The Drax Power (Generating Stations) Order

Land at, and in the vicinity of, Drax Power Station, near Selby, North Yorkshire

Flood Risk Assessment

The Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)(q)

Applicant:	DRAX POWER LIMITED
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EXECUTIVE SUMMARY

WSP was appointed by Drax Power Ltd to prepare a Flood Risk Assessment to support a Development Consent Order (DCO) application for the proposed re-powering project at the Drax Power Station, North Yorkshire. The assessment was undertaken in accordance with the National Planning Policy Framework (NPPF) and Overarching National Policy Statement for Energy (EN-1). The assessment provides a quantitative analysis of pre- and post-development flood risk.

The Environment Agency (EA) Flood Map for Planning shows that the area of the Proposed Scheme is located partially in Flood Zone 2 and partially in Flood Zone 3. During consultation the EA confirmed that the area of the Proposed Scheme and its surroundings are protected up to the 1 in 200 year event by the flood defences located along the banks of the River Ouse. There is however residual risk associated with a breach of the flood defences. A breach of the existing flood defences is unlikely to happen as they are regularly inspected and maintained by the EA to ensure an appropriate level of protection.

The River Ouse at the location of the Proposed Scheme is tidally influenced. The risk of flooding in this area is therefore a combination of fluvial and tidal flooding, with tidal being the dominant source. A 2D TUFLOW hydraulic model of a breach in the flood defences was developed to support this FRA. The results of the hydraulic modelling shows that the area of the pipeline route and the northern part of the Power Station Site could be flooded during the unlikely breach scenario.

A flood relief channel is proposed to be built in the northern part of the Power Station Site as part of the Proposed Scheme to mitigate potential increase in flood depth in the area. The results of the post-development hydraulic modelling shows that the construction of the Proposed Scheme with the proposed flood relief channel would provide sufficient and satisfactory level of mitigation.

The finished floor levels of the proposed structures will be 600 mm above the flood levels predicted for the 1 in 200 year event with climate change allowance during the post-development with mitigation breach scenario. The proposed approach to finished floor levels is considered to provide satisfactory mitigation to ensure that the Proposed Scheme will remain operational during the flood event.

The localised areas along the pipeline route and within the boundary of the Power Station Site are indicated to be susceptible to flooding from surface water.

Surface water runoff from all new development within the Power Station Site will be collected, stored, treated (as necessary) and managed via the existing surface water drainage regimes and discharged from the site via the existing consented outfalls. The existing discharge rates will remain unchanged.

Surface water runoff generated in the area of the AGI will be discharged to the nearby watercourse with discharge rate limited to the rate agreed with the Selby Area Internal Drainage Board (IDB). Appropriate pollution prevention measure will be incorporated in the surface water drainage system proposed for this area.

The new pipeline crossings with watercourses will be constructed a minimum of 1 m below the bed of the watercourses. The new crossings will not interfere with the flow of the watercourse and will not impact the current capacity of the channels, therefore they will not increase the risk of flooding.

The North Perimeter Ditch will be diverted to allow for construction of the battery storage building. The diversion channel will be designed to match the capacity of the existing channel to ensure no change to the existing drainage system. The proposed diversion of the North Perimeter Ditch will not increase the risk of flooding in the area.

The area of the Proposed Scheme is considered to be at low risk of flooding from groundwater, sewers and reservoirs

1 INTRODUCTION

1.1 Project Background

1.1.1. WSP has been appointed by Drax Power Ltd to prepare a site specific Flood Risk Assessment (FRA) to support a Development Consent Order (DCO) application for the proposed re-powering project at the Drax Power Station, North Yorkshire.

1.1.2. The FRA is conducted in accordance with the National Planning Policy Framework (NPPF) and Overarching National Policy Statement for Energy (EN-1), providing a quantitative analysis of flood risk to support the DCO application. The assessment includes the following:

- Review of the relevant policy, legislation and guidance.
- Review of the availability and adequacy of the existing information related to risk of flooding.
- Confirmation of the sources of flooding that may affect the proposal.
- A quantitative assessment of the risk of flooding to the proposal and to the adjacent sites as a result of the proposal.
- Provision of appropriate flood mitigation measures, including an outline surface water drainage strategy.

1.2 Development Proposal

1.2.1. The Proposed Scheme is to repower up to two existing coal-powered generating units (Units 5 and 6) at the Existing Drax Power Station Complex with new gas turbines that can operate in both combined cycle and open cycle modes. The repowered units (which each constitute a new gas fired generating station) would have a new combined capacity of up to 3,600 MW in combined cycle mode (1,800 MW each), replacing existing units with a combined capacity to generate up to 1,320 MW (660 MW each). The new gas turbine generating units have been designated the terms "Unit X" and "Unit Y".

1.2.2. Each unit would have (subject to technology and commercial considerations) a battery energy storage facility with a capacity of up to 100 MW per unit, resulting in a combined battery energy storage capacity of up to 200 MW. All battery units would be stored in a single building.

1.2.3. At present there are two potential options under consideration:

- Repowering of either Unit 5 or 6 and construction of Unit X as a gas fired generating station; or
- Repowering of both Units 5 and 6 and construction of Unit X and Unit Y as two gas fired generating stations.

1.2.4. Construction of the proposed Unit X and Unit Y would require demolition of the existing structures that are currently located in this area.

1.2.5. The location of the Proposed Scheme is shown in Appendix A. The proposed site layout for the repowering of one unit and the construction of one gas fired generating station is shown in Appendix B and the layout for the repowering of two units and the construction of two gas fired generating stations is shown in Appendix C.

1.2.6. For the construction of Unit X, one existing but disused sludge lagoon would be brought back into operation to serve the existing coal fired units, while the southern sludge lagoon would be decommissioned and filled in, allowing the area to be used for construction laydown. If a second unit was repowered, all existing sludge lagoons to the east of the northern cooling towers would be decommissioned and filled in to allow gas turbine Unit Y to be built. New lagoons would be built to the north of the existing northern cooling towers.

1.2.7. In order to repower to gas, a new Gas Pipeline would be constructed from the existing Drax Power Station Complex to the National Transmission System (NTS) operated by National Grid. The new Gas Pipeline will be buried and approximately 3 km long and will be located in the area to the east of the Power Plant Site The Gas Pipeline will begin at the existing NTS located in the vicinity of Rusholme Grange, south of the River Ouse. This connection will run into new above ground installations (AGIs) south of Rusholme Lane. A permanent access road to the AGIs will be constructed off Rusholme Lane. The pipeline will then head in a north-west direction and connect to a new Gas Receiving Facility (GRF) east of New Road.

1.2.8. The proposal also includes re-arrangement of the existing structures, including contractor's compound and offices and car parking areas, located within the southern part of the power plant site.

1.2.9. Construction works would include the following activities:

- Earthworks.
- Deep excavations, drilling and piling.
- Demolition of the existing structures.
- Construction of temporary and permanent access roads.
- Construction of the proposed above ground structures.

1.2.10. The gas turbine generating units will be constructed in stages, which are referred to as Stage 1 and 2 in the assessment. During Stage 1, Unit X will be constructed and one existing coal-firing unit will remain in operation. During Stage 2, Unit Y will be constructed while Unit X is operational as a gas-fired unit.

1.2.11. Each construction stage will take approximately 34 months followed by commissioning. It is anticipated that the two construction stages will be separated by up to a year, but it could be longer depending on commercial considerations. The overall construction programme will last at least 83 months including commissioning of the second unit. The battery storage unit and the gas pipeline will be constructed during Stage 1.

1.2.12. It is envisaged that construction of the first unit will commence in 2019/2020. If two units are built, the construction of the second unit would likely commence in 2024 and be completed in 2027.

1.2.13. The design life of the proposal is considered to be 25 years after which the continued operation of infrastructure will be reviewed. If it is not appropriate to continue operation, the plant will be decommissioned. It is expected that all the above ground plant structures will be removed, while the pipeline would remain in situ.

1.3 Consultation

1.3.1. The Scoping Opinion on the Proposed Scheme was received in October 2017. The summary of the comments related to flood risk and drainage only is shown in Table 1. The complete scoping opinion on the impacts to the water environment is detailed in the Chapter 12 (Water Resources, Water Quality and Hydrology) of the Environmental Statement (ES) prepared for the Proposed Scheme.

Table 1 – Summary of Scoping Opinion Comments Related to Flood Risk and Drainage

Section of Scoping Report	Applicant's Proposed Matter	Planning Inspectorate's Comments	Summary of Response
7.8.2	Surface water runoff associated with operation of the pipeline	The Scoping Report (section 4.12) explains that areas of the site are at risk from surface water flooding, predominantly those areas along field boundaries and in local depressions. However, the Applicant explains that as the pipeline will be buried (and ground surface reinstated to current levels), its operation will not change the rate, volume or quality of surface water runoff. The Inspectorate is in agreement that this matter can be scoped out for the operational phase. However, the effects on surface water runoff from above ground structures associated with the gas pipeline should be considered.	The potential impacts associated with surface water runoff from above ground structures associated with the pipeline are assessed within this FRA.
7.8.2	Changes to fluvial and tidal flood risk during the operation of the pipeline	The Applicant explains that following construction, the existing ground surface associated with the buried pipeline will be reinstated to current levels. The Inspectorate agrees that the potential for significant effects is therefore unlikely and that effects from the pipeline itself can therefore be scoped out. However, the Inspectorate considers that the effects on flood risk from above ground structures associated with the gas pipeline should be considered.	The potential impacts associated with fluvial and tidal flooding associated with above ground structures associated with the pipeline are assessed within this FRA
4.11	Consultation	The Inspectorate notes section 4.11 of the Scoping Report, where Selby	NYCC were consulted as LLFA. Other

Section of Scoping Report	Applicant's Proposed Matter	Planning Inspectorate's Comments	Summary of Response
		Area Internal Drainage Board (IDB) is described as the Lead Local Flood Authority (LLFA) for the area. The Inspectorate advises that North Yorkshire County Council is the LLFA for the area covering the application site.	relevant authorities were also consulted.
7.8.4	FRA	The Inspectorate welcomes that a Flood Risk Assessment (FRA) will be prepared to support the EIA and stresses the need for early discussions with the EA. The Applicant should agree the scope of the FRA with the EA and ensure that up to date and appropriate climate change allowances are utilised in any modelling. Large parts of the site fall within Flood Zones 2 and 3 on the EA Flood Maps (as illustrated on Figure 2 of the Scoping Report). The FRA should therefore demonstrate that the requirements of the sequential and exception tests are satisfied. The approach and conclusions of the FRA should be agreed with the EA prior to submission of the DCO application, with evidence of such agreement provided (for example in a draft SoCG).	Early and extensive engagement has been held with the EA throughout the preparation of the FRA.

1.3.2. The summary of consultation undertaken to the date and that relates to flood risk and drainage only is provided in Table 2. The consultation summary related to all aspects of the water environment is provided in Chapter 12 (Flood Risk, Water Quality and Hydrology) of the Environmental Statement. The important correspondence with the Authorities is shown in Appendix D.

Table 2 – Summary of Consultation

Body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
Environment Agency	Consultation email sent in November 2017, response letter	• The FRA will need to clearly demonstrate that flood risk to others will

Body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
	received via email on 8 January 2018, letter reference RA/2017/137861/02	not be increased as a result of the development. Any increase in risk to others will have to be mitigated, including provision of floodplain compensation if required. • The Upper Humber hydraulic model is being currently developed, and the final report is envisaged to be issued in April 2018. If the Humber model data is available, it should be used to support the assessment. However, if the data is not available at the time of assessment, the best available data should be used. If best available data changes during the assessment period or during the planning process, the assessment may need to be updated using the latest data. • The current climate change policy and guidance should be used in the assessment. If new policy/guidance comes into force during the application process, the assessment should be updated accordingly. • No objections to the proposed study areas, but at this stage cannot determine whether they are appropriate. Study area to be properly defined and justified in line with relevant guidance. • If the 2009 River Ouse hydraulic model is used, it is appropriate to re-run the model in ISIS. If the Upper Humber hydraulic model is used, then the model should be re-run using the same software used to develop the model. • The EA advised that they do not determine the application of the Sequential Test. • A breach scenario should be included. The breach location can be the same as that used for the White Rose Scenario, unless the Upper Humber modelling is available, in which case the breach data from this model should be used. • The design scenario that should be used for the scheme is the 1 in 100 year

Body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
		event plus climate change allowance, or the 1 in 200 year event (tidal) level if greater.
Environment Agency	22 January 2018, Meeting	• EA advised that the early results from the new Upper Humber hydraulic modelling indicate a change in the fluvial and tidal interaction, with the tidal limit possibly shifting and fluvial flows having more of a dominant effect. It is likely to be caused by climate change. Considering this information, the EA will confirm which modelling scenario should be used instead of the 2009 River Ouse model. • EA confirmed that the hydrology of survey in the 2009 River Ouse model does not need to be updated but need to show no effect on local communities. • The sensitivity analysis will be undertaken as per usual modelling specification; • No need to consider the undefended scenario. • Historic flooding records will be requested.
Environment Agency	26 January 2018, Letter via email, letter reference RA/2017/137861/03	• The 2009 River Ouse model data, along with the same methodology used for the White Rose Carbon Capture model will provide a sufficiently robust approach, such that the assessment will not have to be updated using the new Upper Humber model when it becomes available. • The hydraulic model supporting the FRA will have to be reviewed by the EA to determine whether it is fit for purpose.
Environment Agency	26 January 2018, Letter via email, letter reference RA/2017/137861/03-L02	• The EA's Approach to Groundwater protection guidance should be followed. • Discharge of surface water or foul water is not allowed into land impacted by contamination;

Body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
		• No discharge to made ground or directly to the groundwater resources is allowed. •
Environment Agency	27 February 2018,Letter via email (response to consultation on the PEIR), letter reference RA/2018/138164/01	• EA advised that the FRA should be undertaken in accordance with the EA comments received in January 2018. • Any work or structures, in, under, over or within 16m of the top of the bank of the tidal River Aire (Main River) will require an Environmental Permit. • An Environmental Permit will also be required for any temporary structures or stockpiles of materials within the floodplain.
Environment Agency	05 March 2018, Conference call	• The results of the hydraulic modelling and flood mitigation options were discussed. • The EA agreed to the proposed mitigation solutions in principle, however the EA would need further modelling and evidence before providing additional comments.
Environment Agency	14 March 2018, Email	• The FRA should demonstrate no increase in risk pre- and post-development scenarios.
Environment Agency	27 April 2018, Email	• Outcome of the model review by the EA indicates a few minor changes are required to the model before the EA will sign it off.
Environment Agency	4 May 2018, Email	• Response to the comments on the hydraulic model issued to the EA
Environment Agency	10 May 2018, letter via email, letter reference RA-2018-138541-01	• Confirmation that the FRA is considered acceptable – subject to the confirmation that the hydraulic model supporting the FRA is considered fit for purpose

Body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
Selby Area Internal Drainage Board	December 2017 – February 2018, Email and telephone conference	• Surface water runoff from additional new impermeable areas should be limited to the pre-development greenfield runoff rate or 1.4l/s/ha, whichever is the least; • Existing discharge points should be used wherever possible; • New outfalls should be set back from the bank and not protrude into the watercourse. Appropriate erosion prevention measures should be applied if required. A marker post should be provided near a new outfall to highlight the presence of the outfall for maintenance operatives; • The IDB does not have any historic flood records or water quality data.
Selby District Council	January – February 2018, Email	• In accordance with NPPF, the Sequential Test does not need to be carried out. However, it is likely that inspectors reviewing the application would expect that the sequential approach was applied in the design process.
North Yorkshire County Council	November 2017, Email	• The Council advised that the proposal is located within the area of the IDB and therefore, the IDB should be consulted in relation to works near the watercourses; • EA guidance on pollution prevention measures and the NYCC SuDS Design Guidance should be followed; • No consent from NYCC is required as the proposed works are locate in the area under the jurisdiction of the IDB; • The FRA should clearly explain how the potential impacts on flood risk will be mitigated; • Surface water runoff should be contained within the site boundary for all events up to the 1 in 30 year event; • The design of the site must ensure that flows resulting from rainfall in excess of a 1 in 100 year rainfall event are

Body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
		managed in exceedance routes that avoid risk to people and property both on and off site.
Canal and River Trust	February 2018, Letter (response to consultation on the PEIR)	• Any changes to the abstraction (or any discharge) rates compared to existing rates have the potential to affect navigation on the river. As a result, the Trust recommend that full details of any potential changes to the abstraction and return volumes compared to as existing should be fully clarified as part of any full Environmental Statement; • Should a potential discharge to the River Ouse Navigation be required by Drax Power Ltd, the flow rate of the discharges should be agreed with the Trust and ensure that their location and means of construction do not impede navigation on the river or otherwise raise any navigational safety issues;

2 METHODOLOGY

2.1 Overview

2.1.1. This FRA report summarises baseline flood risk information and identifies flood risk to the Proposed Scheme and potential flood risk to other areas caused by the Proposed Scheme.

