and comparison of the four alternative route options within this section. Recommendations are provided for the preferred route options at this stage and further assessments that could aid further route definition are highlighted. The identified routes discussed below are displayed in **Figure 2.3**.

Route option B1:
The route option runs in parallel to the A174 from east to west. The route option passes entirely through agricultural land and crosses Grewgrass lane and Fishponds Road until it reaches the roundabout at the south east corner of the Wilton Complex. For these roads crossings it is assumed that HDD will be required to reduce impacts to these key pieces of transport infrastructure and minimise disruption to the local communities.

There is the potential to locate up to 2GWs of export cable within this route option, either as 1x1GW or 2x1GW. 4x1GW are not considered possible along this alignment due to the lack of space between Grewgrass Lodge, the A147 and the nearby pylon associated with the overhead power line.

Route option B2:
The route option travels west across the agricultural land between Grewgrass Lodge and Grewgrass Farm. The route crosses both Grewgrass lane and Fishponds Road until it reaches the roundabout at the south east corner of the Wilton Complex. There is the



Legend

- Onshore Scoping Area
- Section B
- HDD Locations
- B1 - 2 x 1GW 18m HVDC Cable Route
- B2 - 4 x 1GW 18m HVDC Cable Route
- B3 - 4 x 1GW 18m HVDC Cable Route
- B4 - 4 x 1GW 18m HVDC Cable Route
- Light Airfield
- York Potash Pipeline

0 150 300
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

DRAWING TITLE
Figure 2.3: Section B Routes and Considerations

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/2.3/00

SCALE	1:17,500	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

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potential to locate up to 4GWs of export cable within this route option, as 1X1GW, 2x1GW or 4x1GW. The 4X1GW option is constrained at the point where is passes between the Grewgrass Lodge and Grewgrass Farm, where a Pylon forces the route south, closer to Grewgrass Farm.

Route option B3:
This route option offers a third option to cross the agricultural land south of the A174. The route travels directly west across the agricultural land towards the village of Yearby. The route passes between Turners Arms Farm and the Yearby conservation area and on to the Section C where it reaches the reservoirs. For the first part of the route there is the capacity to support up to 4GW of cable route either as 1x1GW, 2x1GW or 4x1GW.

As the route continues there is a potential sub-option, the route can move south west between Turners Arms Farm and Yearby, however this option would be limited to a maximum of 2x1GW and would be close to the conservation area at Yearby. This southern sub option of route option B3 also crosses a PRoW running north to south adjacent to the Woodland strip adjacent to the reservoirs. Due to the limited width and other constraints this sub option is not recommended. The main 4x1GW route option shown on the plan is therefore to continue the route west, passing to the north of the small airfield and on towards the roundabout, as displayed on **Figure 2.3**.

Route option B4:
Route option B4 travels south west from the A174 towards Thrushwood Farm, located in the southern half of the study area. The route then heads west and passes between the village of Yearby and Yearby Wood before crossing into fields south of the reservoir. South of Yearby the route overlaps the proposed potash pipeline, and this could potentially render this route unfeasible. Once past the pipeline the route would require an HDD to cross the woodland that separates the agricultural field and the field to south of the reservoir. Route option B4 also crosses a PRoW running north to south adjacent to the Woodland strip adjacent to the reservoirs. It may be preferable, if route option B4 was selected, that the route heads north and utilises the gap in the woodland, both options have been displayed on **Figure 2.3**.

There is the potential to locate up to 4GWs of export cable within this route option, either as 1x1GW, 2x1GW or 4x1GW.

Route Recommendation
At this stage it is considered that route option B3 is preferential for a 4x1GW route to reach the Wilton Complex as opposed to the other identified routes. Route option B3 is the shortest route and in the absence of any other environmental or social constraints being identified this is considered the preferential route option. Route option B2 is also similar and would be considered a good potential alternative. If further work identifies additional constraints to cabling within the Wilton Complex this recommendation may alter in line with the alternative route options identified in route Section 3.

Table 2.4 HVDC Cable Route Options in Section B – Comparison

Route ID	Comparative Consenting Risk	Length (m)	No. of HDD	No. of Hedgerow Crossings	No. of road crossings	No. of Landowners	Potential GW	Key environmental, social, technical constraints
B1	Moderate	3,400	3	8	3	6	2	• Proximity to Residential housing • Crossing PROW • Crossing of waterways • Pylons • Potash pipeline crossing
B2	Low	3,250	3	8	3	8	4	• Proximity to Residential housing • Crossing PROW • Crossing of waterways • Pylons • Potash pipeline crossing
B3	Low	2,850	3	9	2	6	4	• Proximity to Residential housing • Crossing PROW • Crossing of waterways • Potash pipeline crossing
B4	Moderate	3,150	2/3	3	2	6	4	• Proximity to conservation areas (Wilton Woods LWS) • Proximity to individual residential properties • Crossing PROW • Conflict with Potash Pipeline • Route can only support 1GW

2.4 Landfall to Wilton: Section C

Section C of the route assessment covers the agricultural land between the roundabout in the south west corner of the Wilton Complex and the National Grid Lackenby Substation (see **Figure 2.1**).

2.4.1 Key consenting considerations

Table 2.5 below provides the key environmental, technical and social considerations for this section of the cable route.

Table 2.5

Environmental	Technical	Social
Wilton Conservation Area	Proximity to reservoirs and associated infrastructure	Wilton Golf Club
Woodland	HDD requirements to cross A174	Proximity to residential properties
Crossing of small waterways		Disruption to road network and access to Wilton Village
Listed buildings		

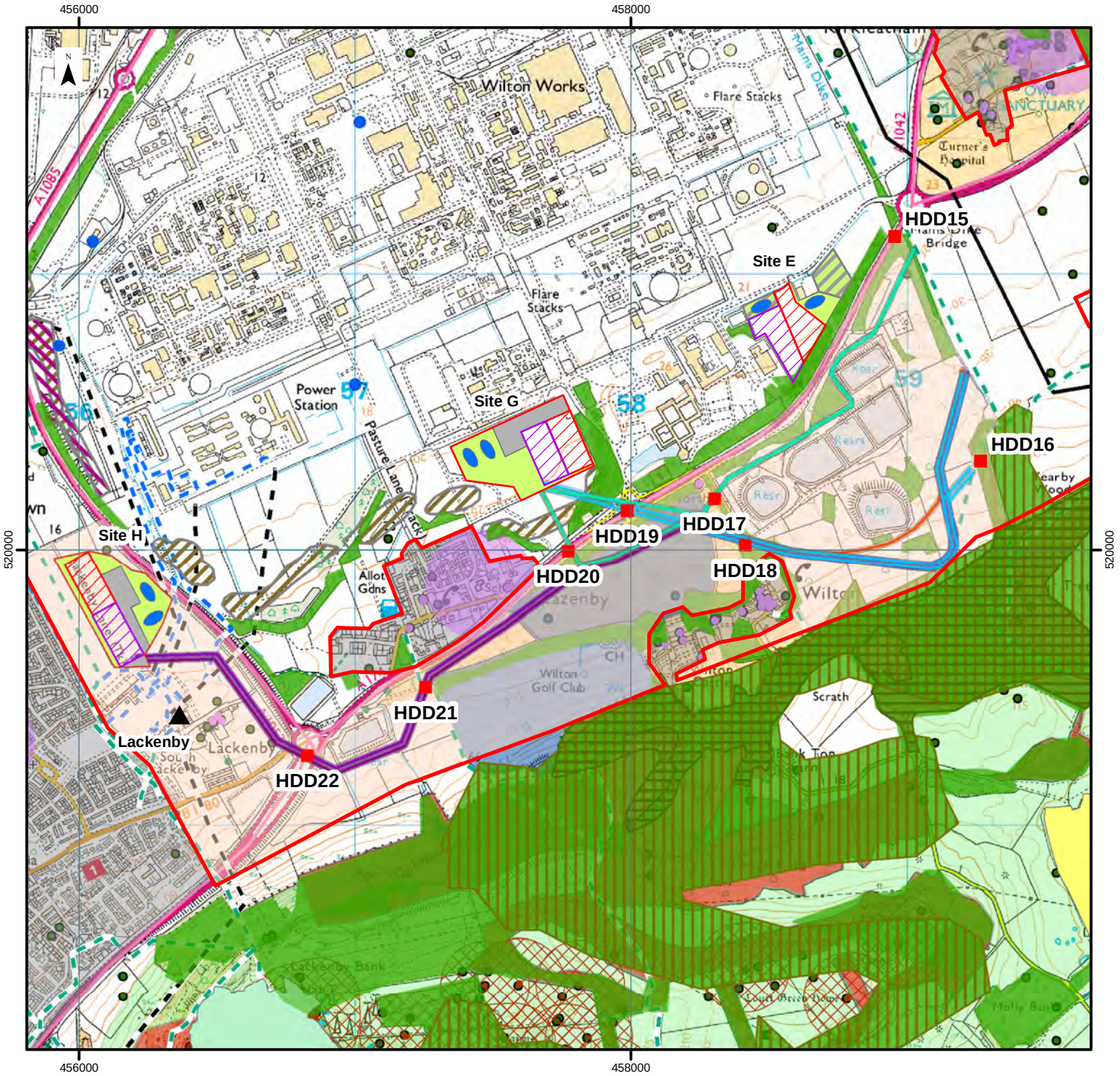
2.4.2 Identified Routes:

Section C is heavily constrained in comparison to the other two sections. There are three primary route options identified within this part of the cable route study area. A fourth route option is also displayed that extends Route C3 around the southern border of the Wilton Complex. The key constraints for this section have been detailed in **Table 2.5** above as well as displayed in **Figure 2.4**.

