



NPPF: Flood Risk Assessment

Land at Station Road, Wombwell

Hartwood Estates Ltd

SHF.1122.009.HY.R.001.A



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Land at Station Road, Wombwell

Project:	NPPF: Flood Risk Assessment
For:	Hartwood Estates Ltd
Status:	Draft for Client Comments
Date:	November 2022
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Executive Summary

This report presents an FRA in accordance with the NPPF and NPPG ID: 7 guidance, for a proposed B8 – Storage or distribution for open-air storage development located on land north of Station Road, Wombwell.

The report includes an assessment of the surface water drainage requirements of the Site and details the flood risk and how this could be managed and mitigated to allow the Site to be developed in support of the planning application.

The FRA has demonstrated the following:

- The 3.80-hectare (ha) Site is comprised of a field with the foundations of a former commercial building with associated parking.
- The Site generally slopes in a south easterly direction and is underlain by clayey soils and bedrock with low infiltration potential.
- The River Dove conveys flow east along the northern boundary of the Site. Bulling Dike conveys flow south-east along the south-western boundary of the Site.
- The risk of flooding is assessed as follows:
 - The risk of fluvial flooding from Bulling Dike and the River Dove is medium for the eastern, southern, and central parts of the Site, with the north-western corner, the south-western part of the Site and small areas towards the centre at low risk.
 - The risk of surface water flooding for most of the Site is assessed as negligible. There are three small areas of ponding in the north of the Site at low risk and a surface water flow pathway along Bulling Dike at high risk.
 - The risk of sewer flooding is low.
 - The risk of flooding from all other sources is assessed as negligible.
- Flood risk from identified sources can be mitigated to a negligible or low and acceptable level through the following approach:
 - Undertake maintenance activities to keep the watercourses clear from debris and overgrown vegetation to maintain the conveyance of the channels.
 - Provide a 4m easement free from development along either side of the onsite/bounding land drains i.e Bulling Dike and 8m easement from the Main River, i.e. River Dove. This easement would provide access for inspection and maintenance purposes, including vehicle access.
 - It is recommended that the number of highway crossings along the route of the land drain is kept to a minimum. Culvert crossings would need to be sized to convey the 1 in 100-year plus climate change event, with a freeboard allowance.
 - Construction of the open space storage area would be using a gravelled surface to allow water to permeate into the proposed ground surface before discharging via throughflow to the River Dove or Bullings Dike.
 - No below ground infrastructure.
Lined gravel surfacing.
 - Provide a development free easement (3m either side) of onsite public surface water sewer assets.

- The proposed land use is classified as water compatible. Water compatible uses are considered acceptable in terms of flood risk in Flood Zones 1, 2 and 3. As such, the Sequential Test would be passed, and the Exception Test would not be required.

The proposed development will be comprised of a gravelled surface used as a storage site, where rainfall will permeate the gravel surface before travelling as through flow, through the underlying soils and geology before flows enter either the River Dove or Bulling Dike.

This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of national policy and guidance. The development should not therefore be precluded on the grounds of flood risk and surface water drainage.

1.0 Introduction

1.1 Background

- 1.1.1 Enzygo Ltd was commissioned by Hartwood Estates Ltd to carry out a site-specific flood risk assessment (FRA), including a surface water drainage strategy, in support of planning application for a proposed change of use of land. The Site is located on land north of Station Road, Wombwell (the 'Site').
- 1.1.2 The proposal is for change of use for the Site to B8 – Storage or distribution for open-air storage development on the 3.80-hectare (ha) Site. A copy of the proposed layout is included in Appendix 1.
- 1.1.3 A site-specific FRA assesses the current and future flood risk to and from a development site. It demonstrates how flood risk will be managed now and over the development's lifetime, taking climate change, drainage, and the vulnerability of its intended users into account.
- 1.1.4 The objectives of a site-specific FRA are to:
- Assess whether a proposed development is likely to be affected by current or future flooding from a range of sources;
 - Assess whether the development will increase flood risk elsewhere;
 - Decide on measures to deal with these effects and risks and assess their appropriateness;
 - Provide enough evidence for the local planning authority to apply (if necessary) the Sequential Test, and;
 - Decide whether the development will be safe and will pass the Exception Test if applicable.
- 1.1.5 In England, planning applications for development need an FRA¹ for most developments including:
- In Flood Zones 2 and 3 including minor development and change of use.
 - Sites of 1ha or larger in Flood Zone 1.
 - Sites of less than 1ha in Flood Zone 1, including change of use to a more vulnerable class (for example from commercial to residential), and where they could be affected by sources of flooding other than rivers and the sea.
 - Land in Flood Zone 1 in a Critical Drainage Area (CDA) as notified by the Environment Agency.
 - Land in Flood Zone 1 identified in a strategic flood risk assessment as being at increased flood risk in future.
- 1.1.6 An FRA is required for this development, as initial screening using Environment Agency online indicative flood mapping shows that the Site is located in Flood Zones 1 and 2 and the Site is 3.8ha and at risk of surface water flooding.
- 1.1.7 The purpose of this FRA is to assess the risk of flooding to the proposed development and where possible provide sufficient mitigation to demonstrate that future users of the

¹ Department for Communities and Local Government (2017). Flood Risk Assessments if You're Applying for Planning Permission [<https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications>].

development would remain safe throughout its lifetime, that the development would not increase flood risk on Site and elsewhere and, where practicable, would reduce flood risk overall.

1.2 Scope

- 1.2.1 Government policy on development and flood risk is set out in the National Planning Policy Framework (NPPF) ² and is supported by National Planning Practice Guidance: Flood Risk and Coastal Change [NPPG ID7] ³.
- 1.2.2 NPPF paragraphs 159-169 set out the need for an appropriate assessment of flood risk at all levels of the planning process and require the application of a sequential risk-based approach to assess the suitability of land for development in flood risk areas.
- 1.2.3 The FRA should also make allowances for climate change ⁴ to minimise vulnerability and provide resilience to flooding and coastal change in the future. The allowances are predictions of anticipated change in:
- Peak river flow by river basin district.
 - Peak rainfall intensity.
 - Sea level rise.
 - Offshore wind speed and extreme wave height.
- 1.2.4 The allowances are based on climate change projections and different scenarios of carbon dioxide emissions to the atmosphere. There are different allowances for different periods of time over the next century.
- 1.2.5 Site-specific FRAs are categorised according to level. Simple Level 1 Screening studies give a general indication of the potential flood risk to a site and identify whether more detailed Level 2 assessment is required or not. A Level 2 assessment is a qualitative appraisal to develop understanding of flood risk to a site and the effects of the site on flooding elsewhere including recommended mitigation measures. Level 3 assessments are more detailed quantitative studies, for example modelling to establish flood levels at a site in the absence of Environment Agency or other data or providing detailed outline drainage designs.
- 1.2.6 This report is a Level 2 qualitative FRA but includes a Level 3 assessment of the surface water drainage requirements for the proposed development.

1.3 Aims

- 1.3.1 This FRA aims to provide enough flood risk information to satisfy the requirements of the NPPF, PPG ID7 and regional/local government plans and policies. It describes the potential for the Site to be impacted by flooding, the impacts of the proposed development on flooding elsewhere near the Site, and the proposed measures that could be incorporated into the development to mitigate the identified risks.

² Department for Communities and Local Government (2018). Revised National Planning Policy Framework (published July 2018 and updated July 2021) [<https://www.gov.uk/government/publications/national-planning-policy-framework--2>].

³ Department for Communities and Local Government (published March 2014). Planning Practice Guidance ID7-030-20140306; Flood Risk & Coastal Change [<https://www.gov.uk/guidance/flood-risk-and-coastal-change>].

⁴ Department for Communities and Local Government (published February 2016 and updated October 2021). Flood Risk Assessments: Climate Change Allowances [<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>].

1.4 Planning Context

National Policy

1.4.1 The FRA was prepared in accordance with the NPPF and NPPG ID7.

Regional/Local Policy

1.4.2 The FRA also considers the following policies within the Barnsley Metropolitan Borough Council Local Plan⁵ (2019 to 2033):

- Policy CC1 Climate Change: Reduce the future impacts of climate change.
- Policy CC3 Flood Risk: Reducing the extent and impact of flooding.
- Policy CC4 Sustainable Drainage Systems (SuDS): The use of SuDS on major and minor developments.

1.5 Report Structure

1.5.1 This report is structured as follows:

- Section 2 identifies the sources of information that were consulted;
- Section 3 describes the existing Site;
- Section 4 outlines the flood risk to the existing site and proposed development;
- Section 5 details the proposed mitigation measures against identified flooding sources;
- Section 6 assesses the potential impacts of the proposed development on surface water drainage and proposes mitigation for those effects; and
- Section 7 presents a summary and conclusions.

⁵ <https://www.barnsley.gov.uk/media/17249/local-plan-adopted.pdf>

2.0 Sources of Information

2.1 Sources of Information

2.1.1 The following information was consulted:

- Ordnance Survey 1:25,000 mapping (Explorer 278: Sheffield and Barnsley).
- Detailed topographic survey (Appendix 2).
- Environment Agency online mapping (Flood Map for Planning⁶, Long Term Flood Risk Assessment for Locations in England⁷, Catchment Data Explorer⁸ and Main River Map⁹).
- Online mapping for Climate Change Allowances for Peak River Flow and Peak Rainfall in England online mapping¹⁰.
- National River Flow Archive¹¹.
- Barnsley Metropolitan Borough Council Strategic Flood Risk Assessment (SFRA) and associated mapping¹² (Appendix 3).
- Barnsley Metropolitan Borough Council Preliminary Flood Risk Assessment (PFRA).
- Humber River Basin Management Plan (RBMP).
- British Hydrological Society Chronology of British Hydrological Events¹³.
- National Soils Resources Institute (NSRI): Soilscales online mapping¹⁴.
- British Geological Survey [BGS] online mapping: Geology of Britain Viewer¹⁵.
- Landmark's Promap: Flood Data package: Additional flood mapping.
- Geosmart 1 in 100-year groundwater flood risk map.
- Yorkshire Water sewer asset plans (Appendix 4).
- DEFRA's Magic Map for identifying Designated Sites¹⁶.
- River Levels UK for identifying Flood Alert and Flood Warning areas¹⁷.

2.2 Consultation and Discussion with Regulators

2.2.1 Consultation and discussions were undertaken with the Environment Agency, the Local Planning Authority (LPA)/Lead Local Flood Authority (LLFA), and Water Utility.

⁶ <https://flood-map-for-planning.service.gov.uk/>

⁷ <https://flood-warning-information.service.gov.uk/long-term-flood-risk/>

⁸ <http://environment.data.gov.uk/catchment-planning/>

⁹ <https://environment.maps.arcgis.com/apps/webappviewer/index.html?id=17cd53dfc524433980cc333726a56386>

¹⁰ <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

¹¹ <http://nrfa.ceh.ac.uk>

¹² <https://www.barnsley.gov.uk/media/18125/barnsley-strategic-flood-risk-assessment-level-1-report-sept-2010.pdf>

¹³ <http://www.cbhe.hydrology.org.uk/search.php>

¹⁴ <http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html>

¹⁵ <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

¹⁶ <http://www.natureonthemap.naturalengland.org.uk/>

¹⁷ <https://riverlevels.uk/flood-map#.XclKwPn7RPZ>

Environment Agency

- 2.2.2 The Environment Agency is a statutory consultee on flood risk and planning and is directly responsible for the prevention, mitigation and remediation of flood damage for main rivers and coastal areas; and it has a strategic overview for all forms of flooding.
- 2.2.3 Environment Agency Standing Advice¹⁸ and the NPPF/PPG ID: 7 was consulted and reviewed.
- 2.2.4 Correspondence with the Environment Agency is included in Appendix 5.

Lead Local Flood Authority (LLFA)

- 2.2.5 Barnsley Metropolitan Borough Council as the Lead Local Flood Authority (LLFA) is responsible for local flood risk management in their area and for maintaining a register of flood risk assets. They also have lead responsibility for managing the risk of flooding from surface water, groundwater and ordinary watercourses.
- 2.2.6 Barnsley Metropolitan Borough Council as the LLFA was consulted on flood risk issues at this Site.
- 2.2.7 Correspondence with the LLFA is included in Appendix 6.

Yorkshire Water

- 2.2.8 Drainage and sewerage services in the UK are provided by a number of water and sewerage companies. Yorkshire Water is responsible for sewerage within the area of the Site.
- 2.2.9 All sewerage undertakers maintain the 'DG5 register' of properties and external areas (such as gardens, highways, open spaces) which have suffered flooding from public foul/combined sewers. It does not include flooding caused by blockages.

Danvm Drainage Commissioners Internal Drainage Board

- 2.2.10 Internal Drainage Boards manage water levels, flood risk and land drainage.
- 2.2.11 Danvm Drainage Commissioners Internal Drainage Board (IDB) is responsible for managing Bulling Dike at the Site.
- 2.2.12 Correspondence with the IDB is included in Appendix 7.

2.3 Site Walkover

- 2.3.1 Enzygo staff carried out a walkover of the Site during November 2022. Observations made were used to inform the Site description.

¹⁸ Department for Communities and Local Government (published April 2012 and updated March 2019). Preparing a Flood Risk Assessment: Standing Advice [<https://www.gov.uk/guidance/flood-risk-assessment-standing-advice>].

3.0 Site Location and Description

3.1 Location

- 3.1.1 The Site is located on land north of Station Road, Wombwell, Barnsley, S73 0BL.
- 3.1.2 The Site is centred on National Grid Reference (NGR) 440492, 403647.
- 3.1.3 The Site location is shown in Drawing 001 and in more detail in Drawing 002, which shows the red line boundary enclosing an area of 3.80ha.

3.2 Land Use

- 3.2.1 The land use comprises of a demolished industrial unit, which included parking areas and internal road. The remnants of these areas of hardstanding are still present along with scrubland and a number of spoil heaps (Figures 3.1 and 3.2).
- 3.2.2 The Site is bounded by woodland to the north-west, the River Dove to the north, residential properties and gardens to the east, Station Road to the south-east and commercial units to the south-west (Figure 3.2). Bulling Dike flows through the southern extent of the Site.
- 3.2.3 The Site is currently accessed via Station Road on the south-east boundary. A second access is located off Valley Road on the south-western boundary.

Figure 3.1: Photographs of the Site





Top: View from north west corner of Site looking south. Bottom: View from north west corner of Site looking east.

Figure 3.2: Aerial Photograph of the Site



Image © 2022 Digital Globe.

3.3 Topographic Information

3.3.1 A detailed topographic survey was carried out during March 2019 (Appendix 2). The Site generally falls in a south easterly direction from 27.08 metres Above Ordnance Datum (m

AOD) (located in the north western corner) to 24.82m AOD (located along the south-western boundary). The fall of 2.26m over approximately 305m gives a gradient of 1:135.

- 3.3.2 In addition, the northern extent of the Site falls north-east towards the River Dove from 26.90m AOD (located within the central-north-western part of the Site) to 26.35m AOD (located close to the River Dove on the central-northern boundary of the Site). The fall of 0.55m over approximately 60m gives a gradient of 1:110.
- 3.3.3 The south-western extent of the Site falls south-west towards Bulling Dike from 26.90m AOD (located within the central-north-western part of the Site) to 26.27m AOD (located close to Bulling Dike within the central-south-western part of the Site). The fall of 0.63m over approximately 40m gives a gradient of 1:64.