2.1.2. Flood risk is assessed in accordance with the NPPF, NPS and local planning policy relevant to the proposed location of the Proposed Scheme. A summary of these policies is provided in this section.

2.2 Overarching National Planning Policy Statement for Energy (EN-1)

2.2.1. The Overarching National Policy Statement for Energy (NPS EN-1) recognises that infrastructure can have adverse effects on the water environment. It states that the effects could lead to adverse impacts on health or on protected species and habitats and could result in surface waters, groundwaters or protected areas failing to meet environmental objectives established under the WFD.

2.2.2. It states that where projects are likely to have effects on the water environment, applicants should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES. The Environmental Statement (ES) should particularly describe: existing quality of watercourses, existing water resources, existing physical characteristics of the water environment and impacts on protected waterbodies and areas.

2.2.3. Section 5.7 (Flood risk) of NPS EN-1 details that projects of 1 hectare or greater in Flood Zone 1 in England and all proposals for energy projects located in Flood Zones 2 and 3 in England should be accompanied by a Flood Risk Assessment (FRA). The requirements for FRAs are that they should (paragraph 5.7.5 of NPS EN-1):

- Be proportionate to the risk and appropriate to the scale, nature and location of the project.
- Consider the risk of flooding arising from the project in addition to the risk of flooding to the project.
- Take the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made.
- Be undertaken by competent people, as early as possible in the process of preparing the proposal.
- Consider both the potential adverse and beneficial effects of flood risk management infrastructure, including raised defences, flow channels, flood storage areas and other artificial features, together with the consequences of their failure.
- Consider the vulnerability of those using the Site, including arrangements for safe access.
- Consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made.
- Consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes.

- Include the assessment of the remaining (known as 'residual') risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular project.
- Consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of the project may affect drainage systems.
- Consider if there is a need to be safe and remain operational during a worst case flood event over the development's lifetime.
- Be supported by appropriate data and information, including historical information on previous events.

2.2.4. In determining an application for development consent, the SoS should be satisfied that where relevant (paragraph 5.7.9 of NPS EN-1):

- The application is supported by an appropriate FRA; the Sequential Test has been applied as part of site selection.
- A sequential approach has been applied at the site level to minimise risk by directing the most vulnerable uses to areas of lowest flood risk.
- The proposal is in line with any relevant national and local flood risk management strategy.
- Priority has been given to the use of sustainable drainage systems (SuDS.
- In flood risk areas the project is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed over the lifetime of the development.

2.3 National Planning Policy Framework

2.3.1. The NPPF and Planning Practice Guidance 'Flood Risk and Coastal Change' documents provide guidance on how new developments must take into account flood risk, including allowance for the impacts of climate change.

2.3.2. In relation to flood risk, the NPPF encourages decision makers to:

- Steer new development to lower risk locations that are appropriate to the proposed use and ensure that development is safe.
- Prevent any increase in flood risk elsewhere and reduce flood risk through the layout and form of the development and the appropriate application of sustainable drainage systems.
- Reduce flood risk by making space for water by creating flood flow paths and by identifying, allocating and safeguarding space for flood storage.
- Use regeneration to help relocate development to lower risk locations when climate change is expected to mean that some existing development may not be sustainable in the long-term.

2.3.3. As discussed below, the NPPF defines flood risk as the product of the likelihood or chance of a flood occurring (flood frequency) and the consequence or impact of the flooding (flood consequence).

2.3.4. Flood frequency is identified in terms of the return period and annual probability. For example, a 1 in 100 year flood event has a 1% annual probability of occurrence. Table 3 provides a conversion between return periods and annual flood probabilities.

Table 3 – Flood Probability Conversion Table

Return Period (years)	2	5	10	20	50	100	200	1000
Annual Flood Probability (%)	50	20	10	5	2	1	0.5	0.1

2.3.5. The NPPF identifies Flood Zones in relation to flood frequency. The zones refer to the probability of river (fluvial) and sea (tidal) flooding, whilst ignoring the presence of defences. Table 4 summarises the relationship between the Flood Zone categories and the identified flood risk.

Table 4 – Flood Zones

Flood Risk Area	Identification	Annual Probability of Fluvial Flooding	Annual Probability of Tidal Flooding
Flood Zone 1	Low Probability	<0.1%	<0.1%
Flood Zone 2	Medium Probability	1% - 0.1%	0.5% - 0.1%
Flood Zone 3a	High Probability	>1%	>1%
Flood Zone 3b	Functional Floodplain	>5%	>5%

Flood Consequences

2.3.6. The consequence of a flood event describes the potential damage, danger and disruption caused by flooding. This is dependent on the mechanism and characteristics of the flood event and the vulnerability of the affected land and land use.

2.3.7. The EA have identified five classifications of flood risk vulnerability and provide recommendations on the compatibility of each vulnerability classification with the Flood Zones. This is outlined in Table 5.

2.3.8. Full details of EA Flood Zones and flood risk vulnerability classifications can be found in the Planning Practice Guidance 'Flood Risk and Coastal Change'.

Table 5 – Flood Risk Vulnerability and Flood Zone Compatibility

EA Flood Zone	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	✗	Exception test required	✓

EA Flood Zone	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 3b	Exception test required	✓	×	×	×

✓ Development considered acceptable

× Development considered unacceptable

2.3.9. In accordance with this guidance, the Proposed Scheme is considered as 'essential infrastructure' and should remain operational during flood events.

2.4 Potential Sources of Flooding

2.4.1. In accordance with the NPPF, the following sources of flooding have been considered in this assessment:

- Fluvial water from watercourses.
- Overland surface water runoff from adjacent sites.
- Site generated surface water runoff.
- Surcharging of sewers.
- Reservoirs.
- Groundwater.
- Tidal water.

2.5 Potential Effects of Climate Change

2.5.1. Scientific consensus is that the global climate is changing as a result of human activity. Whilst there remain uncertainties in how a changing climate will affect areas already vulnerable to flooding, it is expected to increase flood risk significantly over time. Projections of future climate change for the UK indicate that more frequent, short-duration, high-intensity rainfall events and more frequent periods of long-duration rainfall could be expected.

2.5.2. The EA has issued updated guidance on climate change allowances for flood risk assessments in their report, 'Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities' (March 2016). This guidance outlines anticipated changes in extreme rainfall intensity, peak river flows and sea level rise resulting from climate change for the next 100 years. These are outlined in Tables 6 to 8. The guidance recommends that new drainage systems should be assessed using both the 'central' and 'upper end' allowances in order to understand the possible range of the impact of climate change on flood risk.

Table 6 – Anticipated Changes in Extreme Rainfall Intensity (EA Climate Change Guidance, 2016)

Allowance Category	Total Potential Change Anticipated for 2010 to 2039	Total Potential Change Anticipated for 2040 to 2059	Total Potential Change Anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

Table 7 – Peak River Flow Allowances by River Basin District - Humber Area (EA Climate Change Guidance, 2016)

River Basin District	Allowance Category	Total Potential Change Anticipated for the '2020s' (2015 to 2039)	Total Potential Change Anticipated for the '2050s' (2040 to 2069)	Total Potential Change Anticipated for the '2080s' (2070 to 2115)
Humber	Upper end	20%	30%	50%
	Higher central	15%	20%	30%
	Central	10%	15%	20%

Table 8 – Envisaged Sea Level Rise Allowance in Millimetres per Year using 1990 Base Sea Level (EA Climate Change Guidance, 2016)

Area of England	1990 to 2025	2026 to 2055	2056 to 2085	2086 to 2115
East, East Midlands, London, South East	4mm	8.5mm	12mm	15mm

2.5.3. The design life of the Proposed Scheme is considered to be a minimum of 25 years, with the end of the designed life of the Proposed Scheme envisaged to be in c.2052. For the purpose of this assessment a design life of 38 years was considered to allow for a potential extension period to the operation of the plant.

2.5.4. The hydraulic modelling undertaken as part of this FRA considers the sea level rise due to climate change predicted for the year 2065. The predicted sea level rise of 427mm was calculated in accordance with the EA Climate Change Guidance (2016).

2.6 The Flood Water Management Act 2010

2.6.1. The Flood and Water Management Act 2010 (FWMA) introduces new responsibilities for local authorities to manage flood risk and sets out new requirements for the management of sustainable drainage.

Lead Local Flood Authorities

2.6.2. Under the FWMA the unitary authority or County Council for an area is designated the 'Lead Local Flood Authority' (LLFA) with responsibility for managing flood risk from surface water, groundwater and ordinary watercourses within their area. The LLFA is also the consenting authority for works near or within ordinary watercourses.

2.6.3. In areas where there are special drainage requirements such as the areas surrounding Drax Power Station, Selby Internal Drainage Board (IDB) has permissive powers to manage water levels within their drainage district. IDBs undertake works to reduce flood risk to people, property and infrastructure, and to also manage water levels for agricultural and

environmental needs. They are also the consenting authority for works near or within ordinary watercourses. Consultation with NYCC (December 2017) confirmed that the IDB should be consulted on with respect to the following areas:

- Allowable discharge rates.
- Discharge points.
- Outfalls.
- Quality of process water (in joint consultation with the EA).
- Study area.
- Land Drainage Consent

2.7 Sustainable Drainage

2.7.1. The Non-Statutory Technical Standards for Sustainable Drainage Systems (DEFRA, 2015) provides general guidance for the design, maintenance and operation of sustainable drainage systems. Detailed design and guidance is provided in The SUDS Manual (CIRIA, 2015).

2.7.2. In addition, the NPPF promotes the SUDS hierarchy, which states that the following methods of surface water disposal from a site should be considered in descending order of preference:

- Discharge to the ground.
- Discharge to a surface water body.
- Discharge to a surface water sewer
- Discharge to a combined sewer.

2.8 Review of Relevant Local Planning Policy

Selby District Core Strategy Plan (2013)

2.8.1. The following policies relate to drainage and flood risk:

- Policy SP15 (Sustainable Development and Climate Change) sets out to promote sustainable development, and determine scheme layouts which are resilient to climate change:
  - Section A Part D) Ensure that development in areas of flood risk is avoided wherever possible through the application of the sequential test and exception test; and ensure that where development must be located within areas of flood risk that it can be made safe without increasing flood risk elsewhere.
  - Section A Part E) Support sustainable flood management measures such as water storage areas and schemes promoted through local surface water management plans to provide protection from flooding; and biodiversity and amenity improvements.
  - Section B part C) Incorporate water-efficient design and sustainable drainage systems which promote groundwater recharge.
- Policy SP18 (Protecting and Enhancing the Environment) sets out to protect the District's environment, in particular by:
  - Section 7. Ensuring that new development protects soil, air and water quality from all types of pollution.

- Section 8. Ensuring developments minimise energy and water consumption, the use of non-renewable resources, and the amount of waste material.
- Section 9. Steering development to areas of least environmental and agricultural quality.

2.8.2. The Local Plan identifies a number of primary issues which should be considered. Two of these issues are relevant to the Proposed Scheme in relation to the water environment:

- Protection of groundwater: The District is underlain by the Sherwood Sandstone and the Magnesian Limestone aquifers, both of which provide a significant groundwater supply. Where there are no superficial deposits over the aquifers, groundwater contamination is a serious concern so consideration must be given to the prevention of pollution and the protection of water quality within the groundwater. Water conservation measures are promoted across the District to adapt to the future pressures of climate change.
- Flood Risk management: Significant flood risks exist across large areas of Selby District, most developments therefore require the application of the Sequential Test.

2.8.3. The promotion of SuDS across the District encourages infiltration and groundwater discharge.

2.9 Other Local Guidance

2.9.1. North Yorkshire County Council (NYCC) SUDS Design Guidance provides principles for the design of SUDS measures. The following principles should be followed during the design of surface water drainage:

- Surface water runoff should be managed in accordance with the SUDS management train.
- The peak runoff rate from the developed site for the 1 in 1 year, 1 in 30 year and 1 in 100 year events must not exceed the peak greenfield runoff rate from the site for the same event.
- Greenfield runoff rates should be determined using the Institute of Hydrology Report 124 (IH124) or Flood Estimation Handbook (FEH).
- Discharge runoff rate/volume from a whole or part brownfield site should be limited to the 70% of existing positively drained runoff rate/volume for those rainfall events or to the current greenfield runoff rate/volume, however greenfield runoff rate/volume should be achieved where possible.
- Greenfield runoff rate is maximum 1.4 l/s/ha unless modelling conclusively demonstrates greenfield runoff to be greater than this.
- The runoff volume from the developed site for the 1 in 100 year 6 hour rainfall event must not exceed the greenfield runoff volume for the same event.
- Should infiltration methods not be suitable and it is not possible to achieve greenfield runoff volume then it must be demonstrated that the increased volume will not increase flood risk on or off site.
- SUDS design must ensure that the quality of any receiving water body is not adversely affected and preferably enhanced.
- Appropriate ground exceedance flow paths must be included in a site design so in case of SUDS failure or rainfall that exceeds the design capacity of the drainage system, any exceedance flows do not cause flooding of properties on or off site.

- Surface water runoff generated in a development must be contained within the drainage system for all events up to and including the 1 in 30 year event.
- Surface water runoff from rainfall in excess of a 1 in 100 year event must be managed to ensure no increased risk of flooding to people and properties both on and off site.
- SUDS features located in highway and that serve those highways can be adopted by NYCC Highway Authority and maintained as part of the wider highways maintenance subject to agreement with Highway Authority.
- An allowance of 30% increase in rainfall intensity must be considered in SUDS design to allow for climate change.
- An urban creep of 10% must be considered in the drainage design.
- Information on adoption and maintenance of SUDS must be submitted to the Council.

Selby Area Internal Drainage Board Bye-Laws

2.9.2. Selby Area Internal Drainage Board Bye-Laws provide a summary of the requirements related to any works planned to be undertaken within or in close proximity to the ordinary watercourses located in the area under the jurisdiction of the IDB. The bye-laws also provide information on the requirements related to drainage discharge rates to the watercourses under the jurisdiction of the IDB. A summary of the general requirements is given below:

- Any works that may impact the IDB's watercourses and any discharge into these watercourses requires appropriate consent from the IDB. The consent should be obtained prior to commencement of the proposed works.
- Any new surface water discharge to an IDB watercourse must be restricted to the pre-development greenfield runoff rate or 1.4 l/s/ha, whichever is the lesser rate.
- No person shall directly or indirectly obstruct, impede or interfere with the flow of water in, into or out of any watercourses, or cause damage to the bank of any watercourse.
- Where works to an existing bank are necessary, the bank shall be reinstated to the original alignment and slope, and re-seeded as soon as possible thereafter.
- New outfalls should be set back from the bank and should not protrude into the watercourse.
- No materials or rubbish should be stored or stacked on the banks of the watercourses.
- No temporary or permanent structure should be constructed within 7m of the edge of the watercourse.