Below is a brief description of each route option and the main consenting risks identified. **Table 2.6** below provides a summary and comparison of the four alternative route options within this section. Recommendations are provided for the preferred routes at this stage and further assessments that could aid further route definition are highlighted. The identified route options discussed below are displayed in **Figure 2.4**.

Route option C1:
Route option C1 travels from the south side of the roundabout of the A174 with the A1042 in a south west direction towards the reservoirs located to the east of Wilton Golf Club. The route passes underneath a narrow strip of woodland before winding through the northern side of the reservoirs before crossing the Wilton lane and into Wilton Golf Club. The route then crosses the A174 into the Wilton Complex toward Site G of the shortlisted converter station sites. There is the potential to locate only 1GW of export cable within this route option, due to the limited space between the reservoirs and the tree line.

Route option C2:
Route option C2 starts either at the gap between the trees directly east of the four central reservoirs, or just west of the woodland belt, depending on the route taken through Section B. Once within Section C the route heads south west to the border of the field and Neptune Wood where the route curves round the southern-most copses of



Legend

- Lackenby 400KV
- Onshore Scoping Area
- Section C
- HDD Locations
- C1 - 1 x 1GW 18m HVDC Cable Route
- C2 - 2 x 1GW 18m HVDC Cable Route
- C3 - 1 x 1GW 18m HVDC Cable Route
- C4 - 2 x 1GW 18m HVDC Cable Route

0 150 300
Metres

PROJECT TITLE
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DRAWING TITLE
Figure 2.4: Section C Routes and Considerations

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/2.4/00

SCALE	1:20,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

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trees and heads north west to Wilton Golf course. The route then continues along the northern border of the golf course before having several potential options for HDD into the Wilton Complex. There is a trade-off between the potential disruption to the Golf Club and the length of the HDD. A shorter HDD will require a larger percentage of the golf course to be trenched; conversely, minimising impact to the Golf Club would require a substantially longer HDD operation. There is the potential to locate up to 2GW of export cable within this route option, either as 1X1GW or 2x1GW. Due to the constraints posed by the reservoirs, woodland and golf club it is not considered feasible to accommodate a 4x1GW cable route in this location.

Route option C3:

Route option C3 starts at the gap between the trees directly east of the four central reservoirs and travels in a south west direction passing between the southern-most reservoir and a small copse of trees. The route then turns to the north west and travels to the north eastern corner of the Wilton Golf Club. The route may require an HDD to cross Wilton Lane and its associated tree lined verges. It is then proposed that an HDD be employed to pass underneath the A174 to the agricultural land within the Wilton Complex to Site G. There is the potential to locate only 1GW of export cable within this route option due to the constraints posed by the reservoirs and woodland.

Route option C4:
It is also feasible for the route described above, for route option C2, to continue westwards along through the golf course in to a small field adjacent to the A174. There is then the requirement to HDD a small strip of woodland as the route heads south west behind a further reservoir until the route reaches the roundabout at the south west corner of the Wilton Complex and a junction with the B1380 and Greystone Road. The route will then head north across the A174 on the western side of the roundabout, it is likely that this crossing will require a HDD. The cable will then run adjacent to the tree line to maintain maximum distance from High Farm Cottage. The route then has the ability to directly access converter station Site H and the western side of converter station Site G by HDD.

There is the potential to locate up to 2GWs of export cable within this route option, either as 1X1GW or 2x1GWs. Due to the constraints posed by the reservoirs, woodland and golf club it is not considered feasible to accommodate a 4x1GW cable route in this location.

Route Recommendation
At this stage route option C2 is considered preferential for the access to the western edge of Site G, however the options within Section C are less preferred than the access to the Wilton Complex directly via routes options B3 and B2 through Section B.

Route options C1 and C3 are likely to be limited technically be space restrictions, and route option C4 will likely result in substantial disruption to the Wilton Golf Club.

Table 2.6 HVDC Cable Route Options in Section C – Comparison

Route ID	Comparative Consenting Risk	Length (m)	No. of HDD	No. of Hedgerow Crossings	No. of road crossings	No. of Landowners	Potential GW	Key environmental, social and technical constraints
C1	High	2,154	3	0	1		1	• Impact on established woodland • Impact on reservoir infrastructure • Impact on Wilton conservation area • Impact on Wilton golf Club
C2	Moderate	2,215	2	0	1		2	• Impact on Wilton conservation area • Impact on Wilton golf Club • HDD requirements
C3	Moderate	2,202	2	0	1		1	• Impact on Wilton conservation area • Impact on Wilton golf Club • Impact on reservoir infrastructure • Impact on established woodland • HDD requirements
C4 (combined with route C3)	High	4,250	4 to site H 5 to Site G	3 to both sites	2 to site H 3 to site G		2	• Impact on Wilton conservation area • Impact on Wilton golf Club • Impact on residential dwellings • HDD requirements

2.5 Cable laying within the Public Highway

As part of the assessment an option was considered, once the route has reached the A174 at the south east corner of Redcar, of laying the cable in the public highway. For reference **Figure 2.5** has been produced to show the route and the potential entry points to the Wilton Complex.

2.5.1 Key Consenting considerations

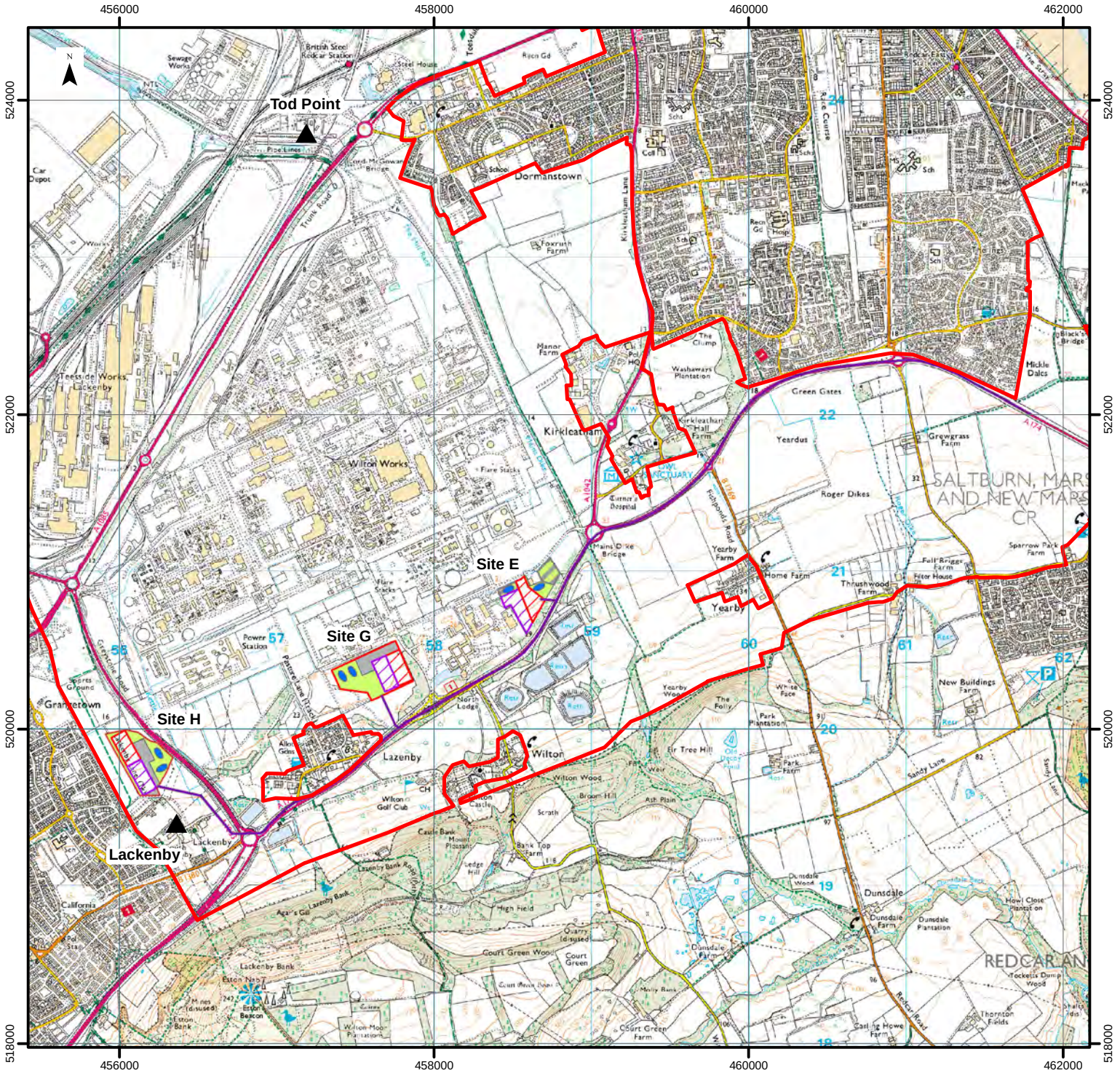
Roads are managed by the Highways Authorities. The Highway Authorities consist of the Highways Agency, for trunk roads and motorways, and County Councils and Unitary Authorities for all other roads. Any cable laying within roads would require consultation and a licence/agreement to carry out any cable laying within the road. Below are the general programme and cost considerations for commencing operations within the public highway:

- Obtaining a licence from the Highways Authorities: Depending on Forewind legal status (Utility or developer) the highways can immediately object and refuse permission, therefore consultation maybe lengthy and impact on project programme;
- The Highways Authority has an obligation to prevent traffic disruption and maintain traffic flow. Forewind will need to demonstrate that they have considered all the alternatives and that there are no other feasible options;
- Cost of traffic management: includes cones, temporary lights, diversions, shuttle services, signing and the manpower to put them in place can increase development costs by upwards of 10% in comparison to an agricultural route.
- Forewind will be responsible for the ongoing maintenance of the road post the construction phase. The maintenance requirements will be at the discretion of the Highways Authority this will lay Forewind open for potential regular and expensive requests.

