



Great Heck Mining Subsidence Remediation Works Environmental Impact Assessment

Environmental Statement

June 2017

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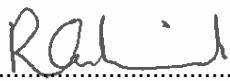
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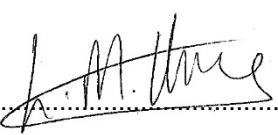
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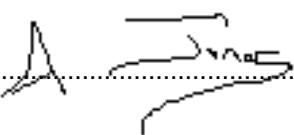
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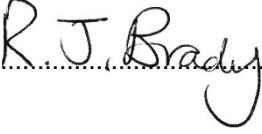
Contract

This report describes work commissioned by Danvm Drainage Commissioners, on behalf of The Coal Authority, by an email dated 19th September 2016. Laura Thomas, Rob Dalziel, Jenny Pullen, Helen Archer, Alex Jones, Brendon McFadden, Catherine Porter and Chris Toop of JBA Consulting carried out this work.

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Purpose

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Abbreviations

AOD	Above Ordnance Datum
AWB.....	Artificial Water Body
BAP	Biodiversity Action Plan
BCT	Bat Conservation Trust
BTO.....	British Trust for Ornithology
CEH	Centre for Ecology and Hydrology
CHA	Cultural Heritage Assessment
CiFA	Chartered Institute for Archaeologists
CMS	Construction Method Statement
CROW.....	Countryside Rights of Way
DEFRA.....	Department for Environment, Food and Rural Affairs
DNA	Deoxyribonucleic acid
EA	Environment Agency
EC	European Community
eDNA	Environmental Deoxyribonucleic acid
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
ENY.....	Event Number NYHER
EPS.....	European Protected Species
ERYBAP	East Riding of Yorkshire Biodiversity Action Plan

ES	Environmental Statement
FAS	Field Archaeology Specialists
FEH	Flood Estimation Handbook
FERA	Food and Environment Research Agency
ha	hectare
HMWB.....	Heavily Modified Water Body
HSI	Habitat Suitability Index
IDB	Internal Drainage Board
IEMA	Institute of Environmental Management and Assessment
IGS	Institute of Geological Sciences
JBA	Jeremy Benn Associates
JNCC	Joint Nature Conservation Committee
LB.....	Listed Building
LBAP	Local Biodiversity Action Plan
LIDAR	Light Detection And Ranging
LNR.....	Local Nature Reserve
LWS	Local Wildlife Site
MAGIC	Multi Agency Geographic Information for the Countryside
MNY	North Yorkshire Monument No.
NCA	National Character Area
NERC.....	Natural Environment and Rural Communities
NEYEDC	North and East Yorkshire Ecological Data Centre
NGR	National Grid Reference
NIA	Nature Improvement Area
NMP	National Mapping Programme
NMR	National Monument Record
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NPPG.....	National Planning Practice Guidance
NTS.....	Non-technical Summary
NYHER	North Yorkshire Historic Environment Record
OS.....	Ordnance Survey
PPG	Pollution Prevention Guidelines
PFR.....	Potential Roosting Feature
PRoW.....	Public Right of Way
PWS.....	Public Water Supply
RBD	River Basin District
RBMP.....	River Basin Management Plan
RSPB	Royal Society for the Protection of Birds
RSS.....	Regional Spatial Strategy

SAAR	Standard Average Annual Rainfall
SAC.....	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SINC	Site of Importance for Nature Conservation
SM.....	Scheduled Monument
SPA.....	Special Protection Area
SPR.....	Source - Pathway - Receptor
SPT	Standard Penetration Test
SPZ	Source Protection Zone
SSSI.....	Site of Special Scientific Interest
UID.....	National Monument Record Unique identifier
WeBS.....	Wetland Bird Survey
WFD	Water Framework Directive
WYAS	West Yorkshire Archaeological Services

1 Introduction and Background

1.1 Introduction

The area around Great Heck, south of Selby, North Yorkshire (see Figure 1-1), has been affected by mining subsidence arising from activities carried out by UK Coal Mining Ltd. Panels of coal have been extracted from the Kellingley Colliery Coalfield underneath the area of Great Heck, High Eggborough and Whitley. The subsidence from the mining has affected the existing land drainage regime and this has led to increased susceptibility to flooding and waterlogging of land, affecting its agricultural productivity. The total catchment area affected by the mining subsidence south of the canal is 495ha.

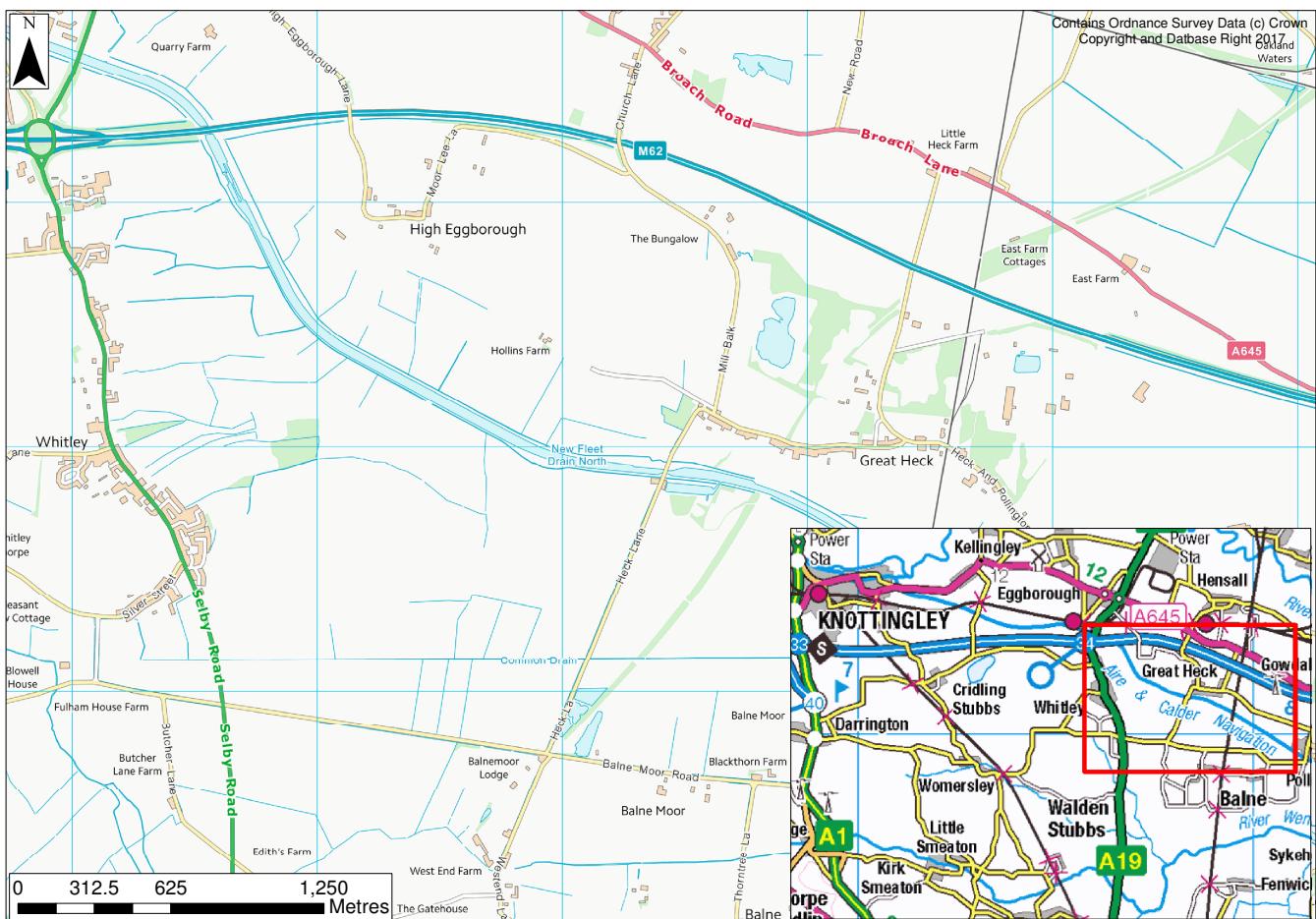


Figure 1-1: Location Map

Under the Coal Mining Subsidence Act 1991 and Doncaster Area Drainage Act 1929, The Coal Authority, and formerly UK Coal Mining Ltd, has obligations to repair the drainage of the catchment area to the reasonable satisfaction of the claimant, i.e. that the flood incidence levels should be returned, as far as is reasonably practicable, to the pre-mining levels.

The Danvrm Drainage Commissioners, as the drainage authority for the area, have been instructed by The Coal Authority to undertake remediation works on their existing drainage infrastructure which has been affected by subsidence.

This Environmental Statement (ES) has been prepared under the Environmental Impact Assessment (Land Drainage Improvement Works) Regulations 1999, as amended by the Environmental Impact Assessment (Land Drainage Improvement Works) (Amendment) Regulations 2017, to assess the potential impact of drainage remediation works on the environment.

The ES is structured as follows:

- Volume 1 – A Non-Technical Summary (NTS) providing a summary of the scheme and the key conclusions of the assessments
- Volume 2 – The ES containing the Environmental Impact Assessments describing the potential significant impacts of the proposed scheme
- Volume 3 – Appendices containing materials used to support or produced by the Environmental Impact Assessments, including associated figures and survey results

1.2 Project History

The Danum Drainage Commissioners have planned to undertake remedial works to the drainage network in the Great Heck area for a considerable period of time. However, implementation of the works has been postponed on a number of occasions due to funding limitations and following UK Coal Mining Ltd entering administration in summer 2013. Following this, responsibility for remediation of mining subsidence was handed-over to The Coal Authority.

The potential environmental impacts of drainage remediation works at Great Heck were first assessed in 2008, with surveys and assessments continuing periodically until April 2012 when an ES for a remediation scheme was produced and consulted on. This followed production of, and consultation on, a Scoping Report in August 2009. However, following completion of the consultation period on the ES the project was postponed and no works went ahead on site.

In Autumn 2016, following transfer of obligations to remediate mining subsidence to The Coal Authority, the Danum Drainage Commissioners again began work to re-examine the scheme and progress with remediation works to the drainage network. Given that a significant period has elapsed since the first ES was produced and consulted upon, and that changes have been made to the scheme, this new ES has been produced to reflect those changes, along with other changes in policy and legislation since 2012. However, given that the works location is unchanged, as has the general nature of the site and broad scope of works, it is considered that the conclusions of the Scoping Report produced in August 2009 are still valid (JBA Consulting, 2009), and it is upon that Scoping Report that the content of this new ES is based.

1.3 Site Location

The area affected by mining is bounded by the M62 to the north, the East Coast Mainline to the east, Balne Moor Road to the South and the village of Whitley to the west. Panels have been worked as indicated on Figure 1-2 and mining operations are now complete.

The effects of mining in this area are evident in the drainage system where static water can be found in low lying depressions within the agricultural fields adjacent to the canal, along with disrupted gradients on the drains in the area, preventing water from flowing in its intended direction.

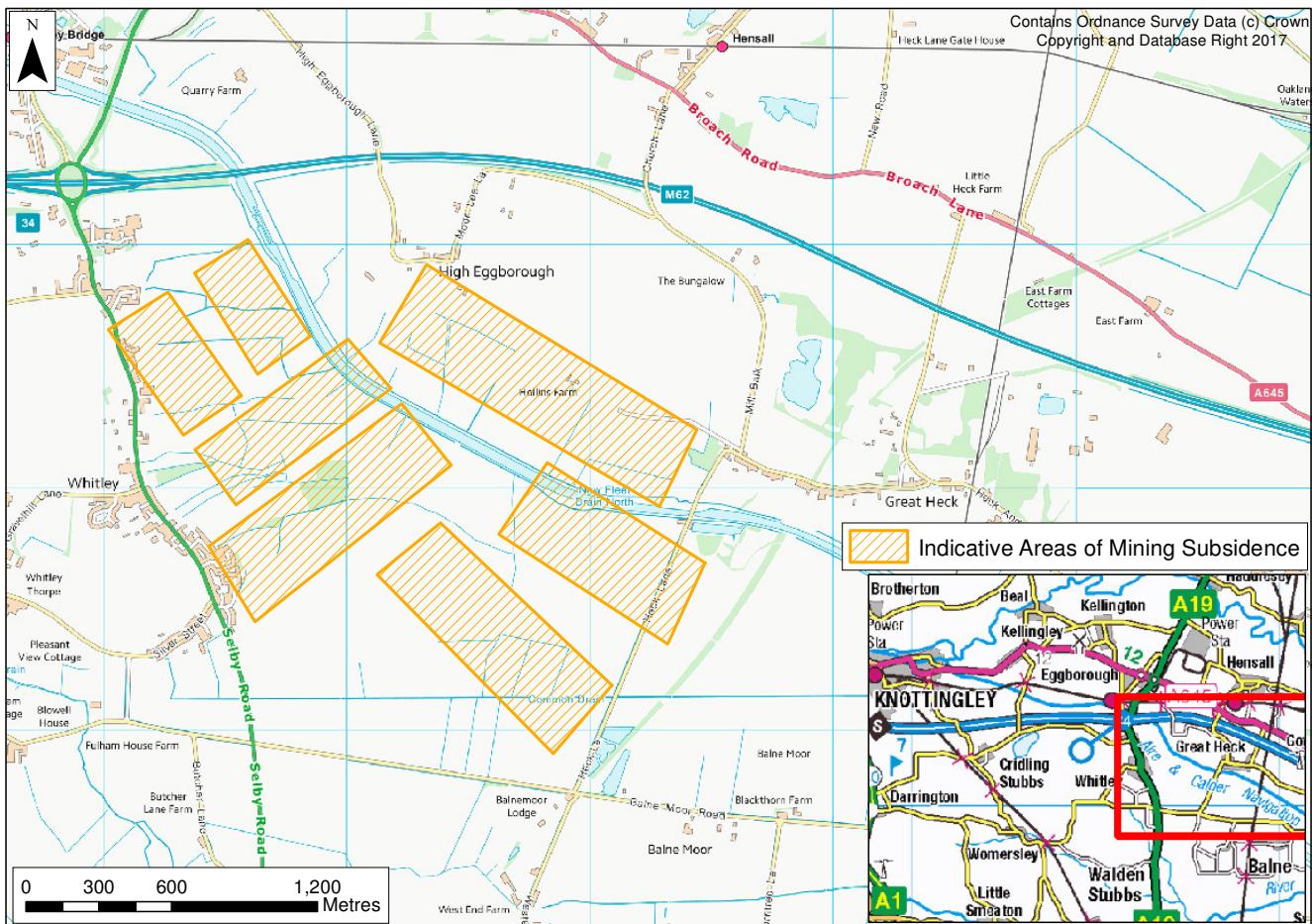


Figure 1-2: Indicative Areas of Mining Subsidence

1.4 Legislative Context

The proposed works to remediate the effects of mining subsidence on the land drainage system within the Great Heck area fall under the Land Drainage Act 1991 and the Coal Mining Subsidence Act 1991.

The Coal Mining Subsidence Act 1991 places a duty on The Coal Authority to take remedial action to land or buildings caused by the withdrawal of support by lawful mining operations.

Under the terms contained in the above Acts, The Coal Authority has agreed to reimburse the Danvm Drainage Commissioners the cost of carrying out the works using their powers as a drainage authority under the Land Drainage Act 1991. Under this act all IDBs have the power to undertake works to improve and maintain existing drainage systems within their district, and also construct new works (e.g. watercourses, pumping stations) required for drainage of any land.

The proposed works fall within the category of Class A Permitted Development under Part 14 of Schedule 2 of the Town and Country Planning (General Permitted Development) Order 1995, provided the works are undertaken by the Danvm Drainage Commissioners.

2 Approach to Environmental Impact Assessment

2.1 Introduction

Environmental Impact Assessment (EIA) is a process which identifies the environmental impacts (both adverse and beneficial) of a proposed development. It ensures that the importance of these impacts, and the opportunity for reducing any adverse impacts, are properly considered as part of the design development process and are understood by the public, statutory authorities and other interested parties. EIA helps to prevent, reduce and offset adverse environmental impacts and ensures that environmental issues can be taken into account during the design of the scheme.

2.2 Legislative Requirements for EIA

EC Directive 85/337/EEC '*on the assessment of the effects of certain public and private projects on the environment*' (since amended by 97/11/EC, 2003/35/EC and 2011/92/EU) requires that an EIA is undertaken for certain types and scales of development that have the potential to cause significant impacts on the environment. The purpose of the Directive is to ensure that decision making bodies have sufficient information on likely significant effects when deciding whether or not such a project should be allowed to proceed.

The requirements of the EIA Directive have been applied to drainage bodies through the Environmental Impact Assessment (Land Drainage Improvement Works) Regulations 1999, as amended by the Environmental Impact Assessment (Land Drainage Improvement Works) (Amendment) Regulations 2017. These Regulations apply only to drainage bodies carrying out specified "improvement works". Improvement works are defined as:

"works which are, in England -

- *(i) the subject of a project to deepen, widen, straighten, or otherwise improve or alter, any existing watercourse or remove or alter mill dams, weirs, or other obstructions to watercourses, or raise, widen, or otherwise improve or alter, any existing drainage work; and*
- *(ii) permitted development by virtue of Class C or Class D of Part 13 (water and sewerage) of Schedule 2 to the Town and Country Planning (General Permitted Development) (England) Order 2015(11)"*

Schedule 2 of the Regulations outlines the selection criteria for determining whether "improvement works" are likely to have significant effects on the environment. This includes consideration of the characteristics and location of the improvement works, and the characteristics of the potential impact.

Due to the scale and environmental sensitivity of the area likely to be affected by the proposed Great Heck mining subsidence remediation works, it was determined that there was the potential for the works to have significant effects on the environment, and therefore the Danvrm Drainage Commissioners are obliged to prepare an ES.

2.3 Requirements of an EIA

The requirements, or scope, of an ES are set out in Schedule 1 of the EIA Regulations. These requirements are detailed in Table 2-1 below, with cross references provided to the relevant ES chapters.

Table 2-1: Requirements of the EIA Regulations and Locations in the ES

Requirement of EIA Regulations	Location in ES
1. A description of the improvement works, including in particular— (a) a description of the location of the improvement works; (b) a description of the physical characteristics of the whole of the improvement works, including, where relevant, requisite demolition works, and the land-use requirements during the construction and operational phases; (c) a description of the main characteristics of the operational phase of the	Section 3.2

Requirement of EIA Regulations	Location in ES
improvement works (in particular any production process), for instance, energy demand and energy used, nature and quantity of the materials and natural resources (including water, land, soil and biodiversity) used; (d) an estimate, by type and quantity, of expected residues and emissions (such as water, air, soil and subsoil pollution, noise, vibration, light, heat, radiation) and quantities and types of waste produced during the construction and operation phases.	
2. A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the drainage body, which are relevant to the proposed improvement works and their specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.	Section 3.3
3. A description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the improvement works as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge.	Chapters 4, 0, 6 and 7
4. A description of the factors specified in regulation 12(2) likely to be significantly affected by the improvement works: population, human health, biodiversity (for example fauna and flora), land (for example land take), soil (for example organic matter, erosion, compaction, sealing), water (for example hydromorphological changes, quantity and quality), air, climate (for example greenhouse gas emissions, impacts relevant to adaptation), material assets, cultural heritage, including architectural and archaeological aspects, and landscape.	Chapters 4, 0, 6 and 7
(5). A description of the likely significant effects of the improvement works on the environment resulting from, among other things— (a) the construction and existence of the improvement works, including, where relevant, demolition works; (b) the use of natural resources, in particular land, soil, water and biodiversity, considering as far as possible the sustainable availability of these resources; (c) the emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste; (d) the risks to human health, cultural heritage or the environment (for example due to accidents or disasters); (e) the cumulation of effects with other existing or approved improvement works or projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources; (f) the impact of the improvement works on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the improvement works to climate change; (g) the technologies and the substances used.	Chapters 4, 0, 6 and 7
6. The description referred to in paragraph 4 of the likely significant effects on the factors specified in regulation 12(2) must cover the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the improvement works. That description must take into account the environmental protection objectives established at EU or member State level which are relevant to the improvement works.	Chapters 4, 0, 6 and 7
7. A description of the forecasting methods or evidence, used to identify and assess the significant effects on the environment, including details of difficulties (for example technical deficiencies or lack of knowledge) encountered in compiling the required information and the main uncertainties involved.	Chapters 4, 0, 6 and 7
8. A description of the measures envisaged to avoid, prevent, reduce or offset any identified significant adverse effects on the environment and,	Chapters 4, 0, 6 and 7

Requirement of EIA Regulations	Location in ES
where appropriate, of any proposed monitoring arrangements (for example the preparation of a post-works analysis). That description must explain the extent, to which significant adverse effects on the environment are avoided, prevented, reduced or offset, and must cover both the construction and operational phases.	
9. A description of the expected significant adverse effects of the improvement works on the environment deriving from the vulnerability of the improvement works to risks of major accidents or disasters which are relevant to the improvement works. Relevant information available and obtained through risk assessments pursuant to EU legislation such as Directive 2012/18/EU of the European Parliament and of the Council on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC(23) or Council Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations(24) or UK environmental assessments may be used for this purpose provided that the requirements of the EIA Directive are met. Where appropriate, the description must include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies	See Appendix A for hydrogeological risk assessment relating to potential risk of contamination of groundwater and Chapter 0 which considers flood risk.
10. A non-technical summary of the information provided under paragraphs 1 to 9.	Non-technical Summary
11. A reference list detailing the sources used for the descriptions and assessments included in the statement.	References at end of ES.

The ES is considered fully compliant with these requirements.

2.4 EIA Scoping

Although not a mandatory requirement of the EIA Regulations, a Scoping Report was produced in August 2009 (JBA Consulting, 2009). The aim of the Scoping Report was to describe the approach to the EIA, identify the issues that will be assessed, identify issues that can be eliminated (i.e. "scoped out") of the EIA process, define the methodology for undertaking the assessment and evaluation stage of the EIA, and determine any potential site-specific environmental impacts, mitigation measures and enhancement opportunities.

Taking into account the nature of the proposed works, the location and the perceived potential impacts arising from construction and operation, along with the responses from the consultation exercise for the Scoping report (see section 2.5), Table 2-2 details the environmental factors that will be assessed as part of this EIA.

Table 2-2: Summary of Environmental Factors to be Considered in the EIA

Environmental Factor	Scoped in/out	Brief justification for scoped-out factors
Ecology	In	
Landscape and visual amenity	In	
Water	In	
Soils, geology and geomorphology	In	
Human beings	Out	Potential minor adverse impacts may arise, although the works are relatively localised and minor in nature, and some distance from the nearest residences and urban areas. This is not likely to be significant and no further consideration is deemed necessary in the ES.
Cultural heritage, archaeology and material assets	In	
Traffic and transport	Out	Potential small increase in traffic (i.e.

Environmental Factor	Scoped in/out	Brief justification for scoped-out factors
		construction and workforce vehicles) during the construction phase are likely. This is not likely to be significant and no further consideration is deemed necessary in the ES.

2.5 Consultation

2.5.1 Scoping

The Scoping Report (JBA Consulting, 2009) was circulated to statutory and non-statutory consultees to further define the scope and approach to the EIA. A notice advertising the intention to prepare an ES was also placed in a local newspaper to allow comments from the general public. A summary of the consultation responses received from the scoping stage are summarised in Table 2-3 below. This table also details how and where the ES addresses these comments, wherever possible.

2.5.2 First ES - April 2012

As discussed in section 1.2, an ES for the Great Heck mining subsidence remediation scheme was originally produced and consulted on in April 2012, however, the works never progressed. Despite the time since these consultation responses were received and the changes to the scheme, the comments received are detailed in Table 2-4 below, and if still applicable they have been addressed in this ES, wherever possible.

Table 2-3: Summary of Consultee Responses from Scoping Stage (2009)

Consultee	Response	Action Taken
Environment Agency	No response received.	n/a
Natural England	No comment to make on the proposed works.	Comment noted.
	Noted that no protected sites will be affected.	Comment noted.
	Advised that additional protected species surveys, as suggested in the scoping report, are carried out and that any appropriate mitigation works are conducted and that all legislation for breeding birds are adhered to during the course of any works.	Comment noted and details of additional surveys undertaken and mitigation proposed are provided in chapter 4.
English Heritage	No comments to make.	n/a
	Advised that the Historic Environment Record at North Yorkshire County Council is contacted to ascertain if they have any records relating to the site or wish to offer any comments.	Comment noted and taken into account in chapter 7.
North Yorkshire County Council	No objection to the proposals in principle. The scope looks thorough.	Comment noted.
	Confirmed the presence of the two Sites of Importance for Nature Conservation (SINC) identified within the study area. Also highlighted a third SINC which is located directly to the west, Balne Moor Ponds. This SINC is known as 'Ditch west of Balne Moor Ponds' and has the code SE51-18. Whilst it has not been surveyed by the SINC Panel (due to lack of access), it is a pre-existing SINC within the Selby District Local Plan and as such the Council is able to apply the relevant Local Plan policy (ENV9). Until the Council are granted access permission to survey this site we are unable to say whether it is still of SINC quality.	Comment noted and details of 'Ditch west of Balne Moor Pond' are included in section 4.4.1 of this report.
	The need for the further, more detailed habitat and species surveys which will allow the impacts of the scheme to be fully assessed is fully supported. Equally this will help to inform any mitigation, compensation and enhancement measures in line with PPS9.	Comment noted. Details of the more detailed habitat and species surveys conducted are provided in section 4.3 of this report.
	Considering the habitats present and the intended improvements to the drainage of the area it is likely that there will be ecological impacts as a result of hydrological changes. These may occur in the short term and must be considered alongside the direct impacts of the work. The hydrological and ecological assessments should not be prepared in isolation given the close links.	Hydrological impacts, and the ecological consequences, of the scheme are assessed in chapters 4 and 6 respectively, with cumulative impacts considered in section 8.1 of this report.
	Any enhancements should be in line with the Selby Biodiversity Action Plan and can be discussed with the Council once more detail is provided in the EIA.	Comment noted and taken into account in section 4.14 of this report.

Consultee	Response	Action Taken
Selby District Council	No response received.	n/a
RSPB	No response received.	n/a
Yorkshire Wildlife Trust	No response received.	n/a
British Waterways (now Canal and River Trust)	No response received.	n/a

Table 2-4: Summary of Responses from Consultation on First ES (2012)

Consultee	Response	Action Taken
Environment Agency	The Environmental Statement is very thorough in respect of impacts on Biodiversity and Nature Conservation, and the impacts on these issues appear to have been fully addressed and mitigation proposed.	Comment noted.
	At Balne Moor Ponds SINC it is stated that the water table will be lowered which could affect groundwater levels and consequently the ponds and that the change in water levels in the area is likely to be insignificant. It seems that there is some uncertainty here and we would recommend that the water levels are monitored for a period during operation to determine if pond levels are stable, or to determine whether mitigation needs to be put in place if the pond level is lowered significantly.	Further work into the potential impacts on Balne Moor Ponds SINC has been undertaken and in conjunction with the Hydrogeological Risk Assessment it has been concluded there will be no impact on this SINC and no requirement for mitigation or monitoring. See section 6.5 and the Hydrogeological Risk Assessment in Appendix A.
	It is disappointing that the subsidence flashes have been drained and that it is not possible to retain these areas as wetland BAP habitat, maybe under an Environmental Stewardship scheme. We would recommend that the IDB seeks involvement from the Humberhead Levels Partnership and Nature Improvement Area to seek support from their officers in liaising with landowners on the potential for retaining these difficult to drain areas. We understand that the RSPB has an officer who is working with landowners in this area on such difficult to farm areas (although we are not sure if the	If the remediation scheme did not progress, this would result in the rapid failure of the land drainage system and continued waterlogging of agricultural land and continued disruption to users of Heck Lane. Whilst wetland habitat would be created the Coal Authority's statutory

Consultee	Response	Action Taken
	<p>project is still running). Of course this applies only if the flashes become re-established.</p> <p>The Environmental Statement makes no reference to the Water Framework Directive (WFD) and Humber River Basin Management Plan (RBMP). This is a key piece of legislation for the water environment that needs to be referred to as part of the Environmental Impact Assessment. The ES sections on ecology and hydrology do consider WFD issues, but do not put them into the context of the WFD and Humber RBMP. The ES should assess any risk that a proposed development could harm a WFD surface waterbody or groundwater body.</p> <p>The proposal is within the WFD waterbody GB104027063410 called New Fleet Drain from Source to River Went. It is an Artificial waterbody, designated as Artificial for the reasons of Land Drainage, and is of Moderate Ecological Status. The drainage scheme should seek to deliver mitigation measures for this Artificial waterbody to contribute to the waterbody meeting Good Ecological Potential.</p> <p>The Humber RBMP notes the following Mitigation Measure Status:</p> <ul style="list-style-type: none"> - Appropriate techniques (invasive species) (Not In Place) - Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone (Not In Place) - Preserve and, where possible, restore historic aquatic habitats (Not In Place) <p>Further notes on WFD for information:</p> <p><i>WFD environmental objectives</i> - The WFD, in Article 4 Environmental objectives, requires that all surface waterbodies should achieve good ecological and chemical status unless they are artificial (AWB) or heavily modified (HMWB) in which case they should achieve good ecological potential. Groundwater bodies must achieve good quality and quantity. All waterbodies must achieve the appropriate objective in accordance with the RBMP and before the end of 2027.</p> <p><i>Assessment for meeting RBMP requirements</i> - An applicant should assess any risk that a proposed development could harm a surface waterbody or groundwater. For EIA development this should be part of the environmental assessment.</p> <p>An assessment should show how the application meets RBMP requirements and as a minimum include:</p> <ul style="list-style-type: none"> - the risk of deterioration:- a proposed development must not cause any waterbody quality element to deteriorate to a lower status class, e.g. from good to moderate status, or from moderate to poor 	<p>obligations under the Coal Mining Subsidence Act 1991 would not be resolved.</p> <p>This new ES now makes reference to the WFD and RBMP in section 6.4.6. The information provided has been updated to reflect cycle 2 of the WFD.</p>

Consultee	Response	Action Taken
	<p>status etc. Our current approach is that we should object to any deterioration to a lower class. Where a quality element would have a lower rating within the current class we may provide advice on how to avoid that or minimise it.</p> <ul style="list-style-type: none"> - support for measures to achieve good status (or potential): a proposed development must not prevent implementation of a measure in the RBMP to improve a surface water body or groundwater unless the applicant proposes an acceptable alternative to meet RBMP requirements. Improvement measures may include local proposals to restore natural conditions in a river corridor or other part of the water environment. - the risk of harming any protected area: a proposed development must not harm a protected area in a RBMP. Protected areas may be areas protected in accordance with EC legislation for surface water, groundwater or areas for the conservation of habitats and species that directly relate to water (e.g. Natura 2000 wetlands). We maintain a register of protected areas. <p><i>Artificial and Heavily Modified waterbodies</i> - The objective for artificial waterbodies (AWB) and heavily modified waterbodies (HMWB) is to achieve good ecological potential and good chemical status. This is because the Directive accepts that they are unlikely to be able to function in the same way as natural waterbodies. AWB include for example man made canals, reservoirs and dams. HMWB are waterbodies with significant physical modifications where for example sustainable development such as river navigations, flood defences, harbours, marinas and dredged shipping channels have significantly modified the waterbodies from their natural state.</p>	
	<p>Fisheries and biodiversity - The physical condition of surface waterbodies is a quality element that supports their biological condition. It includes waterbody profiles, the condition of margins (including vegetation) and silt levels. Varying combinations of these provide the conditions that support the life cycles of fish. Physical modification of waterbodies can threaten fish and overall biodiversity. Research shows that good physical condition must be accompanied by good water quality, free from pollutants and with acceptable nutrient levels, for fisheries and the biodiversity that supports them to thrive.</p> <p>We should advise developers and LPAs that an assessment of physical modifications to a waterbody is always required and emphasise the need to consider all applicable quality elements.</p> <p>Measures to improve the physical condition of waterbodies include de-culverting of rivers, removing barriers to fish movement (for example removing derelict weirs and making sure that all barriers provide suitable fish and eel passes) and re-profiling waterbodies damaged by dredging.</p> <p>The proposed scheme involves deepening of existing drains in an area affected by mining subsidence. This area currently has a layer of clay, which gives protection to the principal aquifer</p>	<p>Comment noted and details regarding the deepening of the drainage network in areas that may cut through the protective layer of clay is addressed in section 6.5. The Hydrogeological Risk Assessment in Appendix A also addresses this risk.</p>

Consultee	Response	Action Taken
	below. Where it is identified that deeper drains will cut through this protective clay layer - or where the clay is already absent, then we suggest that the new drains should be constructed with a clay liner.	
	For this particular site, the amount of habitat upstream of the pump is very limited (a few hundred metres of shallow water, with little cover). We do not consider an eel pass necessary at this location. Without an eel pass, eels will not be able to enter Court Drain from New Fleet Drain South. No eel specific screening will be required at this time, but you may need to install screens if you find eels are being entrained in the pumps once they become operational. There is a chance of this if large, silver eels migrate to the sea via Court Drain. This is likely to be a very infrequent occurrence though, which is why we do not consider screening necessary at this time.	Comment noted. Further liaison regarding fisheries issues has been undertaken since issue of the 2012 ES.
	We would advise that reasonable steps are taken to avoid causing pollution during the works	Comment noted and details of pollution control measures are provided in section 6.5.5.
Natural England	Natural England supports the proposed precautionary surveys for badger, otter and water voles prior to works commencing, as well as precautions to prevent harm to grass snakes and those regarding nesting / Schedule 1 birds. We are also pleased to note that any trees to be removed will be checked for their suitability for roosting bats prior to works commencing. If any trees are found to have bat roost potential then further emergence / re-entry surveys would be required and mitigation may need to be put in place. Please refer to our standing advice for further information on protected species.	Comment noted.
	Whilst we note that many of the subsidence flashes have dried out since the initial 2008 surveys, there is the potential for the extent of flash habitat to increase again if climatic conditions allow. Subsidence flashes provide valuable habitat for waterbirds and so we welcome the provision of berms within the new drains to allow shallow margins to develop. However, given the previous extent of the flashes we would wish to see an increase in the number of berms to allow a larger area of marginal wetland habitat to develop.	Comment noted. The length of drain to contain a berm, including the approach drain with a maintenance berm, will now be 820m.
	We welcome the proposed re-seeding of the banks of watercourses with a grass and wildflower seed mix, and precautionary measures to prevent the spread of Himalayan Balsam, as outlined in section 4.11.4.	Comment noted.
	Whilst the loss of mature trees is regrettable, we are pleased to note that replanting will take place as close as possible to the original locations. We would advise that native species of local provenance are used.	Comment noted and confirmation that native species of local provenance will be used is detailed in section 4.11.8.
	The scheme is not within any sites designated for their landscape value. However, landscape issues	Comment noted.

Consultee	Response	Action Taken
	<p>should be considered with any proposal, as the development should always compliment the local character and distinctiveness of the surrounding area.</p> <p>Natural England is satisfied that the landscape and visual impacts of the scheme have been assessed using an appropriate methodology, using the Guidelines for Landscape and Visual Assessment. We welcome reference to both Natural England's National Character Areas and the Landscape Assessment of Selby District. We agree that overall the landscape impact of the scheme is acceptable.</p>	
English Heritage	Our specialist staff have considered the information received and we do no wish to offer any comments on this occasion	Comment noted.
North Yorkshire County Council	<p>As highlighted in section 4.4 I can confirm that there are three Sites of Importance for Nature Conservation (SINC) (Balne Moor Ponds, Ditch West of Balne Moor Ponds, Disused Railway Line) within the study area. From the proposed works outlined in the EIA, it appears the only potential impact is due to a lowering of groundwater levels. This impact is assessed as negligible in the EIA. However, I would suggest the impact needs to be monitored in the years immediately following completion of the scheme.</p> <p>Whilst acknowledging that the subsidence flashes are recent and ephemeral features they have provided ecological interest in a predominantly intensively farmed arable landscape with limited semi-natural vegetation. In particular, the EIA has highlighted their importance for wetland birds including nationally scarce and declining species. The permanent loss of these features as a result of the proposed works will therefore be detrimental to the natural environment of the area.</p> <p>I support the proposed mitigation in relation to protected species including the need for updated surveys prior to the commencement of works.</p> <p>The proposals will result in the permanent loss of subsidence flash habitat which will only be partially compensated for by the creation of habitat associated with new drainage ditches and grass berms. Proposed enhancements around the new pumping station including bird boxes and hedgerow planting are modest.</p> <p>We believe that more thought should be given to exploring further opportunities for nature conservation enhancements in the study area. For example, we welcome the suggestion that consideration will be given to additional hedgerow planting in existing gappy hedgerows and would</p>	<p>Further work into the potential impacts on Balne Moor Ponds SINC has been undertaken and in conjunction with the Hydrogeological Risk Assessment it has been concluded there will be no impact on this SINC and no requirement for mitigation or monitoring. See section 6.5 and the Hydrogeological Risk Assessment in Appendix A.</p> <p>Comment noted and Chapter 4 assesses the value of these habitats and impact upon them, particularly in relation to wetland birds.</p> <p>Comment noted and details of additional surveys conducted is provided at section 4.3.</p> <p>Comment noted and environmental enhancements will be pursued wherever possible.</p>

Consultee	Response	Action Taken
	like to see this proposal developed further. We would also encourage further new hedgerow planting where feasible to improve connections between existing areas of habitat e.g. linking woodlands, the Aire and Calder Navigation etc.	
	Due to the responsibilities of Internal Drainage Boards with respect to the natural environment and nature conservation I hope that such opportunities will be explored. I would be happy to discuss any opportunities further with you and other relevant consultees and landowners	Comment noted.
Selby District Council	No response received.	n/a
RSPB	No response received.	n/a
Yorkshire Wildlife Trust	<p>The area to be drained has considerable importance for wetland birds and probably also invertebrates in the subsidence flashes. Due to dry conditions in 2011 and 2010 surveys may not have provided a full picture of wetland bird use of the area. Given the value of the area there appears to be insufficient mitigation to prevent long term negative impacts on wildlife.</p> <p>An option instead of a drainage scheme which may not have been considered is examining whether Environmental Stewardship income could be generated for landowners through Entry Level and Higher Level Stewardship schemes. The wet areas could then be enhanced for wildlife such as breeding waders, farmland birds, water vole and invertebrates</p>	Comment noted and mitigation measures to offset impacts on wetland birds have been included wherever possible, as detailed in section 4.11. However, the significance of impacts on wetland birds is assessed post-mitigation as being of moderate significance
British Waterways (now Canal and River Trust)	No response received.	n/a

2.6 Study Area

The geographical area that was covered by the EIA was determined by considering:

- The footprint of the proposed works
- The nature of the existing baseline environment
- The manner in which impacts are likely to be propagated.

Figure 2-1 shows the EIA study area. The majority of the study area falls within Selby district, with the exception of the eastern most part which falls within the East Riding of Yorkshire.

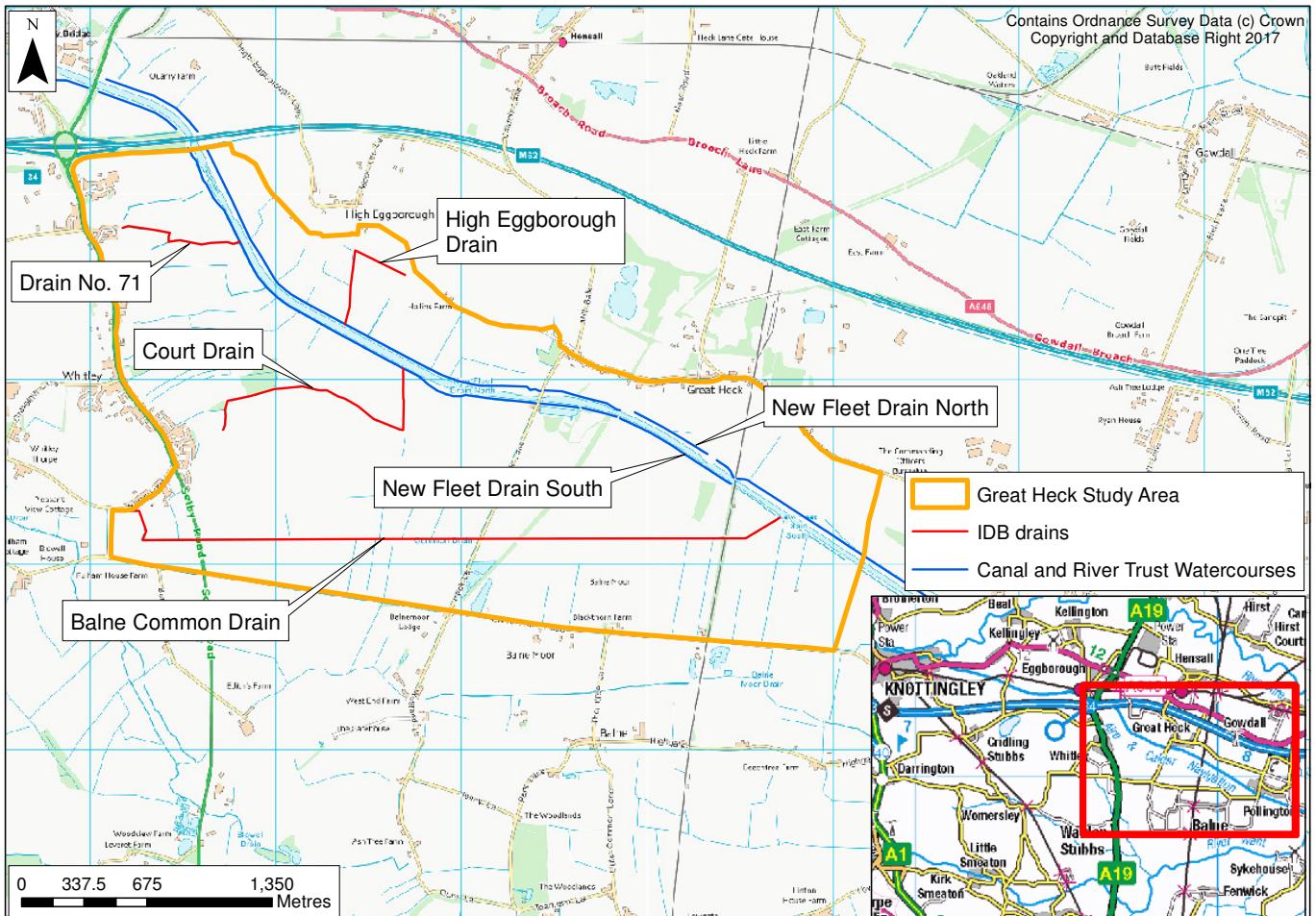


Figure 2-1: Study Area

2.7 Structure of the Environmental Statement

This ES (Volume 2) provides an introduction to the proposed works and details the technical assessments that have been undertaken to determine the likely impacts of the works. The chapters of the ES are as follows:

- Chapter 1 Introduction and Background
- Chapter 2 Approach to Environmental Impact Assessment
- Chapter 3 The Proposed Works and Alternatives Considered
- Chapter 4 Ecology and Nature Conservation
- Chapter 5 Landscape and Visual Amenity
- Chapter 6 Hydrology, Geology and Soils
- Chapter 7 Cultural Heritage, Archaeology and Material Assets
- Chapter 8 Summary and Conclusions

Additional to the Main Report is a series of Appendices (Volume 3). These include details of the methodologies and information used in the assessments and, where appropriate, raw data.

The ES covers a large number of issues and, in doing so, uses numerous technical terms. Consequently, all of the chapters are summarised in a standalone, Non-technical Summary (Volume 1) to provide a review of the proposed works, and the possible environmental implications, in concise lay terms.

3 The Proposed Works and Alternatives Considered

3.1 Introduction

The following chapter provides details of the selected option. It also summarises the alternative options considered to remediate the effects of mining subsidence in the Great Heck area, including the 'Do Nothing' option.

3.2 Proposed Scheme

3.2.1 Summary

The preferred option will involve pumping from Court Drain into New Fleet Drain South which would discharge via gravity to the River Don to the east (Figure 3-1). If the water level in the downstream reach of New Fleet Drain South is high the discharge chamber will divert water to storage in the upstream reach of this drain until the downstream water level has receded. The scheme will include excavating new land drains, re-grading existing drains and the construction of a new land drainage pumping station. The existing Drain No. 71 and Balne Common Drain will drain to Court Drain, and then flow to the pumping station. Drain No.71 currently discharges directly to New Fleet Drain South and will be banded to divert to Court Drain. A weir will be placed at the junction with Balne Common Drain to restrict inflow to the pump station to high flows only, Balne Common Drain will otherwise discharge via gravity to New Fleet Drain South east of Heck Lane

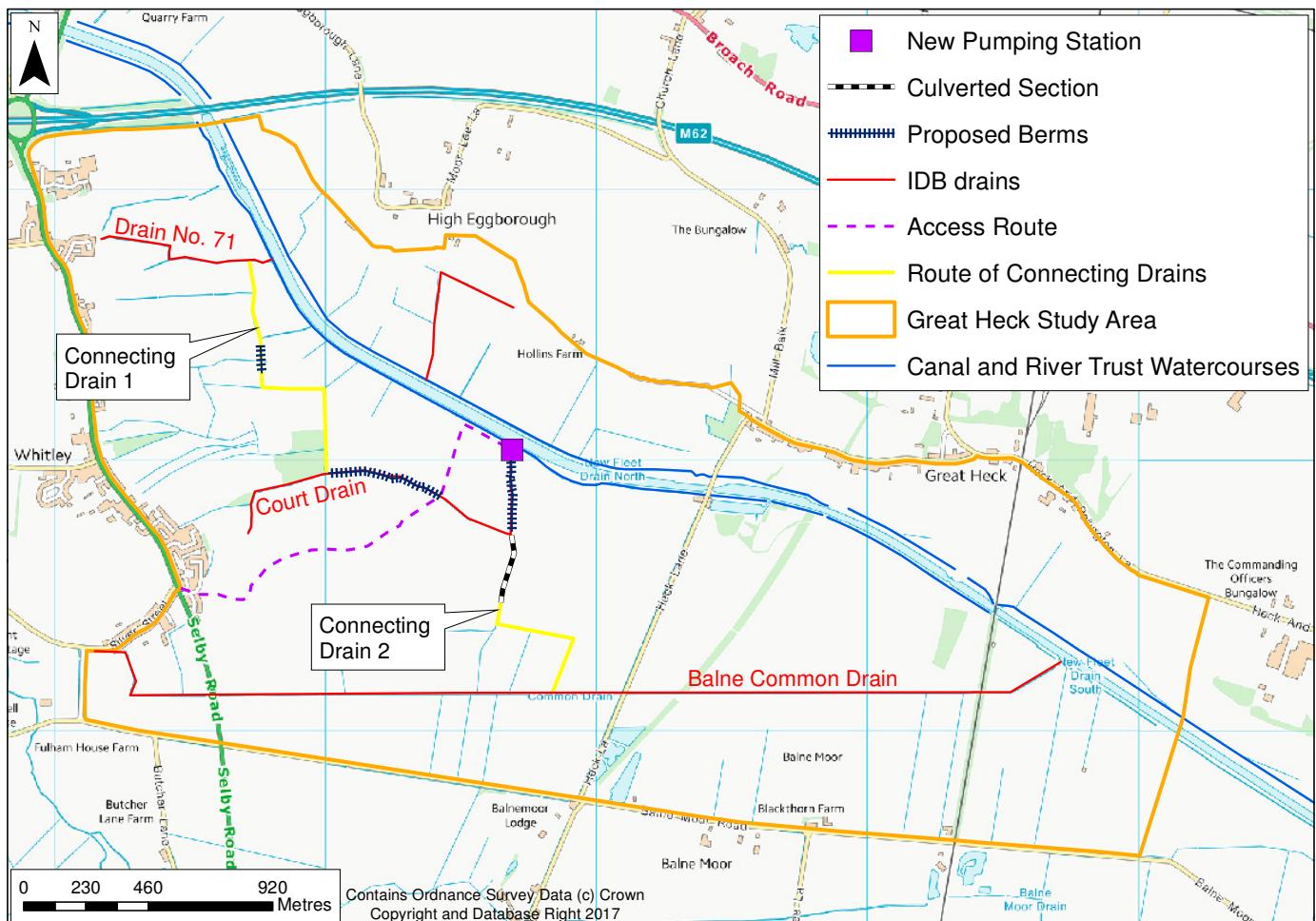


Figure 3-1: Proposed Works

Further details on construction methodology, access and design of the works are provided in the sections below.

3.2.2 Access

Access to the site of the pumping station will be via Lee Lane from the village of Whitley. The first stage of the works will be to construct a stone access track from the end of Lee Lane to the proposed site of the pumping station, by continuing northwards along the existing field boundary, and then turning eastwards and running parallel to New Fleet Drain South. A wheelwash will be placed at the dirt track between Court Drain and the metalled surface of Lee Lane to avoid transporting soil from the fields to residential areas at Whitley and the A19.

3.2.3 Pumping Station

The pumping station location will be at grid reference SE 5768 2103.

The capacity of the pumping station will be 760l/s based upon the catchment area affected by mining subsidence south of the canal. The pumping station will include three pumps and an automatic weedscreen cleaner to ensure the trash screen is kept clear of debris. A high level gravity discharge will be included, controlled by penstock and a flap valve. The compound will be protected by a 2.4m high Paladin fence.

A telemetry system will be installed to remotely monitor and control water levels and pump activity at the site, alarms will be issued to alert the Danvrm Drainage Commissioners of high water levels or pump problems.

Consideration is being given to the inclusion of a wind pump at the station to reduce electricity consumption during “dry weather” conditions. As this aspect of the scheme has yet to be determined or designed, this ES will not consider a wind pump. Should a wind pump be constructed as part of this scheme an addendum to the ES will be required.

3.2.4 New Cut Drains and Drain Regrading

Mining subsidence has resulted in an undulating drain bed along Court Drain, restricting flow to New Fleet Drain South except during high flow conditions. Drain improvement works to enable flow to the pumping station will include re-grading of existing drains and excavation of new connecting drains (Figure 3-1). The re-grading will result in the bed level of Court Drain being lowered by 2.38m at the pumping station. The low point on the right bank of New Fleet Drain South upstream of the pumping station discharge bay will be raised and sealed using excavated clay from the re-grading works.

Drain No. 71 will be connected to Court Drain by excavating new drains which will connect existing non-IDB maintained land drains. The existing non-IDB maintained land drains will be re-graded to suit, and a low berm will be constructed along an approximate 100m length of this connecting drain to provide an occasionally wetted platform for birds. This new connecting drain connects to Court Drain at the eastern side of Watkin's Lower Plantation and will be referred to throughout the remainder of this ES as Connecting Drain 1.

A connection will also be made between Balne Common Drain and Court Drain by re-grading existing non-IDB maintained land drains and excavating a new 187m drain to connect the existing drains. This new connecting drain will be referred to throughout the remainder of this ES as Connecting Drain 2.

Court Drain will be re-graded from where Connecting Drain 1 joins it, to the pumping station site. Berms will be constructed on two sections of this re-graded drain, over a total length of approximately 430m. The berms will be positioned 0.5m above the drain bed to allow occasional wetting to create a habitat for wildlife.

Court Drain and Connecting Drain 1 will be re-graded at 1 in 3000 between the junctions with Connecting Drains 1 and 2. The approach drain to the pumping station will be re-graded to 1:950 generally and will include a 4.5m wide berm on the right bank for maintenance, the length of which will be approximately 300m. Connecting Drain 2 will be re-graded at 1 in 3000. Bank slopes will be 1:1.5 generally, except where berms will be constructed, due to the sandy soils at this location. Due to the sandy soils, and the depth to which the downstream portion of this new watercourse would need to be dug, the last 260m of Connecting Drain 2 will be culverted and not open watercourse.

No re-grading works will be undertaken on the other IDB maintained watercourses in the study area; Balne Common Drain or High Eggborough Drain.

3.2.5 Land Loss

During construction of the pumping station a temporary working area will be required for storage, welfare facilities and safe plant manoeuvring. Temporary fencing will be erected around the compound. The area required for the construction compound will provisionally be 50m x 50m subject to final confirmation by the appointed contractor. The area permanently occupied by the pumping station following completion will be 15m x 10m.

During the drain improvement works, a temporary working zone extending 10m from the drain will be required for plant manoeuvring and temporary spoil storage, however this will only be necessary on the bank of operation.

The following indicates the approximate land take required for each section of drain improvement works:

- Drain No. 71 and Connecting Drain 1 = 3,853m²
- Connecting Drain 2 = 2,019m²
- Court Drain = 6,940m²

In total, it is anticipated that 12,812m² of land would be lost as a result of the re-grading works.