2.10 Methodology

2.10.1. The methodology adopted in the preparation of this FRA comprises:

- Review of available flood risk data to identify existing flood risk from fluvial, tidal, groundwater, surface water and artificial sources.
- Review of existing ground conditions on-site to determine groundwater levels, soil permeability and contamination risks through examination of previous land uses and information available from the EA, the British Geological Survey (BGS) and the National Soil Resources Institute (NSRI) Soils Site Report.
- Review of the Proposed Scheme with respect to the flood risk vulnerability and flood zone compatibility of the Scheme, in accordance with the methodology outlined in the NPPF.
- Assessment of how the Proposed Scheme might affect flood risk to the site and elsewhere supported by a hydraulic modelling of the proposed works.

- Preparation and assessment of proposals for the appropriate management of flood risk to enable construction and operation of the development without increasing flood risk elsewhere.

2.10.2. Data regarding flood risk relevant to the Proposed Scheme and the surrounding area has been obtained from the following sources:

- EA Flood Map for Planning available online, accessed March 2018
- https://flood-map-for-planning.service.gov.uk/.
- EA Flood Risk from Surface Water and Flood Risk from Reservoirs mapping available online, accessed March 2018
- https://flood-warning-information.service.gov.uk/long-term-flood-risk/.
- EA Groundwater mapping available online, accessed March 2018
- http://apps.environment-agency.gov.uk/wiyby/default.aspx.
- Natural England's MAGIC online mapping
- http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx.
- British Geological Survey (BGS) Geology of Britain Viewer available online, accessed March 2018
- http://mapapps.bgs.ac.uk/geologyofbritain/home.html.
- Cranfield Soil and Agrifood Institute Soilscapes mapping available online, accessed March 2018
- http://www.landis.org.uk/soilscapes/index.cfm.
- North Yorkshire County Council Local Flood Risk Strategy, downloaded from the Council's website in March 2018.
- Selby Level Strategic Flood Risk Assessment Update, October 2015.
- Selby Level 2 Strategic Flood Risk Assessment, Living Document, February 2010.
- EA River Ouse Catchment Flood Management Plan, 2010.
- EA Humber River Basin Management Plan, 2016.
- Existing Drainage Plans obtained from Drax Power Ltd.
- Selby Area Internal Drainage Board mapping obtained from Selby Internal Drainage Board.
- Drax Repowering Hydraulic Modelling Report, HR Walingford, March 2018.
- Draft Drax Power Station Stage 1 Flood Risk Assessment, by Peter Brett, February 2018.
- White Rose Carbon Capture and Storage Project Flood Risk Assessment, Volume 2 of Environmental Statement, Chapter C.1, November 2014.
- White Rose Carbon Capture and Storage Project Surface Water and Flood Risk Technical Report, Volume 2 of Environmental Statement, Chapter C, November 2014.

3 SITE DESCRIPTION

3.1 Site Location

3.1.1. The existing Drax Power Station is located approximately 7km to the south-east from the centre of Selby, North Yorkshire, approximate NGR 466444, 427458. The works are proposed to be undertaken partially within the northern and the southern part of the Existing Drax Power Station Complex, and the new gas pipeline with associated infrastructure is proposed to be constructed in the area immediately to the east of the Power Station. The approximate location of Drax Power Station Complex and approximate areas of the proposed works are shown in Figures 1 and 2 respectively. The site location and the exact extent of the Proposed Scheme are shown in Appendix A.

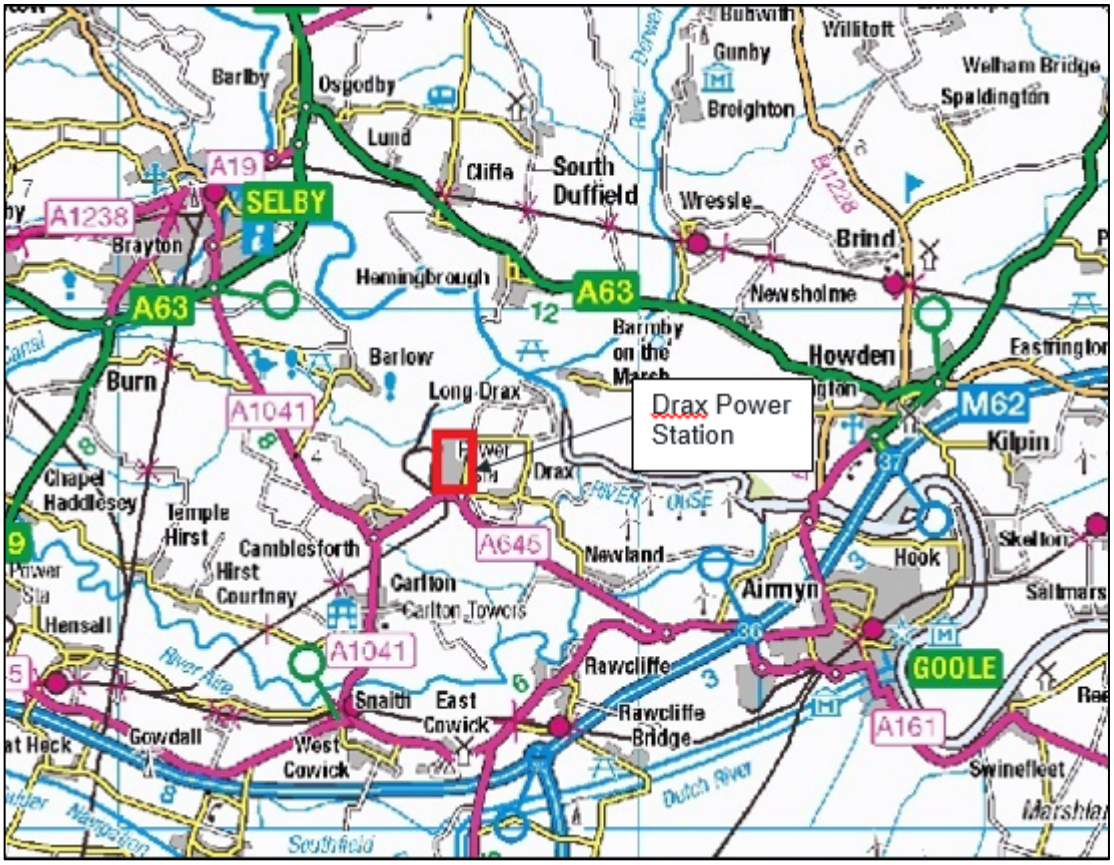


Figure 1 – Drax Power Station Location (Contains OS data © Crown copyright and database right (2018))

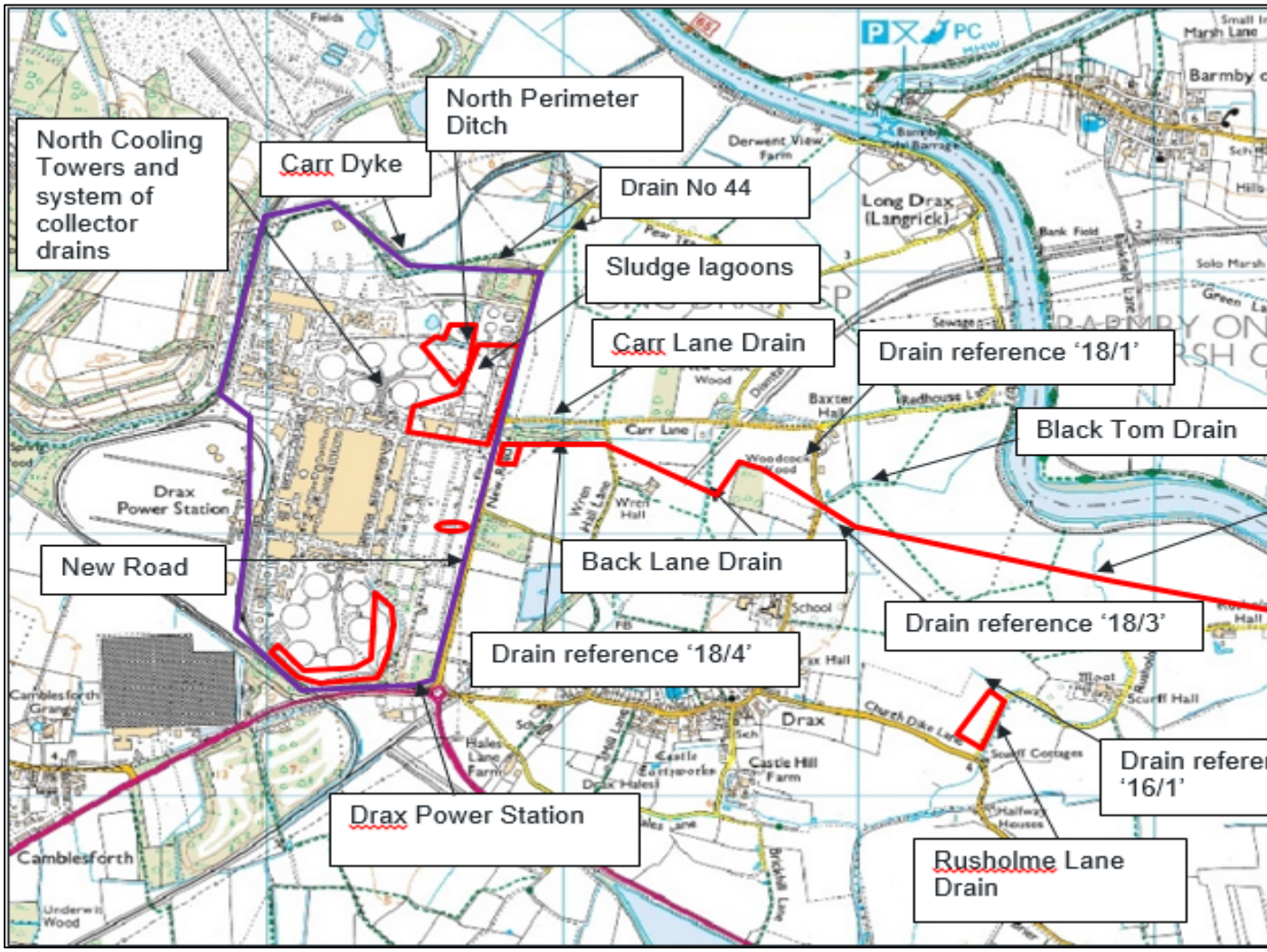


Figure 2 – Approximate Location of the Proposed Works and Surface Water Features (Contains OS data © Crown copyright and database right (2018))

3.2 Site Description

3.2.1. The works proposed within the boundary of the Existing Drax Power Station Complex will be undertaken in the areas that have already been developed. The Power Station is bounded by rural areas to the north, west and south-west and by the A465 carriageway and New Road to the south-east and east respectively.

3.2.2. The new buried gas pipeline and the associated infrastructure are proposed to be constructed in areas currently used for agricultural purposes.

3.2.3. The area of the Existing Drax Power Station Complex and the surrounding areas comprise of general low lying and flat land. The ground levels within the site vary between around 4.6 m AOD and around 5 m AOD in the southern and northern part of the site respectively.

Hydrology and Surface Water Features

3.2.4. The area surrounding Power Station Site is served by a system of drains that discharge to the River Ouse at locations to the north and east of Power Station Site. The drains are designated as ordinary watercourses and their vast majority are under the jurisdiction of the Selby Area IDB. The River Ouse is located approximately 1.5km to the north and east of Power Station Site, and flows in an easterly direction to the Humber Estuary. The river is designated as a main river under the jurisdiction of the EA.

3.2.5. The proposed repowering works within the boundary of the Existing Drax Power Station Complex are located in close proximity to the following drains and watercourses:

- Carr Dyke – the dyke is culverted under the north-western part of the Existing Drax Power Station Complex and flows in a north-easterly direction towards the River Ouse. The dyke is under the jurisdiction of the Selby Area IDB, except for the length culverted under the Existing Drax Power Station Complex, which is under riparian ownership and is the responsibility of Drax Power Ltd. Carr Dyke becomes Lendall Drain just before its discharge to the River Ouse. Water levels in Lendall Drain and the discharge into the River Ouse are controlled by Lendall Pumping Station. The dike and pumping station is under the jurisdiction of the Selby IDB.
- Drain No 44 – the drain is located adjacent to a small wooded area in the north-eastern part of the Existing Drax Power Station Complex and is under the jurisdiction of Selby IDB.
- System of concrete channels – the channels are located in the areas of the north and south cooling towers and form part of the cooling water infrastructure. They are managed by Drax Power Ltd.
- North Perimeter Ditch –the ditch forms part of the existing surface water drainage system serving the Existing Drax Power Station Complex. Drax Power Ltd is responsible for this ditch.
- Sludge lagoons – The lagoons are located in the north-eastern part of the Existing Drax Power Station Complex and form part of the surface water management of runoff from the Coal Mound. Drax Power Ltd is responsible for the lagoons.
- Unnamed drain – the drain is located immediately to the east of the southern cooling towers (Area H). The drain is part of the existing drainage system serving the Existing Drax Power Station Complex and it is managed by Drax Power Ltd.

3.2.6. The new Gas Pipeline and AGI is proposed to cross or be constructed in close proximity to the following drains, all of which are under the jurisdiction of Selby IDB:

- Unnamed drains identified as 18/1, 18/2, 18/3, 18/4 on the Selby Area IDB plan.
- Carr Lane Drain.
- Back Lane Drain.
- Rusholme Lane Drain also known as Willow Row Drain.
- Clough Drain.
- Black Tom Drain also identified as ‘17’ on the Selby IDB plan.
- Dickon Field Drain.

3.2.7. The main construction compound (Area A) is bounded to the west by an unnamed drain located adjacent to New Road, Drain No 44 to the north-west and Carr Lane Drain to the south. The unnamed drain identified along New Road is understood to be in riparian ownership and may form part of the New Road drainage system.

3.2.8. The construction compound (Area B) is bordered by an unnamed drain on the north-western boundary (understood to be in riparian ownership and maintained by Drax Power Ltd) and Drain No 44 along the north-eastern boundary. Drain No 44 extends into Area B along the northern edge of the wooded area. An unnamed drain, possibly an extension of the Drax North Perimeter Ditch, is located along the south-west edge of the wood.

3.2.9. Approximate locations of the above water features are shown in Figure 2 above. A detailed plan showing all water features in the vicinity of the Proposed Scheme is shown in Appendix E.

Geology and Hydrogeology

3.2.10. A review of British Geology Survey (BGS) mapping shows that the Existing Drax Power Station Complex and the area of the new Gas Pipeline are underlain by bedrock identified as Triassic Rocks (undifferentiated) – Sandstone and Conglomerate, interbedded, identified as Principal Aquifer. The BGS mapping also shows that the Power Station and the area of the new gas pipeline are underlain by superficial deposits in the form of Lacustrine Deposits – Clay identified as Unproductive Strata, and Alluvium – Clay, Silt and Sand identified as Secondary A Aquifer respectively.