There also social and technical considerations specific to the use of the main road network within the study area, these are outlined below:

- The A174 is a key transport artery for the local communities; a major adverse impact to this route would cause severe local disruption.
- A section of the A174 is single carriage way and would require closure to ensure the safety of the construction workers. This would be costly and require the input of a diversion of traffic through the residential streets of Redcar and Marske-by-the-Sea.
- The A174 is also a main access road to the Wilton Complex, impacts on the flow of traffic to the complex will affect employees as well as business.

Further to the project specific considerations outlined above, a general comparison between road and field routes, was undertaken for the Dogger Bank Creyke Beck projects. A summary of the relevant issues for each option that is relevant to a number of development considerations is provided in the table below.



Legend

- Tod Point 275KV
- Lackenby 400KV
- Onshore Scoping Area
- HVDC Road Routes to Converter Sites

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0 250 500
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

DRAWING TITLE

Figure 2.5: Road Routes

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/2.5/00

SCALE	1:35,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

ROYAL HASKONING

Table 2.7: Evaluation of potential impacts for road and off-road routes

Development Consideration	Road based	Off-road based
Habitats and associated features *(disruption and loss of habitats)*	Although some trenching would take place within the road surface, in most situations, the working width required would inevitably have a major impact upon road-side verges and hedgerows during construction.	Routes across agricultural land would inevitably require breaches within sections of hedgerows and some watercourses. Route planning would be designed to minimise impact to significant features such as woodland and larger watercourses through the utilisation of directional drilling techniques. Impact to other features will also be minimised by route micro-siting to avoid or minimise impact to boundary trees, utilising gaps in hedgerows and reinstating any disturbed habitats following construction.
Habitats and associated features *(impact to tree roots)*	Some parts of the road route will be bound by mature trees. Trenching within and adjacent to the road-surface would result in direct tree loss as well as impact upon the roots of certain trees along the road, which could result in instability and die-back.	Route planning across agricultural land has the advantage of being able to micro-plan the proposed route to cross boundaries at appropriate locations to minimise impact to tree roots and take advantages of any existing gaps in hedgerows.
Local community and other road users *(road closures and diversions)*	A road based route has the potential to cause significant disruption to road users and the local community by delaying commuting and leisure journeys.	Although off-road routes would still require road-crossings, these are of significantly lower impact and disruption levels.
Settlements *(disruption to local residents)*	It would result in disruption during the construction phase relating to increased noise and dust levels and restricted access.	An advantage of off-road routes is the ability to by-pass settlements to avoid or minimise impact.
Services *(impact to buried services)*	There are likely to be concentrations of buried services within the carriageway, which could restrict the feasibility of the road route.	The occurrence of buried services is generally reduced within agricultural land and can be mitigated easily due to greater availability of space.
Construction timing *(longer construction periods)*	Due to restricted working widths available, trench excavation and reinstatement differences, construction of road-routes are significantly longer in duration.	The installation of the grid connection within agricultural land would be significantly faster than within the road surface.

Development Consideration	Road based	Off-road based
Technical construction considerations *(longer, more disruptive and expensive construction)*	Sloped working conditions, large trees/routes, bridge crossings and existing services.	Construction access, and land ownership issues.
Route Length (*higher construction cost*)	Following roads will require the cable to follow existing roads which may not be travelling in the direction desired, thereby increasing overall route length.	Off-road agricultural routes can in many instances be routed 'as-the-crow-flies' or point to point and can therefore reduce overall cable length.
Excavated materials *(increased requirement for off-site disposal of excavated material and associated additional construction traffic)*	Reinstatement of the road-surface and back-filling of the trench is likely to require significantly higher quantities of materials which need to be brought in and taken away from the site, which would ultimately require off-site disposal.	With the exception of the backfill required surrounding the cables, the majority of the trench backfill would utilise the material excavated from the trench, which would significantly reduce the volumes of material requiring transporting to and from the site.
Maintenance requirements (Ongoing project expense)	Once the road surface has been disturbed Forewind will be responsible for the upkeep and maintenance of that surface as long as the Highway authority requires or schedules a full resurface of the road. This will be costly and legally very expensive	The requirements are much less stringent and there is no requirement to maintain agricultural land after the initial reinstatement.
Statutory Consultees *(Potential for objection from Highways Authority)*	Only acceptable if no other option is available	Road crossings still required but likely to be acceptable to Highways Authority if consulted, necessary consents are received and suitable mitigation measures are adopted.

Taking the above into consideration it is advised that road routing is considered as a less feasible route option at Teesside.

3 CABLE ROUTE ASSESSMENT: HVDC ROUTES TO CONVERTER STATIONS AND HVAC ROUTES TO SUBSTATIONS

3.1 Methodology

The cabling options within the Wilton Complex are limited by the existing facilities and utilities within the site. This section of the report looks at the constraints to DC cabling within the Wilton Complex and identified potential routes to the converter stations, as well as the route options for AC cabling from the converter stations to Lackenby and Tod Point substations.

For the purpose of route selection, indicative converter station locations have been identified within each of the three sites (E, G and H). These locations are the result of ongoing site selection work for the converter station locations and may change subject to further environmental assessments, landowner negotiations, consultation and engineering studies.

3.2 Cable Routes for Site E

3.2.1 HVDC route options

The HVDC route options to the converter stations within Site E are fairly limited due to the proximity of Site E to the entry point of the HDD from the preferred cable route from the landfall. It is currently envisaged that Site E can only accommodate 2x1GW of converter stations, on this basis the cabling of up to 2x1GW can be achieved along the inside southern boundary of Site E directly into the potential converter stations through route option E1 (See **Figure 3.1**).

Potential constraints for the HVDC cable route are few. The route is only 375m long and does not present any major constraints of concern. Consideration will need to be given to root protection zones along the edge of the treeline, as well as investigating potential services within Site E. It is likely that the existing mounding around the lorry park area would need to be removed to facilitate the cable laying.

3.2.2 HVAC route options

The HVAC connection of 2x1GW from the Site E converter stations is problematic, and can be achieved through a variety of means. There are three principle route options heading west towards Lackenby substation and two main route options heading north towards Tod Point substation.

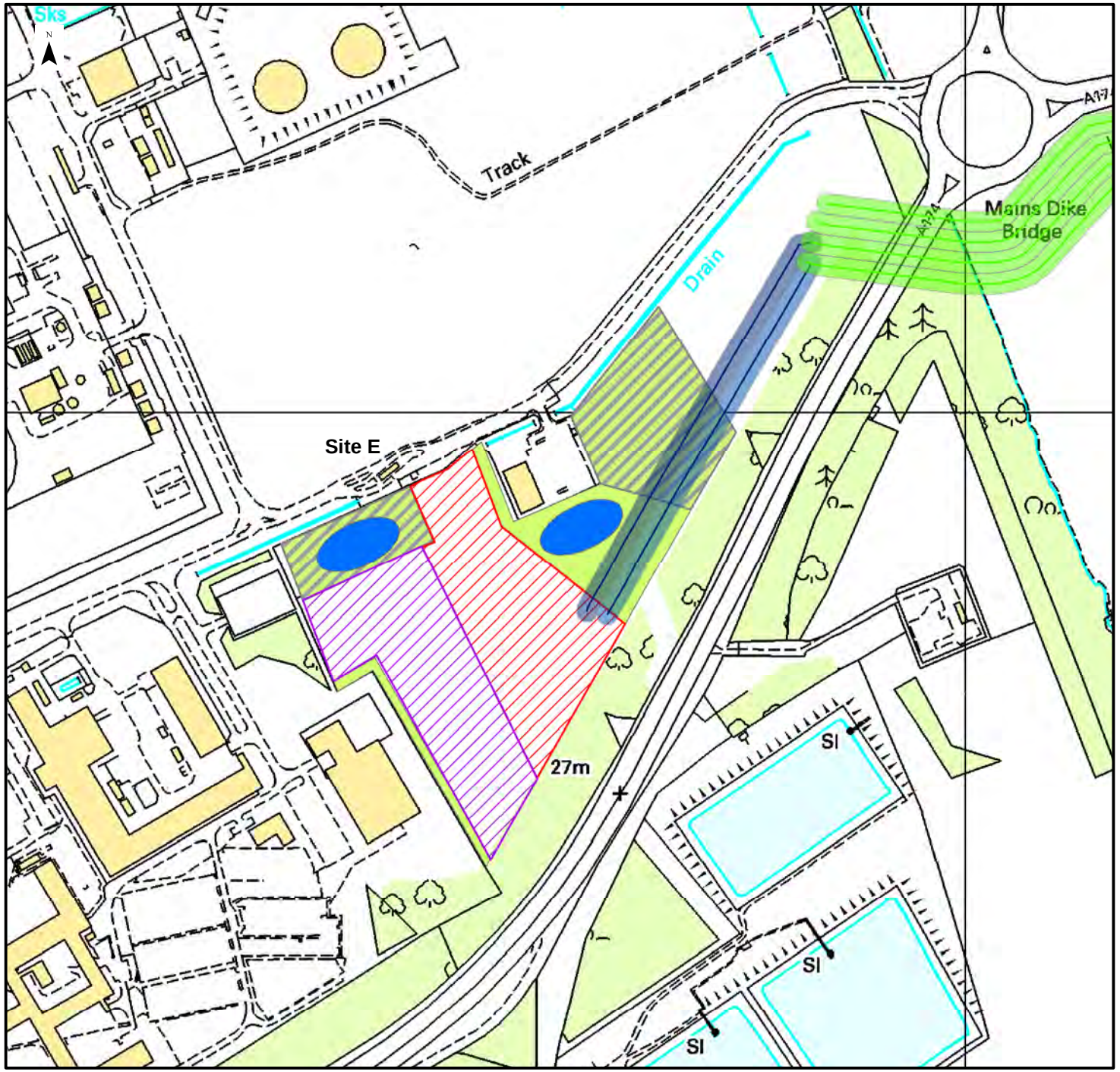
HVAC from Site E to Lackenby Substation

The three route options for a 2x1GW HVAC route from Site E to Lackenby substation (see **Figure 3.2**) are:

E2 A direct route, due west, along the internal Wilton road and verges to Site G and then under Greystone Road (A1053) to Site H and Lackenby Substation.

