Appendix 11.3 Stage 1 Flood Risk Assessment

Contents

This page is intentionally blank

Appendix 11.2 Stage 1 Flood Risk Assessment

1 Introduction

1.1 *Background*

1.1.1 Hagshaw Hill Repowering Ltd is proposing to repower and extend the Hagshaw Hill Wind Farm, approximately 1.6 km north of Glespin and 3.2 km west of Douglas, South Lanarkshire. An Environmental Impact Assessment (EIA) Report has been prepared in support of an application submitted to the Scottish Ministers under Section 36 of the Electricity Act 1989, seeking permission to construct and operate the repowered development (hereafter referred to as the "Proposed Development").

1.1.2 The purpose of this report is to identify and quantify any potential flooding issues associated with the Proposed Development. This report will take into account the recommendations of Scottish Planning Policy (SPP) issued by the Scottish Government in June 2014, Planning Advice Note (PAN) 61 Planning and Sustainable Urban Drainage Systems and PAN 69 Planning and Building Standards Advice on Flooding issued by the Scottish Government in August 2004 which is now superseded by the Online Planning Advice on Flood Risk (updated June 2014).

1.2 *Policies and Guidance*

1.2.1 The following represent the key Scottish planning policies and guidance in relation to flooding:

- **National Planning Framework 3:** Provides the long term spatial strategy for Scotland's development.
- **Scottish Planning Policy (SPP):** Scottish Government's policy on nationally important land use planning matters. Provides policy on flooding and drainage (paragraphs 254-268).
- **Planning Advice Note (PAN) 61 – Planning and Sustainable Urban Drainage Systems:** Good practice advice for planners and the development industry complementing the Sustainable Urban Drainage Systems Design Manual for Scotland and Northern Ireland.
- **PAN 69 – Planning and Buildings Standards Advice on Flooding:** Scottish Government advice on planning and building standards in areas where there is a risk of flooding.
- **PAN 79 – Water and Drainage:** PAN 79 clarifies the role of the planning authority in setting the direction of development to inform the planning and delivery of new water infrastructure in a co-ordinated way. It explains the roles of Scottish Water and SEPA and encourages joint working in order to ensure a common understanding of capacity constraints and agreement on the means of their removal.
- **SEPA Guidance Note 8 - SEPA standing advice for planning authorities and developers on development management consultations:** Outlines methodologies that may be appropriate for hydrological and hydraulic modelling and what information SEPA requires to be submitted as part of a Flood Risk Assessment.
- **SEPA Technical flood risk guidance for stakeholders:** Outlines methodologies that may be appropriate for hydrological and hydraulic modelling and what information SEPA requires to be submitted as part of a Flood Risk Assessment.

- **Clyde and Loch Lomond LFRMP (2016):** Describes the actions which will make a difference to managing the risk of flooding and recovering from any future flood events, setting out the Local Plan District wide actions together with other flood risk management activities. The plan provides information on the funding and co-ordination arrangements for the delivery of actions set out in the Plan and confirms the commitment to use natural features to manage flood risk where beneficial.
- **CIRIA C624 – Development and Flood Risk – guidance for the construction industry:** Provides guidance to developers and the construction industry on the implementation of good practice in the assessment and management of flood risk as part of a sustainable development process.

2 Requirements of a Flood Risk Assessment (FRA)

2.1.1 Paragraph 255 of SPP notes that planning policy should promote:

- A precautionary approach to food risk from all sources;
- Flood avoidance;
- Flood reduction; and
- Promoting the use of Sustainable Drainage Systems (SuDS).

2.1.2 The updated SEPA Policy 41 - Development at Risk of Flooding: Advice and Consultations (2016), provides guidance on requirements and protocol for undertaking flood risk assessments

2.1.3 The Technical Guidance notes that the purpose of an FRA is to '*predict and assess the probability of flooding from all sources for a particular site or area and should recommend mitigation measures, including maintenance. The four key risk receptors to consider are human healthy, economic activity, environment and cultural heritage*'. The scale, nature and location of a proposed development will inform the scope of the FRA required.

2.1.4 The Technical Guidance advises that the detail and technical complexity of an FRA will be proportionate to the scale and potential significance of the study but, in all cases, it should address or comply with the following basic requirements, where relevant:

- the flood risk to the development itself;
- assessment of any mitigation measures proposed by the developer or planning authority;
- the impact upstream and downstream and to adjacent sites /existing development;
- any comments on any nearby hydraulic structures, including formal flood prevention measures;
- any comments on potential erosion related hazards;
- sustainability considerations such as climate change;
- any comments on habitats issues.