3.2.6 Tree Removal

Tree removal is to be kept to a minimum with removal taking place only in cases where the tree would otherwise obstruct the works or where the condition of the tree already appears to be precarious.

Alongside the eastern boundary of Watkin's Lower Plantation, on Connecting Drain 1, an Oak tree obstructs the drain construction and future maintenance and must therefore be removed. An Ash tree, located south of the Oak tree has a severely split trunk and is supported by the adjacent tree. The damaged tree will be removed in the interests of safety.

On Court Drain, most trees east of Watkin's Lower Plantation are on the right bank and can be retained as work will be undertaken to the left bank. An Ash tree 40m east of the plantation on the left bank will be removed as it will be affected by the drain widening. Approximately 110m east of the plantation a Crack Willow tree on the right bank overhangs the left bank and may be in danger of collapse during, or following, the drain improvement works, and therefore requires removal. Approximately 230m east of the plantation a Crack Willow tree on the right bank appears in poor condition but can be retained.

Near the pumping station location an Oak tree on the left bank is located within the footprint of the pumping station approach channel and must be removed.

In total, it is anticipated that five trees will require removal.

3.2.7 Culvert Replacement

A number of new or replacement culverts will be required as follows:

- | | |
|----------------------|---|
| • Connecting Drain 1 | 3 |
| • Court Drain | 7 |
| • Connecting Drain 2 | 2 |

3.2.8 Fisheries Consultation

Consultation has been undertaken recently with the Environment Agency Fisheries Technical Officer with regard to eel and fish passage mitigation required at the site. The officer, Jerome Masters, has requested a copy of the ES when ready but anticipated that the pumping station will be categorised as 'no priority'.

3.2.9 Programme

Works are due to commence in Summer 2017, and last for approximately 11 months. The first phase of works will be the drain re-grading/cutting works which should last for approximately 3-4 months. This will be followed by construction of the pumping station which is scheduled to begin in August/September 2017.

3.3 Alternative Options Considered

3.3.1 Do Nothing

The 'Do Nothing' option involves the IDB ceasing all drain maintenance operations and taking no further action to protect the land from the effects of mining subsidence. As a result of this option, rapid failure of a proportion of the land drainage system would occur and result in permanent damages to a large proportion of agricultural land within the study area through waterlogging. This would result in ongoing and significant financial losses to the landowners who farm within the study area; these costs would significantly exceed those of the preferred option.

The effects of mining subsidence on Heck Lane would also continue and cause disruption to traffic and damage to the road, south of Heck Bridge.

The Do Nothing option was not pursued as it would result in the rapid failure of the land drainage system and continued waterlogging of agricultural land, continued disruption to users of Heck Lane and The Coal Authority's statutory obligations under the Coal Mining Subsidence Act 1991 would not be resolved.

3.3.2 Do Minimum/Continue as Present

This option would involve continuing with the present situation and the Danum Drainage Commissioners would continue with their ongoing annual maintenance works (e.g. flail mowing of bankside vegetation, de-weeding of in-channel vegetation). No measures to remediate the impacts of mining subsidence would be undertaken. As a result of this option, failure of a proportion of the land drainage system would occur and result in permanent damages to a large proportion of agricultural land within the study area. This would result in ongoing and significant financial losses to the landowners who farm within the study area, and it would be necessary for the Coal Authority to compensate/rectify this situation; these costs would significantly exceed those of the preferred option.

The effects of flooding on Heck Lane would also continue and cause disruption to traffic and damage to the road, south of Heck Bridge.

The do minimum/continue as present option was not pursued as it would result in the failure of the land drainage system and continued waterlogging of agricultural land, continued disruption to users of Heck Lane and The Coal Authority's statutory obligations under the Coal Mining Subsidence Act 1991 would not be resolved.

3.3.3 Raising of Heck Road

This option would allow continued use of Heck Lane by raising a 250m length of road which is currently regularly inundated by water from the nearby subsidence flash, along with associated earthworks and construction activities. No remediation works would be undertaken to drain the subsidence flashes on the agricultural land, resulting in ongoing and significant financial losses to the landowners who farm within the study area, and it would be necessary for the Coal Authority to compensate/rectify this situation; these costs would significantly exceed those of the preferred option.

This option was not pursued as it would still result in the failure of the land drainage system and continued waterlogging of agricultural land, although the road would be protected. The Coal Authority's statutory obligations under the Coal Mining Subsidence Act 1991 would not be resolved.

3.3.4 Re-grading of New Fleet Drain South and Pump into River Don

This option would involve re-grading works to lower the levels of New Fleet Drain South, to its outfall at the River Don, approximately 10km downstream of the study area. If the required deepening at the outfall results in the drain bed level being lower than the invert of the existing outfall, then new pumping facilities would be required. In this instance the capacity of the pumping station would need to consider the full catchment leading to the outfall, as opposed to the other pumping options (discussed in sections 3.3.5, 3.3.6 and 3.3.7 below) that only need to consider the area within the catchment affected by the subsidence (i.e. the study area to the south of the canal).

Within this option, re-grading at a 1 in 3,000 gradient would be required on the downstream section of Drain No. 71 and continue along New Fleet Drain South to just upstream of Heck Lane; a length of 2.2km. Re-grading would be to an average depth of 1m and an average bed width of

approximately 2.5m. Re-grading, at a gradient of 1 in 3,000, would also be required on Court Drain (1.2km), with an average depth of 1.3m and an average bed width of 1.2m. The excavation quantity required will be in the order of 45,000m³.

On New Fleet Drain South, beyond the point discussed above, further re-grading to the River Don would be necessary. Due to the distance involved a significant quantity of material may need to be excavated, the exact amount is still to be calculated, but it could be up to 100,000m³ and other issues, such as bank instability could be created.

All excavated material would be used to form an embankment along New Fleet Drain South. Six culverts would require renewal.

Heck Lane would be protected from inundation as a result of this scheme.

This option would be extremely expensive due to the high volume of earth which would need to be excavated as a result of the re-grading, and problems such as bank instability may be created. This option was therefore not pursued on both economic and technical grounds

3.3.5 Pump into New Fleet Drain South, Retention Upstream and Pump into River Don

This option would involve the deepening and widening of Drain No. 71 and Court Drain, along with the cutting and connecting of new drains to re-route the flows away from the existing outfalls into New Fleet Drain South to discharge back into this drain at the downstream end of Court Drain. As a result of the required re-grading, a gravity flow further downstream along New Fleet Drain South would not be possible; water would have to be lifted by pumps (of 760 litres per second (l/s) capacity). This option would also involve construction of a second pumping station to pump into the River Don during times of heavy rainfall (again of 760l/s capacity).

In order to prevent the land adjacent to New Fleet Drain South being affected during pumping operations, a system to restrict the flow would be provided. The redundant upstream reaches of New Fleet Drain South would be used as a balancing feature to hold water back during pump operations. The pumping station on New Fleet Drain South would be a booster pumping station for the water to then continue to flow along its natural course in New Fleet Drain South, to the pumping station on the River Don.

Within this option, re-grading at a 1 in 3,000 gradient would be required on Drain No. 71, for a length of 400m, with an average depth of 0.5m and an average bed width of 0.8m. Court Drain would be re-graded for 1km with an average depth and bed width of 1.7m, and 0.8m respectively. The new drain between Drain No. 71 and Court Drain would be 1km in length with an average depth of 1.25m and an average bed width of 0.8m. A new drain and re-grading works would also be required between Court Drain and Balne Common Drain; the re-grading of existing land drains would be over a length of 800m with an average depth of 2m and an average bed width of 0.8m. The excavation quantity required would be in the order of 39,200m³.

All excavated material would be used to form an embankment along New Fleet Drain South. Six culverts would require renewal.

Heck Lane would be protected from inundation as a result of this scheme.

This option was not pursued on economic grounds as it requires the construction of two pumping stations.

3.3.6 Pump into the Aire and Calder Navigation

This option would be very similar to that described in section 3.3.5 above, but only require construction of a pumping station to pump into the Aire and Calder Navigation (of 760l/s capacity).

Within this option re-grading, at a 1 in 3,000 gradient, would be required on Drain No. 71 and Court Drain, along with new drains to connect Drain No. 71 to Court Drain and also Court Drain to Balne Common Drain (also at a 1 in 3000 gradient). On Drain No. 71 the re-grading would extend for 400m with an average depth of 0.5m and an average bed width of 0.8m. The new drain to connect Drain No. 71 with Court drain would require re-grading of 1km with an average depth and bed width of 0.7m and 0.8m respectively. On Court Drain, re-grading would extend for 1km with an average depth of 1.7m and an average bed width of 0.8m. The new cut and re-grading to connect Court Drain with Balne Common Drain would require re-grading along 800m with an average depth of 2m and an average bed width of 0.8m.

All excavated material would be used to form an embankment along New Fleet Drain South. The excavation quantity required would be in the order of 39,000m³. Six culverts would require renewal.

Heck Lane would be protected from inundation as a result of this scheme.

The Canal and River Trust, who are responsible for the Aire and Calder Navigation, have confirmed that submission of a hydraulic model would be required to prove that no increase in water level would be experienced within the canal, and confirmation that all structures downstream of the discharge would be altered to suit any additional flow. Due to the technical issues and cost that this would entail, this option was not pursued further.

3.3.7 Re-grade watercourses along existing routes, including New Fleet Drain South and Pump into Canal

This option is a variation of some of the above options, and also the preferred option discussed in section 3.2 above, and would involve deepening of the IDB maintained watercourses along their existing routes and direction as previously described. In addition, this would require deepening and widening along the upper reaches of New Fleet Drain South to the required levels. The water would then be pumped into the Aire and Calder Navigation, with a pumping station of 760l/s capacity.

Within this option, re-grading at a 1 in 3,000 gradient would be required on Drain No. 71 and continue along New Fleet Drain to just upstream of Heck Lane. On Drain No. 71 re-grading would extend for 400m with an average depth of 0.5m and an average bed width of 1.5m. On the section of New Fleet Drain South concerned, re-grading would be undertaken on a 1.45km length, with an average depth of 1.4m and an average bed width of 1.5m, followed by re-grading of 550m with an average depth of 2m and an average bed width of 1.5m to just upstream of Heck Lane. Re-grading along the whole of Court Drain would be required, for a length of 1.5km with an average depth of 1.7m and an average bed width of 1.5m. A new drain would need to be cut to connect Balne Common Drain to Court Drain, which would involve re-grading of 800m of existing land drain, at a 1 in 3000 gradient, with an average depth of 2m and an average bed width of 1.5m.

The excavated quantity required would be in the order of 93,000m³ and all excavated material would be used to form an embankment along New Fleet Drain South. Eight culverts would require renewal.

Heck Lane would be protected from inundation as a result of this scheme.

Again, The Canal and River Trust would require submission of a hydraulic model to prove that no increase in water level would be experienced within the canal, and confirmation that all structures downstream of the discharge would be altered to suit any additional flow. Due to the technical issues and cost that this would entail, this option was not pursued further.

3.3.8 Summary of Alternative Options Considered

The following table summarises the alternative options considered.

Table 3-1: Summary of Alternative Options Considered

Option	Reasons for not taking forward
Do Nothing	Aims of the scheme would not be met (i.e. existing land drainage system would fail and Heck Lane would experience disruption and damage). Cost. Legal obligations would not be met.
Do Minimum/Continue as present	Aims of the scheme would not be met (i.e. existing land drainage system would fail and Heck Lane would experience disruption and damage). Cost. Legal obligations would not be met.
Raising of Heck Road	An aim of the scheme would not be met (i.e. existing land drainage system would fail) Cost. Legal obligations would not be met.
Re-grading New Fleet Drain South and pump into River	Cost. Technically infeasible (i.e. bank instability).

Option	Reasons for not taking forward
Don	
Pump into New Fleet Drain South, retention upstream and pump into River Don	Cost.
Pump into Aire and Calder Navigation	Cost. Technically infeasible (i.e. demonstrating no impact on the Canal and River Trust's system).
Re-grade watercourses along existing routes, including New Fleet Drain South and Pump into Canal	Cost. Technically infeasible (i.e. demonstrating no impact on the Canal and River Trust's system).

4 Ecology and Nature Conservation

4.1 Introduction

This chapter describes and evaluates the current nature conservation interest within the study area and assesses the potential impacts of the proposed works on ecological features. Where potentially significant effects upon habitats and species have been identified, the chapter also details appropriate mitigation measures which have been incorporated into the scheme design, or will be undertaken prior to, and during, construction and operational phases. This chapter also details post construction enhancements and monitoring options.

4.2 Legislative and Planning Policy Context

4.2.1 Legislation

Designated Sites

Designated sites are areas of high nature conservation value which are protected to varying degrees by statute, international conventions, or local authority planning controls. The sites form a network of habitats which may be of international, European, national, regional or local importance.

Generally, the priority for the protection of designated sites is as follows:

1. International/European sites (Ramsar, Special Areas of Conservation (SACs), Special Protection Areas (SPAs))
2. National Sites (Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs))
3. Regional or local sites (Local Nature Reserves (LNR), Local Wildlife Sites (LWS))
4. Other wildlife sites.

The Conservation of Habitats and Species Regulations 2010 (as amended) transpose Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (EC Habitats Directive) into English and Welsh law. The Regulations provide for the designation and protection of 'European Sites' (SAC and SPA), and the adaptation of planning and other controls for the protection of European Sites.

SSSIs are legally protected under the Wildlife and Countryside Act 1981, as amended by the Countryside and Rights of Way (CROW) Act 2000 and the Natural Environment and Rural Communities (NERC) Act 2006. This legislation gives Natural England powers to ensure better protection and management of SSSIs and safeguard their existence into the future.

The protection afforded to sites by local authority designations, such as Local Wildlife Sites (LWS) and Sites of Importance for Nature Conservation (SINC), is normally significantly less than for statutory designations. Such designations are predominantly for planning purposes only and, while a local authority may have a stated policy of avoiding development in these areas, there is no statutory protection process.

Protected Species

In addition to habitats, a number of species are considered to be rare or subject to persecution and are also afforded protection through international/European and national law.

The Conservation of Habitats and Species Regulations 2010 (as amended) provide for the protection of 'European Protected Species'. The regulations make it an offence (subject to exceptions) to deliberately capture, kill, disturb, or trade in the animals listed in Schedule 2, or pick, collect, cut, uproot, destroy or trade in the plants listed in Schedule 4. However, these actions can be made lawful through the granting of licences by the appropriate authorities. Licences may be granted for a number of purposes (such as science and education, conservation, preserving public health and safety), but only after the appropriate authority is satisfied that there are no satisfactory alternatives, and that such actions will have no detrimental effect on wild population of the species concerned.

The Wildlife and Countryside Act 1981 (as amended) affords various levels of protection to nesting birds, animal species listed on Schedule 5 and plant species listed on Schedule 8. In addition, Schedule 9 lists non-native invasive species which the Act prohibits from releasing into the wild.

Schedule 12 of the CROW Act 2000 amends the species provisions of the Wildlife and Countryside Act 1981, strengthening the legal protection for threatened species, creating the new offence of reckless disturbance. This is particularly relevant with regard to vegetation management and development activities.

Biodiversity

Section 40 of the NERC Act (2006) states that 'every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity'. Section 40(3) also states that 'conserving biodiversity includes, in relation to a living organism or type of habitat, restoring or enhancing a population or habitat'.

Section 41 of the NERC Act requires the Secretary of State to publish a list of 'Habitats and Species of Principal Importance' for the purpose of conserving biodiversity. To meet this requirement, the England Biodiversity List (the S41 list) has been developed.

The S41 list, which replaces the list published under Section 74 of the CRoW Act 2000, should be used to guide decision-makers such as public bodies, including IDBs, in implementing their duty under section 40 of the NERC Act 2006 to have regard" to the conservation of biodiversity in England, when carrying out their normal functions.

4.2.2 Planning Policy

The following sections briefly outline the policies that are relevant to the study area and the proposed scheme at national and local levels.

National Planning Policy

The National Planning Policy Framework (NPPF) replaces previous planning guidance relating to biodiversity, namely Planning Policy Statement 9: Biodiversity and Geological Conservation.

The NPPF sets out the Government's planning policies for England and how these are expected to be applied, with a presumption in favour of sustainable development a core element of the framework. Twelve core planning principles are identified within the framework, with that relevant to biodiversity stating it will:

Contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser environmental value, where consistent with other policies in this Framework (Department for Communities and Local Government, 2012).

The Framework recognises that, when determining planning applications, local planning authorities should aim to conserve and enhance biodiversity by:

- ensuring that adverse impacts are avoided, adequately mitigated or compensated for;
- refusing developments that may adversely impact on Sites of Special Scientific Interest (SSSIs) or their interest features unless the benefits of the development clearly outweigh the impacts;
- permitting developments where the primary objective is to conserve or enhance biodiversity;
- encouraging proposals to incorporate biodiversity in and around developments; and
- refusing planning permission for developments that would result in the damage or deterioration of irreplaceable habitats (e.g. ancient woodland, veteran trees)

Whilst the NPPF relates specifically to planning policy and the Great Heck mining subsidence remediation scheme will be progressed under the Danvm Drainage Commissioners permitted development rights, the principles of this framework in relation to the conservation and enhancement of biodiversity can be applied to the scheme.

Local Planning Policy

The long-term strategic vision for how Selby District will be shaped is governed by the Core Strategy (Selby District Council, 2013), which was adopted in 2013. This strategy sets out a number of broad policies to guide development, and sits alongside a number of supporting documents, including the Local Plan which was adopted in 2005 and some of which remains in force. Policies from the Selby District Core Strategy Local Plan which are relevant to this chapter and the Great Heck mining subsidence remediation scheme are detailed in Table 4-1 below.

Table 4-1: Relevant Policies from the Selby District Core Strategy Local Plan

Policy	Description
SP18 - Protecting and Enhancing the Environment	<p>The high quality and local distinctiveness of the natural and manmade environment will be sustained by:</p> <ol style="list-style-type: none"> 1. Safeguarding and, where possible, enhancing the historic and natural environment including the landscape character and setting of areas of acknowledged importance. 2. Conserving those historic assets which contribute most to the distinct character of the District and realising the potential contribution that they can make towards economic regeneration, tourism, education and quality of life. 3. Promoting effective stewardship of the District's wildlife by: <ul style="list-style-type: none"> a) Safeguarding international, national and locally protected sites for nature conservation, including SINCs, from inappropriate development. b) Ensuring developments retain, protect and enhance features of biological and geological interest and provide appropriate management of these features and that unavoidable impacts are appropriately mitigated and compensated for, on or off-site. c) Ensuring development seeks to produce a net gain in biodiversity by designing in wildlife and retaining the natural interest of a site where appropriate. d) Supporting the identification, mapping, creation and restoration of habitats that contribute to habitat targets in the National and Regional biodiversity strategies and the local Biodiversity Action Plan. 4. Wherever possible a strategic approach will be taken to increasing connectivity to the District's Green Infrastructure including improving the network of linked open spaces and green corridors and promoting opportunities to increase its multi-functionality. This will be informed by the Leeds City Region Infrastructure Strategy. 5. Identifying, protecting and enhancing locally distinctive landscapes, areas of tranquillity, public rights of way and access, open spaces and playing fields through Development Plan Documents. 6. Encouraging incorporation of positive biodiversity actions, as defined in the local Biodiversity Action Plan, at the design stage of new developments or land uses. 7. Ensuring that new development protects soil, air and water quality from all types of pollution. 8. Ensuring developments minimise energy and water consumption, the use of non-renewable resources, and the amount of waste material. 9. Steering development to areas of least environmental and agricultural quality.

Similarly, the East Riding of Yorkshire Council has produced a Local Plan which contains a suite of planning documents that together provide the long-term development plan for the East Riding. This plan was adopted in 2016 and covers the period to 2012-2029. Within the Strategy Document, which sets the overall strategic direction for the Local Plan, the following policy is relevant to this scheme, as detailed in Table 4-2.

Table 4-2: Relevant Policies from the East Riding Local Plan

Policy	Description
ENV4	<p>A. Proposals that are likely to have a significant effect on an International Site will be considered in the context of the statutory protection which is afforded to the site.</p> <p>B. Proposals that are likely to have an adverse effect on a National Site (alone or in combination) will not normally be permitted, except where the benefits of development in that location clearly outweigh both the impact on the site and any broader impacts on the wider network of National Sites.</p> <p>C. Development resulting in loss or significant harm to a Local Site, or habitats or species supported by Local Sites, whether directly or indirectly, will only be supported if it can be demonstrated there is a need for the development in that location and the benefit of the development outweighs the loss or harm.</p> <p>D. Where loss or harm to a National or Local designated site, as set out in Table 9, cannot be prevented or adequately mitigated, as a last resort, compensation</p>

Policy	Description
	<p>for the loss/harm must be agreed. Development will be refused if loss or significant harm cannot be prevented, adequately mitigated against or compensated for.</p> <p>E. Proposals should further the aims of the East Riding of Yorkshire Biodiversity Action Plan (ERYBAP), designated Nature Improvement Areas (NIAs) and other landscape scale biodiversity initiatives. To optimise opportunities to enhance biodiversity, proposals should seek to achieve a net gain in biodiversity where possible and will be supported where they:</p> <ol style="list-style-type: none"> 1. Conserve, restore, enhance or recreate biodiversity and geological interests including the Priority Habitats and Species (identified in the ERYBAP) and Local Sites (identified in the Local Sites in the East Riding of Yorkshire). 2. Safeguard, enhance, create and connect habitat networks in order to: <ol style="list-style-type: none"> i. protect, strengthen and reduce fragmentation of habitats; ii. create a coherent ecological network that is resilient to current and future pressures; iii. conserve and increase populations of species; and iv. promote and enhance green infrastructure.

4.2.3 Biodiversity Action Plans

'Biodiversity: The UK Biodiversity Action Plan (BAP) (UK Biodiversity Partnership, 2007)' was developed in response to The Earth Summit, held in Rio de Janeiro in 1992. The UK BAP lists a number of priority habitats and species for conservation action in the UK. Although the Action Plan does not confer any statutory legal protection, in practice many of the species listed already receive statutory legal protection under UK and/or European legislation and are a material consideration in planning decisions.

As part of the action plan process, Local BAPs (LBAPs) must be produced for every county in the UK. LBAPs highlight local biodiversity issues and set out a series of objectives and action plans for the conservation of priority species and habitats where they occur in each district, county or region.

Selby District Council, in partnership with several other organisations including the Danvrm Drainage Commissioners, produced a Local BAP for the Selby District (Selby District Council, 2004). This document was published in 2004 and outlines wildlife conservation priorities and provides guidance for the protection and enhancement of the local biodiversity. The plan contains 13 Habitat Action Plans and 12 Species Action Plans, including several for groups of species such as bats, bumble bees and clearwing moths.

In 2010 the East Riding of Yorkshire District Council and partners adopted the East Riding of Yorkshire Biodiversity Action Plan (ERYBAP) Strategy. This strategy sets the overall picture for the ERYBAP as a whole and the framework for how the other sections of the document will be developed (East Riding of Yorkshire Council, 2010). It does not detail specific actions and targets for habitats or species at this stage.

The Danvrm Drainage Commissioners also have their own BAP, produced in accordance with the commitment in the Implementation Plan of the DEFRA Internal Drainage Board Review for IDBs to produce their own BAPs. This plan was first produced in 2010, and subject to an update in 2015. It contains habitat action plans relating 'standing open waters and canals' and 'boundary and linear features', along with species actions plans for Water Vole, Barn Owl, Great Crested Newt and Common Toad and Common Frog (Danvrm Drainage Commissioners, 2015).

4.3 Methodology

4.3.1 Desk-based Study

A desk-based study was undertaken to collate information on statutory and non-statutory nature conservation sites within a 5km and 2km radius of the study area, respectively. Records of species that are afforded legal protection or are otherwise of nature conservation importance within the study area were also collected. Information has also been sought on BAP and other conservation notable species within the study area.

Data for the desk-based study was collected from the following sources:

- Multi-agency Geographical Information Centre (MAGIC) website
- North and East Yorkshire Ecological Data Centre (NEYEDC)
- Selby Local Biodiversity Action Plan (LBAP)
- East Riding of Yorkshire LBAP
- Danvum Drainage Commissioners BAP

A review of the 1:10,000 Ordnance Survey (OS) map was also undertaken to identify ponds within the study area, and within 500m of the works areas, with potential to support Great Crested Newt *Triturus cristatus*.

4.3.2 Field Survey Methodologies

As discussed in section 1.2, this project has been in development for a considerable period of time, with it being postponed in 2013. Consequently, field surveys have been undertaken periodically throughout 2008 to 2011 and in 2016-17.

Extended Phase 1 Habitat Survey

An extended Phase 1 habitat survey of the study area was undertaken in August 2008, updated in November 2011, and then again in April 2017. These surveys have been conducted in accordance with the standard methodology described by the Joint Nature Conservation Committee (JNCC, 2010). This nationally recognised survey method allows for the broad classification of habitat types and rapid assessment of the ecological potential of an area. The standard Phase 1 habitat survey was 'extended' to include recording of the key botanical components of the habitats and searches for evidence indicating the presence of protected species, or habitat potentially suitable for them. Any areas with the potential to support protected species were investigated further during subsequent surveys.

Bird Surveys

All wild birds, their nests and eggs are, with few exceptions, fully protected by law. In addition, over eighty species, or groups of species, are listed under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). These species are specially protected by increased penalties and cannot be intentionally disturbed when nesting or have dependent young, with additional protection also provided to species listed in Annex IV of the Habitats Directive.

In order to inform the production of this ES, surveys of the main subsidence flashes were undertaken for wintering wetland birds in Autumn/Winter 2009/2010. In addition, all bird species observed during other surveys conducted as part of the EIA were also recorded.

The surveys of the subsidence flashes followed a method based on a modified version of the British Trust for Ornithology's (BTO) Wetland Bird Survey (WeBS) core count method (see Gilbert *et al.*, 1998 for details). This method is in turn based on the 'look-see' methodology (Bibby *et al.*, 2000) where an observer familiar with wetland species records those present within particular site boundaries. For the purposes of this survey, the survey boundaries were defined as the main subsidence flashes with potential to be affected by the development and their immediate surroundings.

Water Vole Survey

The Water Vole *Arvicola amphibius* is fully protected under the Wildlife and Countryside Act 1981 (as amended). The legal protection makes it an offence to intentionally kill, injure or take a Water Vole, intentionally damage, destroy or obstruct access to any place or structure which Water Voles use for shelter or protection, or to disturb Water Voles whilst they are using such a place.

All IDB maintained watercourses to be affected by the proposed works, other drains to be re-graded, and adjoining watercourses, were surveyed in June and July 2009 for the presence of Water Vole. Further surveys were undertaken in August 2011, May 2016 and April 2017. The standard Environmental Assessment field survey method outlined in Strachan *et al.* (2011) was used. Field signs were searched for within the survey area, and an assessment made of the suitability of the habitat for Water Voles.

The most important, diagnostic field sign for Water Voles is the presence of latrine sites. These are locations repeatedly used by Water Voles to deposit their droppings, often in prominent locations

along the bank. Other field signs include the presence of burrows, feeding sites and footprints. Although these provide indications of presence and are useful supporting evidence to latrines, they are of limited value on their own.

Badger Survey

Badgers *Meles meles* and their setts are protected under the Protection of Badgers Act 1992. This legislation arises from animal welfare issues (rather than on the basis of nature conservation grounds) and essentially protects Badgers from killing, injuring, capture and disturbance. It is also an offence to intentionally damage, destroy or obstruct access to an area actively used by Badgers for breeding, resting or sheltering (i.e. their setts).

The study area was searched for evidence of Badger activity, including the presence of setts, regularly used paths through vegetation, footprints, foraging marks, dung pits (latrines) and hairs, in 2009 and again in 2011 and 2017.

Furthermore, in April 2017 camera traps were deployed on a series of holes beneath dense scrub vegetation on Court Drain that were inconclusive as to if they were used by Badger. These camera traps remained on site for a period of two weeks, with footage analysed to determine what species was using these holes.

Otter Survey

The European Otter *Lutra lutra* is a European Protected Species (EPS) protected under the Conservation of Habitats and Species Regulations 2010 (as amended), making it an offence to:

- Deliberately capture, injure or kill an Otter.
- Deliberately disturb an Otter such as to affect local populations or breeding success.
- Damage or destroy an Otter holt, possess or transport an Otter or any part of an Otter.
- Sell or exchange an Otter.

Otters also receive protection under the Wildlife and Countryside Act 1981 (as amended), which makes it an offence to intentionally or recklessly disturb any Otter whilst within a holt or intentionally or recklessly obstruct access to a holt.

The Otter survey method was based on the standard works of RSPB (1994); Chanin (2003); and Strachan *et al.* (2011). This involved walking the survey area, examining banks and prominent features for spraints (droppings) and footprints. A search was also made for possible holt and couch (resting) sites. Otters are extremely difficult to observe, and this method provides the most effective and efficient means of investigating presence or absence.

Great Crested Newt Survey

The Great Crested Newt is listed on Annexes II and IV of the Habitats Directive and Appendix II of the Bern Convention. It is protected under Schedule 2 of the Conservation of Habitats and Species Regulations 2010 (as amended) and Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). Under these pieces of legislation, it is an offence to:

- Intentionally or recklessly kill, injure or take a Great Crested Newt or its eggs.
- Intentionally or recklessly disturb a Great Crested Newt.
- Intentionally or recklessly damage, destroy or obstruct access to a breeding site or resting place of a Great Crested Newt.

Habitat features with the potential to support Great Crested Newt were recorded. Such features can include: ponds with habitat suitable for breeding newts; piles of logs, stones or other debris; cracks in the ground; stone or rubble covered ground, and any other features that could support newts.

Pond Assessment

The review of OS maps conducted in 2011 identified four ponds within the study area, along with five subsidence flashes, bringing the total number of waterbodies to nine. Eight of these ponds/subsidence flashes were located within 500m of the works areas and not separated from them by a significant barrier to newt movement (e.g. the Aire and Calder Navigation, A19). Reassessment of the habitats present on site in April 2017 identified a further three ponds within the western part of Watkin's Lower Planation. Furthermore, the number and distribution of

subsidence flashes had altered by 2017, with the largest flash to the west of Heck Lane no longer in existence, but a new flash having developed immediately north of Balne Common Drain. In the north-west of the study area, the subsidence flash to the south of Drain No. 71 had also dried up and was cropped, however, two smaller subsidence areas alongside Drain No. 71 had developed. By mid-April 2017 both of these subsidence flashes had dried up and were only evident in the fields as areas of bare, muddy ground or swamp vegetation. Figure 4-1 below identifies the waterbodies that have been recorded within the study area over the entire survey period, 2008 to 2017. Throughout this chapter, each waterbody will be referenced using the numbers detailed on this map which relate to the Target Notes recorded during the Phase 1 Habitat surveys.

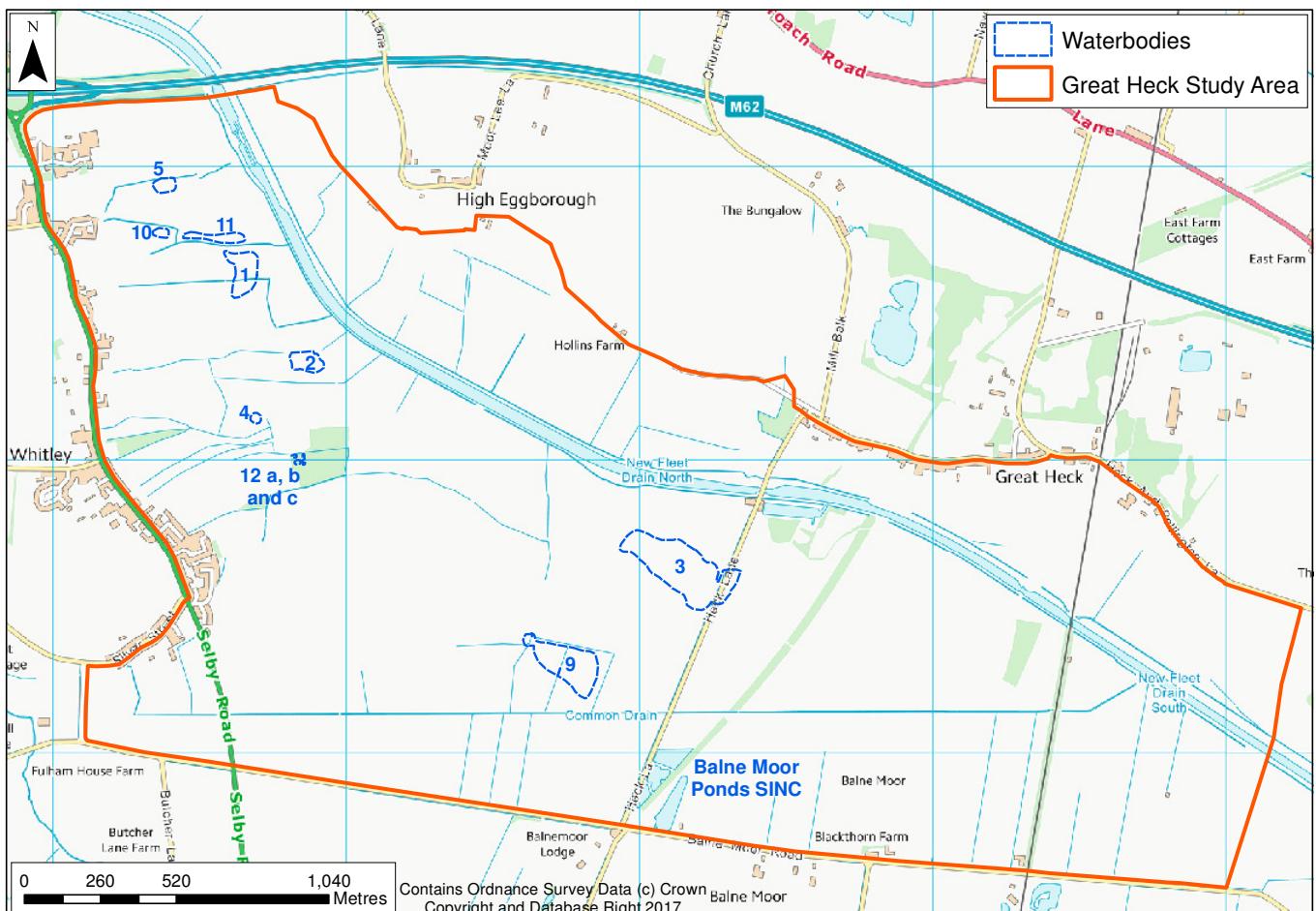


Figure 4-1: Waterbodies recorded within the Great Heck Study Area

For the waterbodies identified between 2008 and 2017, an assessment was made as to whether the aquatic habitat had the potential to support Great Crested Newts using the Habitat Suitability Index (HSI; Oldham *et al.* 2000). The HSI is a scoring method which is a means of evaluating habitat quality for Great Crested Newts using ten suitability indices. The HSI provides a numerical index between 0 and 1, where 0 indicates unsuitable habitat and 1 indicates optimal habitat.

eDNA Assessment

Due to the large number of waterbodies across the site, and the results of the HSI assessment (see section 4.5.6) an environmental DNA (eDNA) survey was conducted on 2nd May 2017 to determine the presence/absence of Great Crested Newt. This technique, which can be carried out between mid-April and June, tests the water for any background Great Crested Newt DNA in the water environment, for example from skins cells or faeces. The approved eDNA sampling technique was followed for testing Great Crested Newt presence/absence at the identified waterbodies. The eDNA results were analysed by the Food and Environment Research Association (FERA) using analysis methods stipulated by the Natural England (Biggs *et al.* 2014). The samples were all determined acceptable in terms of integrity criteria for lab analysis to be conducted, with the exception of the sample from flash 4 which was found to be degraded due to the substantial amount of sediment

within this sample. This is not thought to be a significant limitation to the accuracy of the eDNA sampling as by spring 2017 this flash was significantly dry and therefore considered unsuitable for newts. Balne Moor Ponds SINC was not sampled as it is known to be used for fishing.

Bat Survey

All British bat species are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended), and are included on Schedule 2 of the Conservation of Habitats and Species Regulations 2010 (as amended), EPS. Taken together these pieces of legislation make it an offence to:

- Deliberately capture, injure or kill a bat.
- Intentionally or recklessly disturb a bat in its roost or deliberately disturb a group of bats.
- Damage or destroy a bat roosting place (even if bats are not occupying the roost at the time).
- Intentionally or recklessly obstruct access to a bat roost.

Bat Roost Potential Assessment

Structures and trees likely to be impacted by the proposed works were inspected to determine their potential value for roosting bats, using the methods specified in the Bat Conservation Trust (BCT) Bat Surveys for Professional Ecologists - Good Practice Guidelines (3rd ed.) (Collins, 2016).

The roosting potential of buildings, structures and trees on the site were categorised as having either 'negligible', 'low', 'medium' or 'high' roosting potential and this was determined by applying the definitions given within the BCT Guidelines. Evidence of bat activity associated with potential roost sites includes bat droppings, urine staining, feeding remains and dead/alive bats. Indicators that potential roost locations and access points are likely to be inactive include the presence of cobwebs and general detritus within the apertures.

Potential Roosting Features (PRFs) on trees include cracks, crevices, loose bark, woodpecker holes and splits. Evidence indicating bat presence, including dark stains running below holes or cracks, bat droppings, odours, or scratch marks.

Furthermore, the importance for habitats across the site to support commuting and foraging bats was assessed in terms of habitat type, abundance, connectivity and distribution. These were categorised as having either 'negligible', 'low', 'medium' or 'high' value for bats which was determined by applying the categories given within the BCT Guidelines.

Bat Activity Surveys

Trees identified as having moderate PRF for bats were surveyed at dusk on the 2nd May 2017 and 22nd May 2017.

For each survey, three experienced surveyors using Anabat Walkabout and Batbox Duet detectors, were positioned with clear views of the trees from between 15 minutes before sunset to one and a half hours after sunset.

Bat activity was recorded and evidence of any bats emerging from roosts in the trees was noted.

The first survey commenced at 20:22 (sunset 20:37) and finished at 22:10. The temperature was 11°C, dropping to 8°C and the weather was generally clear and cool. The second survey commenced at 20:40 (sunset 21:10) and finished at 22:40. Temperatures dropped from 22°C to 18°C, the weather was generally clear with a short passing storm cloud with associated gusts of wind and a brief shower between 21:00 and 21:10.

Other Amphibians and Reptiles

Legal protection varies considerably for different species. Smooth Snake *Coronella austriaca*, Sand Lizard *Lacerta agilis* and Natterjack Toads *Epidalea calamita* are EPS receiving the same protection as Great Crested Newt. Under the Wildlife and Countryside Act 1981 (as amended) Adder *Vipera berus*, Grass Snake *Natrix natrix*, Common Lizard *Zootoca vivipara* and Slow Worm *Anguis fragilis* are protected from intentional killing or injuring, additionally Common Frogs *Rana temporaria*, Common Toads *Bufo bufo* and other newt species are prohibited from sale.

Whilst no specific reptile surveys were conducted as part of this EIA, an assessment of the habitat suitability of the area for reptiles and other amphibians was made, involving inspection of the site

for key habitat features such as refuges, open sandy areas and interfaces between different habitat types (English Nature, 2004 and Froglife, 1999).

Other Notable Species

Whilst undertaking the surveys as described above, the presence of any other species of conservation and/or notable interest were considered and noted where seen (e.g. Brown Hare *Lepus europaeus* and Selby LBAP species).

Invasive Non-native Species

Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) lists invasive non-native plant species, or groups of plants, and invasive non-native animal species. It is an offence to release or cause to spread in the wild any of these species. Some of the plant species (e.g. Japanese Knotweed *Fallopia japonica*) are also considered as controlled waste and any plant material or soils in the vicinity of these plants requires handling via strict methods.

Any invasive non-native species observed during the survey were recorded. For stand-forming plant species, the extents of such stands were mapped.

4.4 Baseline Desk-based Study

4.4.1 Nature Conservation Sites

Statutory Nature Conservations Sites

There are no statutory designated nature conservation sites located within the study area.

There are no statutory designated nature conservation sites of international importance (e.g. SAC, SPA, Ramsar Site) within 5km of the study area. There are two SSSI within 5km of the study area, the details of which are summarised in Table 4-3 and shown on Figure 4-2.

Table 4-3: Statutory Nature Conservation Sites within 5km of Study Area

Site Name	Distance from Study Area	Reasons for Designation
Forlorn Hope Meadows SSSI	3.5km to south-west	Traditional hay meadow and wet neutral grassland
Went Ings Meadows SSSI	4.9km to south-east	Unimproved neutral grassland, with some damp areas

Based on the distance of Forlorn Hope Meadows and Went Ings Meadows SSSIs from the site of the proposed works, and the lack of hydrological connectivity with the study area, it is concluded that there would be no direct or indirect impact upon these sites from the proposed works. Therefore, no further assessment relating to these SSSIs is included within this ES.

Non-statutory Nature Conservations Sites

There are three non-statutory nature conservation sites within the study area. These are designated by Selby District Council and the East Riding of Yorkshire Council and are known as SINCs in Selby District and LWS in the East Riding. There are a further 12 SINC/LWS within 2km of the study area, as detailed in Table 4-4 and shown on Figure 4-2; a total of 15 sites. Sites over 2km away are considered to be sufficiently distant that significant effects are unlikely to occur as a result of the proposed works.

Within Selby District there are a number of SINC that have been deleted by the North Yorkshire SINC panel as they have been surveyed and assessed against selection guidelines and found not to qualify for such a designation. These 'deleted SINC' are included in Table 4-4 as some district planning authorities still refer to these sites in their local plans and they are therefore considered in any planning applications. Whilst this project is not subject to planning these 'deleted SINC' are included for completeness.

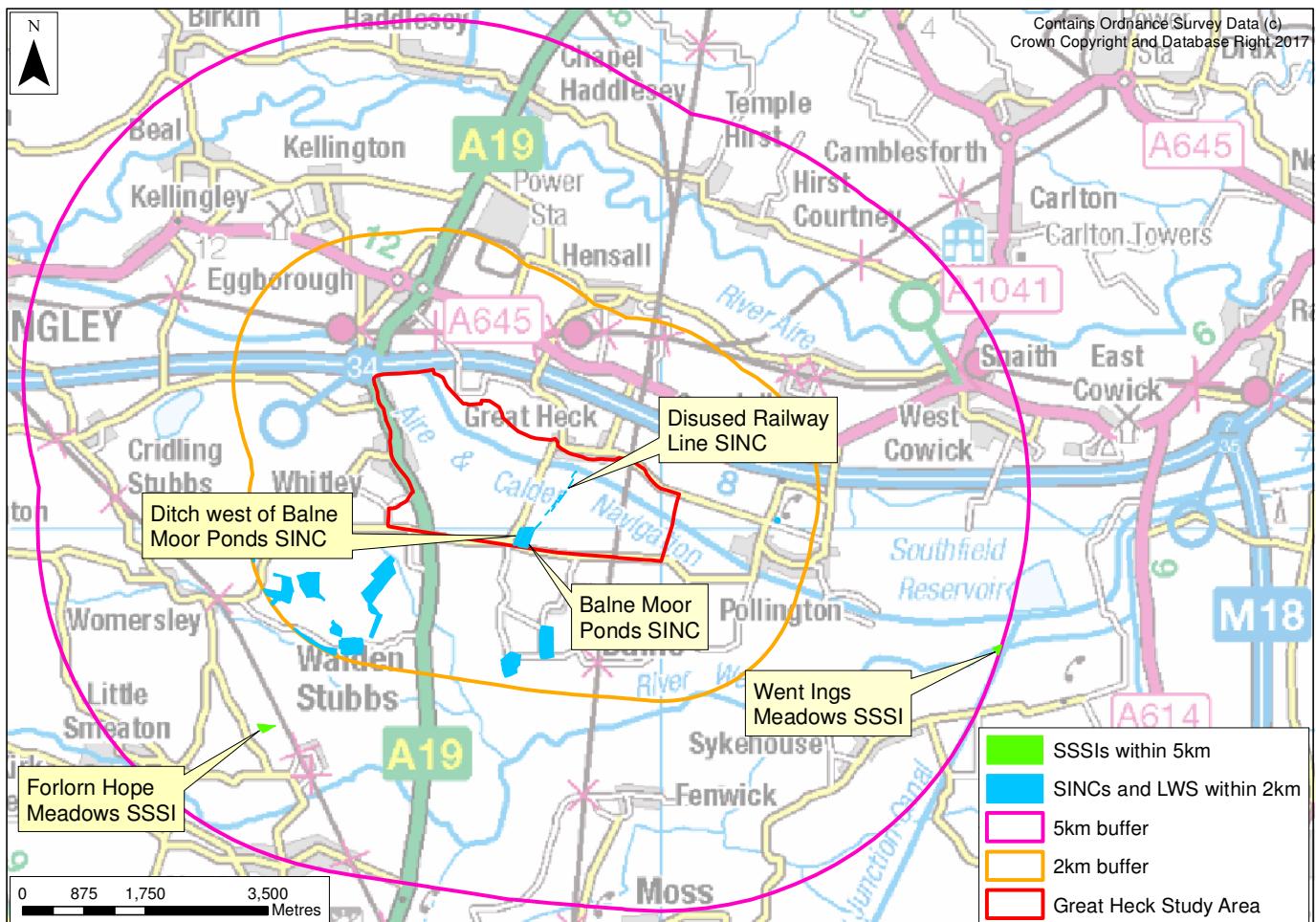


Figure 4-2: Nature Conservation Sites Within and Around the Study Area

Table 4-4: SINCs and LWS within 2km of the Study Area

Site Name	Distance from Study Area	Site Status	Grid Reference
Balne Moor Ponds	Within study area, to east of Heck Road	SINC	SE 581 199
Disused Railway Line	Within study area, to east of Heck Road stretching from Balne Common Drain to the canal	Deleted SINC	SE 584 203
Ditch West of Balne Moor Ponds	Within study area, to west of Heck Road	SINC	SE 580 199
Sand Quarry, Great Heck	Adjacent to north-east boundary of study area	Deleted SINC	SE 598 209
Saulcroft Wood	380m to south-west	Deleted SINC	SE 559 187
Parkshaw Wood	1.0km to south	Deleted SINC	SE 584 184
Disused Pit [part in Eggborough]	1.0km to north	Deleted SINC	SE 579 226
Broad Oak Spring	1.2km to south-west	SINC	SE 550 192
Sand Quarry, Pollington	1.3km to east	Candidate LWS	SE 617 201
Barn Fall Wood	1.5km to south	Deleted SINC	SE 579 181
Busky Wood	1.6km to south-west	Deleted SINC	SE 554 185
Clipshall Wood	1.6km to south-west	Deleted SINC	SE 545 191

Site Name	Distance from Study Area	Site Status	Grid Reference
Ox Stocking Wood, Womersley	1.6km to south	SINC	SE 556 183
Great Lawn Rein, Womersley	1.7km to west	SINC	SE 544 214
Brown Ings Wood	1.9km to south-west	SINC	SE 548 184

The three SINC sites within the study area are located in close proximity to Balne Common Drain and Connecting Drain 2 and therefore these three sites may be impacted upon.

The other 12 non-statutory designated nature conservation sites are located outside of the study area and are considered to be at sufficient distance to avoid any direct or indirect impacts from the proposed works. This includes Sand Quarry, Great Heck deleted SINC which is located adjacent to the north-east boundary of the study area. It is not considered that this site will be impacted upon as it is located outside the study area with the village of Great Heck, has no hydrological connection to the site and is separated from the works areas by the disused railway. Therefore, no further assessment relating to these non-statutory designated sites is included within this ES.

4.4.2 Habitats

A summary of the Habitats of Principal Importance (under Section 41 of the NERC Act 2006) and the Selby LBAP habitats located within the study area is given in Table 4-5. As mentioned in Section 4.2.3 above the ERYBAP are still to devise action plans for the district.

Table 4-5: Habitats of Biodiversity Importance within the Study Area

Habitat	Biodiversity Importance	Presence within Study Area
Ponds Lakes and ponds	S41 List Habitat Selby LBAP Habitat	Scattered throughout study area
Hedgerows Ancient and/or species-rich hedgerows	S41 List Habitat Selby LBAP Habitat	Scattered across study area along some field boundaries
Arable Field Margins	S41 List Habitat	Scattered throughout study area
Arable Farmland	Selby LBAP Habitat	Dominant habitat type in study area
Woodland	Selby LBAP Habitat	Woodland is limited in study area, but is present in a narrow strip along the disused railway, in small pockets within Watkin's Lower and Higher Plantations, Shaw Wood, Heck Hall Wood and around Whitley Lodge.
Canals	Selby LBAP Habitat	The Aire and Calder Navigation passes through the study area
Rivers, Streams and Ditches	S41 List Habitat (Rivers) Selby LBAP Habitat	Ditches are a predominant feature of the landscape, both IDB adopted watercourses and smaller land drains
Towns and Villages	Selby LBAP Habitat	Parts of the villages of Whitley and Great Heck fall within the study area

The Danvrm Drainage Commissioner's BAP includes the following habitats relevant to the study area (JBA Consulting, 2015):

- Standing Open Water and Canals
- Boundary and Linear Features

4.4.3 Protected and Notable Species

The information in Table 4-6 has been compiled from records obtained from the NEYEDC and the Danvrm Drainage Commissioners. Relevant (post-2000) records within 2km of the study area are detailed.