E3 An indirect route heading through the Wilton Complex north, before turning west and then south again following internal roads to Site G and then under the Greystone Road to Site H and Lackenby Substation.

E4 A route predominantly within the highway along A174 and A1053 before entering Site H and Lackenby Substation.



Legend

- Converter Station Site A
- Converter Station Site B
- Laydown and Landscaping
- Attenuation/Drainage
- Landscaping
- B2/B3 - 4 x 1GW HVDC Cable Route
- E1 HVDC - 2 x 1GW Cable Route (18m)

0 50 100
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

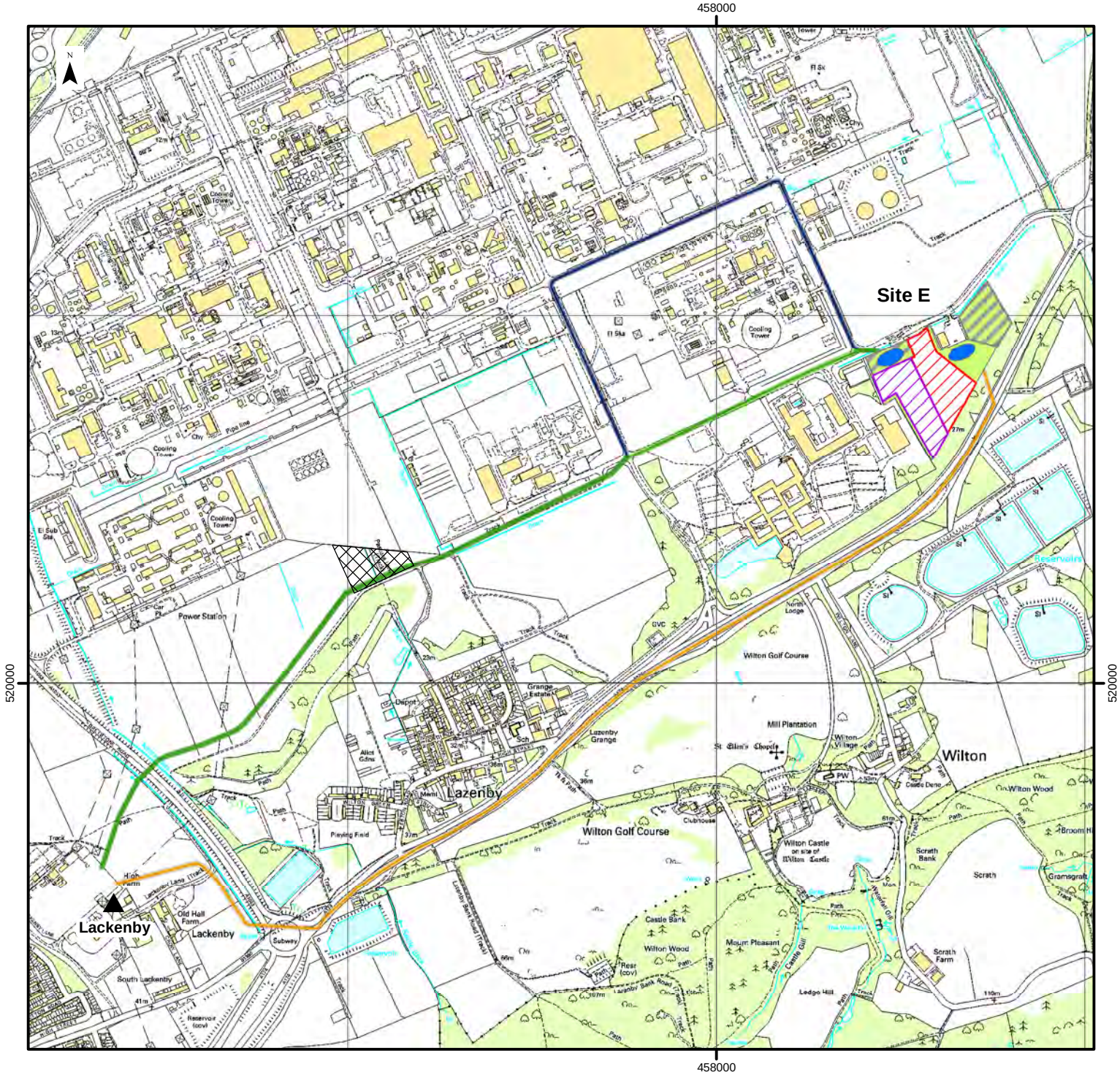
DRAWING TITLE
Figure 3.1: HVDC Route from Wilton Complex to Site E

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/3.1/00

SCALE	1:5,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

ROYAL HASKONING



Legend

- Lackenby 400KV
- Converter Station Site A
- Converter Station Site B
- Grain Storage Facility
- Laydown and Landscaping
- Attenuation/Drainage
- Landscaping
- E2 HVAC 13m Corridor - 2 x 1GW
- E3 HVAC 13m Corridor - 2 x 1GW
- E4 HVAC 13m Corridor - 2 x 1GW

Source:
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0 150 300
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

DRAWING TITLE
Figure 3.2: HVAC Routes from Site E to Lackenby Substation

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/3.2/00

SCALE	1:15,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

ROYAL HASKONING

Table 3.1 Site E: HVAC to Lackenby Substation - Route Comparison

Route ID	Comparative Consenting Risk	Length (m)	Key environmental, social and technical constraints
E2	Low	2,695	Utilities and pipeline crossings, grain storage facility, narrow working width, site traffic, proximity to operational facilities.
E3	Moderate	3,710	Utilities and pipeline crossings, grain storage facility, narrow working width, site traffic, proximity to operational facilities.
E4	High	3,090	See Section 2.5 above.

Route option E2 is considered the preferred option of the identified routes due to the shorter route length and relatively smaller number of constraints in terms of pipelines and utilities crossings. Due to the largely technical and financial nature of these constraints it is recommended that these routes are investigated further for technical feasibility in order to confirm the viability of the routes proposed.

HVAC from Site E to Tod Point Substation

The two main route options for a 2x1GW HVAC route from Site E to Tod Point substation (See **Figure 3.3**) are:

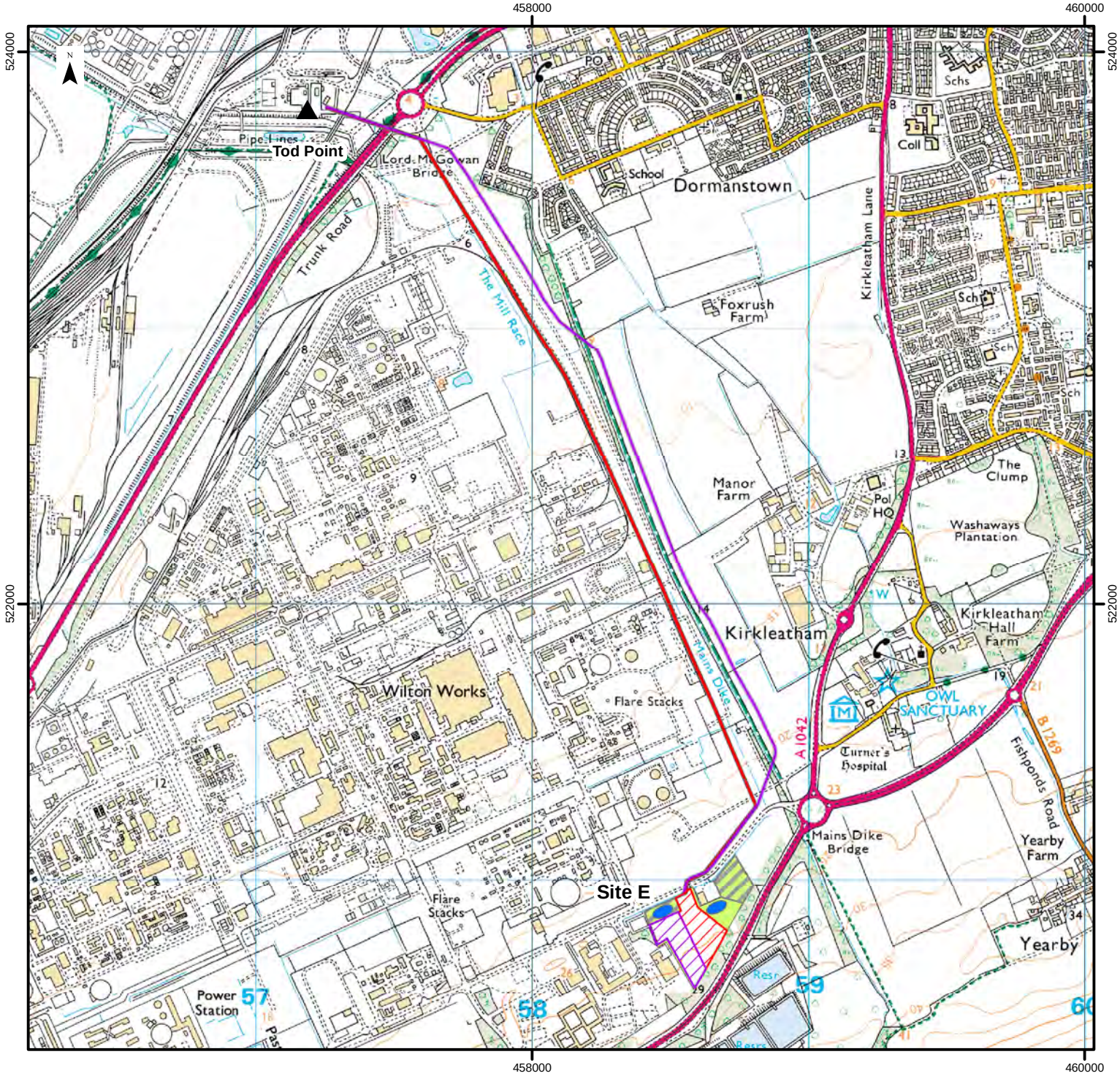
E5 A direct route exiting due east from the Wilton Complex and then travelling northward outside and parallel to the perimeter of the Wilton Complex towards Tod Point substation.