3 Site Information

3.1 *Site Location*

3.1.1 The site is located approximately 3.2 km west of Douglas and 1.6 km north of Glespin (to the nearest proposed turbine) in rural South Lanarkshire.

3.2 *Site Description*

3.2.1 The Proposed Development site is partly formed by the existing Hagshaw Hill Wind Farm, which comprises 26 existing turbines located on three hills, Hagshaw Hill, Common Hill and Broomerside Hill (hereafter referred to as the "Existing Development"). The Proposed Development site also incorporates land to the south of the Existing Development, east-north-east of the Galawhistle Wind Farm development.

3.2.2 The M74 motorway is approximately 6 km east of the proposed turbines, and the site boundary incorporates two access route options from the M74 to the proposed turbine locations.

3.2.3 The site sits within moorland and areas of agricultural grazing. Directly adjacent to the northern site boundary is the Cumberhead Forest complex.

3.2.4 The site occupies an area of approximately 2.75 km². The central grid reference for the site is NS 79240 30238. The site location and site boundary are shown in Appendix Figure 1.

3.3 *Proposed Development*

3.3.1 The Proposed Development will comprise 14 wind turbines of approximately 6 MW generating capacity each (meaning a total generation capacity of approximately 84 MW), plus around 20 MW of storage capacity. The associated infrastructure will include: site access; access tracks (new and re-used/upgraded); crane hardstandings; underground cabling; on-site substation, control room, energy storage facility and maintenance building; temporary construction compounds (including concrete batching plant) and a laydown area; potential excavations/borrow workings; and two permanent meteorological masts.

3.3.2 Decommissioning of the Existing Development (26 turbines) is covered by the original planning permission for Hagshaw Hill Wind Farm (permission ref. P/LK/01940252 P). Some aspects of the Existing Development infrastructure will be retained and re-used by the Proposed Development

3.3.3 The final Proposed Development layout is illustrated in Appendix Figures 2a to 2c.

3.4 *Topography*

3.4.1 The elevation of the main site area (i.e. where all proposed turbines are sited) ranges from approximately 315 m above ordnance datum (AOD) in the southern site area, to a high point in the north-west site area of 488 m AOD. The proposed southern access route slopes downward from the main site area, to approximately 270 m AOD at its southern-most point, and lower still (to approximately 195 m AOD) along the existing coal road which joins the M74.

3.5 *Climate*

3.5.1 The Drumalbin climate station is the nearest station to the Revised Development. Averages for temperature and rainfall at this station from 1981 to 2010 are represented in Table 1 below:

Table 1: Monthly temperature and rainfall averages for Drumalbin

Month	Max. temp (°C)	Min. temp (°C)	Rainfall (mm)
Jan	5.2	0.3	89.9
Feb	5.5	0.0	67.1
Mar	7.6	1.3	71.8
Apr	10.4	2.9	49.1
May	13.8	5.2	50.7
Jun	16.1	7.9	57.0
Jul	18.0	9.9	71.1
Aug	17.7	9.8	78.3
Sep	15.0	8.1	78.1

Month	Max. temp (°C)	Min. temp (°C)	Rainfall (mm)
Oct	11.4	5.3	104.1
Nov	7.8	2.5	93.3
Dec	5.4	0.2	89.9
Annual	11.2	4.5	157.4

3.6 *Geology and Soils*

3.6.1 The site is underlain by sedimentary strata (sandstone, siltstone, mudstone) mainly of the Quarry Arenite Formation, Swanshaw Sandstone Formation, Hagshaw Group, Glenbuck Group and Monks Water Group. An igneous intrusion (mafite of the North Britain Palaeogene Dyke Suite) trends roughly east-west in the north-east site area. Further east along the site's access route the underlying bedrock comprises younger (Carboniferous) sedimentary strata, including Scottish Lower Coal Measures, Limestone Coal Formation, and Passage Formation.

3.6.2 The north-west part of the site (approximately the extent of the Existing Development) has little or no recorded superficial geology, with the exception of a few small and localised areas of peat. Peat probing surveys have identified minimal peat across the proposed infrastructure footprint.

3.6.3 The south-east site area is largely underlain by till, which in this area would typically be expected to comprise stiff to hard clay with variable inclusions of sand, gravel and boulders. There is one localised area of peat shown on the BGS mapping at the north end of the proposed temporary laydown area, and a smaller area of peat just to the south.

3.6.4 Soils in north-west part of the site are classified as Organic Soils, with soils in the central and part of the southern area classified as Ettrick (peaty gleyed podzols). The south-east site area is classified as Rowanhill (peaty gleys). Gleys are termed as wet soils that have poor drainage.

