Eastfield, Shepley

Flood Risk Assessment & Drainage Strategy

September 2025

Banks Group Ltd

AMA Project Number: 23174

Andrew Moseley Associates
15 St Paul's Street
Leeds
LS1 2JG

www.amatp.co.uk
info@amatp.co.uk

REPORT QUALITY MANAGEMENT

	First Issue	Revision 1	Revision 2	Revision 3
Remarks	Planning	Updated Site Plan		
Date	August 2025	September 2025		
Prepared	JE	CS		
Checked	AY	AY		
Authorised	GS	GS		

REPORT PRODUCTION TEAM

Name	Initials	Job Title
Caitlin Shearer	CS	Graduate Flood Risk Engineer
Jasmine Ellenor	JE	Flood Risk and Drainage Engineer
Aaron Yesudian	AY	Senior Flood Risk and Drainage Engineer
Gavin Shepherd	GS	Associate Director

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

1.1.1 This Flood Risk Assessment (FRA) and Drainage Strategy (DS) has been provided at the request of Banks Group Ltd, hereafter referred to as "the client", to assess the flood risks associated with the proposed development of Eastfield, Shepley, 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) 2025.

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

- CIRIA 753 The SUDS Manual V8 (2018);
- DEFRA "Flood Risk Assessment Guidance for New Developments" (2006);
- DEFRA "Surface Water Management Plan Technical Guidance" (2010);
- BS 8533 2017 Assessing & Managing Flood Risk in Development Code of Practice (2017);
- BS 8582:2013 Code of practice for surface water management for development Sites (2013);
- National Planning Practice Guidance (2012 – updated 2022);
- C624 Development and Flood Risk – Guidance for the Construction Industry' (2004);
- Sewage Sector Guidance (2022);
- Planning Policy Guidance – Flood Risk and Climate Change (2014 – updated 2022).

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

- Kirklees Local Plan Strategy and Policies 2019
- Calder Catchment Strategic Flood Risk Assessment – Volume I (2016)
- Calder Catchment Strategic Flood Risk Assessment – Volume II (2016)

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 2025 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 a 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 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 zone 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 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, surface water run-off 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, typical 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 restriction;
    - 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 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 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.
- 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 comment on limitations and opportunities for the site, with recommendations of further mitigation where applicable and appropriate
- Produce indicative design calculations for the 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 Banks Group Ltd to provide a Flood Risk Assessment and Drainage Strategy in support of a residential development, located off Eastfield, Shepley, Kirklees, West Yorkshire, HD8 8EZ, at NGR: SE 19727 09681.

3.1.2 The proposed development is located in the area of Shepley, approximately 5.5 miles southeast of Huddersfield. Proposals for the site are for residential use, consisting of up to 110 residential dwellings, with associated hardstanding, landscaping, and infrastructure. A site layout 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 3-1** below.

Table 3-1 Site Context

Site Name	Eastfield, Shepley
Location	Shepley, Kirklees
NGR (approx..)	SE 19727 09681
Application Site Area (ha)	4.98
General Locality	The site is located on undeveloped greenfield land with some existing agricultural buildings, and borders industrial development to the north, undeveloped land to the east and south, and residential developments to the west. Pedestrian and vehicular access to the site is provided via Eastfield, which is located to the northwest of the site.
Development Type	Residential
EA Flood Zone	Flood Zone 1
Local Planning Authority	Kirklees Council

Figure 3-1 Site Location Plan

3.2 TOPOGRAPHY

3.2.1 A topographic survey provided by Banks Group and undertaken by Castle Keep Surveys (Ref: CKS-2250-OV) shows ground levels at the site are shown to be in the region of 194m to 220m Above Ordnance Datum (m AOD). The topographic survey can be seen in **Appendix B**.

3.2.2 Further review of topographical data shows site levels to be lowest towards the north of the site, while greatest levels are located towards the south of the site. Across the whole site there is a general fall in elevation from south to north.

3.2.3 As indicated by aerial imagery, the site consists of agricultural land consisting of light vegetation, with a few existing agricultural buildings in the centre.

3.3 GEOLOGY AND GROUND CONDITIONS

3.3.1 British Geological Survey (BGS) Open Geoscience website indicates that the north of the site is underlain by Grenoside Sandstone – Sandstone, with no overlying superficial deposits. The south of the site is underlain by Pennine Lower Coal Measures Formation – Mudstone, siltstone and sandstone.

3.3.2 The BGS website information indicates that there are three boreholes located in close proximity to the site (borehole records ref: SE10NE1, SE10NE20, and SE10NE21); which have been provided in **Appendix C**.

3.3.3 Borehole SE10NE1 is located approximately 70m north of the site. The borehole record shows ground conditions to consist of sandstone, rock, blue bind, shale, an alternation of rock and bind, underlain by gritstone, bind, stone, bind, sandy shale, and finally grey bind. Resting groundwater levels were found to be in the order of 28m below ground level (bgl).

3.3.4 Borehole SE10NE20 is located approximately 40m north of the site. The borehole record shows ground conditions to consist of fill, underlain by sandstone, shale, sandstone, mudstone, and sandstone. Resting groundwater levels were found to be in the order of 36m bgl.

3.3.5 Borehole SE10NE21 is located approximately 40m north of the site. The borehole record shows ground conditions to consist of fill, underlain by sandstone, shale, sandstone, mudstone, sandstone, and mudstone. Resting groundwater levels were found to be in the order of 37m bgl.

3.3.6 Information obtained from the Cranfield University's Soilscape website indicates that the northwest corner of the site is located in an area classified as being Soilscape 6, which is defined as having freely draining slightly acid loamy soils. The majority of the site is located in an area classified as being Soilscape 17, which is defined as having slowly permeable seasonally wet acid loamy and clayey soils.

3.4 HYDROGEOLOGY

3.4.1 According to the Department for Environment, Food and Rural Affairs (DEFRA) MAGIC map, the north of the site is indicated as being located in a Groundwater Source Protection Zone 1 (SPZ), as defined by the Environment Agency (EA) for the protection of a potable groundwater supply. This may preclude the use of soil infiltration as the primary means of discharging surface water run-off from the site, due to potential contamination from the development areas and site mineral stockpiles.

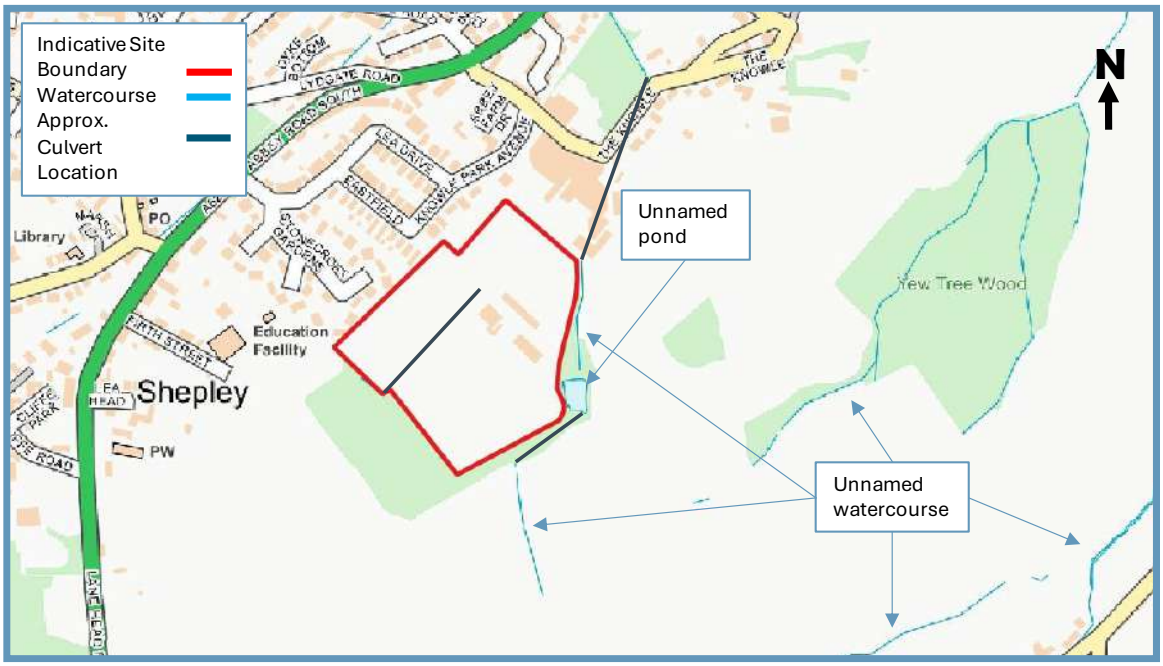
3.4.2 The site is located as being in an area of high groundwater vulnerability and located above a Secondary A bedrock aquifer.

3.5 HYDROLOGY

3.5.1 There are a number of unnamed watercourses surrounding the site as shown in Figure 3-2. Firstly, there is a 9-inch culverted watercourse shown within the centre of the site. There is also an unnamed watercourse located south of the site which becomes culverted through the pond to the east. The unnamed watercourse leading from the pond to the northeast corner of the site then becomes culverted again, leading towards the north of the site.

3.5.2 The EA's Catchment Data Explorer website indicates that the site resides within the Colne and Holme operational catchment and the Fenay beck from Source to River Colne sub catchment.

Figure 3-2 Watercourse Location



4 POTENTIAL FLOOD RISK

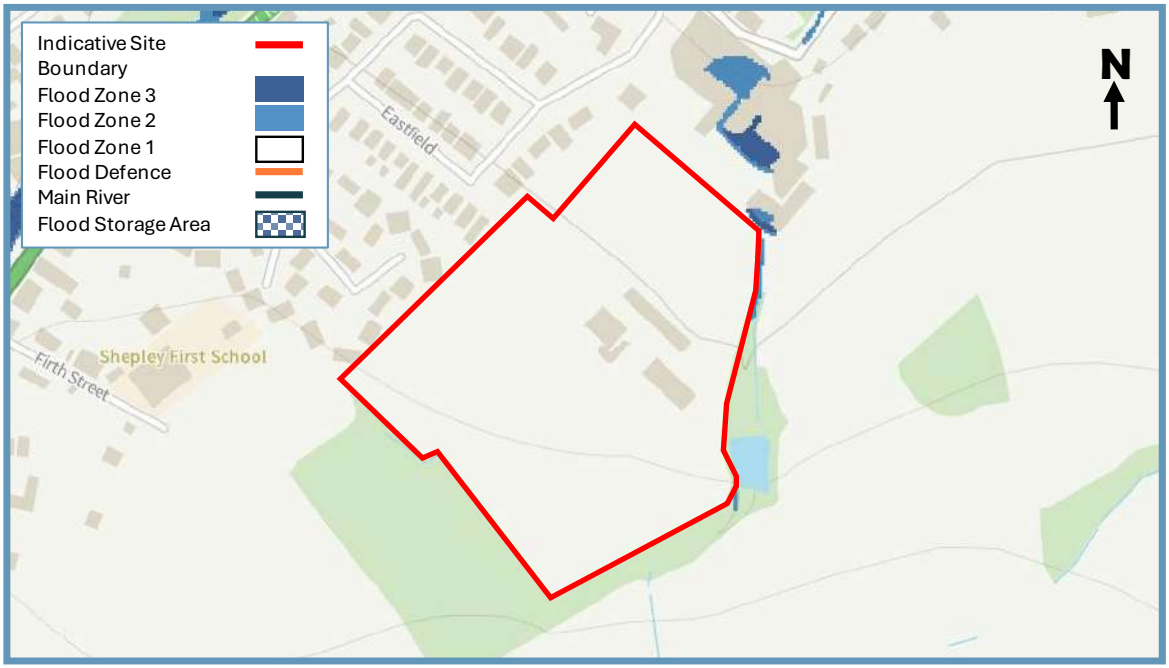
4.1 SOURCES OF FLOODING

4.1.1 This report is to consider flood risk from all potential sources. **Section 5** then discusses in further detail the probability of flooding, any potential impacts and necessary mitigation, where required.

4.2 ENVIRONMENT AGENCY FLOOD ZONES

4.2.1 The EA Flood Map for Planning shows the site is located within Flood Zone 1, which is designated as land having less than a 1 in 1,000 annual probability of river or sea flooding. This potential fluvial/coastal flood risk to the site has been illustrated in **Figure 4-1**.

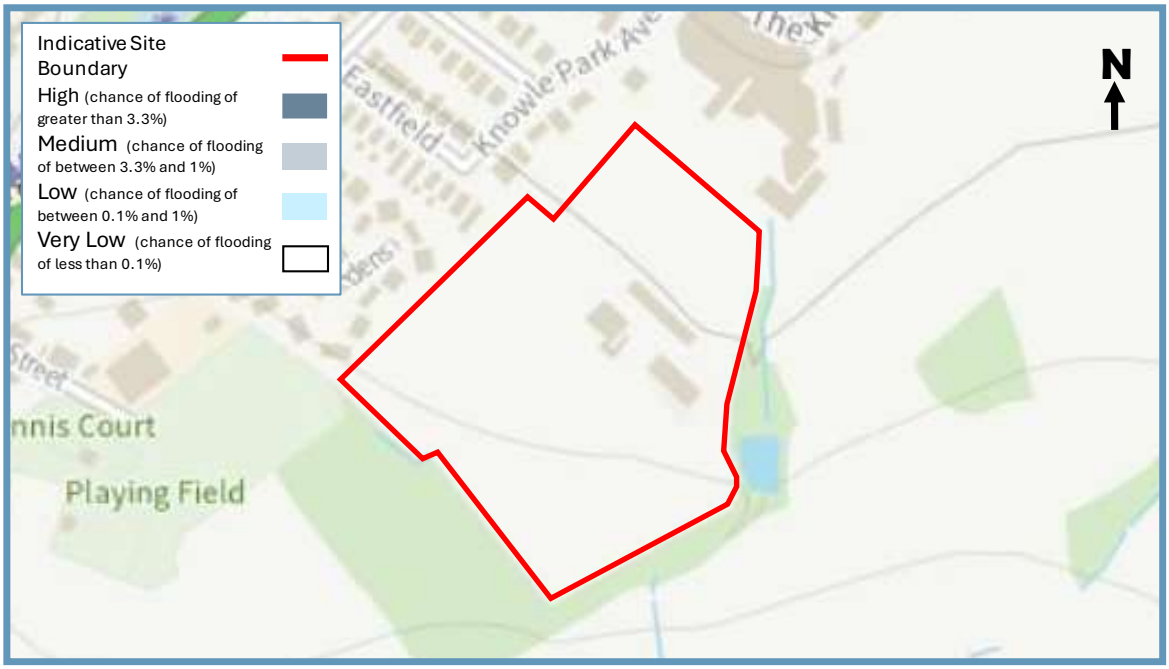
Figure 4-1 Environment Agency Long Term Flood Map for Planning



4.3 FLUVIAL AND COASTAL FLOODING

4.3.1 It is necessary to consider the risk of fluvial and coastal flooding at the site during both present times and with the impacts of climate change. Therefore, the EA Long Term Flood Risk Map for fluvial and coastal flooding between the years 2036 and 2069 has been presented below in **Figure 4.2**. This figure indicates that the site is at very low risk of fluvial and/or coastal flooding.

Figure 4-2 Environment Agency Long Term Flood Map – Rivers and Sea – Yearly Chance of Flooding between 2036 and 2069



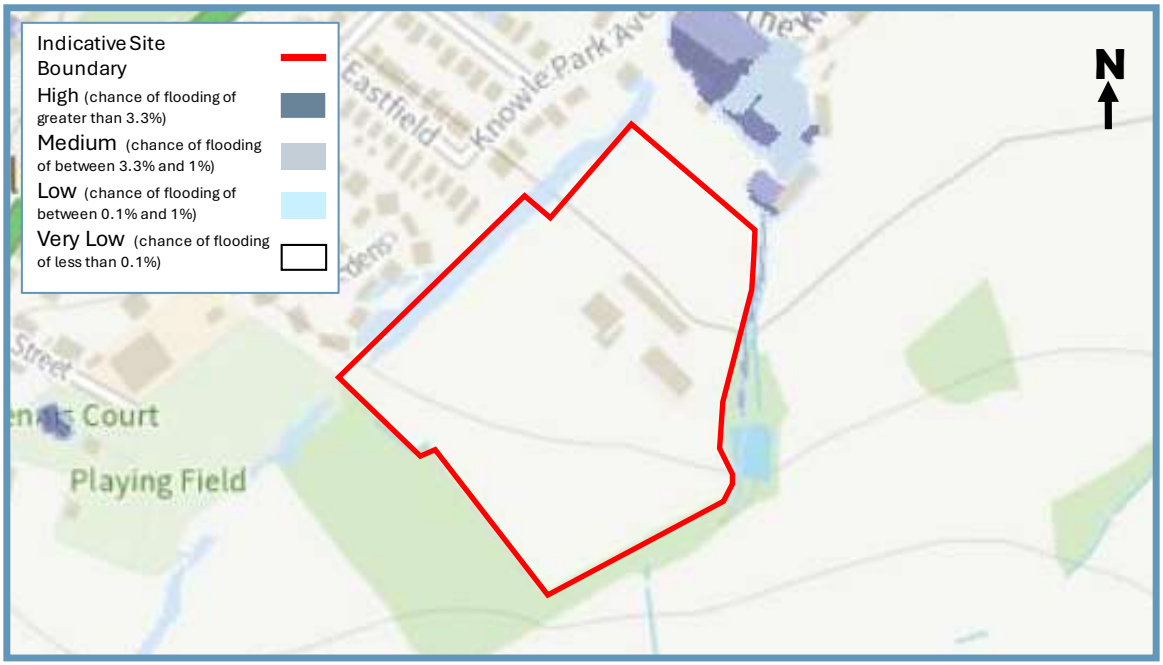
4.4 PLUVIAL (SURFACE WATER) FLOODING

4.4.1 Similarly to that discussed in Section 4.3, the impacts of climate change on the potential for surface water flooding should be considered within the assessment of the flood risk at the site. The EA Long Term Flood Risk Map for surface water flooding between the years 2040 and 2060 is shown below in Figure 4-3. This figure shows that the majority of the site is located in an area at very low risk of surface water flooding. However, there is an area along the western boundary at low risk of surface water flooding. This area is at risk of experiencing flood depths below 0.20m.

4.4.2 As the proposed development of the site may potentially reduce the overall site permeability and potentially increase surface water run-off 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 low potential risk of flooding from pluvial sources.