E6 A route heading east and then north within the Wilton Complex primarily sited within existing internal service roads.

Table 3.2 Site E: HVAC to Tod Point Substation - Route Comparison

Route ID	Comparative Consenting Risk	Length (m)	Key environmental, social and technical constraints
E5	Moderate	3,614	Green Belt land, proximity to housing, road crossings, utility and pipeline crossings.
E6	Moderate	3,486	Utilities and pipeline crossings, narrow working width, site traffic, proximity to operational facilities.

The two route options identified to Tod Point substation are constrained by the multiple above ground and below ground infrastructure associated with the Wilton Complex as well as the busy road network surrounding Tod Point substation. In terms of comparison, it is likely that Route E5 will be more constrained in terms of environmental and social issues such as proximity to housing and development within the Green Belt. In comparison Route E6 is likely to be less constrained environmentally or socially, however it appears to be significantly constrained in terms of technical feasibility and potential financial and health and safety constraints. It is recommended that these routes are investigated further for technical feasibility in order to confirm the viability of the routes proposed, in particular with regard to crossing the pipelines along the eastern boundary of the Wilton Complex and the road network surrounding Tod Point substation.



Legend

- Tod Point 275KV
- Converter Station Site A
- Converter Station Site B
- Laydown and Landscaping
- Attenuation/Drainage
- Landscaping
- E5 HVAC 13m Corridor - 2GW
- E6 HVAC 13m Corridor - 2GW

0 200 400
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

DRAWING TITLE
Figure 3.3: HVAC Routes from Site E to Tod Point Substation

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/3.3/00

SCALE	1:20,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

ROYAL HASKONING

3.3 Cable Routes for Site G

3.3.1 HVDC route options

The HVDC routes to the converter station Site G can be achieved from multiple entry points to the Wilton Complex as shown earlier within this report. Access to Site G can be achieved from the west via route option C4, from the south via route option C1 or C2, or via the preferred entrance to the Wilton Complex via route option B2 or B3.

The preferred route to the Wilton Complex has been identified in the previous section as route option B3. There are two main routes from the end of the B3 HDD point within Site E to Site G (as shown in **Figure 3.4**).

G1 Route option G1 travels westwards along the internal Wilton Complex access roads directly into the eastern edge of Site G.

G2 An alternative route can be achieved by routing north and then east through the Wilton Complex, following the alignment of route option E3, however this is not recommended, for the same reasons that E3 is not considered favourable.

Table 3.3 Site G: HVDC through Wilton Complex - Route Comparison

Route ID	Comparative Consenting Risk	Length (m)	Key environmental, social and technical constraints
G1	Low	1,331	Utilities and pipeline crossings, narrow working width, site traffic, proximity to operational facilities.
G2	Moderate	2,325	Utilities and pipeline crossings, narrow working width, site traffic, proximity to operational facilities.

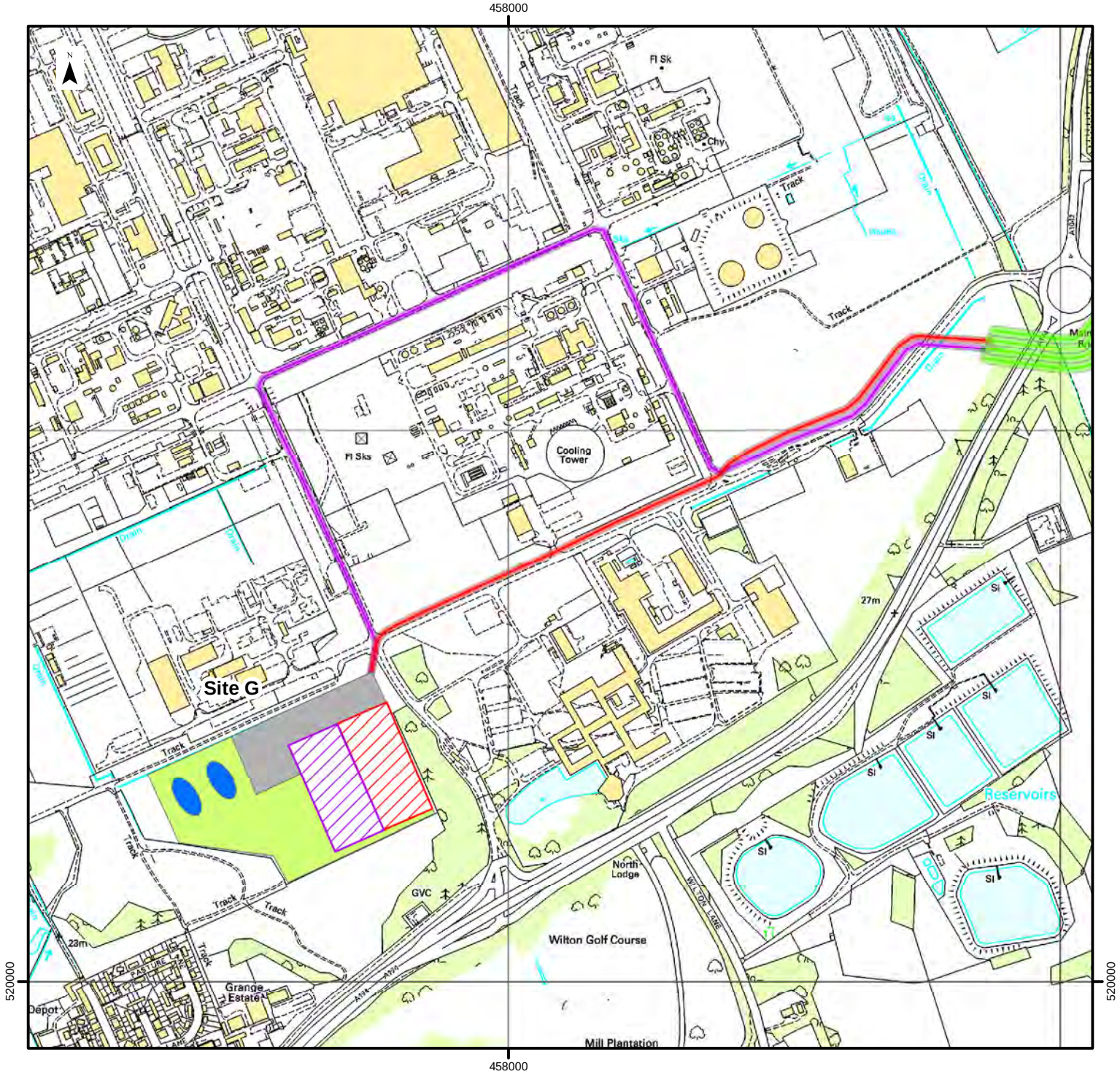
Route option G1 is considered the preferred option of the identified routes due to the shorter route length and relatively smaller number of constraints in terms of pipelines and utilities crossings. Due to the largely technical and financial nature of these constraints it is recommended that these routes are investigated further for technical feasibility in order to confirm the viability of the routes proposed. It is considered that there is potential to accommodate both the preferred Site E HVAC route option E2 to Lackenby substation with the preferred Site G HVDC route option G1. If this is subsequently proved to be technically unfeasible, then a revision of the preferred routes will be necessary.

3.3.2 HVAC route options

HVAC from Site G to Lackenby Substation

The cable route from Site G to Lackenby substation is relatively straightforward due to the proximity of the site with the substation. Therefore only a single route option has been suggested (as shown in **Figure 3.5**).

G3 Route option G3 travels west from the converter stations in Site G towards Lackenby substation. The major constraints are a pinch point between the wooded landscaping bunds and the new grain storage facility. Further constraints include the overhead power lines and the Greystone Road.