- A Principal Aquifer is described as layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. Principal Aquifers may support water supply and/or river base flow on a strategic scale.
- A Secondary A Aquifer is described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
- Unproductive Strata is described as rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

3.2.11. A review of the BGS borehole logs recorded within the boundary or in the vicinity of the the Existing Drax Power Station Complex shows the Sandstone bedrock to be located at a depth of approximately 19 m below ground level (bgl). The borehole logs also indicate that groundwater was recorded at depths of between approximately 4.9 m bgl (borehole reference SE62NE29) and 2.20 m bgl (borehole reference SE62NE126) in the north-eastern and southern part of the area of the Power Station Site respectively.

3.2.12. The borehole logs recorded in the vicinity of the proposed gas pipeline show layers of sand logged at depths of approximately 17 m bgl, with Sandstone bedrock recorded at depths greater than 20 m bgl. Seepage of groundwater was recorded between depths of approximately 1.8 m bgl and 3.9 m bgl (borehole references SE62NE137 and SE62NE136).

3.2.13. The Selby Area IDB advised that high groundwater levels occur in the area of the Proposed Scheme.

3.2.14. The EA's Groundwater Source Protection Zone (SPZ) mapping shows that the Power Station Site and the area of the new Gas Pipeline are located in Zone 3 of the groundwater SPZ.

Soil Infiltration

3.2.15. A number of in-situ soil infiltration tests were undertaken as part of the site investigation undertaken to inform the Surface Water and Flood Risk Chapter of the Environmental Statement prepared for White Rose Carbon Capture and Storage Project. The results show a very low permeability ranging between 1.1 x 10^{-5} m/s and 6.97 x 10^{-8} m/s.

3.2.16. Considering this information and the recorded geology and hydrogeology of the site, the soil infiltration rates in this area are considered to be low and not suitable for infiltration techniques.

Existing Drainage

3.2.17. Information on the existing drainage system serving the Existing Drax Power Station Complex was received from Drax Power Ltd. Surface water runoff generated within the boundary of Power Station Site is managed by a complex drainage system that combines gravity and pumped systems with open ditches, culverts, land drainage and lagoons. These systems include the North Perimeter Ditch. They collect, manage and convey surface water runoff to a consented outfall into Carr Dyke in the north-western part of the site. From here, Carr Dyke conveys the surface water to Lendall Drain from where it outfalls to the River Ouse via the Lendall Pumping Station.

3.2.18. A series of ditches around the perimeter of the Existing Drax Power Station Complex are arranged to intercept and collect the on and off site surface water runoff and convey the water through the Existing Drax Power Station Complex into Carr Dyke.

3.2.19. The ash mound located to the north-west of the Existing Drax Power Station Complex has a self-contained surface water management system with a consented outfall to Carr Dyke.

3.2.20. Surface water runoff from the remaining coal and ash mounds is collected in land drains and conveyed to sludge lagoons where sediment is settled and filtered. The filtered water is then conveyed to the sedimentation tanks, from where it is either re-used in the cooling water make-up or pumped to the purge pump house and discharged to the River Ouse via the consented purge water discharge.

3.2.21. Surface water runoff generated in areas likely to pick up oily contaminants, such as oil tank storage areas and car parks, is passed through oil separators prior to discharge to Carr Dyke or the purge discharge to the River Ouse.

3.2.22. All foul effluent from toilets and welfare facilities is drained via a separate drainage system to an on-site sewage treatment plant. From here, the treated foul effluent is pumped to the primary surface water pumping station, from where it is pumped to the purge pump house and then to the River Ouse via the consented purge water discharge.

3.2.23. A drawing showing the existing drainage system serving the Existing Drax Power Station Complex is shown in Appendix F.

4 EXISTING FLOOD RISK

4.1 Historical Flooding

4.1.1. A review of the Selby District Council Level 1 SFRA indicates there are no records of historical flooding in the area of Drax Power Station or in the area of the proposed gas pipeline. Consultation was held with NYCC (December 2017) and they confirmed that they hold one record of surface water flooding in Barlow from 2011, north-west of the site. No further details were available about this event. Selby IDB (February 2018) were also consulted and they confirmed that they do not hold any historic flooding records.

4.1.2. The flood records received from the EA (February 2018) indicate that there is no known flood history in these areas. The EA Recorded Flood Outlines mapping is shown in Appendix G.

4.2 Risk of Fluvial and Tidal Flooding

4.2.1. The River Ouse is tidally influenced at the location of the Proposed Scheme. The risk of flooding in this area is therefore a combination of fluvial and tidal flooding, with domination of tidal influences.

4.2.2. A detailed Flood Map showing the area of the Proposed Scheme was received from the EA. The EA's Flood Map shows the extent of the floodplain during the 'undefended scenario', which means that the presence of the existing flood defences are not taken into account. The mapping does, however, indicate those areas of the floodplain that will benefit from flood defences during the 1 in 100 year fluvial event or the 1 in 200 year tidal event.

4.2.3. In summary the Flood Map received from the EA shows the following:

- The area where the new battery storage building, the new sludge lagoons, the collection point to the substation, and cable sealing ends and overhead conductors are proposed to be constructed is located in the medium risk Flood Zone 2.
- The area where Unit X and Unit Y are proposed to be constructed is partially located in the medium risk Flood Zone 2.
- The area of the second collection point to the substation and partially the area of the proposed Contractor's Village are located in the high risk Flood Zone 3.
- The area of the new gas pipeline route and the associated GRF and AGI is located in the high risk Flood Zone 3.
- The vast majority of the pipeline route with associated infrastructure is located in the area benefiting from flood defences during the 1 in 100 year fluvial event or the 1 in 200 year tidal event.

4.2.4. The EA's Flood Map is shown in Appendix H.

Flood Defences

4.2.5. The EA confirmed that flood defences in the form of walls and raised embankments are present along the western bank of the River Ouse. The information received from the EA shows that the flood defences present in the area of the Proposed Scheme provide fluvial and tidal protection and are maintained by the EA. Details of the flood defences received from the EA are summarised in Table 9. The exact location of the flood defences is shown in Appendix I.

Table 9 – Existing Flood Defence Details (EA, January 2018)

Asset ID	Description	Type	Downstream Crest Level (mAOD)	Upstream Crest Level (mAOD)	Existing Condition
29000	Floodbank with access steps. Sections of stone walling and piling present.	Embankment	6.16	5.86	3 (fair)
29003	Floodbank with sheet piling wall.	Wall	6.21	6.03	2 (good)
29004	Barrierbank. Public footpath along asset.	Embankment	5.94	6.05	2 (good)
29005	Floodbank wall. Public footpath along asset.	Wall	6.05	5.62	3 (fair)
29053	Barrierbank. Public footpath along asset.	Embankment	5.62	5.95	3 (fair)
77033	Barrierbank. Tidal river.	Embankment	6.06	6.31	3 (fair)
79662	Barrierbank. Public footpath along asset. Gas main runs under asset.	Embankment	5.71	6.13	3 (fair)

4.2.6. The EA advised that despite the fact that the risk of flooding in the area of the Proposed Scheme has been reduced by the presence of flood defences, there is still a residual risk of flooding in case of breach of the flood defences or their overtopping by a flood greater than that for which they were designed. The EA stated that asset inspections are undertaken on average every six months, although some critical assets are assessed on a more regular basis. The aim of the EA is to maintain all assets to at least 'fair' standard to ensure that the assets provide appropriate protection. Although a breach of the existing flood defences is

unlikely to happen, the EA requested a detailed breach modelling exercise to be carried out to support this FRA.

River Ouse Hydraulic Model 2009

4.2.7. The EA advised that the hydraulic model of the River Ouse developed by Halcrow in 2009 is expected to be superseded at the location of the Proposed Scheme by the Upper Humber Flood Mapping Study which is likely to be published in April 2018. However, the EA confirmed in their letter dated 26th January 2018 (Appendix D) that the 2009 River Ouse Model is still the best available data to use at this time and provides a sufficiently robust approach to support this assessment.

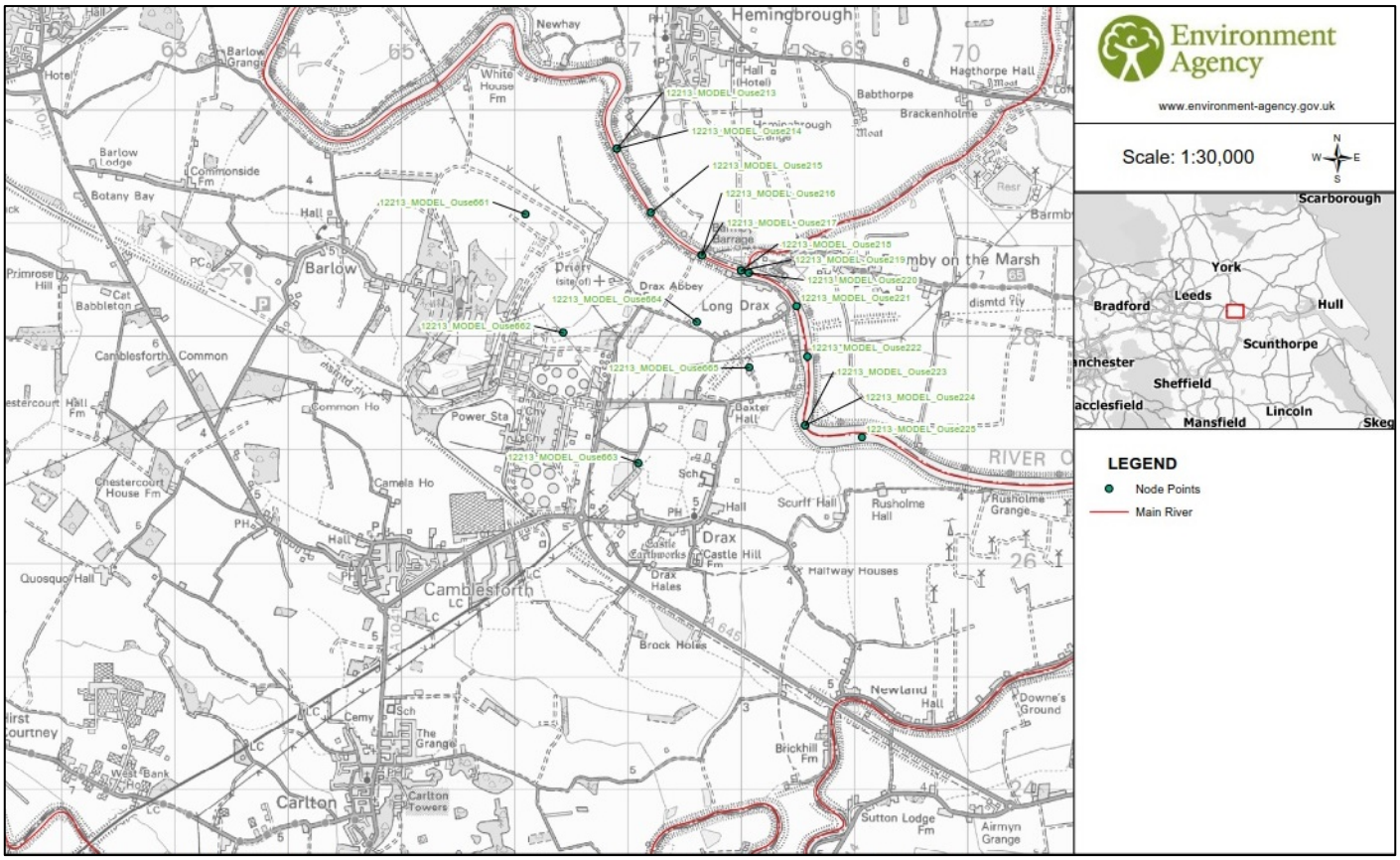
4.2.8. The flood levels extracted from the 2009 River Ouse model were received from the EA and are summarised in Table 10. The table includes the flood levels predicted during the 'defended scenario' only, as the EA confirmed that the undefended flood scenario does not have to be considered in the assessment as the EA has no plans to remove the existing flood defences. The location of the model node points is shown in Figure 3.

Table 10 – Flood Levels during 'Defended Scenario' (EA's River Ouse Hydraulic Model, 2009)

Node Label	Maximum Water Level (mAOD)			
	1 in 25 year Return Period	1 in 100 year Return Period	1 in 200 year Return Period	1 in 1000 year Return Period
12213_Model_Ouse213	5.26	5.52	5.63	5.72
12213_Model_Ouse214	5.26	5.52	5.63	5.72
12213_Model_Ouse215	5.25	5.51	5.62	5.71
12213_Model_Ouse216	5.26	5.52	5.64	5.73
12213_Model_Ouse217	5.26	5.52	5.64	5.73
12213_Model_Ouse218	5.27	5.53	5.64	5.73
12213_Model_Ouse219	5.27	5.53	5.64	5.73
12213_Model_Ouse220	5.28	5.53	5.64	5.74
12213_Model_Ouse221	5.26	5.52	5.63	5.72
12213_Model_Ouse222	5.26	5.52	5.63	5.73
12213_Model_Ouse223	5.27	5.53	5.64	5.74
12213_Model_Ouse224	5.27	5.53	5.64	5.74
12213_Model_Ouse225	5.26	5.53	5.64	5.73
12213_Model_Ouse661	1.80	1.80	1.80	3.17
12213_Model_Ouse662	0.50	0.50	0.50	3.13

Node Label	Maximum Water Level (mAOD)			
	1 in 25 year Return Period	1 in 100 year Return Period	1 in 200 year Return Period	1 in 1000 year Return Period
12213_Model_Ouse663	2.30	2.30	2.30	3.05
12213_Model_Ouse664	0.80	0.80	0.80	3.12
12213_Model_Ouse665	2.30	2.30	2.30	2.30

Figure 3 – Model Nodes Location (EA's River Ouse Hydraulic Model 2009)



4.2.9. A review of the crest levels of the existing flood defences and the flood levels extracted from the 2009 River Ouse hydraulic model indicates that the vast majority of the flood defences provides a protection for up to and including the 1 in 200 year flood event. However it is noted that the crest level of 5.62 mAOD indicated for the flood defence in the area of Derwent View Farm (downstream and upstream section of the assets reference 29053 and 29005 respectively) is 0.02m lower than the flood level predicted for the 1 in 200 year event 'defended scenario'. This location is located approximately 1.2 km to the south-east from the Drax Power Station site. Considering the distance to the Proposed Scheme overtopping at this location is not predicted to pose flood risk to the Proposed Scheme.

4.2.10. A review of the crest levels of the existing flood defences and the flood levels extracted from the 2009 River Ouse hydraulic model indicates that the majority of the flood defences also provides a protection for up to and including the 1 in 1000 year flood event.

4.2.11. Considering the above information, the area of the Proposed Scheme is considered to be protected for up to and including the 1 in 200 year flood event by the existing flood defences.

Breach Scenario

4.2.12. The EA requested a breach modelling exercise to be undertaken to support this FRA.

4.2.13. Breach analysis of the White Rose Carbon Capture and Storage Project which is located immediately north of the Existing Drax Power Station Complex was undertaken by HR Wallingford in 2014. The breach location used in this model is approximately 1 km north of the Power Station Site. The breach model and approach was approved by the EA as part of the 2014 project and used a 2D hydrodynamic model (TUFLOW). The model was run for the 1 in 200 year tidal event with climate change occurring in conjunction with the 1 in 5 year fluvial event, as this was considered to represent the worst case scenario. The design life of White Rose Carbon Capture and Storage was considered to be 50 years, therefore the climate change allowance was calculated for the year 2065.

4.2.14. The EA confirmed that the existing White Rose Carbon Capture and Storage breach model could be used as a suitable future baseline scenario for the Proposed Scheme, without the need for further changes. The design life of the Proposed Scheme is considered to be 25 years (with the end of the design life being in the year approximately 2052), after which the continued operation of infrastructure will be reviewed and decommissioned if necessary. The climate change allowance considered in the existing White Rose Carbon Capture and Storage hydraulic model is therefore considered appropriate and was adopted for the purpose of this assessment providing a conservative approach.