Figure 4-3 Environment Agency Long Term Flood Risk Map – Pluvial (Surface Water) Flooding – Yearly Chance of Flooding between 2040 and 2060



4.5 GROUNDWATER FLOODING

4.5.1 Ground conditions at the northwest corner of the site is located in an area classified as being Soilscape 6, which is defined as having freely draining slightly acid loamy soils. The majority of the site is located in an area classified as being Soilscape 17, which is defined as having slowly permeable seasonally wet acid loamy and clayey 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 During long periods of heavy rainfall, the water table within an area can rise above the natural ground level, resulting in groundwater flooding.

4.5.3 However, given the impermeable nature of the proposed site's hardstanding areas subsequent to development, potential elevation of groundwater or groundwater emergence within the superficial geology causing flooding within the site post-development will be largely eliminated.

4.5.4 According to the Calder Catchment Areas Susceptible to Groundwater Flooding Map presented in **Appendix D**, the site is located in an area at less than 25% risk of groundwater emergence.

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 In accordance with information taken from the EA Long Term Flood Risk information, the site and its surroundings are unlikely to experience flooding from artificial sources such as dam or canal failure. In addition, reservoirs and canals are regularly maintained by relevant local authorities and failure is extremely unlikely. Therefore, the potential risk of flooding from reservoir and/or canal failure is considered to be negligible.

4.7 FLOODING FROM SEWERS

4.7.1 The majority of the site currently consists of greenfield land and is not identified as having any drainage infrastructure within its boundary. There are a couple of existing agricultural buildings within the site boundary which may have existing drainage infrastructure however, there is no evidence of historic sewer flooding within the site.

4.7.2 The site is therefore considered to be at low 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 Calder Catchment SFRA confirms the EA historic flood mapping and indicates that there has been no historic flooding within the area.

5 FLOOD RISK ASSESSMENT

5.1 FLOOD RISK PLANNING POLICY

National Planning Policy Framework

5.1.1 The National Planning Policy Framework (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 a 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 (2025), Flood Zone 1 is defined as having a low probability flood risk. The proposed development includes up to 110 residential dwellings, with associated hardstanding, 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 Zones

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.

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.

Table 5-2 Pre-Mitigation Flood Risk Summary

Sources	Probability of Flood Risk	Impacts	Description
Tidal	N/A	N/A	The site is located inland and therefore, is not tidally influenced.
Fluvial	Very Low	Very Low	The site is not shown to be located in an area susceptible to fluvial flooding.
Surface Water (Pluvial)	Low	Low	Review of information from multiple sources (EA, LLFA) reveals evidence of surface water flooding along the western boundary of the site, with a maximum flood depth of 0.20m.
Groundwater	Low	Low	Groundwater flood risk is considered to be low.
Artificial Sources	Very Low	Very Low	Review of information from multiple sources (EA, LLFA) reveals no evidence of flooding from reservoirs or canals.
Sewers	Very Low	Very 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 run-off 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 INTRODUCTION

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, with some existing agricultural buildings located in the centre of the site. 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. Therefore, a Sequential Test has not been completed for this site.

Finished Floor 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. Therefore, it is recommended that a minimum Finished Floor Level (FFL) of 0.15m above adjacent ground level is set for the proposed development.

6.4 CULVERT OPENING

6.4.1 As discussed in Section 3.5 of this report, there is a 9-inch culvert located through the centre of the site. Within the development proposals, the culvert is to be opened to become an open watercourse through the site.

6.4.2 Opening the culvert provides many benefits with regard to flood risk within the site. Having an open watercourse reduces any restriction to flow, allowing more space for water as well as overland flows. This therefore reduces the risk of water within the culvert backing up and causing flooding upstream.

6.4.3 The risk of blockages restricting flow will also decrease, and allow easier maintenance in the event of a blockage. Additionally, having an open watercourse within the site will provide a storage location for overland flows within the site, providing relief in both fluvial and pluvial flood events.

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 8th Edition and the Civil Engineering Specification for the Water Industry.

7.2 EXISTING SEWERS

7.2.1 AMA attained a Yorkshire Water pre-development enquiry which can be seen in **Appendix E**. This shows that there are no public sewers located within the site. This also shows a number of combined public sewers located within Lea Drive, Knowle Park Avenue, Stonecroft Gardens, and Abbey Road South, as well as a surface water and foul water sewer located to the north of the existing dwellings located on Knowle Park Avenue.

7.2.2 As discussed, there are a couple of existing agricultural buildings in the centre of the site and as such, there may be existing drainage located within the site. A CCTV drainage survey would be required to confirm this.

7.3 FOUL WATER DISCHARGE RATES

7.3.1 The estimate design Dry Weather Flow (DWF) generated by the proposed development, based on a gravity system, has been calculated as 5.09 litres per second.

7.3.2 This figure is based on an estimate of 110 dwellings at 4,000 litres per dwelling as prescribed in Sewers for Adoption.

7.4 FOUL WATER CAPACITY AND POINT OF CONNECTION

7.4.1 Yorkshire Water have advised that the nearest point of connection to the public sewer network is the 225mm combined public sewer in Lea Drive to the north of the site. Yorkshire Water have advised that the sewer network does not have capacity for the development at present. However, should the development receive planning permission, YW will be required to upgrade their sewer to permit a connection from the development as required by the Water Act 1991.

7.4.2 Due to the sites topography and agreed foul water discharge location, a gravity connection cannot be achieved. Therefore, foul water will be pumped.

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

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 up to 110 residential dwellings, with associated hardstanding, 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 4.98 ha.

8.2.2 Review of the site plan shows proposals to consist of an approximate total impermeable area of 2.076 ha, which equates to approximately 42% of the total proposed developable area.

8.2.3 It is considered that green open space and landscaped areas will not produce or contribute run-off to the surface water management infrastructure proposed as part of this strategy. This has been taken into account when deriving the impermeable area for the site.

8.3 PRE-DEVELOPMENT SURFACE WATER RUN-OFF

Greenfield

8.3.1 The site is approximately 4.98 ha in area and currently comprises of undeveloped greenfield 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 run-off 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 G**.

Table 8-1 Existing Run-Off Rates

Area	Q_1	Q_{10}	Q_{30}	Q_{100}	Q_{200}
4.98	11.3	19.0	22.9	27.2	31.0

8.4 GROUNDWATER PROTECTION

8.4.1 The proposed development site is identified as being within a groundwater source protection zone (SPZ), as such infiltration methods are deemed an unsuitable option for draining surface water from the site, due to the potential contamination this may cause.

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 north of the site is underlain by Grenoside Sandstone – Sandstone, with no overlying superficial deposits. The south of the site is underlain by Pennine Lower Coal Measures Formation – Mudstone, siltstone and sandstone.

8.6.3 Information obtained from the Cranfield University's Soilscape website indicates that the northwest corner of the site is located in an area classified as being Soilscape 6, which is defined as having freely draining slightly acid loamy soils. The majority of the site is located in an area classified as being Soilscape 17, which is defined as having slowly permeable seasonally wet acid loamy and clayey soils.

8.6.4 In addition, AMA were provided the LLFA Pre App response regarding the site, which can be found in **Appendix H**. The LLFA state that soakaways would not be suitable at the site.

8.6.5 From a desktop review of the geology, steep nature of the site, high groundwater levels and soil at the site, as well as the site's location within a Groundwater Source Protection Zone, it is believed that infiltration would not be an acceptable way of discharging surface water from the site.

8.7 WATERCOURSE

8.7.1 As discussed in **Section 3.5**, there is a 9-inch culverted watercourse shown within the centre of the site. There is also an unnamed watercourse located south of the site which becomes culverted through the pond to the east. The unnamed watercourse leading from the pond to the northeast corner of the site then becomes culverted again, leading towards the north of the site.

8.7.2 As the site is in close proximity to the watercourses discussed, it would be possible to discharge surface water from the site into the watercourse.

8.7.3 Within the LLFA Pre App response (**Appendix H**) they discuss the watercourses surrounding the site and the possible methods of discharging surface water. They believe that either the watercourse which runs through the centre of the site or the watercourse which runs along the eastern boundary would be the optimal location to discharge surface water.

8.7.4 As such, it is proposed that surface water from the site will discharge into the unnamed watercourse along the northeastern boundary of the site.

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 In the Yorkshire Water pre development enquiry (**Appendix E**) they state that the watercourses surrounding the site is the most obvious location for the discharge of surface water from the site.

8.8.3 Therefore, it would not be possible to discharge surface water from the site into a public sewer.

8.9 PROPOSED DISCHARGED RATES

8.9.1 Surface water from the site will be discharged via an outfall to the watercourse to the east of the site.

8.9.2 As the site will be drained by discharging surface water into the watercourse, surface water will be restricted to 11.3 l/s, based on greenfield run-off rates.

8.10 ATTENUATION REQUIREMENTS

8.10.1 As discussed earlier the site will be drained into a watercourse at a restricted discharge rate of 11.3 l/s. Therefore, attenuation will have to be provided.

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% allowance for climate change and 10% for urban creep. The results of these calculations can be found in **Appendix I**.

8.10.3 Attenuation will be provided via a tank. An attenuation feasibility investigation has been included in **Section 9** of this report.

8.10.4 The results below are based on an attenuation tank located in the northeast of the site, outfalling surface water from the site to the adjacent eastern watercourse at a rate of 11.3 l/s.

8.10.5 A Drainage Layout Drawing can be found in **Appendix F**.

Total Impermeable Area

8.10.6 This volume is based on using an attenuation tank with a discharge rate of 11.3 l/s. The details on the attenuation of the tank can be found in **Table 8-2** below.

Table 8-2 Attenuation Volume

Gross Area (ha)	Max Discharge (l/s)	Imp. Area (ha)	Q100+50% Volume (m^3)
4.98	11.3	2.076	2500

8.11 DRAINAGE NETWORK

8.11.1 A network hydraulic model has been developed so as to assess the conveyance requirements for the proposed drainage strategy. This includes a combination of surface water pipes, manholes, and gullies, which will direct surface water run-off from impermeable areas to the attenuation tank located in the northeast of the site. This will ensure that surface water flows from the site are internally managed before they leave the site and further reduce the potential for impact elsewhere.

8.11.2 The final surface water drainage network servicing the site should ideally consist of permeable paving to limit the run-off from any paved areas, whilst extending time of concentration for discharge to the accompanying drainage network.

8.11.3 For any portion of the network crossing a highway or an area to be trafficked by heavy grade vehicles (HGV's), a minimum cover requirement of 1.20 m below cover level should be provided where practically possible for the internal drainage network to satisfy Sewers for Adoption standards.

8.11.4 Proposals for the drainage network are to discharge to the unnamed watercourse located along the eastern boundary of the site, subject to agreement with the LLFA.

9 ATTENUATION FEASIBILITY INVESTIGATION

9.1 ATTENUATION FEASIBILITY

9.1.1 The attenuation feasibility table below considers all types of attenuation which could be used to attenuate surface water flows from any given site. Each attenuation type has been assessed, in the context of the site at Eastfield, Shepley, and the proposed development to fully evaluate whether each type of attenuation would be feasible.

Attenuation Type	Can they be feasibly incorporated into the site?	Comments
Soakaways	×	As discussed earlier in this report, soakaways have been deemed unsuitable at this site following a desktop review of the ground conditions, high groundwater levels, and steep nature of the site. The site is also located within a Groundwater Source Protection Zone and as such the use of soakaways will increase the possibility of contamination of groundwater supplies. Finally, it was acknowledged within the LLFA Pre App response that soakaways would not be suitable here.
Dry Basin	×	Due to the steep topography of the site, an attenuation basin is not considered to be feasible in providing attenuation for the development. This is due to the massive excavation and high embankments that would be required. The slope of the site also means that run-off velocities are higher, and as such there is an increased risk of erosion at basin inlets, and an inefficiency of storage. An attenuation basin in this area could also lead to groundwater levels rising, causing both groundwater flooding across the site and the flooding of the attenuation basin during extreme rainfall events. This could also exacerbate the flood risk to the surrounding dwellings. Using a dry basin instead of an attenuation tank would also increase the footprint of the attenuation, meaning a loss of plots and amenity space for future residents of the site.
Wet Basin	×	Similarly to the reasoning above, due to the steep topography of the site a wet basin is also not considered to be feasible here. Risk of erosion, inefficient storage and high run-off velocities as well as the increased costing of massive excavation

		make a wet basin unsuitable for the proposed development. A combination of both the high groundwater levels and the wet basin would mean even a small increase in groundwater levels would cause further groundwater intrusion, leading to a loss of pond capacity and therefore flooding across the site. It could also exacerbate the flood risk to the surrounding dwellings. Lining the basin is also not considered viable as it would be required to be weighed down greatly to overcome the pressure of the groundwater. This would require a large quantity of concrete and land mass to be moved and brought to the site, which would be expensive, inefficient, and costly to both the environment at the site and from the source. Using a wet basin instead of an attenuation tank would also increase the footprint of the attenuation, meaning a loss of plots and amenity space for future residents of the site.
Crate Storage	×	Crate storage would not be suitable as it would not be able to resist the upward forces of water pressure caused by the high groundwater. Similarly to the lined wet basin, in order to add enough weight to the crates to resist the high groundwater pressure, a large quantity of concrete and land mass would be required to be brought to the site which would come at great cost and would have negative environmental impacts at both site and source of the materials. This alone would not make the crate storage any more feasible than that of a concrete storage tank. In addition, Yorkshire Water does not favour crates for adopted systems, and their preference would be a concrete tank, especially when accounting for the development size.
Concrete Storage Tank	✓	A concrete tank would provide attenuation for surface water from the site, while reducing the flood risk when compared to the other attenuation options previously discussed. The concrete tank will also need to be able to resist floatation, but an engineered solution will be able to overcome this. Having a concrete underground storage tank would also allow for greater POS amenity space, which benefits the residents of the site.

		This attenuation feature complies with all relevant statutory requirements and LLFA guidance without detriment to the various site-specific constraints. These determine the attenuation feature for the site must maintain a ground level that allows connectivity to the site access, allow enough space for a POS area, and finally, ensure surface water can be successfully stored and discharged at the rate required by the LLFA. As explained above, the other attenuation features discussed cannot feasibly meet all these requirements.

9.2 CONCLUSION

9.2.1 Based on the attenuation feasibility study above, it can be concluded that the concrete storage tank is the most efficient and therefore the most feasible option in regard to attenuating surface water from the site. The concrete tank would provide the lowest flood risk when taking into account the high groundwater levels at the attenuation location, and be most suitable with consideration for the topographical constraints of the site.

9.2.2 An underground attenuation tank provides consistent hydraulic performance, regardless of groundwater levels in the area it is situated in. Underground tanks are designed to operate effectively below the groundwater table and are not affected by a change in groundwater levels. Therefore, if groundwater levels in the area were to rise, the tank will remain consistent in providing sufficient attenuation for the proposed development without increasing flood risk on and off-site, whereas an attenuation basin would have the potential to cause flooding in this scenario.

9.2.3 Additionally, the impact of the pressure exerted by the soil and groundwater must be taken into consideration. Underground attenuation tanks are designed to withstand this pressure as they are constructed using structurally robust materials, and additional weight can be engineered into the final solution to manage against effects of floatation. This ensures the long-term performance and structural integrity of the attenuation under varying soil and groundwater conditions. This makes attenuation tanks suitable for installation in areas with high groundwater levels, where soil conditions may be challenging for traditional dry basin construction.

10 SUSTAINABLE DRAINAGE SYSTEMS

10.1.1 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).

10.2 SUSTAINABLE DRAINAGE (OVERVIEW)

10.2.1 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).

10.2.2 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).

10.2.3 SUDS are technically regarded as 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.

10.2.4 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.

10.3 SUDS PRINCIPALS

10.3.1 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

10.3.2 The above was replicated from www.susdrain.org.

10.4 SUDS TECHNIQUES

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

Table 10-1 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 steep topography and the location of the site above a source protection zone.
Filter Strips, Swales and Bio-Retention	✓	There will be a swale incorporated into the site layout as shown in Appendix F.
Infiltration Techniques	✗	Desktop review of the available data indicate that infiltration would not be feasible at the site due to high ground water levels, geology and the steep nature of 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.

10.5 PROPOSED SUDS FEATURES

10.5.1 The index approach identified within the SuDS Manual (Ciria C753) has been used to quantify the hazard from pollution present at the site and ensure adequate SuDS features are implemented to offset this value.

10.5.2 As identified in Table 26.2 in The SuDS Manual, given the sites proposed end use of residential development, the site would fall under a low pollution hazard level. The corresponding indices for pollutant types have been provided in Table 10-2 below.

Table 10-2 Pollution Hazard Indices for Different Land Use Classifications (Table 26.2 Ciria C753)

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-Carbons
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day	Low	0.5	0.4	0.4

10.5.3 Taking the values shown above, a cumulative pollution hazard index of 1.3 has been calculated for the site.

10.5.4 To offset the pollution index of 1.3, a combination of SuDS features have been proposed for the site. The proposed SuDS features and their associated mitigation indices have been provided in Table 10-3 below.

Table 10-3 Proposed SuDS Features and Associated Mitigation Indices

Types of SuDS Component	Stage of treatment	Treatment factor	TSS	Metals	Hydro-Carbons
Permeable Paving	Primary	1.0	0.5	0.6	0.6
Total			0.5	0.6	0.6

10.5.5 Taking the total values identified in the table above, the cumulative SuDS mitigation indices for each potential contaminant group are shown as providing a greater degree of mitigation than the pollution hazard indices. It is therefore considered that the integrated system of SuDS proposed would provide suitable betterment and quality improvement to the surface water run-off quality for the site, and will not require additional treatment via retention interceptors or other means before being discharged from the site to the external receiving environment.

10.5.6 The exact nature of the SuDS features to be included within the proposed development are to be confirmed at the reserved matters stage.

11 SUDS MAINTENANCE PLAN

11.1 SURFACE WATER MAINTENANCE AND MANAGEMENT SCHEDULE

Attenuation Tank Maintenance Schedule

Table 11-1 Attenuation Tank Maintenance Schedule

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, then annually
	Recover debris from catchment surface (where it may cause risk to performance).	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays.	Annually, or as required
Remedial Actions	Repair/rehabilitate inlets, outlets, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows 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 or as required

Hydrobrake Manhole Maintenance Schedule

Table 11-2 Hydrobrake Manhole Maintenance Schedule

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

Gullies Maintenance Schedule

Table 11-3 Gullies Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove sediment and debris from gullies and channel drain.	Quarterly

Swales Maintenance Schedule

Table 11-4 Swales Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove litter and debris.	Monthly, or as required
	Cut grass – to retain grass height within specified design range.	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants.	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for >48 hours.	Monthly, or when required
	Inspect vegetation coverage.	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies.	Half yearly
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required.	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding.	As required
	Relevel uneven surfaces and reinstate design levels.	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface.	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required
	Remove and dispose of oils or petrol residues using safe standard practices.	As required

Permeable Paving Maintenance Schedule

Table 11-5 Permeable Paving Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequently as required, based on site-specific observations of clogging or manufacturer recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to contain sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As necessary – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As Required
	Remediate work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As Required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10-15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial Inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48hrs after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually

12 SUMMARY

12.1.1 The proposals for the site are for residential use, consisting of up to 110 residential dwellings with associated hardstanding, landscaping, and infrastructure.