3.7 *Hydrogeology*

3.7.1 The main site area is a low productivity aquifer, in which flow is virtually all through fractures and other discontinuities. Part of the proposed southern access road is underlain by bedrock which is identified as a moderately permeable aquifer, again with virtually all flow being through fractures and other discontinuities.

3.8 *Hydrology*

3.8.1 There are three principal watercourses flowing roughly north to south across the site. The Smithy Burn forms the western site boundary; a branch of the Windrow Burn flows across the central part of the site, separating Broomerside Hill from Hagshaw Hill; and another branch of the Windrow Burn flows along the eastern part of the site. There are also minor tributaries of the Podowrin Burn flowing north to south at the far south-west edge of the site and in the south-central part of the site. All of these drain into the Douglas Water to the south/south-east of the site, which itself flows into the River Clyde some 7 km north-east of the site boundary.

3.8.2 Other watercourses flowing into the Douglas Water within the study area (up to 1 km from any proposed infrastructure) are noted below.

- the Robshill Burn, flows between the two borrow pit search areas and under the old railway track which forms the proposed southern site access route;
- the Broadlea Burn, which flows west to east from near the existing Douglas West bing on the proposed access route;
- the Bloodmyre Syke, which flows north-west to south-east in the north-east part of the study area; and

- several unnamed tributaries of the Douglas Water in the eastern part of the study area.

3.8.3 In the northern part of the study area are the Hagshaw Burn and the Shiel Burn, into which drainage from the northern part of the site flows (except the far north-west i.e. T13 area which drains to the Podowrin Burn to the west). The Hagshaw Burn and Shiel Burn drain into the Poniel Water approximately 1.6 km north of the site boundary. The Poniel Water flows into the River Clyde to the north-east of the site.

3.8.4 The Alder Burn is also located in the north-east of the study area, rising just to the north-east of the existing northern access road, flowing north-east to almost meet the proposed new access road (along the existing old railway track), then north where it is crossed by the existing coal road and into the Poniel Water.

3.8.5 As noted above, all of the watercourses on site, and into which the site drain, form part of the wider catchment of the River Clyde.

3.8.6 During site visits in August 2018, there was no indication of surface water flooding or issues with drainage in the Proposed Development area.

Water Crossings

3.8.7 Some of the proposed access tracks to turbines will require new watercourse crossings to be constructed, summarised below and illustrated on Appendix Figure 3.

- WC01: New crossing of an unnamed tributary of the Podowrin Burn between T2 and T3. This is a small overgrown drainage ditch with limited catchment. The proposed crossing would comprise a 600 mm HDPE pipe, designed to maintain existing greenfield run off in the area.
- WC02: New crossing of the Smithy Burn east of T2. This is a well-defined valley with grass treatment beds approximately 8 m high and 1.5 – 2.0 m wide. The proposed crossing would comprise a bottomless arch culvert, designed to provide sufficient capacity for the existing burn under the crossing.
- WC03: New crossing of the western branch of the Windrow Burn between T5 and T6. This is a well-defined valley with grass treatment bed east, with the existing channel being approximately 5 m in height and 1.5 m to 2 m wide. The proposed crossing would comprise a bottomless arch culvert, designed to provide sufficient capacity for the existing burn under the crossing.

3.8.8 Additionally, a historic crossing of the Broadlea Burn on the old railway (proposed access route to the southern site area) will require to be upgraded/replaced. The location of this existing water crossing is shown on Appendix Figure 3, labelled WC04. The proposed crossing would comprise a concrete slab laid over the existing culvert, therefore there would be no impact on existing existing flows.

3.8.9 There are additional existing water crossings along the old railway line (proposed access route), including minor drainage ditches and a more significant crossing of the Windrow Burn (WC05). These are not anticipated to require significant upgrading but may require some localised works.

3.8.10 Further information on the indicative water crossing designs is included in Appendix 11.2 to the EIA Report (Water Crossing Schedule). All final water crossing designs will be subject to authorisation under the CAR Licensing regime and detailed designs will be discussed and agreed with SEPA and SLC.

4 Flood Risk

4.1 *SEPA Flood Map*

4.1.1 The online SEPA flood risk map indicates that most of the site has no identified flood risk. Only the immediate banks of the Windrow Burn, where the proposed new access track crosses it, is indicated to be at risk of localised flooding.

4.1.2 The banks of the Poniel Water to the north, and the banks of the Douglas Water to the south of the site are indicated to be at risk of fluvial flooding. To ensure that these risks are not exacerbated, no site drainage from the Proposed Development will involve direct discharge to these watercourses; furthermore drainage and water crossings will be designed to mimic greenfield conditions as outlined above.

