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# SHEPLEY ROAD, STOCKSMOOR

## FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

APRIL 2024

REPORT NO: 20547-FRADS-001

# SHEPLEY ROAD, STOCKSMOOR

## FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

Newett Homes

Flood Risk Assessment & Drainage Strategy

CONFIDENTIAL

Project no: 20547-FRDS-001

Date: April 2024

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# TABLE OF CONTENTS

# TABLES



# FIGURES

# APPENDICES

# 1 INTRODUCTION

1.1.1 This Flood Risk Assessment (FRA) and Outline Drainage Strategy (DS) has been provided at the request of Newett Homes, hereafter referred to as "the client", to assess the flood risks associated with the proposed development of Shepley Road, Stocksmoor, hereafter referred to as "the site".

1.1.2 The purpose of this FRA and DS is to:

- Identify the possible hazards posed from all major sources of flooding (fluvial, surface water, groundwater, infrastructural and coastal sources);
- Provide a qualitative assessment of the probability of each potential flood hazard representing a constraint on the proposed development, based on the proposed land use type for the development and likelihood of flood occurrence;
- Investigate and define any potential drainage impacts associated with the site;
- Conceptually determine and define necessary surface water management controls to ensure no exacerbation of flood risk on the site or to external receptors due to any increase in surface water runoff; and
- Recommend appropriate and necessary mitigation measures and additional assessments that may be required to progress the sustainable development of the site.

1.1.3 The FRA and DS comprises the following:

- A desktop review of publicly available information, including information from the Environment Agency (EA) and Kirklees Council who are the Lead Local Flood Authority (LLFA) for the proposed development area; and
- An assessment and outline design of hydraulic controls and drainage requirements and drainage elements required to support the development of the site.

1.1.4 This report further details the methodologies employed within this study and provides recommendations as to any further work or investigations required to support the development of the site through the planning application process.

## 1.2 REGULATORY POLICY AND LEGISLATION

1.2.1 This assessment has been carried out in line with the current Government legislation, the National Planning Policy Framework (NPPF) 2023.

1.2.2 It has been assessed with reference to the following documents and legislative guidelines:

- CIRIA 753 The SUDS Manual V6 (2016);
- DEFRA "Flood Risk Assessment Guidance for New Developments" (2006);
- DEFRA "Surface Water Management Plan Technical Guidance" (2010);
- BS 8533 2011 Assessing & Managing Flood Risk in Development Code of Practice (2011);
- BS 8582:2013 Code of practice for surface water management for development Sites (2013);
- National Planning Practice Guidance (2012 – updated 2016);
- C624 Development and Flood Risk – Guidance for the Construction Industry' (2004);
- Design and Construction Guidance for Sewage Sector (DCGSS) (2020);

- Planning Policy Guidance – Flood Risk and Climate Change (2014 and as amended).

1.2.3 In addition to the above, this report has also been informed by the following documents:

- Kirklees Council Local Plan Strategy
- Kirklees Council Level 2 SFRA

## 1.3 SCOPE OF FLOOD RISK ASSESSMENT

1.3.1 The objective of this analysis and report is to provide an FRA in accordance with local and national guidance.

1.3.2 The detail and complexity of the FRA will reflect the level of risk to the site and consider the appropriateness of the proposed development type. This will also include assessment of potential risk to property and livelihoods, consideration of climate change, and the definition of appropriate flood risk mitigations required to satisfy the planning process.

1.3.3 Based on the assessment of requirements for a site-specific FRA as defined within NPPF 2019 technical guidance, the site is indicated as being located within Flood Zone 1, therefore it is necessary to provide a site-specific FRA. Flood Zone 1 refers to an area assessed as having less than 1 in 1,000 annual probability (<0.1%) of river or sea flooding in any one year.

1.3.4 Similarly, as the site is indicatively located in an area that may be subject to other assessable sources of flooding, such as pluvial (surface water) flooding, it is necessary to undertake a further site-specific assessment to verify the proposals for development.

1.3.5 Policy LP27 of the Kirklees Local Plan Strategy states that all future development must ensure that:

- Proposals for development which require a Sequential Test in accordance with national planning guidance will need to demonstrate that development has been directed to areas at the lowest probability of flooding, following a sequential risk based approach. The whole Kirklees district should be the starting point for the sequential test with applicants required to provide justification where a smaller area of search is proposed. If following application of the sequential test, there are no reasonably available sites which could accommodate the development in zones with a lower probability of flooding, it should also be demonstrated that a sequential approach has been applied within sites. This is to ensure that highly vulnerable and more vulnerable uses are directed towards the areas of lowest flood risk within the site. Proposals will also need to demonstrate that the exception test is passed, where applicable, as set out in national planning policy.
- Proposals within flood zone 3ai will be assessed in accordance with national policies relating to flood zone 3a but with all of the following additional restrictions:
    - a. no new highly vulnerable or more vulnerable uses will be permitted;
    - b. less vulnerable uses may only be permitted provided that the sequential test has been passed and;
        - i. where extensions are linked operationally to an existing business or,
        - ii. where redevelopment of a site provides buildings with the same or a smaller footprint;

- c. all proposals will be expected to include flood mitigation measures such as compensatory storage which should be identified and considered through a site specific Flood Risk Assessment;
- d. development will not be permitted on any part of the site identified through a site specific Flood Risk Assessment as performing a functional floodplain role.

- Proposals must be supported by an appropriate site specific Flood Risk Assessment in line with national planning policy. This must take account of all sources of flooding set out in the Strategic Flood Risk Assessment and demonstrate that the proposal will be safe throughout the lifetime of the development (taking account of climate change). The proposal must also not increase flood risk elsewhere and where possible should reduce flood risk. Mitigation measures, where necessary, should be proposed.
- Proposals involving building over existing culverts or the culverting or canalisation of water courses will not be permitted unless it can be demonstrated to be in the interests of public safety or to provide essential infrastructure and that there will be no detrimental effect on flood risk and biodiversity. Where feasible, development proposals should incorporate re-opening of culverts, modification of canalised water courses and consideration of mitigation measures to achieve a more natural and maintainable state.
- Proposals for natural management such as targeted vegetation planting in upper catchments and along river banks will be supported in appropriate locations where consistent with national and local plan policies and relevant water catchment management plans to reduce flood risk and improve water quality.

1.3.6 Potential flood risk at the site has been assessed against the site layout plan, which has been provided as **Appendix A** to this report. Significant changes to the site's developable area may necessitate a further review of this document to ensure that risk of flooding is not exacerbated and has been satisfactorily addressed within the development proposal

## 1.4 SCOPE OF OUTLINE DRAINAGE STRATEGY

1.4.1 Surface water runoff must be effectively managed to ensure that there is no exacerbation of potential surface water flooding issues on the site, or at any external receptors, due to any potential increases in surface water runoff rates and volumes.

1.4.2 The drainage hierarchy will be applied in determining the most suitable type and point of discharge of surface waters runoff from impermeable areas on the site. This will ensure that surface water is sustainably managed on the site, and that there is no exacerbation of flood risk elsewhere as a result of undertaking the development. This will be undertaken in accordance with industry best practice principles and guidance, such as the C753 SUDS Manual (2016), Design and Construction Guidance for Sewage Sector (DCGSS) (2020) and applicable sections of the Planning Policy Guidance (PPG).

1.4.3 Any increase in surface water runoff rate associated with the development of the site must also be managed in accordance with the guidelines set by LPA, the LLFA for the area.

1.4.4 As indicated in Policy LP28 of the Kirklees Local Plan Strategy surface water runoff from the site must adhere to the following:

- The presumption is that Sustainable Drainage Systems (SuDS) will be used to assist in achieving the following on each site:

- a. for proposals on greenfield sites, typically greenfield run-off rates should not be exceeded;
- b. for proposals on brownfield sites there should be a minimum 30% reduction in surface water run-off where previous positive surface water connections from the site can be proven. New connections will be subject to at least greenfield restrictions;
- c. No negative impact on local water quality and improvements in water quality where practicable;
- d. Consider whether proposed open spaces and green infrastructure within sites can contribute to the sustainable drainage of the site.

- Local conditions including the existence of critical drainage areas may require a lower run-off rate to be agreed to reflect volume control, local surface water risks, water course capacity and flood risk further downstream.
- There will be a general presumption against pumping surface water. It must also be demonstrated that the surface water management solution is designed to meet requirements over the lifetime of the development including evidence that management and maintenance arrangements have been secured to cover that period. This includes ensuring proposals to store water meet national standards and latest best practice.
- Flow paths accommodating water from outside the site or due to an exceedance event should be designed to avoid buildings and curtilages.
- Development will only be permitted if it can be demonstrated that the water supply and waste water infrastructure required is available or can be co-ordinated to meet the demand generated by the new development.

1.4.5 The Outline DS will identify potential opportunities and locations for attenuation infrastructure, as well as potential connection points and provide calculations of permissible discharge rates for runoff generated on site.

1.4.6 The Outline DS therefore aims to provide surety that any drainage provided as part of the project development can safely and appropriately convey all flows from the site to appropriate discharge locations. This is to ensure sustainable and safe operation within the site, as well as ensuring sustainable operation of any receiving infrastructure. These assessments have been undertaken in accordance with prescribed best practice and building codes, including prioritising the incorporation of SuDS, where appropriate and practicable for the management of surface water.

1.4.7 Following the completion of a final site masterplan the drainage scheme proposed within this report should be reassessed to ensure surface water runoff and foul water drainage can be appropriately managed in accordance with best practise and local and national standard requirements.

# 2 METHODOLOGY

## 2.1 INTRODUCTION

2.1.1 This report aims to demonstrate that the proposed development is sustainable and will not be impacted by or exacerbate flood risk elsewhere through the development of the site. This assessment will account for the effects of climate change, as well as identifying further opportunities to reduce the probability and consequences of flooding within the site locality.

2.1.2 This report aims to identify constraints and opportunities for the site based on the development proposals provided by the client (**Appendix A**) and provide recommendations for the sustainable provision of drainage and mitigation of any potential flood risk for the site.

2.1.3 The assessment methodology is as follows:

- Desktop review of the geology, hydrology, and other pertinent environmental characteristics of the site, and how these affect flood risk of the proposed development and site drainage.
- Obtain and review existing baseline flood risk and drainage guidance information from relevant environmental authorities (EA, LLFA, etc.) as to site specific flood risk from all applicable sources
- Produce indicative design calculations for the Outline DS to determine the requirements for developing the site's surface water drainage and providing adequate storage in line with local planning policy and guidance. This will include the presentation of drawings with an indicative layout for any additional drainage and attenuation infrastructure located on the site.
- Review the findings from the above and advise on the suitability of developing the site for the proposed development in consideration of the applicable flood risk and drainage and comment on limitations and opportunities for the site, with recommendations of further mitigation where applicable and appropriate

# 3 PROJECT BACKGROUND

## 3.1 DEVELOPMENT DESCRIPTION AND LOCATION

3.1.1 Andrew Moseley Associates (AMA) was appointed by Newett Homes to provide a Flood Risk Assessment and Drainage Strategy in support of a residential development, located on Shepley Road, Stocksmoor, Kirklees, West Yorkshire, HD4 6XW and NGR: SE 18438 10749.

3.1.2 The proposed development is located in the area of Stocksmoor approximately 4.5 miles from Huddersfield. Proposals for the site are for residential use, consisting of 50 dwellings with associated landscaping and infrastructure. A site plan can be found in **Appendix A**.

3.1.3 The Local Planning Authority for this development is Kirklees Council who are also the Lead Local Flood Authority for the area.

3.1.4 This report has been prepared in accordance with the National Planning Policy Framework (NPPF) and the accompanying technical guidance to assess all forms of flooding including the management of surface water on-site.

3.1.5 The site is referenced in **Table 3-1** and **Figure 1** below.

**Table 3-1**. Site Context

| | |
|---|---|
| **Site Name** | Shepley Road |
| **Location** | Stocksmoor |
| **NGR (approx.)** | SE 18438 10749 |
| **Application Site Area (ha)** | 2.4 |
| **General Locality** | The site is located on undeveloped greenfield land and borders residential developments to its south and west, a train track to its north and undeveloped land to its east.<br><br>Pedestrian and vehicular access to the site is provided via Shepley Road which is located to the south of the site. |
| **Development Type** | Residential |
| **EA Flood Zone** | Flood Zone 1 |
| **EA Office** | Yorkshire |
| **Local Planning Authority** | Kirklees Council |

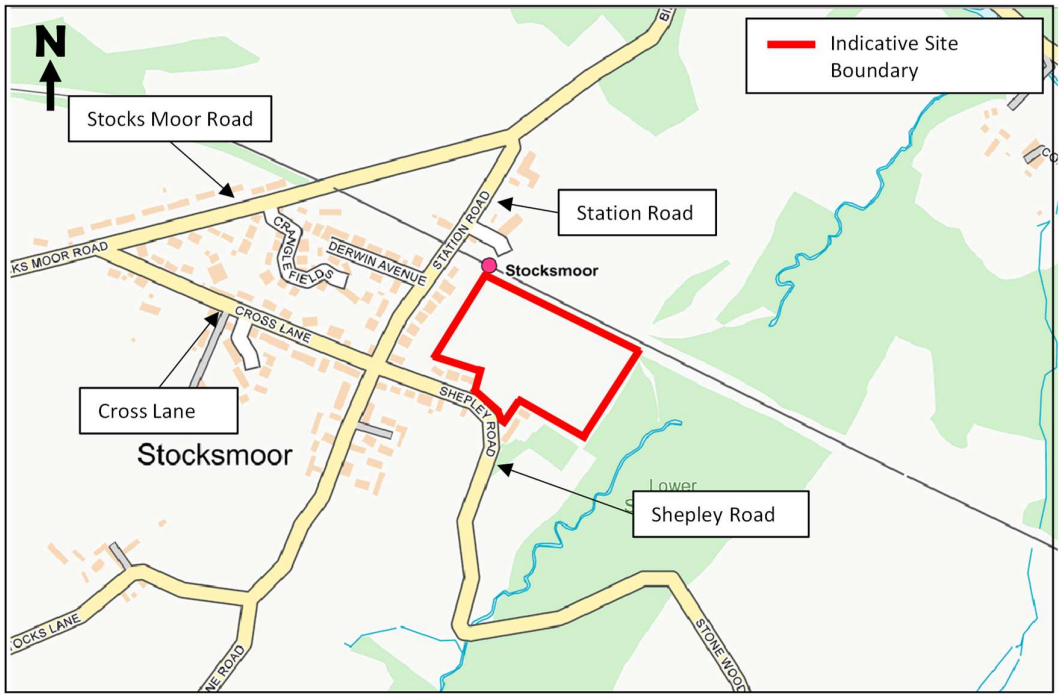



**Figure 1**. Site Location

## 3.2 CURRENT SITE CONDITIONS

### Topography

3.2.1 A topographic survey provided by Newett Homes and can be found in Appendix B. ground levels at the site are shown to be in the region of 166.42m to 187.68m Above Ordnance Datum (m AOD). The topographic survey can be seen in **Appendix B**.

3.2.2 Further review of topographical data from shows site levels to be lowest towards the south west of the site, while greatest levels are located at the north west of the site.

## 3.3 GEOLOGY

3.3.1 British Geological Survey (BGS) Open Geoscience website[1] indicates that the majority of the site is underlain by Grenoside Sandstone – Sandstone with no overlying superficial deposits. The most eastern 30m of the site is underlain by Pennine Lower Coal Measures Formation – Mudstone, siltstone, and sandstone with no overlying superficial deposits.

3.3.2 The BGS website information indicates that there is no borehole record within close proximity of the site.

[1] Available at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html accessed on 11/11/2022

## 3.4 HYDROGEOLOGY

3.4.1 According to the Department for Environment, Food and Rural Affairs (DEFRA) MAGIC map[2], the site is indicated as not being located in a Groundwater Source Protection Zone (SPZ), as defined by the Environment Agency (EA) for the protection of a potable groundwater supply.

3.4.2 The site is located as being in an area of high groundwater vulnerability and located above a Secondary A bedrock aquifer.

3.4.3 Information obtained from the Cranfield University's Soilscape website[3] indicates that the site is located in an area classified as being Soilscape 6, which is defined as having freely draining slightly acid loamy soils.

## 3.5 HYDROLOGY

3.5.1 The Stone Wood Dike is located approximately 85m to the east of the site at its closest point. The Stone Wood Dike is a distributary of the Shepley Dike and flows in a south-westerly direction in the vicinity of the site.

3.5.2 The Shepley Dike is located approximately 600m northeast of the site at its closest point. The Shepley Dike is a distributary of the Thunder Bridge Dike, which flows from Woodsome Beck.

3.5.3 There are two unnamed distributaries of the Shepley Dike located 230m and 550m to the northeast of the site.

3.5.4 The EA's Catchment Data Explorer website[4] indicates that the site resides within the Colne and Holme operational catchment and the Fenay Beck from Source to River Colne sub catchment.

[2] Available at: https://magic.defra.gov.uk/MagicMap.aspx?startTopic, accessed on 11/11/2022
[3] Available at: http://www.landis.org.uk/soilscapes/, accessed on 11/11/2022
[4] Available at: https://environment.data.gov.uk/catchment-planning/ , accessed on 11/11/2022

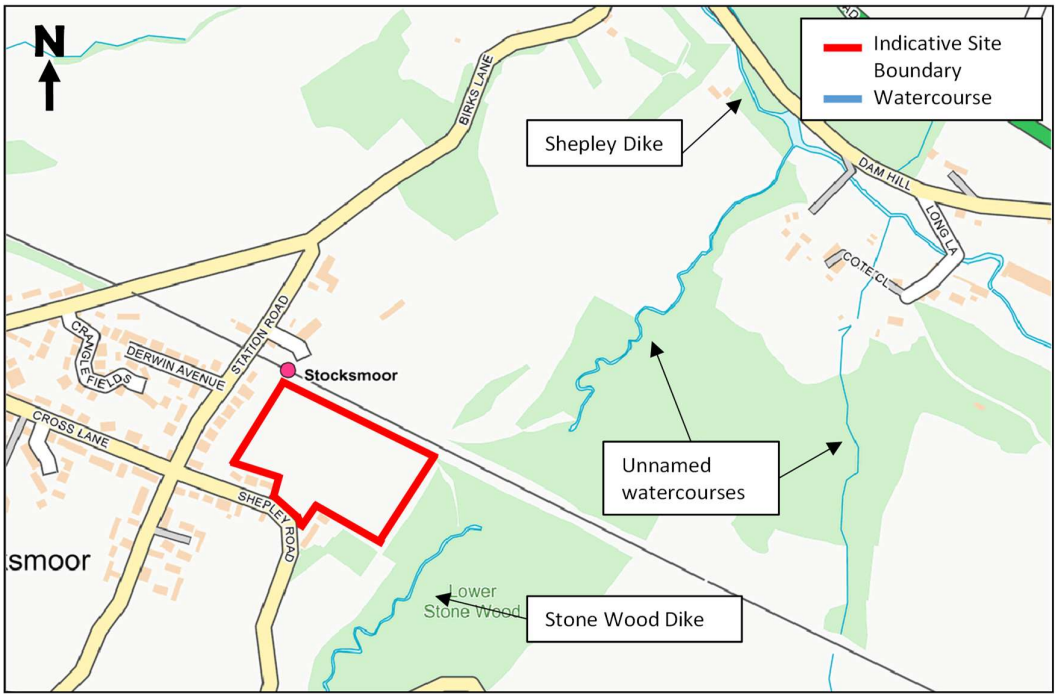



**Figure 2.** Watercourse Location

# 4 POTENTIAL FLOOD RISK

## 4.1 SOURCES OF FLOODING

4.1.1 This report is to consider flood risk from all potential sources. Section 5.0 then discusses in further detail the probability of flooding, any potential impacts and necessary mitigation, where required.

4.1.2 The NPPF (2023) also requires site developers to consider the impact of additional runoff generated by the proposed development on the receiving downstream catchment, and to assess the risk of runoff from the surrounding. This is further discussed in Section 6.0.

## 4.2 ENVIRONMENT AGENCY FLOOD ZONES

4.2.1 The EA Flood Map for Planning shows the site is located within Flood Zone 1, i.e., land assessed as having less than 1 in 1,000 annual probability (<0.1%) of river or sea flooding in any one year.

4.2.2 This potential fluvial/coastal flood risk to the site has been illustrated in **Figure 3.**

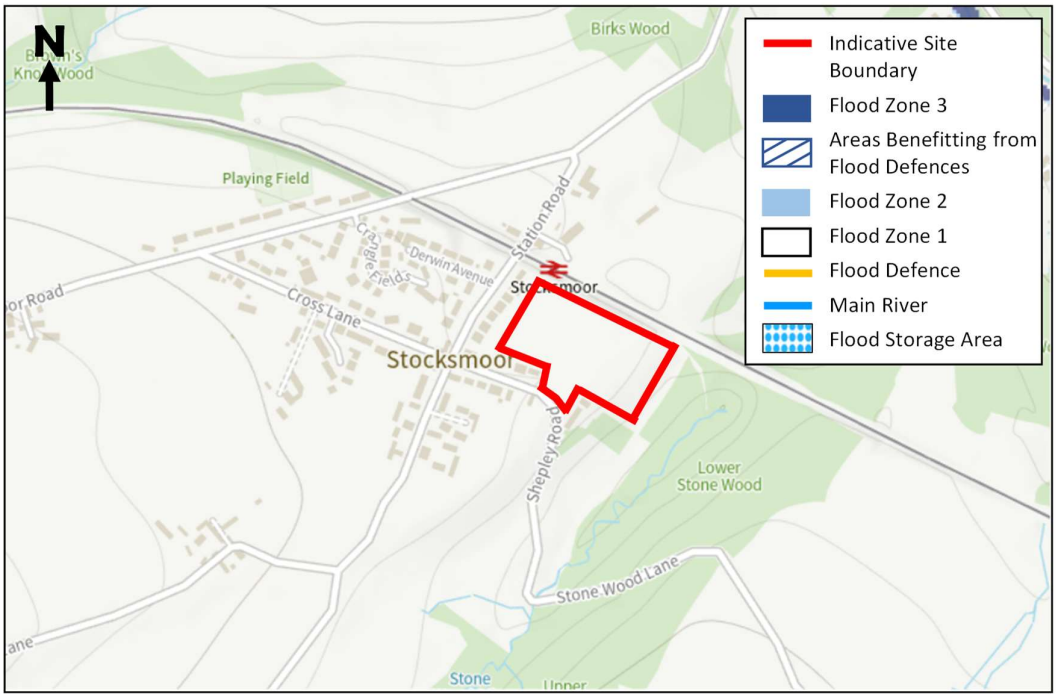



**Figure 3**. Environment Agency Long Term Flood Map for Planning

## 4.3 FLUVIAL AND COASTAL FLOODING

4.3.1 The EA Long Term Flood Risk Map for fluvial and coastal flooding shown in **Figure 4** indicates that the site is at very low risk of fluvial flooding. As the site is situated 55 miles from the nearest coastline the site is also considered to not be at risk from coastal flooding.

4.3.2 The risk of flooding posed to the proposed development is classed as very low. This is because there are no watercourses in close proximity to the site.

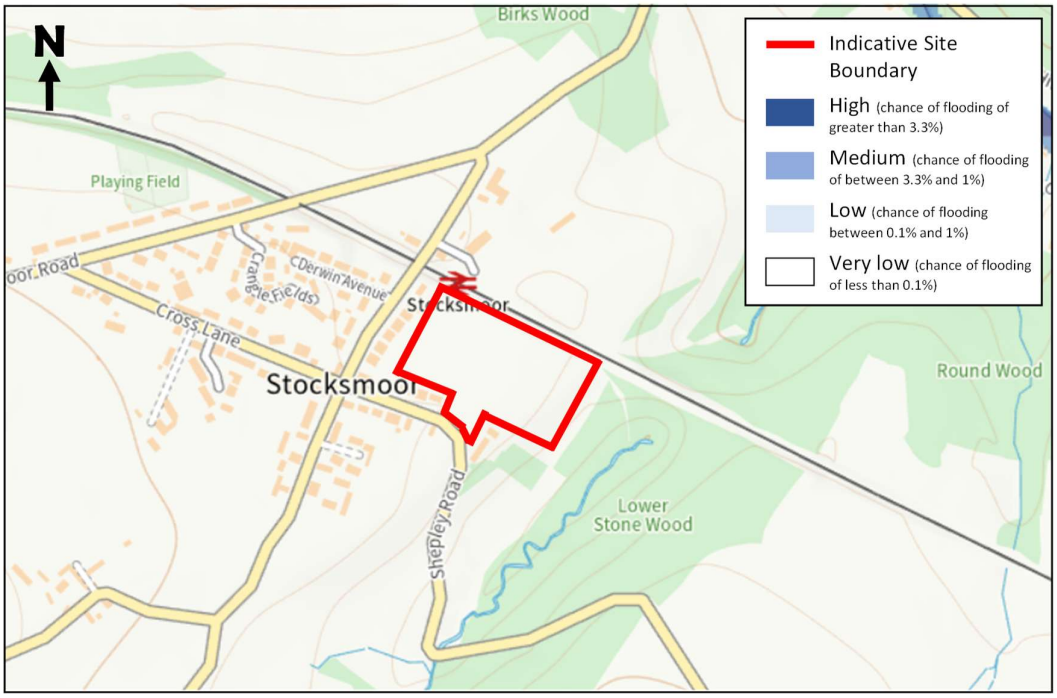



**Figure 4**. Environment Agency Long Term Flood Map – Rivers and Sea

## 4.4 PLUVIAL (SURFACE WATER) FLOODING

4.4.1 The EA Long Term Flood Risk Map (**Figure 5**) shows the site is located within an area at very low potential risk of surface water flooding.

4.4.2 As the proposed development of the site may potentially reduce the overall site permeability and potentially increase surface water runoff rates and volumes, the surface water discharge controls must ensure that any proposal for drainage, or discharge, does not adversely impact upon downstream drainage infrastructure or offsite receptors.

4.4.3 The site is therefore considered to have very low potential risk of flooding from pluvial sources.

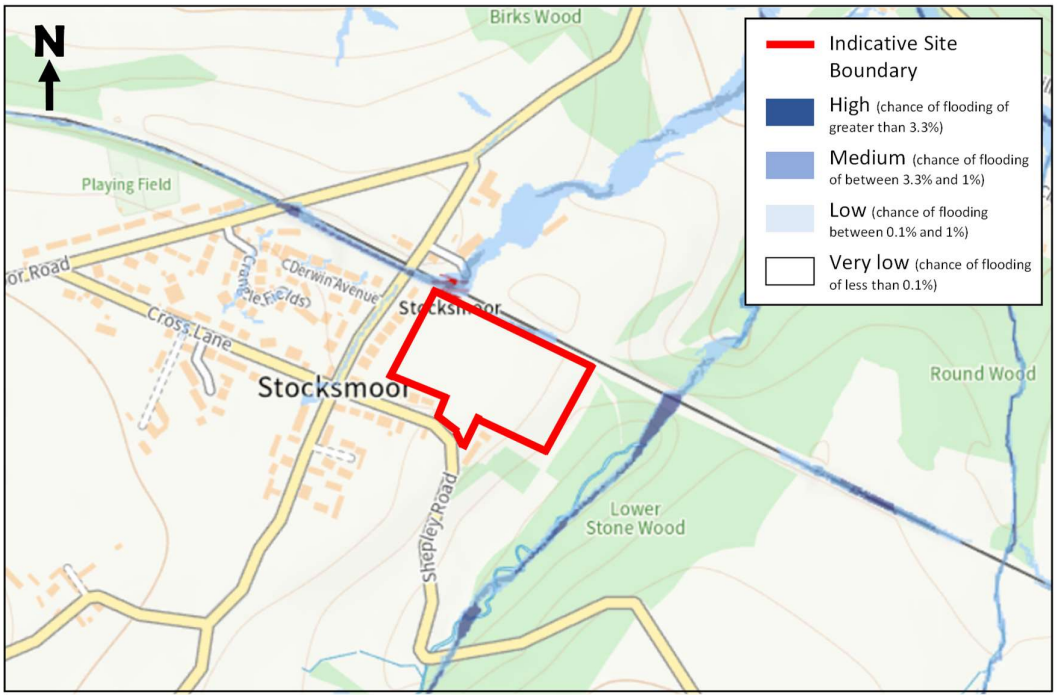



**Figure 5**. Environment Agency Long Term Flood Risk Map – Pluvial (Surface Water) Flooding

## 4.5 GROUNDWATER FLOODING

4.5.1 Ground conditions at the site consist of freely draining slightly acid loamy soils, therefore the propensity for groundwater emergence at the site is considered to be medium, and the potential risk of groundwater emergence affecting the site development is considered to be low.