12.1.2 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.

12.1.3 The site is identified as not being at risk of flooding from tidal, fluvial, groundwater, artificial sources, or sewers.

12.1.4 There is an area along the western boundary of the site which is identified as being at low risk of surface water flooding, with a maximum flood depth of 0.20m.

12.1.5 As the site is located in Flood Zone 1, there are no specific requirements for flood mitigation measures at the site. However, it is recommended that FFLs are set at a minimum of 0.15m above the adjacent ground level.

12.1.6 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.

12.1.7 The primary option for surface water disposal is to form an outfall to a watercourse.

12.1.8 From a desktop review of ground conditions at the site, as well as the site's location within a Groundwater Source Protection Zone, infiltration methods are deemed an unviable option for draining surface water from the site.

12.1.9 There is a suitable watercourse in the vicinity of the site which could be utilised to dispose of surface water from the site. It is proposed that surface water will discharge through an outfall to the unnamed watercourse located adjacent to the site along the eastern boundary.

12.1.10 The culverted watercourse which runs through the centre of the site will be opened up, allowing additional storage in the event of a flood.

12.1.11 There is not a suitable public sewer in the vicinity of the site which could be utilised to dispose of the surface water as Yorkshire Water have stated that the surrounding watercourses are the most obvious place for surface water discharge from the site.

12.1.12 Attenuation is required as the means of surface water disposal is through an outfall to a watercourse. Furthermore, there will be a restricted discharge limit of 11.3 l/s, based on the greenfield run-off rate from the site.

12.1.13 There is a formal point of connection into a Yorkshire Water public foul water sewer in close proximity to the site. Foul water domestic waste can discharge to the 225 mm diameter public combined sewer recorded in Lea Drive, at a point to the north of the site.

13 LIMITATIONS

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

13.1.2 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.

13.1.3 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.

13.1.4 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.

13.1.5 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.

13.1.6 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 Topographic Survey

Appendix C BGS Borehole Records

Appendix D Calder Catchment Areas Susceptible to Groundwater Flooding Map

Appendix E Yorkshire Water Pre-Development Enquiry

Appendix F Drainage Layout Drawing

Appendix G UK SuDS Greenfield Run-Off Rates

Appendix H LLFA Pre App Response

Appendix I Causeway Flow Calculations

Appendix A
Proposed Site Layout

1:500
0 25m 50m

N

SHEPLEY, KIRKLEES – ILLUSTRATIVE FRAMEWORK

| PEGASUSGROUP.CO.UK | TEAM/DRAWN BY: EA | APPROVED BY: ST | DATE: 19.09.25 | SCALE: 1:500@A0 | DRWG: P25-0749.002 | REV: H | CLIENT: BANKS GROUP |

PEGASUS GROUP

Appendix B
Topographic Survey

Castle Keep Surveys Drawing Legend

Topographical Linetypes:

Road
Drop Kerb
Top of Slope
Bottom of Slope
Top of Bank
Bottom of Bank
Dubbing Line
Dubbing Centre
Track
Channel
Kerb
Concrete
Footpath
Surface Channel
Tactile Edge
Barrier
Chain Fence
Metal Fence
Post & Wire Fence
Wooden Fence
Overhead British Telecom
Overhead Electric
Wall
Slot Drain
ACO Drain
Channel Drain
Above Surface Pipe
Verge Line
Tree Canopy Line
Bush Canopy Line
Hedge
Surface Feature
Survey Extents

Symbols:

TP Telegraph Pole
LP Lamp Post
EP Electric Post
TL Traffic Light
FL Floodlight
CTV Cable TV IC
SC Stop Cock
GV Gas Valve
GU Gully
BOL Bollard
0.000 Spot Level
Post Post
Column Column
ER Earth Rod
GR Gas Riser
RWP Rain Water Pipe
RS Road Sign
SIGN Sign Post
SVP Soil Vent Pipe
RE Rodding Eye
Tap Tap
Duct Duct
SIGN Sign
Gate
STAY Stay
PIPE Pipe
EAVES EAVES Dubbing Shot
RIDGE Dubbing Ridge Shot
FFL Finished Floor Level
THL Threshold Level
SOFFIT Soffit Level
Top Of Wall Top of Wall Height
Cope Level Cope Level Height

CL 000.000 IL 000.000 Manhole
IC CL 000.000 Inspection Chamber
CATV CL 000.000 Cable TV Cover
BT CL 000.000 BT Cover
RGS 000.000 Road Gully
GU 000.000 Gully
GU 000.000 Circular Gully
RG 000.000 Circular Road Gully
SV CL 000.000 Stop Valve
WM CL 000.000 Water Meter
AV CL 000.000 Air Valve
FH CL 000.000 Fire Hydrant
GV CL 000.000 Gas Valve
Cabinet Cabinet
CL 100.000 IL 000.000 Circular Manhole
CL 100.000 IL 000.000 Triangular Manhole
Chamber Extent Chamber Extent
WSL 000.000 Water Spot Level
IL 000.000 Invert Level
Tree
EOS End of Signal
SEAT Seat
Tree Stump Tree Stump
BORE HOLE Bore Hole
CKS1 E=000000.000 N=000000.000 Level=00.000 Station Control Details

Approximate National Grid North

Job Title
Shepley
Huddersfield
HD8 8EZ

Client Name
BANKS Group

Drawing Title
Topographical Survey

Scale: NTS @ A1	Surveyor: AH
Date: 05/03/2025	Approved: PK

Castle Keep Surveys Ltd
Unit 7
Penn Court
Peterlee
County Durham
SR8 2RR
T: 01429 895098
E: info@castlekeepsurveys.co.uk

Revision	Amendments	By	Checked

Project Number: CKS - 2250
Drawing No/Revision: OV

Castle Keep Surveys Drawing Legend

Topographical Linetypes:

- Road
- Drop Kerb
- Top of Slope
- Bottom of Slope
- Top of Bank
- Bottom of Bank
- Dubbing Line
- Dubbing Canopy
- Track
- Channel
- Kerb
- Concrete
- Footpath
- Surface Change
- Tactile Edge
- Barrier
- Chain Fence
- Metal Fence
- Post & Wire Fence
- Wooden Fence
- Overhead British Telecom
- Overhead Electric
- Wall
- Slot Drain
- ACO Drain
- Channel Drain
- Above Surface Pipe
- Verge Line
- Tree Canopy Line
- Bush Canopy Line
- Hedge
- Surface Features
- Survey Extents

Symbols:

- TP — Telegraph Pole
- LP — Lamp Post
- EP — Electric Post
- TL — Traffic Light
- FL — Floodlight
- CTV — Cable TV IC
- SC — Stop Cock
- GV — Gas Valve
- GU — Gully
- BOL — Bollard
- 0.000 — Spot Level
- Post — Post
- Column — Column
- ER — Earth Rod
- GR — Gas Riser
- RWP — Rain Water Pipe
- RS — Road Sign
- SIGN — Sign Post
- SVP — Soil Vent Pipe
- RE — Rodding Eye
- Tap — Tap
- Duct — Duct
- SIGN — Sign
- Gate — Gate
- STAY — Stay
- PIPE — Pipe
- EAVES — EAVES Dubbing Shot
- RIDGE — Dubbing Ridge Shot
- FFL — Finished Floor Level
- THL — Threshold Level
- SETT/LEVEL — Settle Level
- Top Of Wall — Top of Wall Height
- Cope Level — Cope Level Height
- Manhole — CL 000.000 / IL 000.000
- Inspection Chamber — IC CL 000.000
- Cable TV Cover — CATV CL 000.000
- BT Cover — BT CL 000.000
- Road Gully — RGS 000.000
- Gully — GU 000.000
- Circular Gully — GU 000.000
- Circular Road Gully — RGC 000.000
- Stop Valve — SV CL 000.000
- Water Meter — WM CL 000.000
- Air Valve — AV CL 000.000
- Fire Hydrant — FH CL 000.000
- Gas Valve — GV CL 000.000
- Cabinet — Cabinet
- Circular Manhole — CL 100.000 IL 000.000
- Triangular Manhole — CL 100.000 IL 000.000
- Chamber Extent — Chamber Extent
- Water Spot Level — WSL 000.000
- Invert Level — IL 000.000
- Tree — T
- End of Signal — EOS
- Seat — SEAT
- Tree Stump — Tree Stump
- Bore Hole — BORE HOLE
- Station Control Details — CK01 E=000000.000 N=000000.000 Level=00.000

Approximate National Grid North

CASTLE KEEP SURVEYS

Job Title:

Shepley
Huddersfield
HD8 8EZ

Client Name:

BANKS Group

Drawing Title:

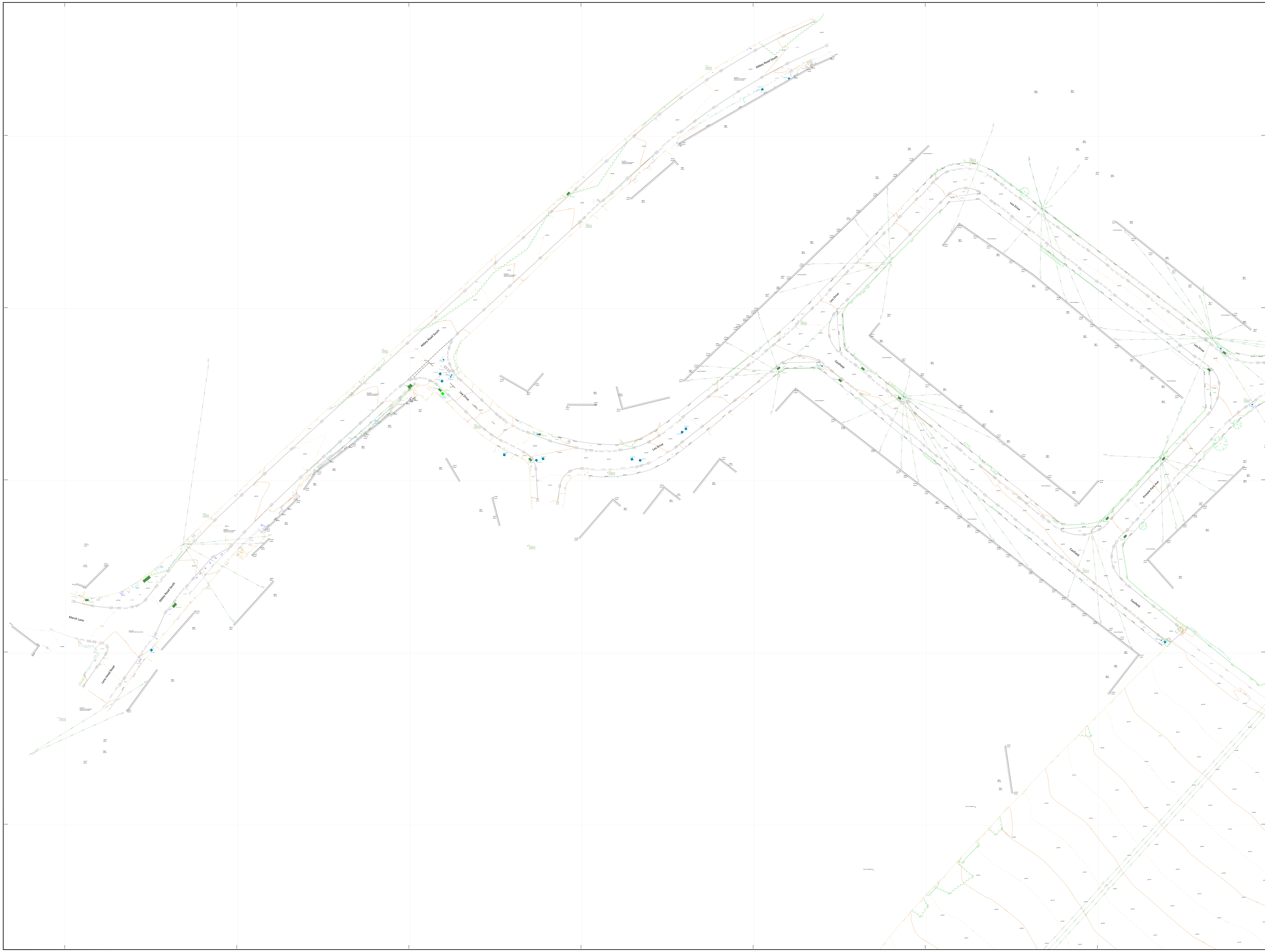
Topographical Survey

Scale	Surveyor
1:500 @ A1	AH
Date	Approved
05/03/2025	PK

Castle Keep Surveys Ltd
Unit 7
Fern Court
Peterlee
County Durham
SR5 2RR
T: 01429 895098
E: info@castlekeepsurveys.co.uk

Revision	Amendments	By	Checked

Project Number	Drawing No	Revision
CKS - 2250	001	



Castle Keep Surveys Drawing Legend

Topographical Linetypes

Symbols

Approximate National Grid North

Job Title

Shepley
Huddersfield
HD8 8EZ

Client Name

Drawing Title

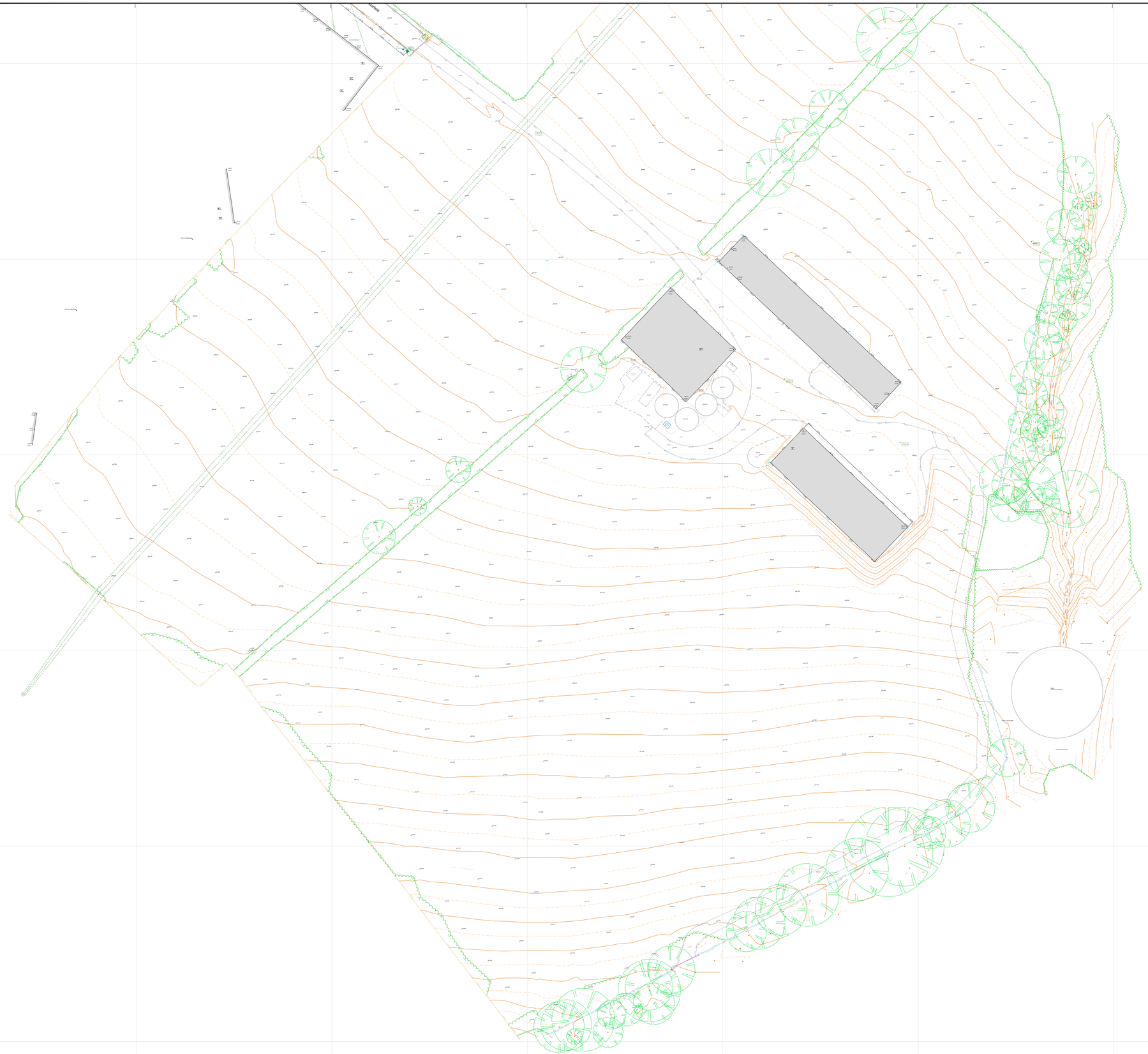
Topographical Survey

1:500 @ A1 (Scale)	AH (Surveyor)
05/03/2025 (Date)	PK (Approved)

Castle Keep Surveys Ltd
Unit 7
Fern Court
Peterlee
County Durham
SR8 2RR
T: 01429 835098
E: info@castlekeepsurveys.co.uk

Revision	Amendments	By	Checked

Project Number	Drawing No.	Revision
CKS - 2250	002	



Castle Keep Surveys Drawing Legend

Topographical Linetypes:

- Road
- Drop Kerb
- Top of Slope
- Bottom of Slope
- Top of Bank
- Bottom of Bank
- Dubbing Line
- Dubbing Canopy
- Track
- Channel
- Kerb
- Concrete
- Footpath
- Surface Change
- Tactile Edge
- Barrier
- Chain Fence
- Metal Fence
- Post & Wire Fence
- Wooden Fence
- Overhead British Telecom
- Overhead Electric
- Wall
- Slot Drain
- ACO Drain
- Channel Drain
- Above Surface Pipe
- Verge Line
- Tree Canopy Line
- Bush Canopy Line
- Hedge
- Surface Feature
- Survey Extents

Symbols:

- TP — Telegraph Pole
- LP — Lamp Post
- EP — Electric Post
- TL — Traffic Light
- FL — Floodlight
- CTV — Cable TV IC
- SC — Stop Cock
- GV — Gas Valve
- KO — Gully
- BOL — Bollard
- 0.000 — Spot Level
- Post — Post
- Column — Column
- ER — Earth Rod
- GR — Gas Riser
- RWP — Rain Water Pipe
- RS — Road Sign
- SIGN — Sign Post
- SVP — Soil Vent Pipe
- RE — Rodding Eye
- Tap — Tap
- Duct — Duct
- SIGN — Sign
- Gate — Gate
- STAY — Stay
- PIPE — Pipe
- EAVES — EAVES Dubbing Shot
- RIDGE — Dubbing Ridge Shot
- FFL — Finished Floor Level
- THL — Threshold Level
- SOFFIT Level — Soffit Level
- Top Of Wall — Top of Wall Height
- Cope Level — Cope Level Height
- CL 000.000 IL 000.000 — Manhole
- IC CL 000.000 — Inspection Chamber
- CATV CL 000.000 — Cable TV Cover
- BT CL 000.000 — BT Cover
- RGS 000.000 — Road Gully
- GO 000.000 — Gully
- CO 000.000 — Circular Gully
- RGO 000.000 — Circular Road Gully
- SV CL 000.000 — Stop Valve
- WM CL 000.000 — Water Meter
- AV CL 000.000 — Air Valve
- FH CL 000.000 — Fire Hydrant
- GV CL 000.000 — Gas Valve
- Cabinet — Cabinet
- CL 100.000 IL 000.000 — Circular Manhole
- CL 100.000 IL 000.000 — Triangular Manhole
- Chamber Extent — Chamber Extent
- WSL 000.000 — Water Spot Level
- IL 000.000 — Invert Level
- Tree — Tree
- EOS — End of Signal
- SEAT — Seat
- Tree Stump — Tree Stump
- BORE HOLE — Bore Hole
- CKS1 E=000000.000 N=000000.000 Level=00.000 — Station Control Details

Approximate National Grid North

CASTLE KEEP SURVEYS

Job Title:

Shepley
Huddersfield
HD8 8EZ

Client Name:

BANKS Group

Drawing Title:

Topographical Survey

Scale	Surveyor
1:500 @ A1	AH
Date	Approved
05/03/2025	PK

Castle Keep Surveys Ltd
Unit 7
Fern Court
Peterlee
County Durham
SR8 2RE
T: 01429 895095
E: info@castlekeepsurveys.co.uk

Revision	Amendments	By	Checked

Project Number	Drawing No/Revision
CKS - 2250	003

Appendix C
BGS Borehole Records

RECORD OF WELL (SHAFT OR BORE)

SE 10 NE/1

86/2
46

At Benjamin Armitage & Sons

Town or Village Shepley. Yorks

County ____ Six-inch quarter sheet 261 S.W.