4.2 *Risk of Fluvial Flooding*

4.2.1 All turbines have been located at least 50 m from all watercourses. In terms of the closest turbines to watercourses, T2 is approximately 65 m from the Smithy Burn, T4 is approximately 50 m from the Smithy Burn, and T6 is approximately 50 m from the eastern branch of the Windrow Burn. All other turbines are at least 140 m from any watercourses. The Smithy Burn is within an incised valley, and the proposed T2 and T4 locations are at elevations of 10 m or more above the elevation of the burn. The watercourse near T6 has a shallower bank, however the turbine location is still approximately 8 m above the level of this small watercourse. Given that SEPA flood risk mapping shows no risk of flooding of either watercourse, and taking account of the elevation of the proposed turbines, there is not considered to be a risk of flood waters impacting the turbines.

4.2.2 The Windrow Burn, at the WC05 water crossing location (existing water crossing which will require some localised works), is within a deep valley approximately 15 to 20 m below the level of the old railway track which forms the existing crossing. SEPA flood risk mapping shows the area of flood risk to be limited to the immediate banks of the Windrow Burn at this location, i.e. contained within the steep-sided valley. The potential for flood waters to rise to the level of the access track is very remote.

4.3 *Risk of Pluvial Flooding*

4.3.1 In terms of any anticipated risk of pluvial flooding the following points are noted. The only areas of surface water flood risk identified within the main site area are very small, localised areas at/alongside watercourses. The proposed site infrastructure, including the turbines and the substation, control room and energy storage facility, are all located on areas of ground which are raised above or are remote from these areas.

4.4 *Flood Routing and Risk*

4.4.1 As noted above, it is considered that fluvial flood risk to the site is low, with flooding considered highly unlikely to affect any site infrastructure.

4.4.2 Drainage for the access tracks and hardstandings within the site will be designed to ensure that runoff from these does not adversely impact any of the site infrastructure or increase the risk of flooding downstream of the site. Water crossings will be designed to mimic greenfield conditions as outlined above.

5 Conclusions

5.1.1 The risk of fluvial flooding impacting the Proposed Development is considered to be very low and therefore not significant.

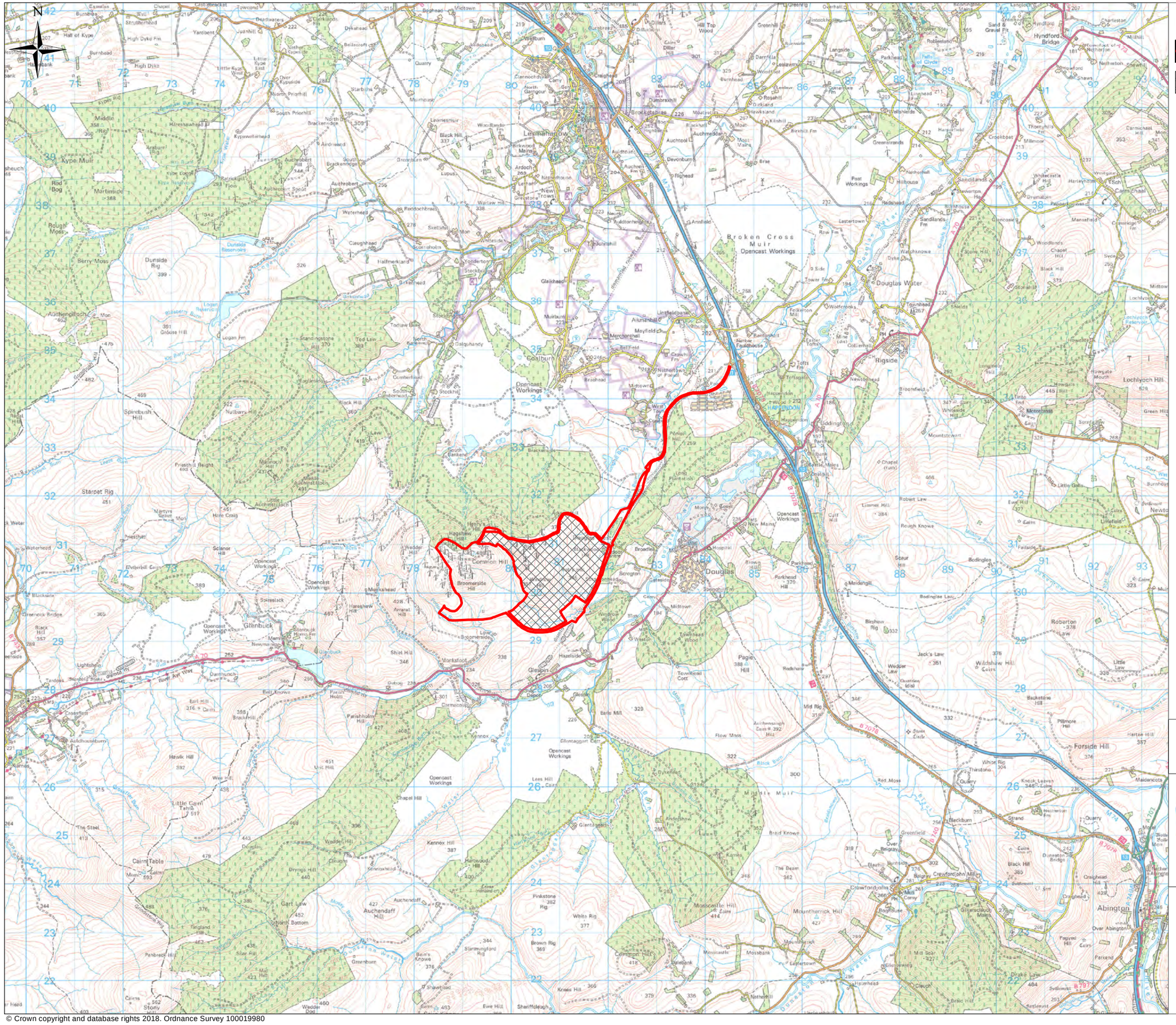
5.1.2 The proposed site infrastructure is all located on areas of ground raised above or remote from the small and highly localised areas of potential pluvial flooding. As such, it is considered that the risk of pluvial flooding to the site is also low and therefore not significant.