Table 4-6: Protected and Notable Species Recorded within 2km of the Study Area

Species	Location	Record Date	Legal Protection
Mammals			
Badger <i>Meles meles</i>	There is a record of one sett within the study area and two others within 2km of the study area boundary. The exact location of the setts is sensitive and therefore not provided in this ES.	2004 2007 2008	Protected under the Protection of Badgers Act 1992
Common Pipistrelle <i>Pipistrellus pipistrellus</i>	Whitley (SE565204)	2015	Protected under the Conservation of Habitats and Species Regulations 2010 (as amended) and the Wildlife and Countryside Act 1981 (as amended) Included within the bats action plan of the Selby LBAP
Pipistrelle sp. <i>Pipistrellus sp.</i>	Pollington (SE610197)	2002 and 2001	Protected under the Conservation of Habitats and Species Regulations 2010 (as amended) and the Wildlife and Countryside Act 1981 (as amended) Included within the bats action plan of the Selby LBAP
Water Vole <i>Arvicola amphibius</i>	Kellington Lane Drain	2007	Receives full protection under the Schedule 5 of Wildlife and Countryside Act 1981 (as amended) S41 list and Selby LBAP species
Amphibians and Reptiles			
Common Toad <i>Bufo bufo</i>	SE5422	2007	Protected under the Schedule 5 of Wildlife and Countryside Act 1981 (as amended) S41 list species
Birds			
Barn Owl <i>Tyto alba</i>	Heck Hall Farm (599202) High Eggborough (SE569216) Cross Hill Farm (SE603187) Low Eggborough (SE545228)	2001 and 2002 2000-2002 2001 and 2002 2000	Species is listed on Appendix 2 of the Bern Convention Protected under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) Selby LBAP Species (as part of Grazing Marsh Habitat Action Plan)
Blue Tit <i>Cyanistes caeruleus</i>	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2009)	2009	Species is listed on Appendix 2 of the Bern Convention
Coal Tit <i>Periparus ater</i>	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2009)	2009	Species is listed on Appendix 2 of the Bern Convention
Corn Bunting <i>Emberiza calandra</i>	Several records throughout study area associated with Bird Conservation Targeting Project 2001-2009	2005-2010	UK BAP Species Selby LBAP Species (as part of Arable Farmland Habitat Action Plan)
Cuckoo <i>Cuculus canorus</i>	Disused Pit (Part in Eggborough) SINC (SE579226)	2000	S41 list Species
Curlew <i>Numenius arquata</i>	Several records throughout study area associated with Bird Conservation Targeting Project 2001-2009	2004-2010	Species is listed on Appendix 2 of the Bonn Convention (Convention on Migratory Species) Listed by the IUCN (2001) as Lower Risk - near threatened S41 list Species

Species	Location	Record Date	Legal Protection
Dunnock <i>Prunella modularis</i>	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2009)	2009	Species is listed on Appendix 2 of the Bern Convention UK BAP Species
Goldfinch <i>Carduelis carduelis</i>	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2009)	2009	Species is listed on Appendix 2 of the Bern Convention
Grasshopper Warbler <i>Locustella naevia</i>	SE52K	2001-2006	S41 list Species
Greater Spotted Woodpecker <i>Dendrocopos major</i>	SE619195 and SE594210 (records associated with the RSPB Big Garden Birdwatch (winter 2009))	2009	Species is listed on Appendix 2 of the Bern Convention
Great Tit <i>Parus major</i>	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2009)	2009	Species is listed on Appendix 2 of the Bern Convention
Greenfinch <i>Carduelis chloris</i>	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2009)	2009	Species is listed on Appendix 2 of the Bern Convention
Grey Partridge <i>Perdix perdix</i>	Several records throughout study area associated with Bird Conservation Targeting Project 2001-2009 Saulcroft Wood	2004-2010 2006	S41 list Species Selby LBAP Species (as part of Arable Farmland Habitat Action Plan)
House Sparrow <i>Passer domesticus</i>	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2009)	2009	S41 list Species
Kestrel <i>Falco tinnunculus</i>	Numerous records from study area relating to British Waterways (now Canal and River Trust) surveys	2000-2002	Species is listed on Appendix 2 of the Bern Convention Species is listed on Appendix 2 of the Bonn Convention (Convention on Migratory Species)
Lapwing <i>Vanellus vanellus</i>	Several records throughout study area associated with Bird Conservation Targeting Project 2001-2009	2004-2010	Species is listed on Appendix 2 of the Bonn Convention (Convention on Migratory Species) S41 list Species Selby LBAP Species (as part of Grazing Marsh Habitat Action Plan)
Lesser Spotted Woodpecker <i>Dendrocopos minor</i>	SE61E (records associated with Bird Conservation Targeting Project 2001-2009)	2001-2009	Species is listed on Appendix 2 of the Bern Convention S41 list Species
Little Owl <i>Athene noctua</i>	Great Heck (SE566217)	2001	Species is listed on Appendix 2 of the Bern Convention
Mallard <i>Anas platyrhynchos</i>	Several records throughout study area	2005-2008	Species is listed on Appendix 2 of the Bonn Convention (Convention on Migratory Species)
Moorhen <i>Gallinula chloropus</i>	SE557202	2006	Species is listed on Appendix 2 of the Bonn Convention (Convention on Migratory Species)
Pied Wagtail <i>Motacilla alba</i>	SE557233	2009	Species is listed on Appendix 2 of the Bern Convention
Redshank <i>Tringa totanus</i>	SE52V	2005-2010	Species is listed on Appendix 2 of the Bonn Convention (Convention on Migratory Species) Selby LBAP Species (as part of

Species	Location	Record Date	Legal Protection
Robin <i>Erithacus rubecula</i>	Broadoak Spring	2006	Grazing Marsh Habitat Action Plan)
	Saulcroft Wood	2006	Species is listed on Appendix 2 of the Bern Convention
	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2009)	2009	
Skylark <i>Alauda arvensis</i>	SE546193	2006	S41 list Species Selby LBAP Species (as part of Arable Farmland Habitat Action Plan)
Song Thrush <i>Turdus philomelos</i>	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2009)	2009	S41 list Species
Snipe <i>Gallinago gallinago</i>	SE62B	2004-2010	Species is listed on Appendix 2 of the Bonn Convention (Convention on Migratory Species)
	SE5419	2007	S41 list Species Selby LBAP Species (as part of Grazing Marsh Habitat Action Plan)
Sparrowhawk <i>Accipiter nisus</i>	Low Eggborough (SE558232 and SE557233)	2009	Species is listed on Appendix 2 of the Bonn Convention (Convention on Migratory Species)
	Pollington (SE619195)	2009	
Starling <i>Sturnus vulgaris</i>	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2008 and 2009)	2008 and 2009	S41 list Species Selby LBAP Species (as part of Arable Farmland Habitat Action Plan)
Tawny Owl <i>Strix aluco</i>	Heck Hall Farm (SE599202)	2000	Species is listed on Appendix 2 of the Bern Convention
	SE604190	2004	
Tree Sparrow <i>Passer montanus</i>	Several records throughout study area associated with Bird Conservation Targeting Project 2001-2009	2004-2010	S41 list Species Selby LBAP Species (as part of Arable Farmland Habitat Action Plan)
Turtle Dove <i>Streptopelia turtur</i>	SE61D	2004-2010	S41 list Species Selby LBAP Species (as part of Arable Farmland Habitat Action Plan)
Yellowhammer <i>Emberiza citrinella</i>	SE619195	2009	Species is listed on Appendix 2 of the Bern Convention S41 list Species Selby LBAP Species (as part of Arable Farmland Habitat Action Plan)
Yellow Wagtail <i>Motacilla flava</i>	Several records throughout study area associated with Bird Conservation Targeting Project 2001-2009	2005-2010	Species is listed on Appendix 2 of the Bern Convention S41 list Species Selby LBAP Species (as part of Grazing Marsh Habitat Action Plan)
Willow Tit <i>Poecile montanus</i>	Several records throughout study area associated with Bird Conservation Targeting Project 2001-2009	2003-2009	Species is listed on Appendix 2 of the Bern Convention S41 list Species
Wood Warbler <i>Phylloscopus sibilatrix</i>	SE51U	2004-2009	S41 list Species
Wren <i>Troglodytes troglodytes</i>	Several records throughout study area associated with the RSPB Big Garden Birdwatch (winter 2009)	2009	Species is listed on Appendix 2 of the Bern Convention

Species	Location	Record Date	Legal Protection
Invertebrates			
Buff-tailed Bumble Bee <i>Bombus terrestris</i>	SE570210 Pollington Quarry	2009 2000-2002	Included within the bumble bees action plan of the Selby LBAP
Early Bumble Bee <i>Bombus pratorum</i>	Pollington Quarry	2000-2002	Included within the bumble bees action plan of the Selby LBAP
Hairy Dragonfly <i>Brachtron pratense</i>	Balne Moor Ponds (SE581198) Saulcroft Wood	2005 2006	Nationally notable species (estimated to occur within the range of 16 to 100 10km squares)
Large Red Tailed Bumble Bee <i>Bombus lapidarius</i>	Pollington Quarry	2000-2002	Included within the bumble bees action plan of the Selby LBAP
Small Garden Bumble Bee <i>Bombus hortorum</i>	Pollington Quarry	2000-2002	Included within the bumble bees action plan of the Selby LBAP
Wall Butterfly <i>Lasiommata megera</i>	SE572209	2009	Listed by the IUCN (2001) as Lower Risk - near threatened S41 list Species
White-tailed Bumble Bee <i>Bombus lucorum</i>	Pollington Quarry	2000-2002	Included within the bumble bees action plan of the Selby LBAP
Vestal Cuckoo Bee <i>Bombus vestalis</i>	Pollington Quarry	2000-2002	Included within the bumble bees action plan of the Selby LBAP
Vascular Plants			
Bluebell <i>Hyacinthoides non-scripta</i>	Brown Ings Wood Ricketcroft Wood SINC (SE541195) Clipsall Wood SINC (SE546193) Saulcroft Wood (SE558190) Broadoak Spring SINC (SE550192) Disused Pit (Part in Eggborough) SINC (SE579226)	2011 2007 2007 2006 2006 2000	Protected under the Schedule 8 of Wildlife and Countryside Act 1981 (as amended)
Flat-stalked Pondweed <i>Potamogeton friesii</i>	SE5419	2007	Listed by the IUCN (2001) as Lower Risk - near threatened Nationally scarce species (Occurring in 16-100 hectads in Great Britain)
Water Germander <i>Teucrium scordium</i>	Saulcroft Wood (SE558190)	2006	Protected under the Schedule 8 of Wildlife and Countryside Act 1981 (as amended) Listed by the IUCN (2001) as endangered S41 list species Nationally rare species (Occurring in 15 or fewer hectads in Great Britain)
Lower Plants			

Species	Location	Record Date	Legal Protection
Overleaf Pellia <i>Pellia epiphylla</i> Liverwort	SE5718	2009	Nationally notable species (estimated to occur within the range of 16 to 100 10km squares)

There are no records for fish species within the study area, including European Eel *Anguilla anguilla*. However, the Danvrm Drainage Commissioners have anecdotal records of European Eel being sighted within New Fleet Drain South during annual maintenance works. It should be noted that no fish or Eel surveys have been conducted as part of this EIA.

4.5 Field Survey Results

As discussed in section 1.2 and 4.3.2 above, this mining subsidence remediation project has been in development for a considerable period of time, beginning in 2008, until issue of this ES in 2017. The character of the study area has changed considerably during this period. Initially it was very wet, with a number of large subsidence flashes and damp areas. During more recent surveys, undertaken in 2011, the area has been much drier with once wet areas now farmed. For the most recent surveys conducted in 2016/17 the area was again wetter, with more standing water present than in 2011, however, not to the same extent as seen in 2008. The distribution of subsidence flashes has also altered between 2011 and 2017, with the largest flash to the west of Heck Lane no longer in existence, but a new flash having developed immediately north of Balne Common Drain. In the north-west of the study area, the subsidence flash to the south of Drain No. 71 had also dried up and was cropped, however, two smaller subsidence areas alongside Drain No. 71 had developed, although neither of these contained water when surveyed in mid-April 2017, and were only evident in the fields as areas of bare, muddy ground or swamp vegetation indicating that they do hold water during wetter periods.

It is considered that the drying seen at the site in 2011 was due to the exceptionally dry conditions experienced, which were preceded by notably wet years. This drying was further aided by ad hoc, small-scale drainage activities undertaken by others independently of Danvrm Drainage Commissioners operations to the east of Heck Lane. This new drainage ditch through what was the largest flash connects to Court Drain and has prevented the largest flash from re-forming. This ES will report the baseline conditions surveyed in 2008/09 and also more recently during 2011 and 2016/17, however, the assessment of impacts and valuation of features will be based on the current site baseline condition.

4.5.1 Habitats

The results of the extended Phase 1 Habitat Survey are shown on Figure 4-3, Figure 4-4 and Figure 4-5; Figure 4-3 shows the habitats present in August 2008, Figure 4-4 shows those present in November 2011 and Figure 4-5 shows those habitats present in April 2017. Target Notes recorded in all Phase 1 Habitat Surveys are shown on Figure 4-6 and detailed in Table 4-7.

The habitats within the study area are, for the most part, typical of the agricultural landscape of the area. The study area is dominated by large arable fields, with some areas of improved and semi-improved grassland, particularly around the subsidence flashes and to the north-east of the canal. Many of the field boundaries are marked by drainage ditches and a few are bounded by species-poor, frequently clipped hedgerows, however, hedgerows are not an abundant feature of the landscape in this area. There are a number of shallow ephemeral waterbodies across the study area, created as a result of the mining subsidence. The following sections provide a summary description of each habitat type.

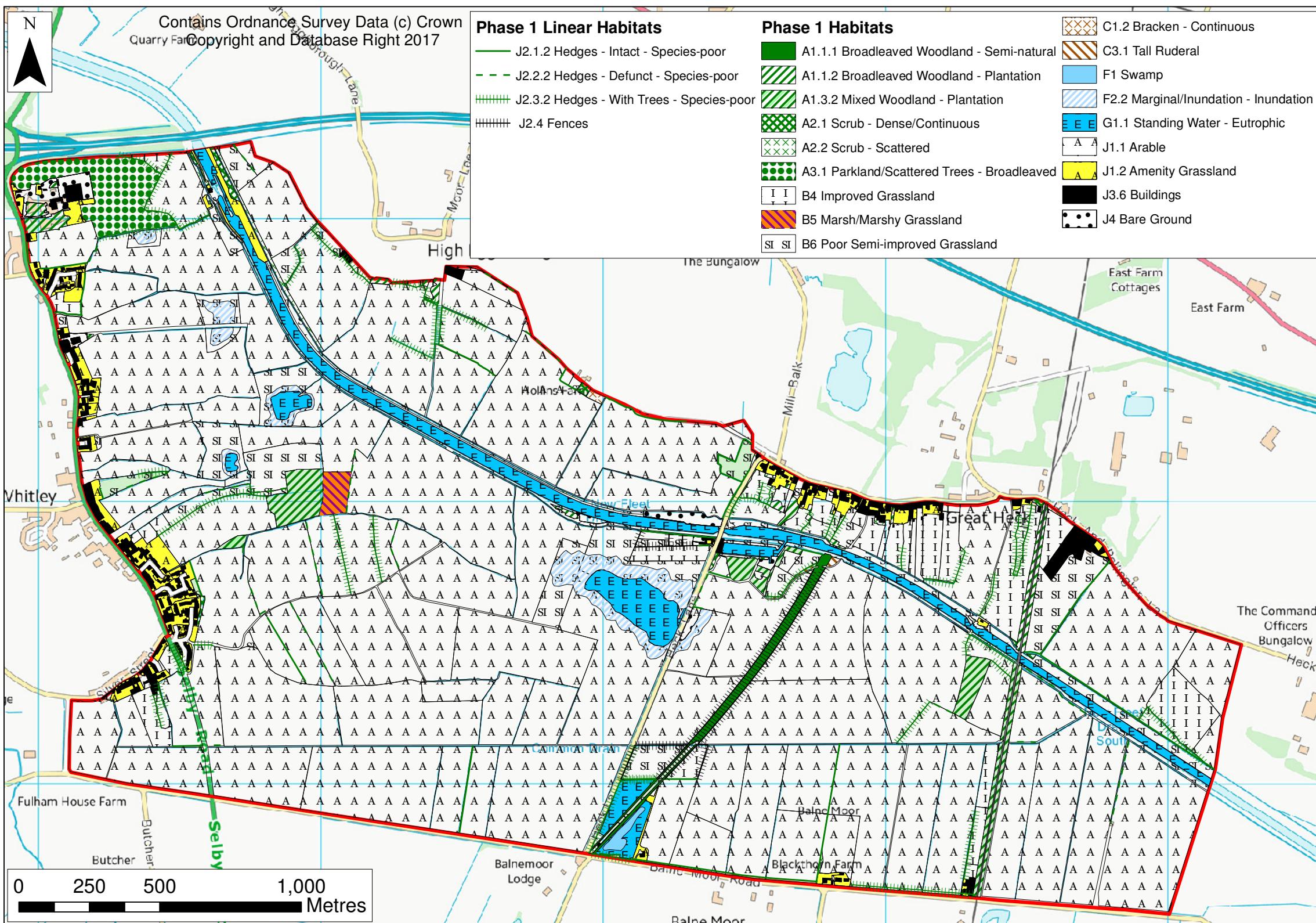


Figure 4-3: Phase 1 Habitat Map from 2008

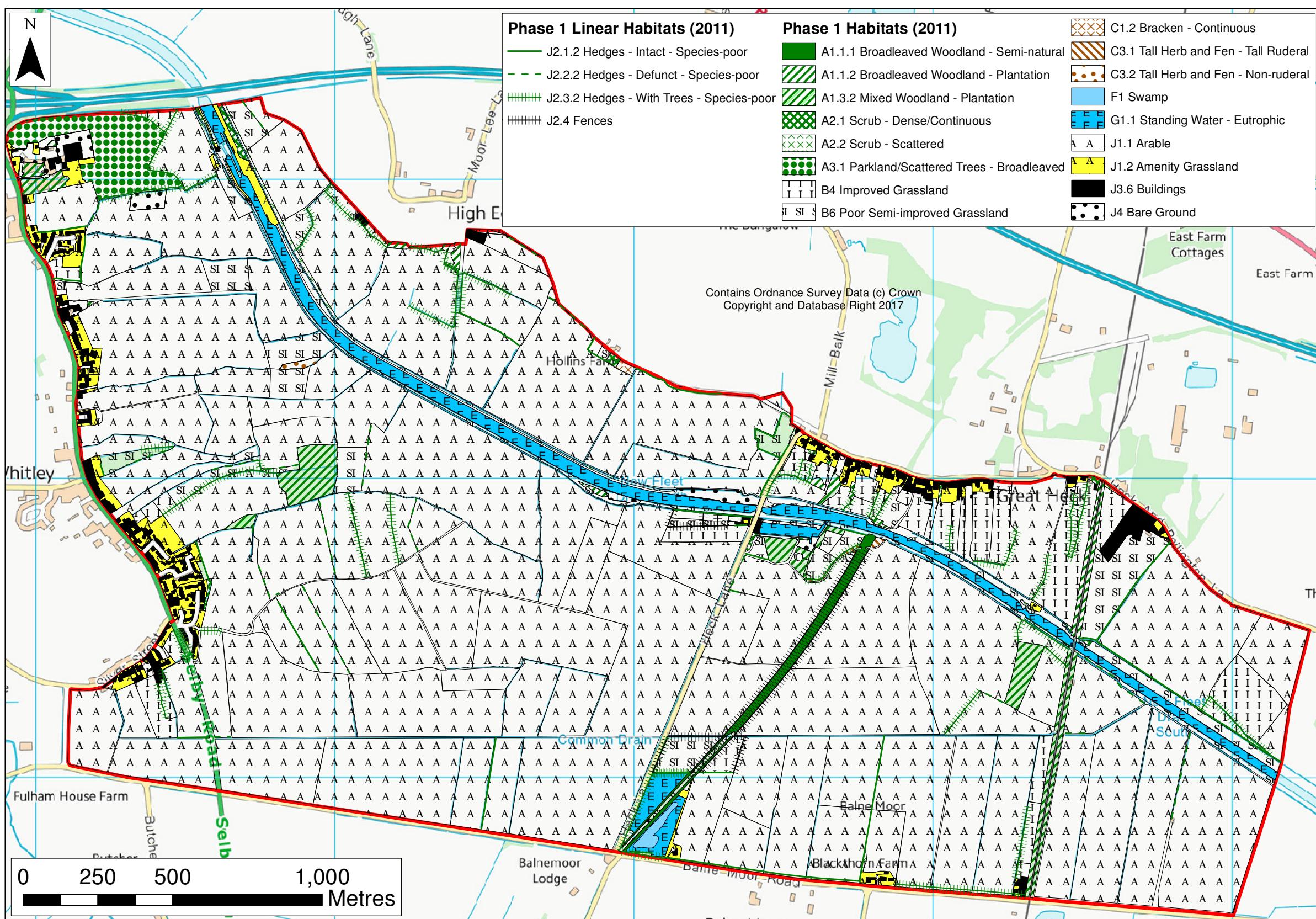


Figure 4-4: Phase 1 Habitat Map from 2011

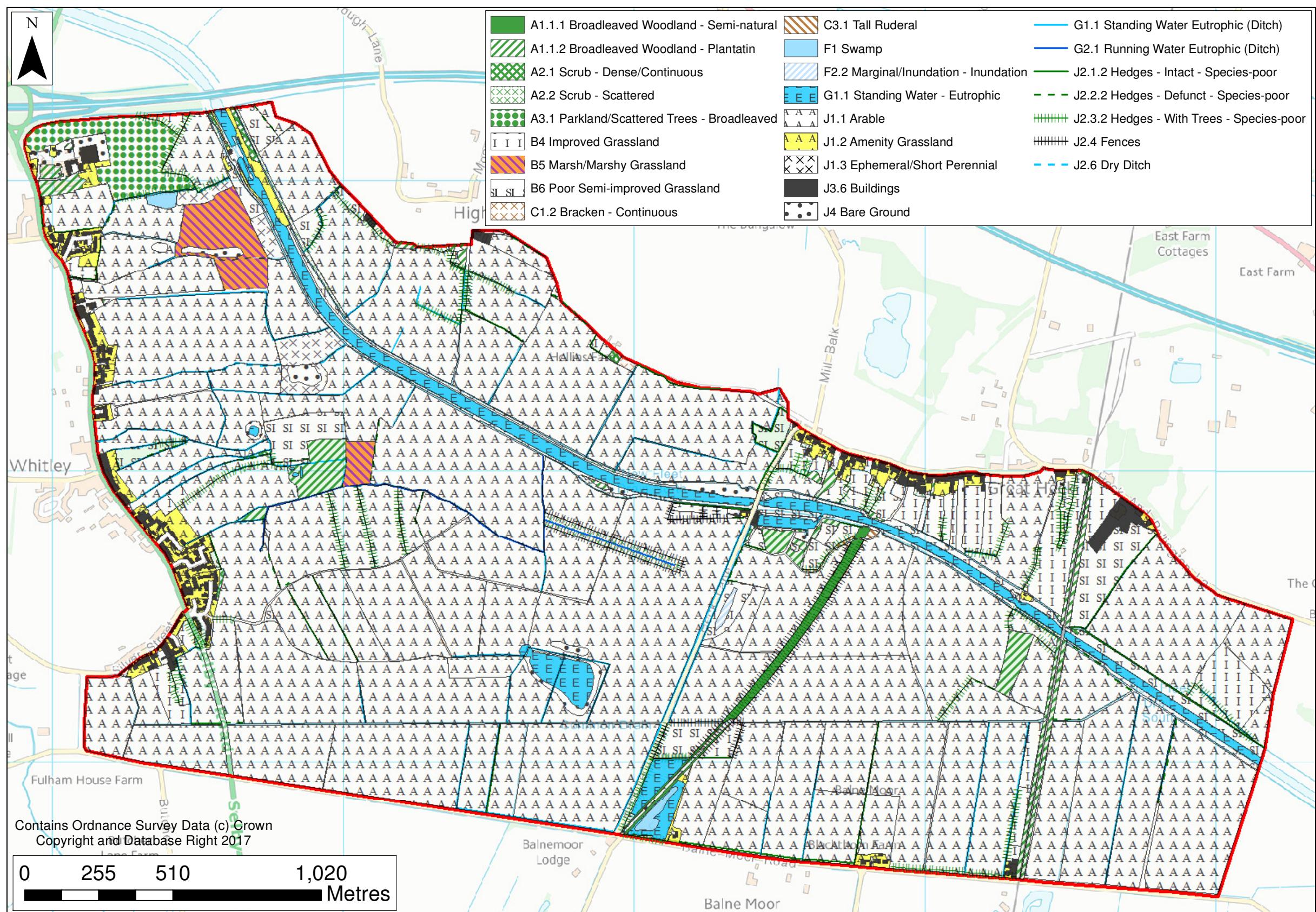


Figure 4-5: Phase 1 Habitat Map from 2017

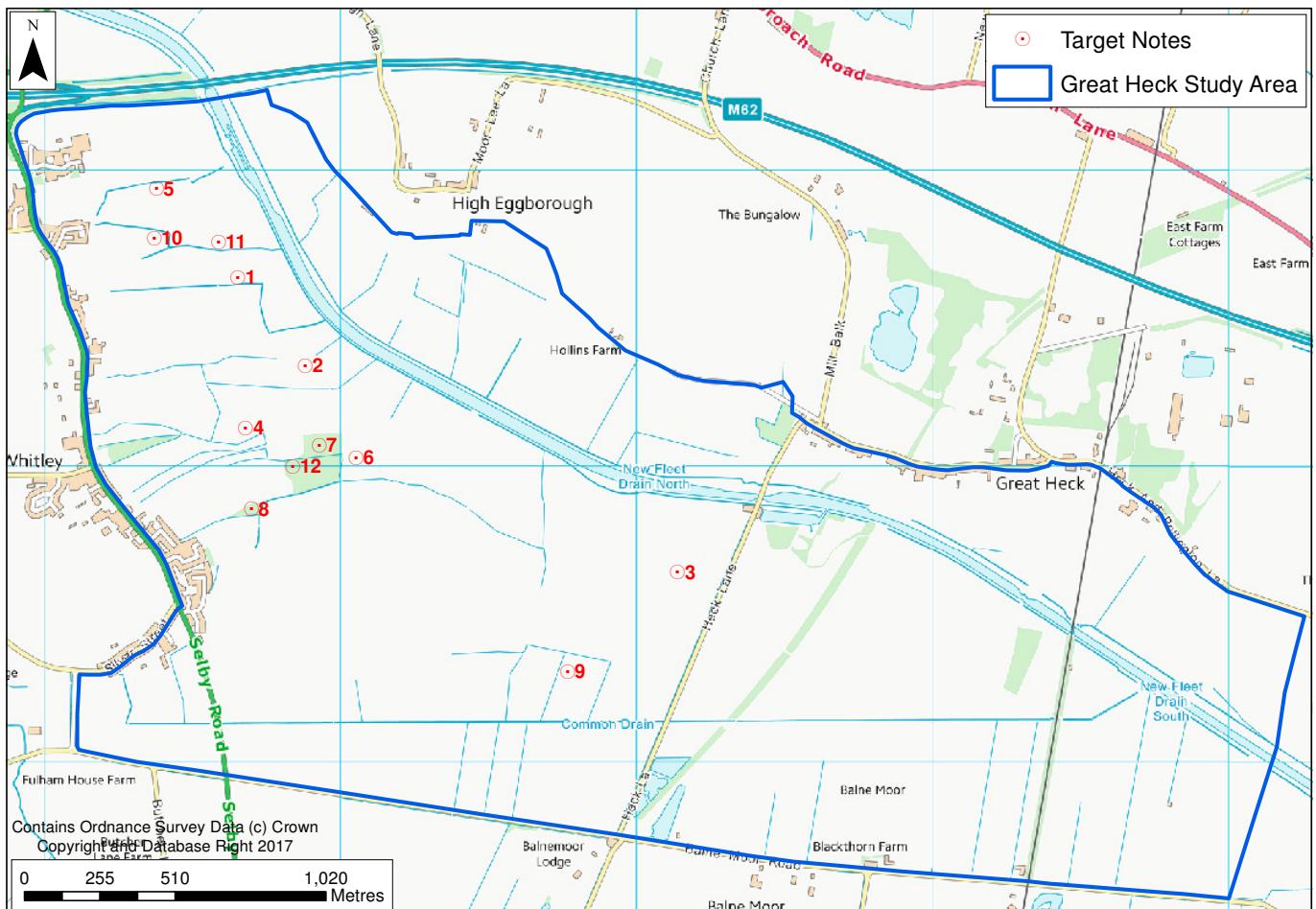


Figure 4-6: Target Notes Recorded During Phase 1 Habitat Surveys

Table 4-7: Target Notes Recorded During Phase 1 Habitat Surveys

Target Note	Description
1	Subsidence flash adjacent to non-IDB maintained drain in north of study area
2	Subsidence flash adjacent to non-IDB maintained drain north of Watkin's Lower Plantation
3	Large subsidence flash adjacent to Heck Lane
4	Subsidence flash north-west of Watkin's Lower Plantation
5	Northerly subsidence flash with swamp vegetation
6	Marshy grassland area adjacent to Watkin's Lower Plantation
7	Watkin's Lower Plantation
8	Watkin's Higher Plantation
9	Subsidence flash north of Balne Common Drain
10	Small subsidence flash alongside Drain No. 71 (western)
11	Small subsidence flash alongside Drain No. 71 (eastern)
12a, b and c	Complex of three small ponds in Watkin's Lower Plantation

Arable

The vast majority of the study area is in arable cultivation, with carrots, potatoes and cereals being the predominant crops. A number of fields have also been in fallow rotation during the study period.

As can be seen by comparing Figure 4-3, Figure 4-4 and Figure 4-5 the area under arable cultivation has increased between 2008/09 and 2011 - 2017 as the area has become drier and the subsidence flashes have been ploughed up and cropped.

Where arable field margins are present they are generally narrow and relatively species-poor and would not classify as the section 41 list habitat of 'arable field margins'.

Subsidence Flashes and Surrounding Marginal Vegetation

Within the study area, in 2008 there were five main subsidence flashes, shown as Target Notes 1 to 5 on Figure 4-6. During very wet periods additional areas of standing water were recorded, however, these have not been persistent and have only developed during extremely wet periods. As discussed above, in the dry conditions of 2011 these subsidence flashes all dried up and were cropped. In 2017, six subsidence flashes were recorded, however, by mid-April only two of these held water. The distribution of these subsidence flashes had also changed from 2008, with the largest flash (Target Note 3) having dried up and a new flash having developed north of Balne Common Drain (Target Note 9). The subsidence flash to the south of Drain No. 71 (Target Note 1) had also dried up and was cropped, however, two smaller subsidence areas alongside Drain No. 71 had developed (Target Notes 10 and 11).

As discussed above, the character of the subsidence flashes has changed considerably during the development of the remediation project. At their largest extent in 2008/09 they covered an area of approximately 6.8ha. In 2017, the area of subsidence flash evident on the ground, although not all holding water by mid-April, was 4.3ha. Table 4-8 below provides details on each of the main subsidence flashes and highlights how their character has changed over time.

Table 4-8: Subsidence Flashes and Surrounding Marginal/Inundation Vegetation - Comparison between 2008, 2011 and 2017

No.	2008	2011	2017
Target Note 1 SE 566 216	 <p>At its largest extent in 2008/09, Subsidence Flash 1 extended across both sides of Bull Lane and covered an area of approximately 1.3ha. At this time the standing water was approximately 10cm in depth and there was substantial cover of emergent vegetation, including Grey Club-rush <i>Schoenoplectus tabernaemontani</i>, Soft, Compact, Jointed and Hard Rushes <i>Juncus effusus</i>, <i>J. conglomeratus</i>, <i>J. articulatus</i> and <i>J. inflexus</i>, Branched Bur-reed <i>Sparganium erectum</i> and Reedmace <i>Typha latifolia</i>. Interspersed with these larger emergent species was Common Spike-rush <i>Eleocharis palustris</i>, Water-plantain <i>Alisma plantago-aquatica</i>, Toad Rush <i>Juncus bufonius</i>, Water-pepper <i>Persicaria hydropiper</i> and Celery-leaved Buttercup <i>Ranunculus sceleratus</i>. Fennel Pondweed <i>Potamogeton pectinatus</i> was also present in the open areas of standing water. Occasional non-wetland species were also present, including False Oat-grass <i>Arrhenatherum elatius</i>, White Clover <i>Trifolium repens</i>, Italian Rye-grass <i>Lolium multiflorum</i> and Redshank <i>Persicaria maculosa</i>.</p>	 <p>In 2011, no standing water remained and the area to the south of Bull Lane was in arable cultivation. To the north of the track the former wet area contained some remnant wetland vegetation, including Reedmace and Celery-leaved Buttercup; however these species were small and clearly under stress due to the dry conditions. To the north of the track a grassy sward had developed, possibly through reseeding, with Crested Dog's-tail <i>Cynosurus cristatus</i>, Meadow Foxtail <i>Alopecurus pratensis</i>, Italian Rye-grass and Perennial Rye-grass <i>Lolium perenne</i> thriving in the drier conditions.</p>	 <p>In 2017, as can be seen from the photo above, both sides of the shallow drain which Subsidence Flash 1 straddled were under arable cultivation, with oilseed rape to the south and a ploughed field to the north.</p>

No.	2008	2011	2017
Target Note 2 SE 569 213	 <p>In 2008/09, Subsidence Flash 2 covered an area of approximately 1.5ha. Parts of the flash contained open water, whereas others contained dense emergent vegetation, dominated by Reedmace, with some Great Willowherb <i>Epilobium hirsutum</i>, Cyperus Sedge <i>Carex pseudocyperus</i>, Compact and Soft Rushes, Grey Club-rush and Sea Club-rush <i>Bolboschoenus maritimus</i>. There were also a considerable number of young willow <i>Salix sp.</i> seedlings developing. Moving away from the open water areas, towards the margins, there were some areas of bare ground and ruderal vegetation, with Redshank, Scented Mayweed <i>Matricaria recutita</i>, Black Grass <i>Alopecurus myosuroides</i>, Bearded Couch <i>Elymus caninus</i>, Spear Thistle <i>Cirsium vulgare</i>, Dandelion <i>Taraxacum officinale</i> agg. and Pineappleweed <i>Matricaria discoidea</i> present.</p>	 <p>In 2011, this flash was dry, with a large proportion of it under arable cultivation (as can be seen on the right of the lower photograph). Only the very northern portion of the flash remained uncropped, with stressed Reedmace and willow the dominant species. Ruderal species had become increasingly prevalent, with Prickly Sow-thistle <i>Sonchus asper</i>, Short-fruited Willowherb <i>Epilobium obscurum</i>, Curled Dock <i>Rumex crispus</i>, Groundsel <i>Senecio vulgaris</i> and Creeping Buttercup <i>Ranunculus repens</i> recorded.</p>	 <p>In 2017, this flash was partially cropped with wheat. Where uncropped large areas of bare mud were present, with some algae. In early April this flash held water, however, by mid-April this flash was dry. Surrounding the areas of bare mud were areas of ephemeral/short perennial vegetation, dominated by grass species.</p>

No.	2008	2011	2017
Target Note 3 SE 581 206	 <p>Subsidence Flash 3 was the largest and most extensive standing water area within the study area, covering approximately 8ha at its largest extent in 2008/09. Water depth at this time was shallow (30cm depth at maximum, becoming shallower around the margins), with extensive muddy margins. Along the northern and western sides, there were extensive areas of marginal vegetation, consisting of Celery-leaved Buttercup, Reedmace, Toad Rush, Marsh Foxtail <i>Alopecurus geniculatus</i> and seedlings of Goat Willow <i>Salix caprea</i> and Osier <i>Salix viminalis</i>. There was also a number of ruderal species present, including Short-fruited Willowherb, Italian Rye-grass, Black Grass, Field Horsetail <i>Equisetum arvense</i>, Fat Hen <i>Chenopodium album</i> agg. and Fool's Parsley <i>Aethusa cynapium</i>. Algal blooms were frequently observed within the open water areas, however there was little aquatic vegetation within the water itself.</p>	 <p>Throughout 2011, Subsidence Flash 3 was predominantly dry, with only very small areas of open water present, if any. By autumn 2011, due to the dry conditions, the area had been ploughed and part of it cropped. The surrounding marginal vegetation areas recorded in 2008/09 had also been ploughed and cropped.</p>	 <p>In 2017, Subsidence Flash 3 was no longer in existence and was completely cropped.</p>

No.	2008	2011	2017
Target Note 4 SE 567 211	 <p>In 2008/09, Subsidence Flash 4 covered an area of approximately 1ha and water levels were very shallow. The marginal area consisted of relatively dense emergent vegetation, including Reedmace, False Fox-sedge <i>Carex otrubae</i>, willow, Great Willowherb, Common Reed <i>Phragmites australis</i> and rushes (Soft, Compact and Hard). Interspersed with these tall emergents were smaller species, including Water-cress <i>Rorippa nasturtium-aquaticum</i>, Toad Rush, Floating Sweet-grass <i>Glyceria fluitans</i>, Pink Water-speedwell <i>Veronica catenata</i> and Common Spike-rush. Ruderal species including Broad-leaved Dock <i>Rumex obtusifolius</i>, Scented Mayweed, Bearded Couch and Creeping Buttercup were also recorded.</p>	 <p>In 2011, Subsidence Flash 4 was no longer evident and was completely under arable cultivation.</p>	 <p>In 2017, Subsidence Flash 4 was again evident on the ground, however, by mid-April it was drying up relatively quickly with the area of open water receding. This was surrounded by extensive muddy margins. No aquatic or wetland plants were recorded, and around the margins depauperate wheat plants, stressed by the waterlogged conditions, were present.</p>

No.	2008	2011	2017
Target Note 5 SE 564 219	 <p>Subsidence Flash 5 was different in character to the others discussed above. In 2008/09 this flash was much more densely vegetated and did not contain any significant areas of standing open water. This wetland area contained tall, dense emergent vegetation, predominantly Reedmace, Grey Willow <i>Salix cinerea</i> and Goat Willow seedlings, Soft, Compact, Hard and Jointed Rushes, Purple Loosestrife <i>Lythrum salicaria</i> and Great Willowherb. Beneath the dense emergent vegetation cover was a ground layer of smaller wetland species, including Toad Rush, Brooklime <i>Veronica beccabunga</i>, Celery-leaved Buttercup, Water-plantain and Gypsywort <i>Lycopus europaeus</i>. Ruderal species including Redshank, Knotgrass <i>Polygonum aviculare</i> agg., White Clover and Creeping Bent <i>Agrostis stolonifera</i> were also present.</p>	 <p>In 2011, this wetland area was completely dry and had been recently ploughed, with only an occasional tussock of Hard Rush indicating its former nature. Other species starting to re-colonise the ploughed area included Creeping Buttercup, Creeping Bent, Perennial Rye-grass and Common Nettle <i>Urtica dioica</i>.</p>	 <p>In 2017, Subsidence Flash 5 again showed evidence of having experienced wetter conditions than the surrounding area for some considerable time, with swamp like vegetation dominating, as in 2008. Reedmace was again the dominant species, with Soft Rush also noted. Ground conditions were too boggy to enter this flash area to compile a full species list.</p>

No.	2008	2011	2017
Target Note 9 SE 578 203	Not in existence in 2008. Area was under arable cultivation.	Not in existence in 2011. Area was under arable cultivation.	 <p>In 2017, this new flash had developed over a large area to the north of Balne Common Drain, with water also ponded around where new connecting drains will be dug. Crops had been planted as close as possible to standing water area and no wetland or aquatic vegetation was recorded. Large expanses of open muddy ground were present as water levels receded during the spring.</p>
Target Note 10 SE 564 218	Not in existence in 2008. Area was under arable cultivation.	Not in existence in 2011. Area was under arable cultivation.	

No.	2008	2011	2017
			<p>This subsidence flash covers a small area immediately north of Drain No. 71. In early April this flash was holding shallow levels of water, however, by mid-April it was completely dry with only muddy areas present. Arable crops surround this flash and no wetland or aquatic vegetation was recorded within it.</p>
Target Note 11 SE 566 218	Not in existence in 2008. Area was under arable cultivation.	Not in existence in 2011. Area was under arable cultivation.	 <p>This subsidence flash covers a linear area immediately north of Drain No. 71. In early April this flash was holding shallow levels of water, however, by mid-April it was completely dry with only muddy areas present. Habitats surrounding this flash consist of marshy-type grassland, which appears to have developed as the field has been left fallow, however, vegetation cover is very sparse.</p>

Grassland

Within the study area there are several areas of grassland habitat, including areas of amenity grassland, improved grassland pasture and also poor semi-improved grassland.

The amenity and improved grassland areas are generally associated with the villages of Great Heck and Whitley and include Perennial Rye-grass dominated lawns and grazed pastures.

There are also a number of areas of poor semi-improved grassland, particularly surrounding the subsidence flash margins where conditions are drier, but still unable to be cultivated. However, the extent of this habitat has declined in area between 2008/09 and 2011, as the drier weather conditions have allowed a larger area to be cultivated. By 2017, further areas of poor semi-improved grassland were evident, particularly in fields left fallow. Where only recently left fallow, and where a dense sward has not yet developed, this habitat type was recorded as ephemeral/short-perennial vegetation. These poor semi-improved grassland areas were generally dominated by grass species typical of agricultural areas, such as False Oat-grass, Couch *Elytrigia repens*, Cock's-foot *Dactylis glomerata*, Black Grass and Yorkshire Fog *Holcus lanatus*. Other frequent species included Creeping Thistle *Cirsium arvense*, Spear Thistle and Broad-leaved Dock. The banks of the Aire and Calder Navigation also generally consisted of poor semi-improved grassland, with some amenity grassland near Whitley Lock.

To the east of Watkin's Lower Plantation there is an area of marshy grassland (see Target Note 6 on Figure 4-6). Although this area hasn't developed into a subsidence flash with open standing water, this field does appear to be damp and waterlogged in places, indicated by the flora present. The field is dominated by grass species typical of arable areas, including Yorkshire Fog, False Oat-grass, Soft Brome *Bromus mollis* and Red Fescue *Festuca rubra*, along with frequent ruderal species such as Common Nettle, Creeping Buttercup, Ragwort *Senecio jacobaea*, thistles, White Clover and Bristly Oxtongue *Picris echioides*. However, there was also a range of species present tolerant of damp conditions, including False Fox-sedge, Soft, Compact, and Hard Rushes, Hoary Willowherb *Epilobium parviflorum* and Tufted Hair-grass *Deschampsia cespitosa*. In 2017, a further area of marshy grassland was recorded in the north of the study area around subsidence flash 11.

Drainage Ditches

There are four IDB maintained watercourses within the study area; Drain No. 71, Balne Common Drain, Court Drain and High Eggborough Drain. The soak drains of the Aire and Calder Navigation (New Fleet Drain North and New Fleet Drain South), which are managed by the Canal and River Trust, also pass through the study area. For this area, two connecting drains have been proposed, which, in part follow existing land drains and will connect the IDB maintained drains. Table 4-9 below provides details of these drainage ditches and the routes of the proposed connecting drains, along with other key ditches in the study area. Figure 2-1 shows the location of the IDB maintained and Canal and River Trust watercourses.

Table 4-9: Drainage Ditches within the Study Area

Drain Name	Photograph	Description
Drain No. 71 (Danvm Drainage Commissioners maintained watercourse)	2008 	SE 562218 - SE 568217 Drain No. 71 flows from the rear of a housing estate, to where it discharges into New Fleet Drain South. It is a wide drain with a good variety of aquatic and wetland vegetation. Species within the channel included Common Duckweed <i>Lemna minor</i> and Common Water-starwort <i>Callitrichia stagnalis</i> . Emergent vegetation was also varied, with Reedmace, Great Willowherb, Water-cress, Soft Rush and Celery-leaved Buttercup recorded. The banks were dominated by False Oat-grass, Yorkshire Fog, Cow Parsley <i>Anthriscus sylvestris</i> and Nettle.

Drain Name	Photograph	Description
Court Drain (Danv'm Drainage Commissioners maintained watercourse)	 (2008)  (2017)	SE 567207 - SE 577211 <p>Court Drain flows in a general easterly direction from near Watkin's Higher Plantation to where it discharges into New Fleet Drain South. Drain width varies along its course, from approximately 0.3m at the upstream end to 1.5m at its connection with the soak drain. Within the channel Common Duckweed was abundant on the water surface, with Common Water-starwort, Reed Canary-grass <i>Phalaris arundinacea</i> and Reed Sweet-grass <i>Glyceria maxima</i> present within the channel. The banks contained a wide variety of ruderal grasses and herbs typical of agricultural areas, including Cow Parsley, Cleavers <i>Galium aparine</i>, Timothy <i>Phleum pratense</i>, Common Knapweed <i>Centaurea nigra</i> and Angelica <i>Angelica sylvestris</i>.</p>
Balne Common Drain (Danv'm Drainage Commissioners maintained watercourse)		SE 561203 - SE 597202 <p>Balne Common Drain extends from the southern end of the village of Whitley, to where it discharges into New Fleet Drain South. It is a relatively narrow drain (0.5m to 1m in width). Species within the channel included Branched Bur-reed, Reed Canary-grass, Pink Water Speedwell, Water-plantain, Common Water-starwort and Celery-leaved Buttercup. The banks were generally grass dominated, with species including False Oat-grass, Couch, Soft Brome, Barren Brome <i>Anisantha sterilis</i> and Meadow Foxtail frequent. However of particular note is the left bank between Heck Lane and the Dismantled Railway Line SINC which, in comparison to other drain banks in the area, was particularly species-rich.</p>

Drain Name	Photograph	Description
	<p>2017</p> 	
<p>High Eggborough Drain (Danvm Drainage Commissioners maintained watercourse)</p>	<p>2008</p> 	<p>SE 576216 - SE 574213</p> <p>High Eggborough Drain is located in the northern portion of the study area, to the north of the Aire and Calder Navigation and is therefore separated from the main areas of proposed works. This drain consists of two branches and discharges into the New Fleet Drain North. It was relatively overgrown with Reedmace, Reed Canary-grass, False Oat-grass, Great Willowherb and some scrub. There were occasional trees, predominantly Ash <i>Fraxinus excelsior</i>, along its length and large patches of the non-native Himalayan Balsam <i>Impatiens glandulifera</i>.</p>
<p>New Fleet Drain South (Part Canal and River Trust maintained watercourse and part Danvm Drainage Commissioners maintained watercourse)</p>	<p>2008</p> 	<p>SE 565222 - SE 601200</p> <p>New Fleet Drain South is the southern soak drain of the Aire and Calder Navigation. Within the study area, the downstream section of this watercourse is maintained by the Danvm Drainage Commissioners. This drain is a large watercourse approximately 1.5m in width with the right bank 2.5m high. The left bank, which embanks the canal, is significantly higher. The channel contained a number of tall emergent species, including Reed Canary-grass, Reedmace, Reed Sweet-grass and also Common Water-starwort. The left bank was very overgrown, with Bramble <i>Rubus fruticosus agg.</i> dominant in many places. Other frequent bankside species included Nettle, Great</p>

Drain Name	Photograph	Description
New Fleet Drain North (Canal and River Trust maintained watercourse)	 2008	<p>Willowherb, Rosebay Willowherb <i>Chamerion angustifolium</i>, Meadowsweet <i>Filipendula ulmaria</i> and Hogweed <i>Heracleum sphondylium</i>. The non-native, invasive Himalayan Balsam was also recorded on this drain.</p> <p>SE 566222 - SE 601200</p> <p>New Fleet Drain North is the northern soak drain of the Aire and Calder Navigation. This drain is a large watercourse approximately 1.5m in width with the left bank 2.5m high. The right bank, which embanks the canal, is significantly higher. When surveyed in 2009 this drain was significantly overgrown, with dense Bramble and scrub (e.g. Goat Willow, Hawthorn <i>Crataegus monogyna</i>, Alder <i>Alnus glutinosa</i>) on significant areas of the right bank. Other species present on the banksides included Great Willowherb, False Oat-grass, Yorkshire Fog, Hemp Agrimony <i>Eupatoria cannabinum</i>, Rosebay Willowherb and Spear Thistle. Within the channel the water surface was dominated by Common Duckweed and there were extensive stands of tall emergent species, including Branched Bur-reed, Reedmace and Reed Canary-grass.</p>
Connecting Drain 1	 2008 	<p>SE 567217 - SE 570210</p> <p>The route of the proposed Connecting Drain 1 is from Drain No. 71, along existing field boundaries and land drains, where possible, to where it will connect to Court Drain. One of these existing land drains (from SE 567216 to SE 567 215) is a wide drain (this is the section of drain shown in the top photograph). This drain contained a variety of species, including Branched Bur-reed, Common Duckweed, False Fox-sedge, Reed Canary-grass, Water Figwort <i>Scrophularia auriculata</i> and Compact Rush.</p> <p>From SE 568213 to SE 570213 a small land drain will be re-graded. This contained a variety of emergent species including Reedmace, Yellow Iris <i>Iris pseudacorus</i>, Reed Sweet-grass, Celery-leaved Buttercup, Purple Loosestrife and aquatic species such as Broad-leaved Pondweed <i>Potamogeton natans</i> and Common Duckweed.</p> <p>The final section of this connecting drain will be alongside Watkin's Lower Plantation (from SE 569210 to SE 570210). The margins of this woodland are dominated by the non-native, invasive Himalayan Balsam.</p>

Drain Name	Photograph	Description
	<p>2017</p> 	
Connecting Drain 2	<p>2008</p> 	<p>SE 578201 - SE 577207</p> <p>The proposed route of Connecting Drain 2 extends from Balne Common Drain to Court Drain, passing along existing field boundaries where possible. The existing drains along this route are generally very shallow, overgrown depressions that do not appear to regularly hold water. They are overgrown with grass species typical of agricultural areas (e.g. False Oat-grass, Couch, Cock's-foot) and ruderal species including Nettle, Bramble, Broad-leaved Dock, Common Knapweed and Hogweed. There are also occasional shrubs, predominantly Hawthorn, along this route.</p>
Ditch West of Balne Moor SINC	<p>2008</p> 	<p>SE 579198 - SE 580200</p> <p>This SINC site consists of the land drain and banks, which is not IDB maintained, to the west of Heck Road. This SINC site appears not to be of SINC quality being species poor and containing few aquatic and wetland species, indicating that it rarely holds water. Wetland species present included Great Willowherb, Reedmace and Purple Loosestrife, however, all were present in low density. The dominant species present included ruderal and grass species typical of arable areas, such as Cock's-foot, Creeping Bent, False Oat-grass, Dandelion <i>Taraxacum officinale</i> agg., and Cow Parsley. Although only the southern section of this drain is designated as a SINC,</p>

Drain Name	Photograph	Description
	<p>2017</p> 	<p>the rest of the drain runs alongside Heck Lane and is very similar in species composition and character.</p>

There are other land drains within the study area that form field boundaries and provide a land drainage function connecting to the IDB maintained watercourses. These drains are generally small (<0.5m in width) with low banks, and only contained low levels of water when surveyed in 2008/09 and 2017 and were dry during 2011. Vegetation within these drains was similar in nature to that described in Table 4-9 above.

The exception to this is the drain extending from SE 562216 to SE 569215, which flows alongside Bull Lane Track for part of its length. This drain appears to have been widened in recent years. This drain will form part of the proposed Connecting Drain 1 and its character is discussed above.

Aire and Calder Navigation

The Aire and Calder Navigation flows through the study area. Due to the heavy boat traffic using this canal there is little vegetation within the watercourse. The banks for the most part consist of poor-semi improved grassland, as described above, with areas around Whitley Lock consisting of Perennial Rye-grass dominated amenity grassland. The works will not impact upon the Aire and Calder Navigation and therefore it will not be considered further in this ES.



Figure 4-7: Aire and Calder Navigation near Whitley Lock

Ponds

As discussed in section 4.3.2, seven ponds were identified from OS maps as being in the study area. The pond to the north of the Aire and Calder Navigation was not surveyed in detail as it is separated from the works areas by the canal. Booty Well Pond to the east of Heck Road was surveyed but found to no longer be in existence, being dry and completely overgrown by Brambles.

Two of the other five ponds in the study area form Balne Moor Ponds SINC. The two ponds at this SINC are separated from each other by the dismantled railway. The western pond consists of three interconnected waterbodies which are used for fishing, with little aquatic vegetation present. The eastern pond contains a large stand of Reedmace and Great Pond-sedge *Carex riparia*, with other wetland species recorded including Water-cress, Angelica, Gypsywort, Cyperus Sedge and False Fox-sedge.



Figure 4-8: Eastern pond of Balne Moor Ponds SINC

The remaining three ponds (Target Note 12) are grouped together in the north-west of Watkin's Lower Plantation. All three are very small, and other depressions not filled with water are also evident on the ground. Two of the waterbodies contained no aquatic vegetation, and have shallow water levels and extensive leaf litter. One also contained extensive litter and debris. Marginal vegetation around these ponds was limited, most likely due to the lack of light due to the woodland cover, however a small patch of Yellow Iris was noted on the margins of one (Figure 4-9). The third waterbody is a rectangular feature, the water surface of which was completely dominated by Common Duckweed (Figure 4-10).



Figure 4-9: Two small waterbodies in Watkin's Lower Plantation



Figure 4-10: Rectangular waterbody in Watkin's Lower Plantation

Woodland and Scrub

Within the study area there are a few scattered patches of woodland, including a narrow strip along the disused railway and small pockets in Watkin's Lower and Higher Plantations, Shaw Wood, Heck Hall Wood and around Whitley Lodge. There is also an area of parkland/scattered trees in the north of the study area, around Whitley Lodge.

The only woodland area which could be potentially affected by the proposed works is Watkin's Lower Plantation (shown as Target Note 7 on Figure 4-6). Watkin's Lower Plantation is an area of broadleaved plantation woodland, with Ash, Sycamore *Acer pseudoplatanus*, Wych Elm *Ulmus glabra*, Pedunculate Oak *Quercus robur* and Wild Cherry *Prunus avium* forming the canopy. The understorey was equally diverse, with Field Maple *Acer campestre*, Hazel *Corylus avellana*, Hawthorn, Holly *Ilex aquifolium* and Blackthorn *Prunus spinosa* recorded. The ground flora contained a wide variety of species, including Ivy *Hedera helix*, Bluebell *Hyacinthoides non-scripta*, Foxglove *Digitalis purpurea*, Cleavers, Wood Avens *Geum urbanum* and Bramble. There was also a considerable amount of the non-native, invasive Himalayan Balsam along the woodland margins.

As discussed above, this plantation also contained three small ponds in the north-west.



Figure 4-11: Watkin's Lower Plantation

The Dismantled Railway Line SINC consists predominantly of woodland and scrub, with the former embankment now also completely wooded. Species present include Hawthorn, Ash, Crack Willow *Salix fragilis* and Blackthorn. This woodland will not be affected by the proposed works.

Hedgerows

Within the study area hedgerows are a relatively infrequent feature, with most field boundaries marked by either a drainage ditch or a low mound. Where hedgerows are present they are generally species-poor, Hawthorn dominated, and gappy, with occasional mature tree specimens within them.

4.5.2 Birds

The bird species and communities present within the study area have shown a predictably strong relationship to the extents and amounts of water present within the various subsidence flashes.

A summary of the species recorded during the various surveys undertaken is presented in Table 4-10. This table also summarises the spatial and temporal distribution of each species, as well as an indication of relative abundance. Species of particular conservation importance are also noted, with species confirmed to have bred within the study area, or considered likely to have, highlighted in bold.