For Mr. ____

Exact site of well Victoria Mills - as on published map. Attach a tracing from a map, or a sketch-map, if possible.
1 mile S by E of Shepley Station

Level of ground surface above sea-level (O.D.) ____ feet.

Is well-top at ground level? ____ If not, state how far above / below ____ feet.

Shaft ____ ft., diameter ____ ft. Details of headings ____

Bore 304 ft.; diameter of bore: at top 12 ins.; at bottom 10 ins.

Lengths, diameters, perforations, etc., of lining tubes 10" tubes to 14'9"

Water struck at depths, below well-top, of (feet) 280 ft.

TEST DETAILS
Month ____
Year ____

Rest-level of water 92 ft. ~~above~~ below well-top. Suction at 175 ft. Yield on 3 ~~hours~~ days' pumping 300 gallons per hour (max. capacity of pump 300 g.p.h.), with depression of 60 feet. Recovery to 92 ft in ½ ~~mins.~~ hours.

WORKING CONDITIONS

Rest-level of water in ____ (month), ____ (year), ____ ft. above / below well-top.

Highest " in ____ (month), ____ (year), ____ ft. above / below "

Lowest " in ____ (month), ____ (year), ____ ft. above / below "

Suction at ____ ft. Rate of pumping ____ galls. per ____ for ____ hours per day.

with average depression of ____ ft. Recovery to ____ in ____ mins. / hours

Quality of water (*attach copy of analysis if available*) ____

Well made by Thos. Matthews, Pendleton Date of well Dec 1937

Information from " " "

ADDITIONAL NOTES.

Visited & sited on Yorks 261 S.W. O.D+625. Only used when there is insufficient surface water. - Then used to supply Benjamin Armitage & W. & Armitage Mills. No further details of yield.
JHY
27.9.99.

LOG OF STRATA OVERLEAF.

GEOLOGICAL SURVEY AND MUSEUM,
SOUTH KENSINGTON,
LONDON, S.W.7.

Date received.	G.S.M. Office File No.	1" N.S. Map No.	1" O.S. Map No.	Site marked (use symbol) on 1" Map.	on 6" Map.

(17208) Wt.42901/0877 10,000 2/41 A.& E.W.Ltd. Gp.686

(For Survey use only) Geological Classification	NATURE OF STRATA If measurements start below ground surface, state how far... 3	Thickness Feet	Thickness Inches	Depth Feet	Depth Inches	Metres
	Stony ground (Sump			2	–	0·61
	Grey sandst. with vertical splits and clay partings. Soft yellow					
	Sandstone down one side of core	32	6	34	6	10·52
	Yellow grey rock	4		38	6	11·73
	Grey rock	2	6	41	–	12·5 m.
	Thin COAL			41	–	"
	Grey rock	8	6	49	6	15·09
	Blue hrd with ¼" Coal seam	8	6	58	–	17·68
	Black shale	36	–	94	–	28·65
	Mussels			94		"
	Dark grey hrd	4		98	–	29·87
	Fossils, "vegatable"	5	6	103	6	31·55
	Dark grey hrd & rock	7	–	110	6	33·68
	Thin coal			110	6	"
	Fireclay	4	–			
	Light grey hrd	2		116		35·36
		8		124	–	37·80
	Grey hrd with ("Vegatable") fossils	5		129		39·32
	" " "	11		140		42·67
	Rock	2		142		43·28
	Dark grey rock mid V. splits.	12		154		46·94
	Dark grey rock	5		159		48·46
	Grey rock with black partings	11		170		51·82
	Grey hrd	34		204		62·18
	Grey rock	52		256		78·03
	Grey quitstone	4		260		79·25
	Grey hrd w. vertical split.	28		278		84·73
	Brown stone	2		280		85·34
	Grey hrd	3	6	283	6	86·41
	Grey Sandy Shale	13	6	296	–	90·22
	Grey hrd	8		304		92·66
	Water lost at 286'0" came back					
	" " " 300					

3

RECORD OF WELL (SHAFT OR BORE)

SE 10 NE 1

86/46

At Messrs. Benjamin Armitage & Son Ltd., Shipley.

Town or Village ____ County Yorks.

Exact site ____

____ in parish of ____

Level of ground surface above sea-level (O.D.) ____ ft. If well starts below ground surface, state how far ____ ft.

Shaft ____ ft., diameter ____ ft. Bore ____ ft. Diameter of bore: at top 11½ ins.; at bottom 9¾ ins.

Details of permanent lining tubes (internal diameters preferred) ____

Water struck at depths of (feet) ____

Rest-level of water below / above top of well ____ feet. Suction at ____ feet. Yield on ____ hours' / days' test ____ gallons per ____ (with pump of capacity ____ g.p.h.); depressing water level to ____ feet below top. Time of recovery ____ hrs. Amount normally pumped daily ____ g.p.h. for ____ hours.

Quality (attach copy of analysis if available) ____

Sunk by Messrs. T. Matthews for Messrs. Benjamin Armitage Date of well 1937

Information from Messrs. Thomas Matthews, Pendleton, Manchester.

(For Survey use only). GEOLOGICAL CLASSIFICATION.	NATURE OF STRATA (and any additional remarks).	THICKNESS Feet.	THICKNESS Inches. (Metres)	DEPTH Feet.	DEPTH Inches.
	Stony ground		0·61	2	-
	Grey sandstone		10·52	34	6
	Yellow grey rock		11·73	38	6
	Grey rock with thin coal at 41 ft.		14·33	47	-
	Blue bind		17·68	58	-
	Black shale		28·35	93	-
	Dark grey bind with muscles at 94 ft.		33·68	110	6
	Blue grey rock		37·80	124	-
	Grey bind		46·94	154	-
	Grey rock		51·82	170	-
	Grey bind		64·67	211	6
	Grey rock		77·11	253	-
	Grey bind		78·03	256	-
	Grey gritstone		79·40	260	6
	Grey bind		84·73	278	-
	Brown stone		85·34	280	-
	Grey bind		86·41	283	6
	Grey sandy shale		90·22	296	-
	Grey bind		92·66	304	-

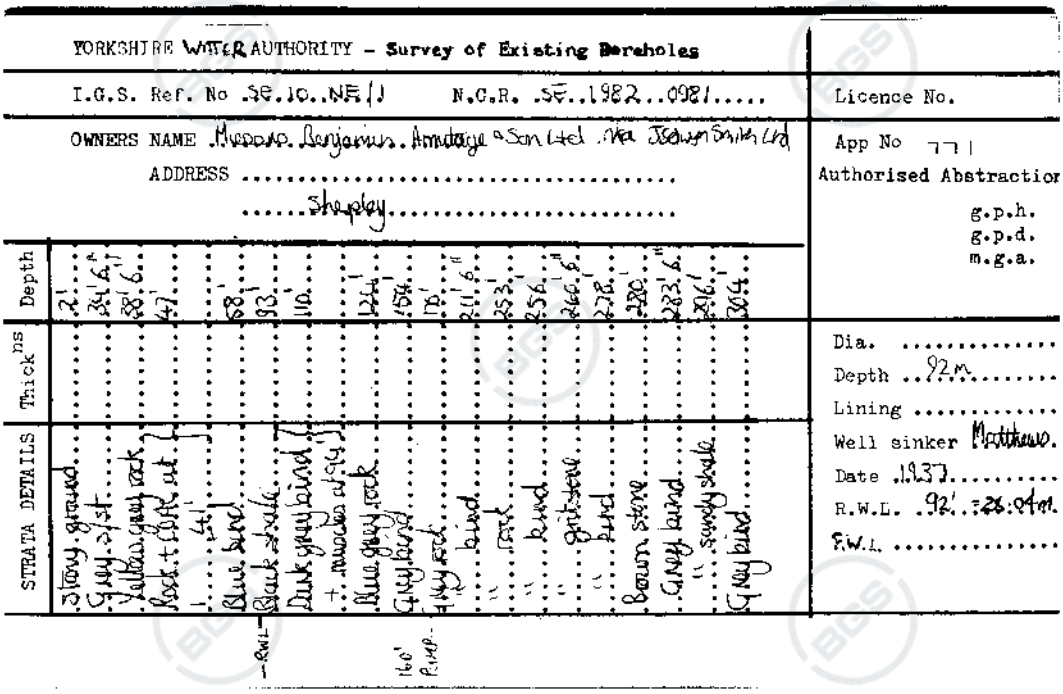
Duplicate of 86/46.

GEOLOGICAL SURVEY AND MUSEUM, SOUTH KENSINGTON, LONDON, S.W.7.

For Survey use only

Date received	G.S.M. Office File No.	Site marked on 1" map (use symbol)

(7908) WL36064/0349 5,000 12/38 A.&E.W.Ltd. Gp.484



YORKSHIRE WATER AUTHORITY – Survey of Existing Boreholes

I.G.S. Ref. No SE.10..NE/1 N.C.R. SE..1982..0981.....

Licence No.

OWNERS NAME Messrs. Benjamin Armitage & Son Ltd. Now Joseph Smith Ltd

App No 771

ADDRESS .....
.....Shipley.....

Authorised Abstraction
g.p.h.
g.p.d.
m.g.a.

Depth	Thicks	STRATA DETAILS
21'		Stony ground
24' 6"		Grey s/st
38' 6"		Yellow grey rock
47'		Rock + Coal out.
54'		
68'		Blue bind
93'		Black shale
110'		Dark grey bind
		+ minerals at 94'
124'		Blue grey rock
154'		Grey bind
175'		Grey rock
211' 6"		Grey bind
253'		" rock
256'		" bind
266' 6"		" gritstone
272'		" bind
280'		Beam stone
283' 6"		Grey bind
296'		" sandy shale
304'		Grey bind

—SWL—

160' P.W.L.

Dia. .....
Depth ..92m.....
Lining .....
Well sinker Matthews.
Date 1937.....
R.W.L. .92'..=26.01m.
F.W.L. .....

INSPECTION REPORT	WATER QUALITY	DATE OF INSPECTION:-
Present Owner:-	Date	Other Comments:-
Access (Yes or No)	pH	
½" Probe	Total hard	
3" Instruments	Temp.hard	
Landrover	Alk.	
Access Agreed	Ca	
	Mg	
	Na	
	K	Sketch Plan of Location
Water Level at time of insp.	HCO_3	
..... metres below	SO_4	
Date	Cl	
Datum above O.D.	NO_3	
R.W.L. above O.D.	Fe	
Date		

RECORD OF WELL (SHAFT OR BORE)

SE1981 0984

8/86 SE10/5 /46 SE10 NE/1

At Benjamin Armitage & Sons

Town or Village Shepley. Yorks

County Six-inch quarter sheet 261 S.W.

For Mr.

Exact site of well Victoria Mills - as on published map. Attach a tracing from a map, or a sketch-map, if possible.
Centre 5 by E of Shepley Station

Level of ground surface above sea-level (O.D.) feet.

Is well-top at ground level? If not, state how far above / below ; feet.

Shaft ft., diameter ft. Details of headings

Bore 304 ft. ; diameter of bore : at top 12 ins. ; at bottom 10 ins.

Lengths, diameters, perforations, etc., of lining tubes 10" tubes to 14'9"

Water struck at depths, below well-top, of (feet) 280 ft.

TEST DETAILS
Month
Year

Rest-level of water 92 ft. above / below well-top. Suction at 175 ft. Yield on 3 days
pumping 300 gallons per hour (max. capacity of pump 300 g.p.h.),
with depression of 60 feet. Recovery to 92 ft in ½ mins. / hours.

WORKING CONDITIONS

Rest-level of water in (month), (year), ft. above / below well-top.
Highest " in (month), (year), ft. above / below "
Lowest " in (month), (year), ft. above / below "
Suction at ft. Rate of pumping galls. per for hours per day.
with average depression of ft. Recovery to in mins. / hours

Quality of water (*attach copy of analysis if available*)

Well made by Thos. Mathews, Pindleton Date of well Dec 1937

Information from " " "

ADDITIONAL NOTES.

Visited & sited on York 261 SW. O.D. 625 Only used when there is insufficient surface water. - Then used to supply Benjamin Armitage & Co. & Armitage bath. No further details of yield. JKF 27.9.49.

LOG OF STRATA OVERLEAF.

GEOLOGICAL SURVEY AND MUSEUM,
SOUTH KENSINGTON,
LONDON, S.W.7.

Date received.	G.S.M. Office File No.	1" N.S. Map No.	1" O.S. Map No.	Site marked (see symbol) on 1" Map.	on 6" Map.

(17906) Wt.42901/0877 10,000 2/41 A.& R.W.Ltd. Gp.666

(For Survey use only) GEOLOGICAL CLASSIFICATION

NATURE OF STRATA If measurements start below ground surface, state how far...	THICKNESS Feet	THICKNESS inches	DEPTH Feet	DEPTH inches
Stony ground (Sump.			2	-
Grey sandst. with vertical splits and clay partings. Soft yellow				
Sandstone drawn one side of core	32	6	34	6
Yellow grey rock	4		38	6
Grey rock	2	6	41	-
Thin COAL			41	-
Grey rock	8	6	49	6
Blue hard with ¼" Coal seam	8	6	58	-
Black shale	36	-	94	-
Mussels			94	
Dark grey hard	4		98	-
Fossils, "vegetable"	5	6	103	6
Dark grey hard & rock	7	-	110	6
Thin coal			110	6
Fireclay	4	-		
Light grey hard	2		116	
	8		124	-
Grey hard with ("vegetable") fossils	5		129	
" " "	11		140	
Rock	2		142	
Dark grey rock with V. splits.	12		154	
Dark grey rock	5		159	
Grey rock with black partings	11		170	
Grey hard	34		204	
Grey rock	52		256	
Grey gritstone	4		260	
Grey hard w. vertical splits.	28		278	
Bearn stone	2		280	
Grey hard	3	6	283	6
Grey Sandy shale	13	6	296	-
Grey hard	8		304	
Water lost at 286'0". cased back " " " 300				

SE 10 15 E.S.D. 86/44

77

SE10/22

FORM WR-38

CENTRAL LS NORTHEAST EA (Please type) (No 2)

National Rivers Authority

..... Region

BOREHOLE RECORD

NRA No. B1107

SE10 NE/20

A. SITE DETAILS

Borehole drilled for	EASTFIELD MILLS -
Location	SHEPLEY - HUDDERSFIELD
NGR (8 fig.)	SE 1984 0977 — Please attach site plan
Ground Level (if known) ..	
Drilling Company	M & D DRILLING Co. LTD.
Date of drilling	Commenced: DEC- 99 Completed: 14-1-00

B. CONSTRUCTION DETAILS

Borehole datum (if not ground level)..... G.L. above / m below GL
(point from which all measurements of depth are taken eg flange, edge of chamber, etc)

Borehole drilled diameter ..... 368 mm from 0 to 18·00 m/depth

200 mm from 18 to 72·50 m/depth

_____ mm from _____ to _____ m/depth

Casing material STEEL and type (eg plain steel, plastic slotted) diameter 200 mm from 0 to 18·00 m/depth

_____ diameter _____ mm from _____ to _____ m/depth

_____ diameter _____ mm from _____ to _____ m/depth

_____ diameter _____ mm from _____ to _____ m/depth

Grouting details ..... ANNULUS GROUTED

Water struck at ..... 50·00 m (depth below datum - mbd)

62·00 m (depth below datum - mbd)

Rest water Level on completion ..... 36·00 mbd

C. TEST PUMPING SUMMARY (Please supply full details on Forms WR-89)

Test Pumping Datum (if different from borehole datum) _____ above / m below borehole datum (mbd)

Pump Suction Depth ..... _____ mbd

Water Level (Start of Test) ..... _____ mbd

Water Level (End of Test) ..... _____ mbd

Pumping rate ..... _____ m^3/d : l/s

for _____ days/hours

Recovery to ..... mbd in _____ mins : hrs : days
(from end of pumping)

Date(s) of measurements ..... _____

Please Supply Chemical Analysis If Available

NOT CARRIED OUT TO DATE

Forms/85

SE10/22

FORM WR-38 (cont.)

(Please type)

NRA No.