5.1.3 Drainage for the access tracks and hardstandings within the site will be designed to ensure that runoff from these does not adversely impact any of the site infrastructure or increase the risk of flooding downstream of the site. Water crossings will be designed to mimic greenfield conditions.

6 References

- CIRIA (2004), Development and Flood Risk – guidance for the construction industry, London;
- Glasgow City Council (2016), Clyde and Loch Lomond Local Plan District - Local Flood Risk Management Plan June 2016;
- Scottish Environmental Protection Agency (SEPA),(2015), *Technical Flood Risk Guidance for Stakeholders;*
- Scottish Environmental Protection Agency (SEPA), (2016), SEPA Guidance Note 8 - SEPA standing advice for planning authorities and developers on development management consultations;
- Scottish Government (2014), Planning Advice Note (PAN) 61 - Planning and Sustainable Urban Drainage Systems;
- Scottish Government (2004), Planning Advice Note (PAN) 69 - Planning and Building Standards Advice on Flooding;
- Scottish Government (2004), Planning Advice Note (PAN) 79 – Water and Drainage;
- Scottish Government (2006, updated June 2014), *Online Planning Advice on Flood Risk*, Available at: http://www.gov.scot/Topics/Built-Environment/planning/Policy/Subject-Policies/natural-resilient-place/Flood-Drainage/Floodrisk-advice, Accessed: 29th June 2017.
- Scottish Government (2014), Scotland's Third National Planning Framework, Edinburgh;
- Scottish Government (2014), *Scottish Planning Policy*; Edinburgh;

This page is intentionally blank.