4.5.2 However, given the impermeable nature of the proposed site's hardstanding areas subsequent to development, potential elevation of groundwater or groundwater emergence within the geology causing flooding within the site post-development will be largely eliminated. Likewise, noting the fall in gradient from the centre to the east and west of the site, any emerging groundwater would be directed away from the proposed development area.

4.5.3 According to the Kirklees Council Level 2 SFRA groundwater flooding map presented in **Appendix C**, the area of Stocksmoor is classified as being less than 25% susceptible to groundwater flooding.

4.5.4 During long periods of heavy rainfall, the water table within an area can rise above the natural ground level, resulting in groundwater flooding. The site is located above a principal bedrock aquifer. This signifies permeable layers which would allow infiltration of water up through the soil.

4.5.5 Site specific investigations should be able to prove the presence of ground water and propose remedial mitigation where required. Flood risk to the proposed development due to groundwater emergence is therefore considered to be low.

4.5.6 Flood risk to the proposed development due to groundwater emergence is considered to be low provided that all reasonable and practicable mitigation measures for any subsurface construction associated with the development are adhered to.

## 4.6 FLOODING FROM ARTIFICIAL SOURCES

4.6.1 The EA Long Term Flood Risk Map of flood risk from reservoir and canal failure (**Figure 6**) indicates that the site and its surroundings, are not affected by potential flood waters from artificial sources such as dam or canal failure. The figures provided within the EA mapping principally indicate the worst-case flooding extents. Therefore, the potential risk of flooding from reservoir and/or canal failure is considered to be negligible.

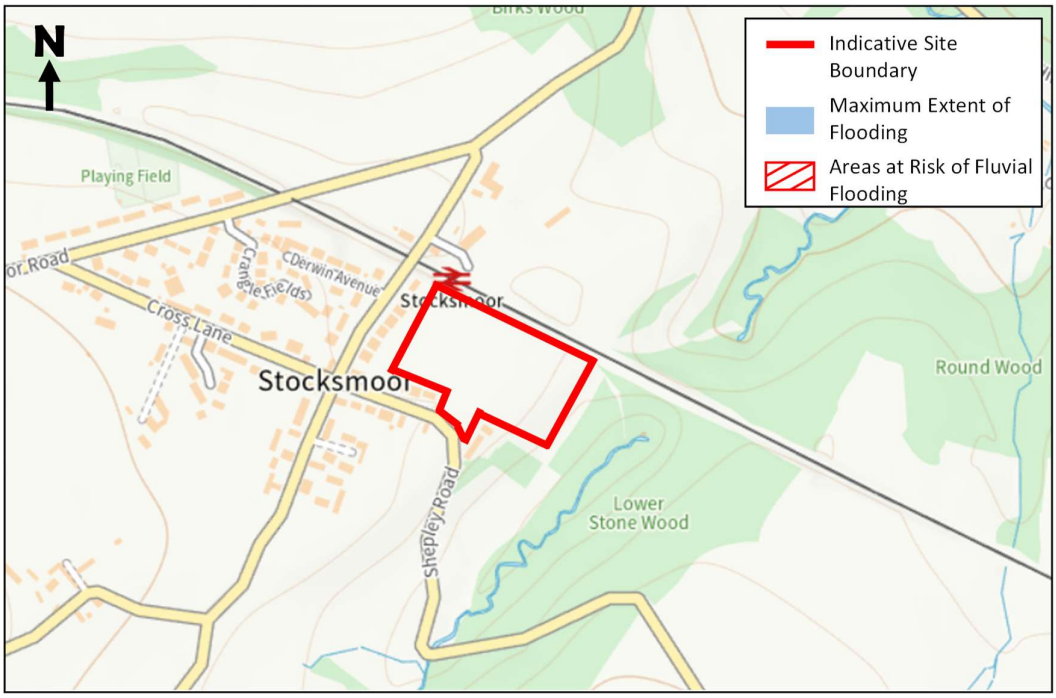



**Figure 6**. Environment Agency Long Term Flood Risk Map – Artificial Sources

## 4.7 FLOODING FROM SEWERS

4.7.1 The site currently consists of greenfield land and is not identified as having any drainage infrastructure within is boundary The site is therefore considered to have very low potential risk of flooding from sewer flooding.

## 4.8 HISTORIC FLOODING

4.8.1 The EA historic flood map shows the site to not have experienced historic flooding.

4.8.2 A review of the Kirklees Council Level 2 SFRA confirms the EA historic flood mapping and indicates that the site has not experienced any historic flooding, as shown in **Appendix D**.

# 5 FLOOD RISK ASSESMENT

## 5.1 FLOOD RISK PLANNING POLICY

### National planning policy framework

5.1.1 The NPPF sets out the Government's national policies on different aspects of land use planning in England in relation to flood risk. Planning Practice Guidance is also available online.

5.1.2 The Planning Practice Guidance sets out the vulnerability to flooding of different land uses. It encourages development to be located in areas of lower flood risk where possible and stresses the importance of preventing increases in flood risk off site to the wider catchment area.

5.1.3 The Planning Practice Guidance also states that alternative sources of flooding, other than fluvial (river flooding), should also be considered when preparing a Flood Risk Assessment.

5.1.4 This Flood Risk Assessment is written in accordance with the NPPF and the Planning Practice Guidance.

5.1.5 The EA Flood Map for Planning locates the site within Flood Zone 1, i.e., land assessed as having less than 1 in 1,000 annual probability (<0.1%) of river or sea flooding in any one year.

5.1.6 The flood map extents indicated on this map show the potential for flooding from fluvial and coastal sources, and although they are indicative, they are a key tool in defining the appropriateness of a development type or the requirement for further assessment.

5.1.7 Under the NPPF (2023), Flood Zone 1 is defined as having a low probability flood risk. The proposed development includes 50 dwellings with associated landscaping and infrastructure, which are defined within Table 2 of the NPPF technical guidance as being 'More Vulnerable'. Therefore, according to the criteria in Table 3 of the NPPF Technical Guidance (Flood Risk Vulnerability and Flood Zone 'Compatibility'), the proposed development may be deemed as 'Appropriate'.

## 5.2 SEQUENTIAL AND EXCEPTION TEST

5.2.1 Both the NPPG and the SFRA require the 'sequential test' to be applied to ensure that proposed developments are carried out in area that are at the least risk of flooding, before considering development in areas that are at risk of flooding. The proposed site falls within Flood Zone 1 and is considered to come under the 'More Vulnerable' category as a residential development.

5.2.2 Based on Table 3 in the National Planning Practice Guidance for Flood Risk and Coastal Change, the proposed use of the site is acceptable due to it being located in Flood Zone 1 and an exception test is not required.

**Table 5-1.** Development Appropriateness Based on Vulnerability and Flood Zone

| Flood Risk Vulnerability Classification | Essential Infrastructure | Water Compatible | Highly Vulnerable | More Vulnerable | Less Vulnerable |
|---|---|---|---|---|---|
| Flood Zone 1 | ✓ | ✓ | ✓ | ✓ | ✓ |
| Flood Zone 2 | ✓ | ✓ | Exception test required | ✓ | ✓ |
| Flood Zone 3a | Exception test required | ✓ | x | Exception test required | ✓ |
| Flood Zone 3b | Exception test required | ✓ | x | x | x |

## 5.3 CONCLUSION

5.3.1 In light of this assessment against the sites applicable flood zone (Flood Zone 1), further assessment against the sequential or exception test is not required. This should be confirmed with (LPA) prior to development of the site.

5.3.2 **Table 5-2** summarises the pre mitigation flood risk associated with the site as well as the impacts of the flood risk on the wider catchment prior to mitigation. The mitigation measures proposed to address flood risk issues and ensure the development is appropriate for its location are discussed within Section 3.0.

**Table 5-2.** Pre-Mitigation Flood Risk Summary

| Sources | Probability of Flood Risk | Impacts | Description |
|---|---|---|---|
| Tidal | N/A | N/A | Site is located inland and not tidally influenced. |
| Fluvial | Low | Low | Site is not shown to be located in an area susceptible to fluvial flooding. |
| Surface Water (Pluvial) | Low | Low | Site is not shown to be located in an area susceptible to surface water flooding. |
| Groundwater | Medium | Low | Site is shown to be at risk of ground water flooding; however, given the hard standing nature of the Site |

| | | | |
|---|---|---|---|
| | | | following development, ground water emergence at the site will be limited. |
| Artificial Sources | Low | Low | Review of information from multiple sources (EA, LLFA) reveals no evidence of flooding from reservoirs or canals. |
| Sewers | Low | Low | The risk of flooding from the surcharging of sewers is considered to be low. |
| Effect of development on wider catchment | Low | Low | The impermeable area of the site is being altered. |

5.3.3 Based on the assessable information presented, the site is considered to meet the requirements of the NPPF, given the assessed potential flood risk posed from all applicable sources, the means of adopting suitable mitigation measures to prevent increase in the potential for flood risk and based on the vulnerability of the development type. Further consideration of necessary surface water runoff mitigation measures will be provided, so as to address the potential for increase of surface water arising from the proposed development of the site.

# 6 FLOOD RISK MITIGATION

## 6.1 FLOOD RISK MITIGATION

6.1.1 Section 4 has identified the sources of flooding which could potentially pose a risk to the site and the proposed development. This section of the FRA sets out the mitigation measures which are to be considered within the proposed development detail design to address and reduce the risk of flooding to within acceptable levels.

## 6.2 EFFECT OF DEVELOPMENT ON WIDER CATCHMENT

### Development drainage

6.2.1 The current site is considered to be greenfield. The amount of impermeable area will be altered. Therefore, the existing drainage systems will not be suitable to discharge the surface water from the site alongside the additional run off from the proposed development. A sufficient Drainage strategy will be therefore provided by AMA.

## 6.3 SITE ARRANGEMENTS

### Sequential arrangement

6.3.1 The Flood Zone mapping shows the site to be located within Flood Zone 1.

### Finished levels

6.3.2 Given the site's location within Flood Zone 1, there are no specific requirements for finished floor levels with regard to flood risk. We recommend that an FFL of 0.15m above the adjacent ground level is set.

# 7 FOUL WATER DRAINAGE

## 7.1 INTRODUCTION

7.1.1 It is proposed to install a new foul drainage system to serve the proposed residential development.

7.1.2 The foul water system will be designed and constructed in accordance with the current Building Regulations, BS EN:752 'Drainage and Sewer Systems Outside Buildings', the Local Authority Building Control specifications and requirements, Sewers for Adoption 7th Edition and the Civil Engineering Specification for the Water Industry.

## 7.2 FOUL WATER DISCHARGE RATES

7.2.1 The estimate design Dry Weather Flow (DWF) generated by the proposed development, based on a gravity system, has been calculated as 1.90 litres per second.

7.2.2 This figure is based on 50 dwellings at 4,000 litres per dwelling as prescribed in Sewers for Adoption.

## 7.3 FOUL WATER CAPACITY AND POINT OF CONNECTION

7.3.1 AMA attained a Yorkshire Water Pre Development enquiry which can be found in **Appendix E**. Yorkshire Water have advised that foul water can discharge to the existing 150 mm diameter combined sewer recorded in Shepley Road. They have not advised of any known capacity issues with the public sewer network in the area which would hinder development at the site.

7.3.2 No depth/level information is available for these sewers and therefore further survey work in the form of a drainage CCTV and tracing survey will be required to confirm whether a gravity connection will be feasible.

7.3.3 Any proposed connection onto the public recorded sewers will require a S106 connection application.

## 7.4 EXISTING SEWERS

7.4.1 No other public sewers have been recorded within the site.

# 8 SURFACE WATER DRAINAGE STRATEGY

## 8.1 INTRODUCTION

8.1.1 The National Planning Policy Framework (NPPF) and accompanying Technical Guidance indicate that surface water run-off should be controlled as near to its source as possible through a sustainable drainage approach to surface water management.

8.1.2 Consideration should therefore firstly be given to using sustainable drainage (SuDS) techniques including soakaways, infiltration trenches, permeable pavements, grassed swales, ponds and wetlands to reduce flood risk by attenuating the rate and quantity of surface water run-off from a site. This approach can also offer other benefits in terms of promoting groundwater recharge, water quality improvement and amenity enhancements. Approved document Part H of the Building Regulations (2015) sets out a hierarchy for the disposal of surface water which encourages a SuDS approach.

## 8.2 OVERVIEW AND CONCEPT

8.2.1 As detailed in Section 3.1, development proposals for the site consist of residential use, consisting of 50 dwellings with associated landscaping and infrastructure. The site Plan shows the developable area of the Site to be restricted to the red line boundary as shown in **Appendix A**, with an approximate total developable area of 2.4 ha.

8.2.2 Review of the site plan shows proposals to consist of an approximate total impermeable area of 0.8 ha.

## 8.3 PRE-DEVLOPMENT SURFACE WATER RUN-OFF

8.3.1 The site is approximately 2.4 ha in area and currently comprises of green field agriculture land.

8.3.2 For the purposes of determining the existing rate of surface water run-off the site is considered to greenfield therefore the run-off will be estimated using the IH124 method.

8.3.3 The table below summarises the existing greenfield runoff rates generated by the development for a range of storm return periods. A calculation summary sheet from the UK SuDS website can be found in **Appendix F**.

**Table 8-1**. Existing Run-Off Rates

| Area (Ha) | $Q_{BAR}$ (L/S) | $Q_1$ (l/S) | $Q_{30}$ (L/S) | $Q_{100}$ (L/S) | $Q_{200}$ (L/S) |
|---|---|---|---|---|---|
| 2.4 | 6.2 | 5.5 | 11.3 | 13.5 | 15.4 |

## 8.4 GROUNDWATER PROTECTION

8.4.1 The proposed development site is not identified as being within a Groundwater Source Protection Zone (SPZ), as such no special measures are required to prevent risk to drinking water supplies.

## 8.5 METHODS OF SURFACE WATER MANAGEMENT

8.5.1 There are three methods that have been reviewed for the management and discharge of surface water which are detailed below; these may be applied individually or collectively to form a complete strategy. They should be applied in the order of priority as listed:

- Discharge via Infiltration
- Discharge to a Watercourse
- Discharge to Surface Water Sewer or Highway Drain
- Discharge to Public Sewer

## 8.6 INFILTRATION

8.6.1 Any impermeable areas that can drain to a soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems.

8.6.2 The British Geological Society (BGS) Geology of Britain Viewer indicates that the majority of the site is underlain by Grenoside Sandstone – Sandstone with no overlying superficial deposits. The most eastern 30m of the site is underlain by Pennine Lower Coal Measures Formation – Mudstone, siltstone, and sandstone with no overlying superficial deposits.

8.6.3 Information obtained from the Cranfield University's Soilscape website indicates that the site is in an area classified as being Soilscape 6, which is defined as freely draining slightly acid loamy soils.

8.6.4 The client provided a preliminary geo environmental investigation undertaken by Lithos which can be found in **Appendix G**. The report concluded that due to the topography of the site along with the position of the existing railway line soakaways would not be possible due to the possibility of springs.

8.6.5 From a desktop review of the geology and soil at the site, it is believed that infiltration would be an acceptable way of discharging surface water from the site.

8.6.6 Percolation testing has not yet been carried out on this site. It is recommended that infiltration testing to BRE 365 digest is undertaken as part of any future site investigations works at the site so that this can be used as satisfactory evidence for the LLFA or Yorkshire Water as necessary. The results of a percolation test will also be required to produce infiltration/soakaway designs.

## 8.7 WATERCOURSE

8.7.1 There are four watercourses in the area as discussed earlier in the flood risk section; firstly, the Stone Wood Dike which is located approximately 85m to the east of the site. Situated between the Stone Wood Dike and the site is third party land, making this an unviable method of surface water disposal.

8.7.2 The Shepley Dike is located approximately 600m to the northeast of the site, with third party land separating the site and this watercourse. Resultantly, it is not viable to discharge surface water into the Shepley Dike.

8.7.3 There are two unnamed distributaries of the Shepley Dike, located 230m and 550m to the northeast of the site. The site and these watercourses are separated by third party land, meaning the disposal of surface water into either of the unnamed watercourses is unviable for this development.

## 8.8 PUBLIC SEWERS

8.8.1 As a last resort and following the hierarchy of surface water, disposal discharge to the public sewer system may need to be considered.

8.8.2 The Yorkshire Water pre development enquiry shown in **Appendix E** indicated that the site is previously undeveloped and no surface water is known to have previously discharged to the public sewer network, and that the local public sewer network does not have capacity to accept any surface water from the proposed site.

## 8.9 PROPOSED DISCHARGE RATES

8.9.1 Discharge via infiltration is required to be explored further before it can be ruled out. However, surface water can discharge into the Stone Wood Dyke to the east of the site. As surface water will be discharged into a watercourse, surface water will be restricted to greenfield runoff, which in this case is 6.2 l/s.

## 8.10 ATTENUATION REQUIREMENTS

8.10.1 As surface water from the site will be restricted to 6.2 l/s, attenuation will be provided at the site.

8.10.2 Causeway Flow drainage design software has been used to estimate the maximum storage volume required on-site for the 100-year storm event plus 40% (30% allowance for climate change and 10% for urban creep). The causeway flow calculations can be found in **Appendix H**

8.10.3 The location of the attenuation can be seen in **Appendix B.**

### Total site

8.10.4 This volume is based on using an attenuation tank with a discharge rate of 6.2 l/s. The details on the attenuation can be found in **Table 8-2** below.

**Table 8-2**. Attenuation Volume

Attenuation Volume

| Gross area (ha) | Max Discharge (l/s) | Imp. Area (ha) | Q100+40% Volume ($m^3$) |
|---|---|---|---|
| 2.4 | 6.2 | 0.8 | 827 |

# 9 SUSTAINABLE DRAINAGE SYSTEMS

9.1.1 Where possible, Sustainable drainage (SuDS) systems/techniques should be used to drain the site of surface water runoff. These could be in the form of permeable paving, rainwater harvesting, ponds, and other above ground green systems. Swales could also be incorporated into the layout to convey surface runoff rather than below ground pipes (which tend to have a higher velocity).

## 9.2 SUSTAINABLE DRAINAGE (OVERVIEW)

9.2.1 Drainage systems can contribute to sustainable development and improve urban design, by balancing the different issues that influence the development of communities. Approaches to manage surface water that take account of water quantity (flooding), water quality (pollution) and amenity issues are collectively referred to as Sustainable Drainage Systems (SuDS).

9.2.2 SuDS mimic nature and typically manage rainfall close to where it falls. SuDS can be designed to slow water down (attenuate) before it enters streams, rivers, and other watercourses, they provide areas to store water in natural contours and can be used to allow water to soak (infiltrate) into the ground or evaporated from surface water and lost or transpired from vegetation (known as evapotranspiration).

9.2.3 SUDS are technically regarded a sequence of management practices, control structures and strategies designed to drain surface water efficiently and sustainably, while minimising pollution and managing the impact on water quality of local water bodies.

9.2.4 SuDS are more sustainable than traditional drainage methods because they:

- Manage runoff volumes and flow rates from hard surfaces, reducing the impact of urbanisation on flooding
- Protect or enhance water quality (reducing pollution from runoff)
- Protect natural flow regimes in watercourses
- Are sympathetic to the environment and the needs of the local community
- Provide an attractive habitat for wildlife in urban watercourses
- Provide opportunities for evapotranspiration from vegetation and surface water
- Encourage natural groundwater/aquifer recharge (where appropriate)
- Create better places to live, work and play.

## 9.3 SUDS PRINCIPALS

9.3.1 Sustainable drainage is a departure from the traditional approach to draining sites. There are some key principles that influence the planning and design process enabling SuDS to mimic natural drainage by:

- Storing runoff and releasing it slowly (attenuation)
- Allowing water to soak into the ground (infiltration)
- Slowly transporting (conveying) water on the surface
- Filtering out pollutants
- Allowing sediments to settle out by controlling the flow of the water

9.3.2 The above was replicated from www.susdrain.org

## 9.4 SUDS TECHNIQUES

9.4.1 The following table is a list of SuDS features that may/may not be feasible for the proposed site.

**Table 9-1**. SuDS Feasibility Table

| SUDS Technique | Can they be feasibly incorporated into the site? | Comments |
|---|---|---|
| Green Roofs | × | The sloping roofs of the proposed development would not permit a green-roof design |
| Basins and Ponds | × | The proposed development could not be designed to incorporate these elements due to site constraints such as the topography. |
| Filter Strips, Swales and Bio-Retention | × | The proposed development could not be designed to incorporate these elements due to site constraints. |
| Infiltration techniques | ✓ | Desktop review of the available data indicate that infiltration would be feasible at the site. |
| Permeable surfaces and tree pits | ✓ | Surfacing of the external areas could be in a permeable material, such as permeable paved access roads and driveways. |
| Rainwater Harvesting | ✓ | New roofs could be directed to rainwater harvesting tanks for reuse. |
| Tanked Systems | ✓ | Attenuation storage could be provided if a restricted discharge is required by the LLFA. |

# 10 SUDS MAINTENANCE PLAN

## 10.1 SURFACE WATER DRAINAGE MAINTENANCE AND MANAGEMENT SCHEDULE

**Attenuation Tank**

**Table 10-1**. Attenuation Tank

| Maintenance Schedule | Required Action | Frequency |
|---|---|---|
| Regular Maintenance | Inspect and identify areas that are not operating correctly. If required, take remedial action. | Monthly for the first 3 months of operation, then annually. |
| | Recover debris from catchment surface area where it may cause risk to performance. | Monthly |
| | Remove sediment and debris from pre-tank system. | Annually |
| Remedial Actions | Repair inlets/outlets/vents/overflows. | As necessary |
| Monitoring | Inspect all inlets/outlets and upstream drainage system to ensure they are in good condition and operating as designed. | Annually |
| | Survey inside of tank for sediment and build up and remove if necessary. | Every 5 years |

**Hydrobrake Manhole**

**Table 10-2**. Hydrobrake Manhole

| Maintenance Schedule | Required Action | Frequency |
|---|---|---|
| Regular Maintenance | Remove sediment and debris from flow control chambers and upstream manholes. | Monthly for first 12 months, then 6 monthly. |
| Remedial Actions | Replace or clean hydrobrake if performance deteriorates or failure occurs. | As necessary |
| Monitoring | Check flow control to ensure emptying is occurring. | Quarterly and post high intensity storm event |

# 11 SUMMARY & CONCLUSION

11.1.1 The site is in an area identified as having a low probability of flooding on the EA Flood Map and is located in Flood Zone 1.

11.1.2 As with any drainage system, blockages within the surface water sewer systems constructed to serve the development has the potential to cause flooding or disruption. Any drainage systems which are not to be offered for adoption to either the Water Company or the Local Authority will have a suitable maintenance regime scheduled and an appropriate management company appointed to carry out the works.

11.1.3 The primary option for surface water disposal is to discharge surface water into a watercourse to the east of the site.

11.1.4 Surface water disposal through infiltration has been show through a preliminary geo investigation that soakaways would not be safe and could not be support at the site.

11.1.5 There is not a suitable public sewer in the vicinity of the site which could be utilised to dispose of the surface water as YW has stated that the sewers do not have capacity.

11.1.6 827m$^3$ of attenuation will be required as surface water will be restricted to 6.2 l/s.

11.1.7 Foul Water from the site will discharge into Shepley Road at a point to the south of the site.

# 12 LIMITATIONS

## 12.1 LIMITATIONS

12.1.1 This report has been prepared for exclusive use by Newett Homes for the purpose of assisting them in evaluating the potential constraints imposed by flood risk and drainage in making a Planning Application.

12.1.2 AMA accepts no liability for any use of this document other than by its client and only for the purposes, stated in the document, for which it was prepared and provided. No person other than the client may copy (in whole or in part) use or rely on the contents of this document, without the prior written permission of AMA. Any advice, opinions or recommendations within this document should be read and relied upon only in the context of the document as a whole.

12.1.3 AMA has endeavoured to assess all information provided to them during this appraisal. The report summarises from several external sources and cannot offer any guarantees or warranties for the completeness or accuracy of information relied upon.

12.1.4 This report has been undertaken with the assumption that the site will be developed in accordance with the above proposals without significant change. The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

12.1.5 A topographic survey has been completed for the site and was supplied to AMA by the client. AMA accepts no liability for the accuracy of this survey, and it is recommended that it is verified on-site prior to the commencement of any construction work.

12.1.6 Existing drainage information is based on third party survey data and record information which is considered to be incomplete. It is therefore recommended that a FULL drainage investigation survey is commissioned to establish the precise alignment, level, and condition of ALL existing drainage within the development site to inform the masterplan and future detailed design proposals.