Table 4-10: Summary of Bird Records

Species	Distribution and Abundance	Conservation Status
Sparrowhawk <i>Accipiter nisus</i>	Single August 2009 record of individual hunting over Flash 3.	Green list
Sedge Warbler <i>Acrocephalus schoenobaenus</i>	Single June 2009 records from Flash 2 and New Fleet Drain South.	Green list
Common Sandpiper <i>Actitis hypoleucos</i>	August and September 2009 records (max. 3 individuals) from Flash 3. Considered to be passage birds.	Amber list - species of European concern and recent breeding population decline
Long-tailed Tit <i>Aegithalos caudatus</i>	Associated with hedgerows and woodland habitats. Widespread.	Green list
Skylark <i>Alauda arvensis</i>	Widespread in study area throughout all survey periods, associated with arable fields and drier margins of flashes.	Red list - recent breeding population decline UK BAP S41 List Species
Red-legged Partridge <i>Alectoris rufa</i>	Widespread across arable parts of study area during all survey periods.	No status assessment
Shoveler <i>Anas clypeata</i>	February 2010 records from Flash 3 (max. 6 individuals).	Amber list - species of European concern & important non-breeding population

Species	Distribution and Abundance	Conservation Status
Teal <i>Anas crecca</i>	Single January 2010 records from Flashes 2 and 4 (12 and 2 individuals respectively). Regular records between June 2009 and February 2010 on Flash 3 (max. of 28, considered to be underestimate due to concealment in marginal vegetation).	Amber list - important non-breeding population
Wigeon <i>Anas penelope</i>	January and February 2010 records from Flash 3 (max. 14 individuals).	Amber list - localised & important non-breeding population
Mallard <i>Anas platyrhynchos</i>	Single June 2009 record of pair on Flash 2. Numerous and regular on Flash 3 2009-2010 (max. c.125 individuals in February 2010). Noted during walkover survey in April 2017. Confirmed breeding in study area drains.	Amber list - recent non-breeding population declines
Gadwall <i>Anas strepera</i>	February 2010 records from Flash 3 (max. 4 individuals).	Amber list - species of European concern & important non-breeding population
Greylag Goose <i>Anser anser</i>	January and February 2010 records from Flash 3 (max. 38 individuals). Noted during walkover survey in April 2017.	Amber list - localised & important non-breeding population
Pink-footed Goose <i>Anser brachyrhynchus</i>	January and February 2010 records from Flash 3 (max. c.250 individuals).	Amber list - localised & important non-breeding population
Swift <i>Apus apus</i>	Recorded feeding over study area through summer months.	Amber list - recent breeding population decline
Grey Heron <i>Ardea cinerea</i>	June 2009 records from Flash 3. No evidence of breeding. Noted during walkover survey in April 2017.	Green list
Tufted Duck <i>Aythya fuligula</i>	Records from June 2009 and February 2010 on Flash 3 (max. of 10 individuals in June 2009).	Green list
Goldeneye <i>Bucephala clangula</i>	Single January 2010 record of lone individual on Flash 3.	Amber list - small breeding population
Linnet <i>Carduelis cannabina</i>	Widespread in farmland, significant component of mixed finch flocks in winter months. Noted during walkover survey in April 2017.	Red list - recent breeding population decline UK BAP S41 List Species
Goldfinch <i>Carduelis carduelis</i>	Widespread across study area in both summer and winter months. Noted during walkover survey in April 2017.	Green list
Little Ringed Plover <i>Charadrius dubius</i>	Records from Flash 3 throughout June 2009 (max. 3 individuals). No direct evidence of breeding but potential. Single June 2009 record of pair on Flash 2	Green list WCA 1981 Schedule 1
Woodpigeon <i>Columba palumbus</i>	Widespread and common throughout study area during all survey periods.	Green list
Carrion Crow <i>Corvus corone</i>	Widespread and common throughout study area during all survey periods.	Green list
Rook <i>Corvus frugilegus</i>	Largely associated with vicinities of Whitley.	Green list
Jackdaw <i>Corvus monedula</i>	Noted during walkover survey in April 2017.	Green list
Black-headed Gull <i>Chroicocephalus ridibundus</i>	Frequent over study area during all survey periods. Regular and numerous on Flash 3 (max. of c.350 individuals in February 2010).	Amber list - recent non-breeding population decline and important non-breeding population
Blue Tit <i>Cyanistes caeruleus</i>	Associated with hedgerows and woodland habitats. Widespread during all	Green list

Species	Distribution and Abundance	Conservation Status
	survey periods.	
Whooper Swan <i>Cygnus cygnus</i>	Single February 2010 record of 3 individuals on Flash 3. Regular winter grazer of arable fields between Flash 3 and Balne Moor Road.	Amber list - small breeding population, localised non-breeding population WCA 1981 Schedule 1
Mute Swan <i>Cygnus olor</i>	Single January 2010 record of pair on Flash 2. Occasional on Flash 3 throughout year, peak of 19 in February 2010. Noted during walkover survey in April 2017.	Amber list
Corn Bunting <i>Emberiza calandra</i>	Single June 2009 records from New Fleet Drain South and Lee Lane. Small flock recorded in July 2011 mixed finch flock.	Red list - historical and recent breeding population declines UK BAP S41 List Species
Yellowhammer <i>Emberiza citrinella</i>	Widespread but not common throughout study area. Joins mixed finch flocks on arable fields in winter. Noted during walkover survey in April 2017.	Red list - recent breeding population decline UK BAP S41 List Species
Reed Bunting <i>Emberiza schoeniclus</i>	Regularly associated, throughout year, with margins of flashes during all survey periods.	Amber list - recent breeding population decline UK BAP S41 List Species
Robin <i>Erithacus rubecula</i>	Associated with villages, hedgerows and woodland habitats. Widespread.	Green list
Kestrel <i>Falco tinnunculus</i>	Single August 2009 record from Flash 1. Noted during walkover survey in April 2017.	Amber list - species of European conservation concern
Chaffinch <i>Fringilla coelebs</i>	Widespread across study area in both summer and winter months.	Green list
Coot <i>Fulica atra</i>	Single June 2009 record from Flash 3.	Green list
Snipe <i>Gallinago gallinago</i>	Regular on Flashes 1, 2 & 4 between August 2009 and February 2010. Max. of 27 individuals in January around Flash 2. Noted during walkover survey in April 2017.	Amber list - species of European concern
Moorhen <i>Gallinula chloropus</i>	Occasional June 2009 records from Flash 3, present throughout year on study area drains.	Green list
Oystercatcher <i>Haematopus ostralegus</i>	Occasional June 2009 records from Flash 3. No evidence of breeding. Noted during walkover survey in April 2017.	Amber list - localised and important breeding population, important non-breeding population
Swallow <i>Hirundo rustica</i>	Recorded feeding over study area through summer months.	Green list - species of European concern
Herring Gull <i>Larus argentatus</i>	Frequent over study area. Regular on Flash 3 (max. of 30 individuals in January 2010).	Red list - recent breeding and non-breeding population declines UK BAP S41 List Species
Common Gull <i>Larus canus</i>	Frequent over study area. Regular and numerous on Flash 3 (max. of c.70 individuals in February 2010).	Amber list - species of European concern and important non-breeding population
Lesser Black-backed Gull <i>Larus fuscus</i>	Occasional on Flash 3 in June 2009 and January 2010 (max. 4 individuals in January).	Amber list - localised & important breeding population
Jack Snipe <i>Lymnocryptes minimus</i>	Single record of 1 individual from Flash 1 in December 2011. Noted during walkover survey in April 2017.	Green list
Pied Wagtail <i>Motacilla alba</i>	Regular around margins of all flashes in breeding season. Evidence of breeding associated with Flash 3. Noted during walkover survey in April 2017.	Green list

Species	Distribution and Abundance	Conservation Status
Grey Wagtail <i>Motacilla cinerea</i>	Single record of 1 individuals in August 2009 on Flash 3. Noted during walkover survey in April 2017.	Red list - recent breeding population decline
Yellow Wagtail <i>Motacilla flava</i>	Regular on margins of Flash 3 in June 2009 considered possible breeder. July 2011 record from vicinity of Common Drain.	Red list - recent breeding population decline UK BAP S41 List Species
Curlew <i>Numenius arquata</i>	Single June 2009 and January 2010 records from Flash 3. Noted during walkover survey in April 2017.	Red list - Species of European Concern, Rapidly Declining UK Population, Recent Breeding Population Decline, Important Breeding Population, Important Non-breeding Population UK BAP S41 List Species
Whimbrel <i>Numenius phaeopus</i>	Single July 2011 record of passage bird flying through study area.	Red list - recent breeding population decline WCA 1981 Schedule 1
Great Tit <i>Parus major</i>	Associated with hedgerows and woodland habitats. Widespread during all survey periods.	Green list
House Sparrow <i>Passer domesticus</i>	Mainly associated with vicinity of Whitley village. Single June 2009 record of small flock feeding on margins of Flash 3.	Red list - recent breeding population decline UK BAP S41 List Species
Tree Sparrow <i>Passer montanus</i>	Single November 2011 record of small flock feeding on arable field margins.	Red list - recent breeding population decline UK BAP S41 List Species
Grey Partridge <i>Perdix perdix</i>	Recorded in small numbers throughout year.	Red list UK BAP S41 List Species
Pheasant <i>Phasianus colchicus</i>	Widespread and common throughout study area during all survey periods.	Status not assessed
Chiffchaff <i>Phylloscopus collybita</i>	Associated with hedgerows and woodland habitats. Widespread during all survey periods.	Green list
Magpie <i>Pica pica</i>	Associated with hedgerows and woodland habitats. Widespread.	Green list
Green Woodpecker <i>Pica viridis</i>	Single June 2009 record in wooded strip on old railway embankment.	Green list
Golden Plover <i>Pluvialis apricaria</i>	Regular winter feeder in substantial flocks on fields south of Flash 3.	Green list - important non-breeding population
Dunnock <i>Prunella modularis</i>	Associated with hedgerows and woodland habitats. Widespread.	Amber list- recent breeding population decline UK BAP S41 List Species
Avocet <i>Recurvirostra avosetta</i>	Single June 2009 record of family group on Flash 3. No direct evidence of breeding, but family group in suitable habitat.	Amber list - localised breeding and non-breeding populations WCA 1981 Schedule 1
Sand Martin <i>Riparia riparia</i>	Single August 2009 record of small flock feeding over Flash 3.	Green list- species of European conservation concern
Stonechat <i>Saxicola torquata</i>	Single February 2010 record of pair adjacent to Flash 4.	Green list
Common Tern <i>Sterna hirundo</i>	Single individual recorded over Flash 3 in June 2009.	Amber list - localised breeding population
Collared Dove <i>Streptopelia decaocto</i>	Mainly associated with vicinity of Whitley village.	Green list
Starling <i>Sturnus</i>	Single June 2009 record of small flock	Red list - recent breeding population

Species	Distribution and Abundance	Conservation Status
<i>vulgaris</i>	from Flash 3, and similar August 2009 record for Flash 1. Mainly associated with vicinity of Whitley village.	decline UK BAP S41 List Species
Blackcap <i>Sylvia atricapilla</i>	Associated with hedgerows and woodland habitats.	Green list
Common Whitethroat <i>Sylvia communis</i>	Associated with drain margins, hedgerows and woodland habitats.	Green list
Shelduck <i>Tadorna tadorna</i>	Regular on Flash 3 throughout breeding season (max. 6 individuals). Confirmed breeding. Noted during walkover survey in April 2017.	Amber list - localised and important non-breeding population
Green Sandpiper <i>Tringa ochropus</i>	Single June 2009 record of 3 individuals on Flash 3.	Amber list - small breeding population WCA 1981 Schedule 1
Wren <i>Troglodytes troglodytes</i>	Associated with villages, hedgerows and woodland habitats. Widespread.	Green list
Redwing <i>Turdus iliacus</i>	Widespread through study area in winter months.	Red list - recent breeding population decline WCA 1981 Schedule 1
Blackbird <i>Turdus merula</i>	Associated with villages, hedgerows and woodland habitats. Widespread during all survey periods.	Green list
Fieldfare <i>Turdus pilaris</i>	Widespread through study area in winter months.	Red list - recent breeding population decline WCA 1981 Schedule 1
Lapwing <i>Vanellus vanellus</i>	Recorded on all flashes through summer months. Evidence of breeding at Flash 3. Regular winter feeder in substantial flocks on fields south of Flash 3, associating with Golden Plover flocks. Noted during walkover surveys in May 2016 and April 2017.	Red list - recent breeding population decline UK BAP S41 List Species

Green / Amber / Red list - species' listing on relevant list from Birds of Conservation Concern (Hayhow et al., 2017)

UK BAP - Priority species under the UK Biodiversity Action Plan

S41 List Species - Species of Principal Importance in England listed on Section 41 of the NERC Act 2006

WCA 1981 Schedule 1 - species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) for which it is an offence to intentionally or recklessly disturb at, on or near an 'active' nest.

The bird communities recorded in the study area include a number of nationally scarce and declining species, as well as species with additional legal protection during the breeding season. The bird species survey data can be summarised as follows:

- 71 species recorded
- 38 species confirmed or believed likely to have bred, of which two are afforded special protection under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) (i.e. Avocet and Little Ringed Plover)
- 10 UK BAP priority species
- 15 red list species, all on the basis of breeding population declines (with Curlew also on non-breeding population declines)
- 24 amber list species

As can be seen from the table above, there is a notable contribution to species numbers from waterbird species, defined as divers, grebes, cormorants, herons, swans, geese, ducks, rails, gulls and waders. Of the 71 total species recorded during the surveys, 32 of these were waterbird species, demonstrating the important contribution of the subsidence flashes to the ornithological value of the study area. Of particular note are the apparent breeding of Avocet and Little Ringed Plover; both species being listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as

amended). In addition to the breeding species, the winter aggregations of swans, geese, Lapwings, Golden Plover and Snipe are also of note.

As has been described in Table 4-10, the extent of the subsidence flashes has changed significantly throughout the development of the project. In 2008 the flashes were at their maximum extent, however, by 2011, all the flashes were found to be almost completely dry, within only very small amounts of water available in Flash 3. This was attributed to unusually dry conditions in 2011, and the maintenance of this situation by the ad hoc drainage measures implemented within Flash 3 independently of the Danvm Drainage Commissioner's operations. In 2011, as a result of this reduction in extent of open water and associated muddy margins, there was an associated decline in the number of waterbird species present. The only waterbirds recorded during survey visits in the vicinities of the former flashes in winter 2011 were occasional Snipe and a single Jack Snipe. Without the presence of the subsidence flashes, the only wetland habitats available to waterbirds in the study area are the drainage ditches and the waterbodies of Balne Moor Ponds SINC.

By 2017, the area of open standing water had again increased, but not to the extents seen in 2008 (see Figure 4-3, Figure 4-4 and Figure 4-5). Whilst no specific bird surveys were conducted in 2017, a number of wetland bird species were noted during other surveys conducted in April 2017 including Shelduck, Mute Swan, Grey Heron, Mallard, Curlew, Snipe, Jack Snipe, Oystercatcher and Black-headed Gull.

The presence and area of the open water areas described above significantly affects the assessment of the study area's importance to birds. In order to account for this, the assessment is undertaken separately for waterbirds.

4.5.3 Water Vole

No evidence of Water Vole activity was recorded on any of the IDB maintained watercourses to be affected by the proposed works, adjoining watercourses, or other land drains to be affected during surveys conducted in either 2009, 2011, 2016 or 2017. In 2011, the majority of the watercourses in the study were dry, providing limited habitat suitability for Water Vole.

Furthermore, in December 2011, a Mink *Neovison vison* was sighted along the wide drain which will become part of Connecting Drain 1, and mustelid droppings have been recorded on several occasions throughout the study area. This is likely to explain the lack of Water Vole records in an area with seemingly suitable habitat (when holding water).

During the walkover survey of May 2016, a small number of potential Water Vole burrows were recorded on Court Drain, close to the location of the new pumping station. No evidence of recent activity (e.g. latrines, droppings, feeding signs) were found. No other evidence of Water Vole activity was found in 2016. These burrows were again noted during 2017 however again no evidence of current Water Vole activity was noted.

As no evidence of Water Vole was found within the study area, and as the majority of the drains were dry in 2011, the impact on this species will not be assessed further in this ES.

4.5.4 Badger

As this species is sensitive the exact location of setts is not provided in this ES.

During surveys conducted, three Badger setts have been recorded within the study area. However, only one of these is located in an area where works will be conducted.

The sett within the works area has been known by the Danvm Drainage Commissioners for a number of years, however, surveys of the sett in 2009, 2011, 2016 and 2017 found it to be inactive. In May 2016, evidence of digging in this location was noted, however, it was considered to be more indicative of Rabbit *Oryctolagus cuniculus* and possibly further digging by Fox *Vulpes vulpes*. Footprints indicative of domestic cat were also recorded which is not surprising given the proximity to housing.

Camera trap surveys of inconclusive burrows noted within dense scrub on Court Drain identified that these were not used by Badger, but by Rabbit, with the burrows having become enlarged due to the sandy soils.

During other surveys of the study area evidence of Badger activity was recorded on a number of other occasions, including footprints, snuffle holes and latrines.

Levels of Badger activity in the study area throughout the survey period are relatively limited across such a wide area, however, there is consistent evidence of use, along with both active and inactive setts. However, within the areas to be directly affected by works, no active setts were recorded.

4.5.5 Otter

During surveys undertaken in August 2011, Otter activity, including a spraint and footprints, was recorded within the channel of New Fleet Drain South, approximately 480m upstream of its connection with Court Drain. At the time of this survey the New Fleet Drain South was dry and the footprints were recorded in the soft mud in the bottom of the channel.

The banks of New Fleet Drain South, with their extensive scrub cover and the dense vegetation within the drain channel, provide suitable habitat for Otter resting sites. The Aire and Calder Navigation also provides a potential food source. However, the wider area provides limited suitable habitat for Otter, with little cover and large open expanses between woodland and scrub areas. It is therefore likely that the Otter activity recorded in 2011 is from a commuting or foraging individual associated with the canal and not a population resident in the wider study area.

No evidence of Otter activity was found during surveys conducted in 2016 or 2017.

4.5.6 Great Crested Newt

As discussed in section 4.3.2, six ponds have been identified in the study area from OS maps and site visits, however, one pond, named as Booty Well pond on OS maps, was no longer in existence. Additionally, there are a number of subsidence flashes across the site, but the location and extent of these has varied between 2008 and 2017. Figure 4-1 shows the location of waterbodies on site.

The results of the HSI assessment of the waterbodies present on site between 2008 and 2017 is shown in Table 4-11 below. This HSI assessment was conducted in 2008 when the standing water in the subsidence flashes was at its maximum extent, with the exception of the new Flashes 9, 10 and 11, and the three ponds in Watkin's Lower Plantation which were assessed in 2017. A comment is included if the ponds are no longer in existence.

This table shows that the HSI assessment has determined that the ponds within the study area are of only poor or below average suitability for Great Crested Newts, with the exception of the rectangular pond within Watkin's Lower Plantation, however, this is only assessed as being of average suitability.

The eDNA sampling conducted on the waterbodies present in May 2017 returned negative results for all, with the exception of flash 4 which returned an inconclusive result. This was deemed to be due to the substantial quantity of silt in the sample, which was unavoidable due to the very shallow water depths present. However, as by late spring 2017 flash 4 was significantly dry, it was therefore considered unsuitable for newts. The results of the eDNA sampling can be found in Appendix A.

Table 4-11: HSI Assessment of Ponds within Study Area

	Flash 1 (TN1)	Flash 2 (TN2)	Flash 3 (TN3)	Flash 4 (TN5)	Flash 5 (TN6)	Balne Moor Ponds W	Balne Moor Ponds E	Flash 9 (TN9)	Flash 10 (TN10)	Flash 11 (TN11)	Watkin's Lower Plantation Pond 1 (TN12a)	Watkin's Lower Plantation Pond 1 (TN12b)	Watkin's Lower Plantation Pond 1 (TN12c)
Grid Ref.	SE 566 216	SE 569 213	SE 581 206	SE 567 211	SE 564 219	SE 581 200	SE 581 198	SE 578 203	SE 564 218	SE 566 218	SE 568 210	SE 568 209	SE568 210
SI1 Geographic Location	1	1	1	1	1	1	1	1	1	1	1	1	1
SI2 Pond Area (to nearest 50m ²)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.1	0.2	0.2
SI3 Pond Drying	0.1	0.1	0.1	0.1	0.1	0.9	0.9	0.1	0.1	0.1	0.5	0.5	1
SI4 Water Quality	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.33	0.33	0.67
SI5 Shade	1	1	1	1	1	1	1	1	1	1	0.4	0.4	0.4
SI6 Fowl	0.67	0.67	0.01	0.67	0.67	0.01	0.01	0.67	0.67	0.67	1	1	1
SI7 Fish	1	1	1	1	1	0.01	0.01	1	1	1	0.67	0.67	0.67
SI8 Pond Count	0.65	0.65	0.45	0.65	0.45	0.65	0.55	0.65	0.8	0.8	0.7	0.7	0.7
SI9 Terrestrial Habitat	0.01	0.01	0.01	0.01	0.01	0.33	0.33	0.01	0.01	0.33	1	1	1
SI10 Macrophyte Cover	0.35	0.35	0.35	0.35	0.3	0.7	0.7	0.3	0.3	0.3	0.35	0.35	0.9
HSI (Total of SI Scores 1/10)	0.39	0.39	0.25	0.39	0.37	0.31	0.30	0.38	0.40	0.56	0.51	0.54	0.68
HSI Rating	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Below Average	Below Average	Below Average	Average
Waterbody Extant	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Balne Moor Ponds W consists of a complex of three interconnected fishing ponds

Note: SI2 Pond Area for the subsidence flashes is assessed at their greatest extent in 2008/09 or 2017

As the subsidence flashes are recently formed ephemeral habitats, they are unlikely to hold resident breeding populations of Great Crested Newt, or other amphibians. There are no relevant historical records of Great Crested Newt within the study area or surrounding 2km from which animals could move to colonise the subsidence flashes. The surrounding intensively farmed arable landscape will also inhibit movements of newts to the subsidence flashes, and landscape features including the A19 and the Aire and Calder Navigation will form a further impediment to newt movements.

The ponds forming Balne Moor Pond SINC (both the western pond complex and the eastern pond) are used as fishing ponds and therefore are considered sub-optimal for Great Crested Newt. This is because fish predate upon newts and newt eggs, generally making ponds with dense fish populations unsuitable for newts.

As the subsidence flashes and ponds are considered unsuitable for Great Crested Newt this species will not be considered further in this ES.

4.5.7 Bats

Bat Roost Potential Assessment

The 2008 and 2011 surveys identified a number of trees with the potential to support roosting bats. In May 2016 an updated assessment of these trees within the proposed works areas was undertaken to determine their suitability for bat roosting.

Figure 4-12 shows the location of the trees assessed, with further details provided in Table 4-12.

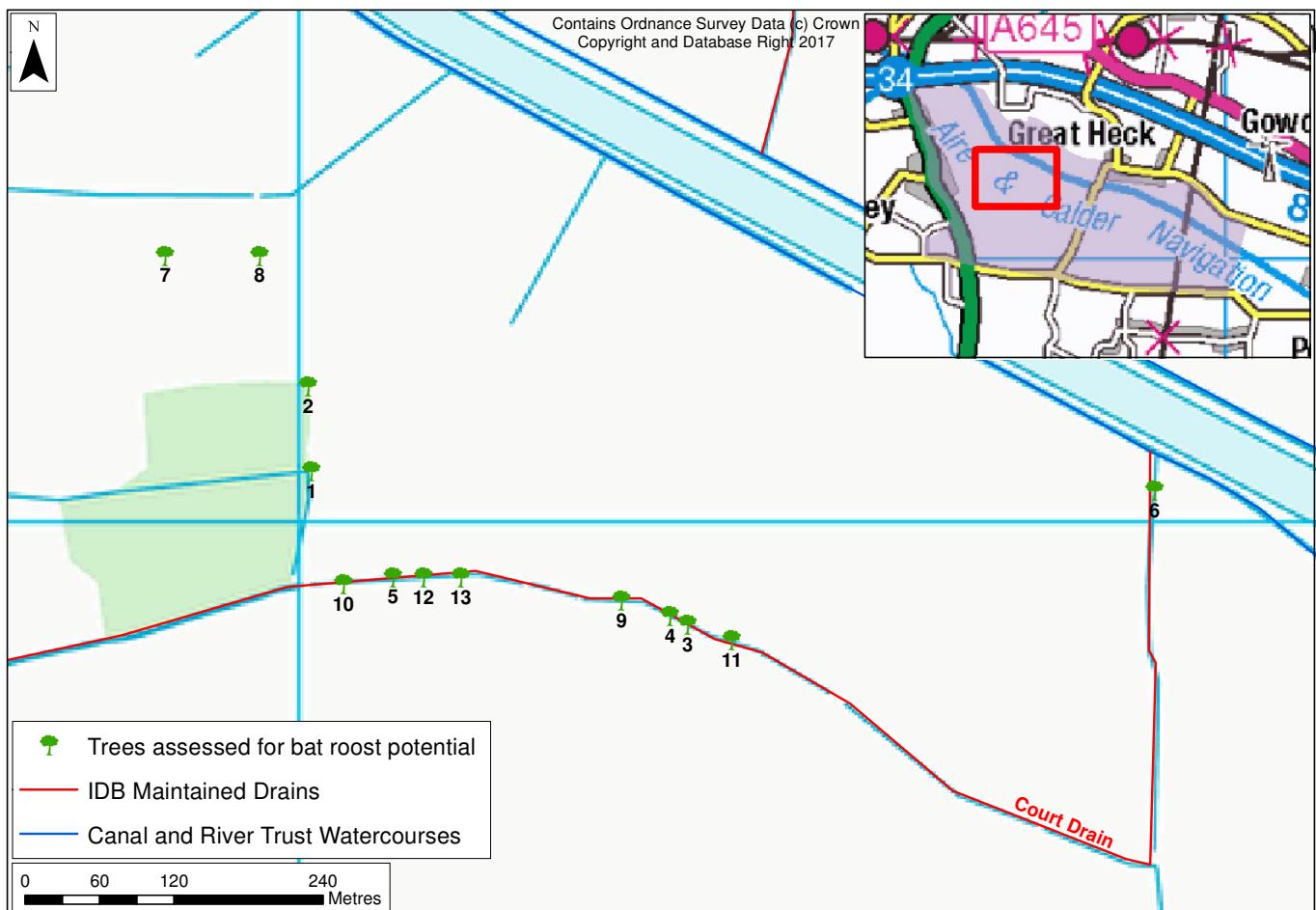


Figure 4-12: Trees Assessed for Bat Roost Potential

Table 4-12: Summary of Potential Bat Roost Sites

Map Ref.	Grid Ref.	Feature	Bat Roost Potential Assessment
1	SE 5701 2104	Pedunculate Oak <i>Quercus robur</i>	Mature specimen in reasonable condition with no obvious signs of deterioration although there is a possibility that there could be roosting features along the upper extent of the tree that could not be observed from ground level. The tree offers low bat roosting potential.
2	SE 5701 2111	Pedunculate Oak <i>Quercus robur</i>	Mature specimen in reasonable condition although showing some signs of age-related deterioration. Features tear-out wounds which provide sufficient openings for roosting bats and hence was judged to have moderate bat roosting potential.
3	SE 5731 2091	Pedunculate Oak <i>Quercus robur</i>	Sub-mature specimen in reasonable condition, with split on southern aspect of trunk. The bat roosting potential is considered to be moderate .
4	SE 5730 2092	Willow <i>Salix</i> spp.	Dead/dying specimen with areas of dead material and hollowing of main stem. The bat roosting potential is considered to be moderate .
5	SE 5708 2096	Willow <i>Salix</i> spp.	Leaning specimen with fissures and a tear-out wound along the over-hanging branch. The bat roosting potential is considered to be low .
6	SE 5769 2102	Pedunculate Oak <i>Quercus robur</i>	Splits on branches giving low bat roosting potential.
7	SE 5689 2121	Pedunculate Oak <i>Quercus robur</i>	Young specimen with negligible bat roost potential.
8	SE 5697 2121	Silver Birch <i>Betula pendula</i>	Young specimen with negligible bat roost potential.
9	SE 5726 2094	Hazel <i>Corylus avellana</i>	Young specimen with negligible bat roost potential.
10	SE 5703 2095	Pedunculate Oak <i>Quercus robur</i>	Specimen in excellent condition with negligible bat roost potential.
11	SE 5735 2090	Pedunculate Oak <i>Quercus robur</i>	Young specimen in excellent condition with negligible bat roost potential.
12	SE 5710 2095	Line of Hazel, Ash, Willow and Hawthorn <i>Crataegus monogyna</i>	Young trees with negligible bat roost potential.
13	SE 5713 2095	Small group of Ash and Hazel	Negligible bat roosting potential.



Figure 4-13: Pedunculate Oak tree with some cracks and flaking bark (Map Ref: 6)



Figure 4-14: Crack Willow with cracks and crevices (Map Ref: 3)

There is also a brick built culvert under the dismantled railway SINC (SE 583 201) and a brick built bridge also under this SINC (SE 588 208) that could have potential for roosting bats. However, these features will be unaffected by the works.

Buildings within the villages of Whitley and Great Heck may also provide roosting opportunities, however, these are not within close proximity of any proposed works and have therefore not been assessed in detail.

The wider study area does provide some suitable habitat features for commuting and foraging bats, with a number of linear habitat features (e.g. the Aire and Calder Navigation, Dismantled Railway Line SINC, drainage ditches) providing potential routes. There are also areas of scattered woodland interconnected with drainage ditches and occasionally hedgerows. However, the intensive arable landscape surrounding these features may reduce habitat suitability as bats tend not to fly over large open expanses. Any pesticide use may also reduce the potential food sources, however, this aspect is unknown.

Bat Activity Surveys

Emergence surveys targeted trees identified within Table 4-12 as having moderate potential to support bat roosts (Figure 4-12). The initial dusk survey, completed on 2nd May 2017, identified generally low levels of foraging Common Pipistrelle bats with highest concentrations of activity focused at two Pedunculate Oak trees situated closest to Watkin's Lower Plantation. This is unsurprising given that the plantation offers valuable edge habitat for this species to forage. Comparatively, the hedgerow in which the two surveyed Pedunculate Oaks are located was used infrequently for foraging/commuting. The second bat activity, completed during 22nd May 2017 captured increased foraging and commuting bat activity, likely to reflect higher and more suitable temperatures at the time of the survey. Similarly, to the findings of the initial survey, Common Pipistrelle bats were the most frequently recorded species with highest levels of activity captured at locations closest to Watkins Lower Plantation. Additionally, Noctule bats *Nyctalus noctula* were recorded occasionally by the surveyors positioned along the hedgerow and closest to open/arable habitat which is favoured by this species.

Despite levels of bat activity, no evidence of roosting was found to be associated with any of the trees surveyed.

4.5.8 Other Species

Table 4-13 below summarises the other species recorded during the field surveys undertaken between 2008, 2011, 2016 and 2017.

Table 4-13: Other Species Recorded during Field Surveys

Group	Common Name	Scientific Name	Location	Comment
Mammal	Brown Hare	<i>Lepus europaeus</i>	Dismantled Railway Line SINC Fields adjacent to New Cut 2	UK BAP Species S41 List Species Selby LBAP Species
	Fox	<i>Vulpes vulpes</i>	Court Drain	
	Grey Squirrel	<i>Sciurus carolinensis</i>	Dismantled Railway Line SINC	
	Mink	<i>Neovison vison</i>	Connecting Drain 1	Non-native species listed on Schedule 9 of Wildlife and Countryside Act 1981 (as amended)
	Roe Deer	<i>Capreolus capreolus</i>	Subsidence Flash 2	
	Wood Mouse	<i>Apodemus sylvaticus</i>	Dismantled Railway Line SINC	
Amphibian	Common Frog	<i>Rana temporaria</i>	Land drain west of Heck Road	Protected under the Schedule 5 of Wildlife and Countryside Act 1981 (as amended)
Reptile	Grass Snake	<i>Natrix natrix</i>	New Fleet Drain South	Protected under the Schedule 5 of Wildlife and Countryside Act 1981 (as amended) UK BAP Species

Group	Common Name	Scientific Name	Location	Comment
				S41 List Species
Lepidoptera	Brimstone	<i>Gonepteryx rhamni</i>	Court Drain	
	Gatekeeper	<i>Pyronia tithonus britanniae</i>	New Fleet Drain North	
	Green-veined White	<i>Pieris napi</i>	New Fleet Drain North Connecting Drain 2	
	Large Skipper	<i>Ochlodes sylvanus</i>	Court Drain	
	Large White	<i>Pieris brassicae</i>	Dismantled Railway Line SINC	
	Meadow Brown	<i>Maniola jurtina</i>	New Fleet Drain South New Fleet Drain North High Eggborough Drain	
	Painted Lady	<i>Cynthia cardui</i>	New Fleet Drain North Balne Common Drain Subsidence Flash 3	
	Peacock	<i>Inachis io</i>	New Fleet Drain North Court Drain High Eggborough Drain	
	Ringlet	<i>Aphantopus hyperantus</i>	Balne Common Drain	
	Small Skipper	<i>Thymelicus sylvestris</i>	Balne Common Drain Connecting Drain 1	
	Small Tortoiseshell	<i>Aglais urticae</i>	New Fleet Drain South Court Drain	
	Speckled Wood	<i>Pararge aegeria</i>	Watkin's Lower Plantation	
Odonata	Azure Damselfly	<i>Coenagrion puella</i>	Balne Common Drain Connecting Drain 1	
	Black-Tailed Skimmer	<i>Orthetrum cancellatum</i>		
	Blue-tailed Damselfly	<i>Ischnura elegans</i>	Drain No. 71 Connecting Drain 1	
	Broad bodied Chaser	<i>Libellula depressa</i>	Connecting Drain 1	
	Common Blue Damselfly	<i>Enallagma cyathigerum</i>	Court Drain Connecting Drain 1	
	Emperor Dragonfly	<i>Anax imperator</i>	Drain No. 71	
	Four Spotted Chaser	<i>Libellula quadrimaculata</i>	Drain No. 71 Connecting Drain 1	
	Large Red Damselfly	<i>Pyrrhosoma nymphula</i>	Court Drain Connecting Drain 1	
	Ruddy Darter	<i>Sympetrum sanguineum</i>	Drain No. 71	

Non-native Invasive Species

The only non-native invasive plant species recorded within the study area was Himalayan Balsam. This was recorded in the following locations:

- The margins of Watkin's Lower Plantation
- The east-west branch of High Eggborough Drain
- New Fleet Drain South, near Whitley Lock
- Dismantled Railway Line SINC, including around the connection with Balne Common Drain

Also, as detailed in the table above and section 4.5.3, a Mink was sighted on Connecting Drain 1.

4.6 Limitations

As discussed previously, the development of this project has occurred over several years, which for ecological features can provide a long-term, annual data set. However, the nature of this project's development has resulted in several periods when work was suspended so the field survey data collected has not been over a continuous period between 2008 and 2017. However, data has been collected from all seasons for at least one year.

It should also be noted that with regards to historical data sets obtained from local ecological records centres, an absence of records does not necessarily confirm the absence of a species, it may just be a reflection of recording effort.

4.7 Assessment of Impacts

4.7.1 Assessment Methodology

The assessment of ecological impacts has been undertaken following current best practice provided by the Chartered Institute of Ecology and Environmental Management (CIEEM, 2016).

Ecological features include nature conservation sites, habitats, species assemblages/communities or populations or groups of species. The assessment of the significance of predicted impacts on ecological features is based on both the 'importance' of a feature and the nature and magnitude of the impact that the project will have on it. Impacts may be direct (e.g. the loss of species or habitats), or indirect (e.g. effects due to noise, dust or disturbance).

Important Ecological Features

It is impractical for an assessment of the ecological impacts of a project to consider every ecological feature (species, habitat etc.) that may be affected; instead it should focus on those that are considered to be important. These are ecological features that are valued in some way, and could be affected by the proposed project; other valued ecological features may occur on or in the vicinity of the proposed works area but do not need to be considered because there is no potential for them to be affected significantly.

Various characteristics contribute towards the importance of ecological features, for example, naturalness, rarity, diversity, and connectivity.

The importance of an ecological feature should be considered within a defined geographical context. For the purposes of this assessment the following frame of reference has been used:

- International and European
- National
- Regional/County
- Local

Consideration of impacts at all scales is important, and essential if objectives for no net loss of biodiversity and maintenance of healthy ecosystems are to be achieved.

Ecological features have been valued using the scale set out in Table 4-14, with examples provided of criteria used when defining the level of importance.

Table 4-14: Examples of the Criteria used to Define the Importance of Ecological Features

Level of Importance	Examples of Criteria
International	An internationally important site e.g. SPA, SAC, Ramsar (or a site considered worthy of such designation); A regularly occurring substantial population of an internationally important species (listed on Annex IV of the Habitats Directive).
National	A nationally designated site e.g. SSSI, or a site considered worthy of such designation; A viable area of a habitat type listed in Annex I of the Habitats Directive or of smaller areas of such habitat which are essential to maintain the viability of a larger whole; A regularly occurring substantial population of a nationally important species, e.g. listed on Schedules 5 and 8 of the Wildlife and Countryside Act 1981 (as amended).
Regional/County (North Yorkshire/ Selby)	Viable areas of Section 41 list or LBAP priority habitat, or smaller areas of such habitat which are essential to maintain the viability of a larger whole; A site designated as a non-statutory designated site e.g. Local Wildlife Site (LWS); A regularly occurring substantial population of a nationally scarce species, including species listed on the Section 41 list or local BAP.
Local (works site and its vicinity, including area of habitats and contiguous with or linked to those on site)	Areas of internationally or nationally important habitats which are degraded and have little or no potential for restoration; A good example of a common or widespread habitat in the local area; Species of national or local importance, but which are only present very infrequently or in very low numbers within site area

The approach of this assessment is to consider the value of the site for the species under consideration, rather than the nature conservation importance of the species itself. While the importance of the species present is taken into account, in order to assess nature conservation importance, the number of individuals of that species using the site, and the nature and level of this use, is also taken into account, and an assessment is made of the value of the site to that species.

Legally Protected Species

Notwithstanding what has been said above, there is also a need to identify all legally protected species that could be affected by the proposed works in order that measures can be taken to ensure that contravention of the legislation is avoided. Therefore, it is inappropriate to assess the significance of impacts within the context of species' legal protection, as impacts on such species have to avoid contravention of the law, otherwise the scheme cannot go ahead.

Where a protected species is not considered to be an important ecological feature, for example Badger, which is protected for animal welfare reasons rather than nature conservation value, the measures that will be taken to ensure compliance with legislation are outlined within this chapter.

Impact Assessment Process

The impact assessment process involves:

- Identifying and characterising impacts;
- Incorporating measures to avoid and mitigate (reduce) these impacts;
- Assessing the significance of any residual effects after mitigation;
- Identifying appropriate compensation measures to offset residual effects; and
- Identifying opportunities for ecological enhancement

The assessment includes potential impacts (direct, indirect, secondary and cumulative) on each ecological feature determined as important from all phases of the project and describes in detail the impacts that are likely to be significant, making reference to the following characteristics:

- Positive or negative
- Extent
- Magnitude
- Duration
- Timing
- Frequency
- Reversibility

Residual Impacts

Where impacts are identified, mitigation measures are proposed to avoid, reduce or minimise them. Those impacts remaining after implementation of mitigation are the residual impacts. An assessment of the residual impacts has then been undertaken to determine the significance of their effects on ecological features.

Determining Ecologically Significant Effects

For the purposes of this assessment, a significant effect is an effect that either supports or undermines biodiversity conservation objectives for important ecological features or for biodiversity in general (CIEEM, 2016). Effects can be considered significant at a wide range of scales from international to local.

Significant effects encompass impacts on structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution). Table 4-15 details the factors that have been considered in the determination of significant effects on ecological features.

Table 4-15: Determining Ecologically Significant Effects

Ecological Feature	Consideration
Designated sites	<p>Will the project undermine the site's conservation objectives?</p> <p>Will the project positively or negatively affect the conservation status of habitats or species for which the site is designated?</p> <p>Will the project have positive or negative effects on the condition of the site or its interest/qualifying features?</p> <p>Will the project remove or change any key characteristics?</p> <p>Will there be an effect on the nature, extent, structure and function of component habitats?</p> <p>Will there be an effect on the average population size and viability of component species?</p> <p>Will there be an impact on wider ecosystem functions and processes?</p>
Habitats	<p>Will the project positively or negatively affect the conservation status of the habitat?</p> <p>Will it affect its extent, structure and function as well as its distribution and its typical species within a given geographical area?</p>
Species	<p>Will the project positively or negatively affect the conservation status of the species?</p> <p>Will it affect its abundance and distribution within a given geographical area?</p>

Precautionary Principle

The evaluation of significant effects has been based on current scientific evidence and professional judgement. Where sufficient information is not available to allow a robustly justifiable conclusion of no significant effect, a significant effect is assumed and any uncertainty is acknowledged.

4.8 Nature Conservation Evaluation

This section evaluates the nature conservation importance of the study area for its habitats and for the species it supports in terms of its relative importance in a geographical context.

The importance of the feature is defined with reference to the geographical context of the study area i.e. the specific importance of the Great Heck area to each of the habitats or protected species populations identified as being present within it, or making use of it. As discussed in section 4.5, this assessment of importance is based on current condition, although reference is made to previous years when conditions have been much wetter (i.e. 2008) and drier (i.e. 2011).

Table 4-16: Evaluation of Nature Conservation Importance

Ecological Feature	Evaluation Rationale	Importance of Feature or Importance of Site to Feature
Balne Moor Ponds SINC	Non-statutory designated local wildlife site supporting ponds and wetland vegetation.	Regional/County
Disused Railway Line SINC	Non-statutory designated local wildlife site supporting woodland and scrub and providing an important wildlife corridor.	Regional/County
Ditch west of Balne Moor Ponds SINC	Non-statutory designated local wildlife site supporting drain habitats and wetland species.	Regional/County
Arable farmland	<p>The study area consists predominantly of arable farmland, with the area increasing between 2008/09 and 2011 due to the drier weather conditions, but then declining slightly in 2017 due to conditions becoming slightly wetter and further subsidence. Arable farmland is a Selby LBAP habitat and the arable farmland within the study area is known to support important breeding birds (e.g. Yellow Wagtail, Corn Bunting, Skylark) and wintering birds (e.g. Whooper Swans, Lapwing and Golden Plover). However, this habitat type is very common and widespread in the local, county and national context, and it is therefore considered to be of local nature conservation value.</p> <p>Arable Field Margins are a UK BAP habitat however the fields of the study area generally only have narrow field margins which would not classify as this UK BAP habitat.</p>	Local
Subsidence Flashes	<p>The study area contains a number of areas which become waterlogged during wet conditions. Five of these flashes became relatively permanent features of the study area in 2008/09, covering an area of approximately 6.8ha at their maximum extent (including standing water and marginal vegetation). These subsidence flashes are generally infrequent features of the regional landscape and, when surrounded by marginal vegetation, provide important habitat for a range of species, particularly birds. They are therefore considered to be of regional/county importance when holding a significant volume of water and surrounded by marginal vegetation.</p> <p>However, in 2011 all five subsidence flashes were dry and several of them had been ploughed and cropped. The nature conservation value of the subsidence flash habitat in the study area was therefore reduced considerably and was considered analogous to the arable and grassland habitats that</p>	<p>Regional/County importance</p> <p>(However, of local importance only if not holding water, with surrounding marginal habitat absent and replaced by arable or grassland habitats)</p>

Ecological Feature	Evaluation Rationale	Importance of Feature or Importance of Site to Feature
	<p>were present in these areas (i.e. local).</p> <p>In 2017, subsidence flashes were again a feature of the study area, however, the location and extent of them in comparison with conditions in 2008/09 had changed. The area of subsidence flash now covers 4.3ha, however, by mid-April a number of these flashes had dried up and were only evident on the ground as areas of bare, exposed mud.</p> <p>As value is assigned on current habitat condition (see section 4.5), and the worst-case scenario (i.e. the highest value assessment) should be assumed, the value of the subsidence flash habitats is considered to be regional/county.</p>	
Grassland (Improved, poor semi-improved, marshy and amenity)	<p>The study area contains some grassland areas, including improved, poor semi-improved and amenity types. These grasslands are typical of the agricultural and village landscape within which the study area is situated and surrounding areas contain habitats of similar character. The grassland habitats present are very common and widespread in local, county and national context.</p>	Local
Drainage ditches	<p>Drainage ditches within the study area include four IDB maintained watercourses, two canal soak drains maintained by the Canal and River Trust and a number of smaller land drains under riparian ownership. These drainage ditches, in general, support a moderate to poor diversity of aquatic macrophytes and other species, including wetland birds and invertebrates.</p> <p>Many of these drainage ditches were dry when surveyed in 2011 and becoming dominated by more terrestrial species. However, in 2017 they again held water.</p> <p>Due to the low-lying nature of the surrounding area drainage ditches are a common feature of the landscape and therefore the watercourses within the study area are assessed as being of local value.</p> <p>Ditches are also included within the Selby LBAP as part of the 'Rivers, Streams and Ditches' habitat action plan.</p>	Local
Ponds	<p>As Booty Well pond was found to be no longer in existence and the pond north of the Aire and Calder Navigation is separated from the works areas by this feature the only ponds to consider further in this ES are those forming Balne Moor Ponds SINC and the three small ponds in Watkin's Lower Plantation. The assessment of value relating to the ponds at Balne Moor Ponds SINC can be found above.</p> <p>The three ponds in Watkin's Lower Plantation are small, seemingly polluted and lack significant aquatic and wetland vegetation.</p>	Regional/County for Balne Moor Ponds SINC Local for the three small ponds in Watkin's Lower Plantation

Ecological Feature	Evaluation Rationale	Importance of Feature or Importance of Site to Feature
Woodland and scrub	<p>There are scattered areas of woodland across the study area, including Watkin's Lower Plantation and the Dismantled Railway Line SINC. These are generally broad-leaved woodlands, some plantation in origin, with a relatively diverse canopy and ground flora. They also provide habitat for birds, bats, Badger and invertebrates, which in a predominantly arable landscape is an important refuge, and they are therefore considered to be of local importance.</p>	Local
Hedgerows	<p>Hedgerows are listed on the UK BAP and ancient and species-rich hedgerows are listed on the Selby LBAP. Hedgerows are a common feature of the region, however, a relatively uncommon feature within the study area itself. Where present in the study area they are generally species-poor and gappy. They are therefore assessed as of local importance.</p>	Local
Birds	<p>As described in the section above on subsidence flashes, the establishment of these features, their subsequent drying in 2011 and partial re-wetting by 2017, has had significant effects on the ecological value of the study area, including to birds. At their greatest extent (2008/9) the subsidence flashes supported a large and varied waterbird community, including important species such as Avocet and Little Ringed Plover. The value of the study area to waterbirds, with the presence of wetted subsidence flashes, is therefore considered to be regional/county. However, the drying of these areas reduced this value, so that when standing water is not present, it is considered to be of only local value to waterbirds.</p> <p>In contrast to waterbirds, the value of the study area to other species (e.g. farmland and woodland species) has stayed relatively constant. The study area supports regularly occurring substantial populations of a number of nationally scarce farmland bird species (e.g. Skylark, Corn Bunting, Yellow Wagtail) and is therefore considered to be of regional/county importance to non-waterbird species.</p>	<p>Regional/County to waterbird species (However, of local importance if subsidence flashes are not holding water and surrounding marginal habitat is absent)</p> <p>Regional/County to non-waterbird species</p>
Badger	<p>Badgers and their setts are protected under the Protection of Badgers Act 1992 on animal welfare grounds.</p> <p>Parts of the study area (e.g. Watkin's Lower Plantation, the canal soak drains, the Dismantled Railway Line SINC) provide good foraging habitat for Badgers. Badgers are confirmed to be present within the local area, although the only sett in close proximity to the works areas is currently inactive. Badgers are common in a local, regional/county and national context.</p> <p>It is therefore considered that the study area is of local nature conservation value with respect to Badgers.</p>	Local
Otter	Otter are protected under the Wildlife and Countryside Act 1981 (as amended) and the	Local

Ecological Feature	Evaluation Rationale	Importance of Feature or Importance of Site to Feature
	<p>Conservation of Habitats and Species Regulations 2010 (as amended). This legislation ensures that Otter and their resting places are protected.</p> <p>Evidence of Otter was recorded in one instance during the survey period (2008 to 2011). The banks of the canal soak drain do provide some suitable habitat for Otter resting sites and the Aire and Calder Navigation provides a potential food source. However, the wider area provides limited suitable habitat for Otter, with little cover and generally large open expanses of arable land. The Otter record is therefore considered to be from a commuting or foraging individual associated with the canal and not a population resident in the wider study area.</p> <p>It is therefore considered that the study area is of local nature conservation value with respect to Otter.</p>	
Bats	<p>UK bat species are protected under the Wildlife and Countryside Act 1981 (as amended) and the Conservation of Habitats and Species Regulations 2010 (as amended). This legislation ensures that bats and their breeding sites and resting places are protected.</p> <p>The site provides some foraging and commuting habitat for bats (e.g. Aire and Calder Navigation, woodland areas, Dismantled Railway Line SINC) and some roosting opportunities, although activity surveys identified only limited levels of bat activity and no roosts were identified in trees requiring removal to facilitate the works. There are only historical Pipistrelle species records within the study area and surrounding 2km.</p> <p>It is therefore considered that the study area is of local nature conservation value with respect to bats.</p>	Local
Other Species	<p>Grass Snake are protected under the Wildlife and Countryside Act 1981 (as amended). Grass Snake is also a UK BAP species. One Grass Snake was sighted during the field survey work. The subsidence flashes and ditches within the study area provide suitable habitat for Grass Snake, however now the subsidence flashes and many of the drains are dry their suitability is reduced. The large arable fields are of low value to Grass Snake. It is therefore considered that the study area is of local conservation value for Grass Snake.</p> <p>Brown Hare is a UK BAP species. Brown Hare were frequently sighted within the study area during the survey period and the area provides suitable habitat for this species. It is therefore considered that the study area is of local conservation value for Brown Hare.</p> <p>Eel is a UK BAP species. Although there are no formal records or observations of Eel within the study area, there are anecdotal records from the North Fleet Drain South. There is considerable</p>	Local Local Local

Ecological Feature	Evaluation Rationale	Importance of Feature or Importance of Site to Feature
	suitable habitat for this species within the larger watercourses of the study area, providing that access is possible. However, there is limited suitable habitat upstream of where the new pumping station will be located. It is therefore considered that the study area is of local conservation value for Eel.	

4.9 Predicted Short-term and Construction Impacts

4.9.1 Balne Moor Ponds SINC

No works are proposed within Balne Moor Ponds SINC and there will be no direct impact upon this site from the construction works. Improved drainage of the study area during the construction phase and lowering of the water table could affect groundwater levels within the ponds (see section 6.5.2). However, due to the distance of the SINC from the nearest ditch (Balne Common Drain), approximately 110m, and that this drain acts as an effective hydraulic barrier between the ponds and the works (see section 6.5), no permanent negative impacts on this SINC are anticipated.

4.9.2 Disused Railway Line SINC

Being separated from the works area by some distance, and not containing water dependant habitats, no impact on this SINC as a result of the construction phase are anticipated.

4.9.3 Ditch west of Balne Moor Ponds SINC

No works are proposed within the Ditch West of Balne Moor Ponds SINC and there will be no direct impact upon this site. However, as a result of the drain re-grading works there is the potential for water quality in the ditch to be affected by the release of sediment or from pollution incidents, which could adversely impact on the species present within the drain. However, the short-term and localised nature of the construction works will result in temporary negative impacts only, if not mitigated against.

Improved drainage of the study area and lowering of the water table during the construction works could also affect groundwater levels within this SINC (see section 6.5.2), which could impact upon the drain habitats within this SINC. However, as Balne Common Drain acts as an effective hydraulic barrier between the works and this drain, no permanent negative impacts on this SINC are anticipated during the construction phase.

4.9.4 Habitats

Arable Farmland

The construction phase will result in disturbance to some arable farmland as a result of site compounds, machinery and working areas adjacent to drains. These habitats are considered to be of local ecological importance only, nonetheless, existing access tracks will be utilised as much as possible. Furthermore, the area of arable farmland expected to experience disturbance during the construction phase is proportionally very small, relative to its availability within the study and surrounding area and consequently only small-scale, temporary, negative impacts on arable farmland are anticipated as a result of the construction phase.

Subsidence Flashes

The construction phase will result in disturbance to the arable farmland, grassland habitats, bare ground and standing water habitats currently present in the areas where subsidence flashes are (or have previously been) located. The subsidence flashes are all located in relatively close proximity to drains that will be re-graded/newly cut and the pumping station construction site. The disturbance will be created as a result of machinery and workforce movements. However, the disturbance created is not anticipated to be significantly above that created by normal agricultural operations. The period of disturbance will also only be during the construction period (long-term operational impacts on these habitats are discussed in section 4.10.4) and therefore

only temporary negative impacts on the subsidence flashes are anticipated as a result of the disturbance generated by the construction phase.