D. STRATA LOG

Geological Classification (BGS only)	Description of strata	Thickness m	Depth m
	FILL	2.00	2.00
	SANDSTONE BROWN	15.00	17.00
	BLACK SHALE	12.80	29.80
	SANDSTONE GREY	6.70	36.50
	GREY MUDSTONE SANDSTONE BANDS.	13.30	49.80
	SANDSTONE GREY	22.70	72.50

[continue on separate page if necessary]

Other Comments (eg gas encountered, saline water intercepted, etc)

FOR OFFICIAL USE ONLY

FILE ..... CONSENT NO ..... BGS REF NO .....

LICENCE NO ..... USE OF BH ..... NGR .....

Forms/85

British Geological Survey

HYDROGEOLOGY RESEARCH GROUP

77

SE10/21

Form WR-38 (BGS)

BOREHOLE RECORD

(No. 1) B1107

CENTRAL LS NORTHEAST EA SE10NE (21)

A SITE DETAILS	
Borehole drilled for	EASTFIELD MILLS
Location	SHEPLEY - HUDDERSFIELD
NGR (8 fig.)	SE 1977 0983 — Please attach site plan
Ground Level (if known)	
Drilling Company	M & D DRILLING CO. LTD.
Date of Drilling	Commenced DEC. 99 Completed 14-1-00

B CONSTRUCTION DETAILS

Borehole Datum (if not ground level) G.L. above / m below GL

(point from which all measurements of depth are taken e.g. flange, edge of chamber, etc.)

Borehole drilled diameter	368 mm	from	0	to	18.50 m/depth
	200 mm	from	18.5	to	83.00 m/depth
	____ mm	from	____	to	____ m/depth
Casing material STEEL diameter and type (e.g. if plain steel, plastic slotted)	200 mm	from	0	to	18.50 m/depth
____ diameter	____ mm	from	____	to	____ m/depth
____ diameter	____ mm	from	____	to	____ m/depth
____ diameter	____ mm	from	____	to	____ m/depth

Grouting details: ANNULUS GROUTED

Water struck at: 46.00 m (depth below datum — mbd)

71.00 m (depth below datum — mbd)

Rest water level on completion: 37.00 mbd

C TEST PUMPING SUMMARY (Please supply full details on Forms WR-39)

Test Pumping Datum (if different from borehole datum)	____	m	above / below borehole datum (mbd)
Pump Suction depth	____	mbd	
Water Level (Start of Test)	____	mbd	NOT Carried out
Water Level (End of Test)	____	mbd	To DATE
Pumping rate	____	m^3/d:l/s	
for	____	days/hours	
Recovery to (from end of pumping)	____ mbd	in mins: hrs: days	
Date(s) of measurements	____		

Please supply chemical Analysis if available.

NGDC ACCESSION NUMBER 36964

D STRATA LOG SE10/21

Geological Classification (BGS only)	Description of strata	Thickness m	Depth m
	FILL	0·30	0·30
	SANDSTONE BROWN	15·50	15·80
	BLACK SHALE	12·80	28·60
	SANDSTONE GREY	7·40	36·00
	GREY MUDSTONE/SANDSTONE BANDS.	12·30	48·30
	SANDSTONE GREY	28·70	77·00
	MUDSTONE GREY	6·00	83·00

(continue on separate page if necessary

Other comments (e.g. gas encountered, saline water intercepted, *etc.*)

FOR OFFICIAL USE ONLY

FILE	CONSENT NO.	NGS REF NO.
LIC NO.	PURPOSE	NRA REF NO.
DATE REC:	COPY TO:	ENTERED BY:

HYDROGEOLOGY RESEARCH GROUP

7.7

SE10/21

Form WR-38 (BGS)

BOREHOLE RECORD (No.1) B1107

CENTRAL LS NORTHEAST EA SE10NE/21

A SITE DETAILS	
Borehole drilled for	EAST FIELD MILLS
Location	SHEPLEY - HUDDERSFIELD
NGR (8 fig.)	SE 1977 0983 — Please attach site plan
Ground Level (if known)	
Drilling Company	M & D DRILLING CO. LTD.
Date of Drilling	Commenced DEC. 99 — Completed 14-1-00

B CONSTRUCTION DETAILS

Borehole Datum (if not ground level) G.L. above / m below GL

(point from which all measurements of depth are taken e.g. flange, edge of chamber, etc.)

Borehole drilled diameter	368 mm	from	0	to	18.50 m/depth
	200 mm	from	18.5	to	83.00 m/depth
	____ mm	from	____	to	____ m/depth
Casing material STEEL diameter and type (e.g. if plain steel, plastic slotted)	200 mm	from	0	to	18.50 m/depth
____ diameter	____ mm	from	____	to	____ m/depth
____ diameter	____ mm	from	____	to	____ m/depth
____ diameter	____ mm	from	____	to	____ m/depth

Grouting details ANNULUS GROUTED

Water struck at 46.00 m (depth below datum — mbd)

71.00 m (depth below datum — mbd)

Rest water level on completion 37.00 mbd

C TEST PUMPING SUMMARY (Please supply full details on Forms WR-39)

Test Pumping Datum (if different from borehole datum)	____ m	above / below borehole datum (mbd)
Pump Suction depth	____ mbd	
Water Level (Start of Test)	____ mbd	Not Carried out To DATE
Water Level (End of Test)	____ mbd	
Pumping rate	____ m^3/d:l/s	
for	____ days/hours	
Recovery to (from end of pumping) ____ mbd	in ____ mins: hrs: days	
Date(s) of measurements	____	

Please supply chemical Analysis if available.

D STRATA LOG SE10/21

Geological Classification (BGS only)	Description of strata	Thickness m	Depth m
	FILL	0.30	0.30
	SANDSTONE BROWN	15.50	15.80
	BLACK SHALE	12.80	28.60
	SANDSTONE GREY	7.40	36.00
	GREY MUDSTONE/SANDSTONE BANDS.	12.30	48.30
	SANDSTONE GREY	28.70	77.00
	MUDSTONE GREY	6.00	83.00
	(continue on separate page if necessary		

Other comments (e.g. gas encountered, saline water intercepted, etc.)

FOR OFFICIAL USE ONLY

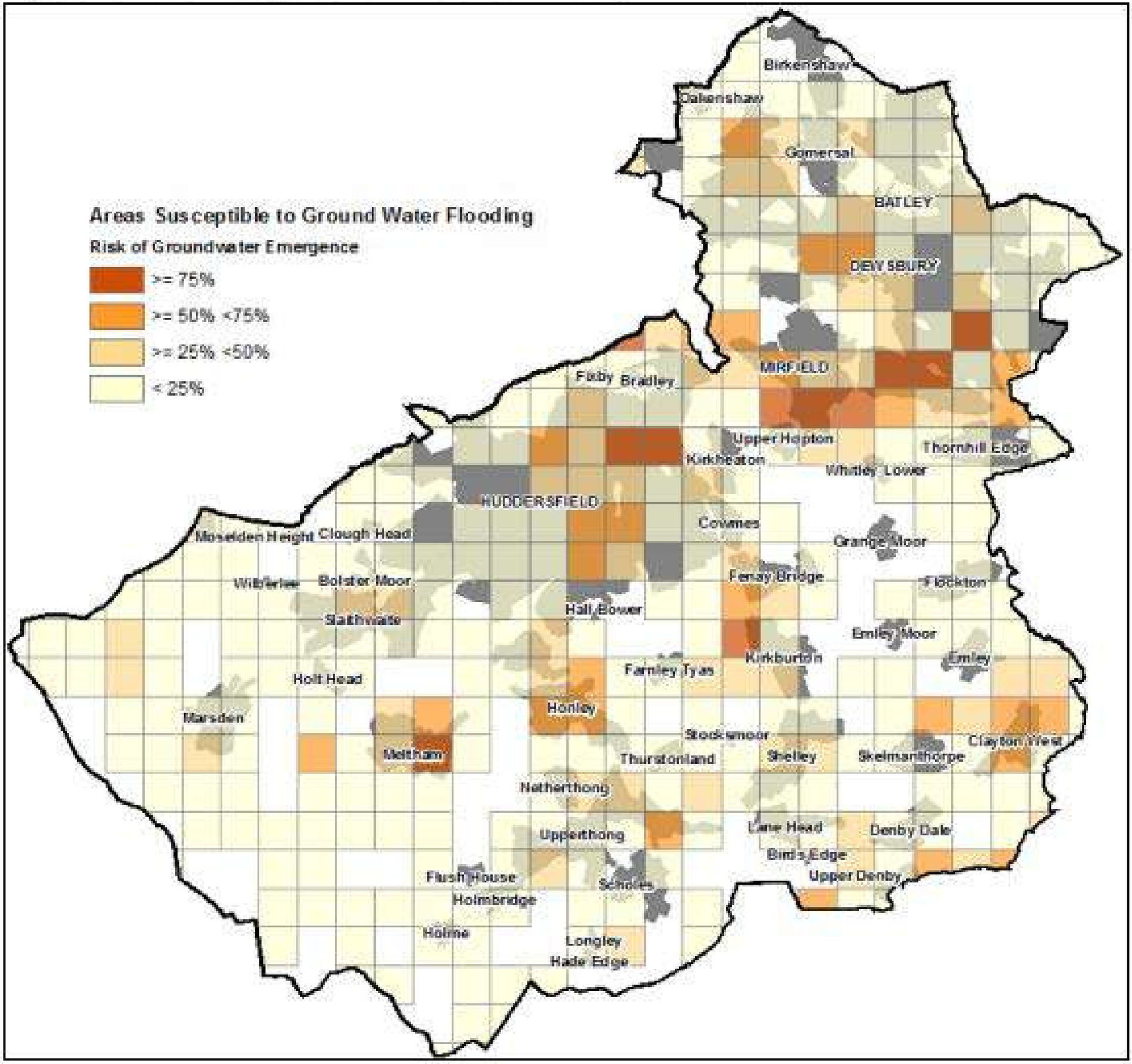
FILE ..... CONSENT NO. ..... NGS REF NO. .....

LIC NO. ..... PURPOSE ..... NRA REF NO. .....

DATE REC: COPY TO: ENTERED BY:

Appendix D
Calder Catchment Areas Susceptible to Groundwater Flooding Map

Figure 3-5: Areas Susceptible to Groundwater Flooding



Appendix E
Yorkshire Water Pre-Development Enquiry

YorkshireWater

Caitlin Shearer
Andrew Moseley Associates
15 St Pauls Street
Leeds
LS1 2JG

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

Email:
technical.sewerage@yorkshirewater.co.uk

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

Your Ref:
Our Ref: A007756

29th April 2025

Dear Caitlin Shearer,

Land off Eastfield, Shepley, HD8 8EZ - Pre-Planning Sewerage Enquiry V870855 (DOMESTIC)

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:

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

At present the sewer network does not have sufficient available capacity to support the size of development proposed. It is understood that the site is not allocated within the adopted Kirklees Local Plan and as such the site has not been considered within the current Yorkshire Water Asset Management Plan (AMP) period. Should the site come forward as part of a planning application Yorkshire Water (YWS) would likely not support the proposal.

Should the site benefit from the grant of permission, the closest practicable point of discharge for foul effluent would be the 225 mm diameter combined public sewer in Lea Drive to the north of the site.

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.

It is understood that watercourses are located around 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 - https://www.yorkshirewater.com/developers/sewerage/sewerage-connections/

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 2025/26, 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 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 reserved for specific allocated and adopted future development. 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

Chris Roberts
Town Planning Technician
Land & Property
For any Pre-Planning correspondence please email -
technical.sewerage@yorkshirewater.co.uk
For any Planning correspondence please email -
planningconsultation@yorkshirewater.co.uk

Shepley

Croft Head Farm

Croft

LYDGATE ROAD

190.8m

194.2m

197.8m

STATION ROAD

Shepley Hall

ABBEY ROAD SOUTH

LEA DRIVE

EASTFIELD

KNOWLE PARK AVENUE

ABBEY FARM DRIVE

THE KNOWLE

STONECROFT GARDENS

FIRTH STREET

Eastfield Mills

Victoria Mills

Tank

Pond

Chy

FB

PO

GP

PH

TCB

PC

Sta

Childrens Nursery

Shepley First School

Recreation Ground

Tennis Courts

Track

Posts

Play Area

Bowling Green

Shepley Methodist Church

Pond

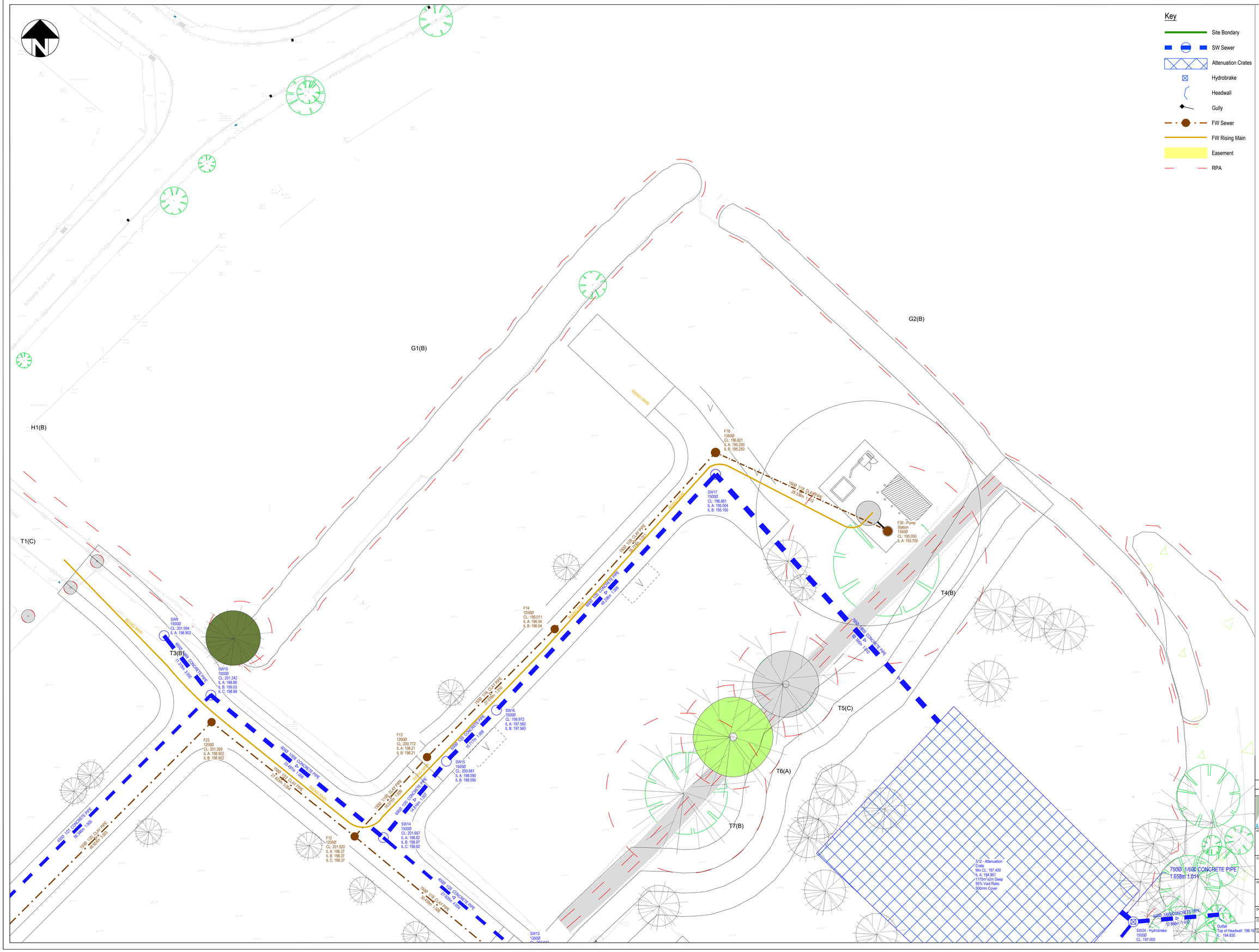
Path (um)

Issues

419524 : 409608	Map Name : SE1909SW	Title	Partial Key
Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : Contact Tel :	Notes	Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD 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 2024. All rights reserved Ordnance Survey Licence number AC0000813445	Date Req : 29/04/2025, 11:50:00	Date Gen : 29/04/2025, 11:50:31
		Source : Sewer Network Enquiry	

UPN: Originator:

Appendix F
Drainage Layout Drawing



P02	Drainage Layout revised to suit new site layout and pumping station relocated	26.09.25	CS
P01	Preliminary Issue	05.08.25	TD

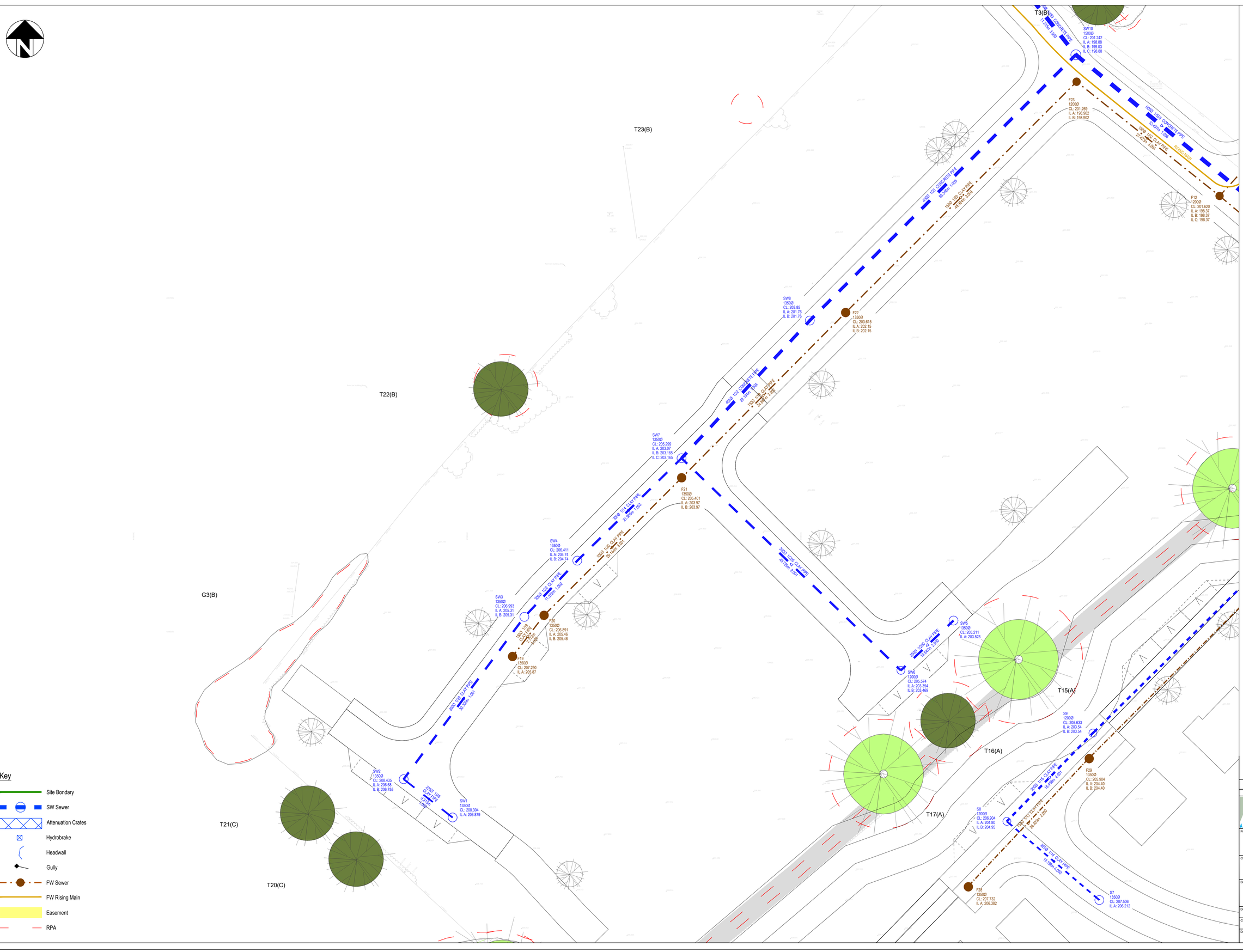
ANDREW MOSELEY ASSOCIATES
Transport & Infrastructure Consultants
15 St Paul's Street
Second Floor
Leeds
LS1 2JG
www.amaltp.co.uk