4.2.15. The flood extent and depth during the future baseline are shown in Figure 4. This figure also indicates the boundary of the Proposed Scheme.

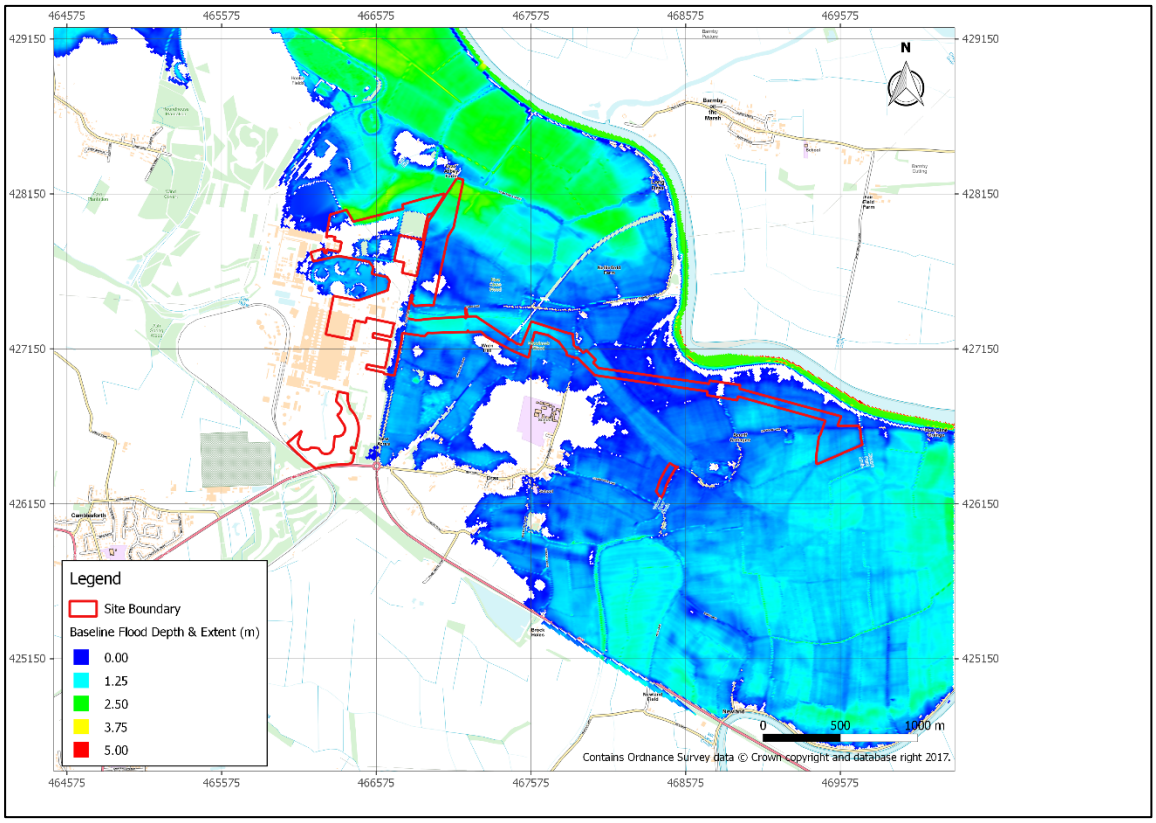


Figure 4 – Future Baseline Floodplain Extent and Flood Depth during Breach Scenario

4.2.16. The results show that the proposed pipeline route with the associated GRF and AGI, the area of the northern cooling towers and the area of the proposed battery storage building are potentially at risk of flooding during the modelled breach scenario. The results also indicate that the eastern edge of the Existing Drax Power Station Complex would be also prone to flooding, including the area of the proposed substation facility and partially the area of the proposed Unit Y. The results also show that the area proposed construction compounds (Area A and Area B) and the area of the proposed widening of Rusholme Lane are potentially at risk of flooding during the modelled breach scenario.

4.2.17. Details of the hydraulic modelling are provided in the 'Drax Repowering – Hydraulic Modelling Report' in Appendix J.

4.3 Risk of Flooding from Surface Water

4.3.1. A review of the EA's Risk of Flooding from Surface Water mapping shows that the vast majority of the area of the Proposed Scheme is not susceptible to flooding from surface water. The EA's Risk of Flooding from Surface Water mapping does, however, indicate that the following area are at risk:

- Isolated areas within the boundary of the proposed Unit X, and along the western edge of New Road indicated to be at low to medium susceptibility of flooding from surface water.
- The area along the new pipeline between New Road and Wren Hall Lane is indicated to be at low susceptibility of flooding from surface water with small pockets indicated to be at medium to high susceptibility of flooding.

- The area of the pipeline route located to the north of Woodcock Wood is indicated to be at low to medium susceptibility of flooding from surface water with isolated pockets indicated to be at high susceptibility of flooding from surface water.
- The south-western and the north-eastern part of the main construction compound (Area A) and the area along the northern and eastern boundary of the smaller construction compound (Area B) are indicated to be mainly low risk of flooding from surface water, with small areas indicated to be at medium and high risk of flooding.

4.3.2. Low risk of flooding from surface water indicates those areas that could be at risk between the 100 year and 1000 year rainfall event. Medium risk of flooding from surface water indicates those areas that could be at risk between the 30 year and 100 year rainfall event, and high risk – those areas that could be at risk greater than 30 year rainfall event.

4.3.3. It is likely that the indicated risk of flooding is associated with localised areas of low ground where water would pond during or after severe or prolonged rainfall events.

4.3.4. Considering this information, the Proposed Scheme is generally considered to be at low susceptibility of flooding from surface water.

4.4 Risk of Flooding from Groundwater

4.4.1. Groundwater flooding occurs when water stored below ground reaches the surface. It is commonly associated with porous underlying geology, such as chalk, limestone and gravels.

4.4.2. Although the area of the Proposed Scheme is underlain by a few metres of clayey superficial deposits which are likely to limit groundwater emergence above ground level, the Selby Area IDB advised that high groundwater levels are likely to occur in the area of the Proposed Scheme.

4.4.3. The EA's Areas Susceptible to Groundwater Flooding (AStGWE) map is a strategic scale map illustrating areas susceptible to groundwater flooding on a 1 km^2 grid. It illustrates the proportion of each 1 km^2 grid square where geological and hydrogeological conditions indicate that groundwater emergence might occur. The Selby District Level 1 SFRA reproduces the relevant portion of AStGW map. The map indicates that the area of the Existing Drax Power Station Complex is located in a 1 km^2 grid square where less than 25% of the land is considered to be susceptible to groundwater flooding. The map also shows that the proposed route of the new gas pipeline is not located in the area susceptible to groundwater flooding.

4.4.4. Considering the above information, there is a potential risk of flooding from groundwater however it is considered to be low.

4.5 Risk of Flooding from Reservoirs

4.5.1. Reservoir flooding may occur as a result of the capacity of the facility being exceeded and/or as a result of dam or embankment failure.

4.5.2. A review of the EA's Risk of Flooding from Reservoirs mapping shows that the northern and southern part of the Existing Drax Power Station Complex is at risk of flooding from reservoirs. In accordance with Selby Level 1 SFRA the nearest reservoir is located approximately 4 km upstream of the Proposed Scheme. The EA is responsible for ensuring that reservoirs are inspected regularly and essential safety works are carried out. The EA therefore advised that

reservoir flooding is extremely unlikely to happen. Considering this information, the risk of flooding from reservoirs is considered to be low.

4.6 Risk of Flooding from Sewers

4.6.1. The Selby Level 1 SFRA includes information on the historical records of flooding from sewers in the area of the Proposed Scheme. The information provided in the Selby Level 1 SFRA shows the total number of properties at a 1 in 30 year risk of sewer flooding based on historic flooding over the previous 10 years. Due to data protection requirements the data has not been provided at individual property level; rather the register comprises the number of properties within 4 digit postcode areas that are at risk of sewer flooding either internally or externally. The map included in the Selby Level 1 SFRA shows that the Proposed Scheme is located in the area where up to three incidents of flooding from sewers were recorded in the last 10 years.

4.6.2. The Existing Drax Power Station Complex is surrounded by rural areas to the north, west and south-west, therefore there is no risk of flooding from sewers from these directions. The power station is bounded by the A645 and New Road to the south-east and east. A new gas receiving facility is also proposed to be located adjacent to New Road. It is likely that these roads are provided with an appropriate highway drainage system that is regularly inspected and maintained, therefore the risk of flooding from the highway drainage system is considered to be low.

4.6.3. The route of the new gas pipeline crosses rural areas with no drainage infrastructure and therefore there is no risk of flooding from sewers.

5 FLOOD RISK DURING CONSTRUCTION AND OPERATIONAL PHASE

5.1 Flood Risk during Construction Phase

Increased Risk of Flooding to the Power Station Site, Construction Workers, and People and Properties Elsewhere Caused by Temporary Works in the Existing Floodplain

5.1.1. The EA advised that the area of the Proposed Scheme and its surroundings are protected by the existing flood defences for up to the 1 in 200 year flood event. The potential risk of flooding during construction is therefore associated with a breach of the existing flood defences. The breach scenario is very unlikely to happen as the flood defences are regularly inspected and maintained by the EA to ensure that they provide an appropriate level of protection. The results of the hydraulic modelling undertaken as part of this FRA indicate that the proposed construction compounds (Areas A and B and potential compounds that may be required along the pipeline route) are located in the area indicated to be at risk of flooding during the unlikely breach of the existing flood defences. The breach of flood defences is considered to be an extreme and rare event. However, appropriate mitigation measures were investigated and are discussed in the 'Proposed Mitigation' further down this section.

Construction of Temporary Culvert(s)

5.1.2. Temporary culvert(s) may be required on the local drains to allow access along the proposed pipeline route. Any works near or within the watercourses would require appropriate consent from the Selby Area IDB. The consent should be obtained prior to the works commencing. Construction of temporary culverts may impede the flow in the channels if not appropriately designed, which could result in an increased risk of flooding in the area. The proposed mitigation measures are discussed in the 'Proposed Mitigation' further down this section.

Works in the Areas Indicated to be at Risk of Flooding from Surface Water

5.1.3. A review of the EA's Risk of Flooding from Surface Water mapping shows that the vast majority of the area of the Proposed Scheme is not susceptible to flooding from surface water. . The EA's Risk of Flooding from Surface Water mapping also shows isolated areas of the Proposed Scheme to be susceptible to flooding from surface water. The risk of flooding is associated with localised low ground level areas where water would pond during or after prolonged and heavy rainfall events. Water ponding in the low ground areas could delay construction works if not appropriately managed. The proposed mitigation measures are discussed in the 'Proposed Mitigation' further down this section.

5.2 Post-Development Flood Risk

5.2.1. The existing flood defences protect the area of the Proposed Scheme and its surroundings for up to the 1 in 200 year flood event, however there remains a residual risk of a breach in the defences. Hydraulic modelling of the post-development scenario was undertaken for the 1 in 200 year with climate change breach scenario with the 1 in 5 year fluvial event to establish the residual risk to the Proposed Scheme and whether the construction of the Proposed Scheme would increase the risk of flooding in the area. Details of the baseline and the post-

development hydraulic modelling are provided in the 'Drax Repower – Hydraulic Modelling Report' attached in Appendix J.

Risk of Flooding to the Proposed Scheme During Breach Event

5.2.2. The results of the hydraulic modelling indicate that the majority of the above ground structures of the Proposed Scheme (namely the proposed AGI, GRF, the battery storage building, the relocated sludge lagoons (if the two unit option is taken forward), partially Unit X and Unit Y, and the electrical connectors) will be constructed in areas indicated to be at risk of flooding during a breach of the existing flood defences.

5.2.3. In accordance with the Planning Policy Guidance 'Flood Risk and Coastal Change', the Proposed Scheme is considered to be 'essential infrastructure' that must remain operational during flood events. It is therefore proposed to raise these features above the predicted flood level to ensure that these areas will not be flooded during the breach scenario and will remain operational. The proposed mitigation measures are discussed in the 'Proposed Mitigation' further down this section.

Increased Risk of Flooding to People and Properties Caused by Construction of New Structures in the Floodplain

5.2.4. Construction of the proposed structures as discussed above within areas indicated to be at risk of flooding following a breach of the flood defences could reduce the floodplain storage capacity and increase the risk of flooding in the area.

5.2.5. The proposed structures were included in the hydraulic model to determine the potential effect elsewhere. In the model, the above ground structures were represented by simple rectangular shapes which provided a conservative approach as no flood water was allowed in these areas, while in reality flood water would flow around the structures.

5.2.6. The post-development results indicated a small increase of up to 3 mm in flood depth across the vast majority of the floodplain in comparison to the future baseline results.

5.2.7. The results indicated that the proposed battery storage and the relocated sludge lagoons could potentially block the existing overland flood flow path shown in the northern part of the Power Station Site in the future baseline scenario. A plan showing the extent of the floodplain during the post-development scenario is shown in Figure 5. The works would result in a very small and localised increase of 13 mm and 20 mm in flood depth at two locations in Drax village. The locations in Drax village where the increase in flood depth are predicted are shown in Figure 6. These areas are shown to be flooded in the future baseline scenario. Appropriate mitigation measures are discussed in the 'Proposed Mitigation' further down this section.