3.4 Soils and Geology

Soils Mapping

- 3.4.1 The Soilscape online soils map viewer shows that the Site is underlain by loamy and clayey floodplain soils with naturally high groundwater (Figure 3.3). The soil is indicative of poor infiltration potential.
- 3.4.2 The soils mapping is indicative and there may be localised variation in soil type.

Figure 3.3: Soils Mapping



Soils Data © Cranfield University (NSRI) and for the Controller of HMSO [2022].

Geology Mapping

- 3.4.3 The Geology of Britain online map viewer shows that there are Alluvium (clay, silt, sand and gravel) superficial deposits beneath the Site (Figure 3.4). The bedrock beneath most of the Site is Pennine Middle Coal Measures Formation (mudstone, siltstone and sandstone). The bedrock beneath the north-east of the Site is Ackton Rock (sandstone) (Figure 3.4).

- 3.4.4 The Site is brownfield (that is, it has previously been developed) and will include Made Ground (man-made deposits such as embankments, infills and spoil heaps on the natural ground surface) of variable composition, location and depth.

Figure 3.4: Geology Mapping (continues over page)

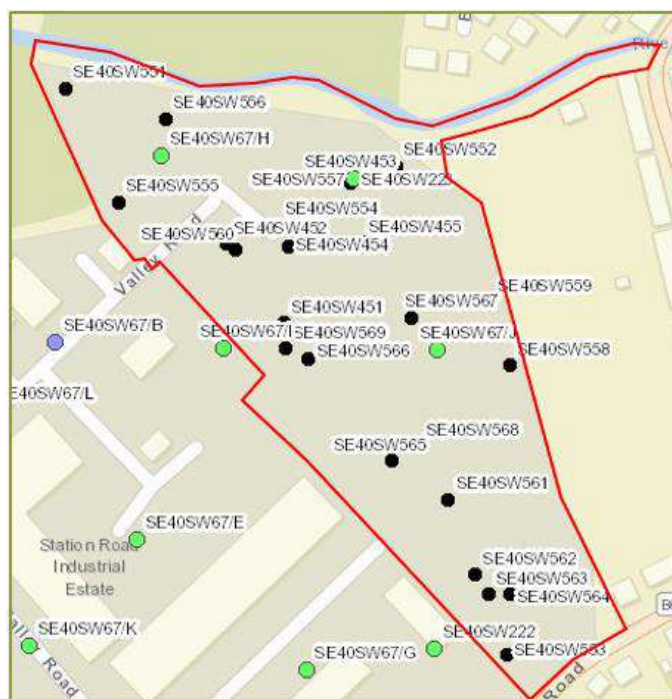


Top: Superficial Deposits **Bottom:** Bedrock Geology. Contains British Geological Survey materials © NERC [2022].

BGS Historical Borehole Records

- 3.4.5 The Geology of Britain online map viewer (Figure 3.5) shows there are five borehole logs located within, or close to, the Site boundary containing accessible data (SE40SW223, SE40SW67/H, SE40SW67/I, SE40SW67/J, and SE40SW222). Numerous additional borehole logs exist within the Site, but these are listed as classified and therefore cannot be accessed.
- 3.4.6 The borehole logs confirm the bedrock geology as depicted by the Geology of Britain mapping (Table 3.1) as well as the presence of Made Ground at depths up to 2.5m Below Ground Level (bgl). Copies of the borehole logs are included in Appendix 8.

Figure 3.5: Borehole Mapping



Contains British Geological Survey materials © NERC [2022].

Table 3.1: BGS Borehole Data

Reference	Summary of Strata	Depth (m bgl)	Groundwater Depth (m bgl)
SE40SW223	0.00 - 0.20m = Topsoil 0.20 - 7.60m = Sand, clay and gravel interbedded 7.60 - 17.55m = Mudstone 17.55 - 20.55m = Sandstone and mudstone interbedded	20.55	Not recorded
SE40SW67/H	0.00 - 0.20m = Topsoil 0.20 - 2.50m = Made ground 2.50 - 4.65m = Clay 4.65 - 9.10m = Sand and gravel 9.10 - 9.40m = Clay 9.40 - 14.20m = Mudstone 14.20 - 14.50m = Siltstone 14.50 - 15.80m = Made ground 15.80 - 16.40m = Mudstone	16.40	4.65
SE40SW67/I	0.00 - 0.20m = Topsoil 0.20 - 1.60m = Made ground 1.60 - 5.80m = Clay 5.80 - 7.45m = Sand and gravel 7.45 - 14.00m = Mudstone and siltstone interbedded	14.00	3.25
SE40SW67/J	0.00 - 0.20m = Topsoil 0.20 - 2.50m = Made ground 2.50 - 4.20m = Clay 4.20 - 8.90m = Sand and gravel 8.90 - 9.00m = Clay 9.00 - 12.20m = Mudstone and siltstone	15.50	0.30

Reference	Summary of Strata	Depth (m bgl)	Groundwater Depth (m bgl)
	12.20 - 14.20m = Made ground 14.20 - 15.50m = Mudstone and siltstone		
SE40SW222	0.00 - 0.20m = Topsoil 0.20 - 0.35m = Clayey sand 0.35 - 1.45m = Mudstone 1.45 - 1.60m = Topsoil 1.60 - 1.70m = Clayey sand 1.70 - 2.45m = Sandy clay 2.45 - 7.10m = Sand and gravel 7.10 - 7.25m = Clay 7.25 - 7.45m = Sand 7.45 - 9.20m = Mudstone 9.20 - 9.90m = Workings containing mudstone 9.90 - 11.05m = Mudstone fragments 11.05 - 11.35m = Sandstone	11.35	Not recorded

Contains British Geological Survey materials © NERC [2022].

3.5 Hydrogeology

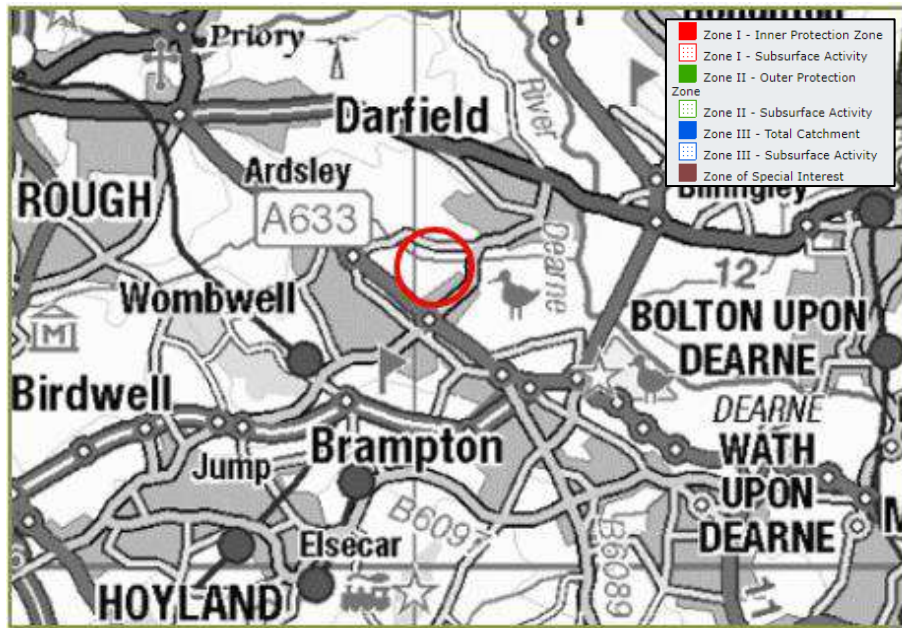
Infiltration potential

- 3.5.1 Soils mapping indicates that the loamy and clayey soils are likely to represent a low infiltration potential.
- 3.5.2 The infiltration potential of the superficial deposits is likely to be variable based on the makeup of the alluvium deposits.
- 3.5.3 Infiltration potential of the bedrock is likely to be low based on the clayey nature of the mudstone.
- 3.5.4 SuDS Infiltration Potential mapping (Drawing 007) shows that the Site has a low infiltration potential.
- 3.5.5 BGS online borehole mapping (Figure 3.5 and Table 3.1) shows groundwater ingress was encountered in three of the five boreholes between 0.30 and 4.65m bgl.

Defra Magic Map

- 3.5.6 Defra Magic Map online mapping (Figure 3.6) shows the Site is not located in a groundwater Source Protection Zone (SPZ).

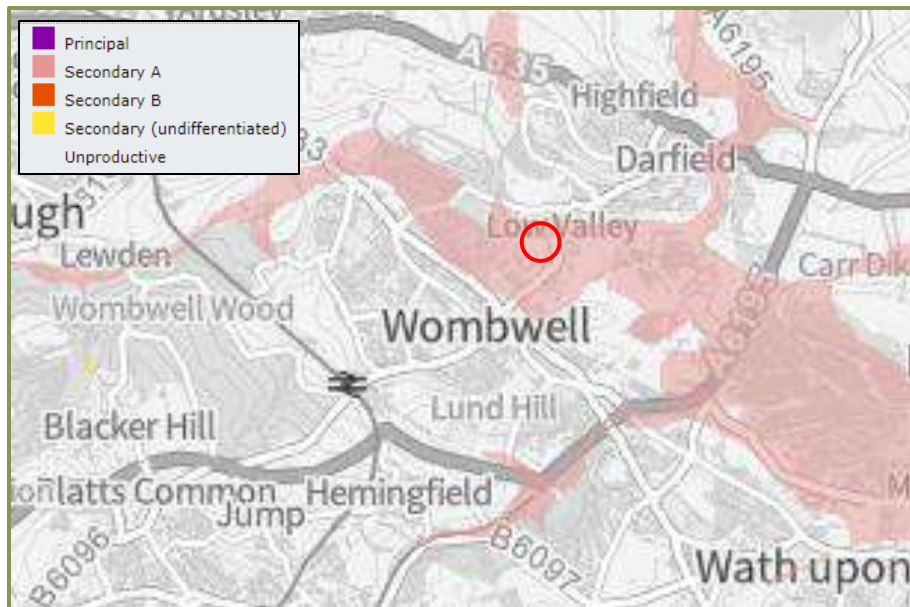
Figure 3.6: Source Protection Zone Map

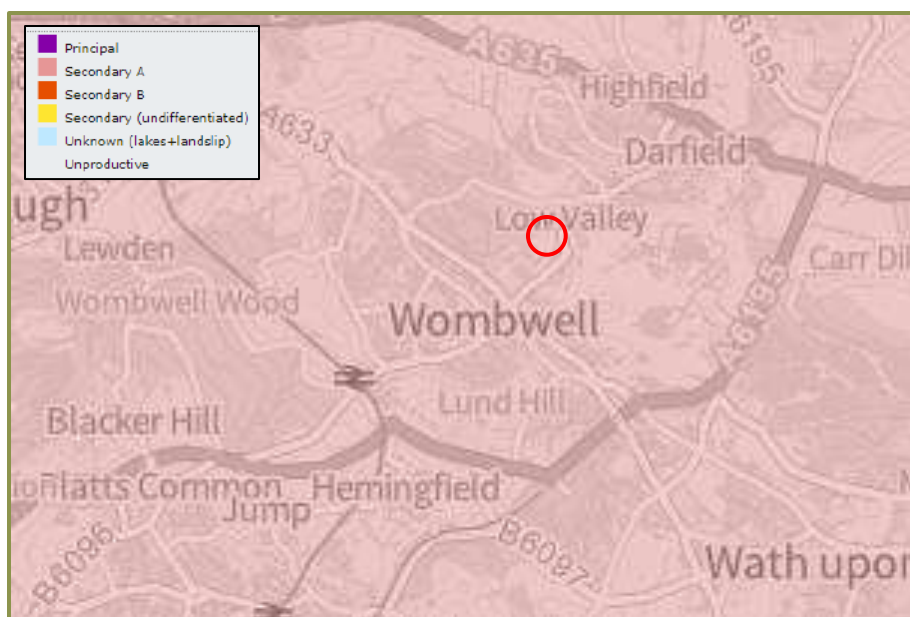


From Magic Map. Contains Environment Agency information © Environment Agency and database right [2022].

3.5.7 The Site is located above a Secondary A Aquifer for both superficial and bedrock deposits (Figure 3.7).

Figure 3.7: Aquifer Designation Map (continues over page)





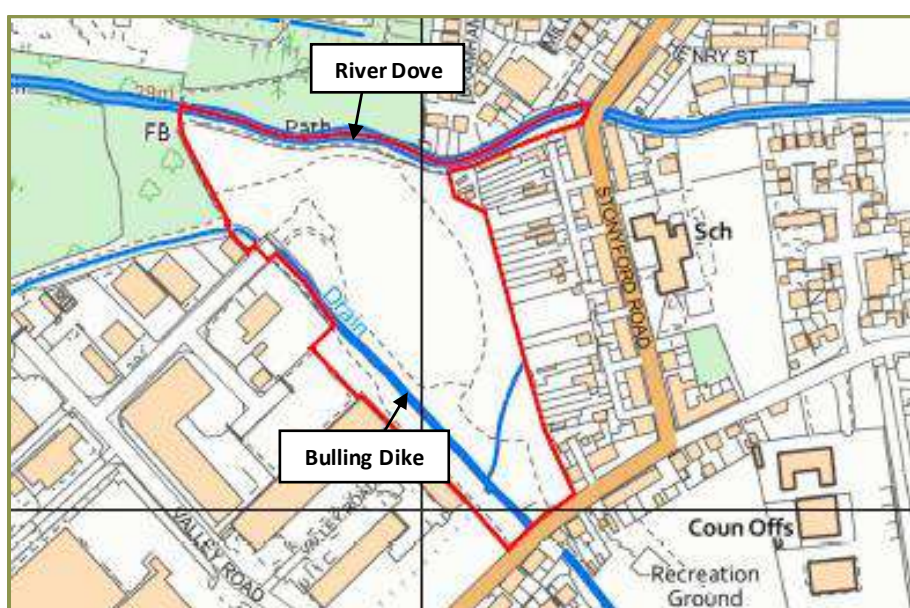
Top: Aquifer Designation (superficial deposits). **Bottom:** Aquifer Designation (bedrock). From Magic Map. Contains Environment Agency information © Environment Agency and database right [2022].

3.6 Catchment Hydrology

OS Mapping and Topographic Survey

- 3.6.1 OS mapping shows mapping shows the River Dove conveys flow east along the northern boundary of the Site. Bulling Dike conveys flow south-east along the south-western boundary of the Site (Figure 3.8).
- 3.6.2 Bulling Dike is classified as an ‘ordinary watercourse’, where flood risk work is carried out by the local drainage authority/riparian landowner.

Figure 3.8: Map of Watercourses



Site Walkover Observations

i. River Dove

- 3.6.3 The River Dove was observed to flow unobstructed along the northern boundary of the Site at the time of visit (Figure 3.9). Wooded vegetation was observed on the northern bank of the River Dove and scrub on the southern bank with a footpath running along it.

Figure 3.9: River Dove



Left: View upstream of the Site. **Right:** View downstream of the Site.

ii. Bulling Dike

- 3.6.4 Bulling Dike was observed to be overgrown with vegetation at the time of visit (Figure 3.10). The reeds and algae in the central reach within the Site are indicators of low velocity flow within the watercourse.

Figure 3.10: Bulling Dike



Left: View upstream from the south-west corner of the Site. **Right:** View downstream from the south-west corner of the Site.

iii. Drainage Cut

3.6.5 During the Site walkover, a drainage cut, with north to south orientation, was observed to cross the centre of the Site (Figure 3.11). The cut was not conveying flow and was vegetated with rough grass at the time of visit (Figure 3.12).