Legend

- Converter Station Site A
- Converter Station Site B
- Laydown
- Attenuation/Drainage
- Landscaping
- B2/B3 - 4 x 1GW HVDC Cable Route
- G1 HVDC 13m Corridor - 2GW
- G2 HVDC 13m Corridor - 2GW

0 100 200
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

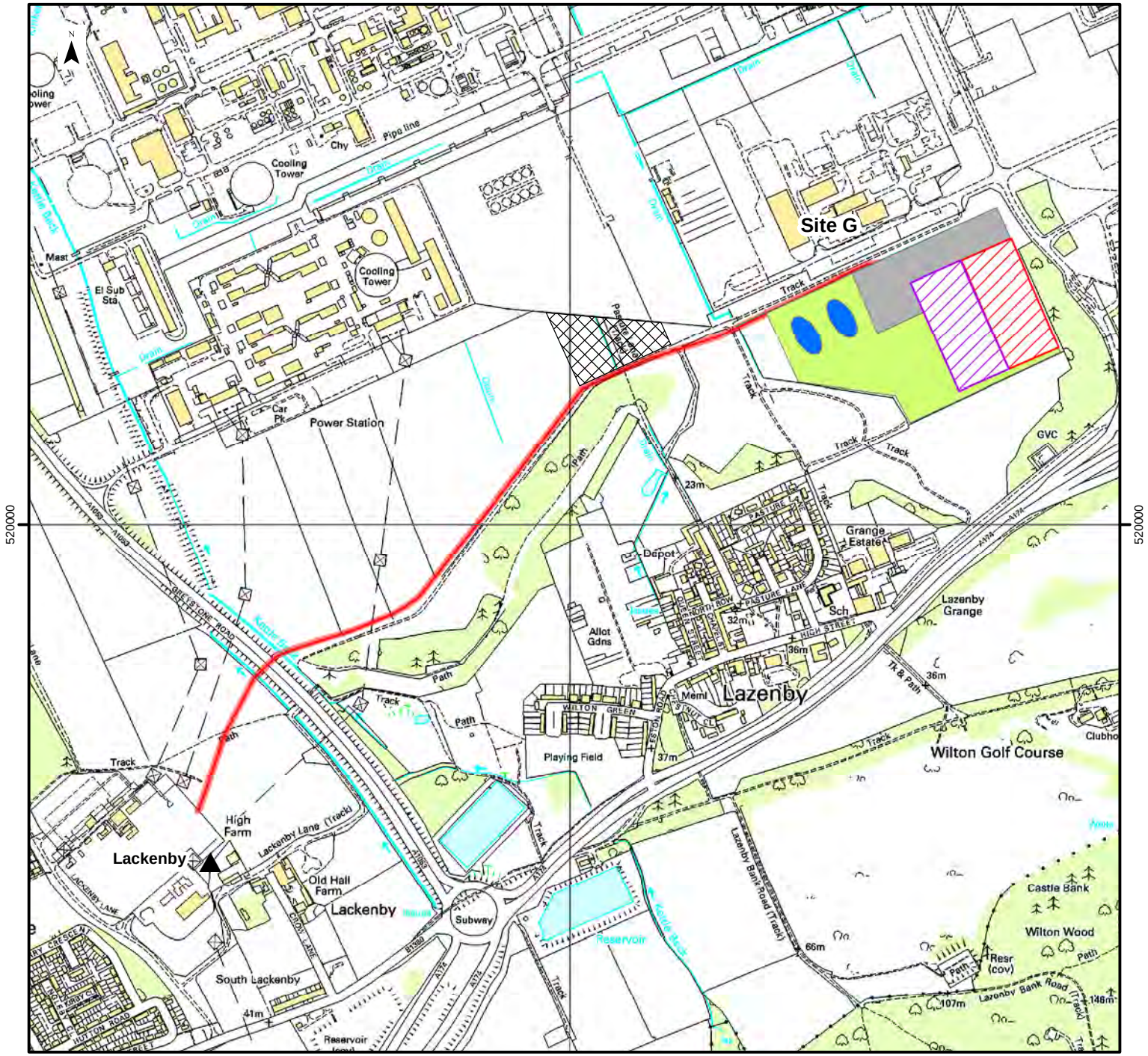
DRAWING TITLE
Figure 3.4: HVDC Routes from Wilton Complex to Site G

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/3.4/00

SCALE	1:10,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

ROYAL HASKONING



Legend

- Lackenby 400KV
- Converter Station Site A
- Converter Station Site B
- Grain Storage Facility
- Laydown
- Attenuation/Drainage
- Landscaping
- G3 HVAC 13m Corridor - 2 x 1GW

0 100 200
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

DRAWING TITLE
Figure 3.5: HVAC Routes from Site G to Lackenby Substation

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/3.5/00

SCALE	1:10,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

ROYAL HASKONING

Table 3.4 Site G: HVAC to Lackenby Substation - Route Comparison

Route ID	Comparative Consenting Risk	Length (m)	Key environmental, social and technical constraints
G3	Low	1,659	Overhead power lines, grain storage facility, Greystone Road (A1053), landfill within existing landscaped bunding.

HVAC from Site G to Tod Point Substation

The two main route options for a 2x1GW HVAC route from Site G to Tod Point substation are:

G4 A direct route exiting due east from the Wilton Complex and then travelling northward outside and parallel to the perimeter of the Wilton Complex towards Tod Point substation.

G5 A route heading north and then east within the Wilton Complex sited within existing internal service roads within the Wilton Complex (as shown in **Figure 3.6**).

Table 3.2 Site G: HVAC to Tod Point Substation - Route Comparison

Route ID & Colour on figure	Comparative Consenting Risk	Length (m)	Key environmental, social and technical constraints
G4	Moderate	4,509	Green Belt land, proximity to housing, road crossings, utility and pipeline crossings.
G5	High	4,510	Utilities and pipeline crossings, narrow working width, site traffic, proximity to operational facilities.

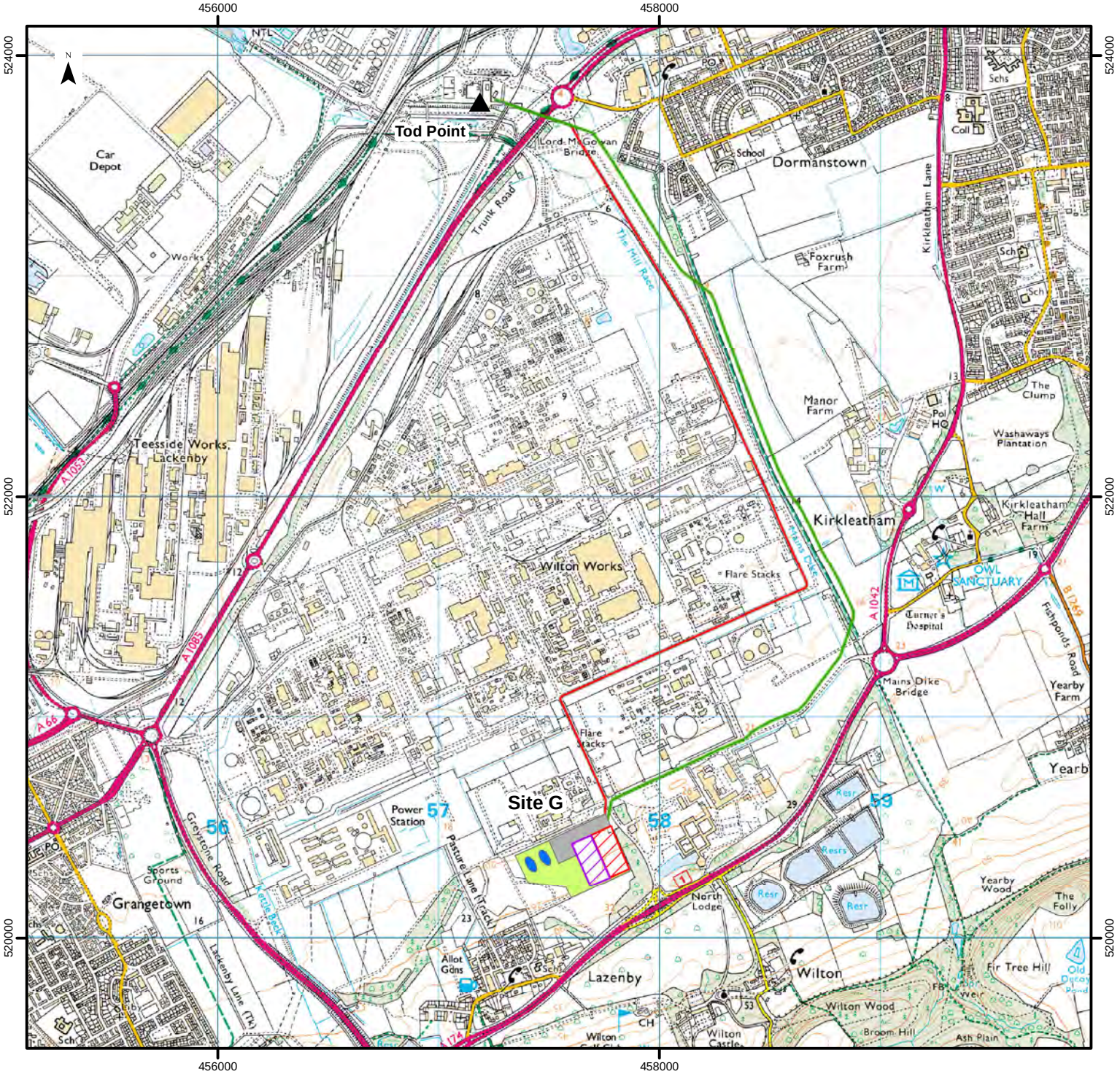
The G4 route option is considered to have less constraints, on balance, than the G5 route option and is therefore preferred. However, in the event that Site G and Site H (see below) are both progressed, there would be a conflict arising from the combination of HVDC route option G1 and HVDC route option H1 leaving little space for HVAC route option G4 from Site G to Tod Point substation through the Wilton Complex without utilising the less preferred G5 route option.

3.4 Cable Routes for Site H

3.4.1 HVDC route options

The HVDC routes to the converter station Site H can be achieved from multiple entry points as shown earlier within this report. Access to the Site H can achieved from the south via route option C4 or via the preferred entrance to the Wilton Complex via route option B2 or B3.