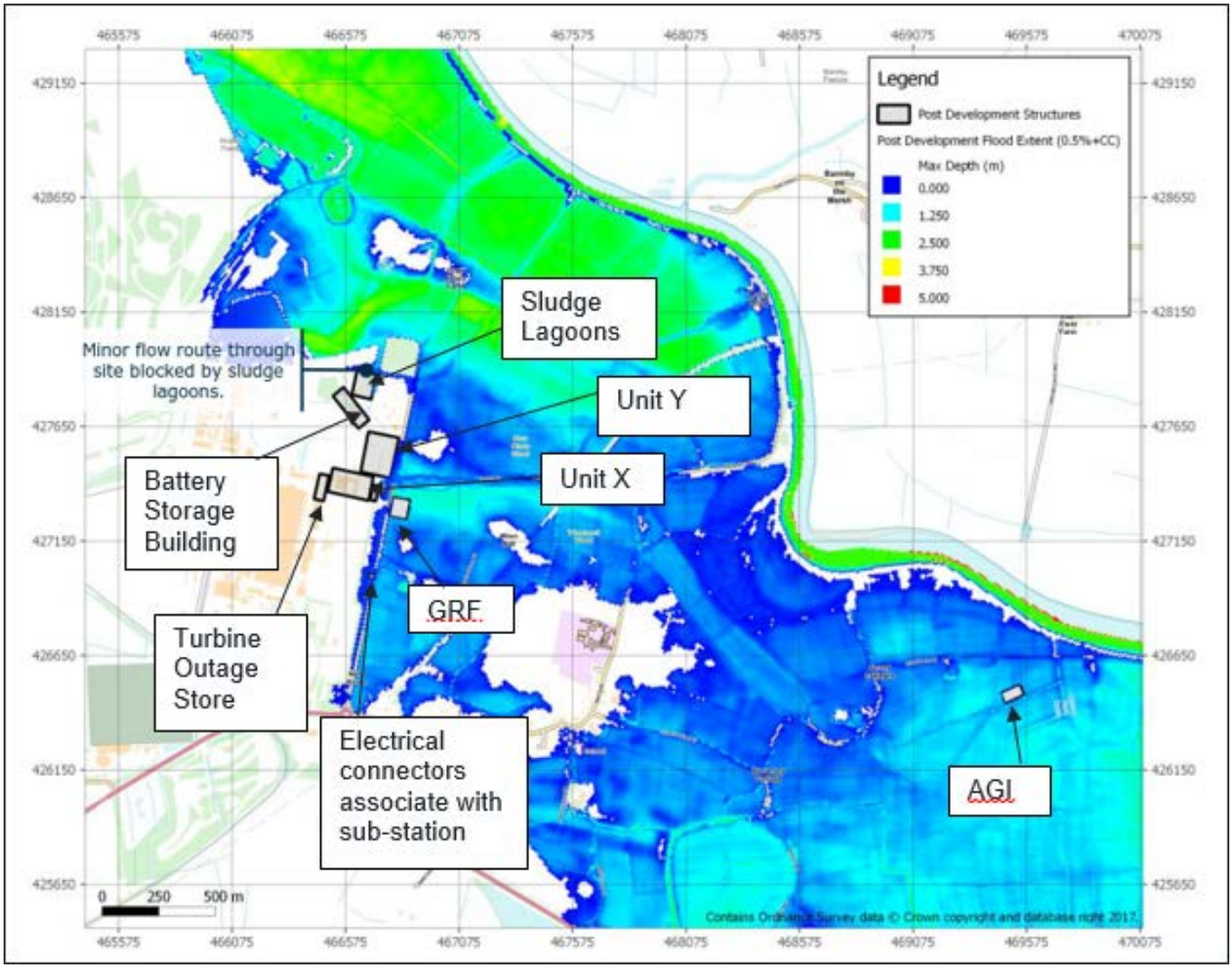


Figure 5 – Post–Development Floodplain Extent

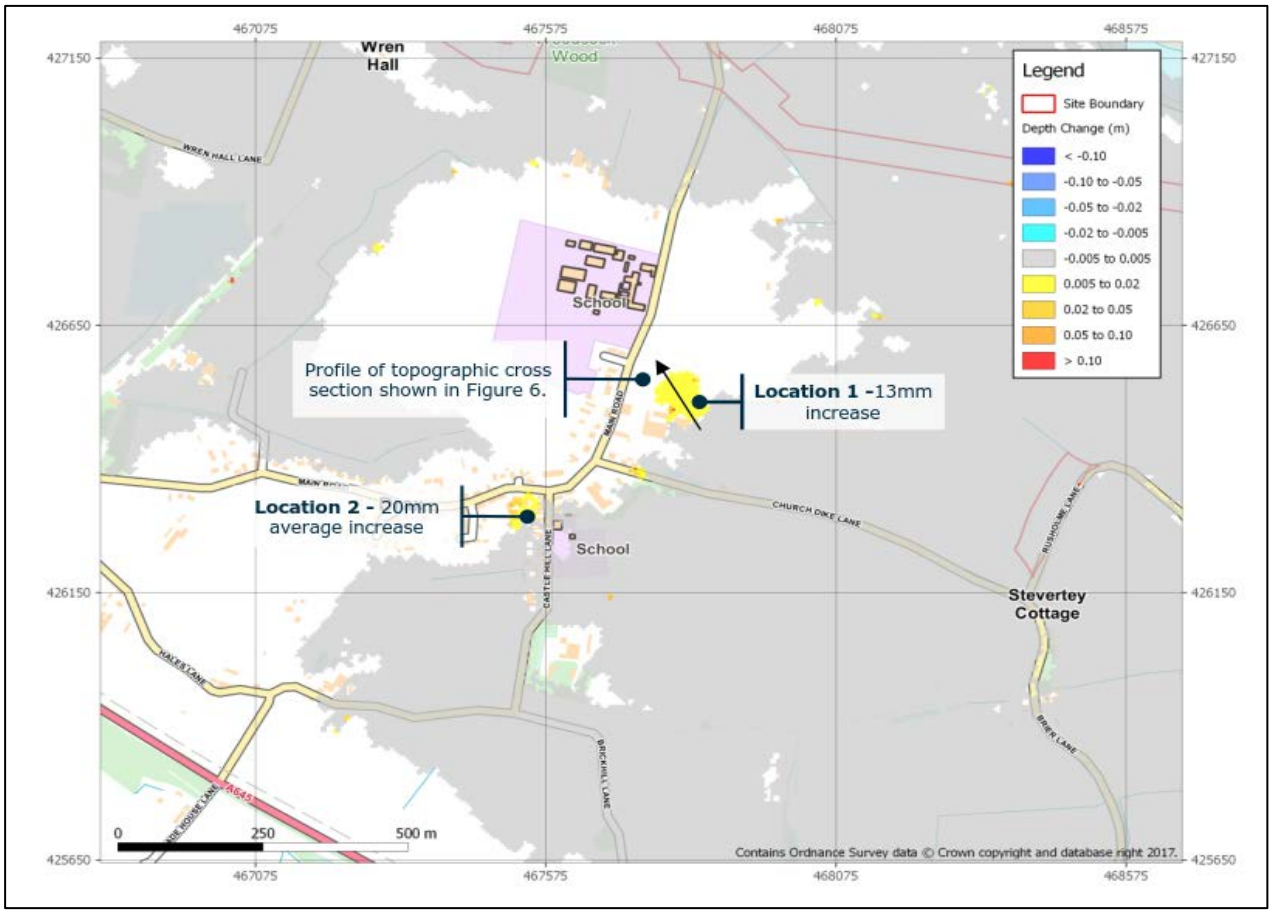


Figure 6 – Post–Development Flood Depth Change

Increased Risk of Flooding Caused by Increase of Impermeable Area

5.2.8. The majority of the proposed construction will take place on land that is already paved or occupied by buildings. Therefore, there will be no increased surface water runoff from these areas.

5.2.9. The proposed AGI with associated access road, GRF, the battery storage unit and the contractor's village area will be constructed on land that is largely unpaved, therefore there is the potential for an increase in the rate and volume of surface water runoff from these areas. The proposed mitigation is discussed in the 'Proposed Mitigation' further down this section and Chapter 6 of this FRA.

New Crossings with Watercourses

5.2.10. The proposed gas pipeline will cross Back Lane Drain, the unnamed IDB's drain reference 18/1 and Rusholme Lane Drain. The new crossings, if not appropriately designed, have the potential to reduce the current capacity of the channels and impact the flows within these watercourses which could result in an increased risk of flooding in the area. The proposed mitigation measures are discussed in the 'Proposed Mitigation' further down this section.

Increased Risk of Flooding to the Proposed Scheme from Surface Water

5.2.11. The EA's Risk of Flooding from Surface Water mappings shows localised areas along the pipeline route and within the boundary of Drax Power Station to be susceptible to flooding

from surface water. It is likely that these areas are associated with localised low ground levels where water would pond during prolonged and heavy rainfall events. The proposed mitigation measures are discussed in the 'Proposed Mitigation' further down this section.

Increased Risk of Flooding to the Proposed Scheme and the Existing Drax Power Station Complex caused by Diversion of North Perimeter Ditch

5.2.12. The battery storage building will be located in the area that is crossed by the North Perimeter Ditch, which is part of the existing drainage system serving Drax Power Station. The diversion of the ditch has the potential to reduce the existing capacity of the channel and therefore increase the risk of flooding to the Proposed Scheme and the Power Station if the diversion channel is not appropriately designed. The proposed mitigation measures are discussed in the 'Proposed Mitigation' further down this section.

5.3 Proposed Mitigation

Construction Phase Mitigation

5.3.1. Site specific flood evacuation procedures will be developed for the construction workers working on the construction of the Gas Pipeline and associated infrastructure. The construction workers undertaking works within the boundary of Power Station Site will follow the existing Drax Power Station Complex flood evacuation procedures in case of flooding. The construction workers will be made aware of potential flood risk and will be familiarised with the flood evacuation procedures.

5.3.2. Appropriate drainage systems and localised amendments to the existing ground levels will be required in the areas of construction works that are indicated to be at risk of surface water flooding, especially in the area of the proposed Unit X and the GRF, and the gas Pipeline route located between New Road and Wren Hall Lane and to the north of Woodcock Wood. It is also recommended that no material is stored and no offices are located in the area of construction compounds indicated to be at risk of flooding from surface water, namely the south-western and the north-eastern part of the main construction compound (Area A) and the area along the northern and eastern boundary of the smaller construction compound (Area B).

5.3.3. Where required, temporary culverts for plant crossings will be sized appropriate to the size of a watercourse to ensure no unacceptable obstruction to the flows and no reduction in the current capacity of the channel. The Selby Area IDB will be consulted to obtain appropriate consent from the IDB for construction of temporary culverts and agree the required sizing parameters.

Post-Development Mitigation

Risk of Flooding to the Proposed Scheme during Breach Scenario

The finished floor levels of the proposed above ground structures will be established a minimum of 600 mm above the flood levels predicted for the 1 in 200 year with climate change breach scenario to ensure that they will remain operational during flood events. The maximum flood levels predicted in the vicinity of the above ground structures of the Proposed Scheme together with the proposed finished floor levels are summarised in Table 11. A plan showing the location of the above ground structures with the predicted flood levels is shown in Figure 7.

Table 11 – Maximum Flood Levels and Proposed Finished Floor Levels

Proposed Structure	Maximum Flood Level (mAOD) during 1 in 200 year with Climate Change Breach Scenario	Proposed Finished Floor Level (mAOD)
Sludge Lagoons	4.52	5.12
Battery Storage Building	4.44	5.04
Unit X and Unit Y with adjacent structures	4.46	5.06
Gas Receiving Facility	4.46	5.06
Above Ground Infrastructure	4.23	4.83
Infrastructure associated with Sub-station/Electrical connectors	4.46	5.06

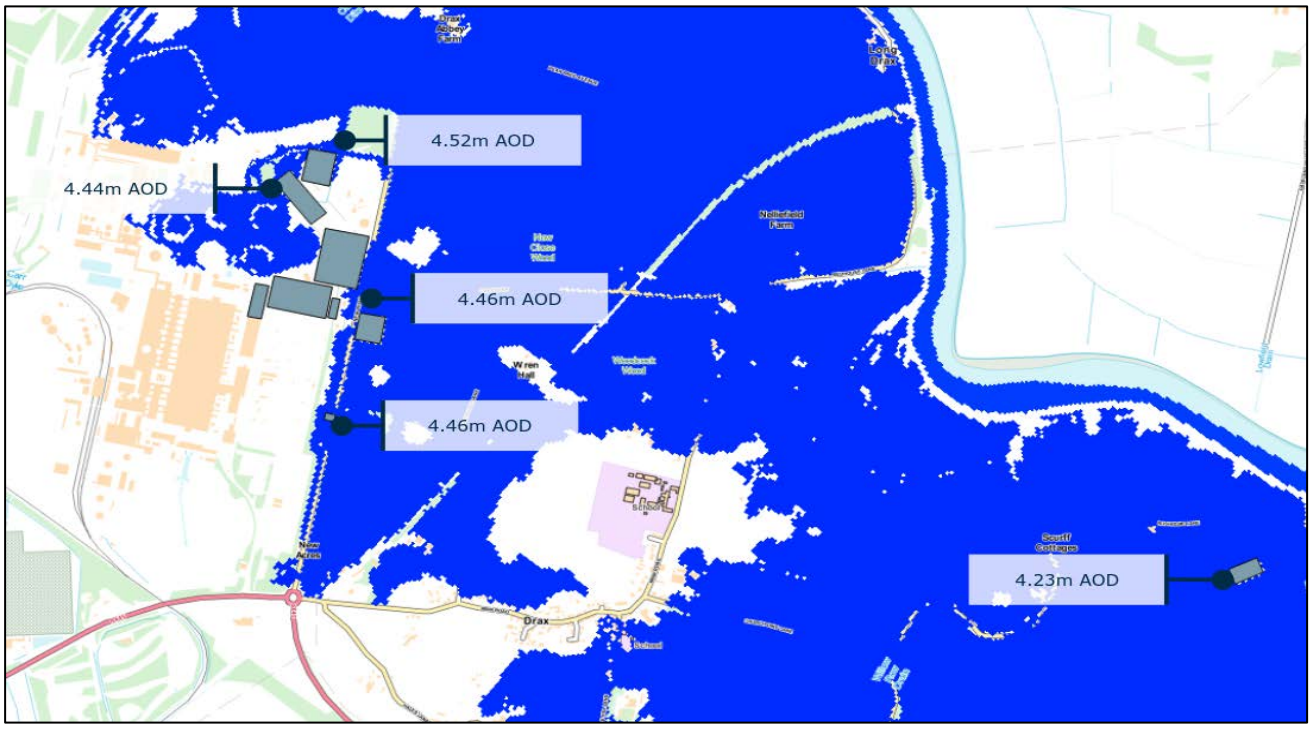


Figure 7 – Maximum Flood Levels in the Vicinity of The Above Ground Structures Predicted for the 1 in 200 year with Climate Change Breach Scenario

Increased Risk of Flooding to People and Properties Caused by Construction of New Structures in the Floodplain

5.3.4. The results of the post-development hydraulic modelling shows that the construction of the Proposed Scheme could result in a localised small increase in flood depth of 13 mm and 20 mm at two locations in Drax village. Mitigation measures were investigated with the aim to

reduce the post-development increase in flood depth to less than 10mm, which is considered the margin of error for TUFLOW hydraulic modelling.

5.3.5. The hydraulic modelling identifies that the proposed sludge lagoons and the battery storage building block the potential flow path of flood water in the northern part of the Power Station Site. The increase in flood depth indicated in the post-development scenario could be mitigated by reinstatement of that flood flow path. The limited space within the Power Station Site does not facilitate relocation of the sludge lagoons and the battery storage building. Therefore, a flood relief channel is proposed to convey the flood flows in a similar way to that identified in the baseline scenario. The modelling has indicated that a channel of minimum 5 m width and depth of 0.75 m is required to convey the flood flows. The channel will be grassed to encourage infiltration and prevent stagnation of water when the flood waters recede. A typical cross section through the channel is shown on drawing reference 70037047-2.5A-C-005 attached in Appendix K. The channel will be designed during the detailed design stage of the Proposed Scheme. The location of the proposed flood relief channel is shown in Figure 8.