KEY

Site Boundary

Not Included in Site Boundary

0 1 2 4 Km

Scale 1:75,000 @ A3

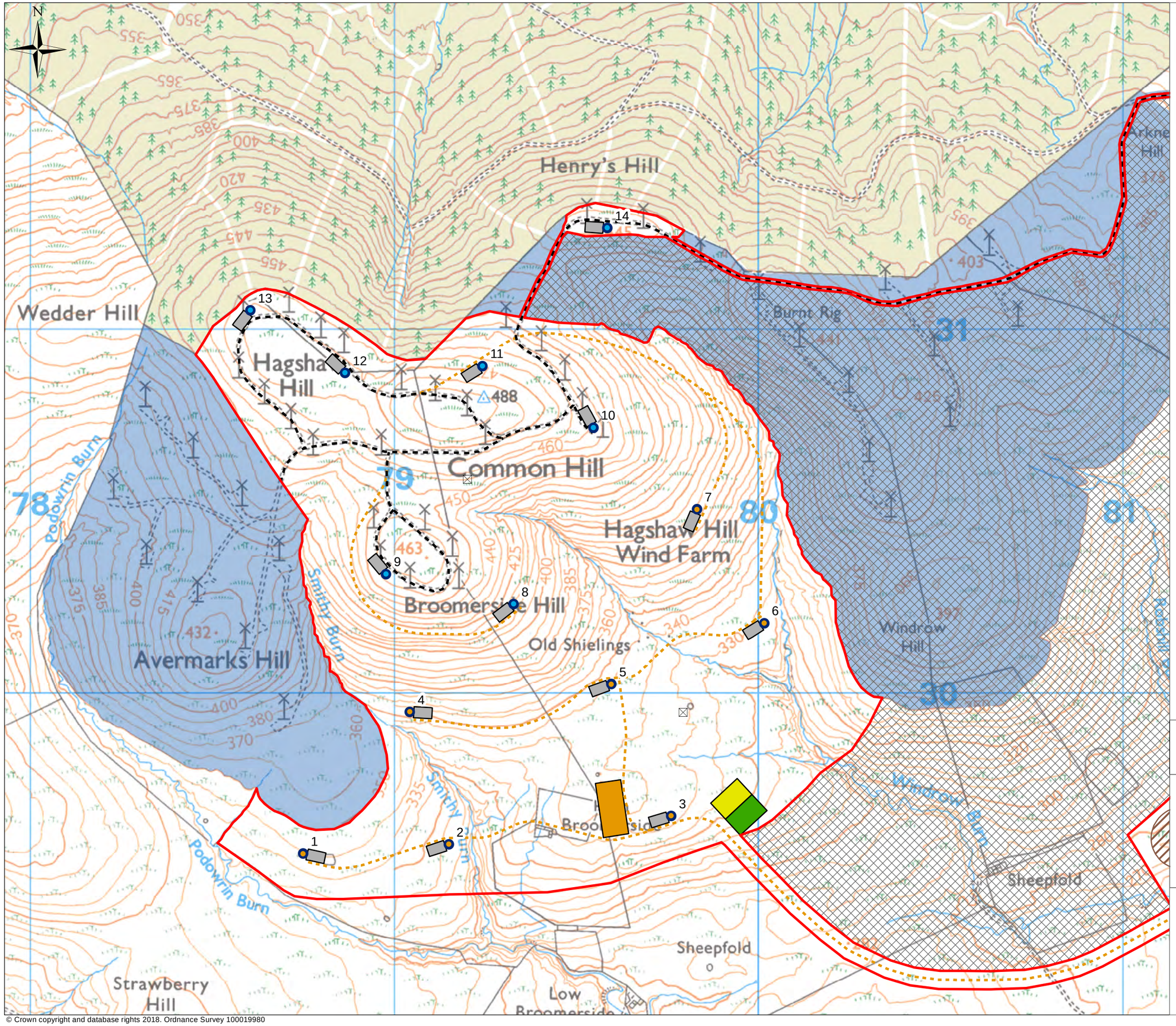
ITPENERGISED
Earth. Smart. Solutions

3R Energy
Wind • Biomass

Hagshaw Hill Wind Farm Repowering

Environmental Impact Assessment Report
Appendix 11.3 Flood Risk Assessment

Figure 1
Site Location Plan



KEY

- Site Boundary
- Not Included in Site Boundary
- Turbine Location Construction Phase 1
- Turbine Location Construction Phase 2
- New Met Mast Location
- Indicative New Access Track
- Existing Hagshaw Hill Wind Farm Access Track (to be retained)
- Hardstanding
- Substation, Control Room & Energy Storage Facility
- Temporary Construction Compound and Concrete Batching Area
- Temporary Turbine Component Laydown Area
- Existing Hagshaw Extension Lease Area
- Borrow Pit Search Area