# APPENDICES

APPENDIX A – PROPOSED SITE LAYOUT

APPENDIX B – ENGINEERING APPRAISAL

APPENDIX C – GROUNDWATER FLOODING MAP

APPENDIX D – HISTORIC FLOOD MAP

APPENDIX E – YORKSHIRE WATER PRE DEVELOPMENT ENQUIRY

APPENDIX F – UK SUDS GREENFIELD RUNOFF RATES

APPENDIX G – PRELIMINARY GEO ENVIRONMENTAL INVESTIGATION

APPENDIX H - ATTENUATION CALCULATIONS

# Appendix A

**PROPOSED SITE LAYOUT**

Station

Track

Mast (Telecommunication)

STATION ROAD

SALES OFFICE

SHOW HOME

SALES PARKING

SALES ARENA

STREET TREES TO BE MAINTAINED BY MANCO

NEW FOOTWAY TO SOUTH OF ACCESS

FOUL WATER PUMP STATION (15M STAND OFF)

ATTENUATION TANK

15m STAND OFF TO ANCIENT WOODLAND

188.7m

Crangle Well

Sun Side

Stone Wood Dike

Key

- Site Boundary
- Proposed Housing
- Affordable Units
- Existing stone walls to be retained
- Existing landscaping
- Proposed landscaping
- Main Road
- Shared Surface
- Area of Play (LAP)
- Potential sales area
- 15M buffer to Ancient Woodland
- Existing Stone Wall retained
- Proposed stone wall to match existing
- EV charging point
- Cycle storage

**ACCOMMODATION SCHEDULE**

Market Units

| Housetype | | Beds | | NDSS | Storey Height | SQFT | SQM | Number | Total SQFT | 2 Bed % |
|---|---|---|---|---|---|---|---|---|---|---|
| RIP | Ripponden | 2 | Semi | Y | 2 | 753 | 70 | 4 | 3012 | |
| SHI | Shibden | 2 | Semi | Y | 2 | 842 | 78 | 1 | 842 | |
| MAR | Marsden | 2 | Semi | Y | 2 | 858 | 80 | 7 | 6006 | |
| **Total** | | | | | | | | **12** | **9860** | **30%** |

| Housetype | | Beds | | NDSS | Storey Height | SQFT | SQM | Number | Total SQFT | 3 Bed % |
|---|---|---|---|---|---|---|---|---|---|---|
| DAL | Dalton | 3 | Semi | Y | 2 | 908 | 84 | 6 | 5448 | |
| SAX | Saxton Detached | 3 | Detached | Y | 2 | 939 | 87 | 6 | 5634 | |
| SAX | Saxton Semi | 3 | Semi | Y | 2 | 939 | 87 | 1 | 939 | |
| BUR | Burneston | 3 | Detached | Y | 2 | 1062 | 99 | 2 | 2124 | |
| **Total** | | | | | | | | **15** | **14145** | **38%** |

| Housetype | | Beds | | NDSS | Storey Height | SQFT | SQM | Number | Total SQFT | 4 Bed % |
|---|---|---|---|---|---|---|---|---|---|---|
| ADD + | Addingham Plus | 4 | Detached | Y | 2 | 1656 | 154 | 2 | 3312 | |
| COL | Collingham | 4 | Detached | Y | 2 | 1510 | 140 | 2 | 3020 | |
| KEY | Keyingham | 4 | Detached | Y | 2 | 1553 | 144 | 4 | 6212 | |
| **Total** | | | | | | | | **8** | **12544** | **20%** |

| Housetype | | Beds | Arrangement | NDSS | Storey Height | SQFT | SQM | Number | Total SQFT | 5 Bed % |
|---|---|---|---|---|---|---|---|---|---|---|
| CAW | Cawthorne | 5 | Detached | Y | 2 | 1661 | 154 | 5 | 8305 | |
| **Total** | | | | | | | | **5** | **8305** | **12%** |

| Sub-total | | | | | | | | 40 | 44854 | 80% |
|---|---|---|---|---|---|---|---|---|---|---|

Affordable Units

| Housetype | Sales Name | Beds | | NDSS | Storey Height | SQFT | SQM | Number | Total SQFT |
|---|---|---|---|---|---|---|---|---|---|
| MALT A | Maltby | 1 | Maisonette | Y | 1 | 651 | 60 | 1 | 651 |
| MALT B | Maltby | 1 | Maisonette | Y | 1 | 651 | 60 | 1 | 651 |
| MALT C | Maltby | 2 | Maisonette | Y | 1 | 794 | 74 | 1 | 794 |
| MALT D | Maltby | 2 | Maisonette | Y | 1 | 794 | 74 | 1 | 794 |
| WET | Wetherby | 2 | Semi | Y | 2 | 753 | 70 | 2 | 1506 |
| OSG | Osgodby | 3 | Semi | Y | 2.5 | 969 | 90 | 4 | 3876 |
| **Total** | | | | | | | | **10** | **8272** | **20%** |

| Sub-total | | | | | | | | 10 | 8272 | |
|---|---|---|---|---|---|---|---|---|---|---|

| GRAND TOTAL: | | | | | | | | Number | Total SQFT | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 50 | 53126 | |
| GROSS DEVELOPMENT AREA: | | | | | | | | 6.13 | ACRES | 2.48 HECTARES |
| NET DEVELOPMENT AREA: | | | | | | | | 3.48 | ACRES | 1.41 HECTARES |
| NET DEVELOPMENT AREA DENSITY: | | | | | | | | | | 35.46 DPH |

Drawing Title
Planning Layout

Site
Shepley Road, Stocksmoor

Thorpe Arch Grange
Walton Road
Thorp Arch
LS23 7BA

01937 543599
www.newetthomes.co.uk

NEWETT HOMES

Scale @ A1 1:500 Date 22/02/2024

Drawn MC

Drawing No. Z159.100 Rev. G

# Appendix B

**ENGINEERING APPRAISAL**

Stocksmoor Station

Track

Mast (Telecommunication)

STATION ROAD

WIN AVENUE

STREET TREES TO BE MAINTAINED BY MANCO

Stone

LOCAL AREA OF PLAY

NEW FOOTWAY TO SOUTH OF ACCESS

FOUL WATER PUMP STATION (15M STAND OFF)

ATTENUATION BASIN

Sun Side

Stone Wood Dike

188.7m

189.6m

Crangle Well

ROAD

0 10 20 30 40 50 m

## Key

- Site Boundary
- Proposed Housing
- Affordable Units
- Existing stone walls to be retained
- Existing landscaping
- Proposed landscaping
- Main Road
- Shared Surface
- Area of Play (LAP)
- Potential sales area

## ACCOMMODATION SCHEDULE

Market Units

| Housetype | | Beds | | NDSS | Storey Height | SQFT | SQM | Number | Total SQFT | Z Bed % |
|---|---|---|---|---|---|---|---|---|---|---|
| RIP | Rippondon | 2 | Semi | Y | 2 | 753 | 70 | 4 | 3012 | |
| SHI | Shibden | 2 | Semi | Y | 2 | 842 | 78 | 1 | 842 | |
| MAR | Marsden | 2 | Semi | Y | 2 | 858 | 80 | 7 | 6006 | |
| Total | | | | | | | | 12 | 9860 | 30% |

| Housetype | | Beds | | NDSS | Storey Height | SQFT | SQM | Number | Total SQFT | 3 Bed % |
|---|---|---|---|---|---|---|---|---|---|---|
| DAL | Dalton | 3 | Semi | Y | 2 | 908 | 84 | 6 | 5448 | |
| SAX | Saxton Detached | 3 | Detached | Y | 2 | 939 | 87 | 6 | 5634 | |
| BUR | Burneston | 3 | Detached | Y | 2 | 1062 | 99 | 2 | 2124 | |
| Total | | | | | | | | 15 | 14145 | 38% |

| Housetype | | Beds | | NDSS | Storey Height | SQFT | SQM | Number | Total SQFT | 4 Bed % |
|---|---|---|---|---|---|---|---|---|---|---|
| COL | Collingham | 4 | Detached | Y | 2 | 1510 | 140 | 2 | 3020 | |
| KEY | Keyingham | 4 | Detached | Y | 2 | 1553 | 144 | 5 | 7765 | |
| Total | | | | | | | | 8 | 12043 | 20% |

| Housetype | | Beds | Arrangement | NDSS | Storey Height | SQFT | SQM | Number | Total SQFT | 5 Bed % |
|---|---|---|---|---|---|---|---|---|---|---|
| CAW | Cawthorne | 5 | Detached | Y | 2 | 1661 | 154 | 5 | 8305 | |
| Total | | | | | | | | 5 | 8305 | 12% |

| Sub-total | | | | | | | | 40 | 44353 | 80% |
|---|---|---|---|---|---|---|---|---|---|---|

Affordable Units

| Housetype | Sale% Name | Beds | | NDSS | Storey Height | SQFT | SQM | Number | Total SQFT |
|---|---|---|---|---|---|---|---|---|---|
| MALT A | Maltby | 1 | Maisonette | Y | 1 | 651 | 60 | 1 | 651 |
| MALT B | Maltby | 1 | Maisonette | Y | 1 | 651 | 60 | 1 | 651 |
| MALT C | Maltby | 2 | Maisonette | Y | 1 | 794 | 74 | 1 | 794 |
| MALT D | Maltby | 2 | Maisonette | Y | 1 | 794 | 74 | 1 | 794 |
| WET | Wetherby | 2 | Semi | Y | 2 | 753 | 70 | 2 | 1506 |
| OSG | Osgodby | 3 | Semi | Y | 2.5 | 969 | 90 | 4 | 3876 |
| Total | | | | | | | | 10 | 8272 | 20% |

| Sub-total | | | | | | | | 10 | 8272 | |
|---|---|---|---|---|---|---|---|---|---|---|

| GRAND TOTAL: | | | | | | | | Number | Total SQFT | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 50 | 52625 | |
| GROSS DEVELOPMENT AREA: | | | | | | | 6.13 | ACRES | 2.48 | HECTARES |
| NET DEVELOPMENT AREA: | | | | | | | 3.48 | ACRES | 1.41 | HECTARES |
| NET DEVELOPMENT AREA DENSITY: | | | | | | | | | 35.46 | DPH |

Drawing Title
Planning Layout

Site
Shepley Road, Stocksmoor

Thorpe Arch Grange
Walton Road
Thorp Arch
LS23 7BA

01937 543599
www.newetthomes.co.uk

Scale @ A1 1:500 Date 22/02/2024

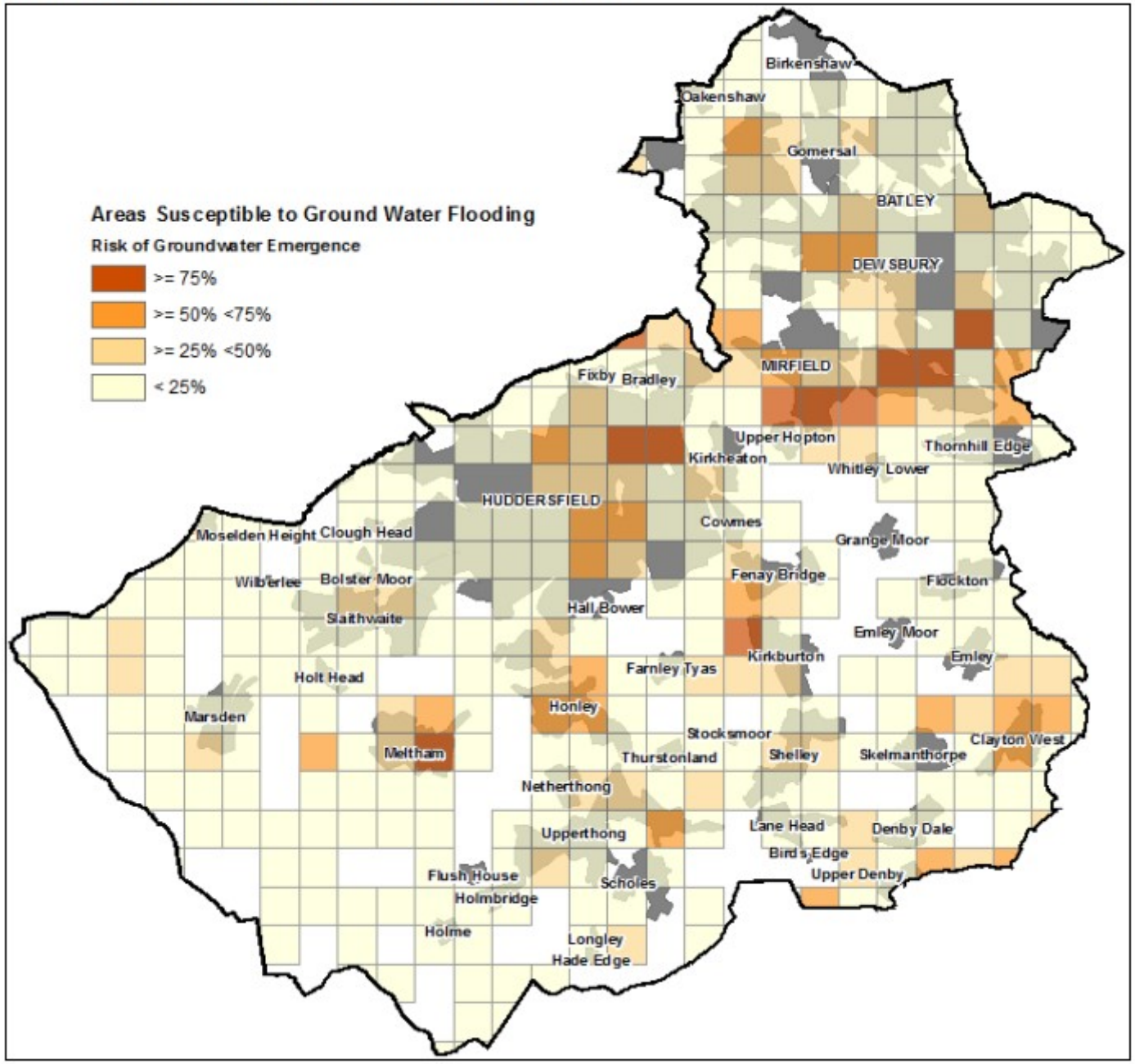
Drawn MC

Drawing No. Z159.100 Rev. G

# Appendix C

**GROUNDWATER FLOOD MAP**

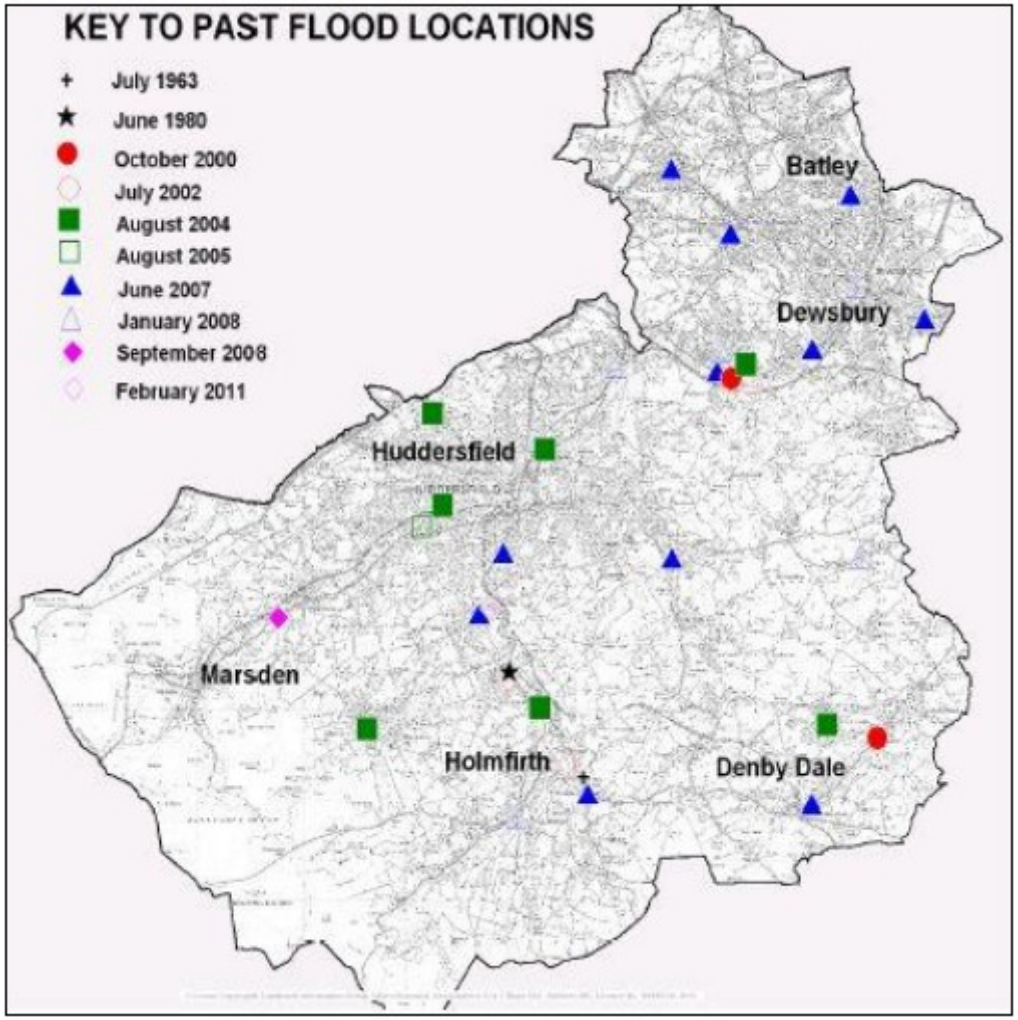
**Figure 3-5: Areas Susceptible to Groundwater Flooding**



# Appendix D

**HISTORIC FLOOD MAP**

**Figure 3-4: Locations of Past Flooding[12]**



# Appendix E

**YORKSHIRE WATER PRE DEVELOPMENT ENQUIRY**

Yorkshire Water Services
Developer Services
Pre-Development Team
PO BOX 52
Bradford
BD3 7AY

Tel: 0345 120 8482
Fax:

Email:
technical.sewerage@yorkshirewater.co.uk

Andrew Moseley Associates
51 St Paul Street
LS1 2TE

Your Ref:
Our Ref: Y013776

18th November 2022

Dear

**Shepley Road, Stocksmoor, HD4 6XW - Pre-Planning Enquiry U842220**

Thank you for your recent enquiry and remittance. Our official VAT receipt has been sent to you under separate cover. Please find enclosed a complimentary extract from the Statutory Sewer Map which indicates the recorded position of the public sewers. Please note that as of October 2011 and the private to public sewer transfer, there are many uncharted Yorkshire Water assets currently not shown on our records.

The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site and are valid for a maximum period of twelve months:

Foul Water

Development of the site should take place with separate systems for foul and surface water drainage. The separate systems should extend to the points of discharge to be agreed.

Foul water domestic waste can discharge to the 150 mm diameter public combined sewer recorded in Shepley Road, at a point to the south of the site.

From the information supplied, it is not possible to determine if the whole site will drain by gravity to the public sewer network. If the site, or part of it, will not drain by gravity, then it is likely that a sewage pumping station will be required to facilitate connection to the public sewer network. If sewage pumping is required foul water discharge must not exceed 4.75 (four point seven five) litres per second. This permission is not an acceptance in respect to any planning conditions imposed under the Grant of Planning Permission.

Surface Water

The developer's attention is drawn to Requirement H3 of the Building Regulations 2010. This establishes a preferred hierarchy for surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration system and watercourse in that priority order.

Sustainable Drainage Systems (SuDS), for example the use of soakaways and/or permeable hardstanding etc, may be a suitable solution for surface water disposal appropriate in this situation. You are advised to seek comments on the suitability of SuDS in this instance from the appropriate authorities.

The public sewer network does not have any capacity available to accept any discharge of surface water from the proposal. If SuDS are not viable, the developer is advised to contact the Environment Agency/local Land Drainage Authority with a view to establishing a suitable watercourse for discharge.

It is understood that a watercourse (Stone Wood Dike) is located to the east of the site. This appears to be the obvious place for surface water disposal (if SuDS are not viable). Please note Yorkshire Water cannot provide plans of culverted watercourses or highway drains. To obtain plans please contact the Lead Local Flood Authority for more details.

Please note further restrictions on surface water disposal from the site may be imposed by other parties. You are strongly advised to seek advice/comments from the Environment Agency/Land Drainage Authority/Internal Drainage Board, with regard to surface water disposal from the site.

Other Observations

Any new connection to an existing public sewer will require the prior approval of Yorkshire Water. You may apply on line or obtain an application form from our website (www.yorkshirewater.com) or by telephoning 0345 120 84 82.

Under the provisions of section 111 of the Water Industry Act 1991 it is unlawful to pass into any public sewer (or into any drain or private sewer communicating with the public sewer network) any items likely to cause damage to the public sewer network interfere with the free flow of its contents or affect the treatment and disposal of its contents. Amongst other things this includes fat, oil, nappies, bandages, syringes, medicines, sanitary towels and incontinence pants. Contravention of the provisions of section 111 is a criminal offence.

YorkshireWater

An off-site foul and surface water sewer may be required which may be provided by the developer and considered for Code for Adoption under Section 104 of the Water Industry Act 1991. Please telephone 0345 120 84 82 for advice on sewer adoptions. Alternatively, the developer may in certain circumstances be able to requisition off-site sewers under Section 98 of the Water Industry Act 1991 for which an application must be made in writing. For further information, please telephone 0345 120 84 82.

Prospectively adoptable sewers and pumping stations must be designed and constructed in accordance with the Code for Adoption 2021/22, pursuant to an agreement under Section 104 of the Water Industry Act 1991. We are happy to offer pre-development technical advice on any prospective sites that you would like to put forward for for adoption, prior to submission of your adoption application.

An application to enter into a Section 104 agreement must be made in writing prior to any works commencing on site. Please contact our Sewer Adoption, Diversion and Requisition (telephone 0345 120 84 82) or email technical.sewerage@yorkshirewater.co.uk or visit - https://www.yorkshirewater.com/developers/sewerage/sewer-adoptions/ for further information.

All the above comments are based upon the information and records available at the present time and is subject to formal planning approval agreement. The information contained in this letter together with that shown on any extract from the Statutory Sewer Map that may be enclosed is believed to be correct and is supplied in good faith. Please note that capacity in the public sewer network is not reserved for specific future development. It is used up on a 'first come, first served' basis. You should visit the site and establish the line and level of any public sewers affecting your proposals before the commencement of any design work.

Yours sincerely

**Development Services Technician**


| | | | |
|---|---|---|---|
| 418319 : 410668 | Map Name : SE1810NW | Title | Partial Key |
| Yorkshire Water,<br>PO Box 500,<br>Halifax Road,<br>Bradford BD6 2LZ<br>Contact Name :<br>G Mullaney<br>Contact Tel : | Notes | Foul Sewer = F<br>Combined Sewer = C<br>Surface Water Sewer = SW<br>Trade Sewer = TD<br>Partially Separate = PS | This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown. |
| | (Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432 | Date Req : 18/11/2022, 14:32:20 | Date Gen : 18/11/2022, 14:32:23 |
| | | Source : Sewer Network Enquiry | |

UPN: Undefined Originator: G Mullaney, ,

# Appendix F

**UK SUDS GREENFIELD RUNOFF RATES**

# Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

| | |
|---|---|
| **Calculated by:** | Aaron Yesudian |
| **Site name:** | Sheply Road |
| **Site location:** | Stockmoor |

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

## Site Details

| | |
|---|---|
| **Latitude:** | 53.59184° N |
| **Longitude:** | 1.72426° W |
| **Reference:** | 1250696537 |
| **Date:** | Apr 12 2024 13:26 |

## Runoff estimation approach

IH124

## Site characteristics

**Total site area (ha):** 2.4

## Methodology

| | |
|---|---|
| **$Q_{BAR}$ estimation method:** | Calculate from SPR and SAAR |
| **SPR estimation method:** | Calculate from SOIL type |

## Soil characteristics

| | Default | Edited |
|---|---|---|
| **SOIL type:** | 2 | 2 |
| **HOST class:** | N/A | N/A |
| **SPR/SPRHOST:** | 0.3 | 0.3 |

## Hydrological characteristics

| | Default | Edited |
|---|---|---|
| **SAAR (mm):** | 948 | 948 |
| **Hydrological region:** | 3 | 3 |
| **Growth curve factor 1 year:** | 0.86 | 0.86 |
| **Growth curve factor 30 years:** | 1.75 | 1.75 |
| **Growth curve factor 100 years:** | 2.08 | 2.08 |
| **Growth curve factor 200 years:** | 2.37 | 2.37 |

## Notes

### (1) Is $Q_{BAR}$ < 2.0 l/s/ha?

When $Q_{BAR}$ is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

### (2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

### (3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Greenfield runoff rates

| | Default | Edited |
|---|---|---|

| | | |
|---|---|---|
| $Q_{BAR}$ (l/s): | 6.24 | 6.24 |
| 1 in 1 year (l/s): | 5.36 | 5.36 |
| 1 in 30 years (l/s): | 10.91 | 10.91 |
| 1 in 100 year (l/s): | 12.97 | 12.97 |
| 1 in 200 years (l/s): | 14.78 | 14.78 |

# Appendix G

**PRELIMINARY GEOENVIRONMENTAL INVESTIGATION**

LITHOS

# Preliminary Geoenvironmental Investigation

## Land at Shepley Road, Stocksmoor

## For Newett Homes

Report no: 4594/1

Date: November 2022

Tel: 01937 545330 • info@lithos.co.uk • www.lithos.co.uk

# SHEPLEY ROAD, STOCKSMOOR SUMMARY OF GEOENVIRONMENTAL ISSUES

| | | | |
|---|---|---|---|
| **Job No.** | 4594 | **Site area/ha** | 2.5 |
| **Client:** | Newett Homes | **NGR:** | SE 184 107 |
| **Site:** | Shepley Road, Stocksmoor | **Nearest postcode:** | HD4 6XW |

The site is located off Shepley Road, Stocksmoor, approximately 7.2km southeast of Huddersfield, and currently comprises a field used for farming.

Lithos were commissioned by Newett to provide a preliminary geoenvironmental appraisal of the site. It is understood that the site is to be redeveloped with housing; a proposed layout is not currently available.

Lithos' investigation included an inspection of historical and geological maps and information provided by the British Geological Survey, the Landmark Information Group, the Coal Authority, and QGIS. In addition, a site inspection has been carried out.

A summary of salient geoenvironmental issues is provided in the table below.

| Issue | Remarks |
|---|---|
| Former uses | The site has remained undeveloped throughout its history and has been used for farming. |
| Anticipated ground conditions | No made ground is expected.<br>No drift soils are recorded but some residual soils are expected.<br>Grenoside Sandstone underlies the site, likely from shallow depth. |
| Anticipated contamination | The site is greenfield and no significant contamination is anticipated. |
| Mining & quarrying | Whilst the site lies within a Coal Authority Low Risk area, no significant risks have been identified, and an intrusive mining investigation will not be required.<br>There are two former sandstone quarries within 250m of the site, but none within site boundary. |
| Hazardous gas | The site is located within 250m of former sandstone quarries and a former reservoir, and may be affected by sources of hazardous gas generation.<br>The site is in an area where between 1% and 3% of homes are estimated to be above the radon action level therefore basic measures may be required. |
| Flooding & drainage | The site lies in Flood Zone 1 where the risk of flooding from rivers or the sea is classified as low.<br>Soakaways are unlikely to provide a viable solution for the disposal of surface water due to the sloping nature of the site and the potential for springs to occur. |
| Preparatory works | General site clearance of any surface materials and vegetation.<br>Topsoil strip and stockpile. |
| Anticipated foundation solutions | At this stage it is envisaged that all plots are likely to be founded on strip footings in the residual soils or on bedrock. |
| Recommendations for ground investigation | About 12 Trial pits to determine the nature, distribution and thickness of shallow soils and depth to bedrock. About 8 dynamic sample boreholes to assess in-situ density of any granular soils and to install gas monitoring wells. |

At this stage, anticipated significant abnormals relating to geoenvironmental issues at the site are:

- Given the existing topography (the slope in the east with gradients of up to 1 in 3), some site regrade may be required, with the need for underbuild and retaining walls.
- Given the likely presence of hard rock from shallow depth, excavation greater than around 2m might prove difficult across the site. It would therefore be prudent to allow for excavation of hard rock in any deep excavations such as those that may be required for drainage etc; a breaker, will be required and possibly even blasting.

## CONTENTS

# APPENDICES

## Appendix A – General notes

| | |
|---|---|
| 01 | Environmental setting |

## Appendix B – Drawings

| Drawing | Title |
|---|---|
| 4594/1 | Site location plan |
| 4594/2 | Site features |
| 4594/3 | Site photos |
| 4594/4 | Preliminary conceptual site model |

## Appendix C - Commission

## Appendix D – Historical OS plans*

## Appendix E – Search responses*

| From | Date | Content |
|---|---|---|
| Landmark | 02/11/2022 | Envirocheck report |
| Coal Authority | 02/11/2022 | Consultants Coal Mining Report |

* Some of this data is not included within the paper or PDF copies of this report can be provided on request.