Project:
Eastfield, Shepley

Client:
BANKS GROUP

Drawing:
Engineering Feasibility
Drainage Strategy SH1

Drawn By: TD	Date: 05.08.25	
Checked: GS	Scale: 1:250	Paper: A1
Drawing No: AMA-23174-ENG-0001		Rev: P02



P02	Drainage Layout revised to suit new site layout and pumping station relocated	26.09.25	CS
P01	Preliminary Issue	05.08.25	TD

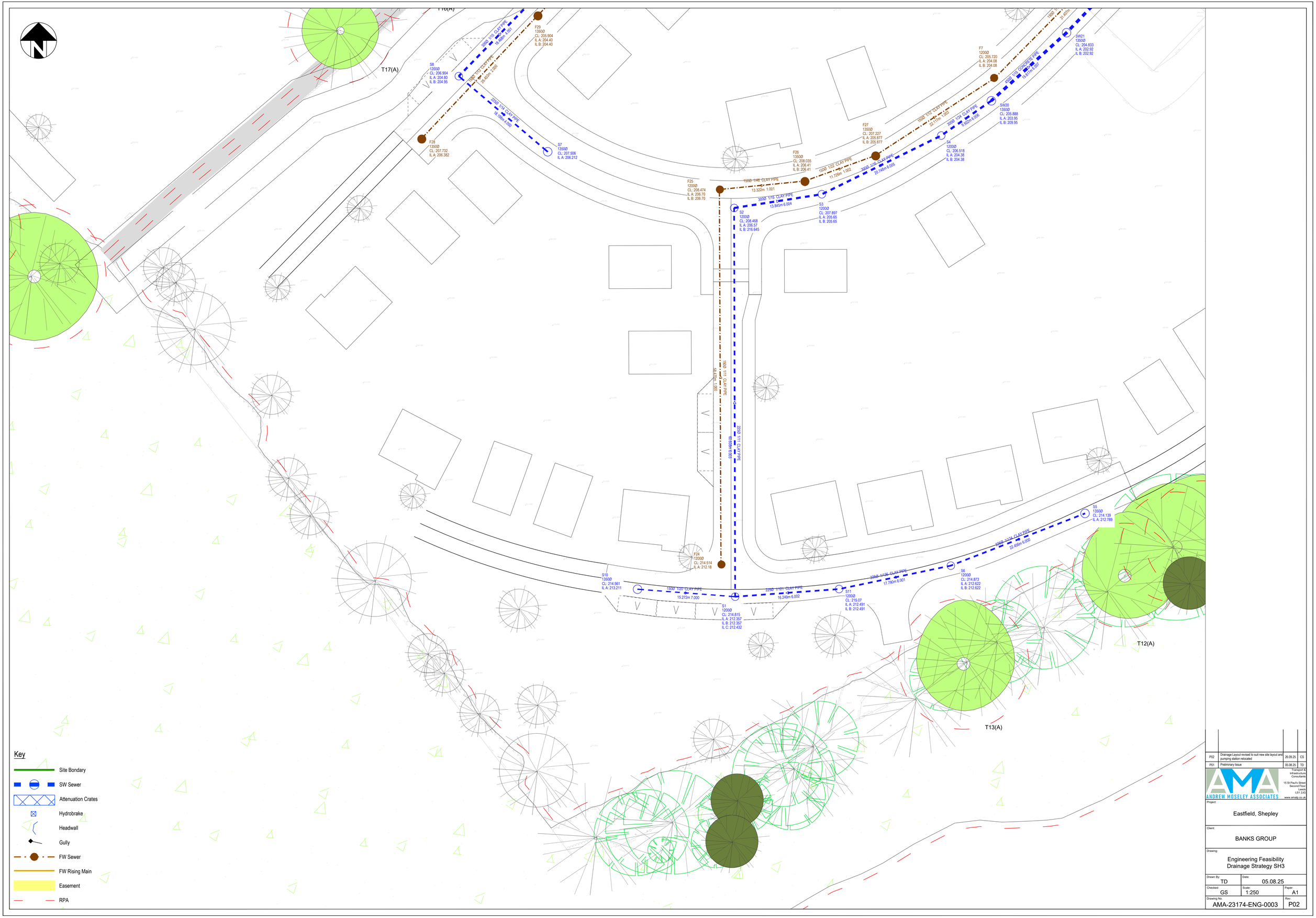
ANDREW MOSELEY ASSOCIATES
Transport & Infrastructure Consultants
15 St Paul's Street
Second Floor
Leeds
LS1 2JG
www.amaltp.co.uk

Project:
Eastfield, Shepley

Client:
BANKS GROUP

Drawing:
Engineering Feasibility
Drainage Strategy SH2

Drawn By: TD	Date: 05.08.25	
Checked: GS	Scale: 1:250	Paper: A1
Drawing No: AMA-23174-ENG-0002		Rev: P02



Key

- Site Bondary
- SW Sewer
- Attenuation Crates
- Hydrobrake
- Headwall
- Gully
- FW Sewer
- FW Rising Main
- Easement
- RPA

P02	Drainage Layout revised to suit new site layout and pumping station relocated	26.09.25	CS
P01	Preliminary Issue	05.08.25	TD

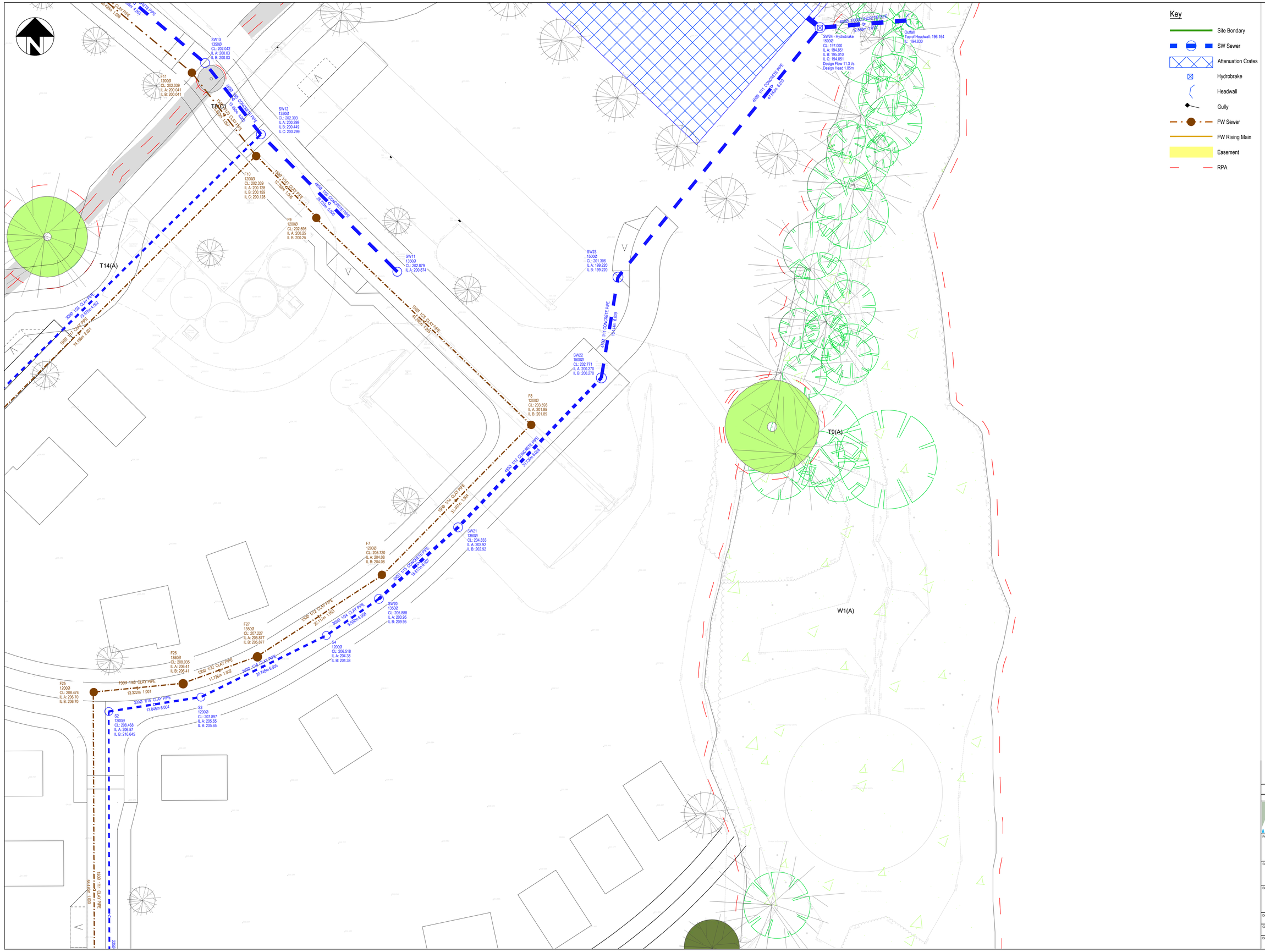
ANDREW MOSELEY ASSOCIATES
Transport & Infrastructure Consultants
15 St Paul's Street
Second Floor
Leeds
LS1 2JG
www.amaltp.co.uk

Project:
Eastfield, Shepley

Client:
BANKS GROUP

Drawing:
Engineering Feasibility
Drainage Strategy SH3

Drawn By: TD	Date: 05.08.25	
Checked: GS	Scale: 1:250	Paper: A1
Drawing No: AMA-23174-ENG-0003		Rev: P02



P02	Drainage Layout revised to suit new site layout and pumping station relocated	26.09.25	CS
P01	Preliminary Issue	05.08.25	TD

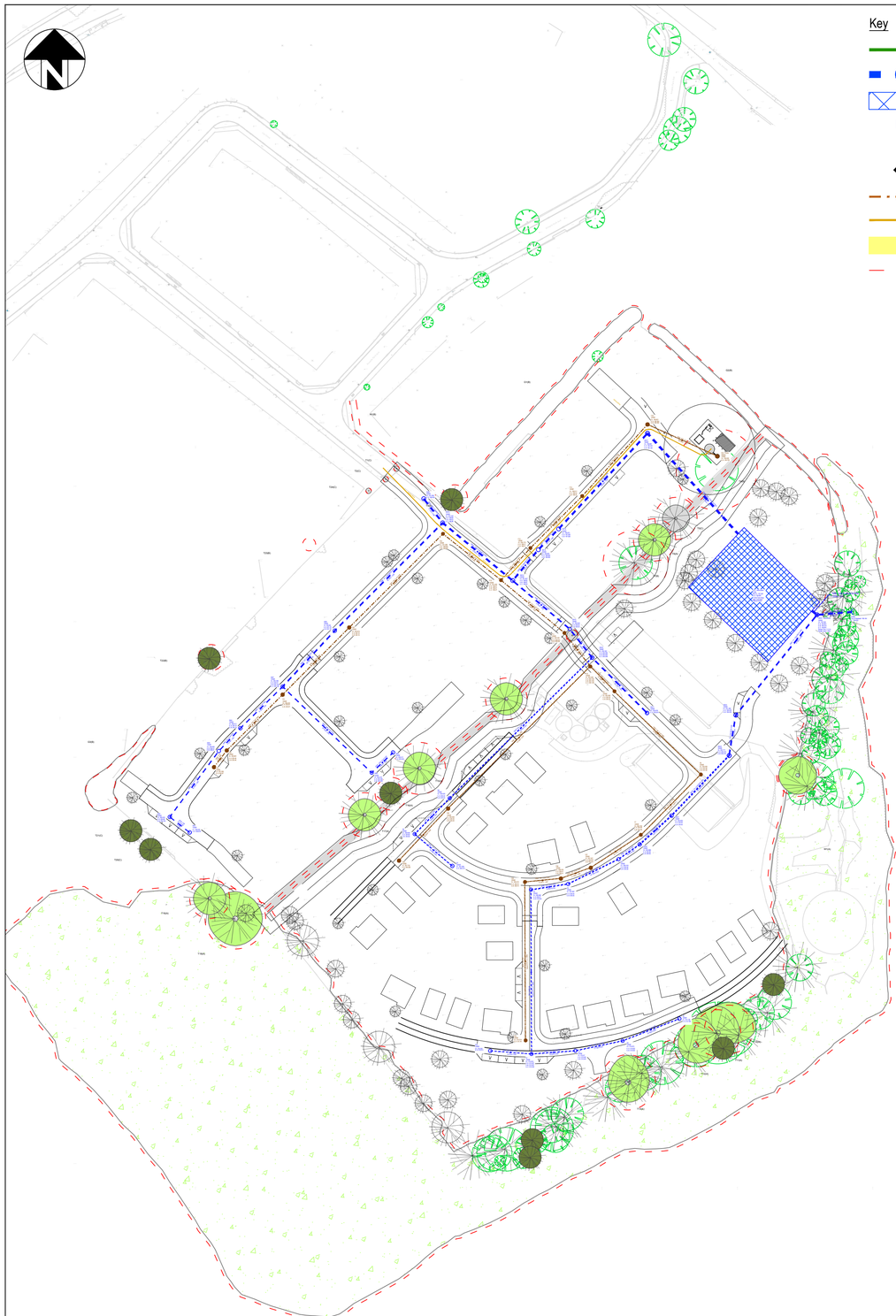
AMA
ANDREW MOSELEY ASSOCIATES
Transport & Infrastructure Consultants
15 St Paul's Street
Second Floor
Leeds
LS1 2JG
www.amaltp.co.uk

Project:
Eastfield, Shepley

Client:
BANKS GROUP

Drawing:
Engineering Feasibility
Drainage Strategy SH4

Drawn By: TD	Date: 05.08.25	
Checked: GS	Scale: 1:250	Paper: A1
Drawing No: AMA-23174-ENG-0004		Rev: P02



Drainage Strategy Layout 1:1000

Impermeable Area Plan 1:1000

Drainage Strategy

The site is currently greenfield with a total area of circa 49800m^2 (4.98Ha).

Under SuDs guidance the first point of discharge for surface water is percolation via soakaway. No testing has been undertaken at this stage to ascertain if infiltration would be an acceptable option for discharging surface water. However, the site is located within a groundwater protection zone due to its' close proximity to Shepley Spring, therefore no infiltration has been proposed

Surface Water:

Flow restriction 11.3 L/s

The proposed impermeable area is 20760m2. Based on a flow restriction of 11.3l/s and modeling using Causeway Flow software the attenuation requirement for a peak return period of 1 in 100year plus 40% climate change + 10% urban creep is approximately 2500m3.

Attenuation to be provided via TANK 1175m^{2}x2.0m DEEP. The flows will be attenuated using a Hydrobrake© ref: CTL:SHE-0141-1130-1850-1130.

The proposed outfall destination is proposed to be within the beck/watercourse to the East of the site.

Foul Water:

Foul water from the proposed new site will be pumped from the Northern extent of the site back onto Eastfield Rd, to the 225mm combined public sewer in Lea Drive.

NOTES:

Route of the proposed rising main is shown indicatively, with the route and pipe size subject to detailed design.

Revised site layout provided did not include plots, driveways and private roads in DWG format. Contributing impermeable areas have therefore been assumed from the indicative PDF plot positions. Once received, due diligence should be undertaken to review and re-assess the contributing areas within the surface water network.