Grassland

The construction phase will result in disturbance to some very small areas of grassland habitat (e.g. arable field margins, the margins of the grassland adjacent to Watkin's Lower Plantation, the poor semi-improved grassland areas scattered around the study area) within the study area as a result of site compounds, machinery and workers. These habitats are considered to be of local ecological importance only, nonetheless, existing access tracks will be utilised as much as possible. Furthermore, the area of grassland to experience disturbance during the construction phase is proportionally very small relative to its availability within the study and surrounding area and consequently only temporary negative impacts on grasslands are anticipated as a result of the construction phase.

Drainage Ditches

The re-grading works will result in disturbance to the flora and fauna of approximately 1.7km of IDB maintained watercourses and 1.2km of other land drains. However, this disturbance will be temporary as the disturbed channels and banks will vegetate reasonably quickly following the works through revegetation and re-seeding. There will also be no net loss of ditch habitat as a result of the works; there will in fact be an increase of 425m in the length of open drainage ditch in the study area as a result of the new connecting drains. There will therefore be only temporary negative impacts on drainage ditch habitats as a result of the construction works, and potential positive impacts may arise in the longer-term if re-seeding is done with a species-rich, native seed mix of greater diversity than the sward currently present.

There is a potential risk of sediment release and chemical contamination during the construction period, however this risk is low, and the implementation of the mitigation measures described in section 6.5.5 will limit the likelihood of this occurring. Furthermore, given the short-term and localised nature of the construction works, the potential release of sediment and/or pollution incidents result in temporary negative impacts only, if not mitigated against.

Large stands of Himalayan Balsam have been recorded along some of the drains where re-grading/new cuts are proposed (e.g. Connecting Drain 1 and New Fleet Drain South). The re-grading works therefore have the potential to spread this species within the study area, which would be an offence under the Wildlife and Countryside Act 1981 (as amended). Without implementation of an appropriate mitigation strategy to prevent this species spread, the works could result in a long-term negative impact on drainage ditch habitats in the study area.

Ponds

The ponds forming Balne Moor Ponds SINC are discussed in section 4.10.1 above.

The three small ponds in Watkin's Lower Plantation are separated from the works and as a result there will be no impact on these features during the construction phase.

Woodland and Scrub

During the construction phase there will be no impacts on any areas of woodland/scrub within the study area. The re-grading works along Court Drain and proposed Connecting Drain 1 will pass along the boundary of Watkin's Lower Plantation. However, this re-grading work will be undertaken from outside of the woodland area in the arable and grassland fields and therefore there will be no impact on woodland habitat as a result of this scheme.

Hedgerows

No hedgerows within the study area are located in close proximity to any works. There will be no impact on hedgerows as a result of this scheme.

4.9.5 Birds

By the nature of the construction works involved in this scheme, a degree of disturbance to birds present in the vicinity of the works areas is inevitable. The magnitude of this impact, however, depends on a number of characteristics of the works, including:

- The timing of the construction activities
- The level of disturbance, both spatially and temporally

- The availability of equivalent habitats outside of the influence of disturbance to accommodate displaced birds.

There is little published literature available on the effects on birds of disturbance associated with construction activities such as those in this scheme. The majority of studies are related to wetland, estuarine and marine species, and to the impacts of recreation, as opposed to the impacts of construction on terrestrial passerines and waterbirds that are most relevant to this scheme.

Gill (2007) in a review of the approaches to measuring the effects of human disturbance on birds, with regard to recreation, provides a useful summary of the potential impacts disturbance can have on birds, that is of relevance here. There are four key types of measure, analogous to effect, which can result from disturbance:

- Changes in distribution e.g. avoidance of disturbed areas; movements in response to humans on site
- Changes in behaviour e.g. increased vigilance; changed flight responses; altered breeding behaviour
- Changes in demography e.g. reduced fecundity or survival in disturbed areas
- Changes in population size e.g. severe changes in demography causing permanent population impacts

The works proposed in this scheme have been phased, with the first phase (drain re-grading/cutting) scheduled to commence in mid-late summer 2017 (after the peak period for breeding birds) and last for approximately 3-4 months. The second phase (pumping station construction) is programmed for late summer/autumn 2017 and be complete by spring 2018.

The phasing of the works, both spatially and temporally, in combination with the substantial amounts of similar habitats outside the influence of the disturbance, should minimise the potential for long-term, negative population impacts from disturbance throughout the construction phases. However, there is the potential that birds will still be nesting in the area when works commence, which could result in disturbance and damage/destruction of nests. Damage/destruction of nests would be an offence under the Wildlife and Countryside Act 1981 (as amended). Also, if the Schedule 1 breeding bird species (i.e. Avocet and Little Ringed Plover) that have been previously recorded in the area during the summer, are confirmed to be breeding in close proximity to the works areas, then an offence under the above act could also occur as a result of disturbance.

The potential for the other three key changes (see bullet points above) to occur would, however, appear to be quite high. Although the birds present will be to some degree habituated to disturbance by machinery and people as a result of the agricultural and other activities in the area these works are likely to be beyond the range of variation normally experienced between years.

In light of the above, the temporary negative impacts associated with disturbance during the construction phase are anticipated. No permanent impacts in a manner to affect the sustainability of the bird populations present are expected. However, given the duration of the construction works, some long-term impacts not affecting the sustainability of the populations are expected. Although beyond the levels usually experienced by birds in the study area, these will ultimately be reversible by removal of the disturbance upon completion of construction.

The works will initially involve the removal of any vegetation that could potentially offer habitat for breeding birds, following a nesting bird survey. This situation will be maintained throughout the works period and will control the potential for direct impacts (damage or loss of nests) on breeding birds within the works areas; however, there may still be some residual, low-level disturbance of breeding birds in the vicinity of the works areas as described above. The second phase of works (the pumping station) has also been timed to minimise potential impacts on breeding birds by commencing late summer/autumn. There is, however, some minor risk of damage to late nests - particularly if a warm autumn is experienced - as a result of the pumping station construction and necessary removal of four trees and bankside habitats along 2.9km of IDB maintained and other land drains (likely to be on one bank only). Without appropriate mitigation, short-term negative impacts could occur in relation to disturbance of bird populations in the study area, however, this will not impact on their conservation status given the localised nature and short duration of the works.

4.9.6 Badger

The known Badger sett within the works areas has been recorded as inactive from 2009 onwards. Other recorded Badger setts in the study area are outside areas where works are proposed and will therefore not be impacted upon. The other records of Badger activity in the study area have been widespread and consistent throughout the survey period, indicating there is a Badger presence in the study area. Therefore, it is possible that new setts could become established within the vicinity of the works areas during the construction phase, or that the inactive sett within the works area may become active again. The re-grading works may also temporarily disrupt existing Badger paths across the study area and cause general disturbance to Badger populations. However, given the localised and short-term nature of the works, only temporary negative impacts on the Badger population in the local area are anticipated, with no long-term impact on the conservation status of this species likely.

4.9.7 Otter

There is only one record of Otter from the study area, associated with New Fleet Drain South and, most likely, the Aire and Calder Navigation, indicating that Otter use of the study area is limited. During the construction phase Otter movements along the canal corridor may be disrupted, particularly in relation to construction of the pumping station and the works around New Fleet Drain South. However, given the localised and short-term nature of the works, the disturbance created by the works will have temporary negative impacts only, with no long-term impact on the conservation status of this species likely.

The works, particularly any vegetation clearance, also has the potential to disturb or damage any Otter resting places that may become established within the vicinity of the works areas during the construction phase. Without mitigation, this could have a significant negative impact on Otter populations in the study area, over the short-term. However, it is not anticipated to have a significant impact on the conservation status of this species as a whole as significant areas of alternative habitat for Otter resting places exist within the wider area.

4.9.8 Bats

Along the length of Court Drain to be re-graded four trees with low to moderate suitability for roosting bats were identified. Two further trees along the eastern boundary of Watkin's Lower Plantation, where Connecting Drain 1 will be dug, were also assessed as having low to moderate suitability for roosting bats. As a result of the drain re-grading and cutting works some or all of these trees may need to be removed, potentially resulting in the loss of bat roosts. However, bat activity surveys conducted in May 2017 identified however, that these trees were not being used by roosting bats, and therefore their removal would have no impact on roosting bats.

The disturbance created during the works also has the potential to impact on bats commuting and foraging in the works areas. The disturbance created in the study area would be localised, of short duration and is anticipated to have temporary negative impacts only on bats in the local area, with no long-term impact on the conservation status of these species likely.

4.9.9 Other species

Grass Snake

As the pumping station will be constructed within an arable field these works are unlikely to have a significant effect on this species. The drains to be re-graded may be used by Grass Snake and therefore this species may be impacted upon by temporary disturbance, with the potential for injury, during the construction phase, with the bankside habitat temporarily becoming unsuitable for them. As the bankside habitat will recover relatively quickly upon completion of the works, this is anticipated to have a temporary negative impact on Grass Snake in the local area, but no impact on the conservation status of this species.

Brown Hare

Brown Hare have been recorded within the study area and the construction works would cause short-term disturbance to this species. However, this species is highly mobile and the large amount of suitable habitat within the study area and surrounding landscape and therefore no permanent negative impacts on Brown Hare populations, or the conservation status of this species, are anticipated.

Eel

The re-grading works have the potential to disturb Eel populations that may be resident within existing watercourses in the study area, and temporarily render the habitat unsuitable for this species. Being restricted to the watercourses, dispersal to other areas is not as easy as for other species, such as Brown Hare. However, given that the re-grading works will be of short duration, only temporary negative impacts are anticipated on Eel, with no long-term impact on the conservation status of this species likely.

4.10 Predicted Operational Impacts

4.10.1 Balne Moor Ponds SINC

As a result of improvements to the drainage system the water table will be lowered which could affect groundwater levels and consequently the ponds of this SINC. However, Balne Common Drain acts as an effective hydraulic barrier between this site and the works and any changes in water level will be minimal (see section 6.5.3). Consequently, no permanent negative impacts are anticipated on water levels in this SINC.

4.10.2 Disused Railway Line SINC

Being separated from the works areas by some distance and not being a water dependant habitat, no impact on this SINC as a result of scheme operation is anticipated.

4.10.3 Ditch West of Balne Moor Ponds SINC

As a result of improvements to the drainage system the water table will be lowered which could affect groundwater levels and consequently the ditch habitats of the SINC Ditch West of Balne Moor Ponds. However, Balne Common Drain acts as an effective hydraulic barrier between this site and the works and any changes in water level will be minimal (see section 6.5.3). Consequently, no permanent negative impacts are anticipated on water levels in this SINC.

4.10.4 Habitats

Arable Farmland

The works will result in the permanent loss of approximately 12,812m² of arable farmland through drain re-grading, cutting new drains and at the pumping station location. This equates to approximately 0.2% of the study area. This habitat will be replaced by alternative habitats (e.g. grassland on drain banks, ditch habitats). The proposed drainage scheme will also remediate against the mining subsidence and restore the ephemeral subsidence flashes to permanently useable agricultural land. This will increase the area of land available to be put back into arable cultivation and increase the area of arable farmland habitat. Given that arable farmland is of local importance only, there are substantial areas of this habitat type in the local area, and the area of useable arable farmland will increase, an overall permanent positive impact is anticipated.

Subsidence Flashes

Although the subsidence flashes are not permanent features of the landscape, drying up at certain times (e.g. 2011) and being cultivated or grassed, the proposed works will prevent these habitats from re-forming if conditions become wetter. The proposed scheme will therefore result in the permanent loss of these habitats, as the potential for these habitats to reform will have been removed. This will have a significant, permanent, negative impact on this habitat type.

Grassland

The works will result in the permanent loss of a very short length of poor semi-improved grassland habitat, where the new drain will be cut alongside Watkin's Lower Plantation. This will equate to less than 0.01% of the study area and given that grassland is assessed as of local importance only, and there are substantial areas of this habitat type in the local area, no permanent negative impact is anticipated.

Drainage Ditches

The proposed works will result in an additional 425m of open ditch habitat within the study area. The re-graded watercourses have the potential to provide improved habitat to flora and fauna,

as some of the new and re-graded drains (approximately 820m) will be constructed with berms, which will potentially result in a more diverse flora, with the wider channel allowing for the establishment of fringes of emergent vegetation. The creation of new drain habitat, and enhancement of existing drains with berms, will therefore have a permanent positive impact on this habitat within the study area.

Ponds

The ponds forming Balne Moor Ponds SINC are discussed in section 4.10.4 above.

The three small ponds within Wakin's Lower Plantation are not located within any works areas and are separated from them by significant woodland areas. It is considered that improved drainage within the study area will have no impact in the long-term on these three small ponds.

Woodland and Scrub

There will be no impact in the long-term as a result of the operational phase of the scheme on any woodland or scrub areas within the study area.

Hedgerows

There will be no impact in the long-term as a result of the operational phase of the scheme on any hedgerows within the study area.

4.10.5 Birds

As described in the section above regarding subsidence flashes, the proposed works will prevent these ephemeral habitats from re-forming when prevailing conditions are wet. This will result in their permanent loss. As this effectively removes a key habitat used by waterbirds from the study area in its entirety, it will have a significant, permanent negative impact on waterbird populations in the area.

The impact of the permanent removal of the subsidence flashes on non-waterbird species is expected to be less significant, however, it will reduce habitat diversity and foraging opportunities. However, this is not expected to be beyond the range of variation experienced between years. The reliance on the standing water habitats for non-waterbird species is not critical for their lifecycle, or certain aspects of it.

The cutting of the new drains will lead to a loss of some arable habitat, but also the creation of equivalent areas of ditch habitat. As described above, some of the re-graded drains and new cuts (approximately 820m) will be constructed with berms, which will potentially result in a more diverse flora with the wider channel allowing for the establishment of fringes of emergent vegetation. This will be of benefit to species that exploit such habitats, such as Reed Buntings, Common Whitethroat and warblers. Given the extensive arable habitats present within the study area and surroundings, and the absence of large drainage ditches with vegetated berms, it is considered that the establishment of the new drain network will lead to a permanent positive impact on bird populations.

4.10.6 Badger

No impact in the long-term as a result of the operational phase of the scheme is anticipated in relation to Badgers using the study area.

4.10.7 Otter

No impact in the long-term as a result of the operational phase of the scheme is anticipated in relation to Otters using the study area.

4.10.8 Bats

No impact in the long-term as a result of the operational phase of the scheme is anticipated in relation to bat populations using the study area.

4.10.9 Other Species

Grass Snake

No impact in the long-term as a result of the operational phase of the scheme is anticipated in relation to Grass Snakes using the study area.

Brown Hare

No impact in the long-term as a result of the operational phase of the scheme is anticipated in relation to Brown Hare using the study area.

Eel

Pumping stations and other structures on watercourses have the potential to restrict Eel passage. The construction of the new pumping station therefore has the potential to prevent Eel moving into other watercourses within the study area. However, upstream of the proposed pumping station location there is limited habitat available for Eels, with only a few hundred metres of shallow watercourse available, with little cover. Therefore, whilst the pumping station operational phase may have a permanent negative impact on Eel by restricting passage upstream of the pumping station, given the limited habitat availability upstream this is not likely to have a significant impact on the conservation status of Eel within the wider area.

Structures such as pumping stations also have the potential to entrain and kill Eels within the pump mechanism, potentially having a permanent, negative impact on Eel populations in the area. However, given the limited habitat suitability upstream, the numbers becoming entrained in the new pumping station is likely to be low and no significant impact on the conservation status of this species is anticipated.

4.11 Mitigation Measures

This section describes the mitigation measures to avoid or reduce impacts on important ecological features and protected species that will be incorporated into the development during the construction phase.

Mitigation measures are also summarised in Table 4-17.

4.11.1 Balne Moor Ponds SINC

No permanent negative impacts are anticipated in relation to Balne Moor Ponds SINC, during both construction and operation, and consequently no mitigation measures are proposed.

4.11.2 Disused Railway Line SINC

No construction or long-term/operational impacts are anticipated on this site and therefore no mitigation is proposed.

4.11.3 Ditch west of Balne Moor Ponds SINC

No permanent negative impacts are anticipated in relation to the Ditch West of Balne Moor Ponds SINC operation of the scheme and consequently no mitigation measures are proposed.

However, during the construction phase, impacts on this SINC could arise from sediment release and pollution incidents. Pollution prevention measures to limit the occurrence of this will therefore be implemented, as detailed in 6.5.5.

4.11.4 Habitats

Arable Farmland

Existing access tracks will be used where possible to limit the amount of arable land disturbed during construction.

Land take will be minimised wherever possible.

Subsidence Flashes

Approximately 820m of re-graded and newly cut drain will include a berm within their cross section which will allow the development of an area of marginal vegetation and in some places shallow muddy margins. This will provide habitat similar to that present around the margins of the subsidence flashes (in particular Flashes 1, 2, 4 and 5) in 2008/09, which will provide cover for species such as Snipe and Jack Snipe. However, the area of new wetland habitat on the berms will not equate to the potential area of subsidence flash that will be lost due to implementation of the proposed scheme.

Grassland

Any grassland areas disturbed during the construction works will be re-sown with an appropriate species-rich grass and wildflower seed mix upon completion of the works.

Drainage Ditches

On completion of the works the banks of the watercourses will be sown with an appropriate species-rich grass and wildflower seed mix. The channel vegetation will be allowed to re-colonise naturally, however, this will be monitored and if deemed necessary additional planting of suitable aquatic plant species will be undertaken.

To limit the likelihood of a pollution incident, appropriate pollution prevention measures will be implemented, as described in section 6.5.5.

An appropriate mitigation strategy will be written and implemented in order to prevent the spread of non-native Himalayan Balsam, which would be an offence under the Wildlife and Countryside Act 1981 (as amended). Himalayan Balsam is an annual plant which completely dies off in the winter and re-grows from seed each spring. The seeds are contained in a highly developed seedpod which is capable of catapulting seeds for up to 7m from the plant, when touched, or blown by the wind once fully ripe. This seed dispersal method can cause problems with construction in areas infested with this species. Working in areas contaminated with Himalayan Balsam when the plant has set seed in late summer (July to October) should therefore be avoided. It is likely that the Himalayan Balsam mitigation strategy will involve:

- Phasing the drain re-grading works so that work along infested sections of drains is avoided between July and October, when the plant has seeds.
- Seeds can also remain viable in soil for over two years, therefore no soil will be removed from site. Any soil spread on site will be monitored and any re-growth of Himalayan Balsam managed appropriately (i.e. by manually uprooting before the plant sets seed in March to June and stockpiling of arisings on site to compost).
- Good site biosecurity practices must be employed to clean any plant or machinery used in the infested areas; wheel washes or a portable power washer may be required.

Ponds

The ponds forming Balne Moor Ponds SINC are discussed in section 4.11.1 above, with no mitigation proposed due to no permanent negative impacts being identified.

No mitigation measures are proposed for the three ponds in Watkin's Lower Plantation as no construction or long-term/operational impacts were identified.

Hedgerows

No construction or long-term/operational impacts are anticipated on hedgerows and therefore no mitigation is proposed.

4.11.5 Birds

As described in Section 4.9.5, some of the potential impacts on birds have been mitigated against by the programming of the proposed works, both temporally and spatially, to avoid key periods. In order to further control potential impacts on breeding birds, through damage or destruction of nests, any vegetation to be removed as part of the scheme between the period March and September inclusive will be assessed for breeding birds by a suitably qualified ecologist prior to removal.

Also, a breeding bird survey will be undertaken in advance of the works to ensure that there will be no impacts on nesting birds. If ground nesting birds are found in areas of works then these areas will be marked, with a suitable buffer, and no works will be undertaken in these areas until the chicks have safely fledged. If Schedule 1 bird species are found to be breeding in close proximity to works areas, work will not be permitted to commence in these areas if disturbance could occur. Works will only commence once the chicks are no longer dependent on their parents or have moved away from the area.

Given that the scheme is to remediate mining subsidence, the loss of the subsidence flashes cannot be mitigated against directly. However, as discussed in section 4.11.4 berms will be included along 820m of re-graded and newly cut drain which will provide a small amount of marginal wetland habitat in mitigation.

4.11.6 Badger

A further survey to identify the presence of any newly active or established setts within 30m of the works areas will be undertaken prior to the commencement of construction activities. If required, appropriate mitigation strategies will be devised and the relevant licenses applied for from Natural England.

No night-time working will be permitted and therefore there should be no disturbance to Badgers foraging within the works areas.

To minimise the potential for Badgers being trapped in any excavations, a suitable means of escape will be provided where such works cannot be sealed off.

4.11.7 Otter

A further survey to identify the presence of any Otter resting places/holts within 30m of the works areas will be undertaken prior to the commencement of construction activities. If required, appropriate mitigation strategies will be devised and the relevant licenses applied for from Natural England.

No night-time working will be permitted and therefore there should be no disturbance to Otters foraging within the works areas.

To minimise the potential for Otters being trapped in any excavations, a suitable means of escape will be provided where such works cannot be sealed off.

4.11.8 Bats

All trees felled will be replaced through re-planting, with appropriate, locally-sourced, native species.

Night-time working will not be permitted to reduce disturbance to commuting and foraging bats.

Any floodlighting used around site compounds must be angled downwards and fitted with a cowl to direct light to the ground, again to minimise light pollution disturbing foraging bats.

4.11.9 Other species

Water Vole

Although no evidence of Water Vole was found in the study area, there are records of Water Vole from within 2km of the study area. As Water Vole populations are relatively mobile and respond to changes in habitat condition there is the potential that they could move into the study area prior to the construction works. Therefore, should more than a year elapse between the surveys conducted in May 2017 and commencement of the drain re-grading works further surveys for Water Vole activity will be undertaken along the drains which will be affected. If Water Voles are found, appropriate mitigation will be devised and agreed with Natural England before implementation.

Grass Snake

A Method Statement for dealing with Grass Snake will be developed prior to works, including vegetation management measures. Potential terrestrial habitat to be affected that may provide a refuge for Grass Snake, such as small areas of poor semi-improved grassland, will be strimmed down to approximately 10-15cm to remove potential cover and encourage any animals to disperse. This will be undertaken outside of the hibernation period (approximately end of October to March) allowing Grass Snake to successfully disperse. The areas will then be kept strimmed until works are completed. Potential refugia within work areas such as rubble and branches will be carefully checked and removed by an ecologist. Material stored on-site will be kept tidy and placed off ground level in order to prevent creating artificial refugia for Grass Snake.

Eel

All required measures to ensure appropriate fish and Eel passage is retained within the land drainage system, and compliance with The Eels (England and Wales) Regulations 2009, will be incorporated into the pumping station detailed design, in full consultation with the Environment Agency's Fisheries Officers.

During operation, the pumping station will be regularly visited and any entrainment of Eel will be reported to the Danvm Drainage Commissioners. If necessary, retrospective measures to prevent further Eel entrainment will be investigated and fitted.

4.12 Impact Summary

Table 4-17 summarises the impacts of the proposed mining subsidence remediation works upon the ecological features before and after mitigation.

Table 4-17: Summary of Impacts and Evaluation of Significance

Ecological Features	Impact	Importance of Feature	Impact without Mitigation	Mitigation	Significance of Effects of Residual Impacts
Construction Impacts					
Ditch West of Balne Moor Ponds SINC	Contamination from sediment released and/or pollution incidents	Regional/ County	Temporary negative impact at the regional/ county scale	Measures taken to prevent significant release of sediment and chemical contamination (see section 6.5.5).	No significant negative effect on the extent or condition of this SINC.
Arable farmland	Short-term, temporary disturbance	Local	Temporary negative impact at the local scale	Existing access tracks will be used where possible to limit the amount of arable land disturbed. Minimise land take.	No significant negative effect on the extent, distribution or conservation status of the habitat.
Subsidence flashes	Short-term, temporary disturbance	Regional/ County	Temporary negative impact at the regional/ county scale	None proposed.	No significant negative effect on the extent, distribution or conservation status of the habitat.
Grassland (improved, poor semi-improved, marshy and amenity types)	Short-term, temporary disturbance	Local	Temporary negative impact at the local scale	Existing access tracks will be used where possible to limit the amount of arable land disturbed. Areas disturbed during the construction works will be re-sown with an appropriate species-rich grass and wildflower seed mix upon completion of the works.	No significant negative effect on the extent, distribution or conservation status of the habitat.
Drainage ditches	Short-term, temporary disturbance to flora and fauna	Local	Temporary negative impact at the local scale	The banks of affected watercourses will be sown with an appropriate species-rich grass and wildflower seed mix upon completion of the works. Channel vegetation will be allowed to re-colonise naturally, but will be monitored, with additional planting of suitable aquatic plant species undertaken if necessary.	No significant negative effect on the extent, distribution or conservation status of the habitat.

Ecological Features		Impact	Importance of Feature	Impact without Mitigation	Mitigation	Significance of Effects of Residual Impacts
		Contamination from sediment released and/or pollution incidents		Temporary negative impact at the local scale	Measures taken to prevent significant release of sediment and chemical contamination (see section 6.5.5).	No significant negative effect on the extent, distribution or conservation status of the habitat.
		Potential spread of non-native invasive Himalayan Balsam present on some drains		Long-term negative impact at the local scale	An appropriate mitigation strategy, as detailed in section 4.11.4, will be implemented to prevent the spread of this species.	No significant negative effect on the extent, distribution or conservation status of the habitat.
Ponds		See assessment for Balne Moor Ponds SINC above.				
Birds	Water -birds	Potential risk of disturbance	Regional/ County to Waterbirds (Local importance if subsidence flashes are not holding water and surrounding marginal habitat is absent)	Temporary, short-term, negative impact at the regional/ county scale	Works have been carefully programmed to avoid key breeding bird season. Prior to commencement of works between March - September inclusive a breeding bird survey will be undertaken. If ground nesting birds are found in works areas, nests will be protected with a suitable buffer. If Schedule 1 birds are found to be breeding no works will commence until the risk of disturbance is removed.	No significant negative effect on waterbird populations or their conservation status.
		Damage to or destruction of nests		Temporary, short-term, negative impact at the regional/ county scale	Any vegetation to be removed as part of the scheme during March - September inclusive will be assessed for breeding birds by a suitably qualified ecologist prior to removal.	No significant negative effect on waterbird populations or their conservation status.
	Non-water-birds	Potential risk of disturbance	Regional/ County to non-waterbird species	Temporary, short-term, negative impact at the regional/ county scale	Works have been carefully programmed to avoid key breeding bird season. Prior to commencement of works between March - September inclusive a breeding bird survey will be undertaken. If ground nesting birds are found in works areas, nests will be protected with a suitable	No significant negative effect on non-waterbird populations or their conservation status.

Ecological Features		Impact	Importance of Feature	Impact without Mitigation	Mitigation	Significance of Effects of Residual Impacts	
		Damage to or destruction of nests		Temporary, short-term, negative impact at the regional/ county scale	buffer. If Schedule 1 birds are found to be breeding no works will commence until the risk of disturbance is removed.		
					Any vegetation to be removed as part of the scheme between March - September inclusive will be assessed for breeding birds by a suitably qualified ecologist prior to removal.	No significant negative effect on non-waterbird populations or their conservation status.	
Badger		Potential risk of disturbance	Local	Temporary negative impact at the local scale	A further survey to identify the presence of any newly active or established setts will be undertaken prior to the works. No night-time working will be permitted. To minimise the potential for Badgers being trapped in any excavations, a suitable means of escape will be provided where such works cannot be sealed off.	No significant negative effect on Badger populations or their conservation status.	
Otter		Potential risk of disturbance	Local	Temporary negative impact at the local scale	No night-time working will be permitted. To minimise the potential for Otters being trapped in any excavations, a suitable means of escape will be provided where such works cannot be sealed off.	No significant negative effect on Otter populations or their conservation status.	
		Damage or disturbance to an Otter resting place		Short-term negative impact at the local scale	A further survey to identify the presence of any Otter resting places/holts will be undertaken prior to the works.	No significant negative effect on Otter populations or their conservation status.	
Bats		Temporary, short-term disturbance	Local	Temporary negative impact at the local scale	Any trees felled will be replaced by replanting with native, locally sourced species appropriate to the area. No night-time working will be permitted. Any floodlighting used around site compounds must be angled downwards and fitted with a cowl to direct	No significant negative effect on bat populations or their conservation status.	

Ecological Features	Impact	Importance of Feature	Impact without Mitigation	Mitigation	Significance of Effects of Residual Impacts
Grass Snake	Potential risk of injury/disturbance	Local	Temporary negative impact at the local scale	A method statement will be produced to mitigate against potential impacts upon Grass Snake. This will include vegetation strimming, removal of potential refugia within work areas and careful storage of material.	No significant negative effect on Grass Snake populations or their conservation status.
Brown Hare	Disturbance	Local	Temporary negative impact at the local scale	None proposed.	Temporary negative impact at the local scale. No significant negative impact on the conservation status of Brown Hare.
Eel	Disturbance and temporary habitat loss	Local	Temporary negative impact at the local scale	None proposed.	Temporary negative impact at the local scale. No significant negative impact on the conservation status of Eel.
Predicted Operational Impacts					
Arable farmland	Permanent loss of approximately 12,812m ² a of arable farmland	Local	Permanent positive impact at the local scale	None proposed.	Permanent, positive impact through overall increase in area of arable farmland that will be able to be cultivated.
	Increase in area of land able to be put into arable cultivation due to implementation of mining subsidence remediation scheme				
Subsidence Flashes	Permanent loss of subsidence flash habitats, with both standing water and marginal habitats, as potential for them to re-form will be removed	Regional/County	Permanent, significant negative impact at the regional/county scale	Approximately 820m of re-graded and newly cut drain will include a berm within their cross section which will allow the development of an area of marginal vegetation and in some places shallow muddy margins.	Significant negative impact which will effect the extent, distribution and conservation status of this habitat.

Ecological Features		Impact	Importance of Feature	Impact without Mitigation	Mitigation	Significance of Effects of Residual Impacts
Drainage ditches		Increase in length of watercourse in study area by 425m	Local	Permanent positive impact at the local scale	None proposed.	Permanent positive impact through increase in length of open ditch habitat present.
		Increase in geomorphological and floristic diversity through incorporation of a berm into 820m of new/re-graded drain		Permanent positive impact at the local scale	None proposed.	Permanent positive impact through increased habitat diversity in 820m of watercourse.
Ponds		See assessment for Balne Moor Ponds SINC above.				
Birds	Water -birds	Prevention of annual formation of subsidence flashes	Regional/ County to waterbirds (Local importance if subsidence flashes are not holding water and surrounding marginal habitat is absent)	Permanent, significant negative impact at the regional/ county scale	Approximately 820m of re-graded and newly cut drain will include a berm within their cross section which will allow the development of an area of marginal vegetation and in some places shallow muddy margins.	Significant, permanent, negative impact on waterbird populations.
		Permanent loss of small areas of arable habitat and creation of new drain network		Permanent positive impact at the regional/ county scale	None proposed.	Permanent positive impact through increase in ditch habitat, with increased habitat diversity.
	Non-water -birds	Prevention of annual formation of subsidence flashes		Permanent, negative impact at the regional/ county scale	Approximately 820m of re-graded and newly cut drain will include a berm within their cross section which will allow the development of an area of marginal vegetation and in some places shallow muddy margins.	Permanent, negative impact on non-waterbird populations.

Ecological Features		Impact	Importance of Feature	Impact without Mitigation	Mitigation	Significance of Effects of Residual Impacts
		Permanent loss of small areas of arable habitat and creation of new drain network	Local	Permanent positive impact at the regional/ county scale	None proposed.	Permanent positive impact through increase in ditch habitat, with increased habitat diversity.
Eel		Eel passage restricted by construction of Pumping Station		Permanent negative impact at the local scale	All required measures to ensure appropriate fish and Eel passage is retained within the land drainage system, and compliance with The Eels (England and Wales) Regulations 2009, will be incorporated into the pumping station detailed design, in full consultation with the Environment Agency's Fisheries Officers	No significant negative impact on the conservation status of Eel.
		Potential for entrainment in pumps		Permanent negative impact at the local scale	The pumping station will be regularly visited and any entrainment of Eel will be reported to the Danum Drainage Commissioners. If necessary, retrospective measures to prevent further Eel entrainment will be investigated and fitted	No significant negative impact on the conservation status of Eel.

4.13 Cumulative Impacts

A search of the Selby District and East Riding of Yorkshire Councils' planning application websites revealed that the majority of other applications in the study area and surroundings are small and relate predominantly to extensions to existing properties and the construction of single dwellings or agricultural buildings. It is highly unlikely that there will be any significant cumulative ecological effects as a result of the proposed scheme in combination with any of these developments, given the distance from these properties/sites, the small-scale nature of the developments and the limited nature of the conservation value of these residential areas.

The only large scale planning applications relate to applications for a caravan storage site off the A19, a residential development of four bungalows and an extension to an existing Auction site. However, the closest of these is 1.4km from the study area and they are therefore not anticipated to have a cumulative impact with the mining subsidence remediation scheme. Two closer residential developments, 150m to the west, consisting of four bungalows and eight dwellings, have also been recently permitted, however this is for within the village of Whitley and being set with the suburban context already will not have a cumulative impact on the ecology of the study area. Therefore, no significant cumulative impacts are anticipated.

4.14 Enhancements

Implementation of the Great Heck mining subsidence remediation scheme provides opportunity for a number of ecological enhancements to be included. Proposed enhancements include:

- Erection of bat and bird boxes on the control house of the new pumping station to provide additional potential roosting and nesting sites.
- Planting of hedgerows around the new pumping station compound. This will provide additional nesting habitat for birds, cover for other species and provide some screening for the new structure.
- Consideration will also be given to additional hedgerow planting in the existing gappy hedgerows in the study area, should landowners agree.
- As part of the project there is the potential that land will be purchased to allow on-site disposal of arisings from the drain regrading and new cuts as it will be too expensive and unsafe to remove from site. Once all arisings have been disposed of their will be opportunity to enhance the disposal area through planting and potentially pond creation to create new areas of habitat for species using the site.

4.15 Conclusions

The evaluation of the ecological impacts, likely to be generated by the proposed mining subsidence remediation scheme at Great Heck, determined that the construction phase would result in the ecological features in the study area generally experiencing temporary negative impacts. However, these impacts are reversible once works are complete and disturbing activities stop, and through mitigation.

The operational phase of the scheme is assessed as having significant, permanent, negative impacts on subsidence flash habitats, and the bird populations they support, as these features will be permanently lost. This will be partially compensated for by the incorporation of berms on 820m of new/re-graded drain which will provide increased geomorphological and floristic diversity within the drains and some compensatory wetland habitat for species such as Snipe and Jack Snipe, however, this will not fully mitigate the loss of these features. Other operational impacts are assessed as not being significant, or as having a positive impact through an increase in open ditch habitat and increased diversity in ditch habitat.

A range of mitigation measures have been suggested to minimise/offset impacts on other habitats and species. Prior to the construction works further surveys will be undertaken for Badger, Otter and Water Vole to ensure any new activity is detected and suitable mitigation, if required, is put in place. With the mitigation proposed, no significant adverse effects on protected species are likely and the works will be fully compliant with wildlife legislation.

No significant impacts are expected on any statutory or non-statutory nature conservation sites as a result of this scheme, either alone or in-combination with any other plans or projects.

5 Landscape and Visual Amenity

5.1 Introduction

This chapter assesses the impact of the proposed drainage remediation scheme on the landscape and visual amenity of the study area.

Landscape effects relate to changes to the fabric, character and quality of the landscape resource and how it is experienced, and include:

- Direct impacts upon specific landscape elements, especially prominent and eye catching features
- Change in character, which is the distinct, recognisable and consistent pattern of elements that creates distinctiveness and a sense of place
- Subtle effects that contribute towards the experience of intangible characteristics such as tranquillity, wildness and cultural associations, and
- Impacts on designated landscapes, conservation sites, and other acknowledged special areas of interest.

Visual impacts relate closely to landscape effects, but concern changes in views i.e. people's perception and response to changes in visual amenity. Impacts may result from new landscape elements that cause visual intrusion or new features that obstruct views across the landscape.

Both landscape and visual impacts can be positive or negative.

5.2 Methodology

5.2.1 Introduction

A landscape assessment was undertaken and comprised of the following:

- Data collection and desk-based review of planning policies, landscape designations and landscape character information
- Identification of key landscape and visual receptors by desk-based study and field survey
- Assessment of impacts on landscape and visual baseline
- Identification of mitigation measures and design considerations to offset or reduce identified impacts

5.3 Legislation, Planning and Other Guidance

The most relevant policies and plans for the purposes of this assessment are identified and the key aspects summarised below.

5.3.1 Landscape Designations

The study area does not lie within any areas of national landscape designation (e.g. National Parks or Areas of Outstanding Natural Beauty), regional landscape designation (e.g. Special Landscape Areas identified by North Yorkshire County Council) or local landscape designation (e.g. Locally Important Landscape Areas identified by Selby District Council).

5.3.2 National Planning Policy

The National Planning Policy Framework (NPPF) replaces previous planning guidance relating to biodiversity, namely Planning Policy Statement 9: Biodiversity and Geological Conservation.

The NPPF sets out the Government's planning policies for England and how these are expected to be applied, with a presumption in favour of sustainable development a core element of the framework. Twelve core planning principles are identified within the framework, with that relevant to biodiversity starting it will:

Contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser environmental value, where consistent with other policies in this Framework (Department for Communities and Local Government, 2012).

The Framework recognises that, when determining planning applications, local planning authorities should aim to conserve and enhance biodiversity by:

- ensuring that adverse impacts are avoided, adequately mitigated or compensated for;
- refusing developments where the primary objective is to conserve or enhance biodiversity;
- encouraging proposals to incorporate biodiversity in and around developments; and
- refusing planning permission for developments that would result in the damage or deterioration of irreplaceable habitats (e.g. ancient woodland, veteran trees)

Whilst the NPPF relates specifically to planning policy and the Great Heck mining subsidence remediation scheme will be progressed under the Danum Drainage Commissioners permitted development rights, the principles of this framework in relation to the conservation and enhancement of biodiversity can be applied to the scheme.

5.3.3 Regional Planning Policy

The approved Regional Spatial Strategy (RSS) policy was revoked by the Government in July 2010. However, the decision to abolish all RSS has been contested and therefore at present RSS remain a part of development plans albeit with some uncertainty. In the meantime, a City Region Interim Strategy Statement has been produced which include the same approved policies from the RSS.

The Yorkshire and Humber Regional Spatial Strategy policy relevant to the proposed scheme with regards to landscape is detailed below in Table 5-1.

Table 5-1: Regional Planning Policies Relevant to Landscape and Visual Amenity

Policy	Description
ENV10 Landscape	<p>The Region will safeguard and enhance landscapes that contribute to the distinctive character of Yorkshire and the Humber. Plans, strategies, investment decisions and programmes should safeguard and enhance the following landscapes and related assets of regional, sub-regional and local importance:</p> <p>A Yorkshire Dales and North York Moors National Parks and the Nidderdale, Howardian Hills, Forest of Bowland, North Pennine and Lincolnshire Wolds Areas of Outstanding National Beauty.</p> <p>B The coastal landscapes of the East Coast and the Humber</p> <p>C Derelict and despoiled urban fringe landscapes, especially in the former coalfield and older industrial parts of South and West Yorkshire</p> <p>D Degraded rural landscapes, especially in parts of the Vale of York and Humberhead Levels</p>

5.3.4 Local Planning Policy

The Selby District Core Strategy Local Plan, which was adopted on the 22nd October 2013, replaces the Selby District Local Plan.

The Selby District Core Strategy Local Plan policies relevant to the proposed scheme with regards to landscape and visual amenity are detailed in Table 5-2 below. As the study area is predominantly located within Selby District, East Riding of Yorkshire Council policies are not considered at this stage, as the portion of the study area they relate to is so small.

Table 5-2: Local Planning Policies Relevant to Landscape and Visual Amenity

Policy	Description
SP18 Enhancing the Environment	<p>The District's natural and man-made environment should be safeguarded and enhanced by:</p> <ul style="list-style-type: none"> - Protecting the historic environment; - Promoting effective stewardship of the District's wildlife; - Supporting the creation and restoration of habitats.
SP19 Design Quality	Proposals for all new development will be expected to contribute to enhancing community cohesion by achieving high quality design and have regard to the local character, identity and context of its surroundings including historic townscapes, settlement patterns and the open

Policy	Description
	countryside.

5.4 Baseline

5.4.1 Landscape Designations

The study area does not lie within any areas of national, regional or local landscape designation.

5.4.2 Landscape Character

National Landscape Character

England has been divided into areas with similar landscape character, which are called National Character Areas (NCAs) (previously known as Joint Character Areas). The study area is located within the Humberhead Levels character area, the key characteristics of which are (Natural England, 2014):

- A flat landscape occupying the area of the former pro-glacial Lake Humber
- Very low-lying, commonly at or below mean high-water mark maintained by drainage
- Difference in the overall flat farmed landscape are created due to underlying deposits, such as lowland raised mires
- Surface geology of drift deposits, including sandy deposits which supports remnant oak and birch woodlands
- Smaller scale pastoral landscape created around Fishlake and Sykehouse due to heavier soils
- Important areas of historic landscape such as the Isle of Axholme, with evidence of mediaeval open fields, the warps near Goole and the unique 'cable' landscape of Thorne
- Widespread evidence of drainage history in rivers, old river courses, ditches, dykes and canals
- Views to distant landscapes are often unbroken; making vertical elements, such as power stations, very prominent
- Important wetland habitats are present due to floodplains, washlands and alluvial flood meadows supporting large numbers of wetland birds
- The waterlogged soils hold internationally important archaeological and palaeo-archaeological deposits
- A sense of remoteness is still present despite motorways and settlements.

Local Landscape Character

A Landscape Assessment of Selby District produced in 1999 (Woolerton Dodwell Associates, 1999) categorised the rural landscape around Selby into ten local landscape character areas. The study area is located within the Southern Farmlands and the River Aire Corridor character areas. The key characteristics of these are summarised in Table 5-3 below.

Table 5-3: Local Landscape Character Areas

Landscape Character Area	Characteristics
Southern Farmlands	<p>Varied character, predominantly flat semi-enclosed arable farmland, with an area of estate-managed wooded farmland, and an area of larger scale more open farmland.</p> <p>Distinctive area of more traditional mixed farmland to the south of Balne Moor, with pastures and orchards.</p> <p>Small wetlands, some of which are medieval moats.</p> <p>Network of minor roads and lanes linking scattered properties and settlements.</p> <p>Traditional farmhouses typically constructed in red brick.</p> <p>Distinctive landform of the ash disposal site at Gale Common.</p> <p>Generally quiet and tranquil character largely unaffected by urban and</p>

Landscape Character Area	Characteristics
	industrial development.
River Aire Corridor	<p>Principal highway for trade and communication.</p> <p>Strong influence of large scale industrial and infrastructure development, in particular power stations and the motorway on the river landscape.</p> <p>Varied character combining flat open farmland and semi-enclosed arable farmland, and small areas of flat wooded farmland.</p> <p>Open heavily drained arable farmland on valley floor, with high grassy flood embankments, and areas of smaller scale mixed farmland.</p> <p>Strategically sited historic villages.</p> <p>Historic parkland and country mansions.</p> <p>Important wetlands, diverse marshy grasslands and unimproved neutral grasslands.</p>

Study Area Landscape Character

The study area is characterised by an agricultural landscape, and is flat and low-lying. The area is bound by the A19 to the west, Balne Moor Road to the south and the M62 to the north. The Aire and Calder Navigation Canal runs through the study area. The East Coast railway line and a disused railway line bisect the farmland in the east. Within the study area there are small areas of broadleaved woodland and two large ponds managed for fishing. Eggborough Power Station is a key feature of the wider landscape.

The fields are mostly medium to large in size and bounded by ditches, some of which have hedgerows and/or mature trees alongside them.

5.4.3 Visual Receptors

The main visual receptors within the study area comprise of the following groups.

Amenity Users

This includes users of the Aire and Calder Navigation, Public Rights of Way (PRoW) and other paths within the study and surrounding area (see Map 1-1). Also included are users of the fishing ponds and cyclists, horse riders and walkers that may use the local road network.

This category also includes users of other recreational spaces, including private gardens and children's play areas associated with residential developments.

Residents

This includes residents within Whitley and Great Heck, and also residents of more isolated properties, the majority of which are farms.

Transient Users

Transient users will be those travelling through the study area via the road network.

Due to the flat, low-lying landscape there are no significant viewpoints from which the whole of the works site will be visible. The raised banks of the Aire and Calder Navigation Canal may provide the clearest viewpoints, however the hedgerows and trees will restrict views.

5.5 Assessment of Impacts

5.5.1 Assessment Methodology

The approach to evaluate the potential impacts on landscape and visual amenity within the study area is based on the Guidelines for Landscape and Visual Impact Assessment (The Landscape Institute and IEMA, 2002).

The significance of any impacts is a product of the magnitude of any changes and the sensitivity of landscape and visual amenity receptors.

5.5.2 Landscape Impacts

Magnitude of Change

The following factors are considered in the evaluation of magnitude of change:

- The nature of the perceived changes in the landscape due to the works
- The scale of change in the landscape with respect to the proportion of the landscape affected by the drainage works and the degree to which it is affected
- The duration and reversibility of the effect on the landscape.

These factors have been brought together to define different levels of magnitude as shown in Table 5-4.

Table 5-4: Magnitude of Landscape Impacts

Level of Magnitude	Definition
High	A change that may be large in scale and extent, and include the loss of key landscape characteristics or the addition of new features that would lead to a large scale change in the overall landscape quality and defined character.
Medium	A change of more limited scale and extent including the loss of some key landscape characteristics, or the addition of some new landscape features that would lead to improvement or decline in landscape quality and indicate the potential for change in landscape character.
Low	A small scale change affecting small areas of defined landscape character, including the loss of some extensive characteristic landscape elements or the addition of new features or elements that are also small scale in the context of a particular landscape character area.
Negligible	A change affecting smaller areas of landscape character, including the limited loss of some extensive characteristic landscape or the limited addition of new features or elements which are characteristic of a particular landscape area or barely perceptible.

Sensitivity of Receptors

The sensitivity of each landscape receptor is dependent on its value and its ability to accommodate the changes that could be generated by the construction and operation of the scheme and is classified as high, medium or low. This classification is derived from consideration of a number of variables including landscape quality, value, scale, visibility and development within the landscape, as described in Table 5-5.

Table 5-5: Sensitivity of Landscape Receptors

Level of Sensitivity	Definition
High	High value landscapes, protected at an international or national level, where there would be a lower capacity or scope for landscape change in the form of development and/or enhancement.
Medium	Landscape of a medium value, designated for protection at a local level, or non-designated landscapes where there is evidence of local value or use. Some capacity and scope for development and/or enhancement.
Low	Lower value and non-designated landscapes where the existing landscape management objectives are focussed on repair, restoration and enhancement. A higher capacity and scope for change.

5.5.3 Visual Impacts

Visual impacts are concerned wholly with the effect of a development on views and the general visual amenity. Visual impacts may be positive, negative or neutral. A positive impact would require development to add to the landscape value, quality, character and or visual amenity of an area. A negative impact may include the loss of landscape elements, or adversely change the visual character of the landscape and the setting of valued locations through the introduction of new features and associated development. A neutral impact would constitute 'negligible change' to the existing landscape or view, and would include changes which may be considered as part of the 'normal' landscape processes (such as harvesting) or a negligible magnitude of change affecting a view.

Magnitude of Change

The following factors are considered in the evaluation of magnitude of change:

- The scale of change in the view, the loss or addition of features in the view and changes in the composition and extent of view affected.
- The degree of contrast or integration of any new features or changes in the landscape with the existing or remaining landscape elements and characteristics in terms of mass, scale, colour and texture
- The distance between the visual receptor and the development and the frequency and ease with which the development may be viewed from a particular viewpoint
- The duration, whether temporary or permanent.

Table 5-6 gives examples of how these factors interact to produce different visual magnitude categories.

Table 5-6: Magnitude of Visual Impacts

Level of Magnitude	Definition
High	A major change, obstruction of a view, or a new element introduced into a view that is directly visible and likely to appear in the foreground or above a prominent section of the horizon.
Medium	A moderate change or partial view of a new element within the view which may be readily noticed, directly or obliquely visible including glimpsed or intermittent views and appearing in the middle ground partly screened or mitigated.
Low	A low level of change, affecting a small part of the view which may be obliquely viewed or partly screened and/or appearing in the background landscape and/or not intruding above any section of the horizon. May include travelling views from roads/rail.
Negligible	Few viewers affected by a small or intermittent change to the view which may be obliquely viewed and/or mostly screened and/or appearing in the distant background and/or viewed at high speed over short periods i.e. capable of being missed by the casual observer.

Sensitivity of Receptors

The sensitivity of each visual receptor is classified as high, medium or low based upon the Guidelines for Landscape and Visual Impact Assessment (The Landscape Institute and IEMA, 2002) and other established best practice. The different visual receptors that have been identified within this assessment are ranked in order of their sensitivity to visual impacts as set out in Table 5-7. It should be noted that this table is indicative only as it is not possible to rigidly tabulate sensitivity to change.

Table 5-7: Sensitivity of Visual Receptors

Level of Sensitivity	Visual Receptor
High	Residential communities (i.e. Whitley, Great Heck)
Medium	Private residential properties (i.e. Farms, homes) PRoWs (i.e. public footpaths) Waterways (i.e. Aire and Calder Navigation Canal)
Low	Public and private recreational open space (i.e. fishing ponds, gardens) Roads (i.e. all roads within the study area)

5.5.4 Evaluation of Significance for Landscape and Visual Impacts

The evaluation of significance determines the level of impact resulting from the combination of sensitivity with the predicted magnitude of change. Table 5-8 shows a matrix which is used for guidance in the assessment of significance, with impacts being considered to be of major, moderate or minor significance, or not significant.

Table 5-8 Impact Significance for Landscape and Visual Assessment

Magnitude of Change	Sensitivity of Receptor		
	High	Medium	Low
High	Major	Major	Moderate
Medium	Major	Moderate	Minor
Low	Moderate	Minor	Minor
Negligible	Negligible	Negligible	Negligible

5.5.5 Predicted Short-term and Construction Impacts

Landscape

The changes to the landscape likely to occur during the construction phase will only take place over a period of approximately 11-12 months, and during this time period individual activities, at different locations, will take place over shorter time periods (as described in detail in Chapter 3). Hence, their consequences will be relatively short-lived, thereby reducing their potential to produce significant adverse landscape effects.

The individual activities are unlikely to generate substantial adverse landscape effects, although, their cumulative impact could be temporarily substantial within parts of the study area. However, the possibility for cumulative landscape effects is likely to be reduced by the physical spread of the activities across the study site, the phasing of the works and the restricted views across the study area afforded by the woodland and hedgerows. Hence, it is not possible to appreciate the entire works areas from a single location or even a series of locations and therefore it is unlikely that it will be possible for the full extent of the various construction activities to be appreciated from any one viewpoint.

The construction works will require the loss of some existing landscape elements (e.g. a small number of trees and subsidence flashes). However, these features are abundant in the study area and will be replaced.

The increased level of traffic associated with the construction activities, that will be periodically taking place across the study area, may temporarily reduce landscape characteristics of quiet and tranquillity, although, during the site survey works undertaken for production of other chapters, it has been noted that current movements of agricultural and other vehicles (cars, transport lorries, trucks) through the study area combine to ensure that baseline tranquillity levels, particularly around the A19 and M62, are currently low. Likewise the cumulative impacts of the different construction works will temporarily modify the existing landscape character of the study area by introducing some new landscape elements, although, once again, the agricultural operations and other activities currently taking place in the area (e.g. works associated with the Aire and Calder Navigation), mean that such activities are not without considerable precedent in close proximity to the work sites.

It is therefore considered that the magnitude of impact on landscape receptors during the construction phase is low.

Visual Amenity

The scale and schedule of the construction works means that they have the potential to be prominent visual elements over only a relatively small proportion of the study area, at any one time. Ground level construction activities will not cause dramatic changes in the views of the large majority of potential visual receptors who are located within the study area. Most visual effects are likely to be caused by the use of construction cranes at the site of the pumping station. It is anticipated that crane activity will last for only about 6 to 8 weeks during the construction period. It should also be noted that the type of activities that will be taking place

are not unusual for this area and the majority of the visual receptors will be used to seeing the machinery involved, particularly associated with the drain network.

Users of the Aire and Calder Navigation are likely to obtain a good view of the majority of the construction activities, although this will only be for a short time as they move through the study area and there will be some screening provided by hedgerows. It is therefore assessed that the magnitude of visual impacts to these users is low, although the sensitivity is medium to high.