## FOREWORD (GEOENVIRONMENTAL APPRAISAL REPORT)

This report has been prepared for the sole internal use and reliance of the Client named on page 1. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Lithos Consulting Limited (Lithos); such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

This report has been reviewed by a Competent Person, as defined in the National Planning Policy Framework. We ensure that all projects are managed by individuals with necessary experience, relevant qualifications, and current membership of a relevant professional organisation. Records of engineers, project managers and reviewers involved in this project are maintained by us. Lithos QA/QC procedures for all our work forms an integral part of our ISO9001 accreditation and as such is regularly audited.

The report presents observations and factual data obtained during our site investigation and provides an assessment of geoenvironmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from Lithos prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. Lithos cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context. However, it should be noted that in order to keep the number of pages to a minimum, some information (e.g. full copy of the Landmark/Groundsure Report) is not included in the PDF; by request it can be provided on a CD.

The findings and opinions conveyed in this report (including review of any third-party reports) are based on information obtained from a variety of sources as detailed within this report, and which Lithos believes are reliable. Reasonable care and skill has been applied in examining the information obtained. Nevertheless, Lithos cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

Lithos cannot be responsible for the consequences of changing practices, revisions to waste management legislation etc that may affect the viability of proposed remediation options.

The report represents the findings and opinions of experienced geoenvironmental consultants. Lithos does not provide legal advice and the advice of lawyers may also be required.

# PRELIMINARY GEOENVIRONMENTAL INVESTIGATION OF LAND AT SHEPLEY ROAD, STOCKSMOOR

## 1 INTRODUCTION

### 1.1 The commission and brief

1.1.1 Lithos Consulting were commissioned by Newett Homes to carry out a preliminary geoenvironmental investigation of land at Shepley Road, Stocksmoor.

1.1.2 Correspondence regarding Lithos' appointment, including the brief for this investigation, is included in Appendix C. The agreed scope of works included:

- A site walkover and inspection
- An assessment of land use history
- Determination of the site's environmental setting
- A mining risk assessment in accordance with Coal Authority guidance.
- Assessment of anticipated ground conditions, including potential contaminants
- Assessment of anticipated foundation and engineering issues associated with redevelopment for a residential end-use
- Provision of recommendations for an appropriate ground investigation

1.1.3 This Preliminary Investigation comprised an inspection of historical and geological maps and information provided by the British Geological Survey, the Landmark Information Group, the Coal Authority, and QGIS[1]. In addition, a site inspection has been carried out by Lithos.

1.1.4 Primary aims of this investigation were to identify salient geoenvironmental issues affecting the site to enable design and costing of an appropriate intrusive investigation, and to support the submission of a planning application.

### 1.2 The proposed development

1.2.1 It is understood that consideration is being given to redevelopment of the site with 2 to 3 storey domestic dwellings, associated gardens, POS and adoptable roads and sewers. No site layout has been provided at this stage.

### 1.3 Report format and limitations

1.3.1 Standard definitions, procedures and guidance are contained within Appendix A, which includes background, generic information on assessment of the site's environmental setting.

1.3.2 General notes and limitations relevant to all Lithos preliminary investigations are described in the Foreword and should be read in conjunction with this report. The text of the report draws specific attention to any modification to these procedures and to any other special techniques employed.

[1] *An Open Source Geographic Information System used by Lithos to access publicly available Government held digital data.*

# 2 SITE DESCRIPTION

## 2.1 General

2.1.1 The site's location is shown on Drawing 4594/1 presented in Appendix B to this report. Site details are summarised in the table below.

| Detail | Remarks |
|---|---|
| Location | 7.2 km southeast of Huddersfield city centre |
| NGR | SE 184 107 |
| Area | 2.5 ha (6.1 acres) |
| Known services | Overhead telecom |

## 2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on 23rd November 2022.

2.2.2 The site comprises a roughly rectangular grassed field of variable topography, with evidence of recent pastoral farming use. In the north, the site gently slopes down to the north from the centre where it is relatively flat-lying. Access is via a locked metal farm gate in the southwest from Shepley Road.

2.2.3 Much of the site is bounded by a barbed wire fence and a dry stone wall with occasional trees (generally 5-10m tall) and shrubs. Trees are more frequent along the site's northern boundary, beyond which is a railway line and Stocksmoor Station. The railway line is within a cutting (about 10m below the site) except in the far east where the railway is above site level because of the site's topography.

2.2.4 In the far east, there is a channel of water flowing from a culvert/outflow from beneath the railway. The channel of water flows down the slope close to the northern boundary towards the woodland beyond the site's eastern boundary.

2.2.5 The east of the site is characterised by a grassed slope (gradient of c.1 in 8) that becomes steeper (gradient of c.1 in 4) and more overgrown with sporadic immature trees (c.5m tall). Overgrown brambles and weeds are present along the southern boundary in the east.

2.2.6 Existing salient features, at the time of the walkover are presented on Drawing 4594/2 in Appendix B to this report, and summarised in the table below.

| Feature | Remarks |
|---|---|
| Current access | Off Shepley Road |
| Topography | Slopes down gently to the north and east.<br>Steeper slope present in the far east with gradients up to 1 in 4. |
| Approximate areas | 18,000m² grass<br>6,000m² overgrown grass<br>400m² brambles & overgrown weeds<br>100m² water channel |
| Nature of boundaries | North, west, south & east - dry stone walls & barbed wire fences with sporadic trees and shrubs. |
| Surrounding land uses | North – Stocksmoor railway station and line.<br>East – Woodland and Stone Wood Dike.<br>South – Housing and Shepley Road.<br>West – Housing. |

2.2.7 A selection of site photographs are included on Drawing 4594/3.

# 3 SITE HISTORY

3.1 In order to investigate the development history and previous land uses at the site and immediate surrounding land, site centred extracts from Ordnance Survey (OS) plans dating back to 1854 have been examined. These plans are presented in Appendix D to this report.

3.2 The table below provides a summary of the salient points relating to the history of the site with respect to the proposed end use. It is not the intention of this report to describe in detail all the changes that have occurred on or adjacent to the site. Significant former uses/operations are highlighted in **bold** text for ease of reference.

| Date | Site | Surrounding land |
|---|---|---|
| 1854 | Site is occupied by fields and is undeveloped. | **Sun Side Quarry** (Sandstone) to the south immediately beyond Sun Side Lane. Several houses shown immediately south of the site off Sun Side Lane.<br>**Reservoir** immediately west.<br>Lower Stone Wood shown immediately east, with Stone Wood Dike flowing north through it.<br>Stocksmoor Station immediately north within a cutting with railway running along northern boundary.<br>Hamlet of Crangle shown 100m west.<br>An **Old Quarry** (Sandstone) is labelled c.250m west, although exact location is not clear. |
| 1893 | No significant changes. | Sun Side Quarry to the south no longer shown.<br>Old Quarry labelled c.350m west. |
| 1906 | | Old Quarry no longer labelled. |
| 1916 | | Additional housing shown immediately south. Railway to the north labelled as L&YR Huddersfield & Penistone Line. |
| 1932 | | Sun Side Lane renamed Shepley Road. |
| 1948 | | No significant changes. |
| 1960 | | Reservoir no longer labelled to the west, although a depression in the ground remains. |
| 1976 | | Housing shown immediately west and southwest along Station Road and Shepley Road |
| 1989 | | Further housing shown 100m southwest. Village labelled Stocksmoor. |
| 2000 | | Further housing shown 150m west. |
| 2016 | | No significant changes. |
| 2022 | | |

# 4 ENVIRONMENTAL SETTING

## 4.1 General

4.1.1 Notes describing how the site's environmental setting has been assessed are included in Appendix A to this report. Reference has been made to publicly available Government held digital data via QGIS (an Open Source Geographic Information System). The response received from the Coal Authority, and extracts from the Landmark Report are presented in Appendix E.

| Issue | Data reviewed | |
|---|---|---|
| Geology | 1:50,000 BGS map (Sheet 86)<br>1:10,000 BGS map (Sheet SE11SE) | Drift soils – None recorded.<br>Solid (bedrock) – Grenoside Sandstone – sandstone and siltstone, medium- and fine-grained, micaceous.<br>Shallowest coal seam – Thin Coal at about 25m depth.<br>Strata Dip - 3° north.<br>Faults – None recorded beneath site or within 100 metres. |
| Mining | Coal Authority<br>BGS maps | This site is located within a Coal Mining Development Low Risk Area.<br>Past and present workings – None recorded.<br>Opencast – None recorded within 500m.<br>Mine entries – None recorded within 100m. Further details in Section 4.2 below. |
| Quarrying | Historical OS plans | Sun Side Quarry shown immediately south and an old quarry is labelled 250m west in 1854. |
| Landfills | Envirocheck Report | No known landfills within 250m. |
| Radon | Public Health England | The site lies in an area where 1-3% of homes are estimated to be above the action level. Therefore basic measures may not be required. Further details in Section 4.4 below. |
| Hydrogeology | Environment Agency electronic open data via QGIS | Source Protection Zone? No.<br>Aquifer: Secondary A (Solid).<br>Groundwater abstractions? Closest is 1,100m southwest for general farming & domestic purposes by K Hall & Sons at Lower Halstead Farm, Thurstonland.<br>Groundwater vulnerability – High Vulnerability (Secondary Bedrock Aquifer).<br>Pollution incidents? None recorded. |
| Hydrology | Envirocheck Report | Nearest watercourse(s) – Stone Wood Dike, 50m southeast, flowing north.<br>Water quality – Moderate (Ecological), Fail (Chemical).<br>Pollution incidents? Category 2 (Significant incident) to stream 400m south in April 1991. Pollutant was yard run off from farm.<br>Abstractions? None related or significant to site. Discharge consents? None related or significant to site. |
| Flood risk | Environment Agency electronic open data via QGIS | The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low.<br>In accordance with Chapter 14 of the National Planning Policy Framework, a site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency. |

## 4.2 Coal & mining

4.2.1 In July 2011 the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology relating to coal mining development areas. This Section provides the necessary mining risk assessment required by the proposed planning application.

4.2.2 Geological maps suggest that only one coal seam underlies the site at shallow depth. This is an Unnamed Thin Coal, a 'thin' seam, at around 25m depth.

4.2.3 The site lies within a Low Risk Area - within the defined coalfield, but no known defined risks have been recorded by the CA; there may still be unrecorded issues.

4.2.4 A CA mining report states that:

- No past underground mining is recorded.
- There are no probable unrecorded shallow workings.
- There are no mine entries within 100 metres.
- No opencast mines are recorded within 500m.
- The Coal Authority has not received a damage notice or claim for the property, or any property within 50m, since 31st October 1994.
- No notices have been given, under Section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.
- The property is not in an area where a notice to withdraw support has been given.

4.2.5 The mining reports suggests there are no known shallow workings (i.e. at less than 30m depth). However, it should be noted that it did not become a statutory requirement to maintain and preserve plans of abandoned mines until the Mine (Coal) Regulations Act of 1872 and consequently there may be mineworkings beneath the site for which the Coal Authority have no records.

4.2.6 Information from historical plans show that the surrounding area has been quarried in the past for sandstone. On the 1854 plan, there are two sandstone quarries shown within 250m of the site, although they are labelled as 'old' or not shown on the 1893 or subsequent OS plans.

## 4.3 Mineral safeguarded areas

4.3.1 The site is underlain by sandstone and might therefore be considered by the Local Authority to lie within a Mineral Safeguarding Area (MSA).

4.3.2 MSAs are areas of known mineral resources that are of sufficient economic or conservation value to warrant protection for generations to come. The purpose of MSAs is not to preclude automatically other forms of development, but to make sure that mineral resources are adequately and effectively considered in land-use planning decisions.

4.3.3 Specialist guidance on Mineral Safeguarding "A Guide to Mineral Safeguarding in England" has been produced by The Coal Authority and the British Geological Survey.

4.3.4 Paragraph 204 of the National Planning Policy Framework (NPPF) requires Local Authorities, when preparing Local Plans to:

- Define Minerals Safeguarding Areas and adopt appropriate policies in order that known locations of specific minerals resources of local and national importance are not needlessly sterilised by non-mineral development, whilst not creating a presumption that resources defined will be worked; and define Minerals Consultation Areas based on these Minerals Safeguarding Areas.
- Set out policies to encourage the prior extraction of minerals, where practicable and environmentally feasible, if it is necessary for non-mineral development to take place.

4.3.5 NPPF Paragraph 204 notes that when determining planning applications, local planning authorities should give weight to the benefits of the mineral extraction.

4.3.6 As a consequence of the NPPF, and the presence of sandstone beneath the site, the Local Authority may require Newett to consider the opportunity to recover the sandstone.

4.3.7 The Kirklees Local Plan states that sandstone within the district is important for construction projects throughout the UK, with several quarries operating in the area.

4.3.8 The Kirklees Local Plan policy of mineral safeguarding states that surface development will only be permitted within a Mineral Safeguarded Area where it has been demonstrated that:

- the mineral concerned is proven to be of no economic value as a result of the undertaking of a Mineral Resource Assessment; or
- the development will not inhibit mineral extraction if required in the future; or
- there is an overriding need for the development; or
- the mineral can be extracted prior to the development taking place.

## 4.4 Hazardous gas

### Methane & carbon dioxide

4.4.1 The site might be affected by sources of hazardous gas generation as it is:

- Located within 250m of former sandstone quarries and a reservoir, for which the nature of backfill is unknown

4.4.2 Consequently, monitoring is recommended in order to determine appropriate gas protection measures for the proposed dwellings.

### Radon

4.4.3 Requirements with respect to radon measures are set out in Building Regulations Approved Document C. Probability bandings (based on the proportion of properties in a given area that exceed the Action Level; currently 200 $Bq.m^{-3}$) are used to determine whether a property requires no, basic or full measures. At present Approved Document C advocates basic measures for the probability banding 3% to 10% (full measures if >10%).

4.4.4 The Public Health England UK radon map and the Landmark report indicate that the site is in an area where **between 1% and 3%** of homes are estimated to be above the action level. Consequently, basic radon protection measures may not be required in new dwellings.

4.4.5 However, Public Health England would like to see all new build include basic measures. Given that the site lies in an area where >1% of homes are estimated to be above the action level, the Developer might consider providing all new dwellings with basic radon protection measures.

## 4.5 Agriculture

4.5.1 Historical plans show that the site has been occupied by arable farmland. Generally farming is not considered likely to have caused significant ground contamination. However, activities such as slurry spreading, the discharge of chemicals to ground, and unregulated burial are known to have occurred on farmland. Potential contaminants associated with farming activity could include any of the following.

| Agricultural activity | Potential contaminant |
|---|---|
| Sewage farming, slurry spreading | Methane, metals, nitrates, oxygen depletion |
| Tracks (if built up with crushed demolition rubble etc) | Metals, asbestos, hydrocarbons |
| Plant & animal protection | Pesticides & herbicides |
| Soil conditioners | Metals, sulphates, PAH |
| Field sports | Lead shot |
| Equipment maintenance | Hydrocarbons, metals |
| Waste burial, land levelling, backfilling ponds/quarries | Methane, metals, PAH etc |
| Naturally occurring contaminants | Arsenic, metals |

# 5 PRELIMINARY CONCEPTUAL SITE MODEL

## 5.1 Potential contaminants

5.1.1 A preliminary conceptual site model, presented as Drawing 4594/4 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 4.

5.1.2 Clearly, the conceptual model will be subject to modification in light of data arising from the proposed intrusive ground investigation.

5.1.3 Potential contaminant linkages are shown on the preliminary conceptual site model. The most significant of these is the migration of hazardous gas from nearby former quarries or dermal contact and ingestion/inhalation of any contaminants within the topsoil to the end users (residents).

## 5.2 Anticipated ground conditions & potential issues

5.2.1 Based on the data reviewed in Section 4 (Environmental Setting), anticipated ground conditions are expected to comprise:

| Anticipated condition | Remarks |
|---|---|
| Made ground | No made ground is expected. |
| Natural soils | No drift soils are recorded at the site however Residual Soils (completely weathered sandstone) are likely to be present. |
| Bedrock | Grenoside Sandstone expected at shallow depths. |
| Mineworkings | No recorded mineworkings beneath the site and Coal Authority suggests no probable unrecorded mineworkings. No shallow workable seams beneath the site. |
| Groundwater | Groundwater likely within bedrock. |

5.2.2 Based on the data above and that in Sections 2 (Site Description) and 3 (History), potential ground-related issues associated with this site are likely to include:

| Type of issue | Specific issue | Remarks |
|---|---|---|
| Potential on-site contamination sources | 1. Reworked topsoil (inorganics, organics, pesticides) | 1. Associated with farming |
| Potential off-site contamination sources | 1. Former quarries and reservoir | 1. Possible sources of hazardous gas |
| Potential geotechnical hazards | - | - |
| Other potential constraints | 1. Underground and/or overhead utilities<br>2. Cutting along northern boundary | 1. Underground utilities unknown, overhead telecom in the south<br>2. Railway within cutting – early consultation with Network Rail recommended |

5.2.3 Given the likely presence of **hard rock** from shallow depth, excavation greater than around 2m might prove difficult across the site. It would therefore be prudent to allow for excavation of hard rock in any deep excavations such as those that may be required for drainage etc; a breaker, will be required and possibly even blasting.

5.2.4 In essence, the need for blasting will be predominantly dictated by two factors: the depth of cut required, and the nature of the bedrock encountered in that cut. Rotary cored boreholes to provide information on unconfined compressive strength and fracture spacing would be prudent if/where cut in excess of 3m is required.

# 6 LAND CONTAMINATION - PART IIA & PLANNING

6.1 Local Authorities have responsibilities with respect to land contamination in the context both of Part IIA of the Environmental Protection Act 1990, and Planning.

6.2 The contaminated land regime in Part IIA was introduced specifically to address the historical legacy of land contamination. It applies where there is unacceptable risk, assessed on the basis of the **current** use and the relevant circumstances of the land. It is not directed to assessing risks in relation to a future use of the land that would require a specific grant of planning permission. This is primarily a task for the planning system, which aims to control development and land use in the **future**.

## *Planning*

6.3 As of March 2012, Planning Policy Statement (PPS23) was replaced by the National Planning Policy Framework (NPPF), supported by web-based planning practice guidance. The NPPF (updated in July 2021) includes the following with respect to contamination and site investigation:

6.4 'Where a site is affected by contamination or land stability issues, responsibility for securing safe development rests with the developer and/or landowner'.

6.5 Planning policies and decisions should ensure that:

- The site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses, and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;
- After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the environmental protection act 1990; and
- Adequate site investigation information, prepared by a competent person, is presented'.

6.6 Annex 2 of the NPPF states that 'all investigations of land potentially affected by contamination should be carried out in accordance with established procedures (such as BS10175[2])'.

## *This site*

6.7 The underlying Grenoside Sandstone is classified as a Secondary A aquifer. The nearest surface watercourse is the Stone Wood Dike, which flows in a northerly direction, approximately 50m beyond the site's eastern boundary. Therefore, the site's environmental setting is considered to be of moderate sensitivity.

6.8 With respect to human health, the proposed end use (residential) is also sensitive.

6.9 Current use of the site is considered unlikely to have given rise to any significant ground and groundwater contamination.

6.10 It is considered that the site should be suitable for the proposed use subject to implementation of appropriate preparatory works.

[2] *BS10175 (2011) - Code of practice for the investigation of potentially contaminated sites*

# 7 GROUND INVESTIGATION DESIGN

## 7.1 Ground investigation design & strategy

7.1.1 The preliminary conceptual site model has been used as a basis for design of an appropriate ground investigation, the scope of which is summarised below.

| Exploratory holes | Purpose |
|---|---|
| 12 Trial Pits | To determine the nature, distribution and thickness of shallow natural soils, including suitability of the ground for founding structures and highways. |
| Dynamic sampling (mini boreholes) c. 8 no. | To confirm the strength (density) of natural in-situ granular soils via SPTs<br>To install monitoring wells across the site in order to:<br>• Monitor for hazardous gas<br>• Determine groundwater levels and assess flow direction |

7.1.2 Proposed exploratory hole locations should be selected to provide a representative view of the strata beneath the site. A nominal 40m grid spacing should be appropriate, with additional exploratory locations scheduled as necessary in light of the ground conditions actually encountered.

7.1.3 Parts of the site were noted to be wet and soft during the site walkover. If ground investigation is not undertaken during drier summer months, it may be necessary to use a tracked excavator.

7.1.4 Representative soil samples of natural and any man-made ground should be taken during the works. The number of soil samples taken should be reflective of the geological complexity actually encountered, but in general about 3 samples should be taken from most exploratory holes.

7.1.5 The investigation should be undertaken in general accordance with:

- BS5930:2015 "Code of practice for site investigation"
- BS10175:2017 "Code of practice for the investigation of potentially contaminated sites"
- "Technical Aspects of Site Investigation" – EA R&D Technical Report P5-065/TR (2000)
- "Development of appropriate soil sampling strategies for land contamination" – EA R&D Technical Report P5-066/TR (2001)

7.1.6 **Trial pitting** will enable determination of:

- Nature, distribution and thickness of shallow soils
- Suitability of the ground for founding structures and highways

7.1.7 The in-situ shear strengths of any cohesive soils encountered should be determined by use of a hand-held shear vane.

7.1.8 Given the sloping nature of site and the presence of a railway cutting to the north, it is considered possible that springs may occur if soakaways were to be utilised on the site. Therefore soakaway testing is not considered necessary.

7.1.9 **Mini-boreholes** will:

- Allow the installation of gas monitoring wells.
- Enable assessment of the density of granular soils either via discrete SPTs or dynamic probing

7.1.10 If bedrock is found to be shallow (say within 1.5m of ground level), rotary probeholes may be required to install gas monitoring wells. This should be reviewed on completion of trial pitting.

7.1.11 Monitoring wells should be installed in about 8 boreholes. The generation potential of potential **gas** sources (former quarries) is considered likely to be Very Low. Therefore, in accordance with CIRIA Report C665[3], it would be prudent to initially allow for 6 visits over a 3 month period. A hazardous gas risk assessment should be issued on completion of monitoring.

7.1.12 Routine **geotechnical soils analysis** (moisture content, Atterberg limits, pH, water soluble sulphate) should be scheduled on about 12 samples.

7.1.13 The site has not been the subject of a past potentially contaminative industrial land use. However, historical mapping suggests arable farming has been carried out on the site. Sampling of the topsoil should be undertaken to confirm its suitability for re-use. At least 10 samples should be taken with analysis to include pH, metals, TOC, speciated PAH and asbestos ID.

7.1.14 Further sampling should be undertaken if made ground is encountered in the exploratory holes.

7.1.15 Whilst it is highly unlikely that PAAH pesticides will be detected by soil sampling, it would be prudent to confirm this via analysis of 3 topsoil samples.

7.1.16 It would also be prudent to analyse about 4 topsoil samples to check compliance with BS3882[4] requirements, via testing for visible contaminants, sharps and clay/sand/silt content.

7.1.17 On completion of the fieldwork and laboratory testing a comprehensive bound, factual and interpretative report should be issued. This should contain detailed engineering records, laboratory test results, copies of all relevant correspondence and drawings of the site. The report should also include qualitative risk assessment with respect to both controlled waters and human health.

[3] *CIRIA C665: Assessing risks posed by hazardous ground gases to buildings (2007).*
[4] *BS3882:2015. Specification for topsoil. Published by BSI Standards Limited.*

# 8 CONCLUSIONS & RECOMMENDATIONS

## 8.1 General

8.1.1 The site comprises c. 2.5 hectares of land located in Stocksmoor about 7.2km southeast of Huddersfield city centre. The site has been occupied by fields and used as farmland throughout its history.

8.1.2 It is understood that Newett are considering acquisition of the site with a view to redevelopment with housing.

8.1.3 The main issues considered in this report, and in particular in Sections 3 & 4 are based on a review of historical maps and available geological/environmental data. This report provides an assessment of geoenvironmental issues and implications associated with the proposed residential redevelopment of the site.

## 8.2 Mining and quarrying

8.2.1 This site is underlain at depth by Grenoside Sandstone bedrock, and the shallowest coal seam (a 'thin' unworkable seam) lies at 25m below the surface. Whilst the site lies within a Coal Authority Low Risk area, no significant risks have been identified, and an intrusive mining investigation will not be required.

8.2.2 Historical OS maps have recorded two former sandstone quarries within 250m of the site, including Sun Side Quarry which was shown immediately south of the site in 1854.

## 8.3 Hazardous gas

8.3.1 The site is in an area where between 1% and 3% of homes are estimated to be above the radon action level. Consequently, basic radon protection measures may not be required in new dwellings.

8.3.2 The site is located within 250m of former sandstone quarries and a former reservoir, and may be affected by sources of hazardous gas generation.

8.3.3 As such, wells should be installed in boreholes to allow subsequent monitoring for hazardous gas in order to determine appropriate gas protection measures for the proposed dwellings.

## 8.4 Foundations

8.4.1 At present, no geotechnical ground investigation data is available and consequently it is only possible to estimate the ground conditions. Before firm foundation recommendations can be given, it will be necessary to undertake an appropriate ground investigation. However, tentative recommendations are provided below.

8.4.2 The published geological data suggests that the site is underlain by Grenoside Sandstone with no drift soils recorded, although residual soils are expected.

8.4.3 Weathered Grenoside Sandstone should provide sufficient bearing capacity to enable the adoption of strip footings for two storey housing. Reinforcement, as a precaution against differential settlement, is recommended only where foundation excavations encounter significant lateral and vertical variations in strata.

8.4.4 If rock is encountered at shallow depth, foundations should be placed entirely on rock and not partially on rock and partially on residual soil. This may, depending on surface gradient, necessitate significant over deepening of foundations.

## 8.5 Highways and external works

8.5.1 There may be a requirement for retaining walls, underbuild and/or tanking in the east where steep slopes are present.

8.5.2 Weathered Grenoside Sandstone (sands) should yield a CBR of at least 20%. This value should be verified prior to or during construction.

## 8.6 Soakaways & drainage

8.6.1 Given the sloping nature of site and the presence of a railway cutting to the north, it is considered possible that springs may occur if soakaways were to be utilised on the site therefore soakaways are considered unlikely to provide a viable solution for the disposal of surface water.

8.6.2 Alternative SUDS options (see CIRIA C753[5] for further details) include:

- Swales – linear grassed features in which surface water can be stored or conveyed. Where suitable, swales can be designed to allow infiltration.
- Basins - a ground depression designed to store surface water that is normally dry, except during and immediately following a rainfall event. There are two types:
  - Infiltration – basin designed to store runoff and infiltrate it gradually into the ground.
  - Detention – an outlet restricts flows, so that the basin fills and provides attenuation.
- Ponds – designed to have permanent pool of water, but with capacity to provide temporary storage-controlled discharge.

8.6.3 Yorkshire Water have published a guide[6] for developers and designers outlining their design requirements for surface water attenuation assets.

8.6.4 With respect to detention basins, which should normally be dry, water table levels should be taken from borehole monitoring wells over 4 consecutive seasons, for at least 3 points in the basin area. The detention basin should be designed to ensure that there is a minimum of 1m of unsaturated soil between the maximum groundwater level and the lowest part of the structure.