Figure 3.11: Drainage Cut Location

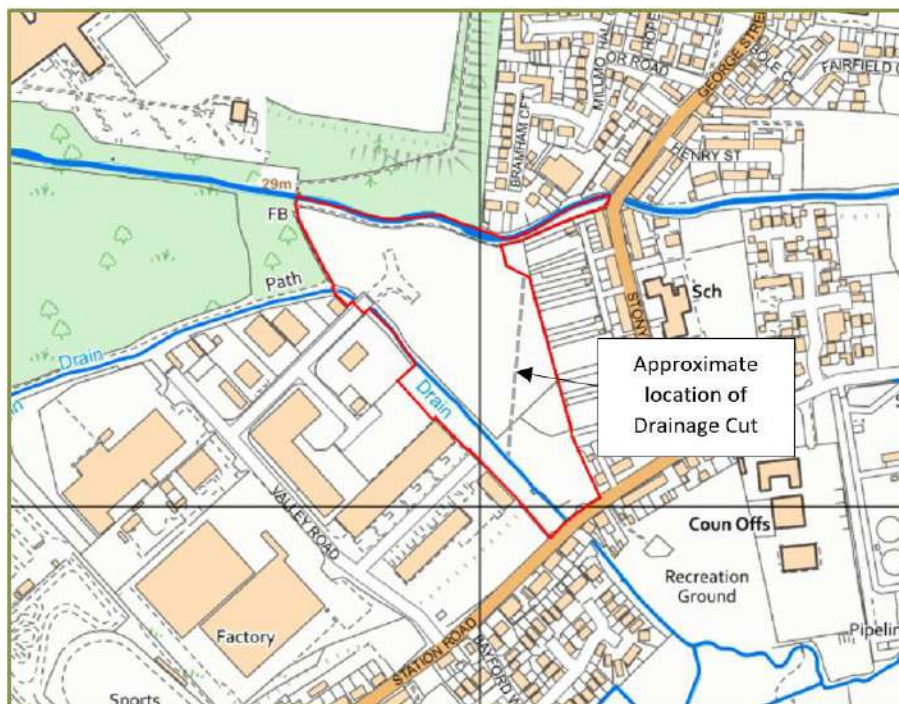


Figure 3.12: Drainage Cut



Left: View north along Drainage Cut. **Right:** View south along Drainage Cut.

Main River Map

3.6.6 The Environment Agency online main river map (Figure 3.13 identifies the River Dove as the nearest main river, located along the northern boundary of the Site, which conveys flows east. The River Dove is a 'main river', which is a watercourse where flood risk work is carried out by the Environment Agency.

Figure 3.13: Main River Map

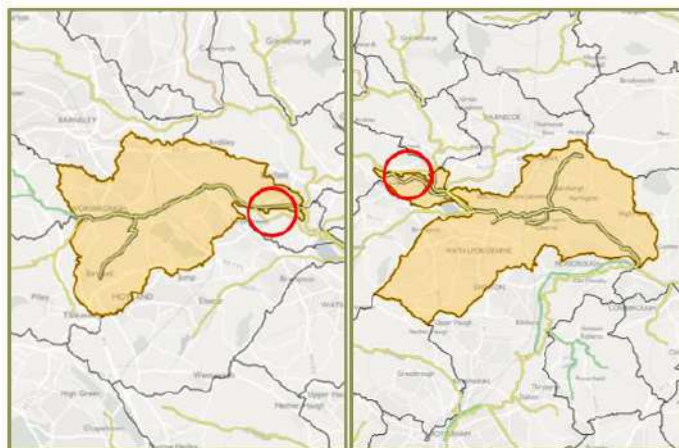


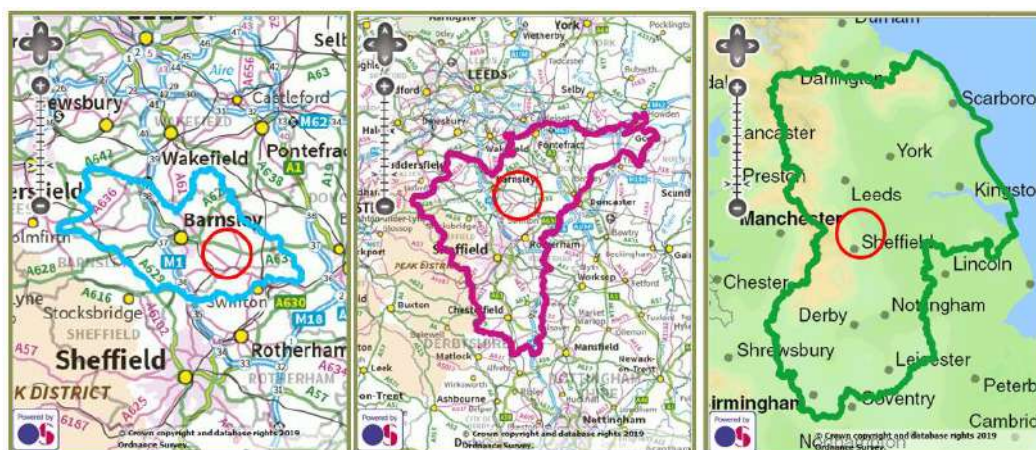
Contains Environment Agency information © Environment Agency and database right [2022].

Environment Agency Catchment Data Explorer Mapping

3.6.7 The north of the Site is within the Dove from Source to River Dearne Catchment and the south of the Site is in the Dearne Darfield Sewerage Treatment Works to River Catchment. The Site is in the Dearne Operational Catchment, which is in the Don and Rother Management Catchment, both lie within the Humber River Basin District (Figure 3.14).

Figure 3.14: Catchment Data Explorer (continues over page)





Top Left: Dove from Source to River Dearne Catchment. **Top Right:** Dearne Darfield Sewerage Treatment Works to River Don Catchment **Bottom Left:** Dearne Operational Catchment. **Bottom Centre:** Don and Rother Management Catchment. **Bottom Right:** Humber River Basin District. Contains Environment Agency information © Environment Agency and database right [2022].

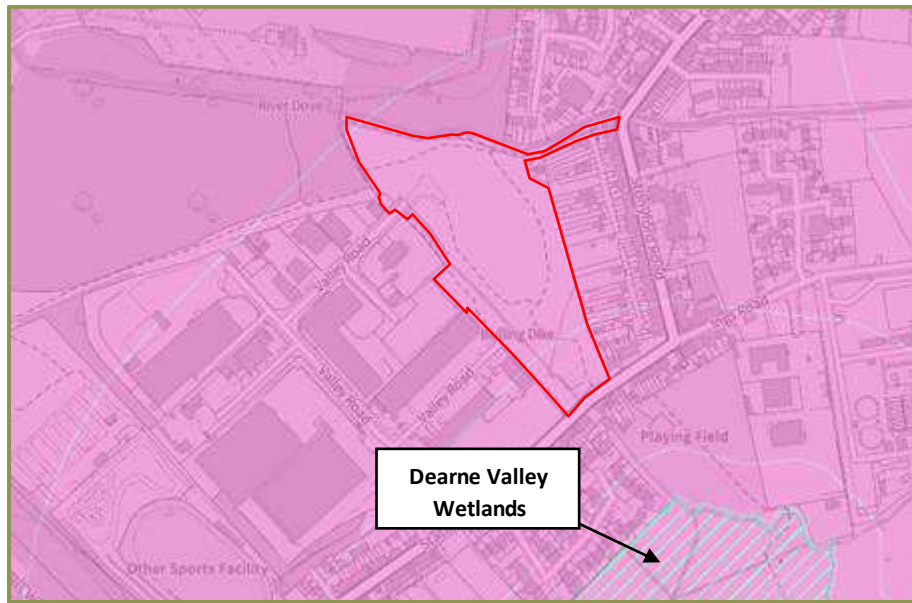
3.7 Sewerage Assets

- 3.7.1 Yorkshire Water asset plans (Appendix 4) show there are two public surface water sewers out falling to Bulling Dike in the south-west corner of the Site; the more northerly is a \varnothing 675mm diameter while the more southerly is a \varnothing 225mm diameter. The sewers serve Station Road and the industrial units on Valley Road.
- 3.7.2 There is a \varnothing 600mm diameter public surface water sewer serving the Bramham Croft residential area north of the Site and which outfalls to the River Dove via the left bank immediately north of the Site.
- 3.7.3 A \varnothing 600mm diameter public combined sewer runs south-east within the south-western boundary of the Site. The sewer then follows Station Road north-east to a Sewerage Treatment Works located south of Ings Road approximately 250m east of the Site.

3.8 Designated Sites

- 3.8.1 The DEFRA Magic Map (England and Wales) shows the Site lies within the Dearne Valley Wetlands (Site of Special Scientific Interest [SSSI]) Impact Risk Zone – to assess planning applications for likely impacts on SSSIs/SACs/SPAs & Ramsar Sites (Figure 3.15).
- 3.8.2 The Site and wider area are located within a Surface Water Nitrate Vulnerable Zone (NVZ).
- 3.8.3 Development of the Site would include SuDS to manage surface water runoff. The use of SuDS would improve the water quality of surface water runoff, thereby providing mitigation measures from the proposed development and would offer a betterment to existing conditions.
- 3.8.4 As such, the proposed development would not pose a significant hydrological impact on the above designated site status or NVZ.

Figure 3.15: Designated Sites



From Magic Map. Contains Environment Agency information © Environment Agency and database right [2022].

4.0 Flood Risk Assessment

4.1 Potential Sources of Flooding

4.1.1 A summary of the potential sources of flooding and the potential risk posed by each source at the Site is presented in Table 4.1. Each source of flooding and level of risk is then assessed in further detail.

Table 4.1: Potential Risk Posed by Flooding Sources

Flooding Source	Potential Flood Risk at Application Site (Yes/No)	Potential Source	Data Sources
Fluvial	Yes	River Dove and Bulling Dike	Environment Agency (Appendix 5) consultation response, Environment Agency flood mapping (Drawing 005) and SFRA mapping (Appendix 3).
Tidal	No	None identified	Environment Agency (Appendix 5) consultation response, Environment Agency flood mapping (Drawing 005) and SFRA mapping (Appendix 3).
Groundwater	Yes	Aquifer	BGS mapping (Drawing 003) and Geosmart Groundwater (Drawing 006)
Surface Water	Yes	Poor permeability and Site topography	Environment Agency online flood mapping, SFRA mapping (Appendix 3), JBA Surface Water Flooding (Drawing 004.1) and Environment Agency Complex mapping (Drawings 010.1 to 010.4).
Sewer	Yes	Public sewers	Yorkshire Water Asset plans (Appendix 4) and topographic survey (Appendix 2).
Infrastructure Failure	Yes	Reservoir failure	Environment Agency online flood mapping, OS mapping, Environment Agency consultation (Appendix 5).

4.2 Fluvial Flooding

Environment Agency Flood Zone Mapping

- 4.2.1 The Environment Agency Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, since these can be breached, overtopped and may not be in existence for the lifetime of a development.
- 4.2.2 The Environment Agency Flood Zones (Drawing 005) shows most of the Site is in Flood Zone 2; between the 1 in 1000-year and 1 in 100-year probability of fluvial (river) flooding (0.1% - 1% Annual Exceedance Probability [AEP]), at 'medium' risk. This risk is associated with the River Dove. The south-western part of the Site and areas in the central-western extent of the

Site are located within Flood Zone 1; which is land located outside the extent of the 1 in 1000-year (<0.1% AEP) risk of fluvial flooding, at 'low' risk.

- 4.2.3 The proposed vehicular Site access via Station Road on the south-eastern boundary and potential emergency vehicular access via Valley Road on the south-western boundary are both located within Flood Zone 2.

Hydraulic Modelling Exercise

- 4.2.4 In August 2019, Enzygo Ltd produced a 1D2D Flood Modeller RUFLOW model for the River Dove and Bulling Dike, which resulted in a successful flood map challenge (Appendix 5).
- 4.2.5 The results show that the Site floods during the 1 in 100-year plus 30% climate change, 1 in 100-year plus 50% climate change, and 1 in 1000-year events (Figure 4.1).

Figure 4.1: Modelled Flood Extents



Top Left: 1 in 100-year Top Right: 1 in 100-year+30%CC Bottom Left: 1 in 100-year+50%CC Bottom Right: 1 in 1000-year

- 4.2.6 Areas within the north-western corner of the Site, within and immediately outside the south-western boundary, and along Station Road to the south of the Site are shown to be free from flooding. The designation of these areas as Flood Zone 2 on the Environment Agency Flood Zone Map (Drawing 005) is based on historical flood outlines from June 2007 and March 1947. Both flood events occurred prior to the replacement of the dilapidated Pitt Bridge on the River Dove upstream of the Site with a new access bridge built for Netherwood Academy in 2012 (Grid Ref. 439991 403853). Prior to its replacement, Pitt Bridge acted as a restriction to flow and during higher flow events water spilled from the right bank immediately upstream of the

structure. Once out of bank, water would flow overland south towards Littlefield Lane before joining Bulling Dike where it was then conveyed towards the Site and Wombwell causing flooding. The results of the Enzygo Ltd hydraulic modelling exercise for the River Dove and Bulling Dike which show these areas to be free from fluvial flooding (Figure 4.1) and the Historic Flood Events Map (Drawing 008) confirm the influence of the bridge replacement.

- 4.2.7 The results show that during the 1 in 100-year plus 50% climate change event flooding within the Site originates along the right bank of the River Dove and then flows south, overland across the Site. The north-west corner, south-western, and eastern boundaries of the Site remain free of flooding. Across the Site, flood depths reach a maximum of 0.50m, maximum velocity is 0.55m/s, and maximum flood hazard is 1.45 (Danger for most - including the general public).
- 4.2.8 During the 1 in 1000-year event, flooding extends further west and south-west across the Site. The same flood mechanisms as in the 1 in 100-year plus 50% climate change event are shown. Across the Site, flood depths reach a maximum of 0.55m, maximum velocity is 0.61m/s, and maximum flood hazard is 1.49 (Danger for most - including the general public).

JBA Flooding from Rivers

- 4.2.9 The JBA mapping (Drawing 004.2) shows that most the Site is not located within the mapped extent of flooding of Flood Zone 3b (functional floodplain), apart from the southern extent of the Site; within the mapped extent of flooding from Bulling Dike during a 1 in 20-year event (5% AEP), at 'high' risk. Areas in the central-north and central-south are at a low risk of fluvial flooding. The eastern boundary, south-east and south-west corners of the Site are not shown to be at risk of fluvial flooding

Flood History

- 4.2.10 The SFRA historic flood mapping (Appendix 3) shows the Site flooded in March 1947 and June 2007.
- 4.2.11 The Environment Agency Historic Flood Events (Drawing 008) shows that there have been three historical flooding events within/along the Site boundary. In March 1947, the north-west of the Site was inundated, with a small area in the west of the Site also affected. In June 2007, most of the Site was flooded, with only the centre shown to be free from flooding. The November 2019 flood event, affected the northern, eastern and southern boundary of the Site.