The preferred route to the Wilton Complex has been identified in the previous section as route option B3. There are two main routes from the end of the B3 HDD point within Site E to Site H (as shown in **Figure 3.7)**.



Legend

- Tod Point 275KV
- Converter Station Site A
- Converter Station Site B
- Laydown
- Attenuation/Drainage
- Landscaping
- G4 HVAC 13m Corridor - 2 x 1GW
- G5 HVAC 13m Corridor - 2 x 1GW

0 250 500
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

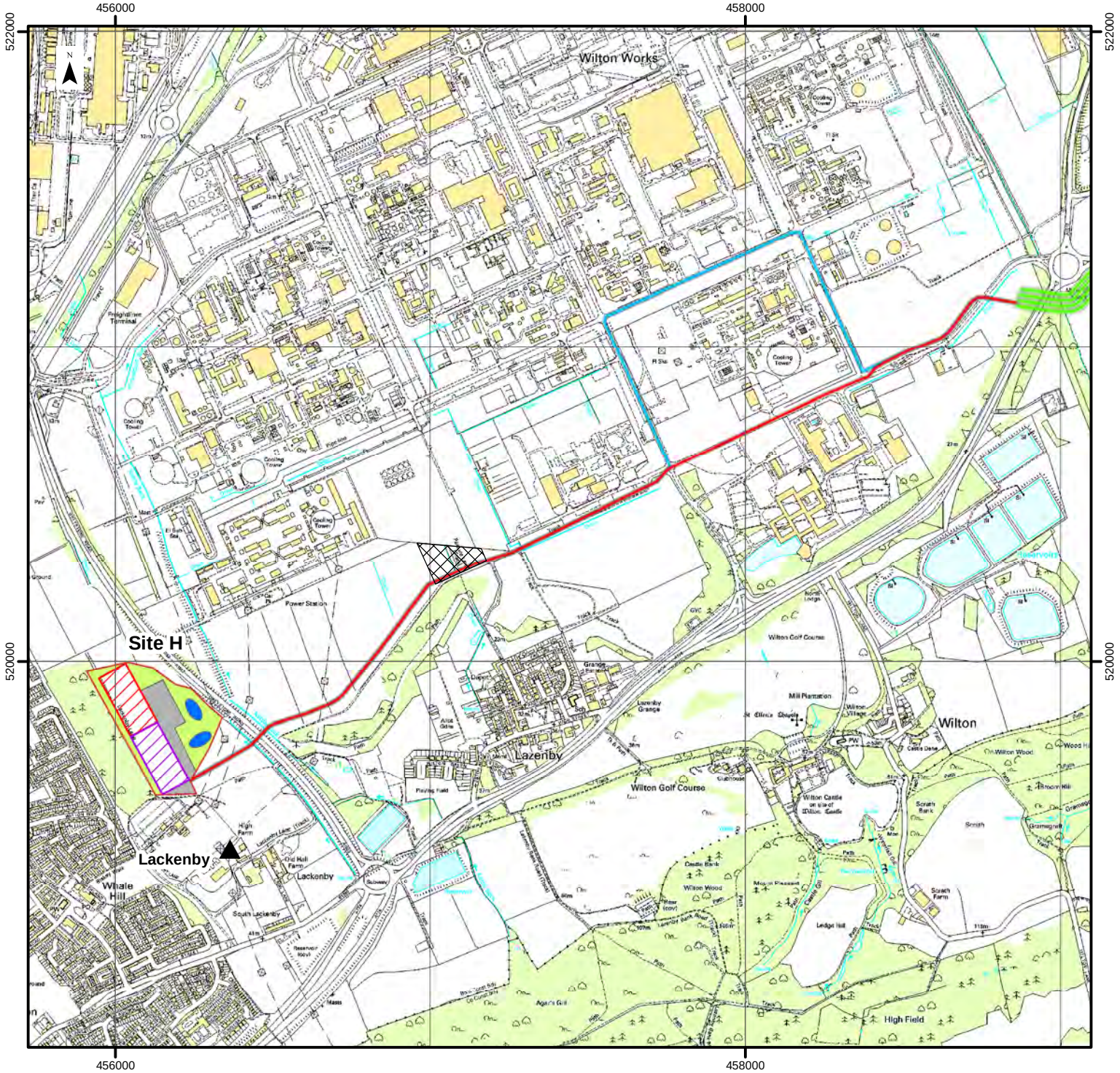
DRAWING TITLE
Figure 3.6: HVAC Routes from Site G to Tod Point Substation

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/3.6/00

SCALE	1:25,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

ROYAL HASKONING



Legend

- Lackenby 400KV
- Converter Station Site 1
- Converter Station Site 2
- Grain Storage Facility
- Laydown
- Attenuation/Drainage
- Landscaping
- B2/B3 - 4 x 1GW HVDC Cable Route
- H1 HVDC 13m Corridor - 2GW
- H2 HVDC 13m Corridor - 2GW

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0 175 350
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

DRAWING TITLE
Figure 3.7: HVDC Routes from Wilton Complex to Site H

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/3.7/00

SCALE	1:17,500	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

ROYAL HASKONING

H1 Route option H1 travels westwards along the internal Wilton Complex access roads through Site G and across the Greystone Road into Site H.

H2 An alternative route can be achieved by routing north and then east through the Wilton Complex, following the alignment of route option E3 and G2, however this is not recommended, for the same reasons that E3 and G2 are not considered favourable.

Table 3.5 Site H: HVDC through Wilton Complex - Route Comparison

Route ID & Colour on figure	Comparative Consenting Risk	Length (m)	Key environmental, social and technical constraints
H1	Low	3,120	Utilities and pipeline crossings, narrow working width, site traffic, proximity to operational facilities, overhead power lines, grain storage facility, Greystone Road (A1053), landfill within existing landscaped bunding.
H2	Moderate	4,118	Utilities and pipeline crossings, narrow working width, site traffic, proximity to operational facilities, overhead power lines, grain storage facility, Greystone Road (A1053), landfill within existing landscaped bunding.

Route option H1 is considered the preferred option of the identified routes due to the shorter route length and relatively smaller number of constraints in terms of pipelines and utilities crossings. Due to the largely technical and financial nature of these constraints it is recommended that these routes are investigated further for technical feasibility in order to confirm the viability of the routes proposed. It is considered that there is potential to accommodate both the preferred Site E HVAC route option E2 to Lackenby substation with the preferred Site H HVDC route option H1. As described above in the analysis of Site G options, in the event that Site G and Site H are both progressed there would be a conflict arising from the combination of HVDC route option G1 and HVDC route option H1 leaving little space for HVAC route option G4 from Site G to Tod Point substation without utilising the less preferred G5 route option.

3.4.2 HVAC route options

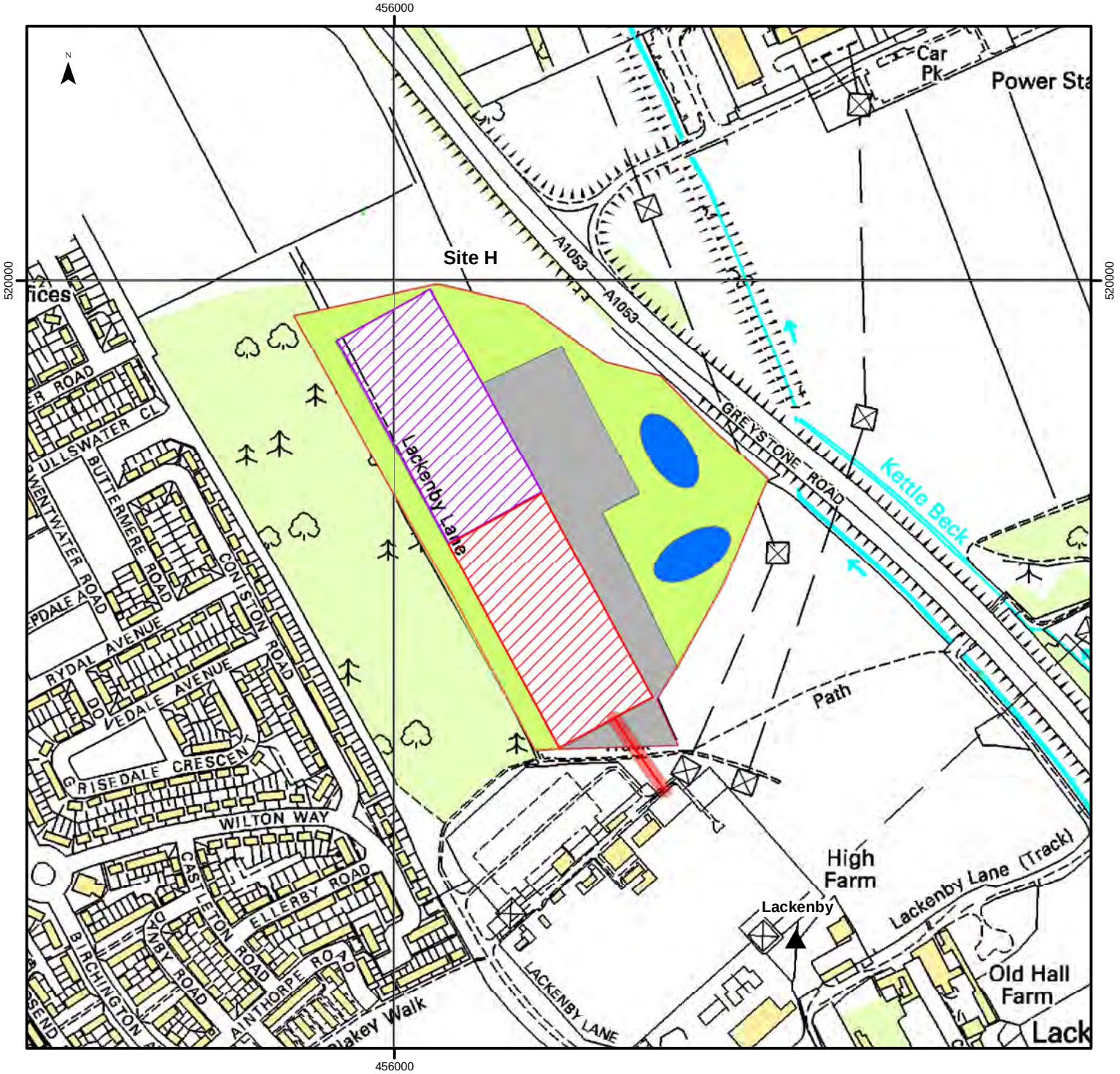
HVAC from Site H to Lackenby Substation

The cable route option from Site H to Lackenby substation is relatively straightforward due to the proximity of the site with the substation. Therefore only a single route option has been suggested.