## 8.7 Contamination

8.7.1 The site's environmental setting is considered to be of moderate sensitivity. With respect to human health, the proposed end use (residential) is also sensitive.

8.7.2 No potentially contaminative industrial land uses were identified as having been present on the site. However, arable farming has historically been carried out. The farming activities may have given rise to some limited contamination.

8.7.3 Consequently, a ground investigation is required in order to assess the suitability of topsoil for re-use.

[5] *CIRIA C753 (2015) – The SuDS Manual.*
[6] *Design Requirements for Surface Water Attenuation Assets, February 2017.*

## 8.8 Potential development constraints

8.8.1 Given the likely presence of **hard rock** from shallow depth, excavation greater than around 2m might prove difficult across the site. It would therefore be prudent to allow for excavation of hard rock in any deep excavations such as those that may be required for drainage etc; a breaker, will be required and possibly even blasting.

8.8.2 Stocksmoor Railway Station and railway line are within a cutting immediately north of the site. Early communication with **Network Rail** is recommended.

8.8.3 The **overhead telecom** utility presents a potential development constraint unless they can be relocated. Additional enquiries are required to ascertain the feasibility of such diversionary works and the particular easement required by each service undertaker if they remain in-situ.

## 8.9 Further investigation

8.9.1 Whilst the site is considered suitable for its current and proposed use, the proposed change in use will require intrusive investigation.

8.9.2 This would include:

- Machine-excavated trial pits to determine near surface ground conditions including depth to bedrock, groundwater and stability
- Geotechnical soils analysis to enable foundation recommendations
- Chemical testing on topsoil samples to assess its suitability for re-use.
- Window sample boreholes to assess in-situ density of any granular soils and allow installation of gas monitoring wells. Rotary probeholes may be required if bedrock is found to be very shallow (within 1.5m of ground level).
- Gas monitoring and risk assessment

8.9.3 An appropriate ground investigation strategy is presented in Section 7.

# Appendix A

## General Notes

# 01 - Environmental setting
# Generic notes – geoenvironmental Investigations

## General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the "Search Responses" Appendix of this Geoenvironmental Report.

## Geology, mining & quarrying

In order to establish the geological setting of a site, Lithos refer to BGS maps for the area, and the relevant geological memoir. Further information is sourced by reference to current and historical OS plans.

In July 2011, the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology. The CA, using its extensive records has prepared plans for all coalfield Local Planning Authorities, which effectively refines the defined coalfield areas into High Risk and Low Risk areas. **High Risk** areas are likely to be affected by a range of legacy issues that pose a risk to surface stability, including: mine entries; shallow coal workings; workable coal seam outcrops; mines gas; and previous surface mining sites. **Low Risk** areas comprise the remainder of the defined coalfield, and are areas where no known defined risks have been recorded; although there may still be unrecorded issues. Where a site lies within either a High or Low Risk area, a mining report is obtained from the CA.

## Landfills

Reference is made to publicly available Government held digital data via **QGIS** (an Open Source Geographic Information System), data from Landmark or Groundsure, and sometimes the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site.

Historical OS plans are also inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

## Radon

Radon is a colourless, odourless gas, which is radioactive. It is formed in strata that contain uranium and radium (most notably granite), and can move though fissures eventually discharging to atmosphere, or the spaces under and within buildings. Where radon occurs in high concentrations, it can pose a risk to health.

In order to assess potential risks associated with radon gas, Lithos refer to BRE Report BR211[1], and the Public Health England website. Advice on the limitation of exposure of the population to radon in buildings was originally published in 1990 by the National Radiological Protection Board (NRPB), which joined the Health Protection Agency (HPA) in 2005; the HPA updated NRPB advice in July 2010[2]. The HPA became part of Public Health England in 2013.

The HPA recommended that the NRPB radon Action Level for homes be retained, and a new Target Level for radon in homes be introduced. The values of the Action Level and Target Level, expressed as the annual average radon concentration in the home, are 200 $Bqm^{-3}$ and 100 $Bqm^{-3}$ respectively. The Target Level was to provide an objective for remedial action in existing homes and preventive action in new homes.

The term 'radon Affected Area' is defined as those parts of the country with >1% of homes estimated to be above the Action Levels. The NRPB first indicated which parts of the country should be regarded as radon Affected Areas in 1990. A more detailed mapping method was developed by the HPA in conjunction with the British Geological Survey in 2007[3]. The level of protection needed is site-specific and can be determined by reference to this mapping on the Public Health England website, which indicates the highest radon potential within each 1km grid square. Each 1km grid square is classified on the basis of the percentage of existing homes within that grid square estimated to have radon concentrations above the Action Level. There are 6 'bands': <1%; 1 to 3%; 3 to 5%; 5 to 10%; 10 to 30%; and >30%.

The NRPB advised that action should be taken to reduce radon concentrations in existing homes if the radon concentration exceeded the Action Level of 200 $Bqm^{-3}$ in room air averaged over a year; ten times the average UK domestic radon concentration. NRPB advice informed changes in the requirements for radon protection in new buildings.

- **Basic** preventive measures are required in new buildings, extensions, conversions and refurbishments if the probability of exceeding the Action Level is **>3%** in England and Wales, and >1% in Scotland and Northern Ireland.
- Provision for further preventive (**Full**) measures is required in new buildings if the probability of exceeding the Action Level is **>10%**.

At present Building Regulations Approved Document C advocates basic measures for the probability banding 3% to 10%, and full measures if >10%. However, Public Health England would like to see all new build include basic measures.

Action & Target Levels should also be applied to non-domestic buildings with public occupancy exceeding 2,000 hrs/yr and to all schools.

## Hydrogeology

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure with respect to:

- Groundwater quality
- Recorded pollution incidents
- Licensed groundwater abstractions

From April 2010 the EA's Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply), but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. The maps are split into two different types of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels
- Bedrock - solid permeable formations e.g. sandstone, chalk and limestone

The maps display the following aquifer designations:

**Principal aquifers**: These are layers of rock or superficial 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.

**Secondary aquifers**: These include a wide range of rock layers or superficial deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into three types:

- **Secondary A** - 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
- **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers
- Secondary undifferentiated - In most cases, this is because the rock type in question has previously been designated as both a minor and non-aquifer in different locations due to the variable characteristics.

[1] BRE Report BR211, 2015: "Radon: guidance on protective measures for new buildings.

[2] Limitation of Human Exposure to Radon, Documents of the Health Protection Agency - Radiation, Chemical and Environmental Hazards, RCE-15. July 2010.

[3] Miles JCH, Appleton JD, Rees DM, Green BMR, Adlam KAM and Myers AH (2007). Indicative Atlas of Radon in England and Wales. Chilton, HPA-RPD-033.

**Unproductive strata**: These are rock layers or superficial deposits with low permeability that have negligible significance for water supply or river base flow.

The EA maps only display the principal and secondary aquifers as coloured areas. All uncoloured areas on the map will be unproductive strata. However, for uncoloured areas on the superficial (drift) designation map it is not possible to distinguish between areas of unproductive strata and areas where no superficial deposits are present; to do this, it is necessary to consult the published geological survey maps.

For the purposes of the EA's Groundwater Protection Policy the following default position applies, unless there is site specific information to the contrary:

- If no superficial (drift) aquifers are shown, the bedrock designation is adopted
- In areas where the bedrock designation shows unproductive strata (the uncoloured areas) the superficial designation is adopted
- In all other areas, the more sensitive of the two designations is used (e.g. If secondary superficial overlies principal bedrock, an overall designation of principal is assumed)

The EA have also designated groundwater Source Protection Zones, which are based on proximity to a groundwater source (springs, wells and abstraction boreholes). The size of a Source Protection Zone is a function of the aquifer, volume of groundwater abstracted and the effective rainfall, and may vary from tens to several thousand hectares.

## Hydrology

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure with respect to:

- Surface water quality
- Recorded pollution incidents
- Licensed abstractions (groundwater & surface waters)
- Licensed discharge consents
- Site susceptibility to flooding

The EA have set **water quality** targets for all rivers. These targets are known as River Quality Objectives (RQOs). The water quality classification scheme used to set RQO planning targets is known as the River Ecosystem scheme. The scheme comprises five classes (RE1 to RE5) which reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

General Quality Assessment (GQA) grades reflect actual water quality. They are based on the most recent analytical testing undertaken by the EA. There are 6 GQA grades (denoted A to F) defined by the concentrations of biochemical oxygen demand, total ammonia and dissolved oxygen.

The susceptibility of a site to **flooding** is assessed by reference to a Flood Map on the Environment Agency's website. These maps show natural floodplains - areas potentially at risk of flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas. There are two different kinds of area shown on the Flood Map:

1. Dark blue areas (Flood Zone 3) could be flooded by the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or by a river by a flood that has a 1% (1 in 100) or greater chance of happening each year
2. Light blue areas (Flood Zone 2) show the additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Where there is no blue shading (Flood Zone 1), there is less than a 0.1% (1 in 1000) chance of flooding occurring each year.

The maps also show all flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, or floods from the sea with a 0.5% (1 in 200) chance of happening each year, together with some, but not all, older defences and defences which protect against smaller floods.

The Agency's assessment of the likelihood of flooding from rivers and the sea at any location is based on the presence and effect of all flood defences, predicted flood levels, and ground levels.

It should also be noted that as the floodplain shown is the 1 in 100 year, areas outside this may be flooded by more extreme floods (e.g. the 1 in 1000 year flood). Also, parts of the areas shown at risk of flooding will be flooded by lesser floods (e.g. the 1 in 5 year flood). In some places due to the shape of the river valley, the smaller floods will flood a very similar extent to larger floods but to a lesser depth.

If a site falls within a floodplain, it is recommended that a flood survey be undertaken by a specialist who can advise on appropriate mitigating measures; i.e. raising slab levels, provision of storage etc. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for: proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and any new development in Flood Zones 2 and 3.

## COMAH & explosive sites

Lithos obtain information from Landmark or Groundsure with respect to Control of Major Accident Hazards (COMAH) or explosive sites within 1km of the proposed development site. Lithos' report refers to any that are present, and recommends that the Client seeks further advice from the HSE.

Areas around COMAH sites (chemical plants etc) are zoned with respect to the implementation of emergency plans. The HSE are a statutory consultee to the local planning authority for all COMAH sites. The COMAH site may have to revise its emergency action plan if development occurs. This might be quite straightforward or could entail significant expenditure. Consequently, the COMAH site may object to a proposed development (although it is the Local Authority who have final say, and they are likely to place more weight on advice from the HSE).

## Preliminary conceptual site model

The site's environmental setting (and proposed end use) is used by Lithos to assess the significance of any contamination encountered during the subsequent ground investigation.

Assessment of contaminated land is based on an evaluation of pollutant linkages (source-pathway-receptor). Contaminants within the near surface strata represent a potential source of pollution. The environment (most notably groundwater), site workers and end users are potential receptors.

Potential pollutant linkages are shown on a preliminary conceptual site model (pCSM). A CSM is essentially a cross-section through a site that reflects both the surface topography and underlying geology, and shows surface features of interest. The most significant sources of contamination are then superimposed onto this cross-section together with potential receptors (human health & controlled waters), and plausible pathways between the two. In addition to environmental issues, the CSM should also highlight geotechnical issues.

A pCSM is prepared after consideration of all available "desk study" data, and before design of the ground investigation. Data reviewed should include historical plans (with superimposition on a current-day plan), previous SI reports, geological maps etc. The pCSM, in conjunction with knowledge of site constraints (buildings, services, slopes etc) is used to design the ground investigation.

The revised CSM takes account of data obtained during the ground investigation, including the distribution of made ground, the nature and distribution of contamination etc.

# Appendix B

## Drawings

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| | |
|---|---|
| CLIENT | NEWETT HOMES |
| JOB TITLE | SHEPLEY ROAD, STOCKSMOOR |
| DRAWING TITLE | SITE LOCATION PLAN |
| DRAWN | CR |
| DATE | 17/11/22 |
| CHECKED | REG |
| DATE | 22/11/22 |
| STATUS | FOR COMMENT ☐ DRAFT ☐ FOR APPROVAL ☐ FINAL ☑ |
| SCALE | 1:25,000 |
| SHEET | A4 |
| DRAWING NO. | 4594/1 |
| REVISION | |


NOTES

- GRASS
- OVERGROWN GRASS
- BRAMBLES & OVERGROWN WEEDS
- STREAM/DRAINAGE CHANNEL
- STREAM CULVERT/DRAINAGE OUTFLOW
- SLOPE
- APPROXIMATE SITE BOUNDARY

| REV. | DESCRIPTION | DATE |
|---|---|---|


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CLIENT

NEWETT HOMES

JOB TITLE

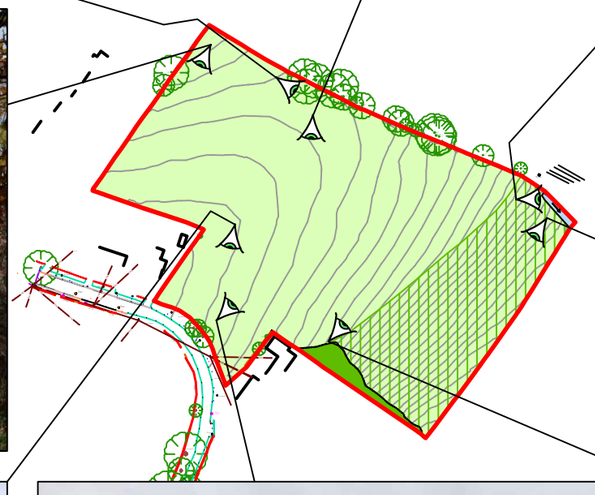
SHEPLEY ROAD, STOCKSMOOR

DRAWING TITLE

SITE FEATURES

| DRAWN | DATE | STATUS |
|---|---|---|
| CR | 22/11/22 | FOR COMMENT ☐ |
| CHECKED | DATE | FOR APPROVAL ☐ |
| REG | 23/11/22 | DRAFT ☐ |
| | | FINAL ☑ |

| SCALE | SHEET | DRAWING NO. | REVISION |
|---|---|---|---|
| 1:1000 | A3 | 4594/2 | |



N

W E

S

NOTES

- GRASS
- OVERGROWN GRASS
- BRAMBLES & OVERGROWN WEEDS
- STREAM/DRAINAGE CHANNEL
- STREAM CULVERT/DRAINAGE OUTFLOW
- APPROXIMATE SITE BOUNDARY
- LOCATION & ORIENTATION OF PHOTOGRAPH

| REV. | DESCRIPTION | DATE |
|---|---|---|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CLIENT

NEWETT HOMES

JOB TITLE

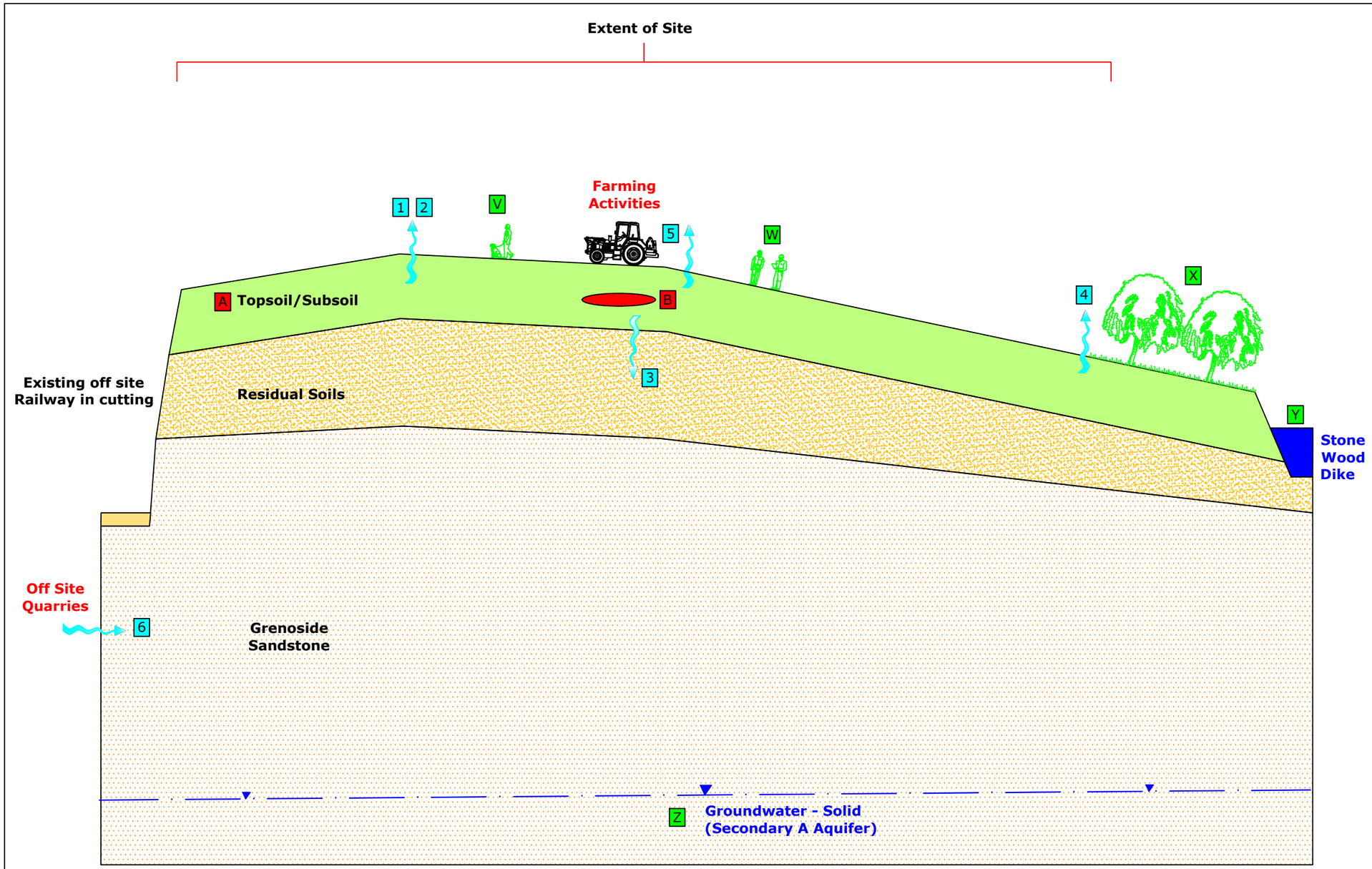
SHEPLEY ROAD,
STOCKSMOOR

DRAWING TITLE

SITE PHOTOGRAPHS

| DRAWN | DATE | STATUS |
|---|---|---|
| CR | 22/11/22 | FOR COMMENT ☐ |
| CHECKED | DATE | FOR APPROVAL ☐ |
| REG | 23/11/22 | DRAFT ☐ |
| | | FINAL ☑ |

| SCALE | SHEET | DRAWING NO. | REVISION |
|---|---|---|---|
| NOT TO SCALE | A3 | 4594/3 | |




| SOURCES | PATHWAYS | RECEPTORS |
|---|---|---|
| A TOPSOIL/SUBSOIL | 1 DERMAL CONTACT | V END USERS (RESIDENTS) |
| B FARMING ACTIVITIES | 2 INGESTION/INHALATION | W SITE WORKERS |
| | 3 LEACHING OF CONTAMINANTS | X VEGETATION |
| | 4 UPTAKE BY PLANTS | Y SURFACE WATERS |
| | 5 VOLATILISATION | Z GROUNDWATER |
| | 6 MIGRATION OF GAS | |

NOTES

| REV. | DESCRIPTION | DATE |
|---|---|---|

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CLIENT

NEWETT HOMES

JOB TITLE

SHEPLEY ROAD, STOCKSMOOR

DRAWING TITLE

PRELIMINARY CONCEPTUAL SITE MODEL

| DRAWN | DATE | STATUS |
|---|---|---|
| CR | 22/11/22 | FOR COMMENT ☐ |
| CHECKED | DATE | FOR APPROVAL ☐ |
| REG | 23/11/22 | DRAFT ☐ |
| | | FINAL ☑ |

| SCALE | SHEET | DRAWING NO. | REVISION |
|---|---|---|---|
| Not to scale | A3 | 4594/4 | |

## Appendix C

## Commission

002/4594/REG

28th October 2022

Registered in England 07068066

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Newett Homes
Thorp Arch Grange
Walton Road
Thorp Arch
Wetherby
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LS23 7BA

Dear

**Shepley Road, Stocksmoor**

Further to your recent invitation, please find below our proposal for preparing a geotechnical and environmental desk study appraisal for the above land. It is understood that the site consists of a single parcel of land of approximately 2.5 hectares and is currently rough grassland.

Brief examination of the relevant geological map suggests the site is directly underlain by sandstone bedrock, likely weathered near surface to a sandy gravel.

This site is located within a Coal Mining Development Low Risk Area (within the defined coalfield, but no known defined risks have been recorded by the Coal Authority; there may still be unrecorded issues), and therefore a Consultant's mining report will be obtained. Our report will include a mining risk assessment (desk-based) that should satisfy the Coal Authority.

Environmental search data and historical maps, obtained from Landmark or Groundsure, will be reviewed in order to determine whether any past land uses have had any effect on the proposed development. In addition, we will visit site to undertake a walkover survey.

The report will include preliminary recommendations with respect to mining, foundations, contamination and hazardous gas. Our report will be in a format familiar to Kirklees CC, and therefore suitable for submission in support of an outline planning application. The report will also include recommendations for an appropriate, intrusive ground investigation, together with a costed proposal.

It is anticipated that a final bound report will be available within 3 weeks of receiving your written instruction to proceed. Our lump sum fee for provision of this report is **£*** ** plus VAT.

We will need a Promap or topo survey in CAD format, to provide a base plan for technical drawings etc. If do not have one, we could obtain at cost plus £***.

Newett and Lithos have an agreed Appointment document, and this work will be undertaken in accordance with that. However, if the Appointment term expires or remains unsigned, works will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely

Mark Perrin
Director
**for and on behalf of**
**LITHOS CONSULTING LIMITED**

**1 DEFINITIONS AND INTERPRETATION**

1.1 In this Agreement, unless the context otherwise requires, the following words and expressions have the following meanings:

"Agreement" means these Terms (entitled "Terms and Conditions for the Appointment of Lithos Consulting"), the Proposal, any document recording your unequivocal acceptance of the Proposal and any other documents or parts of other documents expressly referred to in any of the foregoing;

"Documents" means all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of us, and whether in paper form or stored electronically or on disk, or otherwise;

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Project" means the project described in the Proposal and any enquiry from you on which we have based our Proposal;

"Proposal" means the offer document prepared by us in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by us pursuant to the Agreement and as set out in the Proposal and includes any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment" as amended from time to time.

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

1.5 A reference to legislation includes that legislation as from time to time amended, re-enacted or substituted and any Orders in Council, orders, rules, regulations, schemes, warrants, by-laws, directives or codes of practice issued under any such legislation.

1.6 In the event of conflict between the documents forming part of the Agreement, the Proposal shall prevail, followed by the Terms.

**2 APPOINTMENT**

2.1 You agree to engage us and we agree to provide the Services in accordance with the provisions of this Agreement.

**3 OUR OBLIGATIONS**

3.1 We shall perform the Services using the reasonable standard of skill and care normally exercised by qualified members of our profession, performing similar services under similar conditions.

3.2 We shall use all reasonable endeavours to perform the Services in accordance with relevant environmental and safety legislation.

**4 YOUR OBLIGATIONS**

4.1 Throughout the period of this Agreement you shall afford to us, or procure for our benefit, access to any site where access is required for the performance of the Services.

4.2 You accept responsibility for ensuring that we are notified in writing of all special site and/or plant conditions, including without prejudice to the generality of the foregoing, the existence and precise location of all underground services, cables, pipes, drains or underground buildings, constructions or any hazards, which you shall clearly mark on the ground or identify on accurate location plans supplied to us prior to the commencement of the Services. You shall also inform us in writing of any relevant operating procedures including any site safe operating procedures and any other regulations relevant to the carrying out of the Services. You shall indemnify us against all costs, losses, claims, demands and expenses arising as a result of any non-disclosure in this respect, including but not limited to indemnification against any action brought by the owner of the land or otherwise.

4.3 If you discover any conflict, defect or other fault in the information or designs provided by us pursuant to the Agreement, you will advise us in writing of such defect, conflict or other fault and we shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

**5 COPYRIGHT**

5.1 The copyright in all Intellectual Property prepared by or on behalf of us in connection with the Project for delivery to you shall remain vested in us.

5.2 You shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable you to copy and use the Intellectual Property but solely for your own purposes in connection with the Project and such use shall not include any licence to reproduce any conceptual designs or professional opinions contained therein nor shall it include any license to amend any drawing, design or other Intellectual Property produced by us.

5.3 Should you wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, you must obtain our prior written consent. The giving of such consent shall be at our absolute discretion and shall be upon such terms as we may require. We shall not be liable to you for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on our behalf.

5.4 Ownership of any proposals submitted to you that are not subsequently confirmed as part of the Services to be provided for you remain with us and such proposals must not be used as the basis for any future work undertaken by you or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of you being in default of payment of any fees or other amounts due, we may suspend further use of the licence on giving no less than 2 calendar days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts.

**6 CONFIDENTIALITY**

6.1 Neither you nor we shall at any time disclose to any person any confidential information concerning the business, affairs, customers, clients or suppliers of the other party or of any member of the group of companies to which the other party belongs, except as permitted by clauses 6.2 and 6.4.

6.2 Each party may disclose the other party's confidential information:

(a) to its employees, officers, representatives, contractors, sub-contractors or advisers who need to know such information for the purposes of exercising the party's rights or carrying out its obligations under or in connection with this Agreement. Each party shall ensure that its employees, officers, representatives, contractors, sub-contractors or advisers to whom it discloses the other party's confidential information comply with this paragraph 6; and

(b) as may be required by law, to a court of competent jurisdiction or any governmental or regulatory authority.

6.3 Neither you nor we shall use any other party's confidential information for any purpose other than to exercise our rights or perform our respective obligations under or in connection with this Agreement.

6.4 Subject to the above and our privacy policy which can be found on www.lithos.co.uk, we shall be permitted to use information related to the Services we provide in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

**7 ASSIGNMENT**

7.1 You may assign the benefit of this Agreement on two occasions with our prior written consent (not to be unreasonably withheld) and any additional assignments shall be with our prior consent.

7.2 We may at any time assign, mortgage, charge, subcontract, delegate, declare a trust over or deal in any other manner with any or all of our rights and obligations under this Agreement.

**8 INSURANCE**

8.1 We shall maintain a professional indemnity insurance policy covering our liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) any one claim, save for pollution and contamination claims and asbestos claims both of which carry £2,000,000 (TWO MILLION POUNDS) in the aggregate cover. This policy is annually renewable and whilst renewal is not automatic, We shall maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under this Agreement, provided such insurance is available at commercially reasonable rates and terms.

8.2 If for any period such insurance is not available at commercially reasonable rates and terms, we shall inform you and shall obtain in respect of such period such reduced level of professional indemnity insurance as is available and as would be fair and reasonable in the circumstances for us to obtain.

**9 PAYMENT**

9.1 Invoices for services rendered will be submitted for payment in accordance with the Proposal.

9.2 You shall pay you any VAT properly chargeable on the Services and any amount expressed as payable to us under this Agreement is exclusive of VAT unless stated otherwise.

9.3 The due date for payment is the date of the invoice and the final date for payment is 28 days from the date of the invoice.