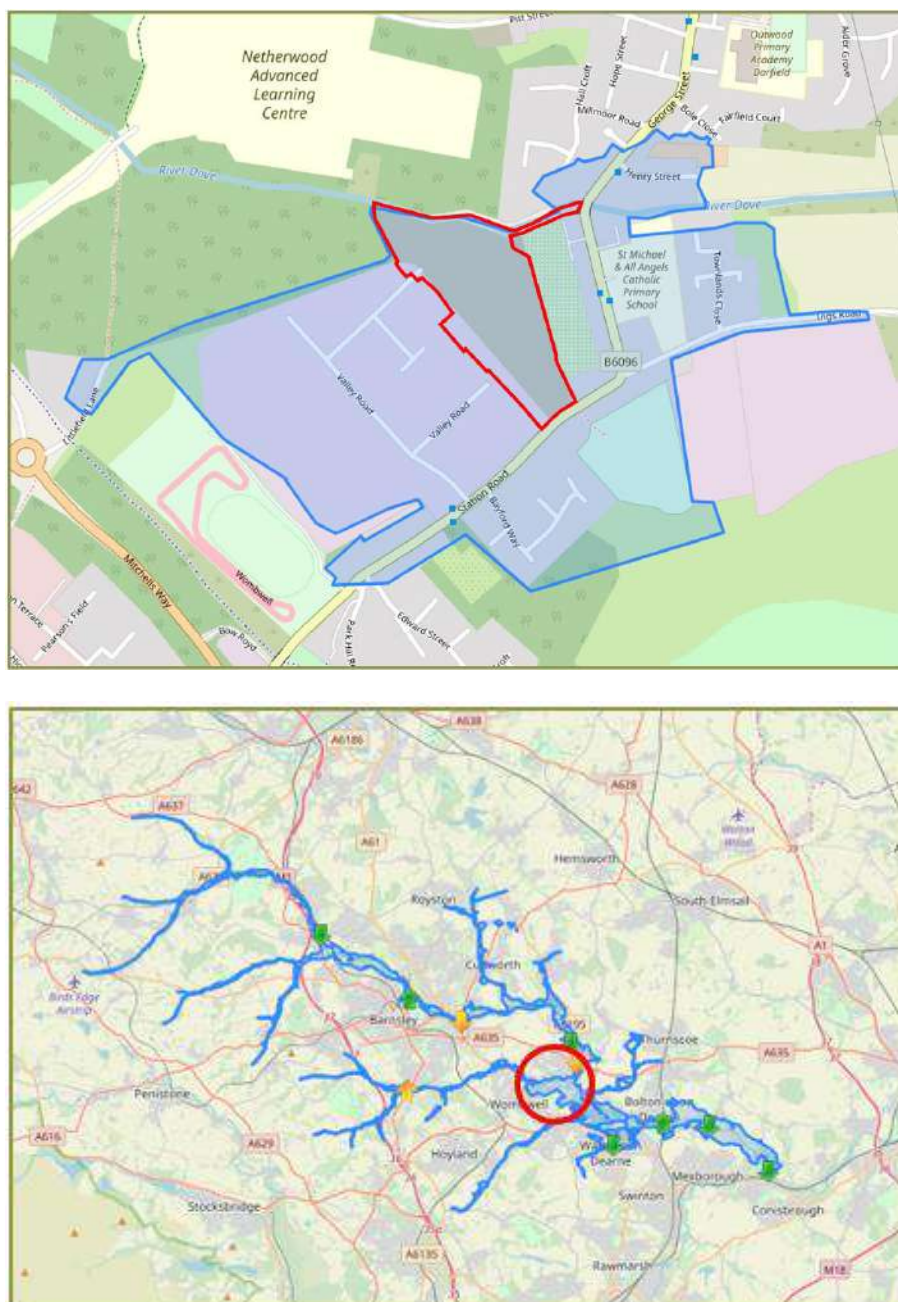
Flood Defences

- 4.2.12 SFRA mapping (Appendix 3) and Environment Agency online flood mapping shows that the Site does not benefit from flood defences. Defences on the River Dove are present approximately 350m downstream of the Site.

Flood Warning Service

- 4.2.13 The River Levels UK website (Figure 4.2) shows the Site is located within two flood warning areas; the River Dove from Aldham Bridge to Low Valley including Wombwell Ings Caravan Site; and the River Dearne Catchment.

Figure 4.2: Flood Warning Areas



Top: River Dove Warning Area. **Bottom:** River Dearne Flood Warning Area

Summary Flood Risk

- 4.2.14 The risk of fluvial flooding is assessed as low to high.
- 4.2.15 Mitigation measures against fluvial flooding are discussed in Section 5.

4.3 Tidal Flooding

- 4.3.1 The Site is not located close to tidally affected flooding sources.

Summary Flood Risk

- 4.3.2 The flood risk from this source is assessed as negligible.

4.4 Groundwater Flooding

Introduction

- 4.4.1 Groundwater flooding occurs when subsurface water emerges either at surface or in made ground or in subsurface structures such as basements and services ducts. It occurs as diffuse seepage, emergence from new point source springs or an increase in flow from existing springs. It results from aquifer recharge from infiltrating rainfall, from sinking streams entering aquifers from adjacent non-aquifers, or from high river levels or tides driving water through near surface deposits. It tends to occur with a delay following rainfall and can last for several weeks or months. Groundwater flooding or shallow water tables also prevent or reduce infiltration and so can worsen surface water flooding.

BGS Groundwater Flooding Susceptibility Map

- 4.4.1 The BGS Groundwater Flooding Susceptibility Map (Drawing 003) shows that most of the Site is within the mapped extent of susceptibility to groundwater flooding, with potential for flooding to occur at surface. The south-eastern corner and eastern boundary of the Site are not shown to be at risk of groundwater flooding. The higher risk of groundwater flooding is likely to be linked to the Alluvium superficial deposits (clay, silt, sand and gravel), which have high permeability. The bedrock underlying most of the Site is Pennine Middle Coal Measures Formation (mudstone, siltstone and sandstone), which has a lower permeability than the alluvium.
- 4.4.2 The BGS mapping is coarse and should be superseded by the Geosmart groundwater flood risk map.

Geosmart Groundwater Flood Risk Map

- 4.4.3 The Geosmart 1 in 100-year groundwater flood risk map (Drawing 006) shows that the entire Site is at negligible risk of groundwater flooding and falls within Risk Class 4 (Table 4.2).
- 4.4.4 Mapped classes combine understanding of likelihood, model and data uncertainty, and possible severity. Likelihood is ranked according to whether we expect groundwater flooding at a site due to extreme elevated groundwater levels with an annual probability of occurrence greater than 1%, considering model and data uncertainty. Severity relates to expectations of the amount of property damage or other harm that groundwater flooding at that location might cause (Table 4.2).

Table 4.2: Groundwater Flood Risk Classification

Risk Class	Probability of Groundwater Flooding	Effect
4: Negligible	Annual probability less than 1%.	Negligible unless unusually sensitive use.
3: Low	Annual probability greater than 1%.	Remote possibility of damage to property or harm to sensitive receptors. Flooding likely to be limited to seepages and waterlogged ground, damage to basements and subsurface infrastructure, and should pose no significant risk to life.

Risk Class	Probability of Groundwater Flooding	Effect
		Surface water flooding may be worsened.
2: Moderate	Annual probability greater than 1%.	Significant possibility of damage to property or harm to other sensitive receptors at or near this location. flooding is likely to be in the form of shallow pools or streams. Surface water flooding and failure of drainage systems may be worsened when groundwater levels are high.
1: High	Annual probability greater than 1%.	Groundwater flooding will occur which could lead to damage to property or harm to other sensitive receptors at or near this location. Flooding may result in damage to property, road or rail closures and, in exceptional cases, may pose a risk to life. Surface water flooding and failure of drainage systems may be worsened when groundwater levels are high.

Borehole Records

- 4.4.5 BGS online borehole mapping recorded groundwater ingress at 0.30 and 4.65m bgl in the superficial deposits. The borehole records support the presence of shallow groundwater beneath the Site.

Summary Flood Risk

- 4.4.6 The risk of groundwater flooding is assessed as negligible as per available mapping, though borehole logs show that there is a low risk of flooding, which is likely to be limited to below ground levels and linked to the water levels in the River Dove.
- 4.4.7 Mitigation measures against groundwater flooding are discussed in Section 5.

4.5 Surface Water Flooding

Introduction

- 4.5.1 Surface water flooding occurs following rainfall on ground where infiltration rates are less than the rainfall precipitation rate. This can occur when either:
- Soils or ground materials are naturally of low permeability or have been compacted (infiltration excess runoff);
 - Soils or ground materials are saturated from previous rainfall either directly or from upslope (saturation excess runoff and return flow) or from high groundwater levels.

SFRA Mapping

- 4.5.2 SFRA mapping (Appendix 3) shows no risk of surface water flooding in the majority of the Site. There is however a surface water flow pathway along the reach of Bulling Dike with depths of up to 1.00-1.50m and three areas of surface water ponding within the centre of the Site at

depths of 0.15-0.50m. The mapping is small scale and should be used with caution for site specific assessments.

- 4.5.3 The SFRA mapping is superseded by the more detailed Environment Agency Complex Surface Water Flood mapping.

JBA Surface Water Flood Map

- 4.5.4 The JBA Surface Water Flood Map (Drawing 004.1) shows that the south-western boundary of the Site, an area associated with Bulling Dike is at risk of surface water flooding. This risk for the south-western boundary is predominantly associated with the 1 in 75-year, 200-year and 1000-year event.
- 4.5.5 The JBA mapping also identifies three areas of surface water ponding in the central northern part of the Site with risk between the 1 in 200-year and 1000-year events.
- 4.5.6 The JBA Surface Water Flood mapping is superseded by the more detailed Environment Agency Complex Surface Water Flood mapping.

Environment Agency Complex Surface Water Flood Mapping

- 4.5.7 The Environment Agency Complex Surface Water Flood Mapping (Drawings 010.1 to 010.4) shows that there is a surface water flow pathway associated with the route of Bulling Dike along the south-western boundary and within the south western extent of the Site. The flood depth is between 0.00 and >1.20m during the extreme 1000-year event. The flood velocity is up to >2.00m/s. The flood hazard is between 'low' (0.50-0.75) and 'extreme' (>2.00).
- 4.5.8 The Bulling Dike surface water flow pathway is shown to flow through the potential emergency vehicular access off Valley Road. At this point, the flood depth is >1.20m during the extreme 1000-year event. The flood velocity is up to >2.00m/s. The flood hazard is between 'low' (0.50-0.75) and 'extreme' (>2.00). The Bulling Dike surface water flow pathway is also shown to affect the proposed vehicular access via Station Road. At this point, the flood depth is >1.20m during the extreme 1000-year event. The flood velocity is up to 2.00m/s. The flood hazard is between 'low' (0.50-0.75) and 'significant' (>1.25-2.00). In both cases, the risk is associated with Bulling Dike and does not consider the conveyance capacity of the Valley Road bridge and Station Road culvert. The Enzygo Ltd hydraulic modelling has shown the fluvial risk from Bulling Dike would be low.
- 4.5.9 A second flow pathway associated with the River Dove is shown along the northern boundary of the Site. The flood depth is between 0.00 and 1.20m during the extreme 1000-year event. The flood velocity is up to 2.00m/s. The flood hazard is between 'low' (0.50-0.75) and 'extreme' (>2.00).
- 4.5.10 Both surface water flow pathways are associated with fluvial flooding and are therefore superseded by the Enzygo Ltd modelling (Section 4.2).
- 4.5.11 The mapping also shows three areas of surface water ponding within the central northern area of the Site. The larger and most northerly of the ponds has a flood depth between 0.15 and 0.60m and flood velocity is up to 0.50m/s during the extreme 1000-year event. The flood hazard is between 'low' (0.50-0.75) and 'moderate' (0.75-1.25). The two smaller ponds have a flood depth between 0.15 and 0.30m and flood velocity is up to >0.50m/s during the extreme 1000-year event. The flood hazard is between 'low' (0.50-0.75) and 'moderate' (0.75-1.25).

Summary Flood Risk

- 4.5.12 The risk of surface water flooding for most of the Site is assessed as negligible. Bulling Dike and the River Dove are associated with fluvial flooding which is assessed in Section 4.2. There are three areas of low risk ponding within the central northern part of the Site.
- 4.5.13 Mitigation measures against surface water flooding are discussed in Section 5.

4.6 Sewer Flooding

Introduction

- 4.6.1 Sewer flooding occurs when urban drainage networks become overwhelmed after heavy or prolonged rainfall due to restrictions or blockage in the sewer network or if the volume of water draining into the system exceeds the sewer design capacity.
- 4.6.2 New sewers are built to the guidelines within Sewers for Adoption¹⁹ and have a design standard to the 1 in 30-year flood event. Older sewers were not designed to any standard. Modern sewer systems will only surcharge during rainstorm events with a return period greater than 1 in 30-years (e.g. 1 in 100-years).
- 4.6.3 There is a public combined sewer within the south-western extent of the Site and two public surface water sewers out falling to Bulling Dike (Appendix 4). Based on the location of these assets, any floodwater from the surcharging or failure of these assets would follow the topography to the south west towards Bulling Dike and away from the development.

Summary Flood Risk

- 4.6.4 The risk of flooding from sewers is assessed as negligible for most of the Site and low for the area in the south-western extent of the Site downslope of the combined sewer.

4.7 Flooding from Infrastructure Failure

Reservoir

- 4.7.1 The Environment Agency online flood mapping shows the Site is located outside the extent of flooding sourced from reservoirs.

Summary Flood Risk

- 4.7.2 The risk of flooding from reservoirs is assessed as negligible.

¹⁹ WRC (2012) Sewers for Adoption 7th Edition.

5.0 Flood Risk Mitigation Measures

5.1 Introduction

5.1.1 The following sources of flooding were identified:

- Fluvial flooding from the River Dove and Bulling Dike;
- Surface water flooding, associated with the River Dove and Bulling Dike, and ponding within the central northern extent of the Site;
- Groundwater Flooding and;
- Sewerflooding.

5.2 Mitigation Measures

Fluvial Flooding from the River Dove

- Undertake maintenance activities to keep the watercourses clear from debris and overgrown vegetation to maintain the conveyance of the channels.
- Provide a 4m easement free from development along either side of the onsite/bounding land drains. This easement would provide access for inspection and maintenance purposes, including vehicle access.
- It is recommended that the number of highway crossings along the route of the land drain is kept to a minimum. Culvert crossings would need to be sized to convey the 1 in 100-year plus climate change event, with a freeboard allowance.
- Construction of the open space storage area would be using a gravelled surface to allow water to permeate into the proposed ground surface before discharging via through flow to the River Dove or Bullings Dike.

Surface Water Flooding

- Ensure final surfacing on the Site is as per above.

Groundwaterflooding

- No below ground infrastructure.
- Lined gravel surfacing.

Sewer Flooding

- Provide a development free easement (3m either side) of onsite public surface water sewer assets.

5.3 Summary of Flood Risk

5.3.1 Table 5.1 summarises the probability and level of risk, both with and without mitigation measures.

Table 5.1: Probability and Consequences of All Sources of Flooding

Flooding Source	Potential Source	Probability	Consequence & Impact Without Mitigation	Consequence & Impact with Mitigation
Fluvial	River Dove and Bulling Dike	Low to high across the Site	Low to high across the Site	Low
Tidal	None identified	Negligible	Negligible	Negligible
Groundwater	Aquifer	Negligible for most of the Site, though borehole logs show that there is a low risk of flooding, which is likely to be limited to below ground levels and linked to the water levels in the River Dove.	Negligible for most of the Site, though borehole logs show that there is a low risk of flooding, which is likely to be limited to below ground levels and linked to the water levels in the River Dove.	Negligible
Surface Water	Poor permeability and Site topography	Negligible for most of the Site but low where there is surface water ponding and flow pathways.	Negligible for most of the Site but low where there is surface water ponding and flow pathways.	Negligible
Sewer	Public sewers	Negligible for most of the Site and low for the area in the south-western extent of the Site downslope of the combined sewer	Negligible for most of the Site and low for the area in the south-western extent of the Site downslope of the combined sewer	Negligible
Infrastructure Failure	Reservoir Failure	Negligible	Negligible	Negligible

Key: Green - Negligible, Yellow - Low, Orange - Medium and Red - High; based on consequence and impact with mitigation from each flooding source.