The only settlement where residents are predicted to potentially have views of ground level works are Whitley. The low-lying landscape, the raised embankments of the canal and field boundary hedgerows means that views from further afield, including the village of Great Heck, would be sufficiently screened. The site of the pumping station is not in close proximity to any properties, and again the canal banks provide some screening. There will be views of the re-grading works for the majority of the residents in Whitley, particularly the properties to the east of the A19. However, these works will be undertaken in phases and will last for only about 2-3 months. It is therefore assessed that the magnitude of visual impacts to communities and residents is low, although the sensitivity is high.

Users of two of the PRoW within the study area are also likely to have good views of the construction activities, although these paths appear not to be very well used and it is likely that they would need to be diverted or closed for a period during the works. It is therefore assessed that the magnitude of visual impacts to users of the PRoW is low and the sensitivity of these users is medium.

Visual impacts to users of public and private recreational open space (i.e. fishing ponds, gardens) will be similar to those experienced by residents. Therefore, it is assessed that the magnitude of visual impacts is low and the sensitivity of these receptors is medium.

Users of the local road network have the potential to be the most affected as the majority of the construction works will be visible from the roads, including the construction activities at the site of the pumping station. However, these impacts will only be temporary as the users travel through the area. Therefore, it has been assessed that the magnitude of visual impacts to road users is low and the sensitivity is also low.

5.5.6 Predicted Operational Impacts

Landscape

It is anticipated that there will be limited significant landscape effects as a result of the operation of the pumping station and maintenance of the drain network. Effects will be limited to within the immediate environs of the pumping station and watercourses.

The only landscape receptor assessed as being likely to sustain a magnitude of landscape change is the NCA. This receptor has been assessed as having medium sensitivity to landscape change. Land drainage pumping stations and their associated drain networks are already key characteristics of the NCA. The works will retain the existing pattern of drains with the addition of short sections of new watercourse and one new pumping station. The pumping station will be located within a large arable field.

The works will not significantly alter the field patterns within the study area although some landscape elements will be lost (e.g. a small number of trees, subsidence flashes). All trees removed will be replaced and therefore there will be no long-term change in landscape character.

It is therefore considered that the magnitude of impact on landscape receptors during the operational phase is low.

Visual Amenity

It is anticipated that there will be limited significant visual impacts as a result of the operation of the pumping stations and maintenance of the drain network.

The addition of a pumping station has the potential to have visual effects. The location of the new pumping station is such that it will be visible to users of the canal, PRoW and local roads. Given the small size of this station and the partial screening that will be provided by the canal banks, and also potentially around the station, it is considered that the magnitude of impact is low.

5.6 Mitigation Measures

Measures to avoid and/or minimise impacts on landscape and visual amenity are described below and summarised in Table 5-9.

The construction period will be kept as short as possible, and construction activities will be undertaken in phases across the study area, to minimise the impacts on the landscape and the visual receptors.

Tree removal will be kept to an absolute minimum. Any trees removed will be replaced as close to their original position, wherever is practicably possible. No hedgerows will be removed as part of this scheme.

The pumping stations have been designed to have a limited footprint. Green paladin fencing will be used around the stations and hedgerows will be planted to provide additional screening.

5.7 Significance of Impacts

Table 5-9 Summarises the impacts of the proposed drainage works upon the landscape and visual amenity receptors and assesses the significance of those impacts.

Table 5-9: Summary of Impacts and Evaluation of Significance

Receptor	Predicted Impact	Sensitivity	Magnitude of Impact	Proposed Mitigation	Impact Significance
Short-term and Construction Impacts					
Existing landscape elements	Loss of a small number of mature trees (4)	Low	Medium	Tree removal kept to a minimum. Replace trees by replanting as close to their original position as possible.	Minor adverse
NCA/Local landscape character areas	Reduction in landscape character due to construction works and vehicles	Medium	Low	Construction period kept to a minimum and phased.	Minor adverse
Aire and Calder Navigation	Reduction in visual amenity value	Medium	Negligible	Construction period kept to a minimum and phased.	Negligible
Communities/Residents	Reduction in visual amenity value	Medium	Low	Construction period kept to a minimum and phased.	Minor adverse
PRoW	Reduction in visual amenity value	Medium	Low	Construction period kept to a minimum and phased.	Minor adverse
Recreational Open Space	Reduction in visual amenity value	Medium	Low	Construction period kept to a minimum and phased.	Minor adverse
Local roads	Reduction in visual amenity value	Low	Low	Construction period kept to a minimum and phased.	Minor adverse
Predicted Operational Impacts					
Existing landscape patterns	Adverse changes to landscape patterns	Medium	Negligible	Tree removal kept to a minimum. Replace trees by replanting as close to their original position as possible.	Negligible
NCA/Local landscape character areas	Reduction in landscape character due to operation of pumping stations	Medium	Low	Green paladin fencing to be used around the pumping station and hedgerows planted to provide	Minor adverse

Receptor	Predicted Impact	Sensitivity	Magnitude of Impact	Proposed Mitigation	Impact Significance
				additional screening.	
Communities/Residents	Reduction in visual amenity value	Medium	Low	Tree removal kept to a minimum. Replace trees by replanting as close to their original position as possible.	Minor adverse
PRoW	Reduction in visual amenity value	Medium	Low	Tree removal kept to a minimum. Replace trees by replanting as close to their original position as possible.	Minor adverse
Local roads	Reduction in visual amenity value	Low	Low	Tree removal kept to a minimum. Replace trees by replanting as close to their original position as possible. Green paladin fencing to be used around the stations and hedgerows planted to provide additional screening.	Minor adverse

5.8 Cumulative Landscape and Visual Amenity Impacts

A search of the Selby District and East Riding of Yorkshire Councils' planning application websites revealed that the majority of other applications in the study area and surroundings are small and relate predominantly to extensions to existing properties and the construction of single dwellings or agricultural buildings. It is highly unlikely that there will be any significant cumulative landscape effects as a result of the proposed scheme in combination with any of these developments, given the distance from these properties/sites and the small-scale nature of the developments.

The only large scale planning applications relate to applications for a caravan storage site off the A19, a residential development of four bungalows and an extension to an existing Auction site. However, the closest of these is 1.4km from the study area and they are therefore not anticipated to have a cumulative impact on landscape receptors with the mining subsidence remediation scheme. Two closer residential developments, 150m to the west, consisting of four bungalows and eight dwellings, have also been recently permitted, however these are within the village of Whitley and being set with the suburban context already will not have a cumulative impact on the landscape of the study area. Therefore, no significant cumulative impacts are anticipated.

5.9 Conclusions

The evaluation of the landscape impacts likely to be generated by the proposed drainage works determined that the construction and operation phases would result in a limited number of landscape receptors sustaining a low to medium magnitude of landscape change. It is concluded that overall the drainage works are acceptable in landscape terms as few landscape receptors will be adversely affected and any changes in landscape character will be short-term.

The visual assessment concludes that the proposed drainage works would be acceptable in terms of its overall visual effects upon identified receptors. The introduction of a new pumping station and the loss of a small number of trees will result in minor adverse impacts to some visual receptors, however, in the long-term, through replanting and screening of the pumping station with hedgerows, this impact will be reduced.

6 Hydrology, Geology and Soils

6.1 Introduction

This chapter assesses the potential impacts of the proposed drainage remediation scheme on the hydrological, geological and soil environments. It describes the baseline situation, assesses the potential impacts, and then considers options for impact mitigation and opportunities for environmental enhancement.

6.2 Methodology

The assessment was carried out using the methodology outlined in section 6.5. It involved a desk-based review of existing information, and also the collection of new field data through site walkover surveys and intrusive site investigation works. Additional information was obtained through correspondence with the Environment Agency, Selby District Council (Department of Environmental Health), and consultation with Natural England, English Heritage, North Yorkshire County Council, RSPB, Yorkshire Wildlife Trust and British Waterways (now Canal and River Trust).

6.2.1 Desk Study

Table 6-1 lists the sources of data used for the desk study.

Table 6-1: Data Sources for Desk Study of Hydrology, Geology and Soils

Topic	Sources
Topography	Digital Ordnance Survey mapping at 1:10,000 and 1:50,000 scales EA 2m LIDAR topography
Climate	Flood Estimation Handbook and CD-ROM version 3 (CEH, 2009)
Soils	1:250,000 soil mapping (Soil Survey of England and Wales, 1983)
Geology	1:50,000 geological map and accompanying memoir (IGS, 1971; Gaunt, 1994) Site investigation report (LSCo Geo Consulting Limited, 2011)
Hydrology and hydrogeology	Flood Estimation Handbook and CD-ROM version 3 (CEH, 2009) Published aquifer properties data (Allen <i>et al.</i> , 1997) Drain cross sections (Went Internal Drainage Board (IDB), 2011) Environment Agency website
Water abstractions	Environment Agency (information on licensed abstractions) Selby District Council (information on private water supplies) East Riding of Yorkshire Council

6.2.2 Field Work

LSCo Geo Consulting Limited (2011), on behalf of Danvm Drainage Commissioners, conducted an intrusive site investigation involving:

- The drilling of 6 'shallow' (approx. 5.5m) and 1 'deep' (12.5m) cable percussion boreholes
- Standard Penetration Tests (SPT) taken at 1m intervals.

A field visit was carried out by JBA hydrogeologists and included the following:

- Walkover surveys:
 - Photography
 - Examination of topography and drainage
 - Observation of land use and vegetation
 - Observations of existing hydrology close to protected (SINC) areas
- Investigation of the ground profile:
 - Examination of ditch banks

- Examination of a recently-excavated, c.1.5 m deep, flood retention trench, in the north-eastern corner of the site [NGR 458200 420750]
- Observation of water levels in ditches and trenches
- Estimation of flow rates in ditches

6.3 Consultations

Consultation responses to the EIA Scoping Study have been described in earlier sections (2.5). The only response relevant to hydrology, geology or soils was that from North Yorkshire County Council, which outlined the presence of SINCs and a need to assess the hydrological impacts on these. The SINCs and their hydrological/hydrogeological setting are described fully in section 6.4.10. Source-pathway-receptor linkages are considered for these sites and an assessment of impacts made in section 6.5.

6.4 Baseline

6.4.1 Topography, Climate and Land Use

The study area consists of relatively flat, low-lying land adjacent to the Aire and Calder Navigation (Knottingley and Goole canal) between Whitley and Great Heck. Topographic elevations range from approximately 5mAOD to 10mAOD (Figure 6-1). The Standard Average Annual Rainfall (SAAR) for the study area is 596mm (FEH CD-ROM, CEH, 2009). The land is predominantly used for arable agriculture, and is dominated by large open fields divided by drains with very few hedgerows or field trees.

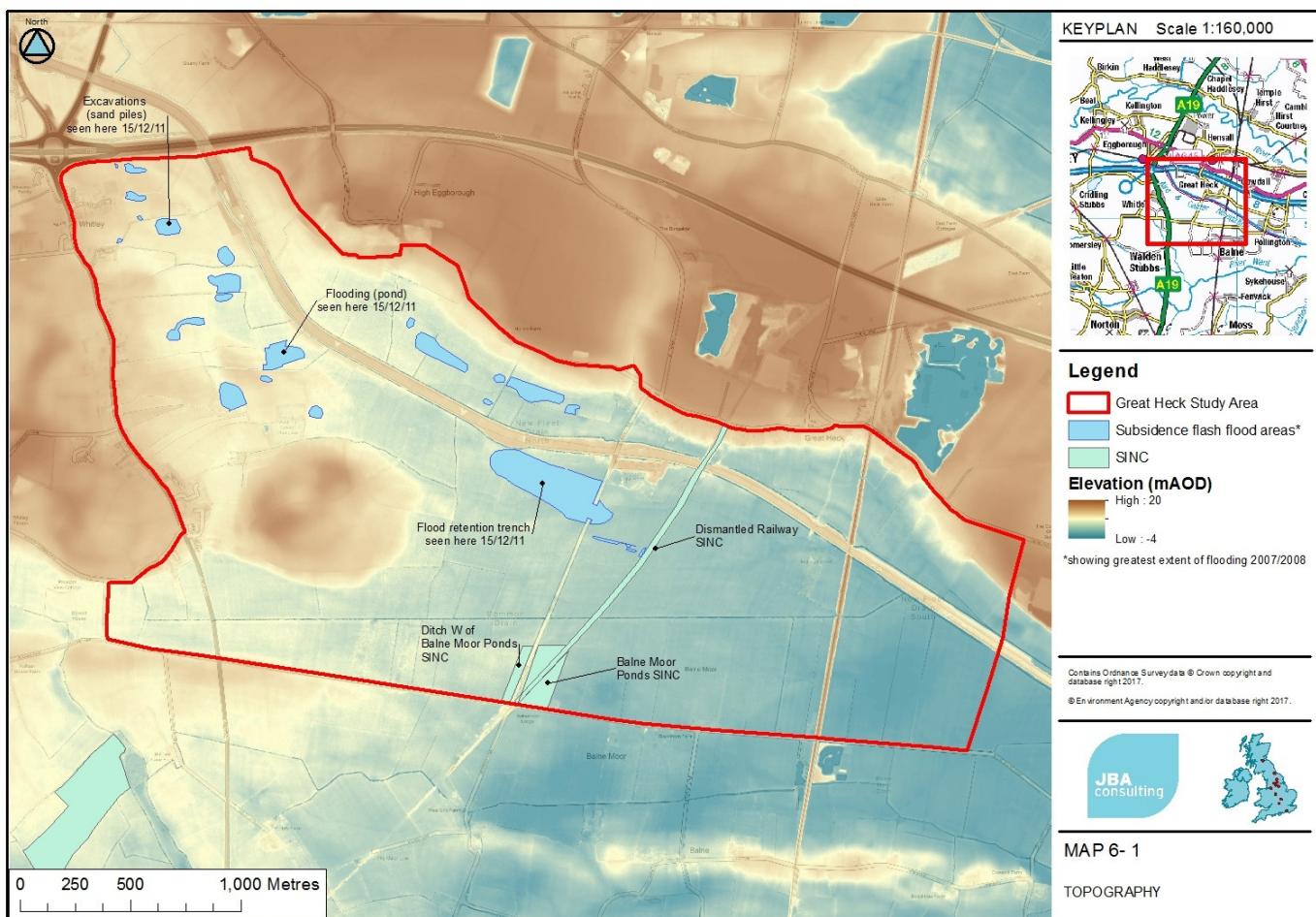


Figure 6-1: Topography of Study Area

The north and west part of the study area include the village of Whitley, which consists of houses and buildings mainly located in close proximity to the A19. The A19 (Selby Road) runs in a general north-south direction, meeting the M62 just outside the northern boundary of the site.

There are three SINCs within the study area, however, there are no SSSIs or SACs. The SINCs include Balne Moor Ponds, which has been designated for its wetland vegetation and habitat (and is also a fishing pond), the Ditch west of Balne Moor Ponds, which has been given SINC status due to its wetland flora, and the Dismantled Railway, which has a woodland and wildlife corridor.

Most of the study area has subsided but there has been evidence of subsidence flashes in the lower lying areas which become waterlogged (Figure 6-1). These areas were observed on the site visit. Due to the dry conditions on the site visit only one small area viewed was actually filled with water at the time of the visit (Figure 6-2). Other areas showed evidence of past flooding or having been waterlogged. Reeds and rushes were often observed amongst the grasses. To the north-west of the site the area affected by subsidence induced flooding at NGR 456370 421900 has been excavated. No trench has been dug out at this location but the ground excavated into mounds (possibly to promote infiltration). At [NGR 458200 420750] an extensive flood prevention trench has been excavated independently of the Danvm Drainage Commissioners operations.



Figure 6-2: Typical site topography and subsidence induced flood area [NGR 456850 421400, looking NW]



Figure 6-3: Court Drain [NGR 457700 421080, looking S]



Figure 6-4: Excavated flood retention drain in subsidence 'flash' zone [NGR 458300 420700, looking WNW] - Taken in 2011

6.4.2 Solid (Bedrock) Geology and Structure

The bedrock immediately beneath the site belongs to the Triassic Sherwood Sandstone Group (the Bunter Sandstone Group) (Table 6-2, Figure 6-5), which is dominated by red/brown (locally greenish grey) fine- to medium-grained (less commonly coarse-grained or pebbly) sandstone (IGS, 1971; Gaunt, 1994). Red/brown and greenish grey mudstone and siltstone occur as thin layers and lenses, and also locally as rolled fragments within the sandstone (Gaunt, 1994).

Strata within the Sherwood Sandstone dip eastwards or east-north-eastwards at an angle of c. 2 to 3 degrees to the horizontal (IGS, 1971). There are no major faults within, or in close proximity to, the study area (IGS, 1971).

At depth, beneath the Sherwood Sandstone, are strata of Permian and Carboniferous age (IGS, 1971; Gaunt, 1994). The Carboniferous strata include the Coal Measures that are mined in the Great Heck area.

Table 6-2: Stratigraphy of the Bedrock and Superficial Deposits*

Age	Stratigraphic Unit	Description	Thickness (m)
Quaternary	Recent	Made Ground	Highly variable, but commonly contains manmade materials such as concrete and brick Most likely up to 2 m (0.3 m in the Great Heck borehole – E of the study area) [Localised distribution - mainly roads, tracks and foundations.]
		Top Soil	0 - c.0.6m (during site observations soils were difficult to distinguish from the clay).
	Devensian	25-Foot Drift	Upper Sand: Fine-grained sand forming low ridges and mounds (shown as 25 foot drift sands and gravels on map). Generally up to 2.5m (no detailed borehole records showing this stratigraphic unit within the site)
			Silt and clay: Laminated silt and clay, locally sandy in the upper part 0 - c. 12 m + (5.5m thickest section of clay recorded in SI borehole)
			Lower Sand: Sand, typically fine-grained (referred to in Gaunt (1994) but not present in IGS (1971). Borehole records show sand beneath the silt and clay of the 25-foot – drift but this could be the Lacustrine Beach Deposits as the two are difficult to distinguish. 0 - c.3.5 m (if present)
	Devensian or Ipswichian	Lacustrine Beach Deposits	Sand and gravel 0 - 3.5 m (best estimate from SI boreholes = 2m)
Triassic		Sherwood Sandstone Group	Sandstone with subordinate mudstone and siltstone. 41.3m in Whitefield Lane Borehole; 24.8m in Whitley (nr. Goole) Borehole,

Age	Stratigraphic Unit	Description	Thickness (m)
			117.2m at Great Heck Borehole (vertical thickness).

Sources: IGS (1971), Gaunt (1994) , BGS (2011), LSCo Geo Consulting Limited (2011)

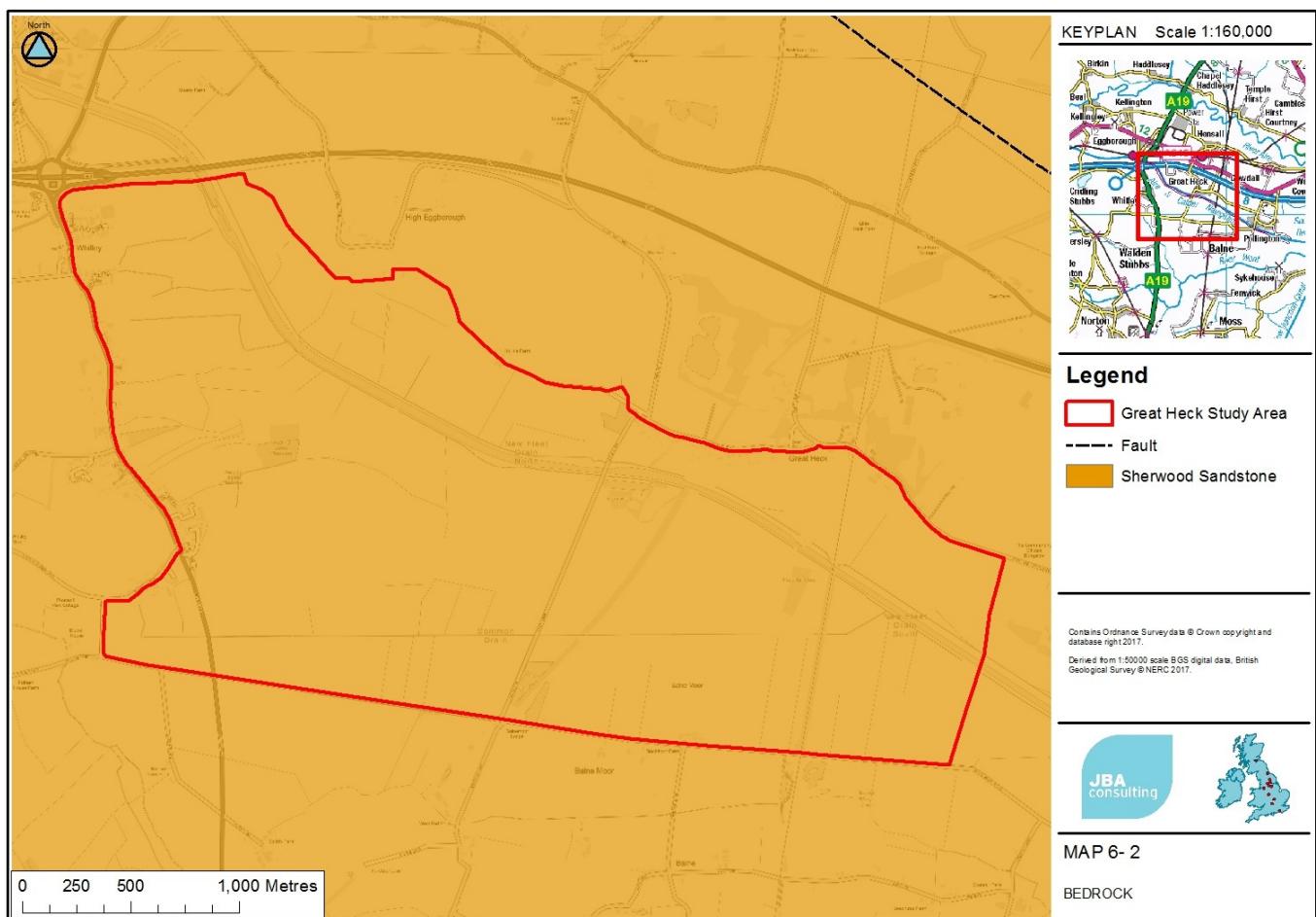


Figure 6-5: Bedrock Geology

6.4.3 Superficial (Drift) Geology

Drift cover is variable across the site area but a large percentage of the Sherwood Sandstone is overlain by silt and clay sediments of the 25-Foot Drift (Figure 6-6). There is a circular outcrop region within the site (around SE 570 200) which has no drift cover with soil lying directly on the Sherwood Sandstone. In this region there are some smaller zones of lacustrine beach deposits (sand and gravel) of a greater age than the 25-Foot drift. To the east of Selby road in Whitley, the superficial deposits have a thicker sequence with a top sand layer of the 25-Foot drift overlying clay and silt. The 25-Foot Drift represents the deposits of a glacial lake, Lake Humber (Gaunt, 1994). They consist of laminated silt and clay, commonly overlain (and often underlain) by sand (Table 6-2). The underlying layer of sand in the 25-foot-drift is not recorded by IGS (1971) (and hence not shown on Figure 6-6), but is referred to by Gaunt (1994). Borehole logs in the area often document a sand layer beneath the 25-foot-drift deposits but do not record details of two different sand layers making it impossible to define the sand as one or the other. The Sherwood Sandstone group is often covered by a sand layer of reworked sandstone, making poorly recorded stratigraphy in borehole logs more complicated to define. Made ground is present locally in the form of roads/tracks and other artificially built-up or infilled areas.

Further details on the superficial geology of the study area can be found in the hydrogeological risk assessment in Appendix A.

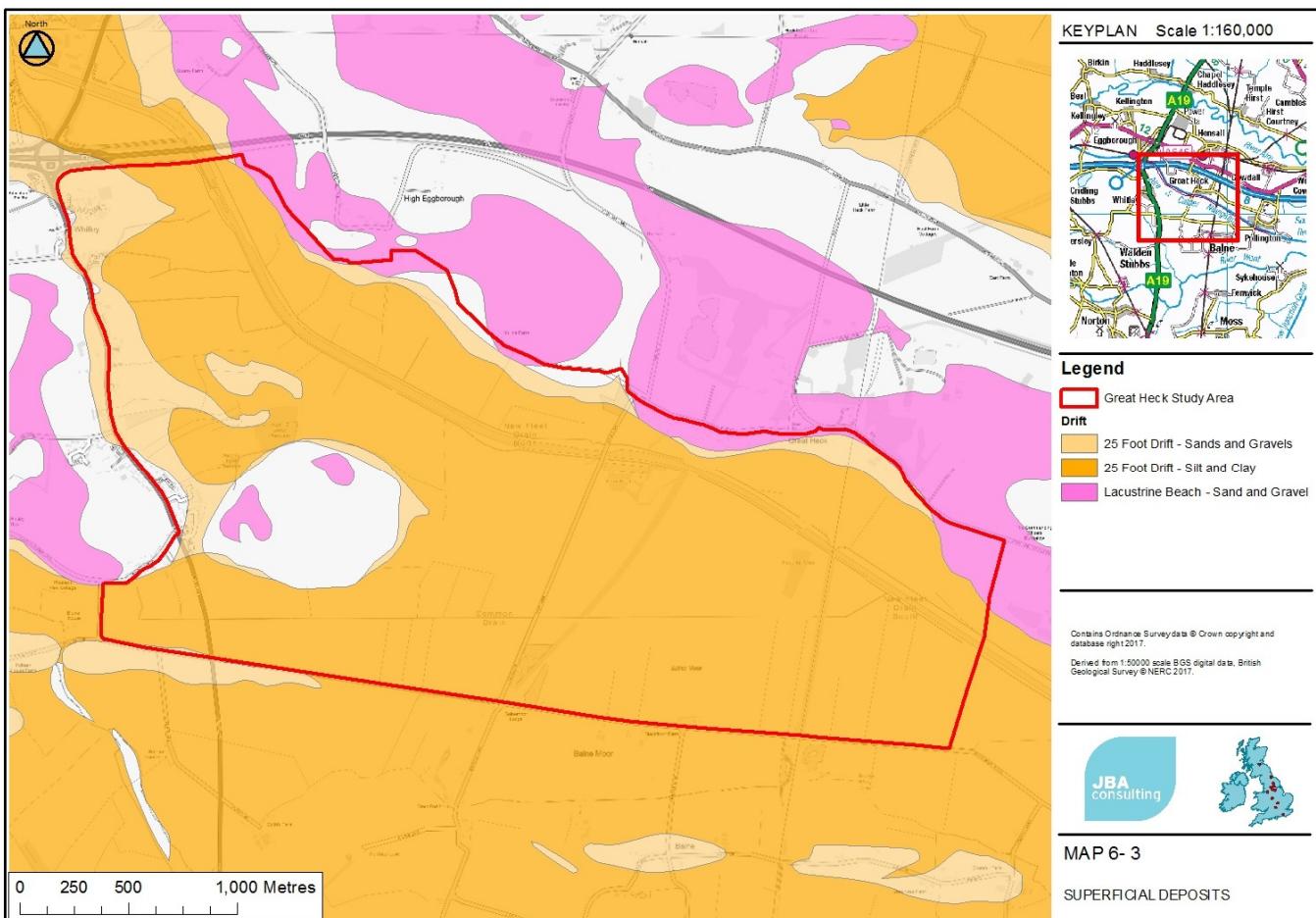


Figure 6-6: Superficial Deposits

6.4.4 Soils

The majority of the area is overlain by soils belonging to the Foggathorpe 2 Soil Association, which includes slowly permeable, seasonally waterlogged, stoneless clayey and fine loamy over clayey soils, and some similar coarse loamy over clayey soils (Soil Survey of England and Wales, 1983). There is also a smaller patch, to the western areas of the study area, of Newport 1 Soil Association, which includes deep well drained sandy and coarse loamy soils with some sandy soils affected by groundwater and some risk of wind and water erosion. These soils allow the agricultural land to be classified as Grade 2.

Borehole logs gathered from the BGS website and from the site investigation show the soil to be 0 to 0.6m in thickness. Exposed areas observed during the site visit showed a soil coverage of approximately 0.2m overlying upper sand of the 25-foot drift. Soil coverage over the clays of the 25-foot drift was very difficult to distinguish from the clay. The most detailed log from the site investigation (LSCo Geo Consulting Limited, 2011) shows a soil thickness of 0.6m in the centre of the study area. However most other logs from the site investigation do not record topsoil thickness. As the area is used for arable farming there must be soil present so it is possible that the soil has been logged as clay, making it hard to distinguish (in the records) from the clay of the 25-foot-drift. There were few exposures in drain banks to observe during the site walkover.

No peat has been mapped within the study area (IGS, 1971; Soil Survey of England and Wales, 1983), so disturbance to the soil is unlikely to release significant amounts of carbon.



Figure 6-7: Soil overlying clay of the 25-Foot Drift [NGR 457950 461800, looking NW]

6.4.5 Surface Water Hydrology and Flood Risk

The main watercourses in and around the area are (Figure 6-8):

- Aire and Calder Navigation Canal
- River Went (approximately 2.5km south of the study area)
- Balne Common Drain (which runs west-east across the south of the study area)

The area has been drained for agriculture, and the Danvrm Commissioners are responsible for managing the drainage network. The study area lies within a catchment which drains and discharges to the New Fleet drain South (a Canal and River Trust Watercourse) and New Fleet Drain North, along the southern and northern edges of the Aire and Calder Navigation Canal. These eventually drain into the River Don. The general direction of flow through the main drains (south of the canal) is east until water enters this New Fleet Drain South (at approximately NGR 456800 421750, 457700 421100 and 459700 420270). The three main IDB drains which flow into the New Fleet Drain South are:

- Balne Common Drain
- Court Drain
- Drain No. 71

Balne Common Drain is the largest of the drains, with a length of approximately 3.8km.

To the north of the Aire and Calder Navigation Canal is the Danvrm Drainage Commissioners adopted High Eggborough Drain, which flows in a southerly direction into New Fleet Drain North.

The presence of the subsidence problem ‘flooded’ areas was noted on site during the visit. Aside from these areas there was only one other ‘pond’ water body noted: the Balne Moor Ponds. As mentioned above these are classed as SINCs due to the wetland habitats present. The ponds are a private fishing area so observations were made from the roadside. The ponds reside in an extremely flat area and are separated into two main ponds either side of the dismantled railway. As noted in Chapter 4, previously there was a pond to the east of Heck Road (Booty Well Pond). However, this is no longer in existence, and is now dry and overgrown.

There are also three small ponds within Watkin's Lower Plantation, however these will be unaffected by the works.

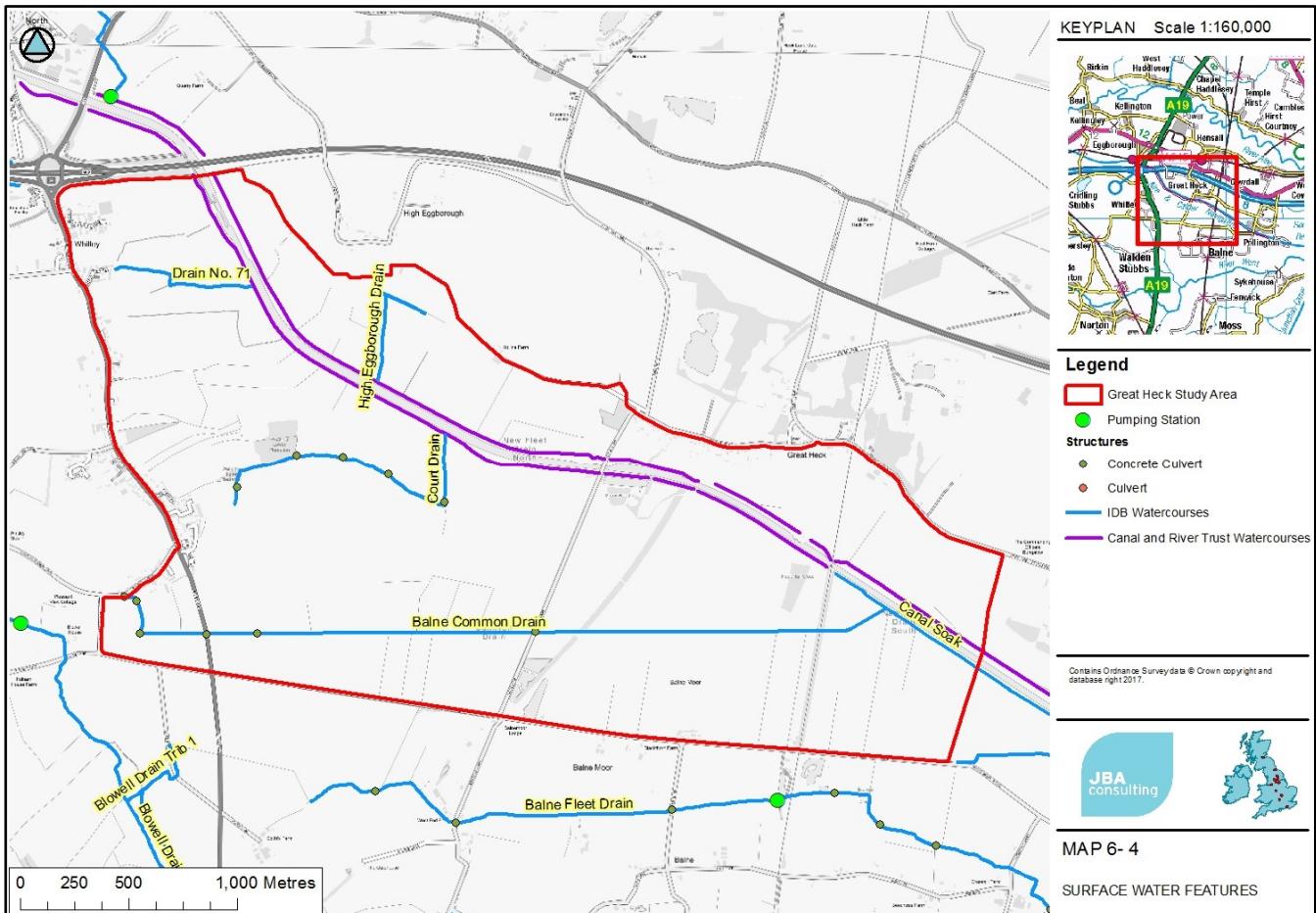


Figure 6-8: Surface Water Features

Surface Water Quality

The Environment Agency's (EA) River Basin Management Plans maps for surface water do not classify the drains or the Aire Calder Navigation Canal within the site area with the exception of the New Fleet Drain (ID GB104027063411). The current chemical quality of the New Fleet Drain is 'Good' and current ecological quality is 'Moderate', with an overall water body classification of 'Moderate'.

The River Aire to the north currently has an ecological status of 'Moderate', chemical status of 'Good' and an overall water body classification of 'Moderate'.

Flood Risk

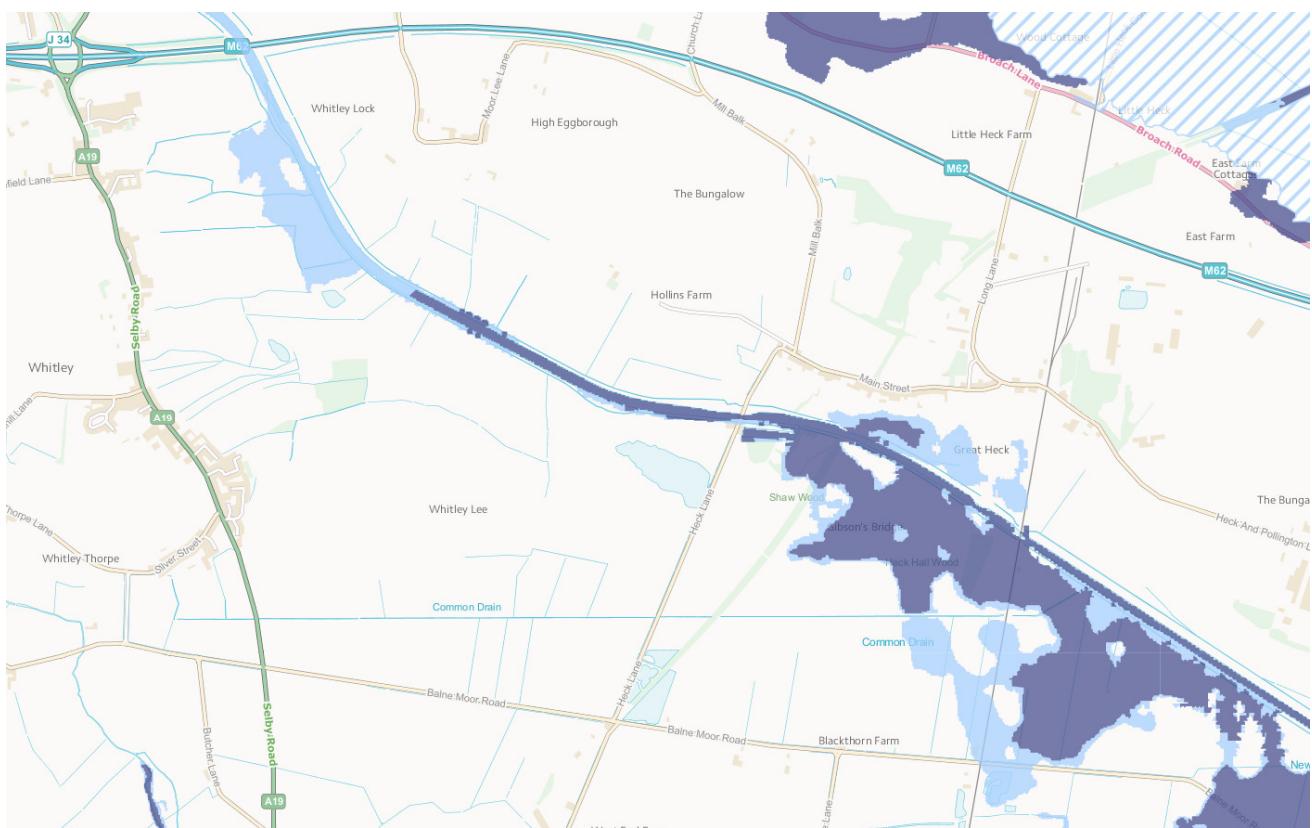
The majority of the study area is not considered to be at risk of flooding from rivers or the sea (EA website). However, the following parts of the study area are considered to have some risk (EA website):

- The land south-west of Aire and Calder Navigation Canal (in the north-east of the study area). This is shown in dark blue on the EA map below, and is categorised as having a 1% or greater chance of flooding in a year.
- A small area (c.0.5 by 0.2 km) south of the Aire and Calder Navigation Canal (in the north-east of the study area). This is shown in light blue on the map and is categorised as having up to 0.1% chance of flooding in a year. This area coincides with one of the subsidence areas, where flooding has occurred. Site observations showed that there is currently no surface water on the fields at this location but the field has obviously been

hes.



Figure 6-9: Aire Calder Navigation Canal [NGR 459490 420500, looking SE]



Reproduced from the Environment Agency webpage visited 27/04/2017

Figure 6-10: EA Flood Risk Areas in and around the study area

6.4.6 Water Framework Directive (WFD)

The Water Framework Directive (WFD) came into force in 2000 and is the most substantial piece of EU water legislation to date. All new activities in the water environment will need to take the Directive into account, including those at Great Heck. The study area is located within the Lower Don Operational Catchment of the Humber River Basin District (RBD). The only waterbody within the study area is New Fleet Drain from source to R. Went (GB104027063411), which within the study area relates to the watercourse to the north of the Aire and Calder Navigation and will therefore be unaffected by the works. Summary information on the current ecological potential of this waterbody is provided in Table 6-3 and Table 6-4 below.

Table 6-3: New Fleet Drain from source to R. Went (GB104027063411) Summary

Water body ID No.	Name of Waterbody	Hydromorphological designation (and reason)	Current Overall Potential (2015 Cycle 2)	Overall Status Objective
GB104027063 411	New Fleet Drain from source to R. Went	Heavily Modified	Moderate	Good by 2027

Table 6-4: Current status of waterbody GB104027063411

Element	Current Status (2015 Cycle 2)	Objectives
Ecological	Moderate	Good by 2027
<i>Biological Quality Elements</i>	Moderate	Good by 2027
Invertebrates	Moderate	Good by 2027
Macrophytes and Phytoplankton Combined	Moderate	Moderate by 2015
<i>Hydromorphological Supporting Elements</i>	Supports Good	Supports Good by 2015
Hydrological Regime	Does Not Support Good	Supports Good by 2021
<i>Physico-chemical Quality Elements</i>	Moderate	Good by 2027
Acid Neutralising Capacity	High	Good by 2015
Ammonia (Phys-Chem)	Moderate	Good by 2027
Biochemical Oxygen Demand (BOD)	Poor	-
Dissolved Oxygen	High	Good by 2015
pH	Moderate	Good by 2027
Phosphate	Poor	Good by 2027
Temperature	Bad	Good by 2027
<i>Specific Pollutants</i>	-	Not Assessed by 2015
Copper	-	-
Trichloroethylene	-	-
Zinc	-	-
Supporting Elements (Surface Water)	Moderate	Good by 2027
Mitigation Measures Assessment	Moderate or Less	Good by 2027
Chemical	Good	Good by 2015
<i>Other pollutants</i>	Does not require assessment	Does not require assessment
<i>Priority Hazardous Substances</i>	Does not require assessment	Does not require assessment
Cadmium and Its Components	-	-
Di(2-ethylhexyl)phthalate (Priority hazardous)	-	-
Nonylphenol	-	-
Tributyltin Compounds	-	-

Element	Current Status (2015 Cycle 2)	Objectives
Priority substances	Does not require assessment	Does not require assessment
Lead and Its Compounds	-	-
Nickel and Its Compounds	-	-

6.4.7 Hydrogeology

Aquifers and Aquitards

An aquifer is a layer of permeable sediment or rock (such as sand or sandstone) that can store and transmit a significant quantity of water. In contrast, an aquitard is a low permeability layer (such as silt or clay) that allows only very slow seepage of water.

Table 6-5 summarises the hydrogeology of the bedrock and superficial deposits (NB, not all of the upper stratigraphic units are present throughout the site). The Sherwood Sandstone is a bedrock aquifer, and the sand deposits are superficial (drift) aquifers. The silt and clay layers of the 25-Foot Drift form an aquitard.

The Sherwood Sandstone is classed as a Principle Aquifer by the EA, an aquifer designation with the following description: 'These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer' (EA website).

The sand and gravel deposits beneath the silt and clay of the 25-Foot Drift rest directly on the Sherwood Sandstone, and are therefore likely to be in hydraulic continuity with the sandstone aquifer. However, the EA classified these deposits separately as a 'Secondary A' aquifer unit. Secondary A aquifers are 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. These are generally aquifers formerly classified as minor aquifers' (EA website)

Table 6-5: Hydrogeology of the Bedrock and Superficial Deposits

Age	Stratigraphic Unit		Hydrogeology	
Quaternary	Recent	Made Ground		Aquifer or aquitard
		Alluvium		Aquifer (sand/gravel) or aquitard (silt/clay)
	Devensian	25-Foot Drift	Upper Sand	Aquifer
			Silt and clay	Aquitard
			Lower sand	Aquifer
	Devensian or Ipswichian	Lacustrine Beach Deposits	Aquifer	
Triassic		Sherwood Sandstone Group	Aquifer	

Groundwater Levels

In this section, the term "groundwater level" is used to refer to the hydraulic head measured by the level (above Ordnance Datum) of standing water in a borehole or piezometer.

LSCo Geo Consulting Limited (2011) recorded levels of groundwater emergence in the site investigation boreholes at the time they were drilled. However, no resting water levels were recorded and unfortunately no piezometers have been installed in the study area with the purpose of monitoring groundwater water levels. The results are summarised in Appendix A.

Groundwater / Surface Water Interactions

In general, the Sherwood Sandstone aquifer and overlying sand/gravel are covered by a layer of clay drift (25-Foot Drift) and are therefore effectively separated from the surface water drainage network. However, at NGR 457000 420500, and to the west of Selby Road the sandstone aquifer is not covered by any superficial deposits and is only overlain by the soil (Newport 1 Soil Association, which includes deep well drained sandy and coarse loamy soils with some sandy soils affected by groundwater and some risk of wind and water erosion). Rainfall/runoff is likely to recharge the aquifer in this area and as such any surface water found here would be in hydraulic connection with the groundwater.

6.4.8 Groundwater Vulnerability

In and within close proximity to the areas where the Sherwood Sandstone is not covered by superficial deposits the groundwater vulnerability zone is classed as 'Major Aquifer High' (EA website). This is found within one central area and to the north-west of the survey area. The remaining cover is classed as 'Major Aquifer Intermediate' due to the importance of the underlying sandstone aquifer being within the catchment of the Public Water Supply (PWS) borehole at Great Heck, although it is slightly more protected due to the drift cover – most importantly the 25-foot drift clay and silt aquitard, which will assist in preventing contamination.

6.4.9 Water Resources

As outlined above the Sherwood Sandstone is classified as a Principal (formerly Major) Aquifer (Allen *et al.*, 1997; EA website) and is strategically important for water supply in the region (Aitkenhead *et al.*, 2002). The upper sand of the 25-Foot Drift is classified as a "Secondary A" aquifer. This is found in the Whitley area and surrounding the central outcrop of Sherwood Sandstone.

Large water abstractions (>20 m³/d) are licensed by the EA. Table 6-6 and Table 6-7 list the licensed abstractions within 5 km of the boundaries of the study area. Small private water supplies are classed as "deregulated" and do not require licensing. However, they may be registered with the Local Authority, particularly if they are used for drinking. Figure 6-11: Abstractions and Source Protection Zones shows the spatial distribution of the abstractions.

There are 51 surface water abstractions over 35 separate EA surface water abstraction licenses and 26 groundwater abstractions over 21 EA groundwater abstraction licences within 5km of the site. Of these, two surface water abstraction licences are within the study area which abstract from New Fleet Drain North and Aire and Calder Navigation Canal for general agriculture spray irrigation and process water purposes respectively.

There are no EA licensed groundwater abstractions within the study area (Table 6-6 and Figure 6-10). With the exception of two more distant groundwater abstractions, all groundwater abstractions are from the Sherwood Sandstone. A set of three boreholes at Great Heck, between 58m and 180m from the site edge provide public drinking water. The Source Protection Zones (SPZs) 2 and 3, for these boreholes, extend into the study area.