9.4 If you dispute the amount included for payment in an invoice then you must serve a written notice on us no later than 14 calendar days before the final date for payment. If no notice is given within the required timeframe the amount due shall be the amount stated in the invoice.

9.5 If you fail to pay any monies in accordance with the foregoing payment provisions, we shall be entitled to charge interest on any monies owed to us, such interest to be at a rate of 4% above the base rate of a clearing bank from time to time calculated from the final date for payment to the date of actual payment on a compound basis. The parties acknowledge that our liability under this clause 10.5 is a substantial remedy for the purposes of section 9(1) of the Late Payment of Commercial Debts (Interest) Act 1998.

**10 LIMITATIONS ON LIABILITY**

10.1 Unless otherwise agreed in writing, our total liability under or in connection with this Agreement whether in contract, tort, negligence, breach of statutory duty or otherwise (other than in respect of personal injury or death) shall be limited to and shall not exceed the lesser of either the level of insurance cover referred to within clause 8.1 above, or 20 times the total value of invoices issued to you for the Services.

10.2 No action or proceedings under or in respect of the Agreement whether in contract, tort, negligence, under statute or otherwise shall be commenced against us after the expiry of a period of six years from the date of the completion (or termination) of the Services under this Agreement.

10.3 Whilst we usually scan for potential exploratory locations with a Cable Avoidance Tool, we shall not be liable for any damage to underground services, cables, pipes, drains or underground buildings, constructions and the like which were either not marked on site or for which accurate plans were not provided.

10.4 We shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by us or for the cost of designing a solution for and rectifying any subsequent works carried out by others pursuant to the conflicting, defective or in any other way faulty information or designs, unless we have been advised in writing of the same by you and have been given the opportunity to rectify the same or where necessary, to design the solution for rectification of any subsequent works carried out by others pursuant to the same.

**11 DELAY**

We shall comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond our reasonable control and in the event of any such circumstances arising we undertake to complete the Services within a reasonable period, but will not be liable to you for any delay as a result.

**12 TERMINATION**

12.1 The Agreement may be terminated by either of us in the event of the other making a composition or arrangement with its creditors, becoming bankrupt, or being a company, making a proposal for a voluntary arrangement for a composition of debts, or has a provisional liquidator appointed, or has a winding-up order made, or passes a resolution for voluntary winding-up (except for the purposes of a bona fide scheme of amalgamation or reconstruction), or has an administrator or an administrative receiver appointed to the whole or any part of its assets. Notice of termination must be given to the party which is insolvent by the other party.

12.2 If for any reason our Services are suspended for a period in excess of three calendar months then we shall be entitled to terminate our appointment under this Agreement in respect of the Services by no less than seven days written notice to you.

12.3 If you fail to pay in full any sum due under the terms of this Agreement by the final date for payment for that sum and no effective pay less notice is issued, we may serve written notice to you demanding payment within 14 days of such notice. If you fail to comply with such notice, we shall be entitled to terminate our employment under this Agreement forthwith.

12.4 Any termination of our appointment howsoever caused shall be without prejudice to our rights to require payment for all Services performed up to the date of such termination including but not limited to payment of a fair and reasonable proportion of any figure identified in the Proposal or otherwise for fees in respect of a particular service which Lithos has started, but not completed.

**13 THIRD PARTY RIGHTS**

The Agreement shall not confer and shall not purport to confer on any third party any benefit or any right to enforce any term of this Agreement for the purposes of the Contracts (Rights of Third Parties) Act 1999 or otherwise.

**14 COLLATERAL WARRANTIES & LETTERS OF RELIANCE**

We shall consider and may consent to a request from you for us to enter into a collateral warranty or letter of reliance with a third party with regard to the Services provided under this Agreement. The giving of such consent shall be at our absolute discretion and providing we agree to our standard form of collateral warranty or letter of reliance (subject to any reasonable changes to be approved by us at our absolute discretion) and in return for payment of a fee (to be notified at the time of the request).

**15 NOTICES**

15.1 Any notice provided for in the Agreement shall be in writing and shall be deemed to be properly given if delivered by hand or sent by pre-paid first class post to the address of the relevant party as may have been notified by each party to the other or, in the absence of notification, to our respective registered office addresses.

15.2 Such notice shall be deemed to have been received on the day of delivery if delivered by hand or on the second working day after the day of posting if sent by pre-paid first class post.

**16 ENTIRE AGREEMENT**

16.1 The Agreement constitutes the complete and entire agreement between us with respect to the Services and supersedes any prior oral and/or written warranties, terms, conditions, communications and representations, whether express or implied and any claim against us in respect of the Services can only be made in contract under the provisions of this Agreement and not otherwise under the law or tort or otherwise.

16.2 No amendments, modifications or variation of this Agreement shall be valid unless made in writing and agreed to by us; such agreement must be recorded in writing by at least one of us.

16.3 We shall not be bound by any standard or printed terms or conditions furnished by you in any of your documents unless we specifically state in writing separately from such documents that we intend such terms and conditions to apply.

**17 DISPUTES, JURISDICTION AND GOVERNING LAW**

17.1 This Agreement shall be governed by and construed in accordance with English law and we irrevocably and unconditionally submit to the jurisdiction of the English Courts.

17.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between us may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

**Subject:** FW: 4594, Shepley Road, Stocksmoor

**From:**
**Sent:** 01 November 2022 14:47
**To:**
**Cc:**
**Subject:** RE: Shepley Road, Stocksmoor

Thanks Reg – as discussed, please proceed on the basis of your updated fee proposal, 28 October 2022 to undertake:

A Geotechnical and environmental desk study appraisal - £*** + VAT

Details for invoicing:

Newett Homes
Thorp Arch Grange, Walton Road
Thorp Arch, Wetherby
LS23 7BA

Invoices should be emailed to: – quoting project ref: Z159 - Shepley Road, Stocksmoor

Charlotte please could we arrange a PO number for this instruction and forward to Reg by return.

*Regards*

Head of Planning
**Newett Homes**

**Web:** www.newetthomes.co.uk

**From:**
**Sent:** 01 November 2022 14:34
**To:**
**Subject:** Shepley Road, Stocksmoor

Hi

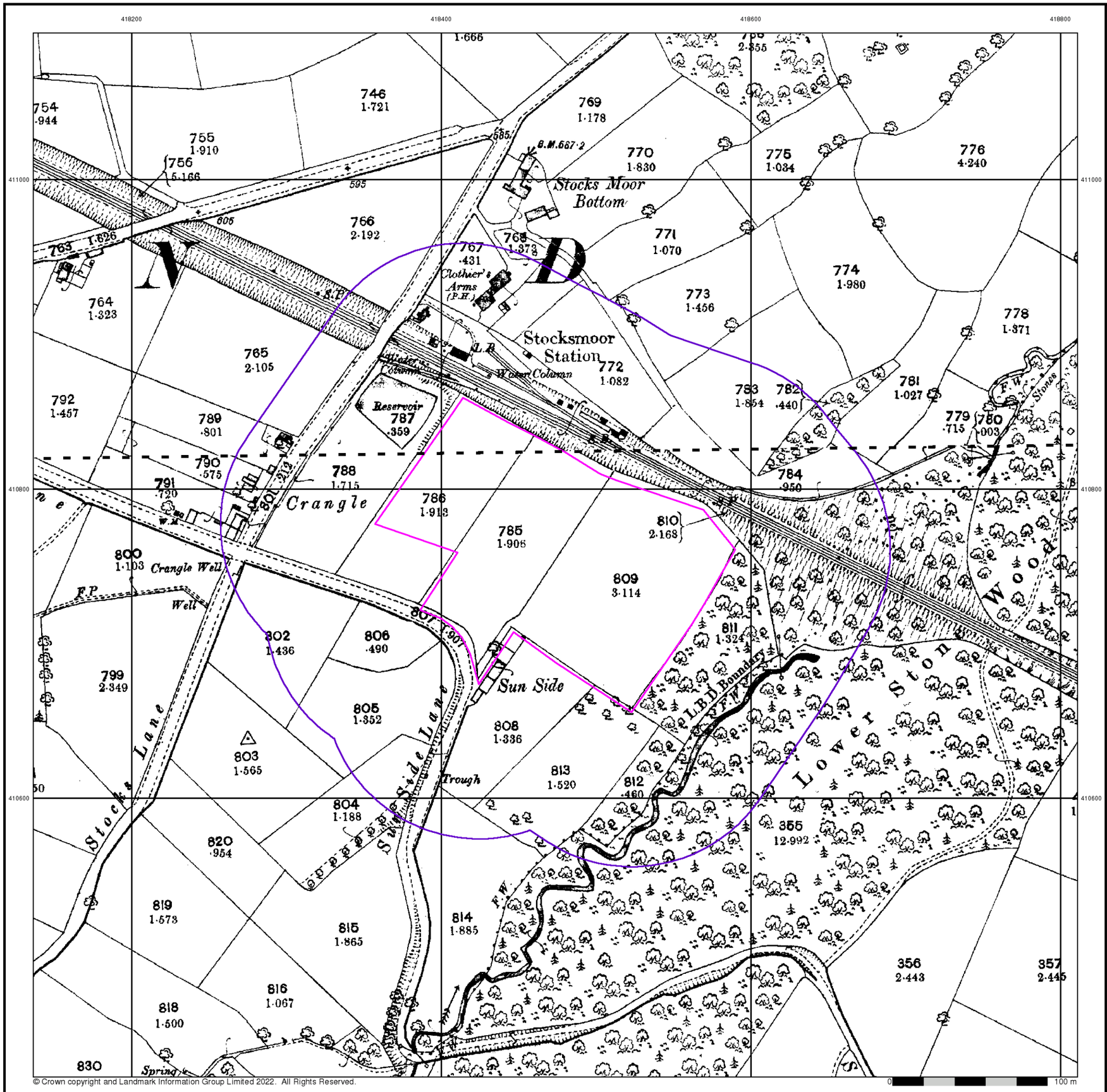
Desk Study (Phase 1) quote (£***) attached. As always, this allows for a well-considered, bespoke Report providing robust & pragmatic site-specific advice. Our Report should be issued c. 3 weeks from instruction.

Any queries, please call.

Regards

# Appendix D

## Historical OS Plans





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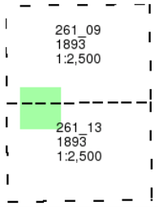
## Yorkshire

## Published 1893

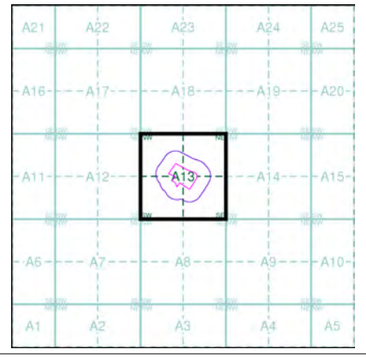
## Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

## Map Name(s) and Date(s)




## Historical Map - Segment A13



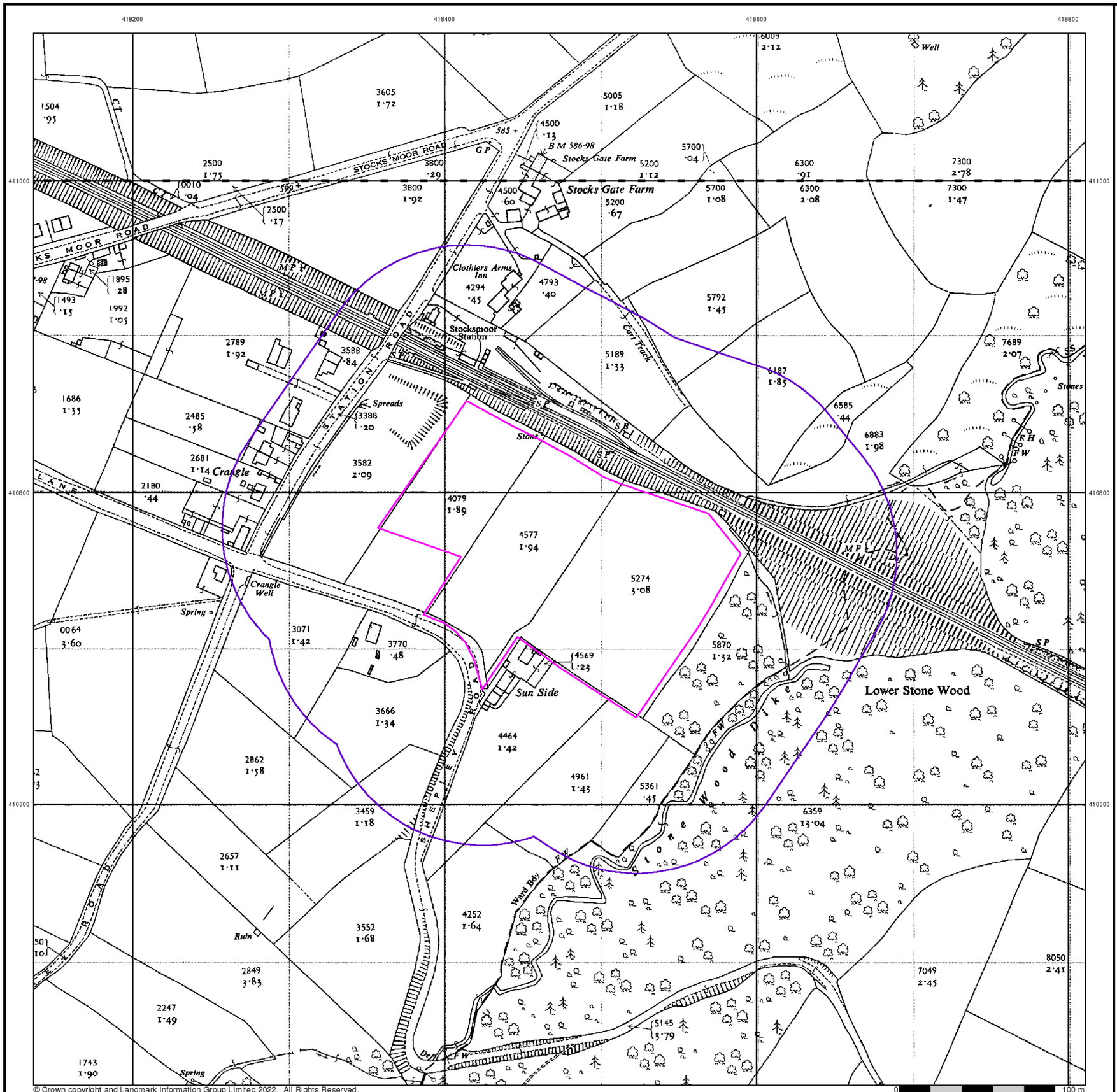

## Order Details

| | |
|---|---|
| Order Number: | 303375508_1_1 |
| Customer Ref: | PO19863/CH/4594 |
| National Grid Reference: | 418470, 410760 |
| Slice: | A |
| Site Area (Ha): | 2.51 |
| Search Buffer (m): | 100 |

## Site Details

Shepley Road, Stocksmoor

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk






LITHOS CONSULTING

## Ordnance Survey Plan

**Published 1959 - 1960**

**Source map scale - 1:2,500**

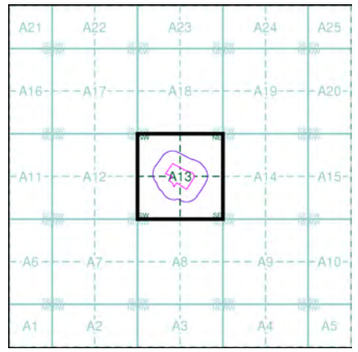
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

## Map Name(s) and Date(s)

SE1811
1959
1:2,500

SE1810
1960
1:2,500

## Historical Map - Segment A13



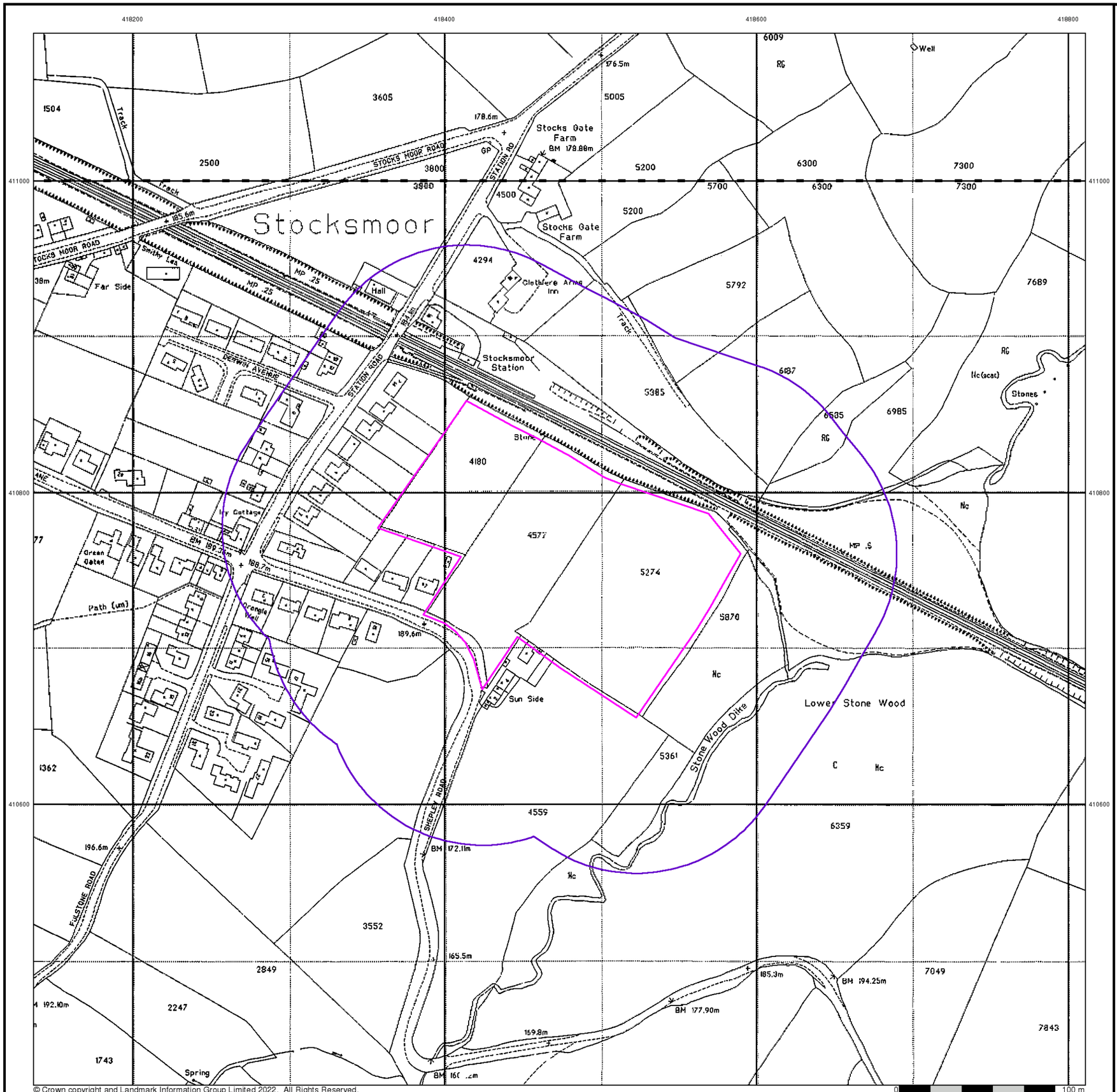

## Order Details

| | |
|---|---|
| Order Number: | 303375508_1_1 |
| Customer Ref: | PO19863/CH/4594 |
| National Grid Reference: | 418470, 410760 |
| Slice: | A |
| Site Area (Ha): | 2.51 |
| Search Buffer (m): | 100 |

## Site Details

Shepley Road, Stocksmoor

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

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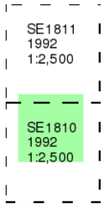
## Large-Scale National Grid Data

**Published 1992**

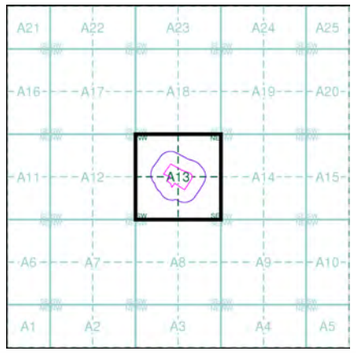
**Source map scale - 1:2,500**

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

## Map Name(s) and Date(s)




## Historical Map - Segment A13




## Order Details

| | |
|---|---|
| Order Number: | 303375508_1_1 |
| Customer Ref: | PO19863/CH/4594 |
| National Grid Reference: | 418470, 410760 |
| Slice: | A |
| Site Area (Ha): | 2.51 |
| Search Buffer (m): | 100 |

## Site Details

Shepley Road, Stocksmoor


Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

## Appendix E

## Search Responses & other Correspondence

# Envirocheck® Report:

# Datasheet

## Order Details:

**Order Number:**
303375508_1_1

**Customer Reference:**
PO19863/CH/4594

**National Grid Reference:**
418470, 410760

**Slice:**
A

**Site Area (Ha):**
2.51

**Search Buffer (m):**
1000

## Site Details:

Shepley Road, Stocksmoor

## Client Details:

Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

LITHOS CONSULTING

# Summary

| Data Type | Page Number | On Site | 0 to 250m | 251 to 500m | 501 to 1000m (*up to 2000m) |
|---|---|---|---|---|---|
| **Agency & Hydrological** | | | | | |
| BGS Groundwater Flooding Susceptibility | pg 1 | Yes | Yes | Yes | n/a |
| Contaminated Land Register Entries and Notices | | | | | |
| Discharge Consents | pg 2 | | | | 10 |
| Prosecutions Relating to Controlled Waters | | | n/a | n/a | n/a |
| Enforcement and Prohibition Notices | | | | | |
| Integrated Pollution Controls | | | | | |
| Integrated Pollution Prevention And Control | | | | | |
| Local Authority Integrated Pollution Prevention And Control | | | | | |
| Local Authority Pollution Prevention and Controls | | | | | |
| Local Authority Pollution Prevention and Control Enforcements | | | | | |
| Nearest Surface Water Feature | pg 4 | | Yes | | |
| Pollution Incidents to Controlled Waters | pg 4 | | | 1 | 12 |
| Prosecutions Relating to Authorised Processes | | | | | |
| Registered Radioactive Substances | | | | | |
| River Quality | pg 7 | | | | 1 |
| River Quality Biology Sampling Points | | | | | |
| River Quality Chemistry Sampling Points | | | | | |
| Substantiated Pollution Incident Register | pg 7 | | | | 2 |
| Water Abstractions | pg 7 | | | | (*24) |
| Water Industry Act Referrals | | | | | |
| Groundwater Vulnerability Map | pg 13 | Yes | n/a | n/a | n/a |
| Groundwater Vulnerability - Soluble Rock Risk | | | n/a | n/a | n/a |
| Groundwater Vulnerability - Local Information | | | n/a | n/a | n/a |
| Bedrock Aquifer Designations | pg 13 | Yes | n/a | n/a | n/a |
| Superficial Aquifer Designations | | | n/a | n/a | n/a |
| Source Protection Zones | pg 13 | | 1 | 1 | |
| Extreme Flooding from Rivers or Sea without Defences | | | | n/a | n/a |
| Flooding from Rivers or Sea without Defences | | | | n/a | n/a |
| Areas Benefiting from Flood Defences | | | | n/a | n/a |
| Flood Water Storage Areas | | | | n/a | n/a |
| Flood Defences | | | | n/a | n/a |
| OS Water Network Lines | pg 13 | | 3 | 10 | 47 |

# Summary

| Data Type | Page Number | On Site | 0 to 250m | 251 to 500m | 501 to 1000m (*up to 2000m) |
|---|---|---|---|---|---|
| **Waste** | | | | | |
| BGS Recorded Landfill Sites | | | | | |
| Historical Landfill Sites | pg 21 | | | 1 | |
| Integrated Pollution Control Registered Waste Sites | | | | | |
| Licensed Waste Management Facilities (Landfill Boundaries) | | | | | |
| Licensed Waste Management Facilities (Locations) | | | | | |
| Local Authority Landfill Coverage | pg 21 | 1 | n/a | n/a | n/a |
| Local Authority Recorded Landfill Sites | | | | | |
| Potentially Infilled Land (Non-Water) | pg 21 | | 1 | 4 | 4 |
| Potentially Infilled Land (Water) | pg 21 | | | | 2 |
| Registered Landfill Sites | | | | | |
| Registered Waste Transfer Sites | | | | | |
| Registered Waste Treatment or Disposal Sites | | | | | |
| **Hazardous Substances** | | | | | |
| Control of Major Accident Hazards Sites (COMAH) | | | | | |
| Explosive Sites | | | | | |
| Notification of Installations Handling Hazardous Substances (NIHHS) | | | | | |
| Planning Hazardous Substance Consents | | | | | |
| Planning Hazardous Substance Enforcements | | | | | |