5.4 Flood Guidance and Sequential Test

- 5.4.1 The proposal is for the change of use of the Site to B8 – Storage or distribution for open-air storage development. The PPG ID: 7 (not included in this report) classifies the proposed use as ‘water compatible’.
- 5.4.2 The Environment Agency Flood Zones and acceptable development types are listed in Table 5.2. All development types (including water compatible uses) are acceptable in Flood Zones 1, 2 and 3 (low to high risk). As such, the Sequential Test would be passed and the Exception Test would not be required as indicated in Table 5.3.

Table 5.2: Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).	All development types generally acceptable.

Flood Zone	Probability	Explanation	Appropriate Land use
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year.	Most development type are generally acceptable.
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.	Some development types not acceptable.
Zone 3b	'Functional Floodplain'	Land where water must flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).	Some development types not acceptable.

Note: The Flood Zones are the current best information on the extent of the extreme flood from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The identified risk of fluvial flooding is highlighted green.

Table 5.3: Vulnerability and Flood Zone 'Compatibility' as Identified in Table 2 of PPG ID: 7

Flood Risk Vulnerability classification (see Table 1 of PPG ID: 7)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception test required	Yes	Yes
Zone 3a	Exception test required	Yes	No	Exception test required	Yes
Zone 3b 'Functional Floodplain'	Exception test required	Yes	No	No	No

Key: Yes: Development is appropriate, No: Development should not be permitted.
The identified risk of fluvial flooding is highlighted green.

6.0 Site Drainage

6.1 Surface Water Drainage

- 6.1.1 Consideration of flood issues is not confined to the floodplain. This is recognised in the NPPF and associated guidance where all proposed development of 1ha or more in flood zone 1 and so outside the floodplain nevertheless requires an FRA. The alteration of natural surface water flow patterns through development can lead to problems elsewhere in a catchment, particularly flooding downstream; and the replacement of permeable vegetated areas by low-permeability roofs, roads and other paved surfaces will increase the speed, volume and peak flow of surface water runoff. So, the NPPF and associated guidance require an FRA for all proposed development of 1ha or more outside the floodplain in flood zone 1.
- 6.1.2 A surface water management strategy for the development is proposed to manage and reduce the flood risk posed by surface water runoff from the Site. The developer will be required to ensure that any scheme for surface water management should build in enough capacity for the entire Site.
- 6.1.3 The surface water drainage arrangements for any development Site should be such that the volume and peak flow rates of surface water leaving a developed Site are no greater than the rates prior to the proposed development, unless specific off-Site arrangements are made and result in the same net effect.
- 6.1.4 An assessment of the surface water runoff rates was undertaken to determine the surface water options and attenuation requirements for the Site.

6.2 Existing Drainage System

- 6.2.1 The 3.80ha Site land use comprises of a demolished industrial unit, which included parking areas and internal road. The remnants of these areas of hardstanding are still present along with scrubland and a number of spoil heaps.
- 6.2.2 The Site is underlain by impermeable soils and bedrock. The current drainage arrangement within the Site is predominantly by overland flow, following the topography towards the River Dove in the northern part of the Site or Bulling Dike in the southern and western parts of the Site. A small amount of infiltration to bedrock, and throughflow to watercourse is also likely.
- 6.2.3 There is currently no foul water discharging from the derelict brownfield site, additionally no buildings are proposed on the Site just open space. As such, foul drainage has not been considered within this report.

6.3 Surface Water Management Strategy

Hierarchy of Discharge

- 6.3.1 In accordance with requirement H3 of the Building Regulations 2010²⁰ rainwater runoff must discharge to one of the following, listed in order of priority:
- 1. An adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable:** The use of infiltration-based SuDs is not feasible due to low infiltration potential.

²⁰ Office of the Deputy Prime Minister, The Building Regulations 2010.

- 2. A watercourse; or where that is not reasonably practicable:** The River Dove is located adjacent to the northern site boundary, with Bulling Dike located on the south western boundary of the Site.
 - 3. A sewer:** There is a combined Ø600mm public sewer along the south-western boundary of the Site and two sewers in the south-west of the Site; the more northerly Ø675mm and southerly Ø225mm.
- 6.3.2 The potential route to discharge from the existing Site will be by rainfall permeating at source before throughflow discharges to the River Dove or Bulling Dike.

Drainage Design

- 6.3.3 The proposed development will be comprised of a gravelled surface used as a storage site, where rainfall will permeate the gravel surface before travelling as through flow, through the underlying soils and geology before flows enter either the River Dove or Bulling Dike. This would offer a betterment on existing conditions.²

6.4 Exceedance Routes

- 6.4.1 Any exceedance of flows which do not permeate to through the proposed gravel surface for the Site, would dependent upon the topography of the Site flow towards either the River Dove or Bulling Dike.

7.0 Summary and Conclusions

7.1 Introduction

- 7.1.1 A site-specific Flood Risk Assessment (FRA) has been undertaken for a proposed change of use for the Site to B8 – Storage or distribution for open-air storage development, located on a 3.80ha Site on land of north of Station Road, Wombwell.

7.2 Flood Risk

- 7.2.1 The risk of fluvial flooding is assessed as low to high across the Site.
- 7.2.2 The risk of surface water flooding is assessed as negligible for most of the Site, but low where there is surface water ponding and flow pathways.
- 7.2.3 The risk of groundwater flooding for most of the Site, though borehole low that there is a low risk of flooding, which is likely to be limited to below ground levels and linked to the water levels in the River Dove.
- 7.2.4 The risk of flooding from sewers/mains is assessed as negligible for most of the Site, but low for the area in the south-western extent of the Site downslope of the combined sewer.
- 7.2.5 The risk of flooding from all other sources is assessed as negligible.

7.3 Mitigation Measures

- 7.3.1 Flood risk can be mitigated to a negligible or low and acceptable level through the following approach:
- Undertake maintenance activities to keep the watercourses clear from debris and overgrown vegetation to maintain the conveyance of the channels.
 - Provide a 4m easement free from development along either side of the onsite/bounding land drains. This easement would provide access for inspection and maintenance purposes, including vehicle access.
 - It is recommended that the number of highway crossings along the route of the land drain is kept to a minimum. Culvert crossings would need to be sized to convey the 1 in 100-year plus climate change event, with a freeboard allowance.
 - Construction of the open space storage area would be using a gravelled surface to allow water to permeate into the proposed ground surface before discharging via through flow to the River Dove or Bullings Dike.
 - No below ground infrastructure.
 - Lined gravel surfacing.
 - Provide a development free easement (3m either side) of onsite public surface water sewer assets.

7.4 Flood Guidance

- 7.4.1 The proposed open storage use is classified as water compatible. Water compatible uses are considered acceptable in terms of flood risk in Flood Zones 1, 2 and 3. As such, the Sequential Test would be passed, and the Exception Test would not be required.

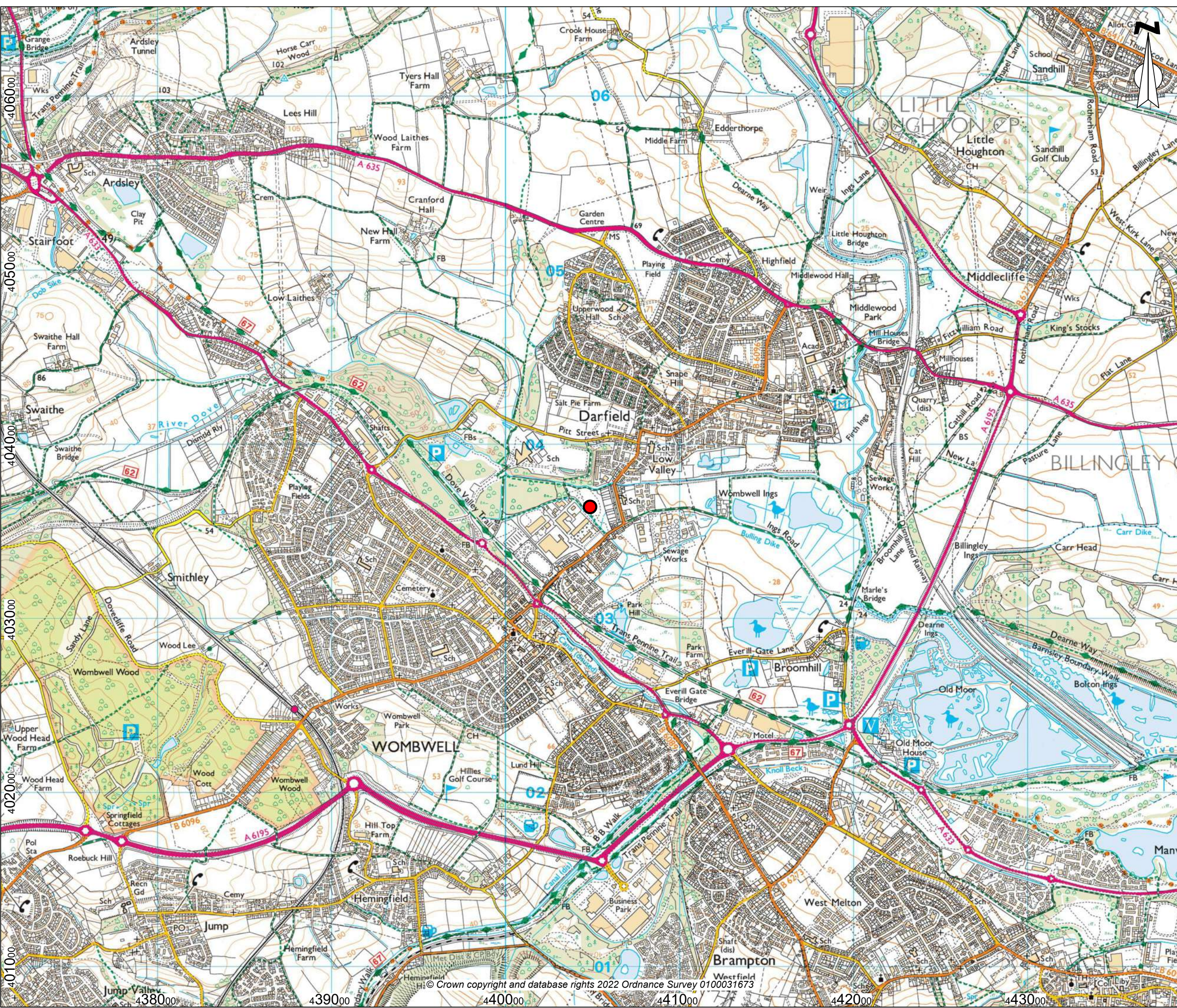
7.5 Site Drainage

7.5.1 The proposed development will be comprised of a gravelled surface used as a storage site, where rainfall will permeate the gravel surface before travelling as through flow, through the underlying soils and geology before flows enter either the River Dove or Bulling Dike.

7.6 Conclusion

7.6.1 This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of national policy and guidance.

7.6.2 The development should not therefore be precluded on the grounds of flood risk and surface water drainage.



Key

Site Boundary (SE 40486 03641)



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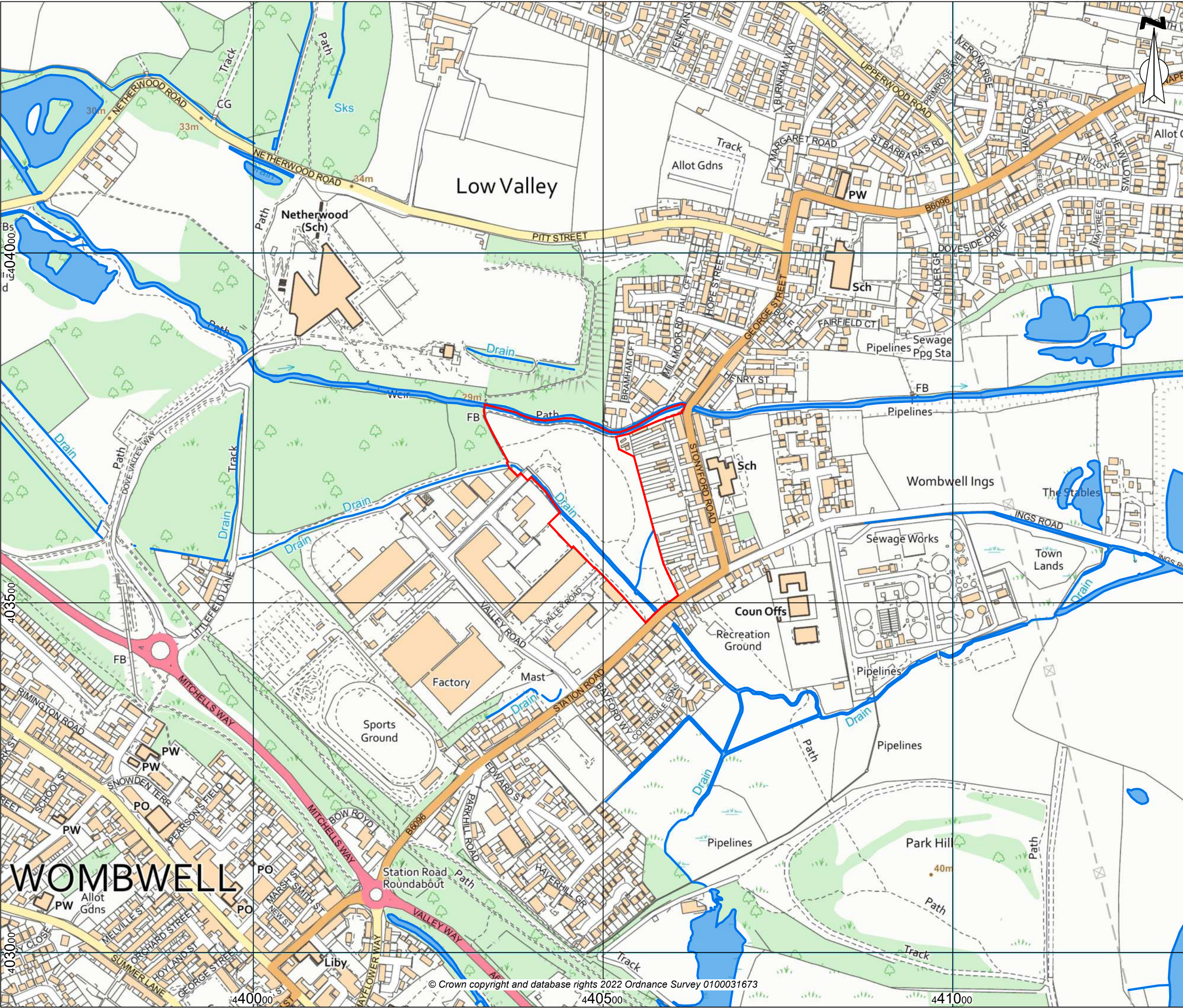
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DRAWN: CHECKED: DATE:
LW MG Nov 2022