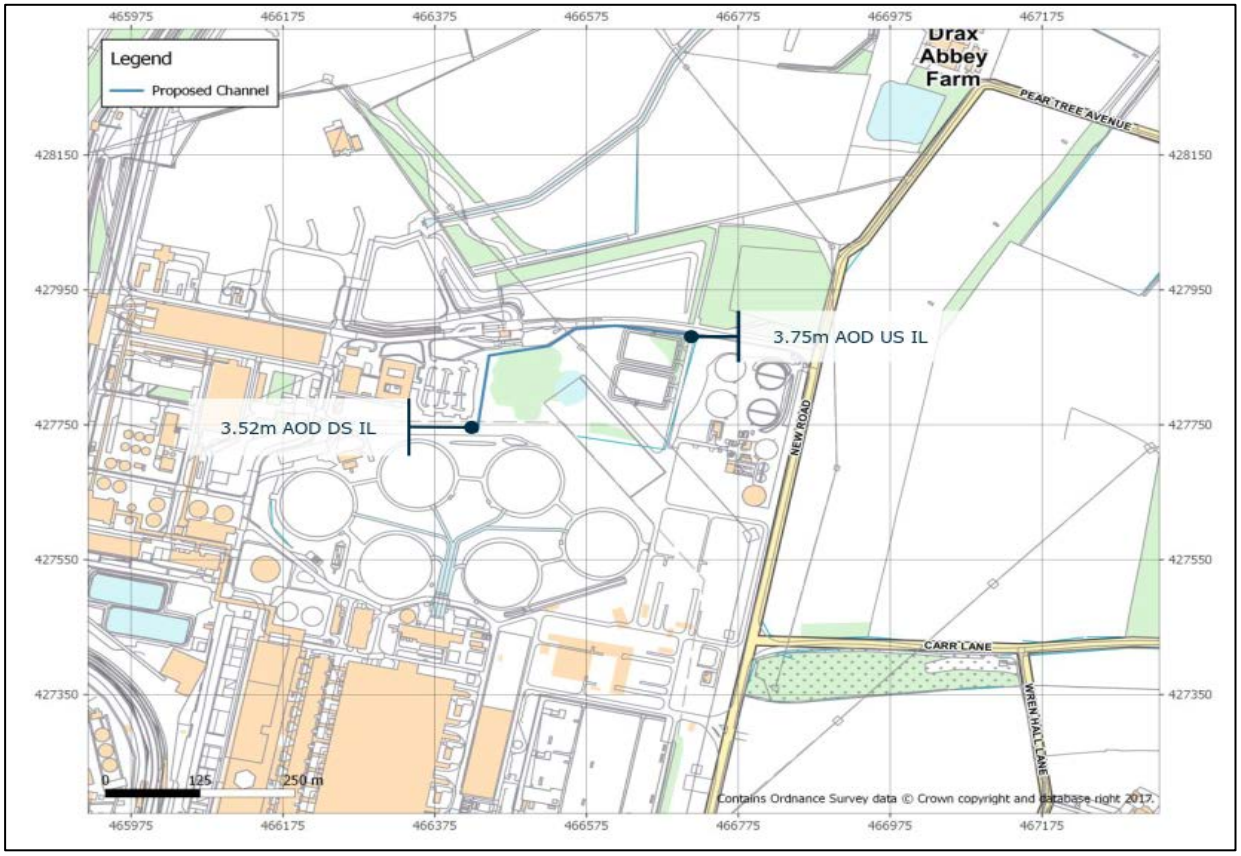


Figure 8 – Location of the Proposed Flood Relief Channel

5.3.6. The proposed flood relief channel was added to the post-development hydraulic model to ensure that the localised increase in flood depth indicated in Drax village for the post-development scenario is not greater than 10 mm. The results of the post-development scenario with the proposed flood relief channel show that the flood flow path in the northern part of the Power Station Site is reinstated and the levels of detriment in flood depth are

reduced to below 10 mm in Drax village. A plan showing the post-development scenario with the mitigated floodplain extent and a plan indicating the location of maximum increased flood depths in Drax village are shown in Figure 9 and Figure 10 respectively.

5.3.7. The results of the post-development scenario with the proposed flood relief channel show no increase in the extent of floodplain in comparison to the future baseline results.

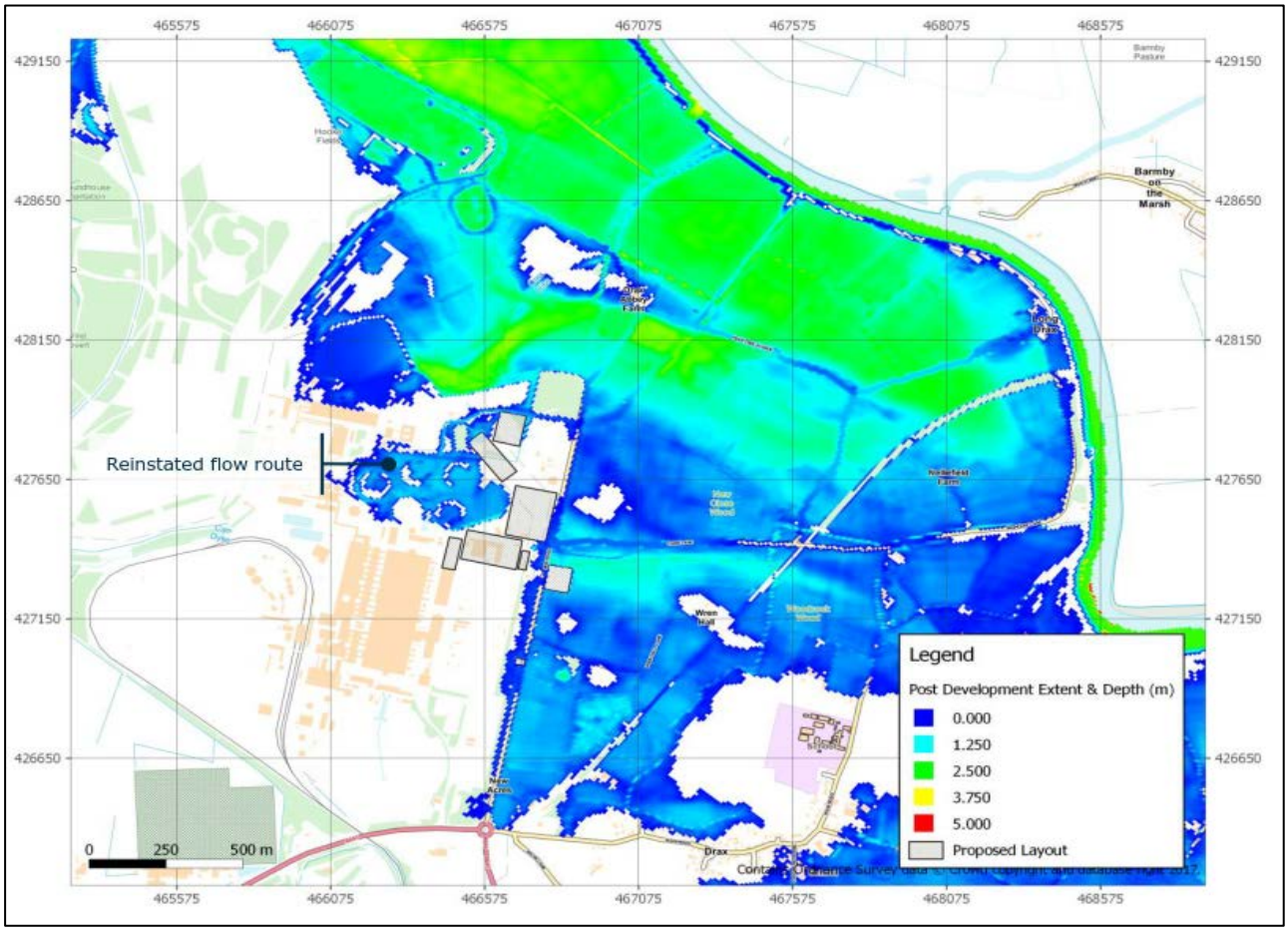


Figure 9 – Post–Development with Mitigation Floodplain Extent

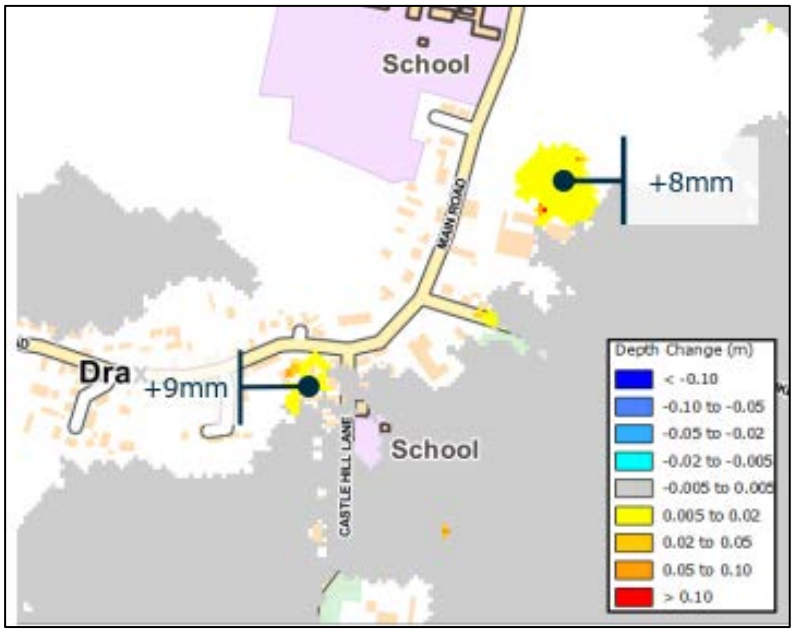


Figure 10 – Post–Development Scenario with Mitigation - Flood Depth Change

5.3.8. Details of the hydraulic modelling, including baseline, post-development and post-development with mitigation scenarios are shown in 'Drax Repower – Hydraulic Modelling Report' shown in Appendix J.

Increased Risk of Flooding Caused by Increase in Impermeable Area

5.3.9. Surface water runoff generated by the Proposed Scheme will be discharged to the existing drainage systems serving Drax Power Station, which discharge via consented outfalls to Carr Dyke or the River Ouse, with the exception of the remote new AGI facility which will discharge to the Dickon Field Drain. Details of the proposed outline surface water drainage strategy are provided in Chapter 6 of this FRA; a brief summary is provided below:

- The proposed outline surface water drainage strategy was prepared in accordance with the advice from the Selby Area IDB.
- Surface water runoff generated in the area of the AGI and the associated access road will be collected, attenuated and routed through an oil separator. The discharge rate for Dickon Field Drain will be limited to pre-development Greenfield runoff rates or 1.4 l/s/ha whichever is lesser.
- Surface water runoff generated in the remaining areas of the Proposed Scheme will be discharged to the existing drainage systems serving the Existing Drax Power Station Complex. The existing discharge rates to Carr Dyke and the River Ouse will remain unaltered.

New Crossings with Watercourses

5.3.10. The new Gas Pipeline will be buried and, in accordance with the requirement of the Selby Area IDB, the new crossings with watercourses will be constructed a minimum of 1 m below the bed of the watercourses. This will ensure the pipelines do not reduce the capacity of the existing watercourses and that the Gas Pipeline will not be damaged during maintenance of the watercourses. The new crossings will therefore not increase the risk of flooding in the area or elsewhere.

Increased Risk of Flooding to the Proposed Scheme from Surface Water

5.3.11. New buildings in the Proposed Scheme will be elevated 600 mm above the flood levels predicted for the 1 in 200 year event with climate change during breach scenario. In addition, the Proposed Scheme will be served by appropriately designed surface water drainage system. The proposed surface water drainage strategy and the finished floor levels proposed for the important elements of the Proposed Scheme will provide adequate mitigation against the increased risk of flooding to the Proposed Scheme from surface water, and no additional mitigation is required.

Increased Risk of Flooding to the Proposed Scheme and the Existing Drax Power Station Complex Caused by Diversion of North Perimeter Ditch

5.3.12. The North Perimeter Ditch will be diverted to the north of its current location to allow for construction of the battery storage building. The diversion channel will be designed to ensure no reduction of the existing capacity of the channel. The diverted ditch is likely to be about 50% longer than the existing North Perimeter Ditch and therefore provide additional capacity within the overall drainage system to ensure there is no increase to the risk of local surface water flooding. The diversion channel is proposed to be combined with the proposed flood relief channel, and to operate as a two-stage channel. The diversion channel is discussed in detail in Chapter 6 'Proposed Surface Water Drainage Strategy'. The location on the proposed diversion channel and a typical cross section through a two stage channel is shown on drawing reference 70037047-2.5A-C-005-A shown in Appendix K.

6 PROPOSED SURFACE WATER DRAINAGE STRATEGY

6.1 Above Ground Installation

6.1.1. The Above Ground Installation (AGI) will be located adjacent to the National Transmission System (NTS) gas pipeline, as shown on Drawing No 70037047-2.5B-C-003 included in Appendix K. It will comprise two small compounds, one to be operated by National Grid and one to be operated by Drax Power Ltd.

6.1.2. The AGI compounds will contain a Minimum Offtake Connection (MOC) and Pipeline Inspection Gauge (PIG) PIG Trap Facility (PTF) and on-site Pressure Reduction and Metering Station (PRMS). No large buildings are proposed. A permanent paved access road will be required from Rusholme Lane, with a turning head and two parking spaces in each compound. The remainder of the compounds will be surfaced with gravel scalpings or a similar non-paved finish.

6.1.3. A surface water drainage scheme will be provided for the new AGI facility to ensure surface water runoff is controlled in accordance with Selby IDB requirements. Essentially, these are that surface water runoff is limited to existing pre-development greenfield runoff rates or 1.4 l/s/ha, whichever is the lesser, and should comply with general pollution prevention guidelines. Selby IDB has indicated that a new surface water discharge can be made into the nearest available IDB watercourse – in this instance Dickon Field Drain - subject to final approval and consent by Selby IDB.

6.1.4. Surface water drainage will be provided for the paved surfaces (access road, turning head and parking spaces), with runoff routed through an oil separator and attenuation storage to a new consented outfall into the adjacent Dickon Field Drain. At this stage, it is envisaged that attenuation storage would be provided in over-sized pipes or a buried tank. An indicative surface water drainage scheme is shown on Drawing No 70037047-2.5B-C-004 in Appendix K.

6.1.5. The surface water drainage system will be managed and maintained by Drax Power Ltd in accordance with the Selby IDB consent.

6.2 Gas Pipeline Route

6.2.1. The gas pipeline route is shown on Drawing No 70037047-2.5B-C-003 in Appendix K. The gas pipeline will be a buried pipeline. No permanent surface water drainage requirements are proposed.

6.2.2. Temporary pumping of groundwater from excavated trenches during construction will require a separate consent from Selby IDB. A separate consent may also be required from the EA under new EA abstraction regulations. These will be included as part of the Construction Environmental Management Plan (CEMP). No separate surface water drainage scheme is required for the gas pipeline route.

6.3 Gas Receiving Facility and Compressor Station

6.3.1. The Gas Receiving Facility (GRF) and compressor station will be located in a fenced compound to the east of New Road, as shown on Drawing No 70037047-2.5B-C-003 in

Appendix K. The GRF will comprise a gas compressor building, associated gas compression apparatus and an access road.

6.3.2. A new surface water drainage scheme will be provided in the GRF compound for the building roof and access road, which will be connected to the Existing Drax Power Station Complex surface water drainage system. At this stage, it is proposed that a connection will be made to the existing surface water drainage culvert running the length of New Road. The New Road culvert drains through the Power Station Site via a network of culverts and open ditches to the main surface water discharge point for the site at the consented outfall to Carr Dike. An indicative surface water drainage scheme in the GRF compound is shown on Drawing No 70037047-2.5B-C-002 (single unit option) and 70037047-2.5A-C-006 (twin unit option).

6.3.3. The surface water drainage system for the GRF compound will be managed and maintained by Drax Power Ltd in accordance with the existing Selby IDB consent.

6.4 Construction of Single Unit Option (Unit X Only)

6.4.1. The proposed site layout for Unit X is shown on Drawing Nos 70037047-2.5B-C-001 and 002 in Appendix K.

6.4.2. Unit X will comprise two gas turbines and two Heat Recovery Steam Generators (HRSG) and a 100MW Battery Storage Facility (BSF). All permanent construction will be within the Drax Power Station site on land that is already paved or built upon and serviced by existing surface water drainage. Much of the existing surface water drainage within the areas will become redundant and removed to clear the site for the new construction. However, some existing surface water drainage in the areas will need to be retained and diverted locally to the north and south of the proposed Unit X construction area.

6.4.3. A new surface water drainage scheme will be provided, as required, to service the new Unit X buildings and associated paved access and service areas surrounding the facilities. The new drainage will connect locally into the existing surface water drainage network for the Drax Power Station Complex. No additional surface water runoff is envisaged from the gas turbine and HRSG areas, as these areas are already paved with impermeable surfaces, or covered by existing buildings, and drain via the existing surface water drainage system.