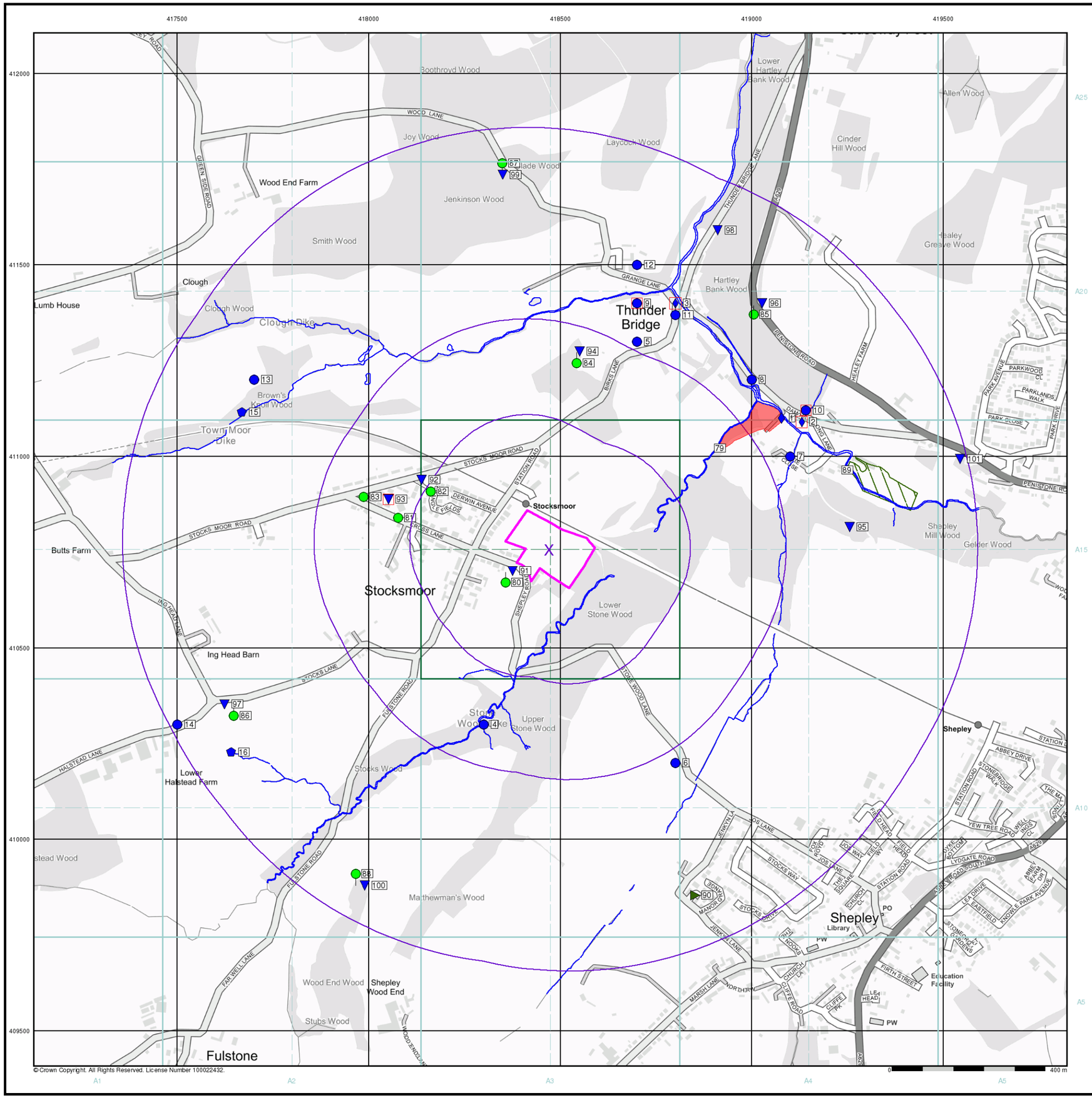
LITHOS CONSULTING

# Summary

| Data Type | Page Number | On Site | 0 to 250m | 251 to 500m | 501 to 1000m (*up to 2000m) |
|---|---|---|---|---|---|
| **Geological** | | | | | |
| BGS 1:625,000 Solid Geology | pg 22 | Yes | n/a | n/a | n/a |
| BGS Estimated Soil Chemistry | pg 22 | Yes | Yes | Yes | Yes |
| BGS Recorded Mineral Sites | pg 24 | | 1 | 4 | 7 |
| BGS Urban Soil Chemistry | | | | | |
| BGS Urban Soil Chemistry Averages | | | | | |
| CBSCB Compensation District | | | n/a | n/a | n/a |
| Coal Mining Affected Areas | pg 26 | Yes | n/a | n/a | n/a |
| Mining Instability | pg 26 | Yes | n/a | n/a | n/a |
| Man-Made Mining Cavities | | | | | |
| Natural Cavities | | | | | |
| Non Coal Mining Areas of Great Britain | | | | n/a | n/a |
| Potential for Collapsible Ground Stability Hazards | pg 26 | Yes | | n/a | n/a |
| Potential for Compressible Ground Stability Hazards | | | | n/a | n/a |
| Potential for Ground Dissolution Stability Hazards | | | | n/a | n/a |
| Potential for Landslide Ground Stability Hazards | pg 26 | Yes | Yes | n/a | n/a |
| Potential for Running Sand Ground Stability Hazards | | | | n/a | n/a |
| Potential for Shrinking or Swelling Clay Ground Stability Hazards | pg 27 | Yes | Yes | n/a | n/a |
| Radon Potential - Radon Affected Areas | | | n/a | n/a | n/a |
| Radon Potential - Radon Protection Measures | | | n/a | n/a | n/a |
| **Industrial Land Use** | | | | | |
| Contemporary Trade Directory Entries | pg 28 | | 1 | 2 | 5 |
| Fuel Station Entries | | | | | |
| Points of Interest - Commercial Services | pg 28 | | | | 1 |
| Points of Interest - Education and Health | | | | | |
| Points of Interest - Manufacturing and Production | pg 28 | | | | 3 |
| Points of Interest - Public Infrastructure | pg 29 | | 2 | | 5 |
| Points of Interest - Recreational and Environmental | pg 29 | | | 3 | 2 |
| Gas Pipelines | | | | | |
| Underground Electrical Cables | | | | | |

# Summary

| Data Type | Page Number | On Site | 0 to 250m | 251 to 500m | 501 to 1000m (*up to 2000m) |
|---|---|---|---|---|---|
| **Sensitive Land Use** | | | | | |
| Ancient Woodland | pg 30 | | 3 | 2 | 3 |
| Areas of Adopted Green Belt | pg 30 | 1 | | | |
| Areas of Unadopted Green Belt | pg 30 | 1 | | | |
| Areas of Outstanding Natural Beauty | | | | | |
| Environmentally Sensitive Areas | | | | | |
| Forest Parks | | | | | |
| Local Nature Reserves | | | | | |
| Marine Nature Reserves | | | | | |
| National Nature Reserves | | | | | |
| National Parks | | | | | |
| Nitrate Sensitive Areas | | | | | |
| Nitrate Vulnerable Zones | | | | | |
| Ramsar Sites | | | | | |
| Sites of Special Scientific Interest | | | | | |
| Special Areas of Conservation | | | | | |
| Special Protection Areas | | | | | |
| World Heritage Sites | | | | | |




LITHOS CONSULTING

## General

Specified Site
Specified Buffer(s)
Bearing Reference Point
Map ID
Several of Type at Location

## Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

## Hazardous Substances

- COMAH Site
- Explosive Site
- NIHHS Site
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

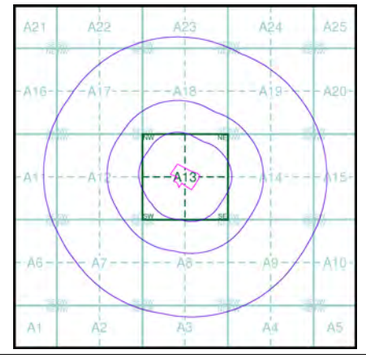
## Geological

- BGS Recorded Mineral Site

## Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

## Site Sensitivity Map - Slice A




N

## Order Details

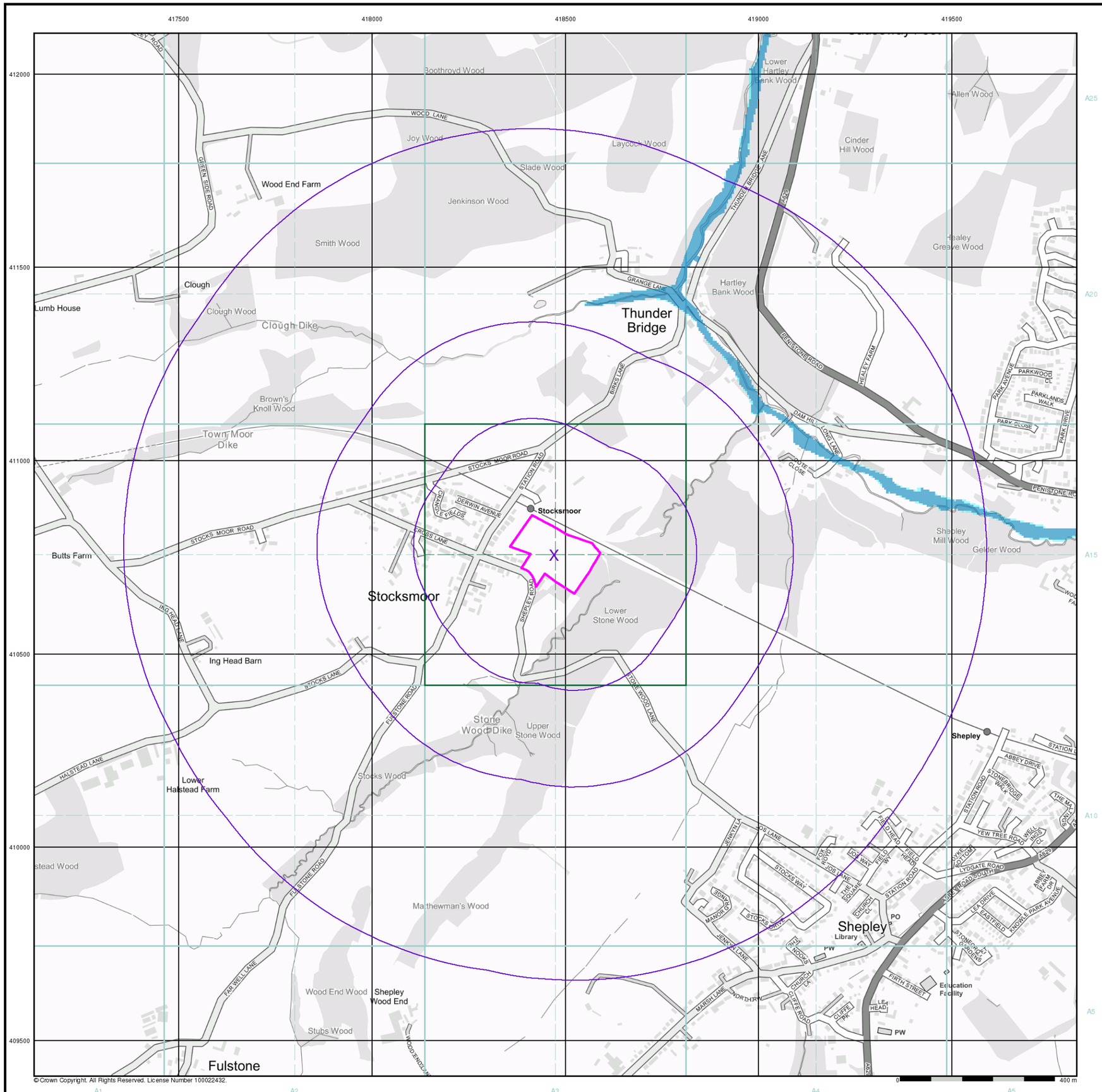
| | |
|---|---|
| Order Number: | 303375508_1_1 |
| Customer Ref: | PO19863/CH/4594 |
| National Grid Reference: | 418470, 410760 |
| Slice: | A |
| Site Area (Ha): | 2.51 |
| Search Buffer (m): | 1000 |

## Site Details

Shepley Road, Stocksmoor


Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk




LITHOS CONSULTING

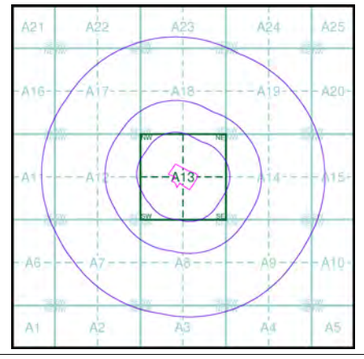
## General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

## Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

## Flood Map - Slice A




## Order Details

| | |
|---|---|
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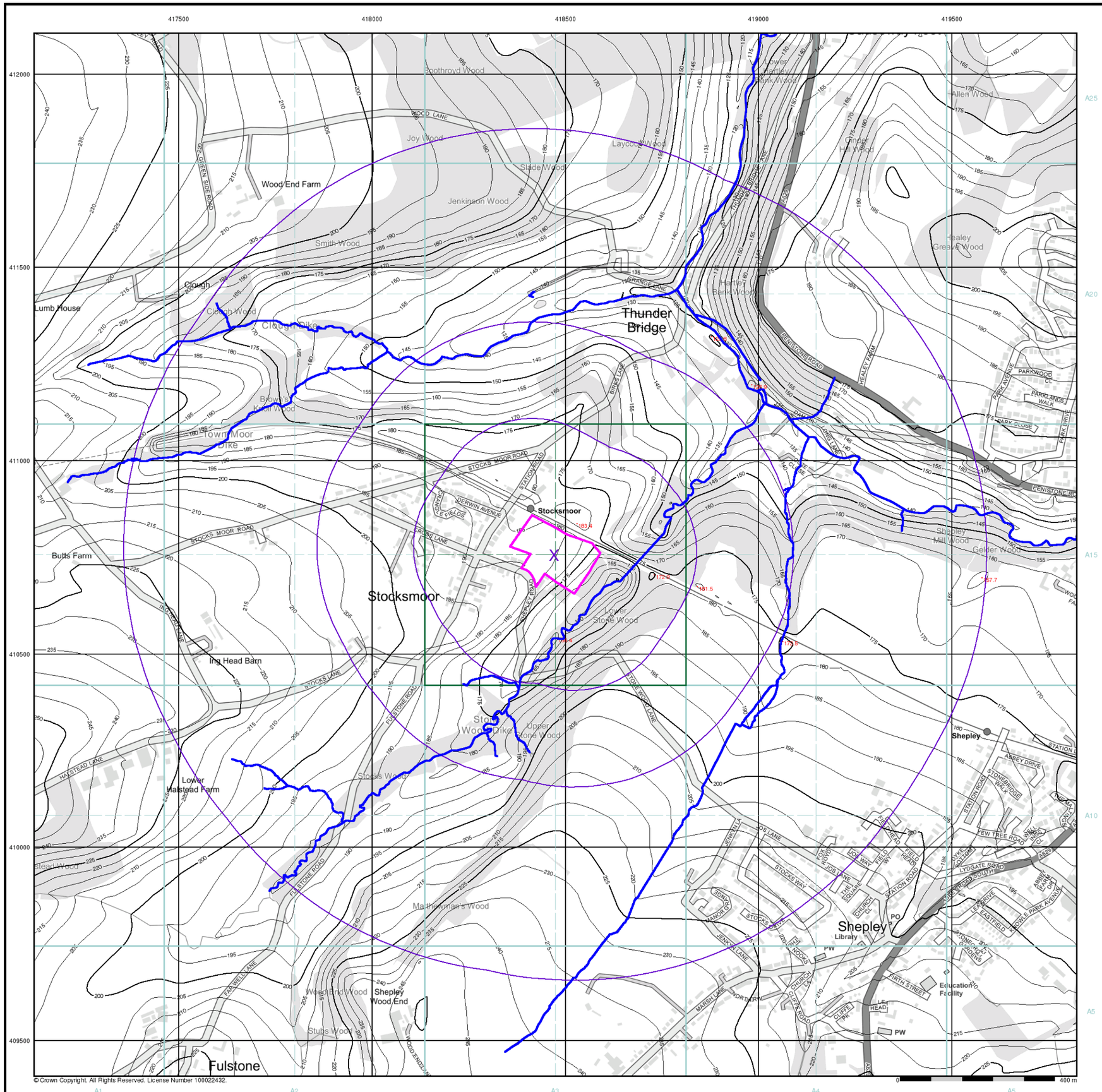



LITHOS CONSULTING

## General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

## OS Water Network Data

- Canal
- Reservoir
- Foreshore
- Marsh
- Tidal River
- Inland River
- Drain
- Other
- Lake
- Transfer
- Lock Or Flight Of Locks
- Sea

## Contours (height in meters)

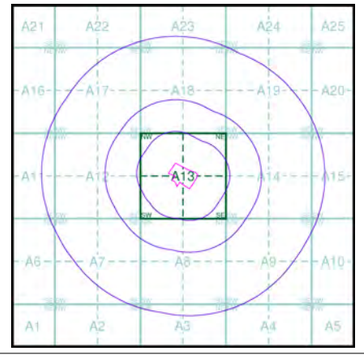
Standard Contour 105 100 95

Master Contour

Spot Height 167.3

- MLW Mean Low Water
- MHW Mean High Water

## OS Water Network Map - Slice A




## Order Details

| | |
|---|---|
| Order Number: | 303375508_1_1 |
| Customer Ref: | PO19863/CH/4594 |
| National Grid Reference: | 418470, 410760 |
| Slice: | A |
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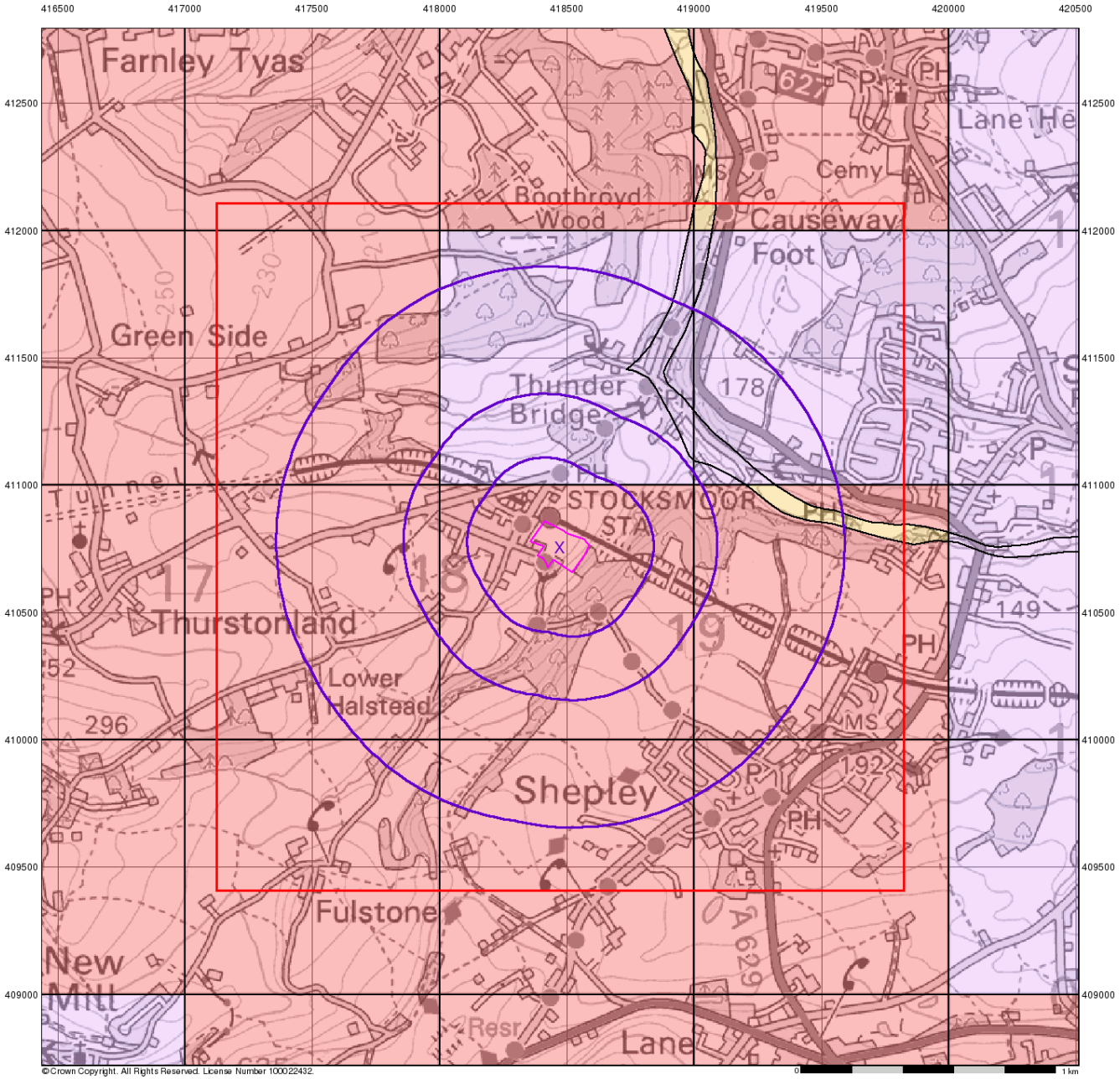



LITHOS CONSULTING

# Groundwater Vulnerability

## General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

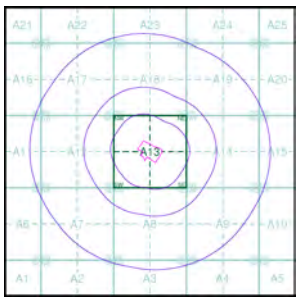
## Agency and Hydrological

| Bedrock Aquifers | Superficial Aquifers |
|---|---|
| High Vulnerability, Principal Aquifer | High Vulnerability, Principal Aquifer |
| High Vulnerability, Secondary Aquifer | High Vulnerability, Secondary Aquifer |
| Medium Vulnerability, Principal Aquifer | Medium Vulnerability, Principal Aquifer |
| Medium Vulnerability, Secondary Aquifer | Medium Vulnerability, Secondary Aquifer |
| Low Vulnerability, Principal Aquifer | Low Vulnerability, Principal Aquifer |
| Low Vulnerability, Secondary Aquifer | Low Vulnerability, Secondary Aquifer |

Unproductive Aquifer

Soluble Rock

## Site Sensitivity Context Map - Slice A




## Order Details

| | |
|---|---|
| Order Number: | 303375508_1_1 |
| Customer Ref: | PO19863/CH/4594 |
| National Grid Reference: | 418470, 410760 |
| Slice: | A |
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## Site Details

Shepley Road, Stocksmoor

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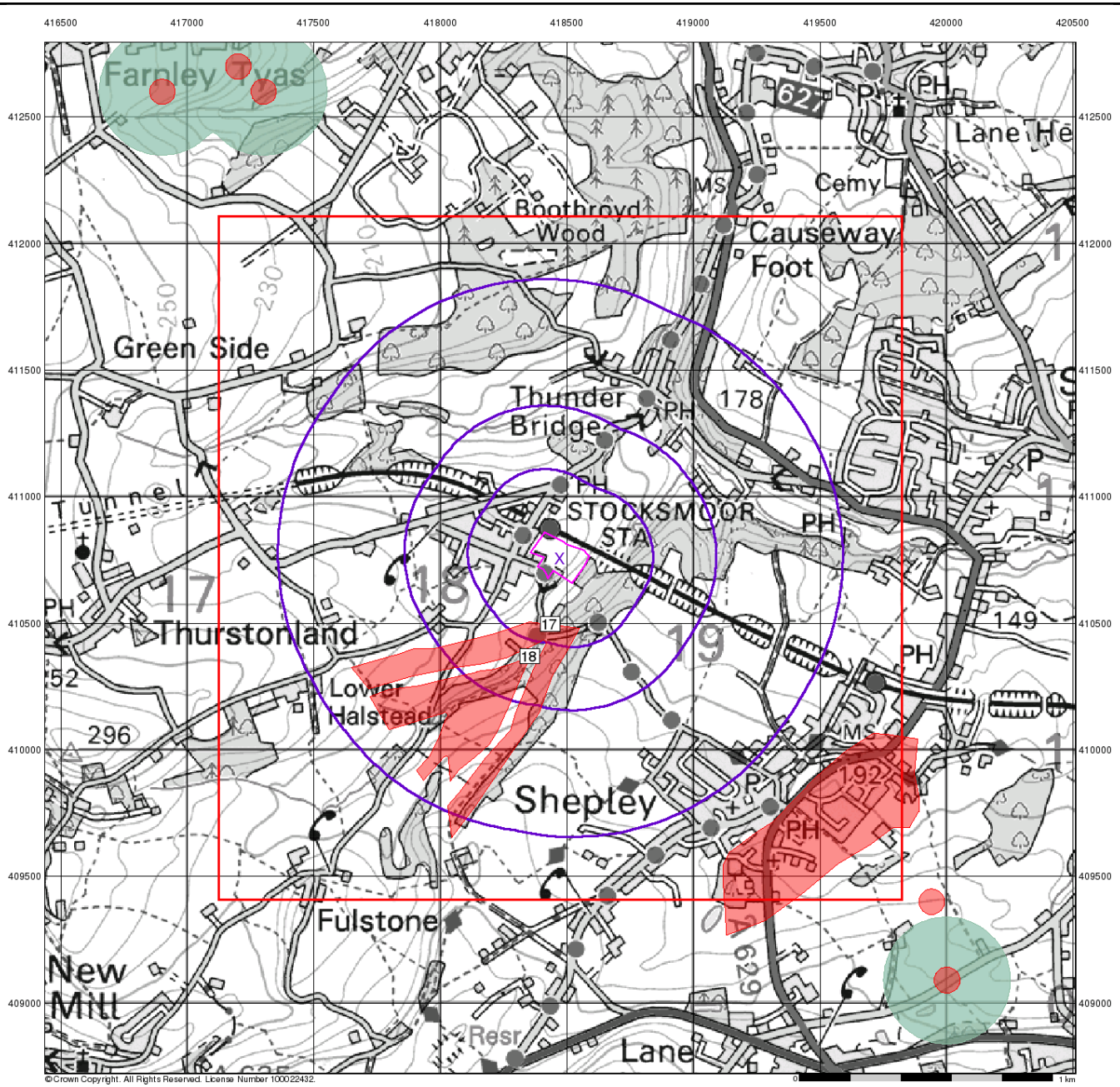
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk




LITHOS CONSULTING

# Source Protection Zones

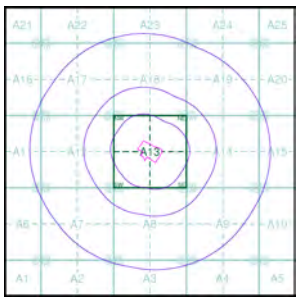
## General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

## Agency and Hydrological

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

## Site Sensitivity Context Map - Slice A




## Order Details

| | |
|---|---|
| Order Number: | 303375508_1_1 |
| Customer Ref: | PO19863/CH/4594 |
| National Grid Reference: | 418470, 410760 |
| Slice: | A |
| Site Area (Ha): | 2.51 |
| Search Buffer (m): | 1000 |

## Site Details

Shepley Road, Stocksmoor


Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

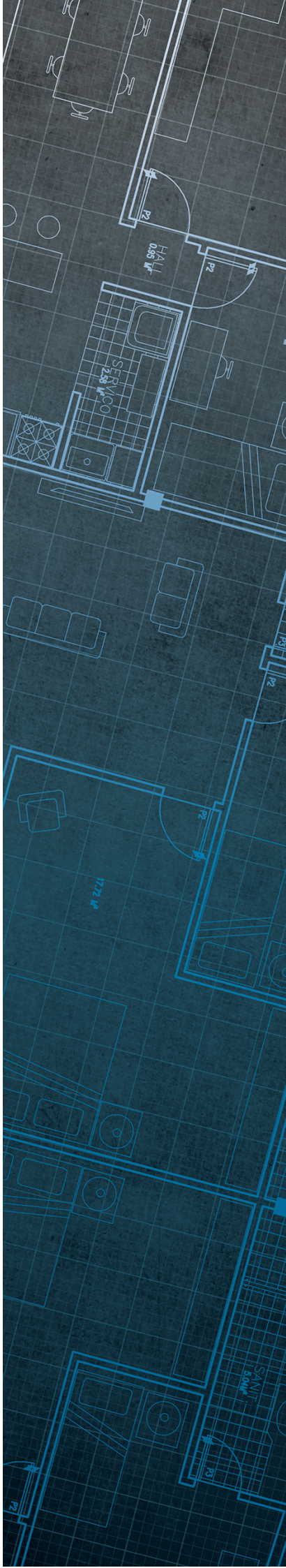
The Coal Authority

# Consultants

## Coal Mining Report

Shepley Road
Stocksmoor
HD4 6XW

| | |
|---|---|
| Date of enquiry: | **2 November 2022** |
| Date enquiry received: | **2 November 2022** |
| Issue date: | **2 November 2022** |
| Our reference: | **51003322213001** |
| Your reference: | **PO19864/CH/4594** |



# Consultants

# Coal Mining Report

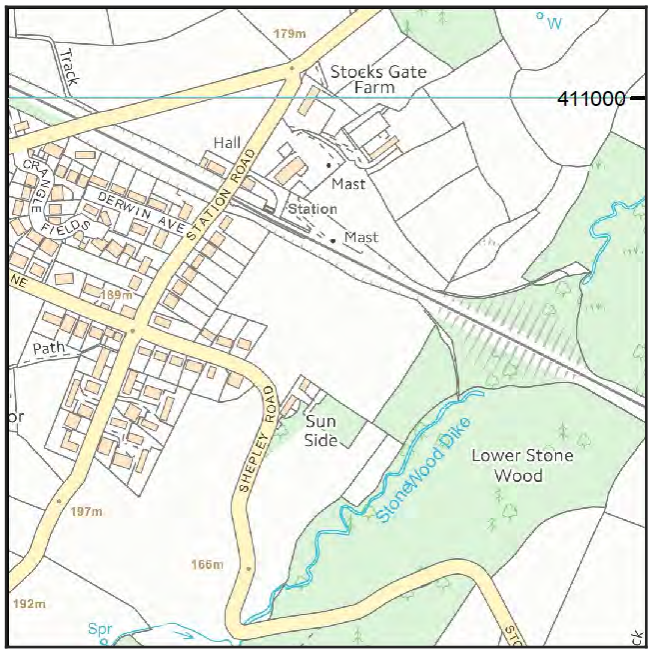
This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

**Client name**

LITHOS CONSULTING LTD

**Enquiry address**

Shepley Road
Stocksmoor
HD4 6XW




Approximate position of property



**How to contact us**

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+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

@coalauthority
/company/the-coal-authority
/thecoalauthority
/thecoalauthority

# Section 1 – Mining activity and geology

### Past underground mining
No past mining recorded.

### Probable unrecorded shallow workings
None.

### Spine roadways at shallow depth
No spine roadway recorded at shallow depth.

### Mine entries
None recorded within 100 metres of the enquiry boundary.

### Abandoned mine plan catalogue numbers
None available.

### Outcrops
No outcrops recorded.

### Geological faults, fissures and breaklines
No faults, fissures or breaklines recorded.

### Opencast mines
None recorded within 500 metres of the enquiry boundary.

### Coal Authority managed tips
None recorded within 500 metres of the enquiry boundary.

# Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

### Site investigations
None recorded within 50 metres of the enquiry boundary.

### Remediated sites
None recorded within 50 metres of the enquiry boundary.

### Coal mining subsidence
The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

### Mine gas
None recorded within 500 metres of the enquiry boundary.

### Mine water treatment schemes
None recorded within 500 metres of the enquiry boundary.

# Section 3 – Licensing and future mining activity

### Future underground mining
None recorded.

### Coal mining licensing
None recorded within 200 metres of the enquiry boundary.

### Court orders
None recorded.

### Section 46 notices
No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

### Withdrawal of support notices
The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

### Payments to owners of former copyhold land
The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

# Section 4 – Further information

Based on the responses in this report, no further information has been highlighted.

# Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk.**

### Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

### Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

### Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

### Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

### Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

### Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

### Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

### Opencast mines
Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

### Coal Authority managed tips
Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

### Site investigations
Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

### Remediated sites
Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

### Coal mining subsidence
Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

### Mine gas
Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission.

### Mine water treatment schemes
Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

### Future underground mining
Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

### Coal mining licensing
Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

### Court orders
Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

### Section 46 notices
Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

### Withdrawal of support notices
Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

### Payment to owners of former copyhold land
Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

The Coal Authority

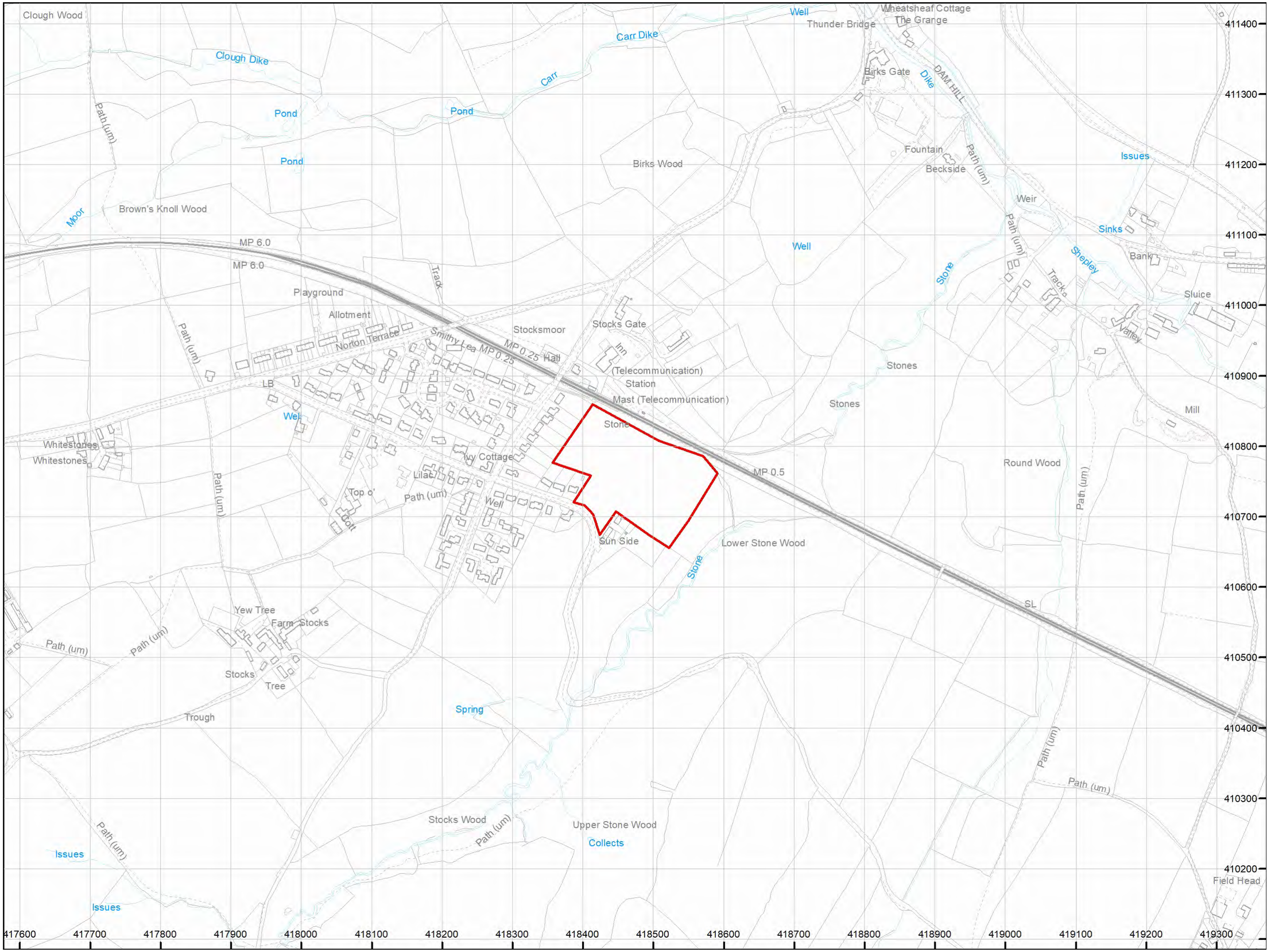
# Summary of findings



The map highlights any specific surface or subsurface features within or near to the boundary of the site.

## Key

Approximate position of the enquiry boundary shown




**How to contact us**
0345 762 6848 (UK)
+44 (0)1623 637 000 (International)
www.groundstability.com

# Appendix H

**ATTENUATION CALCULATIONS**

## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Maximum Time of Concentration (mins) | 30.00 |
| Return Period (years) | 100 | Maximum Rainfall (mm/hr) | 50.0 |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 |
| FSR Region | England and Wales | Connection Type | Level Soffits |
| M5-60 (mm) | 20.000 | Minimum Backdrop Height (m) | 0.200 |
| Ratio-R | 0.300 | Preferred Cover Depth (m) | 1.200 |
| CV | 1.000 | Include Intermediate Ground | ✓ |
| Time of Entry (mins) | 5.00 | Enforce best practice design rules | ✓ |

## Nodes

| Name | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Easting (m) | Northing (m) | Depth (m) |
|---|---|---|---|---|---|---|---|
| AT | 0.800 | 5.00 | 100.000 | 1200 | 100.000 | 100.000 | 1.500 |

## Simulation Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Analysis Speed | Normal |
| FSR Region | England and Wales | Skip Steady State | x |
| M5-60 (mm) | 20.000 | Drain Down Time (mins) | 240 |
| Ratio-R | 0.300 | Additional Storage (m³/ha) | 20.0 |
| Summer CV | 1.000 | Check Discharge Rate(s) | x |
| Winter CV | 1.000 | Check Discharge Volume | x |

### Storm Durations

| 15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 |
|---|---|---|---|---|---|---|---|---|---|---|---|

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 |
| 100 | 40 | 10 | 0 |

## Node AT Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | x | Sump Available | ✓ |
| Invert Level (m) | 98.500 | Product Number | CTL-SHE-0117-6200-1000-6200 |
| Design Depth (m) | 1.000 | Min Outlet Diameter (m) | 0.150 |
| Design Flow (l/s) | 6.2 | Min Node Diameter (mm) | 1200 |

## Node AT Carpark Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m) | 98.500 | Slope (1:X) | 500.0 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) | | Depth (m) | 1.000 |
| Safety Factor | 2.0 | Width (m) | 28.000 | Inf Depth (m) | |
| Porosity | 1.00 | Length (m) | 30.000 | | |

**Results for 1 year Critical Storm Duration. Lowest mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 720 minute summer | AT | 465 | 98.692 | 0.192 | 22.4 | 138.5828 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 720 minute summer | AT | Hydro-Brake® | 6.0 | 221.6 |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 720 minute summer | AT | 570 | 98.936 | 0.436 | 45.8 | 345.9297 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 720 minute summer | AT | Hydro-Brake® | 6.2 | 280.9 |

**Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 960 minute winter | AT | 930 | 99.500 | 1.000 | 48.6 | 827.2591 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 960 minute winter | AT | Hydro-Brake® | 6.2 | 376.4 |

**Results for 1 year 15 minute summer. 255 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | AT | 19 | 98.593 | 0.093 | 130.0 | 54.0199 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 15 minute summer | AT | Hydro-Brake® | 3.7 | 36.5 |

**Results for 1 year 15 minute winter. 255 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | AT | 19 | 98.593 | 0.093 | 122.0 | 54.0985 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 15 minute winter | AT | Hydro-Brake® | 3.7 | 36.5 |

**Results for 1 year 30 minute summer. 270 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 30 minute summer | AT | 33 | 98.614 | 0.114 | 121.4 | 71.5916 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 30 minute summer | AT | Hydro-Brake® | 4.7 | 49.9 |

**Results for 1 year 30 minute winter. 270 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 30 minute winter | AT | 33 | 98.614 | 0.114 | 98.1 | 71.7959 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 30 minute winter | AT | Hydro-Brake® | 4.8 | 50.0 |

**Results for 1 year 60 minute summer. 300 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 60 minute summer | AT | 62 | 98.636 | 0.136 | 96.6 | 90.8666 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 60 minute summer | AT | Hydro-Brake® | 5.6 | 67.7 |

**Results for 1 year 60 minute winter. 300 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 60 minute winter | AT | 61 | 98.637 | 0.137 | 69.8 | 91.2152 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 60 minute winter | AT | Hydro-Brake® | 5.6 | 67.7 |

**Results for 1 year 120 minute summer. 360 minute analysis at 2 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 120 minute summer | AT | 120 | 98.658 | 0.158 | 67.6 | 109.5309 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 120 minute summer | AT | Hydro-Brake® | 5.8 | 91.0 |

**Results for 1 year 120 minute winter. 360 minute analysis at 2 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 120 minute winter | AT | 118 | 98.659 | 0.159 | 46.6 | 110.1372 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 120 minute winter | AT | Hydro-Brake® | 5.8 | 91.1 |

**Results for 1 year 180 minute summer. 420 minute analysis at 4 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute summer | AT | 156 | 98.670 | 0.170 | 52.8 | 119.2766 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 180 minute summer | AT | Hydro-Brake® | 5.9 | 108.6 |

**Results for 1 year 180 minute winter. 420 minute analysis at 4 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute winter | AT | 172 | 98.670 | 0.170 | 36.3 | 119.7460 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 180 minute winter | AT | Hydro-Brake® | 5.9 | 109.1 |

**Results for 1 year 240 minute summer. 480 minute analysis at 4 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 240 minute summer | AT | 192 | 98.677 | 0.177 | 46.0 | 125.6090 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 240 minute summer | AT | Hydro-Brake® | 5.9 | 124.2 |

**Results for 1 year 240 minute winter. 480 minute analysis at 4 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 240 minute winter | AT | 196 | 98.676 | 0.176 | 30.6 | 125.1281 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 240 minute winter | AT | Hydro-Brake® | 5.9 | 124.8 |

**Results for 1 year 360 minute summer. 600 minute analysis at 8 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 360 minute summer | AT | 256 | 98.685 | 0.185 | 36.4 | 132.6812 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 360 minute summer | AT | Hydro-Brake® | 6.0 | 151.8 |

**Results for 1 year 360 minute winter. 600 minute analysis at 8 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 360 minute winter | AT | 272 | 98.683 | 0.183 | 23.6 | 130.8869 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 360 minute winter | AT | Hydro-Brake® | 6.0 | 152.9 |

**Results for 1 year 480 minute summer. 720 minute analysis at 8 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 480 minute summer | AT | 328 | 98.690 | 0.190 | 29.4 | 136.5963 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 480 minute summer | AT | Hydro-Brake® | 6.0 | 177.2 |

**Results for 1 year 480 minute winter. 720 minute analysis at 8 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 480 minute winter | AT | 352 | 98.686 | 0.186 | 19.6 | 132.8584 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 480 minute winter | AT | Hydro-Brake® | 6.0 | 178.8 |

**Results for 1 year 600 minute summer. 840 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 600 minute summer | AT | 405 | 98.692 | 0.192 | 24.6 | 138.1986 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 600 minute summer | AT | Hydro-Brake® | 6.0 | 199.9 |

**Results for 1 year 600 minute winter. 840 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 600 minute winter | AT | 435 | 98.685 | 0.185 | 16.8 | 132.3219 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 600 minute winter | AT | Hydro-Brake® | 6.0 | 201.7 |

**Results for 1 year 720 minute summer. 960 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 720 minute summer | AT | 465 | 98.692 | 0.192 | 22.4 | 138.5828 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 720 minute summer | AT | Hydro-Brake® | 6.0 | 221.6 |

**Results for 1 year 720 minute winter. 960 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 720 minute winter | AT | 510 | 98.683 | 0.183 | 15.0 | 130.7678 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 720 minute winter | AT | Hydro-Brake® | 6.0 | 223.6 |

**Results for 1 year 960 minute summer. 1200 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 960 minute summer | AT | 615 | 98.691 | 0.191 | 18.9 | 137.5897 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 960 minute summer | AT | Hydro-Brake® | 6.0 | 259.7 |

**Results for 1 year 960 minute winter. 1200 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 960 minute winter | AT | 645 | 98.677 | 0.177 | 12.6 | 125.4479 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 960 minute winter | AT | Hydro-Brake® | 5.9 | 261.3 |

**Results for 1 year 1440 minute summer. 1680 minute analysis at 30 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 1440 minute summer | AT | 870 | 98.682 | 0.182 | 14.3 | 129.6501 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 1440 minute summer | AT | Hydro-Brake® | 6.0 | 315.8 |

**Results for 1 year 1440 minute winter. 1680 minute analysis at 30 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 1440 minute winter | AT | 930 | 98.661 | 0.161 | 9.6 | 111.5268 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 1440 minute winter | AT | Hydro-Brake® | 5.8 | 317.8 |

**Results for 30 year 15 minute summer. 255 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | AT | 19 | 98.686 | 0.186 | 318.4 | 133.5771 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 15 minute summer | AT | Hydro-Brake® | 6.0 | 79.5 |

**Results for 30 year 15 minute winter. 255 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | AT | 19 | 98.687 | 0.187 | 298.7 | 133.7123 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 15 minute winter | AT | Hydro-Brake® | 6.0 | 79.6 |

**Results for 30 year 30 minute summer. 270 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 30 minute summer | AT | 34 | 98.741 | 0.241 | 298.0 | 180.2585 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 30 minute summer | AT | Hydro-Brake® | 6.2 | 92.3 |

**Results for 30 year 30 minute winter. 270 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 30 minute winter | AT | 34 | 98.741 | 0.241 | 240.7 | 180.3922 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 30 minute winter | AT | Hydro-Brake® | 6.2 | 92.4 |

**Results for 30 year 60 minute summer. 300 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 60 minute summer | AT | 64 | 98.800 | 0.300 | 232.4 | 230.6015 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 60 minute summer | AT | Hydro-Brake® | 6.2 | 102.7 |

**Results for 30 year 60 minute winter. 300 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 60 minute winter | AT | 62 | 98.801 | 0.301 | 168.0 | 230.8147 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 60 minute winter | AT | Hydro-Brake® | 6.2 | 103.0 |

**Results for 30 year 120 minute summer. 360 minute analysis at 2 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 120 minute summer | AT | 124 | 98.858 | 0.358 | 156.9 | 280.1377 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 120 minute summer | AT | Hydro-Brake® | 6.2 | 119.4 |

**Results for 30 year 120 minute winter. 360 minute analysis at 2 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 120 minute winter | AT | 120 | 98.859 | 0.359 | 108.1 | 280.5538 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 120 minute winter | AT | Hydro-Brake® | 6.2 | 119.9 |

**Results for 30 year 180 minute summer. 420 minute analysis at 4 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute summer | AT | 184 | 98.888 | 0.388 | 118.7 | 304.8842 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 180 minute summer | AT | Hydro-Brake® | 6.2 | 135.2 |

**Results for 30 year 180 minute winter. 420 minute analysis at 4 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute winter | AT | 180 | 98.888 | 0.388 | 81.7 | 305.6413 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 180 minute winter | AT | Hydro-Brake® | 6.2 | 136.0 |

**Results for 30 year 240 minute summer. 480 minute analysis at 4 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 240 minute summer | AT | 244 | 98.905 | 0.405 | 101.3 | 320.1975 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 240 minute summer | AT | Hydro-Brake® | 6.2 | 151.5 |

**Results for 30 year 240 minute winter. 480 minute analysis at 4 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 240 minute winter | AT | 236 | 98.907 | 0.407 | 67.3 | 321.2176 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 240 minute winter | AT | Hydro-Brake® | 6.2 | 152.6 |

**Results for 30 year 360 minute summer. 600 minute analysis at 8 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 360 minute summer | AT | 360 | 98.924 | 0.424 | 78.2 | 335.9082 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 360 minute summer | AT | Hydro-Brake® | 6.2 | 183.9 |

**Results for 30 year 360 minute winter. 600 minute analysis at 8 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 360 minute winter | AT | 352 | 98.926 | 0.425 | 50.8 | 337.2420 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 360 minute winter | AT | Hydro-Brake® | 6.2 | 185.9 |

**Results for 30 year 480 minute summer. 720 minute analysis at 8 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 480 minute summer | AT | 432 | 98.931 | 0.431 | 62.0 | 342.2134 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 480 minute summer | AT | Hydro-Brake® | 6.2 | 216.9 |

**Results for 30 year 480 minute winter. 720 minute analysis at 8 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 480 minute winter | AT | 456 | 98.933 | 0.433 | 41.2 | 343.4835 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 480 minute winter | AT | Hydro-Brake® | 6.2 | 219.5 |

**Results for 30 year 600 minute summer. 840 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 600 minute summer | AT | 495 | 98.934 | 0.434 | 51.1 | 344.4221 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 600 minute summer | AT | Hydro-Brake® | 6.2 | 248.0 |

**Results for 30 year 600 minute winter. 840 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 600 minute winter | AT | 555 | 98.933 | 0.433 | 34.9 | 343.3271 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 600 minute winter | AT | Hydro-Brake® | 6.2 | 251.7 |

**Results for 30 year 720 minute summer. 960 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 720 minute summer | AT | 570 | 98.936 | 0.436 | 45.8 | 345.9297 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 720 minute summer | AT | Hydro-Brake® | 6.2 | 280.9 |

**Results for 30 year 720 minute winter. 960 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 720 minute winter | AT | 570 | 98.932 | 0.432 | 30.8 | 342.4255 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 720 minute winter | AT | Hydro-Brake® | 6.2 | 285.4 |

**Results for 30 year 960 minute summer. 1200 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 960 minute summer | AT | 690 | 98.934 | 0.434 | 37.9 | 344.1826 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 960 minute summer | AT | Hydro-Brake® | 6.2 | 346.2 |

**Results for 30 year 960 minute winter. 1200 minute analysis at 15 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 960 minute winter | AT | 735 | 98.925 | 0.425 | 25.1 | 337.0981 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 960 minute winter | AT | Hydro-Brake® | 6.2 | 352.5 |

**Results for 30 year 1440 minute summer. 1680 minute analysis at 30 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 1440 minute summer | AT | 990 | 98.918 | 0.418 | 27.7 | 331.0518 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 1440 minute summer | AT | Hydro-Brake® | 6.2 | 470.5 |

**Results for 30 year 1440 minute winter. 1680 minute analysis at 30 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 1440 minute winter | AT | 1050 | 98.897 | 0.397 | 18.6 | 312.6337 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 1440 minute winter | AT | Hydro-Brake® | 6.2 | 480.9 |

**Results for 100 year +40% CC +10% A 15 minute summer. 255 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | AT | 20 | 98.845 | 0.345 | 634.1 | 269.3203 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 15 minute summer | AT | Hydro-Brake® | 6.2 | 92.2 |

**Results for 100 year +40% CC +10% A 15 minute winter. 255 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | AT | 20 | 98.846 | 0.346 | 595.0 | 269.4683 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 15 minute winter | AT | Hydro-Brake® | 6.2 | 92.3 |

**Results for 100 year +40% CC +10% A 30 minute summer. 270 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 30 minute summer | AT | 35 | 98.963 | 0.463 | 599.8 | 369.5804 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 30 minute summer | AT | Hydro-Brake® | 6.2 | 95.0 |

**Results for 100 year +40% CC +10% A 30 minute winter. 270 minute analysis at 1 minute timestep. Mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 30 minute winter | AT | 34 | 98.963 | 0.463 | 484.5 | 369.8966 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 30 minute winter | AT | Hydro-Brake® | 6.2 | 95.1 |

**Results for 100 year +40% CC +10% A 60 minute summer. 300 minute analysis at 1 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 60 minute summer | AT | 64 | 99.094 | 0.594 | 470.6 | 481.4204 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 60 minute summer | AT | Hydro-Brake® | 6.2 | 98.5 |

**Results for 100 year +40% CC +10% A 60 minute winter. 300 minute analysis at 1 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 60 minute winter | AT | 63 | 99.094 | 0.594 | 340.1 | 481.7536 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 60 minute winter | AT | Hydro-Brake® | 6.2 | 98.6 |

**Results for 100 year +40% CC +10% A 120 minute summer. 360 minute analysis at 2 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 120 minute summer | AT | 124 | 99.230 | 0.730 | 317.2 | 597.1365 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 120 minute summer | AT | Hydro-Brake® | 6.2 | 107.2 |

**Results for 100 year +40% CC +10% A 120 minute winter. 360 minute analysis at 2 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 120 minute winter | AT | 122 | 99.230 | 0.730 | 218.5 | 597.7766 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 120 minute winter | AT | Hydro-Brake® | 6.2 | 107.4 |

**Results for 100 year +40% CC +10% A 180 minute summer. 420 minute analysis at 4 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute summer | AT | 184 | 99.300 | 0.800 | 238.3 | 657.5100 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 180 minute summer | AT | Hydro-Brake® | 6.2 | 127.8 |

**Results for 100 year +40% CC +10% A 180 minute winter. 420 minute analysis at 4 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute winter | AT | 184 | 99.302 | 0.802 | 164.0 | 658.9743 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 180 minute winter | AT | Hydro-Brake® | 6.2 | 128.2 |

**Results for 100 year +40% CC +10% A 240 minute summer. 480 minute analysis at 4 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 240 minute summer | AT | 244 | 99.349 | 0.849 | 202.3 | 699.0196 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 240 minute summer | AT | Hydro-Brake® | 6.2 | 148.3 |

**Results for 100 year +40% CC +10% A 240 minute winter. 480 minute analysis at 4 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 240 minute winter | AT | 240 | 99.351 | 0.851 | 134.4 | 700.5598 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 240 minute winter | AT | Hydro-Brake® | 6.2 | 148.5 |

**Results for 100 year +40% CC +10% A 360 minute summer. 600 minute analysis at 8 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 360 minute summer | AT | 368 | 99.411 | 0.911 | 154.9 | 751.3615 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 360 minute summer | AT | Hydro-Brake® | 6.2 | 187.5 |

**Results for 100 year +40% CC +10% A 360 minute winter. 600 minute analysis at 8 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 360 minute winter | AT | 360 | 99.415 | 0.915 | 100.7 | 754.8376 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 360 minute winter | AT | Hydro-Brake® | 6.2 | 188.1 |

**Results for 100 year +40% CC +10% A 480 minute summer. 720 minute analysis at 8 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 480 minute summer | AT | 480 | 99.448 | 0.948 | 122.2 | 783.7076 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 480 minute summer | AT | Hydro-Brake® | 6.2 | 226.7 |

**Results for 100 year +40% CC +10% A 480 minute winter. 720 minute analysis at 8 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 480 minute winter | AT | 472 | 99.454 | 0.954 | 81.2 | 788.0355 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 480 minute winter | AT | Hydro-Brake® | 6.2 | 227.1 |

**Results for 100 year +40% CC +10% A 600 minute summer. 840 minute analysis at 15 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 600 minute summer | AT | 600 | 99.470 | 0.970 | 100.2 | 801.6600 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 600 minute summer | AT | Hydro-Brake® | 6.2 | 263.1 |

**Results for 100 year +40% CC +10% A 600 minute winter. 840 minute analysis at 15 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 600 minute winter | AT | 585 | 99.476 | 0.976 | 68.5 | 807.4454 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 600 minute winter | AT | Hydro-Brake® | 6.2 | 264.0 |

**Results for 100 year +40% CC +10% A 720 minute summer. 960 minute analysis at 15 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 720 minute summer | AT | 720 | 99.483 | 0.983 | 89.4 | 812.7758 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 720 minute summer | AT | Hydro-Brake® | 6.2 | 301.2 |

**Results for 100 year +40% CC +10% A 720 minute winter. 960 minute analysis at 15 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 720 minute winter | AT | 705 | 99.490 | 0.990 | 60.1 | 819.4835 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 720 minute winter | AT | Hydro-Brake® | 6.2 | 302.0 |

**Results for 100 year +40% CC +10% A 960 minute summer. 1200 minute analysis at 15 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 960 minute summer | AT | 960 | 99.490 | 0.990 | 73.4 | 819.1708 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 960 minute summer | AT | Hydro-Brake® | 6.2 | 376.0 |

**Results for 100 year +40% CC +10% A 960 minute winter. 1200 minute analysis at 15 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 960 minute winter | AT | 930 | 99.500 | 1.000 | 48.6 | 827.2591 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 960 minute winter | AT | Hydro-Brake® | 6.2 | 376.4 |

**Results for 100 year +40% CC +10% A 1440 minute summer. 1680 minute analysis at 30 minute timestep. Mass balance: 99.99**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 1440 minute summer | AT | 1200 | 99.477 | 0.977 | 53.2 | 808.3458 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 1440 minute summer | AT | Hydro-Brake® | 6.2 | 514.3 |

**Results for 100 year +40% CC +10% A 1440 minute winter. 1680 minute analysis at 30 minute timestep. Mass balance: 99.99%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 1440 minute winter | AT | 1320 | 99.481 | 0.981 | 35.8 | 811.3824 | 0.0000 | OK |

| Link Event | US Node | Link | Outflow (l/s) | Discharge Vol (m³) |
|---|---|---|---|---|
| 1440 minute winter | AT | Hydro-Brake® | 6.2 | 516.4 |

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