Table 6-6: Groundwater Abstraction Licences within 5km

Licence Number	Distance from site (m)	Easting	Northing	Source	Usage
2/27/18/07 7	58	458910	421070	BOREHOLE 3 - SHERWOOD SANDSTONE - GREAT HECK	Potable Water Supply - Direct
	139	458930	421150	BOREHOLE 1 - SHERWOOD SANDSTONE - GREAT HECK	Potable Water Supply - Direct
	180	458940	421190	BOREHOLE 2 - SHERWOOD SANDSTONE - GREAT HECK	Potable Water Supply - Direct
NE/027/00 09/015	205	460036	420804	BOREHOLE - SHERWOOD SANDSTONE - POLLINGTON AIRFIELD	Spray Irrigation - Direct
2/27/09/02 5	247	455729	421765	BOREHOLE - SHERWOOD SANDSTONE - WHITLEY BRIDGE	Spray Irrigation - Direct
2/27/18/01 2	272	460470	420230	BOREHOLE - SHERWOOD SANDSTONE - POLLINGTON	Process Water
2/27/18/14	342	458185	421665	BOREHOLE - SHERWOOD SANDSTONE -	Spray Irrigation -

Licence Number	Distance from site (m)	Easting	Northing	Source	Usage
6/R01				GREAT HECK - GOOLE	Direct
2/27/18/04 4	494	459840	421400	BOREHOLE - SHERWOOD SANDSTONE - HECK	Steam Generation - Mineral Washing
NE/027/00 09/021	547	455634	420900	BOREHOLE - SHERWOOD SANDSTONE - WHITLEY BRIDGE	Horticultural Watering
NE/027/00 18/009	577	457396	422415	BOREHOLE-SHERWOOD SANDSTONE-HIGH EGGBOROUGH-GOOLE	Spray Irrigation - Direct
2/27/18/07 8	1123	461340	420190	BOREHOLE 3 - SHERWOOD SANDSTONE - POLLINGTON	Potable Water Supply - Direct
2/27/18/15 9/R01	1161	459697	422153	BOREHOLE - SHERWOOD SANDSTONE - LITTLE HECK FARM	Spray Irrigation - Direct
2/27/18/07 8	1164	461380	420180	BOREHOLE 1 - SHERWOOD SANDSTONE - POLLINGTON	Potable Water Supply - Direct
2/27/18/12 3/R01	1231	456670	423490	BOREHOLE B - SHERWOOD SANDSTONE - EGGBOROUGH POWER STATION	Boiler Feed
2/27/18/07 8	1300	461520	420180	BOREHOLE 2 - SHERWOOD SANDSTONE - POLLINGTON	Potable Water Supply - Direct
2/27/18/15 8/R01	1677	455502	423806	BOREHOLE - SHERWOOD SANDSTONE - KELLINGTON	Spray Irrigation - Direct
2/27/18/13 1/R01	1857	458083	423602	BOREHOLE - SHERWOOD SANDSTONE - HENSALL	Spray Irrigation - Direct
2/27/18/14 2/R01	2449	455101	424481	BOREHOLE-SHERWOOD SANDSTONE-KELLINGTON-GOOLE	Vegetable Washing
2/27/18/12 3/R01	2633	457480	424790	BOREHOLE A - SHERWOOD SANDSTONE - EGGBOROUGH POWER STATION	Boiler Feed
2/27/18/06 0	2871	453900	424200	BOREHOLE - SHERWOOD SANDSTONE - BEAL	Spray Irrigation - Direct
2/27/18/05 3	3233	453830	424630	BOREHOLE - SHERWOOD SANDSTONE - KELLINGTON	Spray Irrigation - Direct
2/27/09/10 7	3615	455000	416600	BOREHOLES - MAGNESIAN LIMESTONE - WALDEN STUBBS	Fish Farm/Cress Pond Throughflow
2/27/18/12 5/R01	4204	462470	424060	BOREHOLE - SHERWOOD SANDSTONE - CARLTON	Spray Irrigation - Direct
NE/027/00 18/006	4243	462719	423947	BOREHOLE - SHERWOOD SANDSTONE - CARLTON - GOOLE	Spray Irrigation - Direct
2/27/18/15 4/R01	4382	451542	422579	BOREHOLE - LOWER MAGNESIAN LIMESTONE - KNOTTINGLEY	Spray Irrigation - Direct
NE/027/00 18/005	4506	463364	423759	BOREHOLE - SHERWOOD SANDSTONE - CARLTON - GOOLE	Spray Irrigation - Direct

Table 6-7: Surface Water Abstraction Licences within 5km

Licence Number	Distance from site (m)	Easting	Northing	Source	Usage
NE/027/00 18/013	0	459539	420418	CANAL KNOWN AS AIRE & CALDER NAVIGATION	Process Water
2/27/09/1 43	0	456640	422230	NEW FLEET DRAIN NORTH	Spray Irrigation - Direct
2/27/09/1 43	100	456570	422340	NEW FLEET DRAIN NORTH	Spray Irrigation - Direct
2/27/09/1 78/R01	294	460406	419851	AIRE & CALDER NAVIGATION - GOOLE	Production of concrete and supply to steam-raising plant

Licence Number	Distance from site (m)	Easting	Northing	Source	Usage
2/27/09/2 05	1273	454903	420839	BLOWELL DRAIN	Spray Irrigation - Direct
2/27/09/0 81	1394	457213	418455	POND ADJACENT TO BLOWELL DRAIN - WALDEN	Spray Irrigation - Direct
2/27/09/2 05	1473	457078	418399	BLOWELL DRAIN	Spray Irrigation - Direct
2/27/09/1 67	1538	455200	418800	BRADLEY DRAIN	Spray Irrigation - Storage
2/27/09/2 01	1645	454379	422769	SOUTHFIELD LANE DRAIN - GOOLE	Spray Irrigation - Direct
2/27/09/2 02	1870	454326	423159	CANAL SOP DYKE	Spray Irrigation - Direct
2/27/09/0 81	2403	455352	417765	LAKE DRAIN - WALDEN - DONCASTER	Spray Irrigation - Direct
2/27/09/2 04/R01	2445	457320	417370	LAKE DRAIN	Spray Irrigation - Direct
2/27/09/2 03/R01	2487	458912	417130	RIVER WENT - BALNE - GOOLE	Spray Irrigation - Direct
NE/027/0 009/012	2496	456850	417390	LAKE DRAIN - WALDEN	Spray Irrigation - Direct
2/27/09/11 7	2504	461300	417400	RIVER WENT - BALNE	Spray Irrigation - Direct
NE/027/00 09/012	2519	456900	417360	LAKE DRAIN - WALDEN	Spray Irrigation - Direct
NE/027/00 18/021	2760	453141	422145	BLOWELL DRAIN - NEAR COBCROFT LANE - CRIDLING STUBBS	Spray Irrigation - Direct
2/27/18/13 5/R01	2898	458892	424391	INGS AND TETHERING DRAIN - EGGBOROUGH	Spray Irrigation - Direct
NE/027/00 09/012	2970	454850	417350	BIRKA DRAIN	Spray Irrigation - Direct
NE/027/00 18/025	3071	459417	424276	INGS AND TETHERINGS DRAINS	Spray Irrigation - Direct
NE/027/00 18/020	3138	457490	425317	INGS & TETHERING DRAIN - WIDE ARCH, KELLINGTON	Spray Irrigation - Direct
2/27/18/03 3	3155	456400	425400	OLD HEE FISH POND - ROALL MANOR - KELLINGTON	Spray Irrigation - Direct
NE/027/00 18/007	3184	462578	422662	RIVER AIRE AT GOWDALL	Spray Irrigation - Direct
NE/027/00 18/025	3190	460247	424119	INTAKE & MARSH DRAIN	Spray Irrigation - Direct
2/27/09/20 3/R01	3283	462788	417810	RIVER WENT	Spray Irrigation - Direct
2/27/18/13 0/R01	3368	458322	425241	RIVER AIRE AT MYRTLE FARM	Spray Irrigation - Direct
NE/027/00 18/024	3528	463211	422418	INGS DRAIN - GOWDALL INGS	Spray Irrigation - Direct
2/27/18/13 4/R01	3555	458359	425437	RIVER AIRE	Transfer Between Sources (Post Water Act 2003)
2/27/18/14 5/R01	3606	462252	423496	RIVER AIRE	Spray Irrigation - Direct
2/27/18/00 7	3678	452400	423260	AIRE AND CALDER NAVIGATION-KELLINGLEY-KNOTTINGLEY	Process Water
2/27/18/12 8/R01	3746	459569	424987	RIVER AIRE - TIDAL - TEMPLE HIRST - SELBY	Spray Irrigation - Direct

Licence Number	Distance from site (m)	Easting	Northing	Source	Usage
NE/027/00 18/007	3749	463444	422468	RIVER AIRE AT GOWDALL	Spray Irrigation - Direct
2/27/18/12 8/R01	3752	458655	425492	RIVER AIRE - TIDAL - CHAPEL HADDLESEY	Spray Irrigation - Direct
2/27/18/13 7/R01	3794	455810	425990	RIVER AIRE - KELINGLEY	Spray Irrigation - Direct
2/27/18/13 7/R01	3797	454960	425850	RIVER AIRE - KELLINGLEY	Spray Irrigation - Direct
2/27/09/08 1	3801	455201	416353	RIVER WENT - WALDEN	Spray Irrigation - Direct
NE/027/00 09/013	3906	456090	416080	DRYHURST DRAIN - WALDEN	Spray Irrigation - Direct
2/27/09/20 6	3976	452130	420790	BOREHOLE - LOWER MAGNESIAN LIMESTONE - CRIDLING STUBBS	Spray Irrigation - Direct
2/27/18/04 5	4023	457946	426108	RIVER AIRE - EGGBOROUGH POWER STATION	Cooling - Ash Disposal
NE/027/00 18/014	4026	457985	426099	RIVER AIRE AT CHAPEL HADDLESEY (HEP)	Hydroelectric Power Generation
2/27/18/11 4	4032	457880	426130	RIVER AIRE - CHAPEL HADDLESEY	Evaporative Cooling
2/27/18/13 7/R01	4034	457890	426130	RIVER AIRE - KELLINGLEY	Spray Irrigation - Direct
2/27/18/14 1/R01	4234	451892	423495	AIRE AND CALDER NAVIGATION - POLLINGTON GOOLE	Spray Irrigation - Direct
2/27/18/13 2/R01	4234	451892	423495	AIRE AND CALDER NAVIGATION - EGGBOROUGH GOOLE	Spray Irrigation - Direct
NE/027/00 09/013	4299	457150	415520	RIVER WENT OLD COURSE	Spray Irrigation - Direct
2/27/18/13 7/R01	4311	453290	425580	RIVER AIRE	Spray Irrigation - Direct
2/27/18/12 9/R01	4416	454299	426280	RIVER AIRE - BIRKIN HOLME - SELBY	Spray Irrigation - Direct
2/27/18/11 7/R01	4425	452100	424400	RIVER AIRE - KELLINGTON	Spray Irrigation - Direct
NE/027/00 09/013	4426	457100	415400	GREAT COMMON DRAIN	Spray Irrigation - Direct
2/27/18/13 3/R01	4442	457192	426688	SELBY CANAL	Spray Irrigation - Direct
2/27/09/08 1	4709	456856	415152	GREAT COMMON DRAIN	Spray Irrigation - Direct

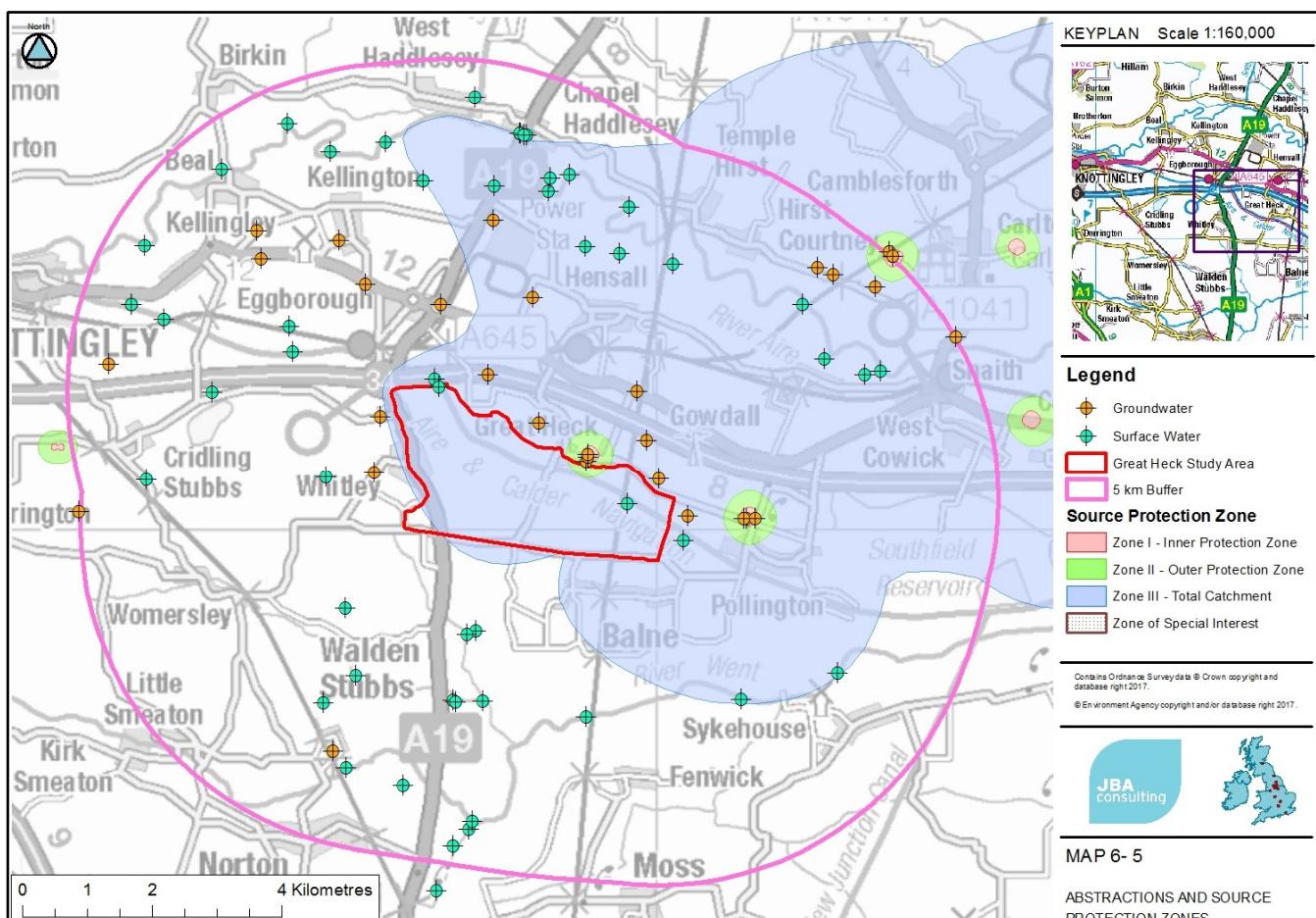


Figure 6-11: Abstractions and Source Protection Zones

The study area is covered by Selby District Council and the East Riding of Yorkshire Council. They were contacted for information of private water supplies within a 5km radius of the study area. Only Selby District Council had records of a private water supply within the area (Table 6-8).

Table 6-8: Deregulated Abstractions (Private Water Supplies)

Name	Use	Source	Easting	Nothing	Distance from Study Area (m)
Hazel Grove Farm	Drinking water for own purposes	Groundwater	457700	423100	1240
Data supplied by Selby District Council					

6.4.10 Environmentally Sensitive Sites

Statutory Designated Nature Conservation Sites

There is one statutory designated nature conservation sites within the study area or within a 5km radius, Forlorn Hope Meadow SSSI. Due to its location, on a hill 3.3km to the south west, no feasible hydraulic connection between it and the proposed works could be identified.

Non-statutory Designated Nature Conservation Sites

There are three non-statutory nature conservation sites located within the study area (see section 4.4.1). These are designated SINCs, however one of which is still to be surveyed by the North Yorkshire County Council SINC panel. The list of SINCs within the study area and the reasons for their designations are listed in Table 6-9.

Table 6-9: Non-statutory Designated Nature Conservation Sites

Site Name/Figure reference	Distance from Study Area	Reason for Designation
Balne Moor Ponds (Figure 6-13)	Within the study area	Wetlands vegetation and habitat (also used as fishing ponds – ‘Horseshoe fishing ponds’)
Ditch West of Balne Moor Ponds (Figure 6-14)	Within the study area	Wetland Flora (designation still not finalised by panel)
Dismantled Railway (Figure 6-15)	Within the study area	Woodland and wildlife corridor

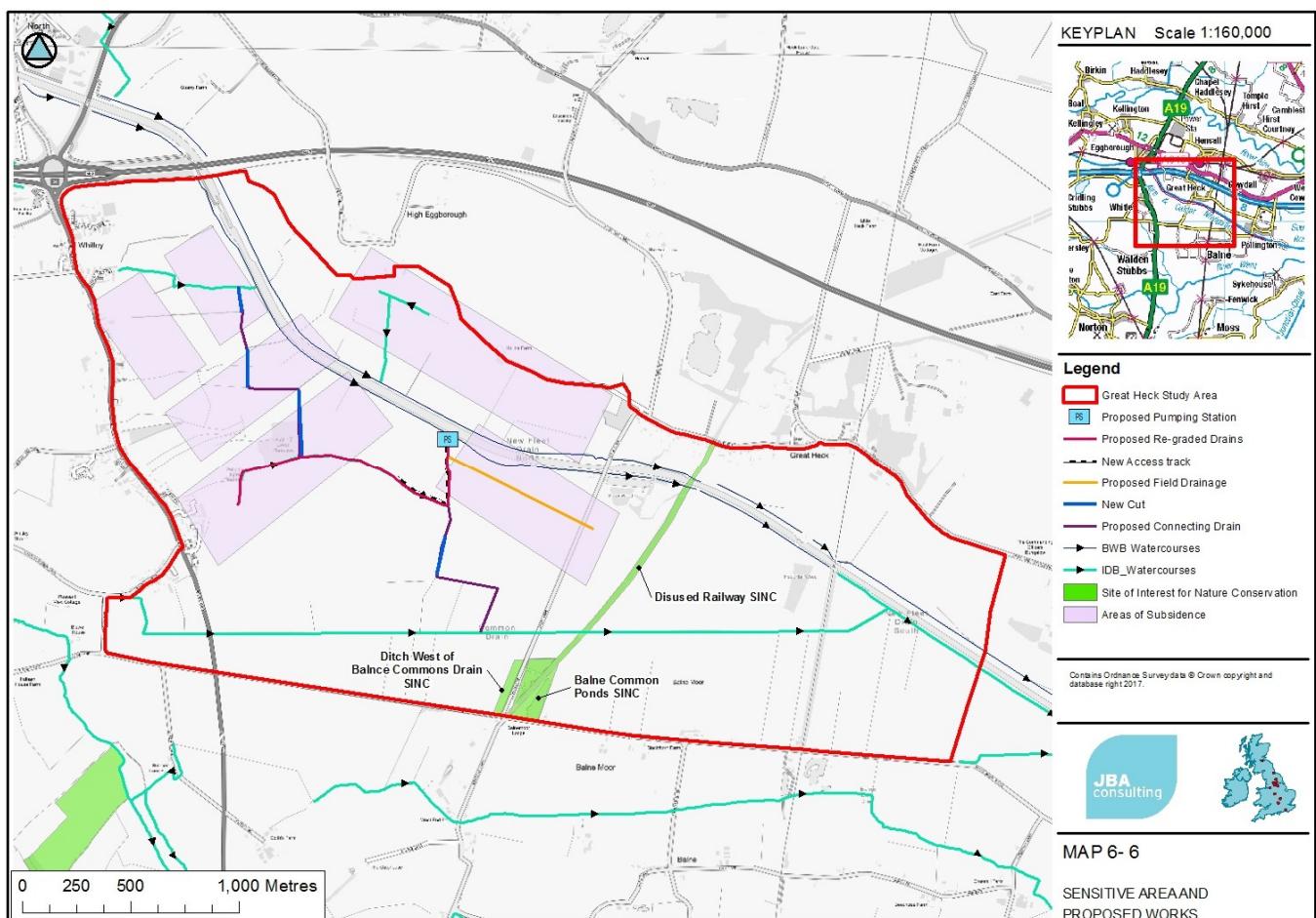


Figure 6-12: Sensitive Area and Proposed Works



Figure 6-13: SINC-Balne Moor Ponds [NGR 458100 419800, looking NE from Balne Moor Road]



Figure 6-14: SINC Ditch West of Balne Moor Ponds [NGR 457950 461800, looking SSW]



Figure 6-15: SINC Ditch West of Balne Moor Ponds junction with Balne Common Drain [NGR 458150 420200, looking SSW down the length of the ditch]

Hydrology/hydrogeology of the Balne Moor Ponds and the associated ditch

There is little geological information from logs available at or near the location of Balne Moor Ponds SINC. The two borehole logs available (at NGR 458187 419649 and 458155 419608) were drilled below ground (coal mines) and provide no information about the Sherwood Sandstone depths or drift cover depths at this location.

According to geological maps (IGS, 1971) the Sherwood Sandstone is covered by the 25-foot drift at the location of the ponds with the uppermost layer being the middle 'silt and clay' layer. The pond is therefore unlikely to be in hydraulic connection with the aquifer below this, being perched on top of the impermeable clays. There are no inflowing or discharging streams. The surrounding area is covered with a similar geological sequence, i.e. the top most geological layer is the silt and clay of the 25-foot drift, and is very flat. It is therefore unlikely that there is a superficial aquifer close to the pond which is draining into it as the water reaches the impermeable clay. Water infiltrating through the slowly permeable soil (Foggathorpe 2) could be draining into the pond, as well as surface runoff and direct rainfall/recharge.

Figure 6-13 shows the designated SINC ditch west of Balne Moor Ponds which was dry at the time of the site visit. This ditch connects to the Balne Common Drain, but site observations showed that the base of Balne Common Drain is actually 1m below the base of this ditch (Figure 6-14).

Balne Common Drain act as a hydrological boundary between the proposed works and the SINCs. This will limit the potential for the proposed works to affect the SINCs.

Hydrology/hydrogeology of the dismantled railway (SINC)

The dismantled railway is an embankment which rises approximately 5m above the surrounding ground level. It lies in an area where the uppermost geological layer is the middle 25-foot drift (silt and clay) and as such is not likely to be in hydraulic connection with the Sherwood Sandstone aquifer. Within the study area the southern extent of the dismantled railway line is close to the Balne Moor Pond. The northern extent of the dismantled railway line is the Aire and

Calder Navigation. Balne Common Drain crosses beneath the embankment at NGR 458350 420220 (Figure 6-16).



Figure 6-16: Ditch West of Balne Moor Ponds [NGR 458430 420200, looking E]

6.5 Assessment of Effects

6.5.1 Source - Pathway - Receptor Linkages

Many of the potential effects of the proposed development involve contamination of soil and water, and can therefore be analysed within a "Source - Pathway - Receptor" (SPR) framework (e.g. Nathanail and Bardos, 2004). In this framework, an environmental receptor is considered to be at risk of contamination if a viable pathway exists between the receptor and the contamination source. All three components - source, pathway and receptor - are needed in order for there to be a risk. Where all three components exist, there is said to be an SPR pollutant linkage. For example, groundwater flow may provide a viable pathway for contamination to migrate from a fuel spill (source) to a drinking water supply borehole (receptor).

The SPR framework can be applied in reverse to the impact of improved drainage on a pond or wetland: in this case, water travels from the receptor (pond or wetland) to the "source" (the drain), but the existence of a viable pathway remains the critical factor. The drain is the "source" of the drainage rather than the source of the water.

Table 6-10 evaluates the potential sources (e.g. impacts), pathways and receptors relevant to the drainage scheme at Great Heck. In some cases, no viable SPR linkage exists, and the receptor can therefore be screened out as not being at risk. In other cases, there is a viable SPR linkage, and further assessment is required. This assessment is presented in the following sections.

Table 6-10: Source - Pathway - Receptor Linkages

Receptor (R)	Source (S)	Pathway (P)	SPR linkage?
Soil	Chemicals (fuel/oil/cement) released on	Chemicals may be spilled directly onto the soil, or may enter the soil indirectly via runoff.	Yes

Receptor (R)	Source (S)	Pathway (P)	SPR linkage?
	site.		
Agricultural drainage ditches	Sediment released as a result of site works.	Ditches may receive contaminated or sediment-laden runoff. Material eroded or slumped from the ditch banks may enter the ditches directly.	Yes
River Don		Sediment-laden or contaminated water from drainage ditches could enter the River Don via New Fleet Drain North and New Fleet Drain South.	Yes
Aire and Calder Navigation Canal		No viable pathway exists as the canal is not hydraulically connected to the drains or groundwater beneath the site. It is perched above the flood plain.	No
Wet grassland/ subsidence flash areas		Wet grassland areas/subsidence flash areas may receive contaminated or sediment-laden runoff.	Yes
Balne Moor Ponds SINC		Common Drain acts as a hydrological divide between the SINC and the proposed works.	No
Ditch West of Blane Moor Ponds (potential SINC)		Common Drain acts as a hydrological divide between the SINC and the proposed works.	No
Dismantled Railway SINC		No viable pathway exists as the dismantled railway is perched above potentially affected surface water.	No
Wet grassland areas/subsidence flash areas		Wet grassland areas may lose water to widened/deepened drainage ditches if the ditches intersect the furrows or other topographic depressions that make up the wet areas.	Yes
Designated wetland sites outside the study area		Only the Humber Estuary SSSI is downstream of the proposed works, and this is some 15 km away. A theoretical pathway exists, but this is very unlikely to be significant, especially given the distance and dilution involved.	No
Balne Moor Ponds SINC	Widened/ deepened drains are a "source" of drainage.	Balne Moor Ponds are not connected to the current or proposed drainage network.	No
Ditch West of Balne Moor Ponds (potential SINC)		Balne Common Drain act as a hydrological boundary between the works and the SINC	No
Dismantled Railway SINC		The dismantled railway is perched above the drains.	No
Surface water abstractions	Changes in available flow	No viable pathways exist as the abstractions are not downstream of the proposed works.	No
Ground-water in the drift	Sediment released as a result of site works. Chemicals (fuel/oil/cement) released on site.	Across most of the area the upper part of the drift consists of low permeability silt and clay, and is therefore not very susceptible to groundwater contamination. However, in some places the upper part of the drift consists of sand; here the groundwater in the drift is more vulnerable to contamination. The pathway is provided by downward flow through the soil and unsaturated zone.	Yes (locally)
Ground-water in the Sherwood Sandstone (Principal Aquifer) SPZ3		Hydrogeological risk assessment in Appendix XX identifies several zones where	Yes (locally)

Receptor (R)	Source (S)	Pathway (P)	SPR linkage?
Ground-water abstraction	Chemicals (fuel/oil/cement) released on site.	A large proportion of the study area is within the SPZ3 for a series of public water supply groundwater abstractions. SPZ3 indicates the total catchment of the abstractions and therefore there is a source-pathway-receptor linkage.	Yes

The last two pathways in the table above are discussed in more detail in the hydrogeological risk assessment in Appendix A.

6.5.2 Construction Phase

The construction phase will involve:

- Movement of heavy plant on site,
- Deepening and widening of existing drainage ditches,
- Excavation of new connecting ditches,
- Installation of one pumping station and associated infrastructure.

Potential impacts on the hydrological, geological and soil environments include:

- Soil erosion - the risk of erosion will be increased by excavation, vehicle movements and by the temporary stockpiling of soil on site
- Soil compaction due to the movement of heavy plant on site, reducing permeability and rainfall infiltration. This could lead to increased runoff
- Release of sediment into surface watercourses, increasing their turbidity and nutrient content
- Chemical contamination of soil, surface water and groundwater - for example, by fuel hydrocarbons, lubricating oil or unset concrete (concrete is highly alkaline and corrosive). This could affect the groundwater in the drift where there is not a surface cover of clay. IGS (1972), superficial geology map suggests that there is always an upper clay layer in the areas where work will be carried out. This limit downward migration of contaminants through the superficial layers. However, SI boreholes ((LSCo Geo Consulting Limited, 2011), C and D from the central part of the study area show an upper layer of sand and limited thickness of clay in the geological succession. At Court Drain the proposed re-grades near cross section 21 and 22 come into contact or close to the top of the Sherwood Sandstone (0.1m into the sandstone at CS 22 and 0.6m into the sandstone at CS 21). There are also proposed re-grades between cross sections 24 and 25 which lie on an area with no drift cover. The sandstone will therefore be vulnerable at this location. The study area is included in SPZ3 of the Great Heck PWS. It is hence important that it does not become contaminated. This is discussed in more detail in Appendix A.
- Improved drainage of wet grassland/subsidence flash areas, including lowering of water levels, removing the habitat which was present. The purpose of the remediation project is to drain these areas to allow normal agricultural operations to continue and to protect Heck Lane, so no mitigation measures are suggested to counteract this.
- Improved drainage of the study area, lowering the water table could affect the groundwater level at the ditch to the west of Balne Moor Ponds SINC or the ponds themselves. Balne Common Drain acts as an effective hydraulic barrier between the proposed works and the SINCs. The SINCs are likely to lie over a clay layer which will act to hydrogeological isolate them (however the drift in the area has variable permeability and is horizontally interbedded). The exact drift succession is not known so there could be a groundwater. Predicted changes in water level the vicinity of these SINCs are however, expected to be minimal.

Table 6-15 summarises the likely magnitude and significance of impacts during the construction phase, both pre- and post-mitigation. Mitigation methods are discussed in Section 6.5.5.

6.5.3 Operational Phase

The operational phase will involve:

- Management of water levels and flow through the operation of the new pumping station,
- Occasional maintenance of the pumping station and annual maintenance of the ditch network.

Potential impacts on the hydrological, geological and soil environments include:

- Possible erosion/slumping of steep, poorly-vegetated, ditch banks
- Possible release of eroded/slumped sediment into surface watercourses, increasing their turbidity and nutrient content
- Soil erosion/compaction - the risk of erosion/compaction will be increased due to the occasional presence of maintenance vehicles on site, reducing permeability and rainfall infiltration.
- Chemical contamination of soil, surface water and groundwater - for example, by fuel hydrocarbons or lubricating oil transferred or spilled by vehicles carrying out routine maintenance. Appendix A identifies the zones which where the underlying bedrock aquifer may be most vulnerable to pollution.
- Lowering in water levels resulting from improved drainage, including drying out of wet grassland/subsidence flash areas. The purpose of constructing the new drains is to dry these areas out, so no mitigating measures are suggested to counteract this.
- Improved drainage of the study area, lowering the water table could affect the groundwater level at the ditch to the west of Balne Moor Ponds SINC or the ponds themselves. Balne Common Drain acts as an effective hydraulic barrier between the proposed works and the SINCs. The SINCs are likely to lie over a clay layer which will act to hydrogeological isolate them (however the drift in the area has variable permeability and is horizontally interbedded). The exact drift succession is not known so there could be a groundwater. Predicted changes in water level the vicinity of these SINCs are however, expected to be minimal.

Table 6-16 summarises the likely magnitude and significance of impacts during the operational phase, both pre- and post-mitigation. Mitigation methods are discussed in Section 6.5.5.

6.5.4 Decommissioning Phase

It is not planned to decommission the pumping stations in the foreseeable future. However, any impacts during decommissioning would be similar to those during construction and are therefore not considered separately in this assessment.

6.5.5 Mitigation Measures (all Phases)

The following measures would be taken to mitigate potential impacts of the drainage improvement scheme on the hydrological, geological and soil environments:

- Designing ditch profiles and cross-sections in such a way as to minimise the risk of bank failure and erosion.
- Designing ditch profiles and cross-sections in such a way as to minimise the change in the connectivity of the drains with the underlying bedrock aquifer. This is analysed in the hydrogeological risk assessment in Appendix A.
- Implementing a Pollution Prevention Plan following the relevant Pollution Prevention Guidelines (PPG) produced jointly by the EA¹, Scottish Environment Protection Agency (SEPA) and the Environment and Heritage Service of Northern Ireland (Table 6-11). Measures will include:

¹ Current withdrawn by the EA (only) but have not been replaced

- Minimising erosion by keeping exposed areas of ground and soil stockpiles to a minimum, and by avoiding earthworks in very wet weather.
- Employing sediment control measures such as silt traps and settlement ponds.
- Locating any chemical, fuel and oil stores on impervious bases within a secured bund with a storage capacity 110% of the stored volume.
- Placing drip trays underneath any standing machinery to prevent pollution by oil/fuel leaks. Where practicable, refuelling of vehicles and machinery will be carried out on an impermeable surface in one designated area well away from any watercourse or drainage.
- Not carrying out maintenance of construction plant on site, with the exception of emergency maintenance work. Emergency maintenance work should ideally be carried out on an impermeable surface away from any watercourse or drainage; however, it is recognised that broken-down vehicles may require maintenance at the point of breakdown.
- Restriction of plant and wheel washing to a designated area of hard standing with suitable drainage.
- Designing any on-site toilet facilities in such a way as to ensure appropriate disposal of sewage and to prevent pollution.
- Batching concrete within a secure bunded area on an impermeable surface at least 10 m away from any watercourse and not on areas directly underlain by Sherwood Sandstone, and taking measures to prevent the release of cement, fresh concrete and wash waters (which are alkaline and corrosive) into watercourses.
- Suitable disposal of any waste generated during the works.
- Setting out all proposed mitigation measures within a Construction Method Statement (CMS) and Environment Management Monitoring Plan (EMMP). The CMS will describe the methods to be used in construction whilst the EMMP will detail additional management and mitigation commitments, including monitoring programmes and a site-specific Pollution Incident Response Plan.

Table 6-11: Pollution Prevention Guidelines

Authority	Guideline
Environment Agency	PPG 3: Use and design of oil separators in surface water drainage systems [April 2006]
Scottish Environment Protection Agency (SEPA)	PPG 4: Treatment and disposal of sewage where no foul sewer is available [July 2006]
Environment and Heritage Service for Northern Ireland	PPG5: Works and maintenance in or near water [October 2007]
	PPG7: Refuelling facilities [August 2004]
	PPG8: Safe storage and disposal of used oils [February 2004]
	PPG13: Vehicle washing and cleaning [July 2007]

6.5.6 Classification of Impacts

The significance of an impact is determined by the magnitude of the impact and the sensitivity of the receptor, as detailed in Table 6-12, Table 6-13 and Table 6-14. Figure 6-17 shows the proposed works in context with the superficial geology and exposed bedrock and SINCs, highlighting some of the potential impact areas.

Table 6-12: Receptor Sensitivity

Sensitivity of Receptor	Criteria and Examples
High	<p>Receptor is of national or international importance, or supplies water for human consumption. Environmental equilibrium is precarious, and cannot absorb changes without fundamentally altering its present character.</p> <p>Examples:</p>

Sensitivity of Receptor	Criteria and Examples
	<p>Designated wetland site of national or international value (SSSI, Ramsar, etc.)</p> <p>Watercourse classified as good or excellent with respect to chemical and/or ecological quality</p> <p>Principal Aquifer or surface water reservoir supplying potable water</p> <p>EC designated salmonid fishery</p> <p>Mineral resource that is rare and/or of high economic value</p> <p>Peat body with high carbon storage capacity</p>
Medium	<p>Receptor is of local environmental importance and/or is moderately resilient to change.</p> <p>Examples:</p> <p>Conservation area of local importance (including SSIs)</p> <p>Private water supply not for human consumption (e.g. abstraction for spray irrigation)</p> <p>Local small-scale angling amenity</p> <p>Mineral resource that is common or of moderate economic value</p>
Low	<p>Receptor is of low environmental importance. Environmental equilibrium is stable and very resilient to changes that are significantly greater than natural fluctuations. Receptor may already be severely damaged or polluted.</p> <p>Examples:</p> <p>Heavily engineered watercourses and artificial drainage channels</p> <p>Surface water bodies with little or no ecological value</p>

Table 6-13: Impact Magnitude

Magnitude	Criteria
High	<p>Fundamental permanent (or long-term) changes to the soil, geology or water environment.</p> <p>Examples:</p> <p>Permanent derogation of a drinking water supply by pollution or water table drawdown</p> <p>Destruction of, or extensive damage to, a designated wetland site</p> <p>Permanent derogation of water quality in a Grade A or salmonid river</p> <p>Permanent loss of a valuable mineral resource</p> <p>Permanent loss of a significant volume of peat</p>
Medium	<p>Material but non-fundamental changes to the soil, geology or water environment. May be permanent or temporary.</p> <p>Examples:</p> <p>Significant change in recharge (replenishment) of a groundwater body</p> <p>Significant change in drainage pattern, river flow or groundwater level</p> <p>Permanent loss of a large area of soil with agricultural value</p> <p>Moderate increase in pollution risk</p>
Low	<p>Detectable but non-material changes to the soil, geology or water environment. May be permanent or temporary.</p> <p>Examples:</p> <p>Localised compaction of the soil by heavy vehicles</p> <p>Permanent but medium-scale loss of soil with agricultural value</p> <p>Slight temporary increase in pollution risk during site works</p>
Negligible	<p>Little or no impact on the soil, geology or water environment.</p> <p>Examples:</p>

Magnitude	Criteria
	Permanent loss of a small area of soil during widening/deepening of ditches Compaction of soil restricted to vehicle access routes Small-scale temporary excavation works, e.g. trial pits and auger holes

Table 6-14: Significance of Impacts

Receptor Sensitivity	Magnitude of Impact			
	High	Medium	Low	Negligible
High	Major	Major / moderate	Moderate	Negligible
Medium	Major / moderate	Moderate	Moderate / minor	Negligible
Low	Moderate	Moderate / minor	Minor	Negligible

Impacts that are "major" or "major / moderate" are deemed significant for the purposes of the EIA regulations.

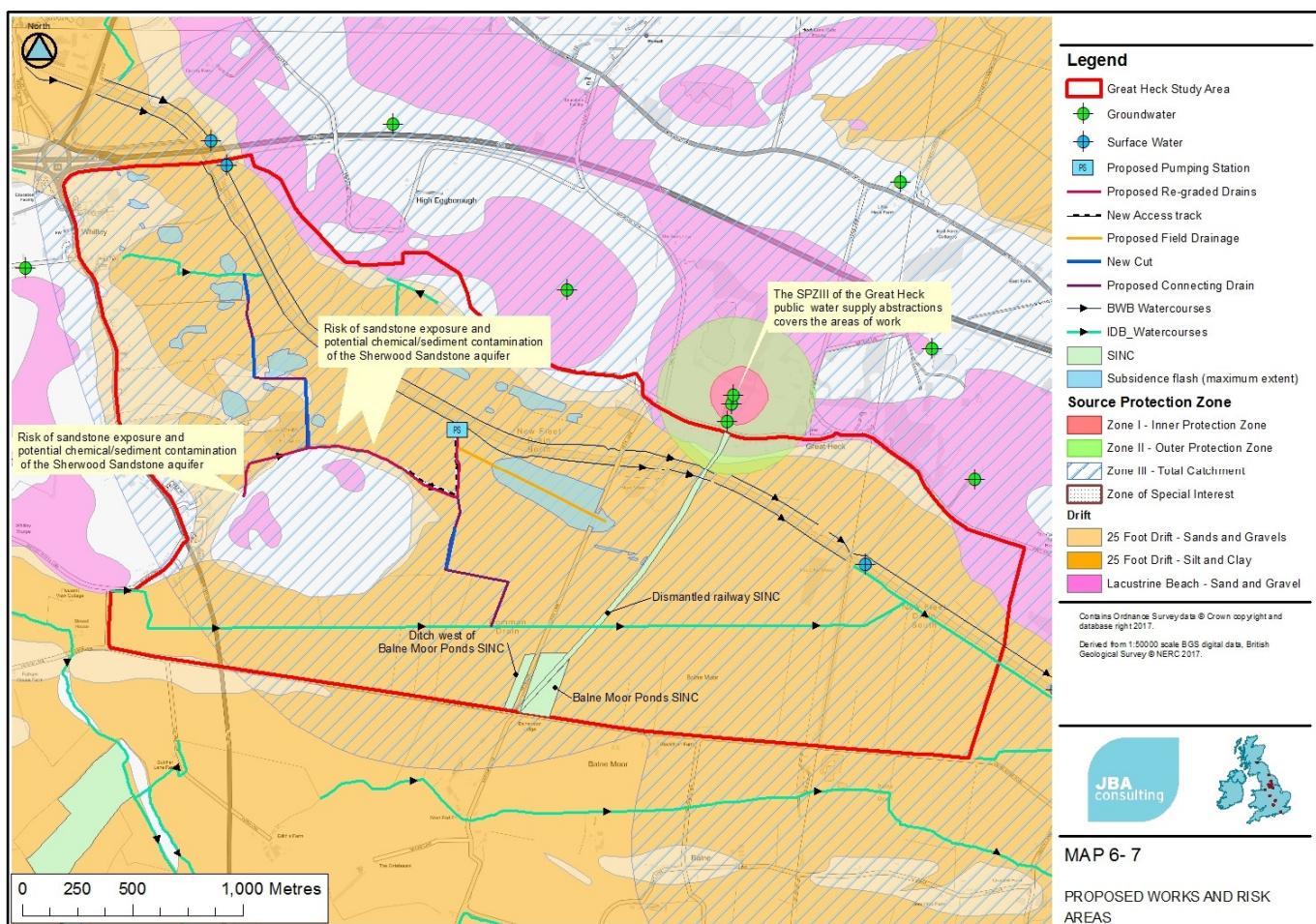


Figure 6-17: Proposed Works and Risk Areas

Table 6-15: Assessment of Hydrological and Geological Impacts during the Construction Phase

Receptor (Sensitivity)	Potential Impact	Magnitude	Significance before mitigation	Magnitude after Mitigation	Residual Significance
Soil (Agricultural Land Classification: 2) (Medium)	Compaction	Low (localised compaction of soil along vehicle access routes)	Moderate/Minor	Low (unavoidable impact)	Moderate/minor
	Excavation	Low (limited permanent widening and deepening of ditches; localised loss of soil)	Moderate/Minor	Low (unavoidable impact)	Moderate/minor
	Erosion	Low (soil will be exposed during the works; however, its cohesive nature, along with the low topographic gradient, mean that significant erosion is unlikely)	Moderate/Minor	Negligible (measures taken on site to prevent significant erosion)	Negligible
	Contamination	Medium (slight increase in pollution risk due to the presence of vehicles/plant on site, and the use of cement)	Moderate	Low (measures taken to minimise the risk of chemical contamination)	Moderate/minor
River Don (Medium)	Sediment release	Low (sediment released into the drainage ditches could potentially find its way into the River Don, however there would be significant attenuation)	Moderate/minor	Low (measures taken to prevent significant release of sediment)	Moderate/minor
	Chemical contamination	Low (increase in pollution risk due to the presence of vehicles/plant on site, the use of cement, and the connection between the drainage ditches and the River Don however there would be significant attenuation)	Moderate/minor	Low (measures taken to minimise the risk of chemical contamination)	Moderate/minor

Receptor (Sensitivity)	Potential Impact	Magnitude	Significance before mitigation	Magnitude after Mitigation	Residual Significance
Agricultural drainage ditches (Low)	Sediment release	Medium (excavation works will disturb the ground and have the potential to release sediment; the parts of the ground profile dominated by cohesive clay, should be relatively resistant to erosion. Sand layers may be more difficult to control)	Moderate / minor	Low (implementation of sediment control measures; engineering design of banks to minimise risk of failure)	Minor
	Chemical contamination	Medium (slight increase in pollution risk due to the presence of vehicles/plant on site, and the use of cement)	Moderate/minor	Negligible (measures taken to minimise the risk of chemical contamination)	Negligible
Wet grassland/ subsidence flashes within the study area (Medium)	Improved drainage, damaging the habitat	Medium (significant improvement of drainage where new or widened ditches intersect topographic lows)	Moderate	Medium – no mitigation measures to be taken	Moderate
	Sediment release and/or chemical contamination	Medium (the wet grassland/subsidence flash areas are at/close to the proposed new drains so there will be increased risk of pollution during site works)	Moderate	Low (mitigate measures to prevent significant release of sediment)	Moderate/minor
Groundwater in the Sherwood Sandstone SPZ3 (High)	Chemical contamination/ sediment release	Medium (across most of the area, the underlying aquifer is protected by between 1 and 5m of clay. However, the design depth of the proposed drain re-grades at Court Drain are expose the sandstone as described in Section 6.5.2)	Major/Moderate	Medium (to minimise risk to the groundwater, the drains would have to be redesigned in the areas where the Sherwood Sandstone is close or at the current design bed level – this re-design has not yet taken place so the residual significance does not change)	Major/moderate
Groundwater in		Medium		Moderate	

Receptor (Sensitivity)	Potential Impact	Magnitude	Significance before mitigation	Magnitude after Mitigation	Residual Significance
the drift (Low)		(pollution risk to drift groundwater. The superficial geology map (IGS, 1971) shows most the areas where work will be undertaken are covered by an upper clay layer of the 25 foot drift, however SI boreholes show some central areas (BHs C and D) that have an upper sand layer which would be vulnerable)		(measures taken to minimise risk of chemical contamination/sediment release)	
Groundwater abstractions (High)	Chemical contamination	Medium (the clay in the upper part of the drift covering most of the study area helps to protect the groundwater from contamination originating at the surface. Some areas which only have a layer of sand drift cover over the aquifer are more vulnerable. The study area falls within SPZ3 of the Great Heck PWS groundwater abstraction so drain cuts that are proposed at depths reaching the sandstone could be a risk however there would be attenuation before contaminants could reach the abstraction)	Major/Moderate	Low (measures taken to minimise the risk to groundwater)	Moderate

Table 6-16: Assessment of Hydrological and Geological Impacts during the Operational Phase

Receptor (Sensitivity)	Potential Impact	Magnitude	Significance before mitigation	Magnitude after Mitigation	Residual Significance
Soil / subsoil (Medium)	Compaction	Low (localised compaction of soil along vehicle access routes, but only during occasional maintenance works)	Moderate/minor	Low (unavoidable impact)	Moderate/minor

Receptor (Sensitivity)	Potential Impact	Magnitude	Significance before mitigation	Magnitude after Mitigation	Residual Significance
	Erosion	Low (possible erosion/slumping of steep, poorly-vegetated, ditch banks; however, the upper part of the ground profile is cohesive and not very prone to erosion/slumping)	Moderate/minor	Negligible (measures taken to prevent significant erosion/failure of ditch banks)	Negligible
	Contamination	Low (slight increase in pollution risk due to the presence of vehicles/plant on site during maintenance works, and possibly the storage of fuel/lubricants at the pumping stations)	Moderate/minor	Low (measures taken to minimise the risk of chemical contamination)	Moderate/minor
River Don (Medium)	Sediment release	Low (sediment released into the drainage ditches by erosion/slumping could potentially find its way into the River Don)	Moderate/minor	Negligible (engineering design to prevent significant erosion/failure of ditch banks)	Negligible
	Chemical contamination	Low (slight increase in pollution risk due to the presence of vehicles/plant on site during maintenance works, and possibly the storage of fuel/lubricants at the pumping station)	Moderate/minor	Low (measures taken to minimise the risk of chemical contamination)	Moderate/minor
Agricultural drainage ditches (Low)	Sediment release	Low (possible erosion/slumping of steep, poorly-vegetated, ditch banks, releasing sediment; the clay sections of the ground profile are cohesive and not very prone to erosion/slumping. Sand will be a greater risk of erosion/slumping)	Minor	Negligible (engineering design to prevent significant erosion/failure of ditch banks)	Negligible
	Chemical	Low	Minor	Low	Minor

Receptor (Sensitivity)	Potential Impact	Magnitude	Significance before mitigation	Magnitude after Mitigation	Residual Significance
	contamination	(slight increase in pollution risk due to the presence of vehicles/plant on site during maintenance works, and possibly the storage of fuel/lubricants at the pumping stations)		(measures taken to minimise the risk of chemical contamination)	
Wet grassland/subsidence flashes within the study area (Medium)	Sediment release and/or chemical contamination	Low (the wet grassland/subsidence flash areas are at or close to the new drain locations so if they still exist after the construction phase there will be a slight risk of sediment release or chemical contamination associated with maintenance vehicles)	Moderate/minor	Negligible (measures taken to minimise the risk of chemical/sediment contamination)	Negligible
	Improved drainage, damaging the habitat	Medium (improvement of drainage expected in subsidence flash/waterlogged areas due to construction of new drains and re-grading of existing drains)	Moderate	Medium No mitigation measures to be undertaken	Moderate
	Intensification of agriculture following improved land drainage	Medium (the new/improved drainage network is likely to drain wetland/subsidence flash areas, which will then, once again, be used for arable farming if conditions are suitable)	Moderate	Medium (no mitigation measure to be undertaken)	Moderate
Groundwater (Sherwood Sandstone SPZ3) (High)	Chemical /sediment contamination	Negligible (the new drains and reprofiling will not significantly change the vulnerability of the aquifer (see hydrogeological risk assessment in Appendix A))	Negligible	Negligible (mitigation measures such a lining taken to minimise the risk to groundwater)	Negligible
Groundwater in the drift (Low)		Low (pollution risk to drift groundwater during routine maintenance of drains. The	Minor	Low (measures taken to minimise risk of chemical contamination/sediment	Minor

Receptor (Sensitivity)	Potential Impact	Magnitude	Significance before mitigation	Magnitude after Mitigation	Residual Significance
		superficial geology map (IGS, 1971) shows most the areas where work will be undertaken are covered by an upper clay layer of the 25 foot drift, however SI boreholes show some central areas (BHs C and D) that have an upper sand layer which would be vulnerable)		release)	
Groundwater abstractions (High)	Chemical contamination	Medium (the new drains and reprofiling will not significantly change the vulnerability of the aquifer (see hydrogeological risk assessment in Appendix A))	Major/Moderate	Low (mitigation measures such a lining taken to minimise the risk to groundwater)	Moderate

6.6 Conclusions

Construction and re-grading of drains at Great Heck involves several phases and activities which may potentially affect the soil, hydrological and hydrogeological environments. These activities have been identified and an assessment of their potential effects made.

One of the threats is chemical/sediment contamination to the Sherwood Sandstone aquifer. The Hydrogeological Risk Assessment in Appendix A shows that the vulnerability of the aquifer will not be significantly changed by the works.

The only other noteworthy affect is the drying out of wetland habitat in the subsidence flash areas, as a result of the improved drainage. However, as this is the purpose of the scheme no mitigation measures have been recommended.

7 Cultural Heritage, Archaeology and Material Assets

7.1 Introduction

A Cultural Heritage Assessment (CHA) was carried out for an area of proposed mining subsidence remediation works for land between Great Heck and Whitley, North Yorkshire (centred at NGR: SE 5750 2100). The assessment was undertaken by FAS Heritage, on behalf of JBA Consulting for The Coal Authority. The report makes use of an earlier CHA undertaken for a previous scheme of proposed mining subsidence remediation works (FAS Heritage 2012). Desk-based research and report preparation were undertaken during March and April 2017.

7.2 Location and Land Use

For the purposes of the assessment, a rectangular study area of 20km² was established around the proposed area of mining subsidence remediation works (Figure 7-1). The study area occupies low-lying land forming part of the Humberhead Levels, being drained by the River Aire to the north and the River Went to the south. The settlement pattern is rural and dispersed, characterised by the villages of Great Heck and Whitley, and the nucleated hamlet of High Eggborough along with scattered farmsteads. The surrounding fields, which generally lie below 9m AOD, are traversed by a network of lanes, dykes and land drains, which form part of widespread systems of water management that have been implemented since the 17th century. A mixed agricultural regime is practised, with alluvial soils providing excellent arable farmland which has led to areas of intensive arable exploitation (Van de Noort and Davies 1993, 7).

The study area is dominated by large-scale manmade communications. The Knottingley and Goole Canal crosses the study area in a broadly NW-SE direction, passing to the south of Great Heck and to the north of Whitley. The East Coast mainline and the Pontefract rail line traverse the study area. The M62 dominates the north part of the study area, linking the local road network with the national motorway system.

7.2.1 Geology

The solid geology comprises Permian and Triassic Bunter Sandstone and coal measures (East Pennine Coalfields) overlain by alluvial silts and glacio lacustrine clays, silts and sands deposited by the pre-Glacial Lake Humber which once covered the area (British Geological Survey 2002, 3). The area is also host to gleyed soils; many areas have been improved in recent centuries through drainage and warping which has resulted in good quality agricultural land (Ellis 1997, 9).

7.3 Aims and Objectives

The CHA aimed to establish the significance of known and potential heritage assets within the area to be affected by the proposed mining subsidence remediation works, and to establish the likely impact of the proposed works on that heritage significance, thereby allowing appropriate mitigation measures to be put in place.

7.4 Assessment Methodology

The CHA was prepared in accordance with the Chartered Institute for Archaeologists (ClfA) Standard and Guidance for Historic Environment Desk-Based Assessment (2014).

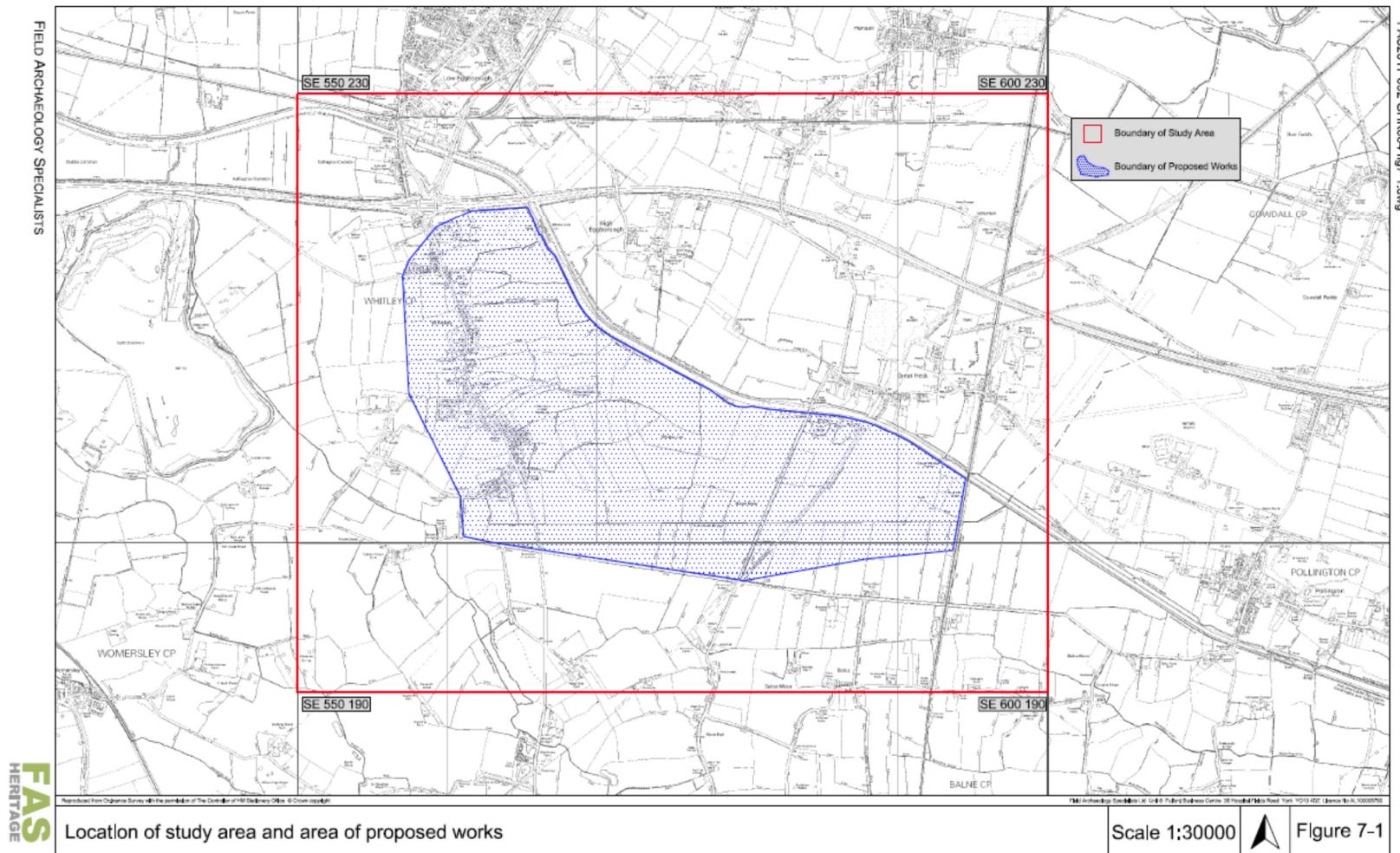


Figure 7-1: Location of Study Area and Area of Proposed Works

7.5 Legal Frameworks and Planning Guidance

The CHA aims to address the requirements of relevant legal frameworks and planning policy pertinent to the proposed mining subsidence remediation works. The following apply:

Planning Policy

- National Planning Policy Framework (NPPF), 2012

Guidance

- National Planning Policy Guidance (NPPG)

Legal Framework

- Ancient Monuments and Archaeological Areas Act, 1979
- Town and Country Planning (Listed Buildings and Conservation Areas) Act, 1990
- Hedgerows Regulations 1997
- Protection of military remains Act, 1986

7.6 Definitions

7.6.1 Heritage Assets

Those parts of the historic environment that have significance because of historical, archaeological, architectural or artistic significance are called heritage assets. A heritage asset can be defined as

'a building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions, because of its heritage interest' (NPPF 2012).

Heritage assets may be formally designated, but also include those sites or monuments which are identified through documentary research or fieldwork but which have not been formally designated.

7.6.2 Setting

The Glossary to NPPF (2012) defines the setting of a heritage asset as:

'The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral'

Historic England (2015, 2) state that

'Setting...does not have a fixed boundary and cannot be definitively and permanently described for all time as a spatially bounded area or as lying within a set distance of a heritage asset.'

7.7 Assessment Procedure

7.7.1 Desk-based Research

Known and potential archaeological sites in the study area were identified through a search of the North Yorkshire Historic Environment Record (NYHER) and the National Monuments Record (NMR), Swindon. The NMR was also consulted for events records, aerial photography and the availability of data from the National Mapping Programme. Cropmarks within the study area have been mapped as part of the National Mapping Programme (NMP) and digital copies of these plots were obtained. Information on Scheduled Monuments and Listed Buildings was obtained via the National Heritage List for England (online at www.historic-england.org.uk).

Cartographic data included old versions of Ordnance Survey, dating from the mid-19th century. A variety of secondary and published sources were also consulted, as well as unpublished archaeological and environmental reports.

The sources consulted reflect those available for study at the time of the assessment and easily accessible by the researcher. Every effort was made to consult all available sources and no

source was omitted knowingly from the assessment. It is therefore considered that the sources used reflect accurately those available for the area and that no intellectual bias has been imposed knowingly on the findings of this assessment.