PROJECT:
Land at Station Road, Wombwell

TITLE:
Site Location Plan

FIGURE NO:
SHF.1122.009.HY.D.001



Key

- Site Boundary
- Surface Water Features



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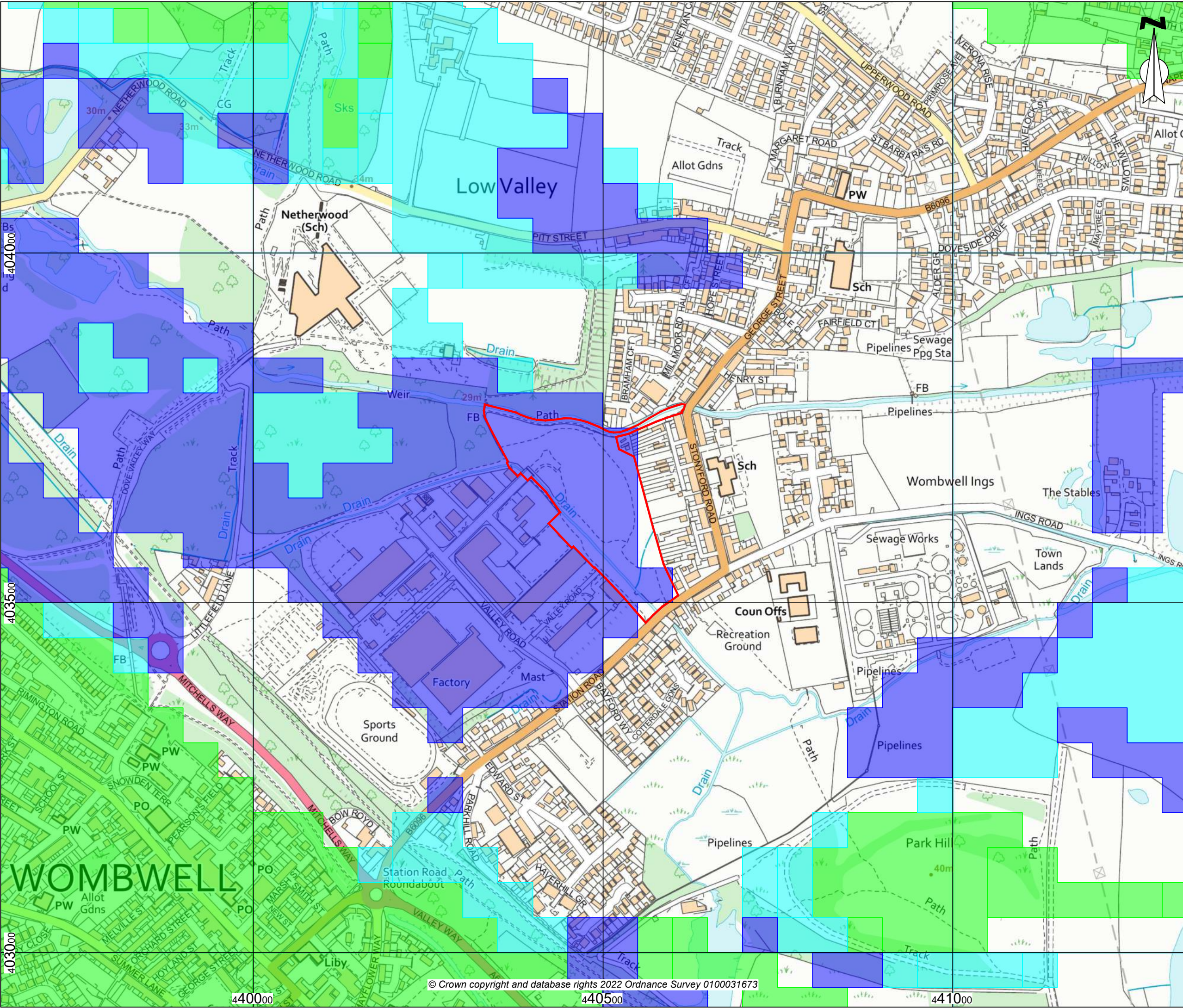
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DRAWN: LW
CHECKED: MG
DATE: Nov 2022





PROJECT:
Land at Station Road, Wombwell

TITLE:
Surface Water Features

FIGURE NO:
SHF.1122.009.HY.D.002



Key

-  Site Boundary
-  Potential for Groundwater Flooding to Occur at Surface
-  Potential for Groundwater Flooding of Property Situated Below Ground Level
-  Limited Potential for Groundwater Flooding to Occur



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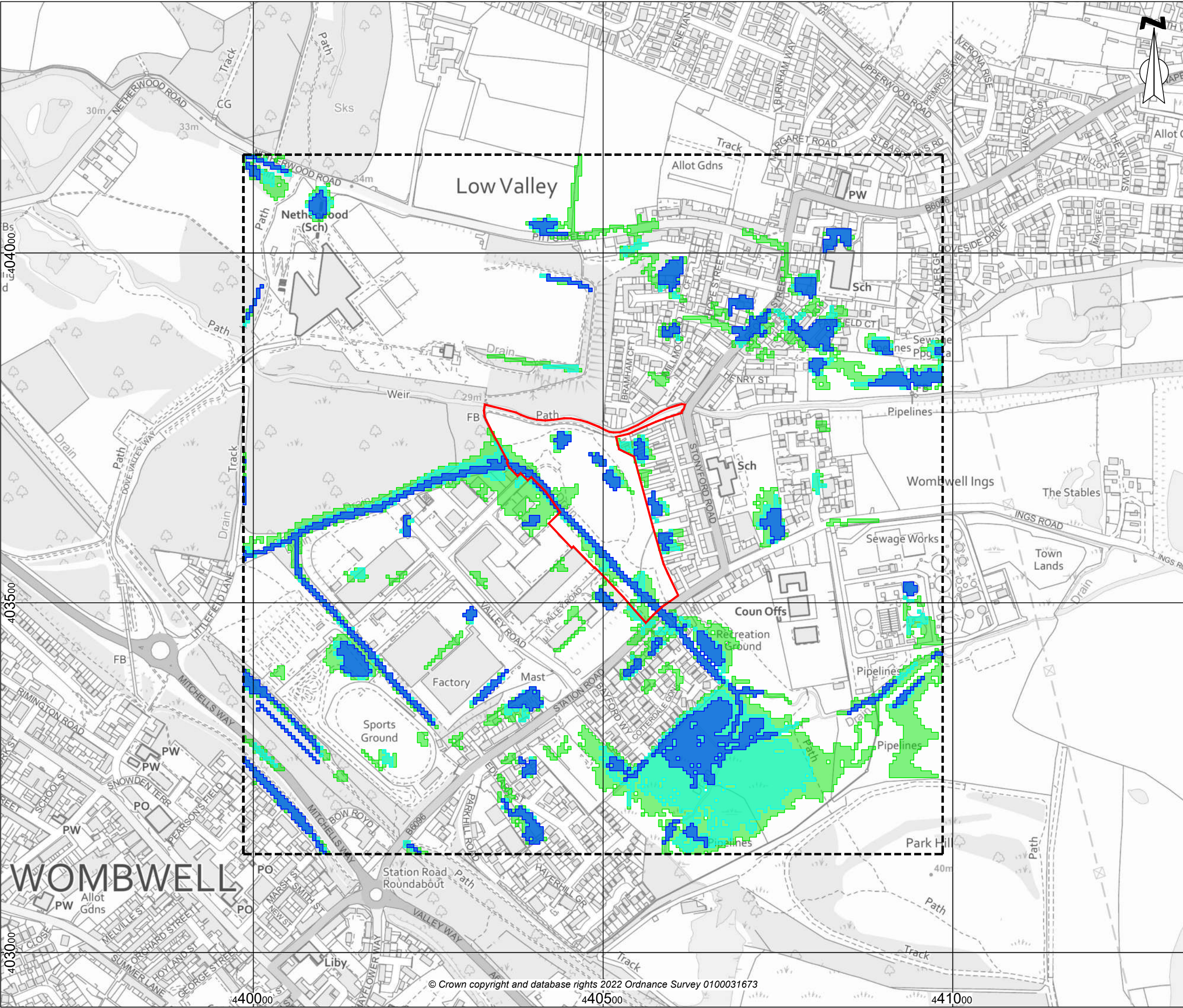
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DRAWN: LW CHECKED: MG DATE: Nov 2022






PROJECT:
Land at Station Road, Wombwell

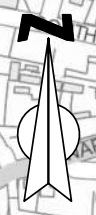
TITLE:
BGS Groundwater Flooding Susceptibility

FIGURE NO:
SHF.1122.009.HY.D.003



Key

-  Site Boundary
-  Search Extent
-  1 in 75 Year Surface Water Flooding
-  1 in 200 Year Surface Water Flooding
-  1 in 1000 Year Surface Water Flooding



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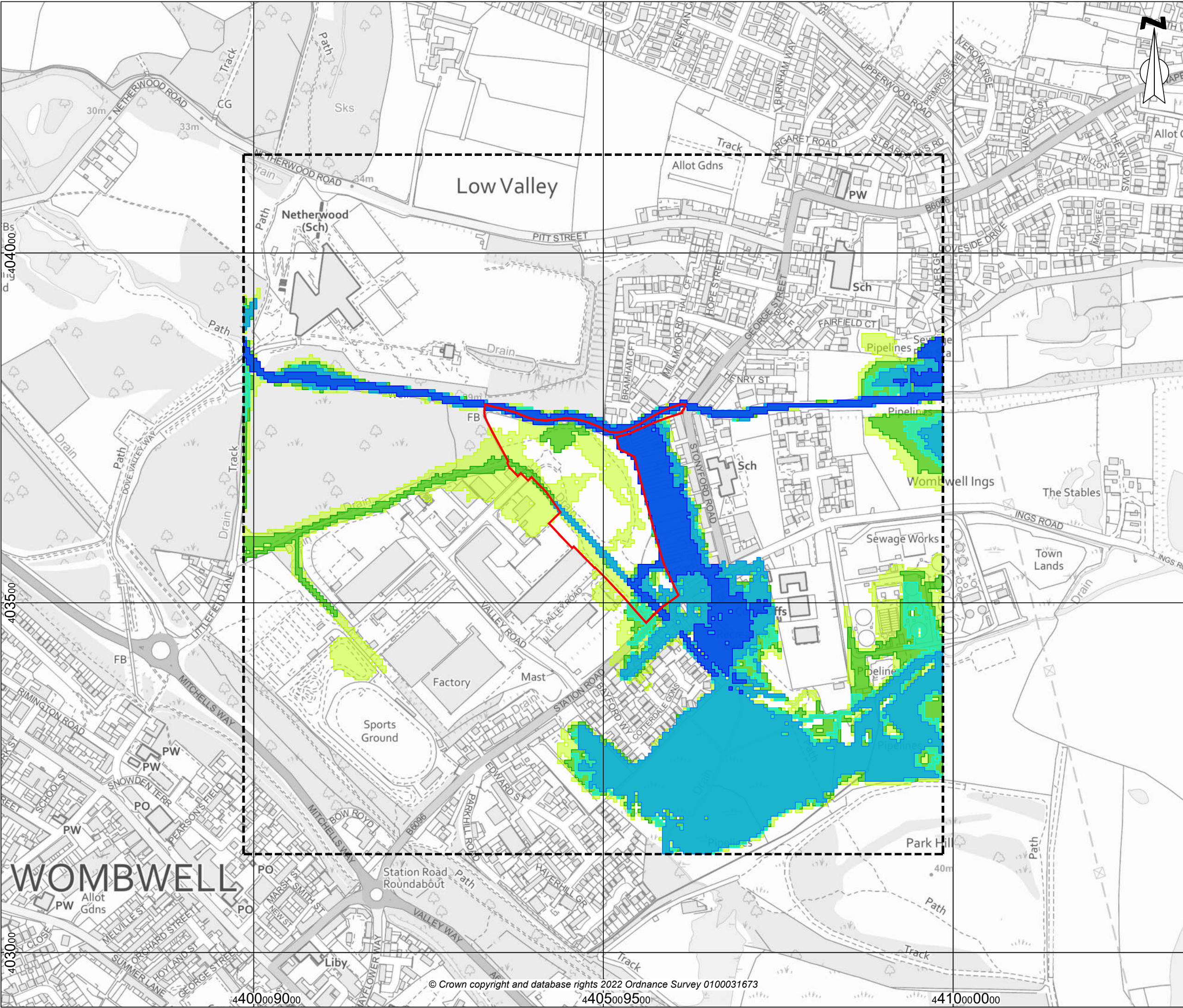
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DRAWN: LW CHECKED: MG DATE: Nov 2022








PROJECT:
Land at Station Road, Wombwell

TITLE:
JBA Surface Water Flooding

FIGURE NO:
SHF.1122.009.HY.D.004.1



Key

-  Site Boundary
-  Search Extent
-  1 in 20 Year Flooding from Rivers
-  1 in 75 Year Flooding from Rivers
-  1 in 100 Year Flooding from Rivers
-  1 in 200 Year Flooding from Rivers
-  1 in 1000 Year Flooding from Rivers



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Nov 2022

PROJECT:
Land at Station Road, Wombwell

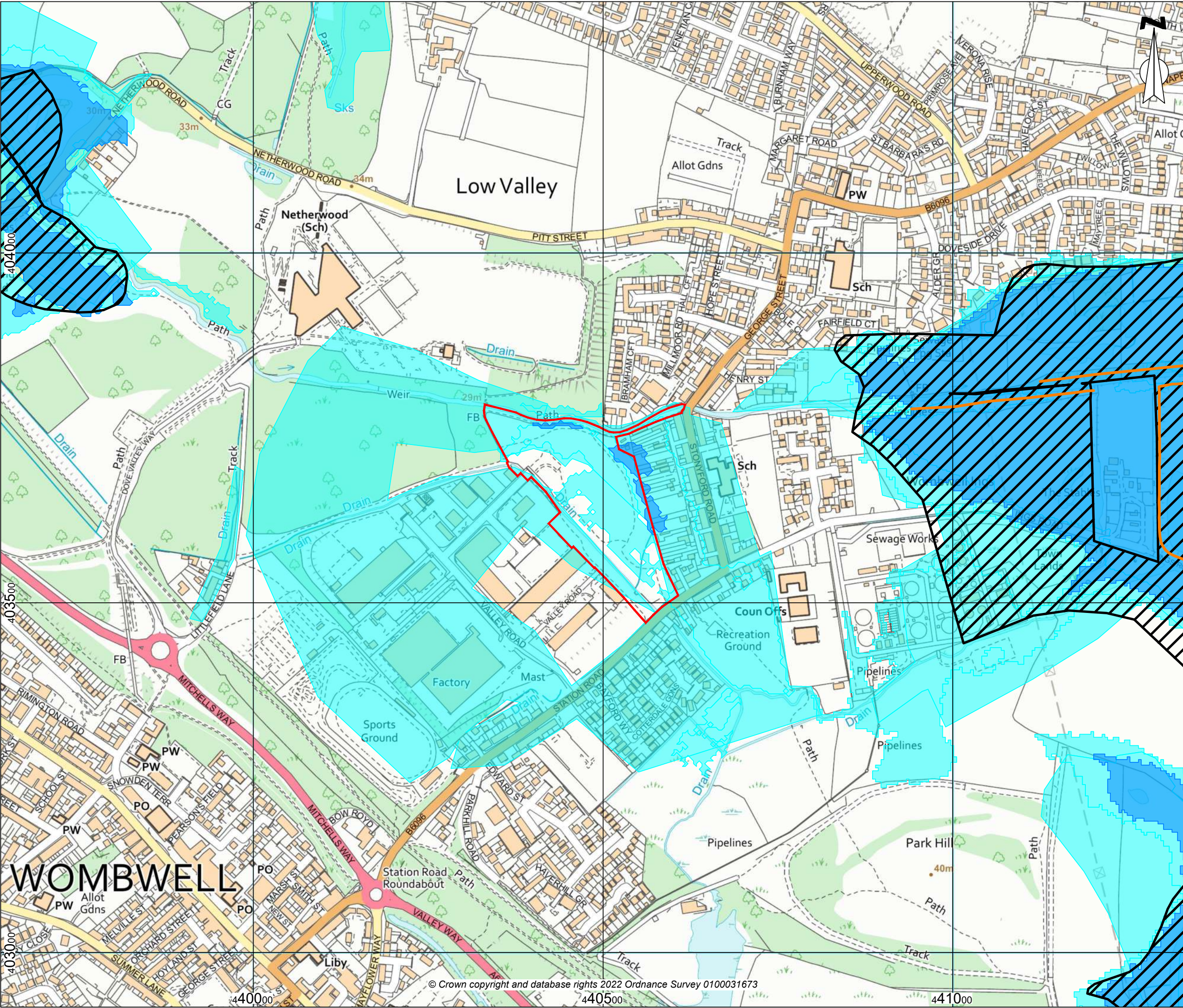
TITLE:
JBA Flooding from Rivers

FIGURE NO:
SHF.1122.009.HY.D.004.2







WOMBWELL

404000.5
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Key

-  Site Boundary
-  Flood Defences
-  Flood Water Storage Areas
-  Flood Zone 3
-  Flood Zone 2
-  Flood Zone 1