P02	Drainage Layout revised to suit new site layout and pumping station relocated	26.09.25	CS
P01	Preliminary Issue	05.08.25	TD

ANDREW MOSELEY ASSOCIATES
Transport & Infrastructure Consultants
15 St Paul's Street
Second Floor
Leeds
LS1 2JG
www.amaltp.co.uk

Project:
Eastfield, Shepley

Client:
BANKS GROUP

Drawing:
Engineering Feasibility
Drainage Strategy Full Site

Drawn By: TD	Date: 05.08.25	
Checked: GS	Scale: 1:1000	Paper: A1
Drawing No: AMA-23174-ENG-0005		Rev: P02

Appendix G
UK SuDS Greenfield Run-Off Rates

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

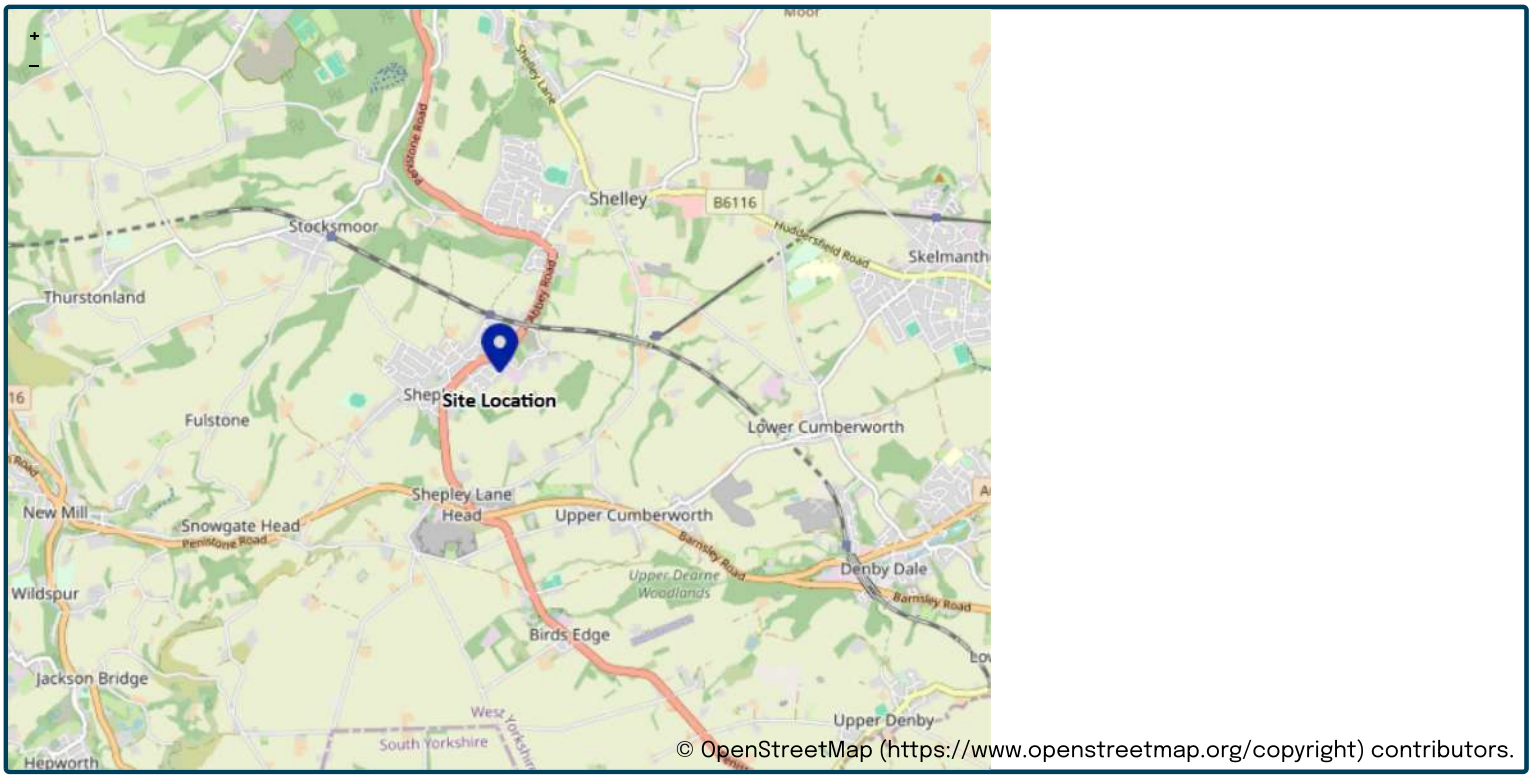
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015).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

Project details

Date	11/08/2025
Calculated by	Jasmine Ellenor
Reference	23174
Model version	2.1.2

Location

Site name	Eastfield
Site location	Shepley



Site easting (British National Grid)	419712
Site northing (British National Grid)	409667

Site details

Total site area (ha)	5.0231 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value		Map value
SAAR (mm)	950 mm		950
How should SPR be derived?	WRAP soil type		
WRAP soil type	2		2
SPR	0.3		
QBar (IH124) (l/s)	13.09 l/s		

Growth curve factors

	My value		Map value
Hydrological region	3		3
1 year growth factor	0.86		
2 year growth factor	0.94		
10 year growth factor	1.45		
30 year growth factor	1.75		
100 year growth factor	2.08		
200 year growth factor	2.37		

Results

Method	IH124
Flow rate 1 year (l/s)	11.3 l/s
Flow rate 2 year (l/s)	12.3 l/s
Flow rate 10 years (l/s)	19.0 l/s
Flow rate 30 years (l/s)	22.9 l/s
Flow rate 100 years (l/s)	27.2 l/s
Flow rate 200 years (l/s)	31.0 l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

Appendix H
LLFA Pre App Response

Kirklees Council
Planning and Development Service
PO Box 1720
Huddersfield

Gradient of the Site	
Officer Comments – The site has a gradient of a 1in11. The site falls southwest to northeast.	

Water Features on Site
There is a watercourse recorded that runs through the middle of the site, southwest to north east, its essential for the developer to survey the culverted sections as part of a flood risk assessment including all inlets/outlets, width, depth, precise location and condition. The opening up of the culvert section should be considered as this is Kirklees Policy. Total blockage scenarios will be expected to form part of the flood risk assessment for both watercourses where they enter culvert (now and post layout design).   

Relevant Water Features Off Site
There is a pond adjacent to the eastern boundary of the site formerly listed as a reservoir on old OS maps. It is fed by a watercourse that continues adjacent to the eastern boundary flowing north and eventually joins Shepley Dike over 1km away. A culverted section up to the highway known as the Knowle.

Main River Flood Risk	Level of Risk

Kirklees Council
Planning and Development Service
PO Box 1720
Huddersfield

Flood Zone 1	X	Land assessed as having a less than 1 in 1,000 annual probabilities of river or sea flooding (<0.1%)	Low Risk
Flood Zone 2		Land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%)	Medium Risk
Flood Zone 3		Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%)	High Risk

Officer Comments:
Our data shows that the proposed site and the surrounding area is in flood zone 1. This is because the watercourses have not been modelled. An overland flow route in flood must be assumed and a clear standoff distance must be agreed with the LLFA dependent on the survey required.

Flood Vulnerability Classification – The LLFA deem this development as:	
Essential Infrastructure	
Highly Vulnerable	
More Vulnerable	X
Less Vulnerable	
Water Compatible Development	

In line with the NPPF this development is deemed appropriate in this flood zone	YES

This Development should be subject to a sequential test	A sequential test is not needed due to being in line with the Flood risk vulnerability classifications.

Surface Water Flood Risk	
1:30 Year Surface Water Flood Risk	Surface water flood risk maps show surface water flooding East of the site following the course of the watercourse along the boundary.

Kirklees Council
Planning and Development Service
PO Box 1720
Huddersfield

	
1:100 Year Surface Water Flood Risk	Surface water flood risk maps show surface water flooding within on the site, suggesting a depth of 150mm. Looking at the watercourse as it comes into the site, it may have been diverted away from its natural route and the surface water flooding suggests where water may actually go in a blockage scenario. This needs to be taken into account as a constraint on the layout. 
Off Site Surface Water Flood Risk	Surface water flood risk maps show surface water flooding West on the site, including up

	to a potential of 150mm of surface water flooding. 

Officer Comments.

The 1in30 and 1in100 year surface water flood has highlighted risk on site. The developer should understand where these risks are when designing the site lay out.

Flood Incidents on and Off Site
Officer Comments There are multiple incidents of flooding shown at The Knowle attributed to the watercourse. All incidents are pre 2010. These must be assessed as part of the FRA. We suspect that both watercourses in the immediate vicinity of the site converge at this point.

Flood Routing/Site Layout	
Preliminary Site Plan Provided	Yes

Officer Comments

During intense rainfall events drainage systems can often become blocked or overwhelmed. We expect developers to understand where the flow of water will be in these circumstances and avoid unnecessary risk to curtilage by utilised roads and open space for overland flood routing.

The masterplan mentions swales in the central section. This is where a watercourse is located and a blue/green corridor is suggested. Access road across can be permitted but we suggest that this is carefully designed to hold water back in major storm events and allow for safe overspill into the downstream network where the watercourse continues.

Kirklees Council
Planning and Development Service
PO Box 1720
Huddersfield

All on site watercourse are expected to be managed via a management company set up under section 106 of the Town and Country Planning Act.

Surface Water Management Strategy
At Kirklees Council we aim to promote sustainable drainage throughout the district. As the Lead Local Flood Authority, we expect developers to follow our drainage strategy hierarchy. • Soakaways • Watercourse • Sewer Connection Following the provided list where the first option is the most sustainable, lower options will only be considered once more sustainable options have been proven to be not feasible.

Soakaway	Officer Comments Most the site has a BGs score of 3 which means that other areas may be more suitable but a localised test ordinarily should be carried out. Further interrogation indicated shallow ground water levels and stability issues. As there are watercourses within and adjacent to the site we conclude that soakaways are not suitable for this site.
Watercourse	Officer Comments There is a watercourse that runs straight through the middle of the site and to the East of the site, its essential for the developer to survey the culvert as part of a flood risk assessment including all outlets, including the width, depth, and location and condition of piped sections of watercourses before the LLFA can approve a connection. The watercourse adjacent to the eastern boundary may prove more suitable to connect to.

Kirklees Council
Planning and Development Service
PO Box 1720
Huddersfield

Sewer Connection	Officer Comments North of the site on Eastfield there is a 150mm surface water sewer. Northwest of the site there is a 150mm combined sewer. It is unlikely that sewers will be required for surface water run offg

Kirklees Council
Planning and Development Service
PO Box 1720
Huddersfield

	Greenfield	Brownfield
Site Classification		X

Officer comments:
The site has building located on it. The existing drainage of these buildings should be assessed as part of an FRA.

Attenuation
Attenuation must store the critical 1 in 30-year storm event. Volumes generated by storms up to and including the 1 in 100 + 45% climate change critical storm also must be stored on site. Opportunities to store the additional volume in safe areas on the surface can be explored however many sites in Kirklees will be sloping and this volume may also need to be stored in an underground system. Brownfield sites are required to provide a betterment to the current discharge rate of 30%. Greenfield aspects to the site could be considered by the LLFA where there are open sections of watercourse that the land naturally drains to at 5l/s/ha. If attenuation span is greater than 1500mm and positioned under highway this is likely to preclude adoption by Kirklees Council. Please speak to our Structures department for more information. Storage in landscaped areas or non-adoptable highway is unaffected

Appendix I
Causeway Flow Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	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)	19.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.330	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)
SW1	0.068	5.00	208.304	1350	419597.512	409622.477	1.425
SW2			208.435	1350	419590.182	409628.222	1.755
SW3	0.026	5.00	206.993	1350	419608.265	409652.534	1.683
SW4	0.105	5.00	206.411	1350	419616.195	409660.958	1.671
SW5	0.018	5.00	205.211	1350	419672.565	409651.984	1.688
SW6	0.025	5.00	205.574	1200	419664.686	409644.529	2.180
SW7	0.031	5.00	205.299	1350	419631.816	409676.307	2.229
SW8	0.197	5.00	203.850	1350	419651.034	409696.935	2.090
SW9	0.145	5.00	201.094	1500	419683.905	409745.657	2.191
SW10	0.054	5.00	201.242	1500	419690.897	409736.757	2.362
S7	0.110	5.00	207.506	1350	419694.427	409610.111	1.294
S8	0.044	5.00	206.904	1200	419680.565	409621.902	2.104
S9	0.127	5.00	205.633	1200	419693.459	409635.124	2.093
SW11	0.134	5.00	202.879	1350	419766.318	409666.599	2.005
SW12	0.029	5.00	202.303	1350	419746.072	409686.987	2.004
SW13	0.071	5.00	202.042	1350	419737.786	409697.581	2.012
SW14			201.657	1500	419716.736	409715.440	2.837
SW15	0.086	5.00	200.681	1500	419726.181	409726.852	2.591
SW16	0.151	5.00	199.972	1500	419733.680	409734.508	2.412
SW17	0.042	5.00	196.881	1500	419766.496	409769.820	1.877
SW18			197.400	1800	419821.434	409708.721	2.533
S5	0.077	5.00	214.139	1350	419778.203	409553.725	1.350
S6	0.011	5.00	214.873	1200	419757.275	409545.582	2.251
S11	0.008	5.00	215.070	1200	419739.863	409541.935	2.579
S10	0.047	5.00	214.561	1350	419708.429	409541.906	1.350
S1	0.071	5.00	214.815	1200	419723.657	409540.747	2.458
S2			208.468	1200	419723.493	409601.354	1.898
S3	0.021	5.00	207.897	1200	419737.173	409603.485	2.247
S4	0.048	5.00	206.518	1200	419755.790	409612.643	2.138
SW20	0.123	5.00	205.888	1350	419763.592	409618.066	1.938
SW21	0.054	5.00	204.833	1350	419775.324	409628.675	1.913
SW22	0.152	5.00	202.771	1500	419796.595	409650.854	2.501
SW23			201.306	1500	419799.065	409665.795	2.086
SW24			197.000	1500	419829.054	409702.814	2.149
SW25			196.164	1	419841.864	409703.893	1.334

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	SW1	SW2	9.313	0.600	206.879	206.755	0.124	75.1	225	5.10	50.0
1.001	SW2	SW3	30.300	0.600	206.680	205.310	1.370	22.1	300	5.25	50.0
1.002	SW3	SW4	11.569	0.600	205.310	204.740	0.570	20.3	300	5.31	50.0
1.003	SW4	SW7	21.900	0.600	204.740	203.165	1.575	13.9	300	5.39	50.0
2.000	SW5	SW6	10.847	0.600	203.523	203.469	0.054	200.9	225	5.20	50.0
2.001	SW6	SW7	45.720	0.600	203.394	203.165	0.229	199.7	300	5.88	50.0
1.004	SW7	SW8	28.193	0.600	203.070	201.760	1.310	21.5	450	5.99	50.0
1.005	SW8	SW10	56.346	0.600	201.760	199.030	2.730	20.6	450	6.20	50.0
3.000	SW9	SW10	11.318	0.600	198.903	198.880	0.023	492.1	600	5.17	50.0
1.006	SW10	SW14	33.497	0.600	198.880	198.820	0.060	558.3	600	6.75	50.0
4.000	S7	S8	18.198	0.600	206.212	204.950	1.262	14.4	225	5.09	50.0
4.001	S8	S9	18.468	0.600	204.800	203.540	1.260	14.7	300	5.16	50.0
4.002	S9	SW12	73.878	0.600	203.540	200.449	3.091	23.9	300	5.54	50.0
5.000	SW11	SW12	28.733	0.600	200.874	200.299	0.575	50.0	450	5.17	50.0
4.003	SW12	SW13	13.450	0.600	200.299	200.030	0.269	50.0	450	5.62	50.0
4.004	SW13	SW14	27.605	0.600	200.030	198.970	1.060	26.0	450	5.74	50.0
1.007	SW14	SW15	14.814	0.600	198.820	198.090	0.730	20.3	600	6.79	50.0
1.008	SW15	SW16	10.717	0.600	198.090	197.560	0.530	20.2	600	6.82	50.0
1.009	SW16	SW17	48.206	0.600	197.560	195.160	2.400	20.1	600	6.97	50.0
1.010	SW17	SW18	82.166	0.600	195.004	194.867	0.137	599.8	750	8.18	48.8
1.011	SW18	SW24	9.641	0.600	194.867	194.851	0.016	602.6	750	8.32	48.4
6.000	S5	S6	22.456	0.600	212.789	212.622	0.167	134.5	225	5.33	50.0
6.001	S6	S11	17.790	0.600	212.622	212.491	0.131	135.8	225	5.60	50.0
6.002	S11	S1	16.249	0.600	212.491	212.357	0.134	121.3	225	5.83	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.510	60.0	12.3	1.200	1.455	0.068	0.0	69	1.194
1.001	3.357	237.3	12.3	1.455	1.383	0.068	0.0	46	1.794
1.002	3.505	247.8	17.0	1.383	1.371	0.094	0.0	53	2.040
1.003	4.237	299.5	36.0	1.371	1.834	0.199	0.0	69	2.884
2.000	0.919	36.5	3.2	1.463	1.880	0.018	0.0	45	0.571
2.001	1.109	78.4	7.8	1.880	1.834	0.043	0.0	64	0.715
1.004	4.397	699.3	49.4	1.779	1.640	0.273	0.0	80	2.577
1.005	4.490	714.1	84.9	1.640	1.762	0.470	0.0	104	3.070
3.000	1.091	308.4	26.2	1.591	1.762	0.145	0.0	117	0.676
1.006	1.023	289.3	120.9	1.762	2.237	0.669	0.0	270	0.980
4.000	3.463	137.7	19.9	1.069	1.729	0.110	0.0	58	2.485
4.001	4.127	291.7	27.8	1.804	1.793	0.154	0.0	62	2.628
4.002	3.229	228.2	50.7	1.793	1.554	0.280	0.0	96	2.616
5.000	2.881	458.2	24.3	1.555	1.554	0.134	0.0	70	1.563
4.003	2.880	458.1	80.2	1.554	1.562	0.444	0.0	126	2.185
4.004	3.996	635.5	93.0	1.562	2.237	0.515	0.0	116	2.893
1.007	5.421	1532.8	213.9	2.237	1.991	1.184	0.0	150	3.874
1.008	5.431	1535.5	229.4	1.991	1.812	1.270	0.0	155	3.955
1.009	5.449	1540.7	256.7	1.812	1.121	1.421	0.0	164	4.094
1.010	1.135	501.5	257.7	1.127	1.783	1.462	0.0	381	1.143
1.011	1.132	500.3	255.6	1.783	1.399	1.462	0.0	380	1.138
6.000	1.126	44.8	14.0	1.125	2.026	0.077	0.0	87	0.999
6.001	1.120	44.5	16.0	2.026	2.354	0.089	0.0	94	1.032
6.002	1.186	47.2	17.6	2.354	2.233	0.097	0.0	95	1.103

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
7.000	S10	S1	15.272	0.600	213.211	212.432	0.779	19.6	150	5.11	50.0
6.003	S1	S2	60.608	0.600	212.357	206.645	5.712	10.6	225	6.08	50.0
6.004	S2	S3	13.845	0.600	206.570	205.650	0.920	15.0	300	6.13	50.0
6.005	S3	S4	20.748	0.600	205.650	204.380	1.270	16.3	300	6.22	50.0
6.006	S4	SW20	9.502	0.600	204.380	204.100	0.280	33.9	300	6.28	50.0
6.007	SW20	SW21	15.817	0.600	203.950	202.920	1.030	15.4	450	6.33	50.0
6.008	SW21	SW22	30.730	0.600	202.920	200.270	2.650	11.6	450	6.42	50.0
6.009	SW22	SW23	15.144	0.600	200.270	199.220	1.050	14.4	450	6.46	50.0
6.010	SW23	SW24	47.642	0.600	199.220	195.010	4.210	11.3	450	6.59	50.0
1.012	SW24	SW25	12.855	0.600	194.851	194.830	0.021	612.1	750	8.51	47.8