0 0.125 0.25 0.5 Km

Scale 1:10,000 @ A3

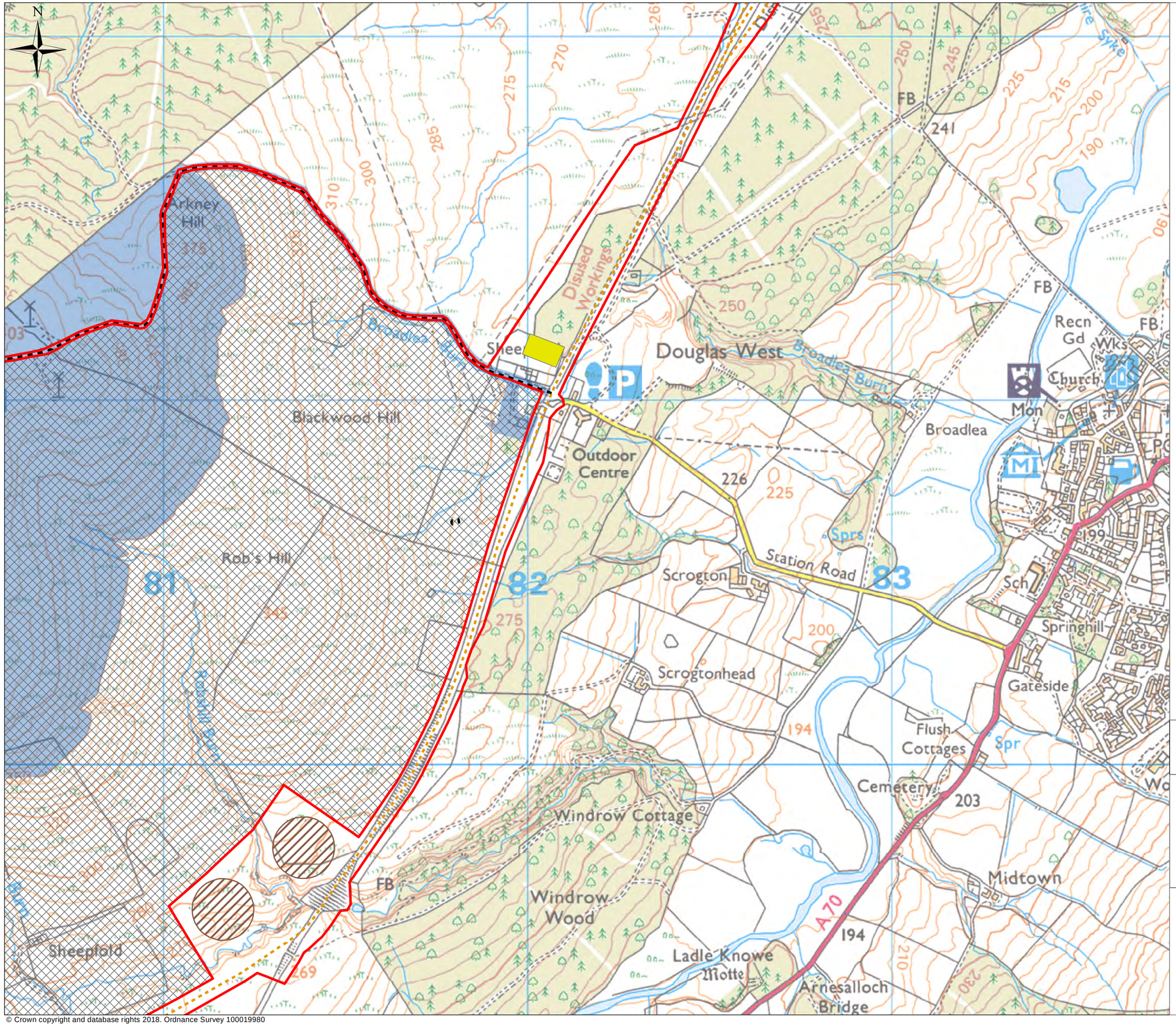
ITPENERGISED Earth. Smart. Solutions

3R Energy Wind • Biomass

Hagshaw Hill Wind Farm Repowering

Environmental Impact Assessment Report
Appendix 11.3 Flood Risk Assessment

Figure 2a
Site Layout Plan - West



KEY

- Site Boundary
- Not Included in Site Boundary
- Indicative New Access Track
- Existing Hagshaw Hill Wind Farm Access Track (to be retained)
- Temporary Construction Compound
- Existing Hagshaw Extension Lease Area
- Borrow Pit Search Area