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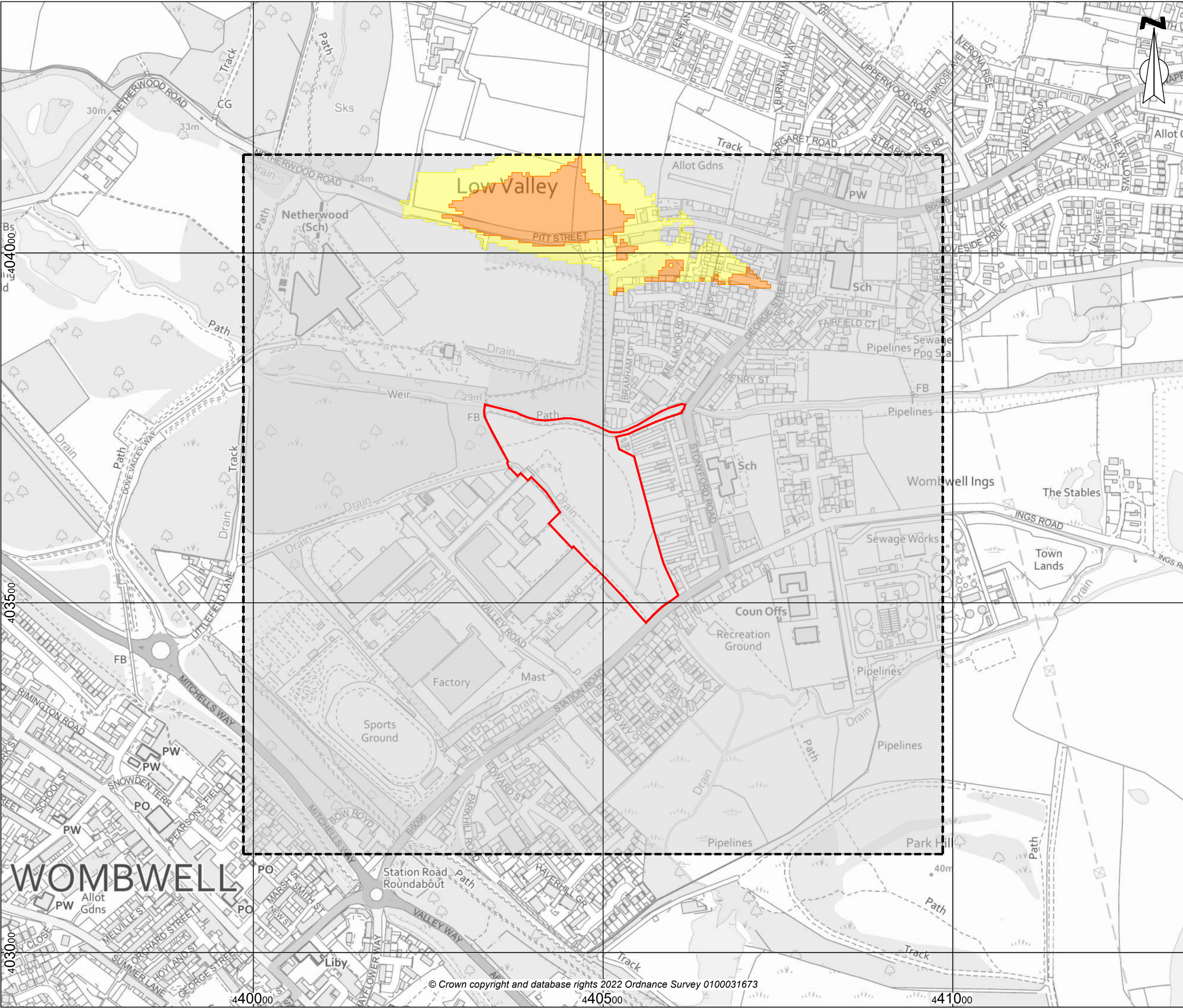
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
PROJECT:
Land at Station Road, Wombwell

TITLE:
Environment Agency Flood Zones

FIGURE NO:
SHF.1122.009.HY.D.005



Key

-  Site Boundary
-  Search Extent
-  Class 1 - High Risk
-  Class 2 - Moderate Risk
-  Class 3 - Low Risk
-  Class 4 - Negligible Risk

Notes:
 GEOSMART GROUNDWATER FLOOD RISK MAP GW5
 Version 2.2© - www.geosmartinfo.co.uk



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SCALE: 1:5,000@A3 PROJECT REF: SHF.1122.009

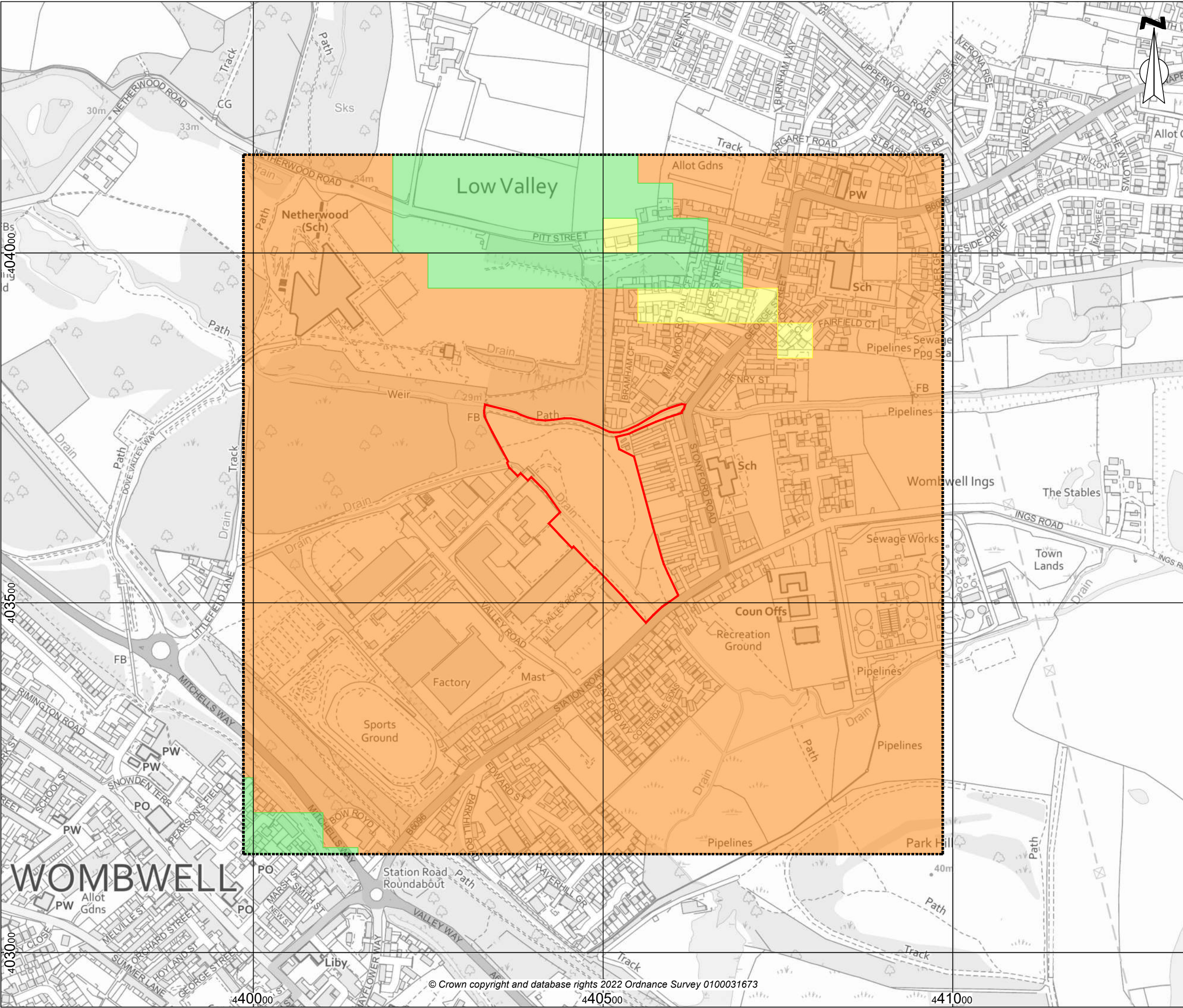
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PROJECT:
 Land at Station Road, Wombwell






TITLE:
 Groundwater Flood Risk Map

FIGURE NO:
 SHF.1122.009.HY.D.006

WOMBWELL



Key

-  Site Boundary
-  Search Extent
-  High Potential
-  Moderate Potential
-  Low Potential

Notes:

GEOSMART SUDS INFILTRATION POTENTIAL MAP SD50
Version 1.0© - www.geosmartinfo.co.uk



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SCALE: **1:5,000@A3** PROJECT REF: **SHF.1122.009**

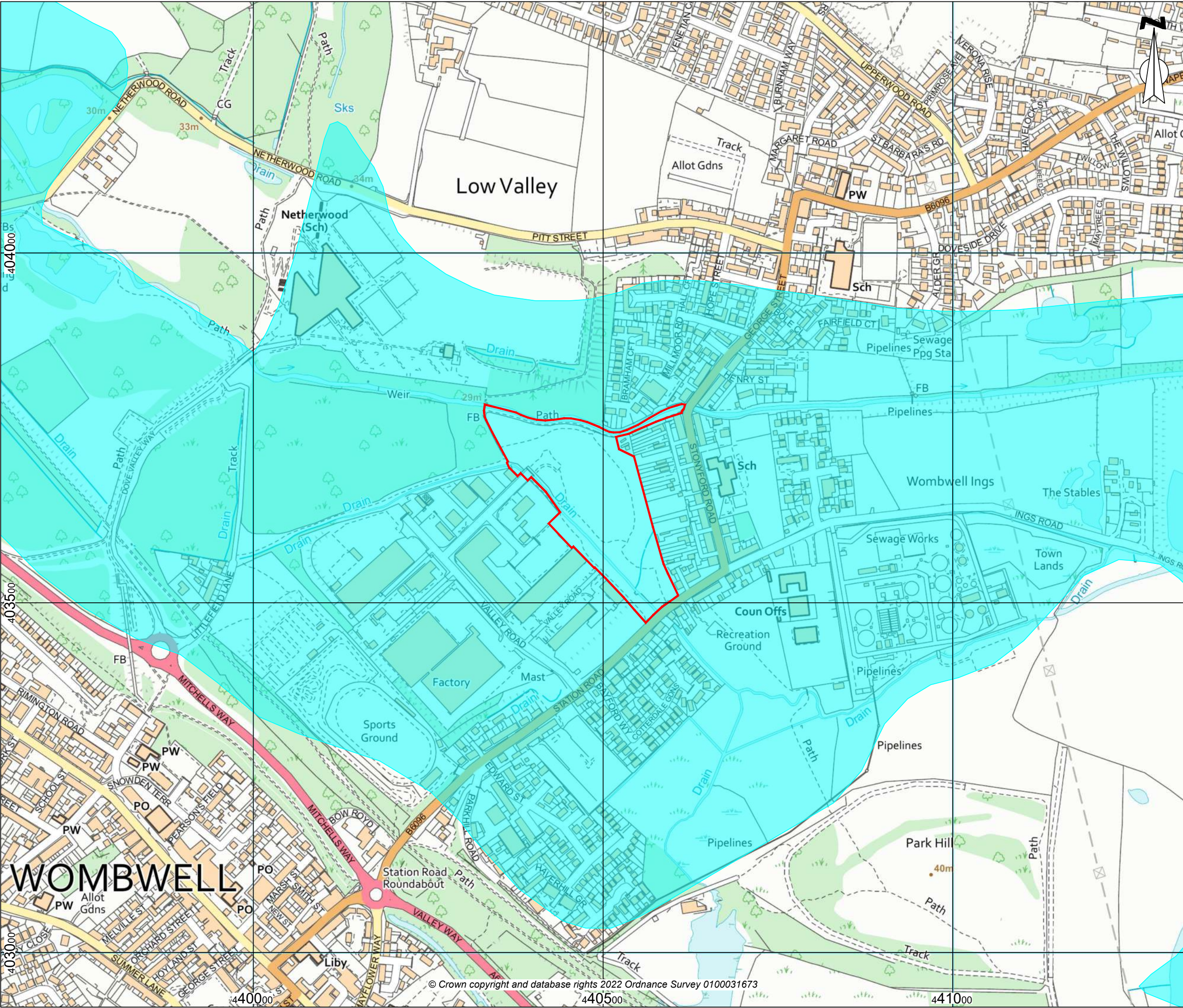
DRAWN: **LW** CHECKED: **MG** DATE: **Nov 2022**

PROJECT:
Land at Station Road, Wombwell



TITLE:
SuDS Infiltration Potential Map

FIGURE NO:
SHF.1122.009.HY.D.007

WOMBWELL



Key

-  Site Boundary
-  Geological Indicators of Flooding (Inland Flooding)