H3 Route option H3 travels south 79m directly from the converter stations in Site H into Lackenby substation (as shown in **Figure 3.8**).

HVAC from Site H to Tod Point Substation

Based on a 5.5ha per 1GW converter station design it is not considered feasible to site 4x1GW converter stations at Site H. As it is not recommended to site the 2nd 2x1GW converter stations at Site G for the purpose of connection to Tod Point substation, a HVAC cable route to Tod Point has not been provided for Site H.



Legend

- Lackenby 400KV
- Converter Station Site A
- Converter Station Site B
- Laydown
- Attenuation/Drainage
- Landscaping
- H3 HVAC 13m Corridor - 2 x 1GW

0 50 100
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

DRAWING TITLE
Figure 3.8: HVAC Routes from Site H to Lackenby Substation

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/3.8/00

SCALE	1:5,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

ROYAL HASKONING

4 SUMMARY AND CONCLUSIONS

This report has outlined the various cable route options linking the preferred landfall to the preferred converter stations through HVDC cable routes and from the converter stations to the substations through HVAC cable routes. This work has been completed iteratively at the same time as the converter stations have been assessed and micro-sited. The routes shown within this report are a work in progress and will alter following further engineering studies, environmental assessments and consultation with landowners and consultees.

4.1 Preferred Converter Station Locations

The assessment of cable route options both informs, and is informed by, the selection of viable converter station locations. The three shortlisted converter station Sites E, G and H have been assessed based on known constraints and an outline converter station layout placed within each site. Each site has been shown with 2x1GW converter stations (2ha) along with associated drainage (0.5ha), landscaping (2ha) and laydown areas (1ha) for construction. These layouts (5.5ha) are indicative and may subsequently change depending on the outcome of further studies. Based on the constraints present at each location, and informed by the cable route option constraints, it is recommend that Site G is progressed for the first 2x1GW connection to Lackenby substation and Site E is progressed for the later 2x1GW connection to either Tod Point substation of Lackenby.

4.2 Preferred Cable Routes

The route options to Site G and Site E have been assessed and evaluated against the known social, technical and environmental considerations within and adjacent to the study area. **Table 4.1** below provides an overview of all route options considered. **Table 4.2** provides the preferred routes for the preferred converter station sites. The preferred cable routes to each site are outlined in **Figure 4.1**.

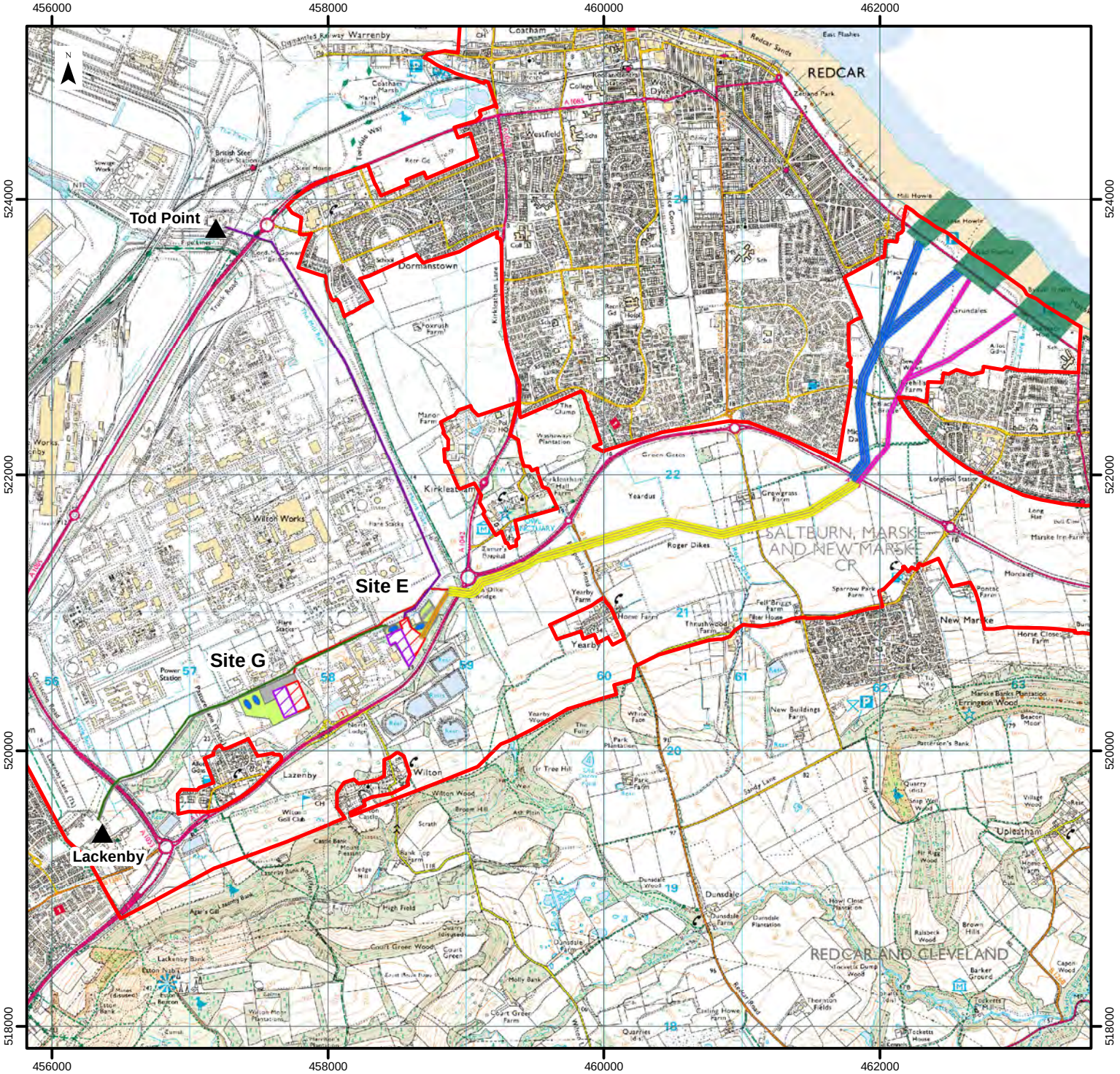
Table 4.1 Summary of Route Options

Site	HVDC Section A		HVDC Section B				HVDC Section C				HVDC Wilton					HVAC Lackenby			HVAC Tod Point	
Site E	A1	A2	B1	B2	B3	B4	C1	C2	C3	C4	E1	G1	G2	H1	H2	E2	E3	E4	E5	E6
Site G	A1	A2	B1	B2	B3	B4	C1	C2	C3	C4	E1	G1	G2	H1	H2	G3	NA	NA	G4	G5
Site H	A1	A2	B1	B2	B3	B4	C1	C2	C3	C4	E1	G1	G2	H1	H2	H3	NA	NA	NA	NA

Table 4.2 Preferred Routes for Preferred Converter Station Sites

Converter Station Site	HVDC Route	HVAC Route
Site G	A2, B3, G1	G3 (to Lackenby substation)
Site E	A1, B3, E1	E2 (to Lackenby) E6 (to Tod Point)

A range of factors have been carefully considered and balanced in determining the proposed route. It is believed that the preferred cable route identified is optimal in terms of environmental, technical and social development considerations, based on the desk-top studies and assessments completed to date. It is now recommended further engineering, consultation and assessment is carried out to survey the identified engineering considerations to assess the feasibility of the routes on those grounds.



Legend

- Tod Point 275KV
- Lackenby 400KV
- Onshore Scoping Area
- Cable Landfall Envelope
- Converter Station Site A
- Converter Station Site B
- Laydown and Landscaping
- Laydown
- Attenuation/Drainage
- Landscaping
- A1 - 4 x 1GW 18m HVDC Cable Route
- A2 - 2 x 1GW 18m HVDC Cable Route
- B3 - 4 x 1GW 18m HVDC Cable Route
- E1 - 2 x 1GW 18m HVDC Cable Route
- E2 - 2 x 1GW 13m HVAC Cable Route
- E6 - 2 x 1GW 13m HVAC Cable Route
- G1 - 2 x 1GW 13m HVDC Cable Route
- G2 - 2 x 1GW 13m HVAC Cable Route

0 375 750
Metres

PROJECT TITLE
DOGGER BANK R3 DEVELOPMENT
Teesside

DRAWING TITLE

Figure 4.1: Preferred Cable Routes

REV	DATE	REMARKS	Drn. By	Ckd. By
0	12/07/2012	Original	MCG	DM

DRAWING NUMBER:
9W7904/Cable_Route/4.1/00

SCALE	1:40,000	PLOT SIZE	A4	DATUM	OSGB	PROJECTION	BNG

ROYAL HASKONING