7.7.2 Site Visit

Given the limited change in proposed works, a site visit to the proposed mining subsidence remediation works and immediate surroundings, was deemed unnecessary and information gained during a previous site visit was retained.

7.7.3 Gazetteer

All heritage assets identified within the study area were assigned a unique identifier and entered into a gazetteer with cross-references to their National Heritage List number and North Yorkshire Historic Environment Record number (NYHER) where applicable (Appendix A). The distribution of sites within the study area was then plotted onto Ordnance Survey mapping. Throughout the report, heritage assets are cross-referenced to their gazetteer numbers in bold type (e.g. CHA 1).

A second gazetteer details all archaeological investigations undertaken in the immediate area (Appendix D). These are referenced as event numbers (e.g. CHA Event 1) (Figure 7-2).

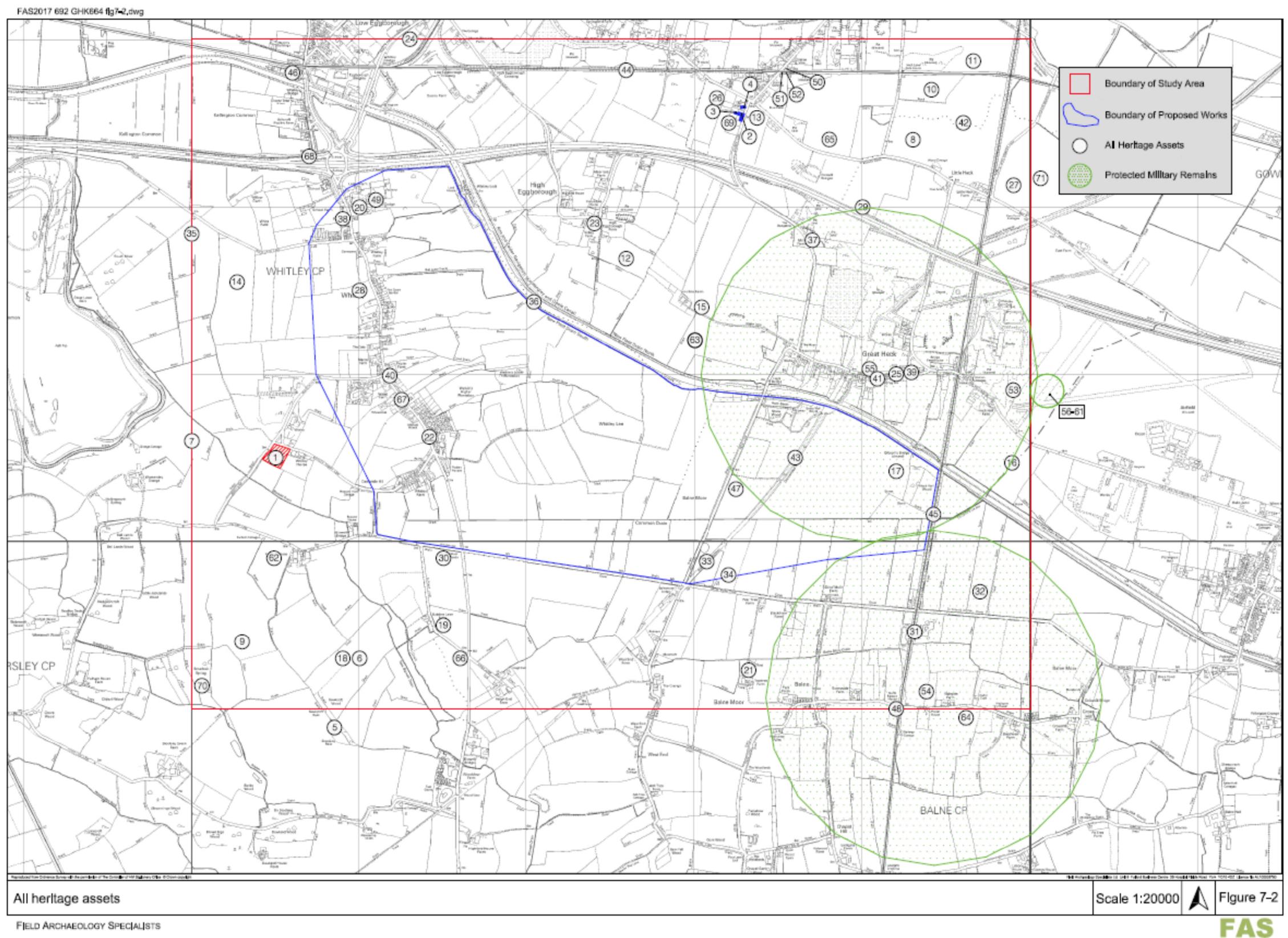


Figure 7-2: All Heritage Assets

7.8 Criteria for Assessment

7.8.1 Assessment of Significance

An assessment of the significance of known and potential heritage assets likely to be affected by works at the site was undertaken as the first stage in establishing heritage impact. This is in line with NPPF (Paragraph 128), which states that

'In determining applications, local planning authorities should require an applicant to describe the significance of any heritage assets affected, including any contribution made by their setting. The level of detail should be proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance.'

The significance of a heritage asset is defined as:

'The value of a heritage asset to this and future generations because of its heritage interest. That interest may be archaeological, architectural, artistic or historic. Significance derives not only from a heritage asset's physical presence, but also from its setting.' (NPPF Glossary)

A series of criteria for assessing the significance of historic monuments is laid out in Annex 1 of the Policy Statement on Scheduled Monuments (2010) and includes the following: period, rarity, documentation, group value, survival/condition, fragility/vulnerability, diversity, potential.

Assessment of significance has therefore been undertaken taking into account:

- **archaeological interest**
- **architectural interest**
- **artistic interest**
- **historic interest**

The following grades of significance have been employed.

- **Exceptional significance** - elements which can be demonstrated to have international or national significance, special relevance to British history or culture, and/or are of extraordinary or unique archaeological, architectural, artistic or historic merit. This will include World Heritage Sites, Scheduled Ancient Monuments (or those monuments which otherwise meet scheduling criteria) all Listed Buildings Grades I and II*, Registered Historic Parks and Gardens grades I and II*, and Registered Historic Battlefields;
- **Considerable significance** - resources with importance within a national or regional context, due to special archaeological, architectural, artistic or historic interest. This category will include Conservation Areas, Grade II Listed Buildings and Registered Parks and Gardens Grade II;
- **Moderate significance** - resources of local importance. This might include heritage assets with archaeological, architectural, historic or artistic interest, but which do not meet the criteria for designation;
- **Some significance** - resources of limited local importance, due to their high frequency, lack of provenance or limited survival. This might include resources of local significance that have been partially destroyed by past land use, whether by agricultural activity or development;
- **Unknown significance** - resources of uncertain importance based on their type or condition;
- **Neutral** - elements which have no heritage value but which do not detract from elements of greater significance; this may include resources that are so badly damaged or altered that too little remains to justify their inclusion in a higher category;
- **Intrusive** - elements which are identified as intrusive may include those which have a degree of heritage value, but which detract from elements of greater significance.

Assignment to a category of significance is a value judgement based on the knowledge and professional expertise of the authors of the CHA. This ranking of significance is designed to be

of assistance in understanding the relative importance of different elements of the site or study area, and assessing the likely impact of future works. It is critical, however, that the designation of 'some significance' should not be regarded as a suggestion that individual elements might be removed or damaged without affecting the cultural heritage resource as a whole.

7.8.2 Assessment of Impact

The impact of works upon the significance of a heritage asset may be adverse or beneficial. The significance of a heritage asset might be affected by direct physical impact, including destruction, demolition and alteration, but may also be affected by changes to its setting. This could include changes to the historic character of an area, alterations to views to and from a site, accidental damage from construction work, temporary loss of amenities (largely arising during development work and including air and noise pollution, visual intrusion, increased traffic, changes in the character of a landscape or townscape).

Categories of impact have been graded thus:

- **Substantial** - elements which contribute to the significance of the heritage asset, including its setting, are substantially harmed or lost;
- **Moderate** - elements which contribute to the significance of the heritage asset, including its setting, are harmed;
- **Slight** - there is change to elements which contribute to the significance of the heritage asset or its setting, but that harm is minimal;
- **Beneficial** - those elements which contribute to the significance of the heritage asset, including its setting, are enhanced or better revealed;
- **No change** - no change.

Following consideration of the value of the heritage asset, the attributes which contribute to its significance, and the likely magnitude of the impact of development on those attributes, an assessment can be made of the overall effect of the proposed work on each asset and on the heritage resource as a whole. This is broadly based on the assumption that the most significant effect will result in circumstances where the very highest impact occurs to very important remains.

7.9 Baseline Conditions

7.9.1 Designated Heritage Assets

Four heritage assets within the study area are designated as Scheduled Monuments or Listed Buildings (Figure 7-2) and a further eight are Protected Military Remains. No World Heritage Sites, Registered Parks and Gardens or Registered Battlefields were identified within the study area.

Scheduled Monuments

There is one Scheduled Monument within the study area, identified as the remains of a medieval moated site at Whitley Thorpe (CHA 1). The moat survives as an earthwork defining a dry moat with an entrance on the north side and a partially visible outer moat still visible on the west and east sides.

Listed Buildings

A total of three Listed Buildings were identified within the study area, all within the southern end of Hensall village. The Primary School and Schoolmaster's House is Grade II Listed (CHA 2), while St Paul's Church and The Red House or Hensall Vicarage are Grade II* Listed (CHA 3 and 4).

Protected Military Remains

Protected Military Remains are 'the remains of military aircraft and vessels that have crashed, sunk or been stranded and...associated human remains'. The wreckage of all military aircraft are automatically protected whether or not there was loss of life.

Eight designated heritage assets are Protected Military Remains and are identified as crash sites and crash zones of military aircraft (CHA 54 to 61) which were operating from the WWII Snaith Airfield (CHA 53).

7.9.2 Non-designated Heritage Assets

In addition to these twelve designated heritage assets, the CHA identified a further 59 non-designated heritage assets (CHA 5 to 53 and 62 to 71), which range in date from the Iron Age-Romano-British period (CHA 8 to 15 and 64) to evidence for 19th- and 20th-century infrastructure (Figure 4 and 5). Of these, 17 occur within or close to the immediate area of proposed works (CHA 17, 20, 22, 28, 30, 33, 34, 36, 38, 40, 43, 45, 47, 49, 54, 55 and 69).

7.9.3 Historic Environment Characterisation

North Yorkshire has been the subject of Historic Environment Characterisation. The study area presents a mosaic of character areas marked by the linear rural settlements of Whitley (HNY 5953, HNY 725) and Great Heck (HNY 704, HNY 705 and HNY 710), nucleated and linear hamlets at High Eggborough (HNY 746) and Balne (HNY 700) and smaller farmsteads such as at Heck Lane and elsewhere (HNY 630, HNY 653, HNY 634, HNY 657, HNY 658, HNY 667, HNY 709, HNY 729, HNY 753).

These small settlements lie within a landscape in which the process of piecemeal and parliamentary enclosure is still highly legible. Most notable are parcels of planned large-scale parliamentary enclosure at Balne Moor (HNY 567), an area which prior to drainage in 1844 was probably wetland, and Kellington Common (HNY 582 and HNY 661). Older and piecemeal areas of enclosure, some perhaps encompassing landholding originating in the medieval period, are also identified along with less frequent examples of strip enclosure across the study area (HNY 690, HNY 5943, HNY 659, HNY 688, HNY 742, HNY 744, HNY 749, HNY 750, HNY 754). Rare stands of woodland are also identified at Broadoak Spring, now coppiced formerly Ancient and Semi-Natural Woodland (HNY 663), as well as broadleaved plantations at Watkin's Lower Plantation (HNY 748) and Willow Garth (HNY 752). There is a possible remnant of designed landscape at the north end of Whitley village visible as open ground with mature trees with a parkland character (HNY 669).

Small-scale quarrying characterises small parcels of land throughout the area and testifies to the extraction of gravel, sand and other minerals from the post-medieval period, but flourishing during the 19th century (HNY 576, HNY 574, HNY 597, HNY 590, HNY 633, HNY 732). Other more intrusive modern features also contribute to the landscape character such as the M62 and junction (HNY 595), industrial and commercial complexes (HNY 594, HNY 660, HNY 668, HNY 738, HNY 755). To a lesser extent, the creation of very large modern 'prairie-style' fields, created by amalgamating smaller enclosed parcels, is slowly eroding the historic legibility of the area (HNY 629, HNY 632, HNY 727, HNY 743, HNY 747).

The areas of proposed works are characterised by rural fields, bounded by drains with occasional surviving hedgerows. Some hedgerows may reflect historic features. As such, they might meet the criteria to be considered 'important' under the Hedgerows Act 1997, which includes those hedges over 30 years of age, and 'recorded in a document held at the relevant date at a Record Office as an integral part of a field system pre-dating the Inclosure Acts'. No field survey has, however, been undertaken as part of the CHA to specifically assess the age of the extant hedgerows.

7.10 Archaeological and Historical Development of the Area

7.10.1 Prehistory

Palaeolithic (c.250,000BC - c.8000BC)

No remains of Palaeolithic date have been recovered from the study area. The widespread absence of finds datable to this period in the Vale of York and the Humberhead Levels reflects the former extent of Lake Humber, a late-glacial lake which finally silted up about 11,000BP (Gaunt et al 1971; Van de Noort and Davies 1993, 49; Jones 2003, 50). The presence of this large mass of water prohibited human activity or settlement in the area. It is therefore unlikely that any late Palaeolithic finds from the surrounding area are in their original context. Late Palaeolithic finds from within Humberside have all been found out of their original context as an advancing Devensian ice sheet destroyed any existing sites and the action of the ice led to the redeposition of material (Van de Noort and Davies 1993; Catt 1990).

Mesolithic (c.8000BC - c.4500BC)

Although a relatively high number of Mesolithic finds are known from the Humberhead Levels (see Van de Noort and Davies 1993; Wymer 1977), none have so far come from within the study area. Van de Noort and Davies (1993, 52) have suggested that the known distribution of finds reflects the higher archaeological visibility of sites on the Isle of Axholme, a raised Keuper Marl outcrop and the only area within the Humberhead Levels to exceed 10m AOD (some distance to the southeast of the study area). Because the Isle of Axholme occupies higher ground, Mesolithic finds have not been masked by later marine, estuarine and riverine sedimentation. This suggests that a much larger density of Mesolithic finds may be expected beneath sediment in the Humberhead Levels west of the Isle of Axholme (including the study area) and into the Vale of York, as this was a lowland area that would have been habitable at this time.

Neolithic (c.4500BC - c.2500BC)

Extensive evidence for Neolithic activity is known throughout the Humber wetlands, although none has so far been recovered from within the study area. This does not necessarily imply an absence of human activity during the period, but may reflect circumstances of discovery and a lack of targeted research. Recent excavations at Topham Farm, Sykehouse c.3km to the southeast of the study area encountered some possible evidence for late Neolithic activity, in the form of a late Neolithic or early Bronze Age flint tool, found residually in later deposits (Roberts 2003, 25). Further afield, a number of Neolithic spot finds are known from within and around the town of Thorne (Cumberpatch 2004, 4). These sparse finds indicate some level of human activity in the area during the Neolithic period.

Bronze Age (c.2500BC - c.700BC)

The low-lying Humber area is noted for its wetland archaeology, and extensive research has been conducted by the Humber Wetlands Project (Van de Noort and Davies 1993, 2-3). A variety of Bronze Age sites and finds are known from the wider area, including settlements, cemeteries, boats, trackways and evidence for possible woodland management (Van de Noort and Davies 1993, 59).

The lowland raised mires of the Thorne and Hatfield Moors, situated to the southeast and east of the study area, are among the most important holocene sites in Britain, and have produced significant palaeoenvironmental evidence for landscape development during this period (Dinnin and Whitehouse 1997, 4). Radiocarbon dates from the base of the peat on Thorne and Hatfield Moors indicate that the peat beds first began to develop about 4500 years ago, during the Bronze Age. These early samples indicate that the peat developed following the progressive southeastern displacement of pine forests by burning which previously had been relatively undisturbed. The remains of this pine forest, as well as ancient birch trees survive buried in the peat beds (Dinnin 1994, ii; Van de Noort and Davies 1993, 63). Palaeoenvironmental samples from the peat, including Sphagnum mosses, beetles, samples for tree-ring dating (dendrochronology) and well-preserved artefactual material have therefore allowed the environment and human activity in the area to be assessed from the late prehistoric through to the post-medieval period. These provide an invaluable resource and, specific to this assessment, provide the broader context for the development of the landscape of the study area.

Despite evidence from the surrounding area, Bronze Age material from the study area is absent. Again, archaeological investigations at Topham Farm recovered a number of lithic artefacts, but only one could be dated with some degree of certainty to either the late Neolithic or early Bronze Age (Roberts 2003, 25).

Iron Age (c.700BC - AD43)

Palaeoenvironmental evidence from Thorne and Hatfield Moors has indicated that during the later prehistoric period the climate became cooler and wetter, perhaps enhanced by phases of sea-level rise (Dinnin and Whitehouse 1997, 6). This corresponds with evidence from within the Humberhead Levels for more intensive settlement in the lowland areas, but with a marked concentration of sites on higher land to the west and east, (Van de Noort and Fenwick 1997). Consequently, a variety of Iron Age sites have been identified in the area (Van de Noort 1993, 70), and several cropmark sites within the study area may represent field systems of farmsteads or small villages of Iron Age to Romano-British date (CHA 8 to 19 and 64). A magnetometer survey was undertaken in 2009 by Geo Quest Associates at Pollington Airfield and identified enclosures and a trackway which may represent remains of Iron Age date (CHA Event 9).

A few kilometres to the south of the study area two excavations have produced notable Iron Age remains, at Topham Farm and Sutton Common near Askern. Recent excavations at Topham Farm revealed a late Iron Age and early Romano-British settlement characterised by two distinct types of feature: circular gullies of former roundhouses and linear ditches that enclosed and subdivided the various phases of the settlement. Assemblages of late Iron Age pottery (rare in the region (Van de Noort and Davies 1993, 57)) and contemporary fired clay or briquetage (usually associated with salt production) were recovered indicating activity at the site from the late Iron Age through to the Roman period. Of particular interest to this assessment, the Topham Farm site was not located through either aerial photography or during remote sensing surveys (WYAS 2002), possibly demonstrating why much of the archaeology of the Humberhead Levels remains a relatively unknown quantity (Roberts 2003, 30). It is therefore possible that other sites remain undiscovered within the study area.

At Sutton Common an early Iron Age settlement was identified consisting of two D-shaped enclosures separated by a palaeochannel. Evidence for a log trackway has been identified from finds of cut logs dragged up by ploughing, and excavation in 1936 defined structural wood, a stone revetment wall and palisade, hut stances and associated artefactual and ecofactual assemblages (Whiting 1936; Van de Noort and Davies 1993, 67). Archaeological monitoring at Hensall Quarry during 2007 to 2014 encountered the remains of a late Iron Age enclosure complex including evidence for a crop-drying kiln and two possible roundhouses (MNY36303) (CHA 65). Further analysis of the results of the programme of recording suggests a multi-phase site with occupation extending into the Roman period

7.10.2 Romano-British (AD43 - AD409)

In comparison with southern England, the Romano-British period is not well represented in Lincolnshire and Yorkshire (Millett 1990, 247), although fieldwork has produced evidence for military sites, settlement patterns, industry and funerary rites within the Humber area. Of particular interest is an apparent shift of population and settlement from Holderness, the Hull valley and the Ancholme Valley to the Vale of York and the Humberhead Levels.

A single example of Romano-British settlement has been identified within the study area and was the result of archaeological monitoring at Hensall Quarry which identified the truncated remains of a multi-phase Romano-British field system dated by a 'largish' assemblage of pottery (Forum 2008, 36; CHA Event 8). There is also a frequency of cropmarks assigned to the Iron Age/Romano-British period within the study area (CHA 8 to 19 and 64).

Beyond the study area, Romano-British occupation at Topham Farm was represented by the reorganisation of the earlier Iron Age enclosures and the creation of discrete plots or tenements, resulting in what may be termed a 'ladder settlement'. Artefactual evidence included Roman ceramic, including a small group of Samian, further evidence for salt production in the form of briquetage, and a very small amount of environmental evidence suggesting a mixed arable and pastoral regime with horses kept as working animals. In an area where pre-medieval archaeology was negligible, the Topham Farm site is of considerable importance and suggests pre-Roman colonisation of the low-lying levels. The introduction of Roman pottery and the later reorganisation of the site indicates external contact and trade, but not necessarily Romanisation (Roberts 2003, 30) and this fits the model proposed by Millett (1990) that the Parisi in this area did not become wholly Romanised.

7.10.3 Medieval (cAD1066 - c.AD1539)

A range of evidence attests to activity within the study area during the medieval period. Whitley (CHA 22), High Eggborough (CHA 23) and Great Heck (CHA 25) all represent medieval settlements. Great Heck and Whitley both represent linear villages and some legibility of tofts to the rear of properties on the main thoroughfares survives, while High Eggborough, now a scatter of houses, may represent a nucleated hamlet which has shrunk.

By 1248 the manor of Whitley is known to have been held by the Order of the Knights of the Temple of Jerusalem and much of the surrounding medieval landscape has been influenced accordingly. In 1248 they were granted free warren on their landholding at Whitley (Page 1974, 260). The Order began to acquire lands in Yorkshire from the middle of the 12th century and it is possible the Whitley landholding predates 1248 by some time since the Yorkshire holdings were significant enough from early times to warrant a chief preceptor (Page 1974, 256). The Scheduled Monument at Whitley Thorpe located to the southwest of Whitley comprises a

partially-visible dry moat and silted outer moat (CHA 1). Jean le Patourel considered the site likely to represent a moated grange belonging to the manor of the Knights Templar (MNY 9837).

The preceptory at Whitley became the subject of a dispute between the Templars with holdings at Kellington and the abbot of Hirst Priory as to which should benefit from tithes paid at the Whitley chapel. The dispute resulted in worshippers at Whitley having to attend church at Kellington with the exception of Christmas and Whitsun where they could worship at Snaith Church and in exchange Kellington was to provide a minister for Whitley (Webb 2006, 14). Documentary evidence also suggests the site of a Templar preceptory at Whitley (CHA 20) thought to be close to Whitley Lodge (CHA Event 4); no physical evidence for the preceptory has yet been forthcoming.

When the Templars' properties in Yorkshire were seized by the Sheriff the Whitley holding was valued at £130 15s and 10s and a Robert de Langton was named as Preceptor of Whitley. The formal order to dissolve the Yorkshire Templars was issued in 1312 by Archbishop Greenwood from Cawood by order of Pope Clement V, after which the properties passed to the Knights Hospitallers (Page 1974, 260; Webb 2006, 14).

The study area also retains evidence for medieval agriculture, in the form of ridge and furrow and ditch systems often associated with the immediate hinterland of these settlements (CHA 26, 28 to 30). Ridge and furrow cultivation has been recorded as earthworks and cropmarks to the north of Great Heck (CHA 30), and close to Whitley (CHA 28 and 29), both areas originally seen as earthworks but are no longer extant.

Evidence for medieval occupation beyond the core settlements is represented by a number of further moated sites. A moated site is recorded at Yewtree House (CHA 21) which le Patourel records simply as unclassified and survives as a partial earthwork (le Patourel 1973, 122). Other possible candidates have been recorded near Low Eggborough at the northern limit of the study area (CHA 24), although this may have been destroyed by the rail link to Eggborough Powerstation, and a ditched enclosure recorded as a rectilinear cropmark at the eastern side of the study area close to Little Heck Farm (CHA 27).

7.10.4 Post-medieval to Early Modern (c.AD1539 - AD1900)

The landscape of the study area underwent dramatic change during the post-medieval period and early modern periods, reclamation of land for agriculture, the Enclosure Acts from the later 18th century and the construction of large-scale communications. The landscape was still dominated by agriculture and retained many elements of the medieval landscape. Small parcels of Ancient and Semi-natural Woodland are recorded within the study area and while not all of them are still extant they nevertheless probably originated during the post-medieval period (CHA 5 to 7).

Some continuity of land-use can be surmised as areas containing evidence for medieval together with post-medieval ridge and furrow cultivation lie within the study area (CHA 30). More extensive are areas of post-medieval ridge and furrow on the northern margins of Balne Moor suggesting that localised drainage and reclamation of land for cultivation had been achieved (CHA 32 and 34). Likewise, evidence for reclamation of land from the margins of Kellington Common is also present in the form of post-medieval ridge and furrow on its eastern margin (CHA 35). Along with this increased agricultural intensity a windmill appears on Jeffreys' map of 1772 to the north of Great Heck (CHA 37). The windmill is still marked on the first edition OS as 'Heck Windmill Corn' and another can be identified just outside the northwestern boundary of the study area near Kellington Common.

Piecemeal enclosure followed by the Enclosure Acts saw change across the study area. Prior to planned enclosure piecemeal enclosure had apparently been underway for some time and parcels of old enclosure can be seen within the study area. Awards which enclosed common fields at Pollington, Whitley, Whitley Thorpe, and Great and Little Heck date to 1772 and 1775 and mark the beginning of planned enclosure. Balne Moor was the subject of wide-scale planned enclosure and drainage awarded in 1844 and this phase of reclamation is still highly legible. However, some enclosure boundaries have been removed reducing this legibility; some survive as cropmarks to the north of Little Heck Farm (CHA 42).

Increased extraction of minerals within the study area can also be traced from the post-medieval period. Quarry pits and clay pits are marked at two sites within Balne Moor (CHA 31 and 33) with several further sites of extraction noted by the North Yorkshire Historic Landscape Characterisation. This marks the beginning of the large-scale exploitation of the region's natural resources and from the early 19th century the area became host to a number of man-made communications which connected to the national network. The Aire and Calder Navigation obtained the Act to build the Knottingley and Goole Canal (CHA 36) in 1820 which canalised the Lower Aire from Knottingley to Goole which developed quickly as a port on the River Ouse. The canal carried stone from Knottingley and Brotherton and a branch was planned to Womersley to open up the limestone resource there. Coal became an increasingly important cargo and W.H. Bartholomew of the Aire and Calder Navigation designed the 'Tom Pudding', a large rectangular steel vessel with much greater capacity than a barge. The ability to maintain the transport of large quantities of material mitigated the potential decline in the canal's fortunes at a time when rail was began to take over from the waterways (Ogden 1976, 114).

By 1820 planning for a mineral railway from Kirk Smeaton to the canal was underway and was to be called the Heck and Wentbridge Railway (CHA 47). The line was designed with the intent that it would transport magnesian limestone from Kirk Smeaton to the Knottingley and Goole Canal via a new canal basin at Great Heck, thereby opening the quarry up to the demand for building stone in London (Boyes 1973, 3). In 1826 the Act to construct the railway received Royal Assent and the Heck and Wentbridge Railway Company was incorporated, but by 1829 the Company was in severe financial difficulties and when in 1831 a five-year period conditional for construction of the line had elapsed it was still not completed. The individuals behind the Company were ruined. Very little of the line is now visible along its route with the best preserved portion near Kirk Smeaton and Wentbridge. The route of the railway passes through the study area from canal basin down the east side of Heck Lane traversing Balne Moor.

The boom of the railways in the mid-19th century also had a significant effect on the landscape of the study area being traversed by three separate lines. Between 1854 and 1848 two railways had been built and opened, the Wakefield, Pontefract and Goole Railway in 1848 (CHA 44) and the Hull and Doncaster Railway in 1855 (CHA 43) with the extension of the Great North Railway (CHA 45) in 1871.

The construction of the Wakefield, Pontefract and Goole Railway which opened in 1848 (CHA 44) appears to have stimulated settlement and investment at Hensall. Aside from the necessary infrastructure such as Station House (CHA 50) and later the Hensall Signal Box (CHA 51) and waiting shelter (CHA 53) investment in a primary school, church and vicarage by the 7th Viscount Downe is broadly contemporary with the opening of the line. The primary school and schoolmaster's house, the vicarage and St Paul's Church, all Listed Buildings (CHA 2 to 4) were designed by William Butterfield and built by Charles Ward of Lincoln in 1854 for the Viscount. A small row of terraced cottages are also likely to owe their origins to the construction of the railway. The buildings patronised by the Viscount are all architecturally simple and reflect the style and grouping of similar developments at Pollington and Cowick.

The stimulus of the line also seems to have been enjoyed at Whitley where a station was constructed (CHA 46) and no doubt stimulated investment in the village such as the construction of the Victorian villa at Whitley Lodge (CHA 49). Increased population and investment in the area also saw the construction of All Saints' Church (CHA 38) and a Non-Conformist Chapel (CHA 40) in Whitley. Great Heck acquired a Chapel of Ease (CHA 39) and a Wesleyan Association Chapel (CHA 41) in the same period.

The construction of the Hull to Doncaster Railway appears to have had a lesser impact seeing a station constructed at the small linear hamlet of Balne (CHA 48).

7.10.5 20th Century to Present Day

The canal and railways with the obvious exception of the Heck and Wentbridge route continued to dominate the study area into the modern period, although the Hull and Barnsley Railway was finally closed in 1969 and was dismantled. The decrease in industrial vessels on the canal lead to its increasing amenity value and canal basin now forms the headquarters of the South Yorkshire Boat Club (Ogden 1976, 116). To the immediate east of the study area lies Snaith Airfield (CHA 53) which opened in 1941 as part of Number 1 Group, Bomber Command host to 150 Squadron with a fleet of Wellingtons and then as part of Number 4 Group and 51 Squadron

with a fleet of Halifax bombers. Some of the airfield survives as runways and associated structures.

During operations four Halifax, two Wellington bombers and a Spitfire fighter crash-landed at or near the airfield. The crash sites do not always represent loss of life but are nevertheless designated Protected Military Remains (CHA 54 to 61). A further monument of World War II date associated with the Snaith Pollington Airfield, but at some distance from it, is a searchlight battery near Fulham House Farm (CHA 62).

A feature of the solid geology of the study area and surrounding region is the presence of coal measures which resulted in the construction of several large, coal-fired power stations at Drax, Ferrybridge and Eggborough during the 20th-century; these power stations dominate the surrounding low-lying landscape. The mining of coal in the area went hand-in-hand with the development of the power stations and the Kellingley Colliery was sunk in 1958 with production starting in 1965; mining continues along the Beeston and Silkstone seams. The Kellingley Colliery, Knottingley operates beneath Great Heck. Mining has resulted in subsidence in the wider area which is the result of ongoing mitigation, most famously perhaps with the total excavation of Kellington Church in the early 1990s. Kellingley colliery remains open and is the last operational coal mine in North Yorkshire.

Road communications to the settlements of the study area were greatly increased with the opening of the M62 motorway in the 1970s, which is another dominant feature in the landscape.

7.11 Assessment of Significance and Impact

7.11.1 Heritage Assets within the Proposed Drainage Area

Eleven heritage assets fall entirely or partially within the area of proposed works, and a further five are situated close to the boundary (Table 7-1; see Figure 7-3).

Table 7-1: Assessment of Significance

CHA No	Identity	Heritage value	Significance	Justification
17	Field system cropmark	Evidential	Some	Some local significance as part of Iron-Age/Romano-British settlement in the area
20	Possible site of Templar preceptory	Historical	Some	Limited local significance as evidence for medieval landholding of Knights' Templar. Knowledge of broad location has some cumulative value as part of the wider medieval landscape.
22	Whitley village	Evidential Historical	Some	Local significance as part of the late Saxon and medieval landscape.
28	Medieval ridge and furrow visible on aerial photographs. No longer extant.	Evidential	Some	Limited local significance as evidence for medieval rural landscape. Has greater cumulative value as part of the medieval landscape.
30	Medieval ridge and furrow visible on aerial photographs. Visible as earthworks and cropmarks.	Evidential	Some	Limited local significance as evidence for medieval rural landscape. Has greater cumulative value as part of the medieval landscape.
33	Quarry pits	Evidential	Some	Limited local significance as evidence for post-medieval extraction.
34	Post-medieval ridge and furrow visible on aerial photographs. No longer extant.	Evidential	Some	Limited local significance as evidence for post-medieval agricultural regimes. Cumulative value with other areas of similar features.

CHA No	Identity	Heritage value	Significance	Justification
36	Knottingley and Goole Canal	Evidential Historical Aesthetic Communal	Considerable	Regional significance as part of widespread infrastructure linked historically to the industrialisation of the area.
38	All Saints Church, Whitley	Evidential	Some	Limited local significance as evidence for growth in places of worship in the village during the 19thC.
40	Non-Conformist Chapel, Whitley, no longer extant	Evidential Communal Historical Aesthetic	Some	Of regional significance as part of widespread infrastructure linked historically to industrialisation of the area.
43	Hull and Doncaster Railway	Evidential Historical	Some	Of regional significance as part of former 19thC rail infrastructure.
45	Great Northern Railway	Evidential Historical	Considerable	Of regional significance as part of mainline route.
47	Heck Bridge and Wentbridge Railway and canal basin	Evidential Historical	Some	Some local significance as part of investment and speculation in infrastructure in region.
49	Whitley Lodge	Evidential	Some	Some local significance as part of 19thC fabric of the village
54	WWII Wellington bomber crash site, near Highgate	Evidential Historical	Considerable	Protected Military Remains, 1km radius lies partly within the area of proposed works
55	WWII Wellington bomber crash site, near Great Heck	Evidential Historical	Considerable	Protected Military Remains, 1km radius lies partly within the area of proposed works
69	Milepost on east side of A19 at south end of Whitley village beside Whitley Bridge Garage	Evidential Communal	Some	Some local communal significance of communication network signposting

Four assets within or close to the area of proposed works have been assigned considerable significance, being the Knottingley and Goole Canal (CHA 36), the route of the Great North Railway (CHA 45), now the East Coast mainline and the Protected Military Remains of two Wellington Bomber crash sites (CHA 54 and 55) and the Great North Railway (CHA 45). The remainder are considered to have some local significance as components of the historic landscape, the value of which is enhanced by their cumulative value.

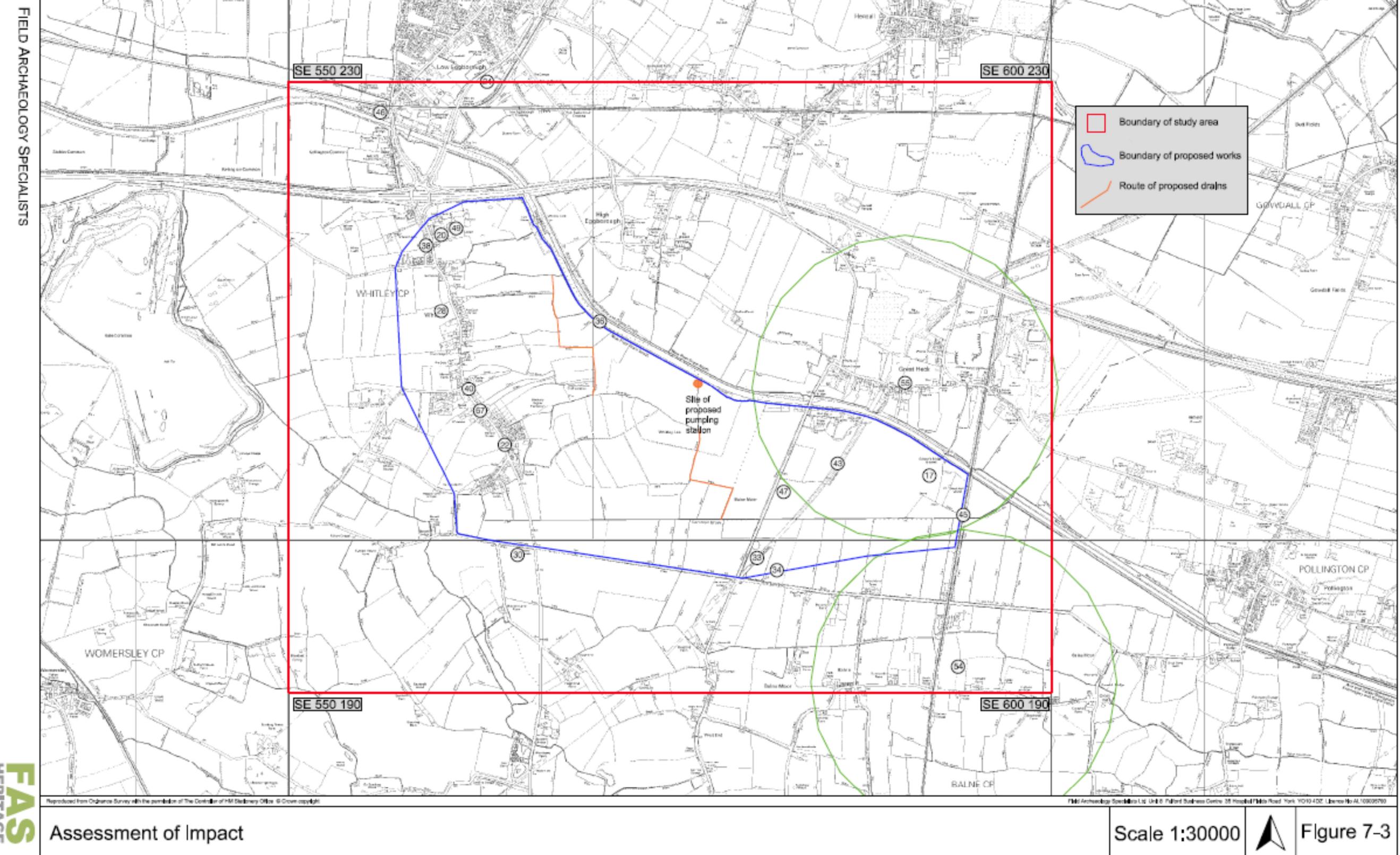


Figure 7-3: Assessment of Impact

7.11.2 Archaeological Potential within the Proposed Drainage Area

The archaeological discoveries and investigations from the wider area have demonstrated human activity from at least the Iron Age to the modern day. Archaeological evidence is, however, notably scarce within the area of proposed mining subsidence remediation works (see Figure 7-3). This may be attributed in part to the lack of investigation within this area, confined to desk-based research, geophysical survey and a single phase of archaeological evaluation at the north end of Whitley village (CHA Event 1, 10 and 11), none of which produced evidence for remains of archaeological significance.

Within the area proposed for mining subsidence remediation works, archaeological features of pre-medieval date are rare, represented only by cropmarks of a field system of possible Iron Age/Romano-British date (CHA 17). There is some potential for hitherto unknown remains of Iron Age to Romano-British date to lie within the area proposed for drainage works.

The medieval landscape is still legible within the works area, primarily Whitley village itself and areas of ridge and furrow cultivation. In one area the remains survive as earthworks, while others have been eroded by ploughing and survive only as cropmarks. The drainage works proposed to the east of Whitley village have the potential to encounter evidence for further similar remains.

The agricultural character of the area persists to the modern day, and ridge and furrow of post-medieval date is also evidenced within the area. Many of the drains and hedgerows in the landscape have been in existence since at least the 19th-century, and contribute to the historic character of the landscape.

The former route of the Heck Bridge and Wentbridge Railway which is situated along the east side of Heck Lane are away from areas of proposed drainage works and will not be impacted. The site of the new pumping station adjacent to New Fleet Drain is not close to any identified heritage assets with the exception of the canal to the north, but this will not be affected directly by the proposed works.

7.11.3 Assessment of Impact

The proposed drainage works will involve three main elements which have the potential to impact the heritage assets of the area and the historic character of the landscape (see Figure 7-3):

- Construction of a pumping station
- Creation of new drains
- Regrading of existing drains

The impact of these works on the known heritage assets of the area is indicated in Table 7-2.

Table 7-2: Assessment of Direct and Indirect Impact

CHA No	Identity	Significance	Direct impact	Impact on setting	Justification
17	Field system cropmark	Some	None	None	The cropmarks are located some distance from proposed works and are screened by vegetation along Heck Lane.
20	Possible site of Templar preceptory	Some	None	None	The location of the former preceptory is not known and so has no meaningful context that can be impacted by the proposed works.
22	Whitley village	Some	None	Minor temporary	The village lies away from the proposed works, and while there is some intervisibility with proposed works the visual impact of groundworks will be temporary. The landscape is dominated by Eggborough Power station and the M62.

CHA No	Identity	Significance	Direct impact	Impact on setting	Justification
28	Medieval ridge and furrow visible on aerial photographs. No longer extant.	Some	None	None	The remains are no longer extant and so have no meaningful context that can be impacted by the proposed works.
30	Medieval ridge and furrow visible on aerial photographs. Visible as earthworks and cropmarks.	Some	None	None	This area of ridge and furrow lies just outside the proposed works area and any effects will be mitigated by distance.
33	Quarry pits	Some	None	None	The remains are no longer extant and so have no meaningful context that can be impacted by the proposed works.
34	Post-medieval ridge and furrow visible on aerial photographs. No longer extant.	Some	None	None	The remains are no longer extant and so have no meaningful context that can be impacted by the proposed works.
36	Knottingley and Goole Canal	Some	None	Minor temporary	The proposed works will have a temporary visual impact on the immediate setting of the canal, but the setting is already dominated by Eggborough Power station and the M62.
38	All Saints Church, Whitley	Some	None	None	The church is set some distance from the area of works and will be partially screened and temporary effects mitigated by distance. The setting is dominated by the M62.
40	Non-Conformist Chapel, Whitley	Some	None	None	The chapel is no longer extant and so has no meaningful context that can be impacted by the proposed works.
43	Hull and Doncaster Railway	Some	None	None	The proposed works will have a temporary visual impact on the immediate setting of the route, but the northern end is screened by vegetation. The setting is already dominated by Eggborough Power station and the M62.
45	Great Northern Railway	Considerable	None	None	The route is at the eastern edge of the area of proposed works and will be partly screened by vegetation and possible temporary visual effects mitigated by distance.
47	Heck Bridge and Wentbridge Railway and canal basin	Some	None	None	The route of the railway has been largely dismantled and so has no meaningful context that can be impacted by the proposed works.
49	Whitley Lodge	Some	None	None	Whitley Lodge is set some distance from the area of works and will be partially screened and temporary visual effects mitigated by distance. The setting is dominated by the M62.
54	WWII Wellington bomber crash site, near Highgate	Considerable	None	None	While the crash zone falls partly within the area of proposed works, groundworks are set at some distance away.
55	WWII Wellington bomber crash site, near Great Heck	Considerable	None	None	While the crash zone falls partly within the area of proposed works, groundworks are set at some distance away.

CHA No	Identity	Significance	Direct impact	Impact on setting	Justification
69	Milepost on east side of A19 at south end of Whitley village beside Whitley Bridge Garage	Some	None	None	The setting of the milepost is provided by the context of Whitley village and is set at a distance from groundworks.

7.11.4 Direct Impact

Notwithstanding the presence of hitherto unknown remains, there will be no direct impact of the proposed drainage remediation works on known heritage assets.

The pumping station will be set low and does not represent potential visual intrusion in its immediate surroundings. The canal is perched and will shield the setting of the pumping station from the surrounding area. The proposed new drains will partly follow existing field boundaries and partly form new routes. The position and route of proposed new drains are set some distance from known heritage assets and the rectilinear form of proposed drains reflects the pattern of surrounding field systems and landholding and should not have any intrusive visual impact on the appearance of the area.

7.11.5 Indirect Impact

The nature of the proposed mining subsidence mitigation scheme, consisting of the construction of a pumping station and associated drainage works, means that the indirect impact of the works, and in particular the impact on the setting of heritage assets, will be minor and temporary. The low-lying landscape is already characterised by a network of drains and the pumping station will by its nature be a non-intrusive, low-lying structure. The surrounding landscape is dominated by Eggborough Power station and the M62. The regrading of drains will have a temporary effect on the landscape, as stripped areas will stand out against surrounding vegetation, but will soon blend with the current character of the agricultural landscape.

7.12 Recommendations and Mitigation

The CHA has demonstrated that any impact of the proposed mining subsidence remediation works on the heritage assets of the Great Heck and Whitley area will be minor or negligible. No remains of exceptional, considerable or local significance will be impacted. There remains the potential for the proposed works to have a more significant effect on the remains of hitherto undetected sites.

The greatest impact will be caused by the new drains, and the construction of the new pumping station. It is recommended that a continuous archaeological watching brief be maintained during these groundworks, to allow for the investigation and preservation by record of any hitherto unknown archaeological remains to be impacted by the works.

The regrading of drains is likely to have only a minor effect on below ground remains, restricted to a small area at the edge of the extant drains. It is recommended that these works be monitored intermittently by the archaeological contractor, to ensure that any archaeological features exposed within the newly graded section are preserved by record.

8 Summary and Conclusions

8.1 Cumulative Impacts and Inter-relationships

Impacts of different types arising under different topics can combine to potentially increase effects on a single receptor or environmental resource. For example, ponds and the species they support may be affected by risks of pollution and disturbance due to construction activities and changes to drainage.

These interactions have been dealt with under the respective topics in any event. For example, the assessment of ecological impacts takes into account the impacts on hydrology and drainage. Cross references are made through the ES to demonstrate where cumulative impacts and inter-relationships arise.

The aspects discussed in this ES are not discrete; there are considerable overlaps and interrelationships between the aspects, receptors and impacts detailed, particularly in relation to the hydrology of the subsidence flashes and their importance for bird populations. Where relevant, cross-references are provided throughout the report to demonstrate where these links and inter-relationships arise.

8.2 Conclusions

Table 8-1 summarises the conclusions of the assessments of each of the aspects of the environment likely to be significantly affected by the proposed mining subsidence remediation scheme.

Table 8-1: Summary of Assessment Conclusions

Topic	Key Issues	Mitigation Measures	Assessment of Significance
Ecology	<p>Permanent loss of small areas of habitat (arable, poor semi-improved grassland, subsidence flashes), five trees, and the potential for subsidence flash habitats to re-form.</p> <p>Disturbance of protected species, in particular bird populations, but also potentially Badger, Otter, bats, Grass Snake, Brown Hare and Eel.</p> <p>Potential spread of non-native, invasive Himalayan Balsam.</p> <p>Accidental contamination of watercourses through sediment release and pollution incidents.</p> <p>Increase in length of drainage ditch habitat within the study area and 820m of new/re-graded drains with berms.</p>	<p>Area of habitat affected kept to a minimum and use existing access tracks.</p> <p>Re-instatement of affected habitats through sowing of appropriate species-rich grass and wildflower mixes and replacing of felled trees with native, locally sourced specimens.</p> <p>Monitor channel vegetation recolonisation and undertake additional planting if required.</p> <p>Further protected species surveys and implementation of mitigation, if required.</p> <p>No night-time working.</p> <p>Any flooding lighting to be angled downwards and fitted with a cowl to direct light to the ground.</p> <p>Produce method statement for working in areas with the potential to support Grass Snake, which will detail vegetation management techniques required.</p> <p>Provide all excavations with a</p>	<p>The evaluation of the ecological impacts, likely to be generated by the proposed mining subsidence remediation scheme at Great Heck, determined that the construction phase would result in the ecological features in the study area generally experiencing temporary negative impacts. However, these impacts are reversible once works are complete and disturbing activities stop, and through mitigation.</p> <p>The operational phase of the scheme is assessed as having significant, permanent, negative impacts on subsidence flash habitats, and the bird populations they support, as these features will be permanently lost. Given the rationale of the project and the requirement to fulfil the duties of the Coal Mining Subsidence Act 1991, the project cannot avoid the loss of these habitats and the impacts upon the waterbird species they support, which can only be partially compensated for by the new watercourses and inclusion of berms on new/re-graded watercourses.</p> <p>Other operational impacts are assessed as not being significant, or as having a positive impact through an increase in open ditch habitat and increased diversity in ditch habitat.</p>

Topic	Key Issues	Mitigation Measures	Assessment of Significance
		<p>suitable means of escape for Badger, Otter and other fauna.</p> <p>Develop appropriate mitigation strategy to prevent the spread of Himalayan Balsam.</p> <p>Schedule works to commence outside of the key breeding bird season.</p> <p>Breeding bird surveys prior to commencement of works and vegetation clearance between March and September.</p> <p>Implement measures to prevent significant release of sediment and chemical contamination.</p> <p>Regular monitoring of pumping station and if Eel entrainment is occurring.</p>	<p>A range of mitigation measures have been suggested to minimise/offset impacts on other habitats and species.</p> <p>No significant impacts are expected on any statutory or non-statutory nature conservation sites as a result of this scheme, either alone or in-combination with any other plans or projects.</p> <p><i>Overall impact: No significant negative impact, with the exception of the impact on subsidence flashes and wetland birds which is assessed as being a permanent, negative impact</i></p>
Landscape and Visual Amenity	<p>Direct impacts on the landscape fabric (e.g. arable land, trees, and watercourses).</p> <p>Visual impacts associated with construction traffic and plant.</p> <p>Visual impacts of new permanent drainage infrastructure (e.g. pumping stations).</p>	<p>Construction period kept to a minimum and phased.</p> <p>Tree removal kept to a minimum and trees felled replaced by replanting in original position.</p> <p>Green paladin fencing to be used around the stations and hedgerows planted to provide additional screening.</p>	<p>The evaluation of the landscape impacts likely to be generated by the proposed drainage works determined that the construction and operation phases would result in a limited number of landscape receptors sustaining a negligible to minor magnitude of landscape impact.</p> <p>It is concluded that overall the mining subsidence remediation works are acceptable in landscape terms as few landscape receptors will be adversely affected and any changes in landscape character will be short-term.</p> <p>The visual assessment concludes that the proposed mining subsidence remediation works would be acceptable in terms of its overall visual effects upon identified receptors. The introduction of a new pumping station and the loss of a small number of trees will result in minor adverse impacts to some visual receptors, however, in the long-term through replanting and screening of the pumping station, this will be reduced.</p> <p><i>Overall impact: Minor adverse</i></p>
Hydrology, Geology and Soils	Soil erosion and compaction due to excavations, the movement of heavy plant on site and the stockpiling of materials.	<p>Design ditch profiles and cross-sections in such a way as to minimise the risk of bank failure and erosion.</p> <p>Design ditch profiles and cross-</p>	Construction and re-grading of drains at Great Heck involves several phases and activities which may potentially affect the soil, hydrological and hydrogeological environments. One of the threats is chemical/ sediment contamination to

Topic	Key Issues	Mitigation Measures	Assessment of Significance
	<p>Release of sediment into surface watercourses, increasing their turbidity and nutrient content.</p> <p>Potential chemical contamination of soil, surface water and groundwater.</p> <p>Improved drainage of wet grassland/subsidence flash areas, including lowering of water levels, removing the habitat which was present.</p> <p>Improved drainage of study area leading to lowered groundwater levels which could impact on wetland SINC sites (however, Balne Common Drain acts as an effective hydraulic barrier between the works and SINC sites and therefore changes in water levels will be negligible).</p>	<p>sections in such a way as to minimise the change in the connectivity of the drains with the underlying bedrock aquifer.</p> <p>Measures to be taken to prevent significant release of sediment and chemical contamination, which will be detailed within a Construction Method Statement (CMS) and Environment Management Monitoring Plan (EMMP).</p>	<p>the Sherwood Sandstone aquifer. However, a hydrogeological risk assessment (see Appendix A) has demonstrated that this risk will be negligible.</p> <p>The only other noteworthy affect is the drying out of wetland habitat in the subsidence flash areas, as a result of the improved drainage. However, as this is the purpose of the scheme no mitigation measures have been recommended.</p> <p><i>Overall impact: Moderate / Minor Adverse</i></p>
Cultural Heritage, Archaeology and Material Assets	<p>Construction of pumping station within study area</p> <p>Re-grading of existing drains within study area</p> <p>Creation of new drains within study area has the potential to uncover previously unknown archaeological remains.</p>	<p>Intermittent monitoring of works by an archaeological contractor during re-grading phase.</p> <p>Continuous archaeological watching brief maintained during the pumping station groundworks phase of construction.</p> <p>Area of land affected kept to a minimum.</p>	<p>The CHA has demonstrated that any impact of the proposed mining subsidence remediation works on the heritage assets of the Great Heck and Whitley area will be minor or negligible.</p> <p>No remains of exceptional, considerable or local significance will be impacted. There remains the potential for the proposed works to have a more significant effect on the remains of hitherto undetected sites.</p> <p>The greatest impact will be caused by the cutting of the new drains, and the construction of the new pumping station.</p> <p>The re-grading of drains is likely to have only a minor effect on below ground remains, restricted to a small area at the edge of the extant drains.</p> <p><i>Overall impact: Negligible / Minor adverse</i></p>

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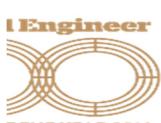
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