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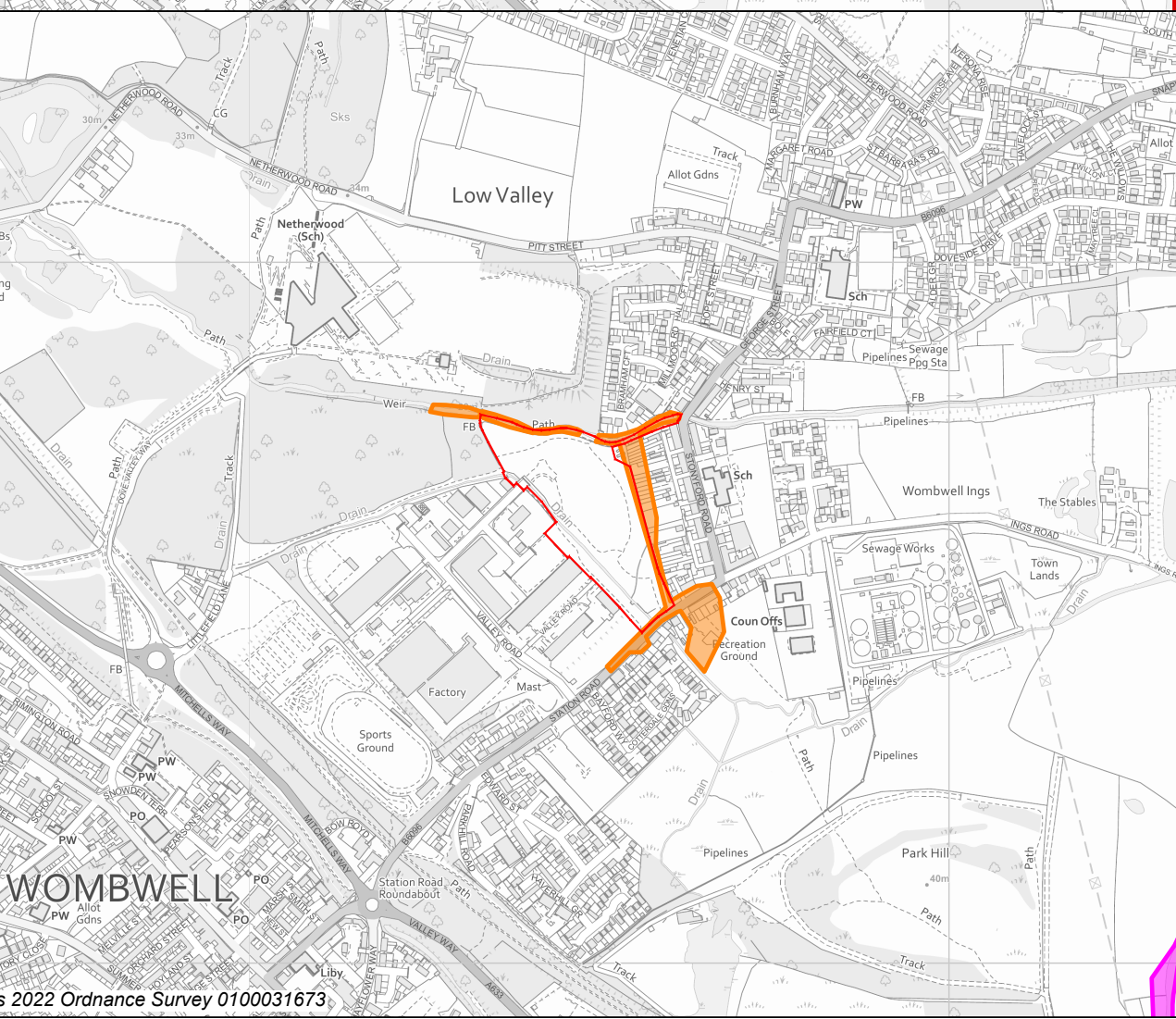
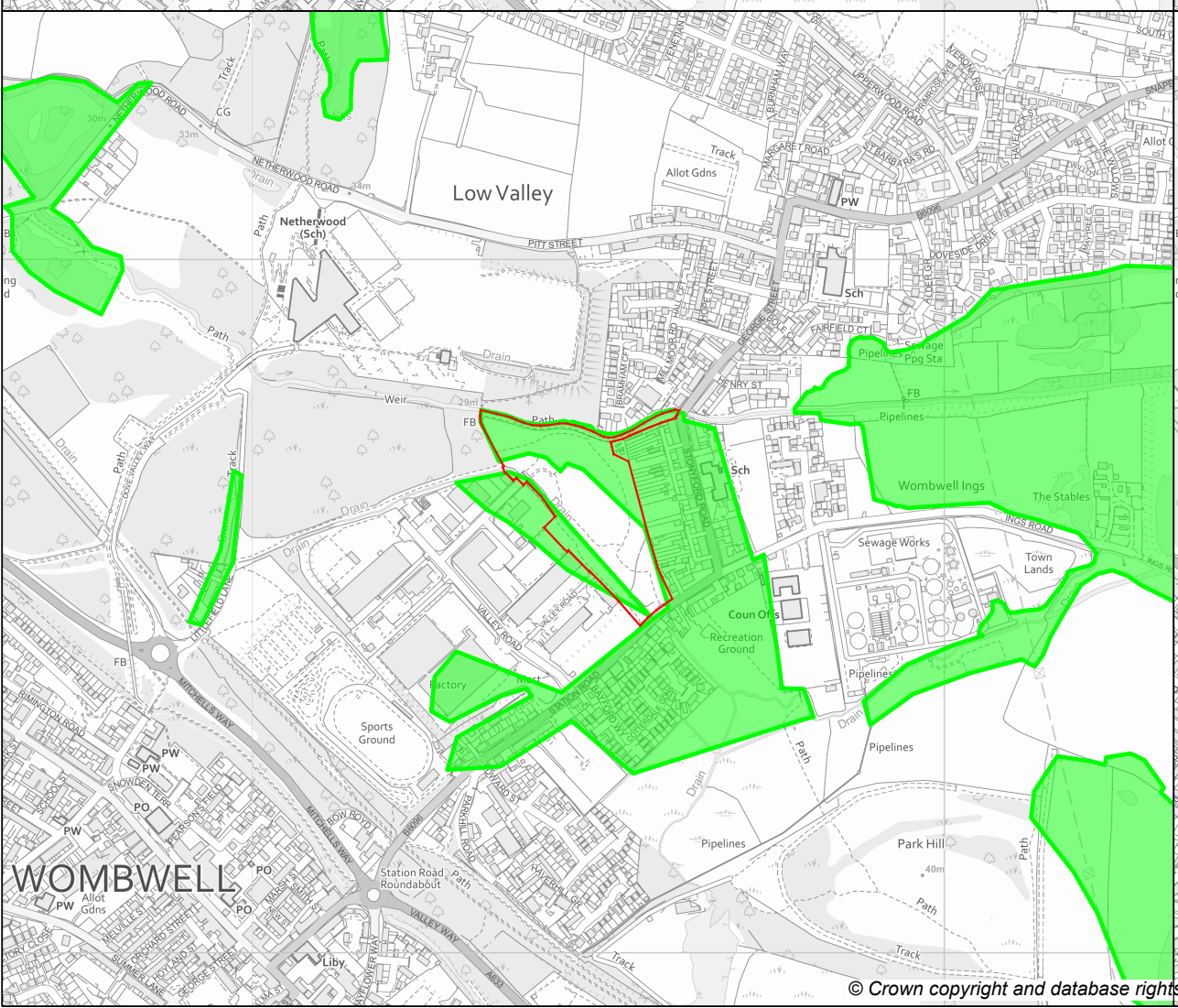
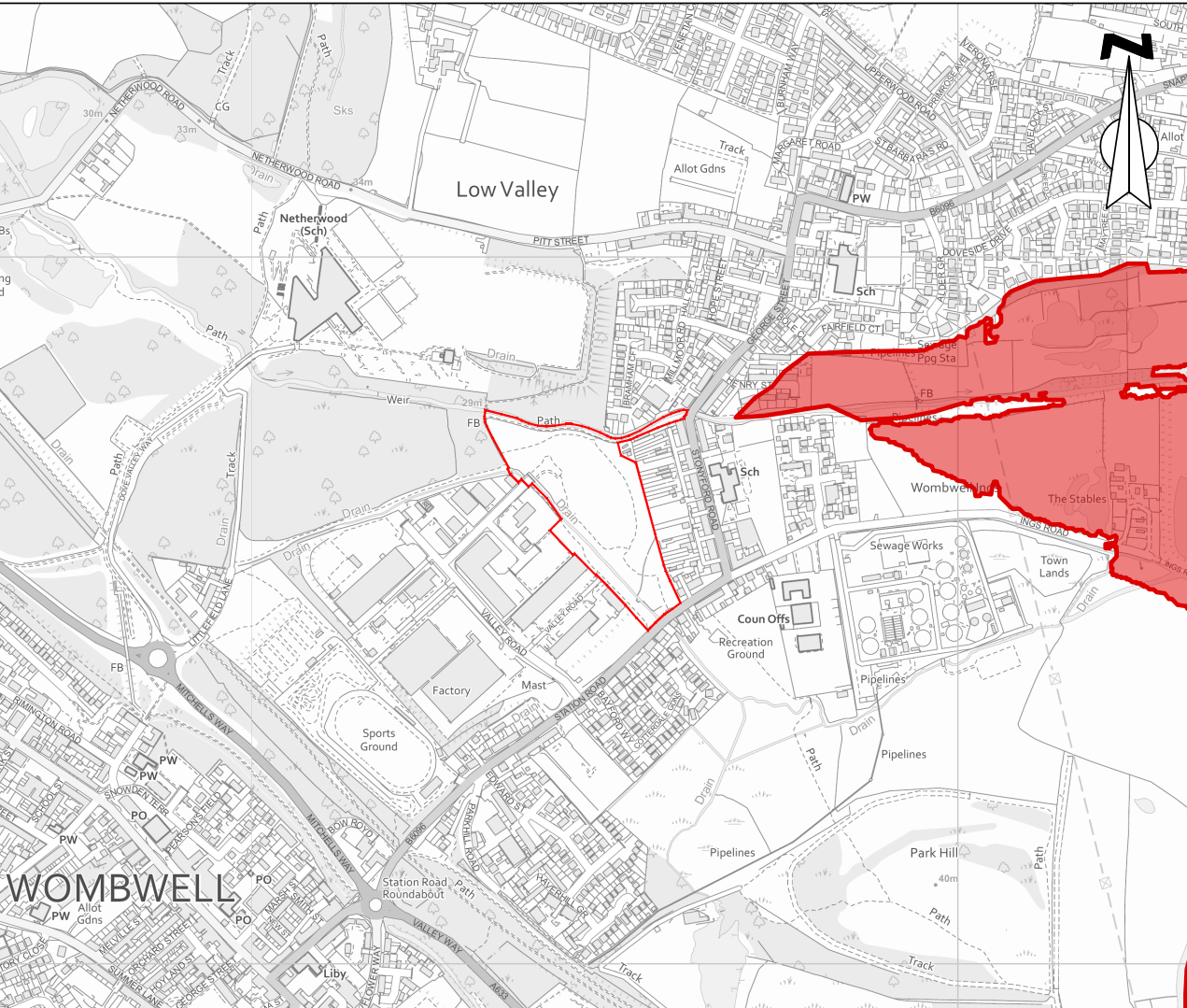
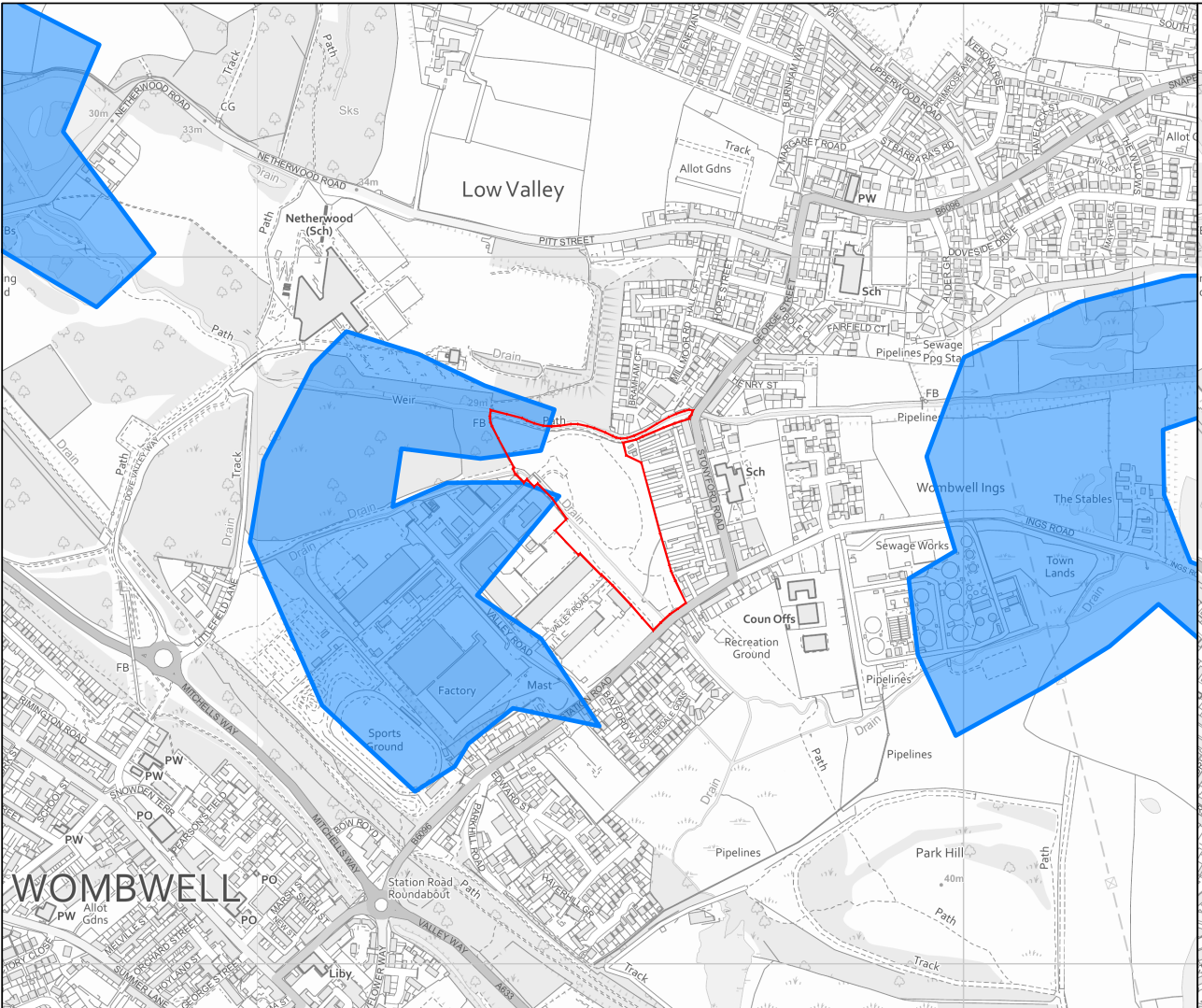
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DRAWN: LW CHECKED: MG DATE: Nov 2022







PROJECT:
Land at Station Road, Wombwell

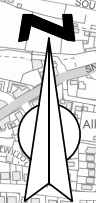
TITLE:
Geological Indicators of Flooding (based on geological deposits)

FIGURE NO:
SHF.1122.009.HY.D.008



Key

-  Site Boundary
-  Historic Flood Zone
(Date of flood 19/03/1947 - 22/03/1947)
-  Historic Flood Zone
(Date of flood 06/11/2000 - 04/12/2000)
-  Historic Flood Zone
(Date of flood 25/06/2007 - 26/06/2007)
-  Historic Flood Zone
(Date of flood 07/11/2019 - 08/11/2019)
-  Historic Flood Zone
(Date of flood 08/02/2020 - 14/02/2020)



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SCALE: PROJECT REF:
1:10,000@A3 SHF.1122.009

DRAWN: CHECKED: DATE:
LW MG Nov 2022

PROJECT:
Land at Station Road, Wombwell

TITLE:
Historic Flood Events

FIGURE NO:
SHF.1122.009.HY.D.009