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
7.000	2.285	40.4	8.5	1.200	2.233	0.047	0.0	47	1.815
6.003	4.040	160.6	39.0	2.233	1.598	0.216	0.0	75	3.345
6.004	4.073	287.9	39.0	1.598	1.947	0.216	0.0	74	2.875
6.005	3.908	276.3	42.8	1.947	1.838	0.237	0.0	79	2.865
6.006	2.708	191.4	51.5	1.838	1.488	0.285	0.0	106	2.307
6.007	5.207	828.2	73.8	1.488	1.463	0.408	0.0	90	3.281
6.008	5.995	953.4	83.6	1.463	2.051	0.462	0.0	89	3.757
6.009	5.374	854.7	111.0	2.051	1.636	0.614	0.0	109	3.760
6.010	6.068	965.1	111.0	1.636	1.540	0.614	0.0	102	4.111
1.012	1.123	496.3	359.0	1.399	0.584	2.076	0.0	474	1.218

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	9.313	75.1	225	Circular	208.304	206.879	1.200	208.435	206.755	1.455
1.001	30.300	22.1	300	Circular	208.435	206.680	1.455	206.993	205.310	1.383
1.002	11.569	20.3	300	Circular	206.993	205.310	1.383	206.411	204.740	1.371
1.003	21.900	13.9	300	Circular	206.411	204.740	1.371	205.299	203.165	1.834
2.000	10.847	200.9	225	Circular	205.211	203.523	1.463	205.574	203.469	1.880
2.001	45.720	199.7	300	Circular	205.574	203.394	1.880	205.299	203.165	1.834
1.004	28.193	21.5	450	Circular	205.299	203.070	1.779	203.850	201.760	1.640
1.005	56.346	20.6	450	Circular	203.850	201.760	1.640	201.242	199.030	1.762
3.000	11.318	492.1	600	Circular	201.094	198.903	1.591	201.242	198.880	1.762
1.006	33.497	558.3	600	Circular	201.242	198.880	1.762	201.657	198.820	2.237

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW1	1350	Manhole	Adoptable	SW2	1350	Manhole	Adoptable
1.001	SW2	1350	Manhole	Adoptable	SW3	1350	Manhole	Adoptable
1.002	SW3	1350	Manhole	Adoptable	SW4	1350	Manhole	Adoptable
1.003	SW4	1350	Manhole	Adoptable	SW7	1350	Manhole	Adoptable
2.000	SW5	1350	Manhole	Adoptable	SW6	1200	Manhole	Adoptable
2.001	SW6	1200	Manhole	Adoptable	SW7	1350	Manhole	Adoptable
1.004	SW7	1350	Manhole	Adoptable	SW8	1350	Manhole	Adoptable
1.005	SW8	1350	Manhole	Adoptable	SW10	1500	Manhole	Adoptable
3.000	SW9	1500	Manhole	Adoptable	SW10	1500	Manhole	Adoptable
1.006	SW10	1500	Manhole	Adoptable	SW14	1500	Manhole	Adoptable

Pipeline Schedule

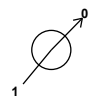
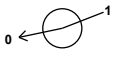
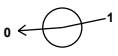
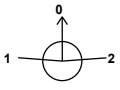
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
4.000	18.198	14.4	225	Circular	207.506	206.212	1.069	206.904	204.950	1.729
4.001	18.468	14.7	300	Circular	206.904	204.800	1.804	205.633	203.540	1.793
4.002	73.878	23.9	300	Circular	205.633	203.540	1.793	202.303	200.449	1.554
5.000	28.733	50.0	450	Circular	202.879	200.874	1.555	202.303	200.299	1.554
4.003	13.450	50.0	450	Circular	202.303	200.299	1.554	202.042	200.030	1.562
4.004	27.605	26.0	450	Circular	202.042	200.030	1.562	201.657	198.970	2.237
1.007	14.814	20.3	600	Circular	201.657	198.820	2.237	200.681	198.090	1.991
1.008	10.717	20.2	600	Circular	200.681	198.090	1.991	199.972	197.560	1.812
1.009	48.206	20.1	600	Circular	199.972	197.560	1.812	196.881	195.160	1.121
1.010	82.166	599.8	750	Circular	196.881	195.004	1.127	197.400	194.867	1.783
1.011	9.641	602.6	750	Circular	197.400	194.867	1.783	197.000	194.851	1.399
6.000	22.456	134.5	225	Circular	214.139	212.789	1.125	214.873	212.622	2.026
6.001	17.790	135.8	225	Circular	214.873	212.622	2.026	215.070	212.491	2.354
6.002	16.249	121.3	225	Circular	215.070	212.491	2.354	214.815	212.357	2.233
7.000	15.272	19.6	150	Circular	214.561	213.211	1.200	214.815	212.432	2.233
6.003	60.608	10.6	225	Circular	214.815	212.357	2.233	208.468	206.645	1.598
6.004	13.845	15.0	300	Circular	208.468	206.570	1.598	207.897	205.650	1.947
6.005	20.748	16.3	300	Circular	207.897	205.650	1.947	206.518	204.380	1.838
6.006	9.502	33.9	300	Circular	206.518	204.380	1.838	205.888	204.100	1.488
6.007	15.817	15.4	450	Circular	205.888	203.950	1.488	204.833	202.920	1.463
6.008	30.730	11.6	450	Circular	204.833	202.920	1.463	202.771	200.270	2.051
6.009	15.144	14.4	450	Circular	202.771	200.270	2.051	201.306	199.220	1.636
6.010	47.642	11.3	450	Circular	201.306	199.220	1.636	197.000	195.010	1.540
1.012	12.855	612.1	750	Circular	197.000	194.851	1.399	196.164	194.830	0.584

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
4.000	S7	1350	Manhole	Adoptable	S8	1200	Manhole	Adoptable
4.001	S8	1200	Manhole	Adoptable	S9	1200	Manhole	Adoptable
4.002	S9	1200	Manhole	Adoptable	SW12	1350	Manhole	Adoptable
5.000	SW11	1350	Manhole	Adoptable	SW12	1350	Manhole	Adoptable
4.003	SW12	1350	Manhole	Adoptable	SW13	1350	Manhole	Adoptable
4.004	SW13	1350	Manhole	Adoptable	SW14	1500	Manhole	Adoptable
1.007	SW14	1500	Manhole	Adoptable	SW15	1500	Manhole	Adoptable
1.008	SW15	1500	Manhole	Adoptable	SW16	1500	Manhole	Adoptable
1.009	SW16	1500	Manhole	Adoptable	SW17	1500	Manhole	Adoptable
1.010	SW17	1500	Manhole	Adoptable	SW18	1800	Manhole	Adoptable
1.011	SW18	1800	Manhole	Adoptable	SW24	1500	Manhole	Adoptable
6.000	S5	1350	Manhole	Adoptable	S6	1200	Manhole	Adoptable
6.001	S6	1200	Manhole	Adoptable	S11	1200	Manhole	Adoptable
6.002	S11	1200	Manhole	Adoptable	S1	1200	Manhole	Adoptable
7.000	S10	1350	Manhole	Adoptable	S1	1200	Manhole	Adoptable
6.003	S1	1200	Manhole	Adoptable	S2	1200	Manhole	Adoptable
6.004	S2	1200	Manhole	Adoptable	S3	1200	Manhole	Adoptable
6.005	S3	1200	Manhole	Adoptable	S4	1200	Manhole	Adoptable
6.006	S4	1200	Manhole	Adoptable	SW20	1350	Manhole	Adoptable
6.007	SW20	1350	Manhole	Adoptable	SW21	1350	Manhole	Adoptable
6.008	SW21	1350	Manhole	Adoptable	SW22	1500	Manhole	Adoptable
6.009	SW22	1500	Manhole	Adoptable	SW23	1500	Manhole	Adoptable
6.010	SW23	1500	Manhole	Adoptable	SW24	1500	Manhole	Adoptable
1.012	SW24	1500	Manhole	Adoptable	SW25	1	Manhole	Adoptable

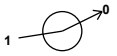
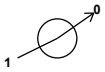
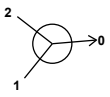
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW1	419597.512	409622.477	208.304	1.425	1350		0	1.000	206.879	225
SW2	419590.182	409628.222	208.435	1.755	1350		1	1.000	206.755	225
							0	1.001	206.680	300
SW3	419608.265	409652.534	206.993	1.683	1350		1	1.001	205.310	300
							0	1.002	205.310	300
SW4	419616.195	409660.958	206.411	1.671	1350		1	1.002	204.740	300
							0	1.003	204.740	300
SW5	419672.565	409651.984	205.211	1.688	1350		0	2.000	203.523	225
SW6	419664.686	409644.529	205.574	2.180	1200		1	2.000	203.469	225
							0	2.001	203.394	300
SW7	419631.816	409676.307	205.299	2.229	1350		1	2.001	203.165	300
							2	1.003	203.165	300
							0	1.004	203.070	450
SW8	419651.034	409696.935	203.850	2.090	1350		1	1.004	201.760	450
							0	1.005	201.760	450
SW9	419683.905	409745.657	201.094	2.191	1500		0	3.000	198.903	600
SW10	419690.897	409736.757	201.242	2.362	1500		1	3.000	198.880	600
							2	1.005	199.030	450
							0	1.006	198.880	600
S7	419694.427	409610.111	207.506	1.294	1350		0	4.000	206.212	225
S8	419680.565	409621.902	206.904	2.104	1200		1	4.000	204.950	225
							0	4.001	204.800	300
S9	419693.459	409635.124	205.633	2.093	1200		1	4.001	203.540	300
							0	4.002	203.540	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW11	419766.318	409666.599	202.879	2.005	1350		0	5.000	200.874	450
SW12	419746.072	409686.987	202.303	2.004	1350		1	5.000	200.299	450
							2	4.002	200.449	300
							0	4.003	200.299	450
SW13	419737.786	409697.581	202.042	2.012	1350		1	4.003	200.030	450
							0	4.004	200.030	450
SW14	419716.736	409715.440	201.657	2.837	1500		1	4.004	198.970	450
							2	1.006	198.820	600
							0	1.007	198.820	600
SW15	419726.181	409726.852	200.681	2.591	1500		1	1.007	198.090	600
							0	1.008	198.090	600
SW16	419733.680	409734.508	199.972	2.412	1500		1	1.008	197.560	600
							0	1.009	197.560	600
SW17	419766.496	409769.820	196.881	1.877	1500		1	1.009	195.160	600
							0	1.010	195.004	750
SW18	419821.434	409708.721	197.400	2.533	1800		1	1.010	194.867	750
							0	1.011	194.867	750
S5	419778.203	409553.725	214.139	1.350	1350		0	6.000	212.789	225
S6	419757.275	409545.582	214.873	2.251	1200		1	6.000	212.622	225
							0	6.001	212.622	225
S11	419739.863	409541.935	215.070	2.579	1200		1	6.001	212.491	225
							0	6.002	212.491	225
S10	419708.429	409541.906	214.561	1.350	1350		0	7.000	213.211	150
S1	419723.657	409540.747	214.815	2.458	1200		1	7.000	212.432	150
							2	6.002	212.357	225
							0	6.003	212.357	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S2	419723.493	409601.354	208.468	1.898	1200	1	6.003	206.645	225
									
						0	6.004	206.570	300
S3	419737.173	409603.485	207.897	2.247	1200	1	6.004	205.650	300
									
						0	6.005	205.650	300
S4	419755.790	409612.643	206.518	2.138	1200	1	6.005	204.380	300
									
						0	6.006	204.380	300
SW20	419763.592	409618.066	205.888	1.938	1350	1	6.006	204.100	300
									
						0	6.007	203.950	450
SW21	419775.324	409628.675	204.833	1.913	1350	1	6.007	202.920	450
									
						0	6.008	202.920	450
SW22	419796.595	409650.854	202.771	2.501	1500	1	6.008	200.270	450
									
						0	6.009	200.270	450
SW23	419799.065	409665.795	201.306	2.086	1500	1	6.009	199.220	450
									
						0	6.010	199.220	450
SW24	419829.054	409702.814	197.000	2.149	1500	1	6.010	195.010	450
						2	1.011	194.851	750
									
						0	1.012	194.851	750
SW25	419841.864	409703.893	196.164	1.334	1	1	1.012	194.830	750
									

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	19.000	Drain Down Time (mins)	240
Ratio-R	0.330	Additional Storage (m³/ha)	0.0
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 %)
100	40	0	0

Node SW24 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	194.851	Product Number	CTL-SHE-0147-1130-1500-1130
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	11.3	Min Node Diameter (mm)	1500

Node SW18 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	194.867
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1173.8	0.0	2.000	1175.2	0.0	2.001	0.0	0.0

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	10	207.053	0.174	47.8	0.2496	0.0000	OK
15 minute summer	SW2	10	206.770	0.090	47.4	0.1290	0.0000	OK
15 minute summer	SW3	10	205.420	0.110	65.8	0.1579	0.0000	OK
15 minute summer	SW4	10	204.897	0.157	139.4	0.2241	0.0000	OK
15 minute summer	SW5	10	203.619	0.096	12.5	0.1371	0.0000	OK
15 minute summer	SW6	11	203.524	0.130	30.1	0.1474	0.0000	OK
15 minute summer	SW7	10	203.233	0.163	189.6	0.2330	0.0000	OK
15 minute summer	SW8	10	201.970	0.210	327.5	0.2999	0.0000	OK
15 minute summer	SW9	11	199.503	0.600	102.3	1.0601	0.0000	OK
15 minute summer	SW10	11	199.498	0.618	461.6	1.0921	0.0000	SURCHARGED
15 minute summer	S7	10	206.344	0.131	77.6	0.1882	0.0000	OK
15 minute summer	S8	10	204.925	0.125	108.0	0.1416	0.0000	OK
15 minute summer	S9	10	203.762	0.221	197.0	0.2505	0.0000	OK
15 minute summer	SW11	10	201.010	0.136	94.7	0.1952	0.0000	OK
15 minute summer	SW12	10	200.631	0.332	308.0	0.4752	0.0000	OK
15 minute summer	SW13	10	200.300	0.270	355.9	0.3861	0.0000	OK
15 minute summer	SW14	11	199.223	0.403	813.9	0.7118	0.0000	OK
15 minute summer	SW15	11	198.549	0.459	875.9	0.8107	0.0000	OK
15 minute summer	SW16	11	197.943	0.383	979.5	0.6768	0.0000	OK
960 minute winter	SW17	930	196.497	1.493	73.5	2.6378	0.0000	SURCHARGED
960 minute winter	SW18	930	196.497	1.630	92.4	1822.4590	0.0000	SURCHARGED
15 minute summer	S5	11	213.446	0.657	54.5	0.9402	0.0000	SURCHARGED
15 minute summer	S6	11	213.170	0.548	59.5	0.6196	0.0000	SURCHARGED
15 minute summer	S11	11	212.871	0.380	64.9	0.4300	0.0000	SURCHARGED
15 minute summer	S10	10	213.324	0.113	33.2	0.1623	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	47.4	1.552	0.790	0.2840	
15 minute summer	SW2	1.001	SW3	47.2	2.293	0.199	0.6253	
15 minute summer	SW3	1.002	SW4	65.4	2.168	0.264	0.3510	
15 minute summer	SW4	1.003	SW7	138.7	3.961	0.463	0.7670	
15 minute summer	SW5	2.000	SW6	12.3	0.803	0.338	0.1667	
15 minute summer	SW6	2.001	SW7	29.6	1.031	0.378	1.3141	
15 minute summer	SW7	1.004	SW8	189.0	3.059	0.270	1.7483	
15 minute summer	SW8	1.005	SW10	325.5	3.147	0.456	6.4997	
15 minute summer	SW9	3.000	SW10	98.9	0.426	0.321	3.1868	
15 minute summer	SW10	1.006	SW14	460.5	1.856	1.592	8.0868	
15 minute summer	S7	4.000	S8	77.2	3.390	0.561	0.4145	
15 minute summer	S8	4.001	S9	107.8	2.583	0.370	0.7719	
15 minute summer	S9	4.002	SW12	193.4	3.584	0.848	3.9986	
15 minute summer	SW11	5.000	SW12	94.3	1.150	0.206	2.3838	
15 minute summer	SW12	4.003	SW13	305.9	2.740	0.668	1.5105	
15 minute summer	SW13	4.004	SW14	354.7	3.783	0.558	2.6125	
15 minute summer	SW14	1.007	SW15	818.3	3.779	0.534	3.2028	
15 minute summer	SW15	1.008	SW16	878.0	4.250	0.572	2.2566	
15 minute summer	SW16	1.009	SW17	985.2	3.789	0.639	11.3661	
960 minute winter	SW17	1.010	SW18	72.4	0.837	0.144	36.1630	
960 minute winter	SW18	1.011	SW24	-20.0	-0.321	-0.040	4.2432	
15 minute summer	S5	6.000	S6	51.8	1.302	1.157	0.8931	
15 minute summer	S6	6.001	S11	59.2	1.488	1.329	0.7075	
15 minute summer	S11	6.002	S1	64.6	1.667	1.369	0.5917	
15 minute summer	S10	7.000	S1	32.9	2.421	0.815	0.2075	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1	11	212.532	0.175	144.5	0.1974	0.0000	OK
15 minute summer	S2	11	206.739	0.169	144.9	0.1912	0.0000	OK
15 minute summer	S3	11	205.824	0.174	159.3	0.1963	0.0000	OK
15 minute summer	S4	11	204.862	0.482	191.0	0.5453	0.0000	SURCHARGED
15 minute summer	SW20	10	204.155	0.205	271.0	0.2929	0.0000	OK
15 minute summer	SW21	11	203.093	0.173	307.0	0.2477	0.0000	OK
15 minute summer	SW22	11	200.542	0.272	412.1	0.4803	0.0000	OK
15 minute summer	SW23	11	199.422	0.202	412.6	0.3574	0.0000	OK
960 minute winter	SW24	930	196.497	1.646	30.9	2.9081	0.0000	SURCHARGED
960 minute winter	SW25	930	194.893	0.063	11.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	S1	6.003	S2	144.9	4.500	0.902	1.9514	
15 minute summer	S2	6.004	S3	145.0	3.534	0.504	0.5755	
15 minute summer	S3	6.005	S4	158.9	2.539	0.575	1.1688	
15 minute summer	S4	6.006	SW20	188.0	2.670	0.982	0.6691	
15 minute summer	SW20	6.007	SW21	270.6	4.293	0.327	0.9977	
15 minute summer	SW21	6.008	SW22	308.6	3.961	0.324	2.4005	
15 minute summer	SW22	6.009	SW23	412.6	4.876	0.483	1.2807	
15 minute summer	SW23	6.010	SW24	413.0	4.808	0.428	4.9427	
960 minute winter	SW24	1.012	SW25	11.5	0.554	0.023	0.2687	662.2

Andrew Moseley Associates, 15 St Paul's Street, Leeds, LS1 2JG

www.amatp.co.uk

info@amatp.co.uk