6.4.4. A new surface water drainage scheme will be provided for the BSF which could form part of the new surface water drainage scheme for Unit X. The BSF and service road will be constructed on land that is currently largely unpaved. In addition, the existing North Perimeter Ditch and main surface water carrier drains are routed through this area along with the existing Coal Store Drain to the sludge lagoons. It will be necessary to divert these outside the proposed construction area. A permanent flood relief channel is proposed to be routed around the north and west of this area. It is proposed that the North Perimeter Drain is diverted along the same route as the flood relief channel and that the two channels are combined to form a two-stage channel arrangement. This will increase the length of the North Perimeter Ditch and provide additional attenuation storage capacity. An indicative surface water drainage scheme is shown on Drawing Nos 70037047-2.5B-C-001 and 002. All new surface water drainage for Unit X will be managed and maintained by Drax Power Ltd in accordance with the existing drainage consents.

6.4.5. Surface water runoff for temporary construction laydown areas will be managed locally via the CEMP, with runoff either piped by gravity, or pumped if necessary, back to the existing Drax surface water drainage network.

6.4.6. Overall, surface water runoff arising from the construction of Unit X can be managed within the existing surface water drainage regime so as not to increase the surface water discharge from the site

6.5 Construction of Twin Unit Option (Unit X and Unit Y)

6.5.1. The proposed site layout for Unit X and Unit Y is shown on Drawing Nos 70037047-2.5A-C-005 and 006 in Appendix K.

6.5.2. Unit Y will replicate the components of Unit X and will be constructed consecutively rather than concurrently. It is anticipated that there would be a gap of one year between construction periods but this could be longer depending on commercial considerations.

6.5.3. The surface water drainage scheme for Unit X will already be in place when Unit Y is constructed. Additional surface water drainage will be provided for Unit Y, which could form part of the Unit X surface water drainage or be provided separately. In either case, all new surface water drainage for Unit Y will connect locally into the existing surface water drainage network for the Drax Power Station Complex and be managed and maintained by Drax Power Ltd in accordance with the existing consented discharges.

6.5.4. The proposed location of Unit Y will require the existing sludge lagoons to be moved and the diversion of the existing pumping main from the Primary Surface Water Common Plant Pumping Station to the Purge Pump House. All other existing surface water drainage in this area will become redundant.

6.5.5. An indicative surface water drainage scheme for the twin unit option is shown on Drawing Nos 70037047-2.5A-C-005 and 006.

6.5.6. Surface water runoff for temporary construction laydown areas will be managed locally via the CEMP, with runoff either piped by gravity, or pumped if necessary, back to the existing Drax surface water drainage network.

6.5.7. Overall, surface water runoff arising from the construction of Units X and Y can be managed within the existing surface water drainage regime so as not to increase the surface water discharge from the site.

6.6 Area H – Site Contractor Village

6.6.1. The proposed layout of the site contractor village is shown on Drawing No 70037047-2.5B-C-007 in Appendix K.

6.6.2. The proposed site contractor village will be located on land surrounding the southern half of the south cooling towers. It will comprise contractors' site offices, welfare, storage compounds and parking areas. The land is already partially paved to provide site access roads and parking and storage areas. It is estimated that the facilities will cater for about 250 site personnel.

6.6.3. Existing surface water drainage is present around the cooling towers, draining approximately 50% of the area to the western drainage systems and 50% to the eastern systems. The western drainage system drains by gravity through open ditches and carrier pipes to the

existing Coal Drain Sump Pumps 41A and 41B, and is pumped from there to the Ash Lagoons and East Settlement Lagoons. Most of this water is re-used in the cooling water make-up, with the excess passed to the Purge Pump Chamber. The eastern drainage system drains by gravity via open ditches and carrier pipes to the North Perimeter Ditch. Existing foul drainage is also present in the area, just to the south west of the south station entrance, which currently drains by gravity to an existing foul pumping station (identified as FPS 1A) located to the south of cooling towers 1A and 1B. All drainage is within the existing Drax Power Station Complex and maintained by Drax Power Ltd.

6.6.4. It is proposed that surface water runoff from the contractor village continues to drain to the eastern and western drainage systems in a similar manner to the existing drainage in this area. Additional local connections will be made where required to drain the contractor village areas. The existing ditches may be culverted where the alignment protrudes into the proposed village area. A new ditch will be provided for the additional parking spaces created to the south of the site access road. Fuel storage areas will be bunded, with fuel handling areas drained through Class 1 oil separators in accordance with the existing site measures for pollution control. All new surface water drainage will be operated and maintained by Drax Power Ltd.

6.6.5. Separate foul drainage will be provided, with foul effluent from toilets and welfare facilities in the contractor village drained to the existing foul drainage network. A new foul pumping station is proposed to the south west of the south station entrance (at location 'X' shown on Drawing No 70037047-2.5B-C-007) as part of a planned upgrade of the foul drainage system in this area. The new foul pumping station will pump to the existing foul pumping station FPS 1A. From here effluent is pumped to the existing on-site sewage treatment plant. All new foul drainage, including the new foul pumping station, will be operated and maintained by Drax Power Ltd.

6.6.6. An indicative surface water drainage scheme is shown on Drawing No 70037047-2.5B-C-007.

7 SEQUENTIAL TEST

7.1 Sequential Test

7.1.1. The NPPF recommends that the risk-based Sequential Test should be applied by the Local Planning Authority when considering applications for new development. Its aim is to steer new development to areas at the lowest risk of flooding (Flood Zone 1). Where this is not possible, higher risk flood zones can be considered, but in the context of flood risk vulnerability classification and the possible application of the Exception Test.

7.1.2. Selby District Council confirmed (February 2018) that as the proposed development is part of the existing Power Station, therefore the proposal could not be located somewhere else and the Sequential Test does not need to be carried out. However the sequential approach should be considered in the design process.

7.1.3. The EA advised that only the 'defended scenario' and the 'breach scenario' should be considered in this assessment as the EA do not plan to remove the existing flood defences. Considering the crest levels of the existing flood defences, the area of the Proposed Scheme is protected for up to the 1 in 200 year flood event.

7.1.4. The results of the 'breach scenario' show the area of the proposed battery building and sludge lagoons may be flooded during a 1 in 200 year breach event with climate change. The area of the existing Drax Power Station is heavily developed with very limited areas of not-developed land that can be used for further improvements. The proposed location of the new battery building and the new sludge lagoons was therefore chosen considering the space available within the boundary of the Power Station. In addition, the decision on the location of the new battery building and the sludge lagoons was also influenced by the requirement of where these features should be located in relation to the existing infrastructure that needs to be linked to the proposed features.

7.1.5. The results of the 'breach scenario' shows that the southern part of the Power Station area, where rearrangement of the existing infrastructure is proposed to be carried out, is located in the area that would not be flooded during the 1 in 200 year breach event with climate change.

7.1.6. Similarly to the Power Station, the new gas pipeline route and the associated infrastructure are located in the area that is protected by the existing flood defences for up to the 1 in 200 year flood event. The location of the AGI was chosen to suit the existing gas main infrastructure located in the vicinity of Rusholme Grange on the right bank of the River Ouse. The results of the hydraulic modelling of the breach scenario show that the vast majority of the area to the east of the Power Station Site may be flooded during the 1 in 200 year breach event with climate change allowance. Considering this information, the new pipeline could not be located in the area with lower risk of flooding.

7.2 Exception Test

7.2.1. In accordance with Table 2 of the Planning Practice Guidance 'Flood Risk and Coastal Change', the proposed development is considered as 'essential infrastructure'. In accordance with Table 3 of the same guidance, essential infrastructure can be located in Flood Zone 3, but the Exceptional Test should be carried out.

7.2.2. In accordance with the NPPF for the Exception Test to be passed:

- It must demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk.
- A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

7.2.3. The Proposed Scheme is an improvement to the existing Power Station, and therefore it cannot be located in a different area. The Proposed Scheme consists of conversion of the power plant units that are currently running on coal, into units that are running on gas. The proposal provides a sustainable approach to the production of energy, which is less harmful to the environment.

7.2.4. The Proposed Scheme will be constructed as part of the existing power plant, therefore appropriate flood emergency procedures are already in place. In addition, the finished floor levels of the proposed structures will be established 600 mm above the flood levels that may occur during the 1 in 200 year breach scenario with climate change allowance to ensure that these elements will remain operational. The results of the hydraulic modelling of the post-development scenario with the proposed mitigation in the form of a flood relief channel shows that construction of the proposed structures is unlikely to increase the risk of flooding elsewhere.

7.2.5. Considering the information provided in the paragraphs above, the Proposed Scheme fulfils the requirements of the Exception Test.

8 CONCLUSIONS

8.1 Existing Flood Risk

8.1.1. The EA's Flood Map for Planning shows that the area of the Proposed Scheme is located partially in Flood Zone 2 and partially in Flood Zone 3. During consultation the EA confirmed that the area of the Proposed Scheme and its surroundings are protected up to the 1 in 200 year event by the flood defences located along the banks of the River Ouse. There is however residual risk associated with a breach of the flood defences. A breach of the existing flood defences is unlikely to happen as they are regularly inspected and maintained by the EA to ensure an appropriate level of protection.

8.1.2. The River Ouse at the location of the Proposed Scheme is tidally influenced. The risk of flooding in this area is therefore a combination of fluvial and tidal flooding, with tidal being the dominant source. A 2D TUFLOW hydraulic model of a breach of the existing flood defences was undertaken for the future baseline scenario as part of this FRA. The model was run for the 1 in 200 year event with the 50 year climate change allowance along with a 1 in 5 year fluvial event. The design life of the Proposed Scheme is 25 years, therefore the 50 year climate change allowance provides a very conservative approach. The results of the future baseline hydraulic modelling shows that the area of the pipeline route and the northern part of the Power Station Site could be flooded during the unlikely breach scenario.

8.1.3. The EA Flood Risk from Surface Water mapping shows localised areas along the pipeline route and within the boundary of the Power Station Site to be susceptible to flooding from surface water. The indicated areas at risk of flooding are likely to be associated with the localised lower ground levels where water would pond during or after prolonged and heavy rainfall events.

8.1.4. The area of the Proposed Scheme is considered to be at low risk of flooding from groundwater, sewers and reservoirs.

8.2 Flood Risk during Construction

8.2.1. The most notable potential risk of flooding during construction is associated with a breach of the existing flood defences. The hydraulic modelling undertaken as part of this FRA indicated that the proposed construction compounds (Areas A and B and potential compounds that may be required along the pipeline route) are located in the area indicated to be at risk of flooding during the unlikely breach of the existing flood defences. Appropriate flood evacuation procedures will be developed for construction works along the pipeline route. Construction workers working within the boundary of the Power Station Site will follow the existing Drax Emergency Plan.

8.2.2. The area of the proposed Unit X and along the proposed Gas Pipeline route, especially in the area between New Road and Wren Hall Lane and to the north of Woodcock Wood, are at risk of flooding from surface water. The south-western and the north-eastern part of the main construction compound (Area A) and the area along the northern and eastern boundary of the smaller construction compound (Area B) are also indicated to be susceptible to flooding from surface water. The potential risk to construction works will be mitigated by provision of appropriate drainage systems and potential localised amendments to the existing ground

levels. It is also recommended that no materials and plant are stored and no offices are located in these areas of the construction compounds which are indicted to be at risk of flooding.

8.2.3. The ground levels will be reinstated once the works are completed to ensure no reduction of the floodplain storage during the unlikely breach scenario.

8.3 Post-Development Flood Risk Management

New Structures in Floodplain

8.3.1. Hydraulic modelling of the post-development breach scenario was undertaken to support this FRA. The results of the hydraulic modelling shows no increase in the extent of floodplain in comparison with the future baseline results. However the results show a small and localised increase in flood depth of 13 mm and 20 mm at two locations in Drax village. Although the breach scenario is considered unlikely, further mitigation was investigated.

8.3.2. To mitigate the potential increase in flood depth at Drax village, a flood relief channel will be constructed in the northern part of the Power Station Site. The flood relief channel was represented in the 2D breach model to ensure it would provide appropriate mitigation. The results show that the potential increase in flood depth indicated at the two locations in Drax village was reduced to less than 10 mm, which is considered as the margin of error for TUFLOW hydraulic modelling. The construction of the proposed flood relief channel is considered to provide sufficient and satisfactory level of mitigation.

Surface Water Runoff Management

8.3.3. Surface water runoff from all new development within the Power Station Site will be collected, stored, treated (as necessary) and managed via the existing surface water drainage regimes and discharged from the site via the existing consented outfalls.

8.3.4. The majority of the proposed construction will take place on land that is already paved or occupied by buildings. Therefore, there will be no increased surface water runoff from these areas. Where new construction is proposed on land that is currently unpaved, increased surface water runoff will be managed either within the existing surface water drainage system or the provision of additional new drainage ditches, over-sized pipes or buried storage tanks.

8.3.5. Where a new surface water discharge is required outside the Power Station Site for the AGI facility, on land that is currently farm land, additional surface water runoff from paved surfaces will be collected and routed through an oil separator and attenuation facility to a new outfall into the Dickon Field Drain. A new consent application will be made to Selby IDB for this discharge.

8.3.6. The proposed surface water runoff management will ensure no increase in the flood risk in the area or elsewhere.

Risk of Flooding to the Proposed Scheme

8.3.7. The Proposed Scheme is considered as ‘essential infrastructure’ and should remain operational during flood events. The proposed finished floor level of the proposed structures will be established 600 mm above the flood levels predicted for the 1 in 200 year event with

climate change allowance during the post-development with mitigation breach scenario. The proposed approach to finished floor levels is considered to provide satisfactory mitigation to ensure that the Proposed Scheme will remain operational during the flood event.

New Crossings with Watercourses

8.3.8. In accordance with the requirements of the Selby Area IDB, the new pipeline crossings with watercourses will be constructed a minimum of 1 m below the bed of the watercourses. The new crossings will not interfere with the flow of the watercourse and will not impact the current capacity of the channels, therefore they will not increase the risk of flooding in the area or elsewhere.

Diversion of North Perimeter Ditch

8.3.9. The diversion channel will be designed to match the capacity of the existing channel to ensure no change to the existing drainage system. The proposed diversion of the North Perimeter Ditch will not increase the risk of flooding in the area.

8.4 The Sequential Test and the Exception Test

8.4.1. The Proposed Scheme is part of the Existing Drax Power Station Complex and therefore cannot be located elsewhere. The sequential approach was considered during the design of the Proposed Scheme.

8.4.2. The Proposed Scheme consists of conversion of the power plant units that are currently running on coal, into units that are running on gas. The Proposed Scheme provides sustainable approach to production of energy, which is less harmful to the environment.

8.4.3. The Proposed Scheme will be constructed as part of the existing power plant, therefore appropriate flood emergency procedures are already in place. In addition, the finished floor levels of the proposed structures will be 600 mm above the flood levels that may occur during the 1 in 200 year breach scenario with climate change allowance to ensure that these elements will remain operational during the unlikely breach scenario. The results of the hydraulic modelling of the post-development scenario with the proposed flood relief channel shows that construction of the proposed structures is unlikely to increase the risk of flooding elsewhere.

8.4.4. Considering the information provided in the paragraphs above, the Proposed Scheme fulfils the requirements of the Exception Test.

APPENDIX A: SITE LOCATION

APPENDIX B: PROPOSED SITE LAYOUT – ONE UNIT OPTION

APPENDIX C: PROPOSED SITE LAYOUT – TWO UNIT OPTION

APPENDIX D: CONSULTATIONS

APPENDIX E: SURFACE WATER FEATURES

APPENDIX F: DRAX POWER STATION EXISTING DRAINAGE

APPENDIX G: HISTORICAL FLOODING

APPENDIX H: EA FLOOD MAP

APPENDIX I: EXISTING FLOOD DEFENCE

APPENDIX J: HYDRAULIC MODELLING REPORT

APPENDIX K: PROPOSED SURFACE WATER DRAINAGE STRATEGY