0 0.125 0.25 0.5 Km

Scale 1:10,000 @ A3

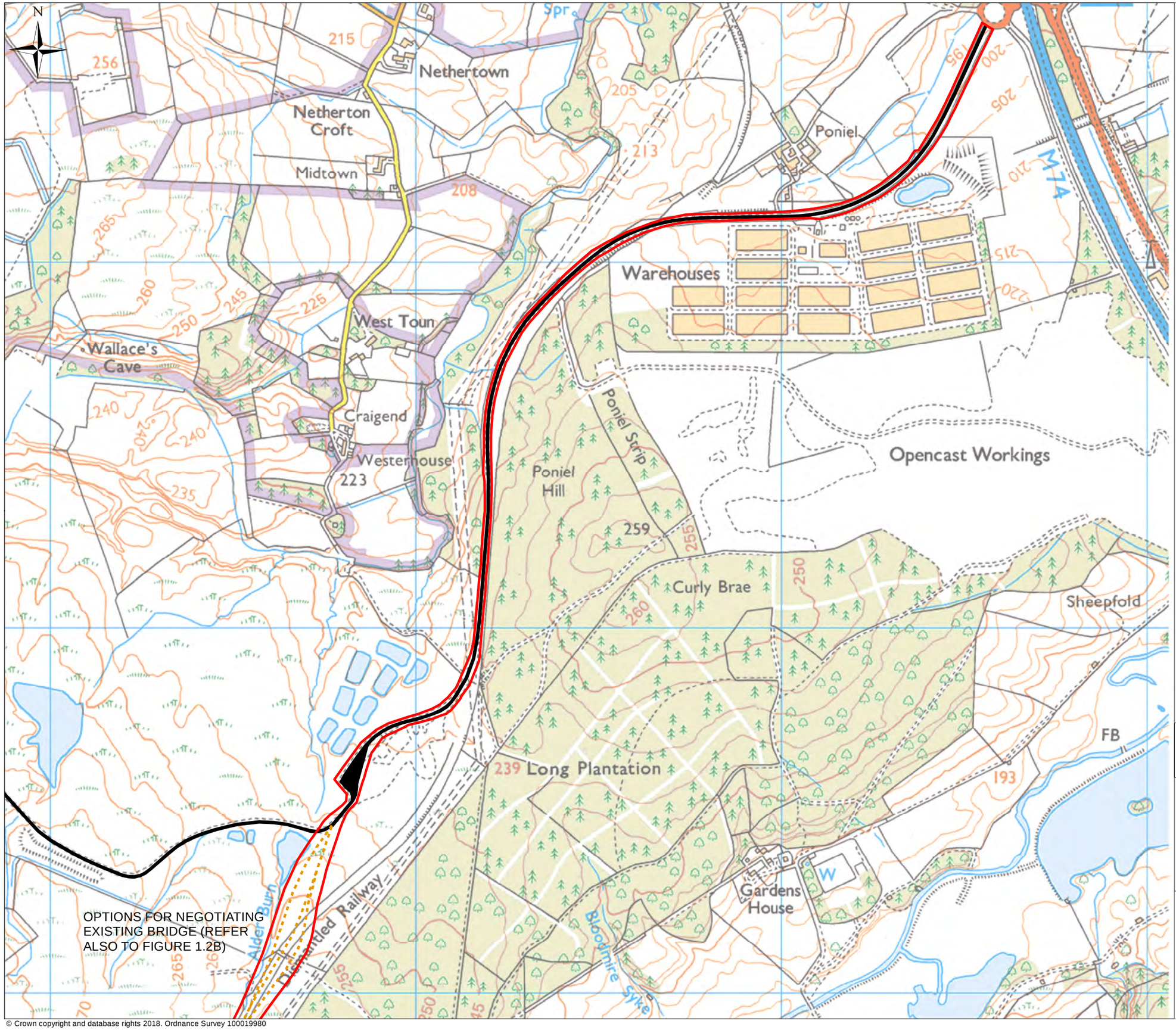
ITPENERGISED
Earth. Smart. Solutions

3R Energy
Wind • Biomass

Hagshaw Hill Wind Farm Repowering

Environmental Impact Assessment Report
Appendix 11.3 Flood Risk Assessment

Figure 2B
Site Layout Plan - Centre



KEY

- Site Boundary
- Existing Access Road (Coal Road)
- Indicative New Access Track

0 0.125 0.25 0.5 Km

Scale 1:10,000 @ A3

ITPENERGISED Earth. Smart. Solutions

3R Energy Wind • Biomass

Hagshaw Hill Wind Farm Repowering

Environmental Impact Assessment Report
Appendix 11.3 Flood Risk Assessment

Figure 2C
Site Layout Plan - East

KEY

- Site Boundary
- Hydrology Study Area - 1km Buffer around Proposed Infrastructure
- Turbine Location
- New Met Mast Location
- Indicative New Access Track
- Existing Hagshaw Hill Wind Farm Access Track (to be retained)
- Existing Access Road (Coal Road)
- Hardstanding
- Substation, Control Room & Energy Storage Facility
- Temporary Construction Compound
- Temporary Turbine Component Laydown Area
- Borrow Pit Search Area
- Watercourse
- Waterbody
- Watercourse/Waterbody (50m Buffer)
- WC01 Proposed New Water Crossing
- WC04 Existing Water Crossing

0 0.2 0.4 0.8 Km

Scale 1:15,000 @ A3

ITPENERGISED Earth. Smart. Solutions

3R Energy Wind • Biomass

Hagshaw Hill Wind Farm Repowering

Environmental Impact Assessment Report
Appendix 11.3 Flood Risk Assessment

Figure 3
Proposed New and Altered Water Crossings