Flood Risk Assessment & Drainage Strategy

Title	Stuart Avenue, Mansfield
Client	arc partnership
Location	Stuart Avenue, Mansfield, Nottinghamshire
Project number	22-0541
BIM reference	SAMN-BSP-XX-XX-T-W-0001-P01_Flood_Risk_Assessment
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Authorisation Sheet & Revisions Record

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Executive Summary

Introduction	BSP Consulting has been commissioned by arc partnership to undertake a Flood Risk Assessment and Drainage Strategy for new residential development at Stuart Avenue, Mansfield, Nottinghamshire. This Flood Risk Assessment has been prepared in accordance with the Technical Guidance to the National Planning Policy Framework.
Existing Site Conditions	The site currently comprises largely of greenfield land, with a small portion of the site to the north which comprising unused concrete hardstanding. The site is shown to comprise a general fall in levels in a south-easterly direction, with a peak on-site level of 113.97m AOD, down to a level of 103.30m AOD.
Development Description and Planning Context	The proposals are to develop the 3.34ha site to comprise approximately 90 residential dwellings, together with car parking, access, landscaping and supporting infrastructure. In accordance with the NPPF, the project falls under the **more vulnerable** category in terms of flood risk.
Definition of Flood Hazard	The River Maun is a non-tidal EA Main River which flows in a north-easterly direction approx. 970m to the east of the site. There are no other watercourses in close proximity to the site.
Probability (Rivers/fluvial)	The EA Risk of Flooding from Rivers and Sea mapping indicates that the proposed development site has less than a 1 in 1,000 annual probability of flooding from rivers or the sea. This map shows the indicative extent of the natural floodplain if there were no flood defences or certain other manmade structures.
Climate Change	The implications of climate change of up to 40% have been considered in this assessment and mitigation measures have been determined accordingly.
Development Proposals	The technical guidance to the NPPF states that developments of a more vulnerable category such as the proposed residential use are appropriate within Flood Zone 1, without being subject to the application of the Sequential Test.
Off-Site Impacts	The proposed development surface water will discharge at reduced rates via the provision of attenuation, with part of the development discharging to ground via infiltration. Therefore, the development will bring about improvements to the surface water regime in the area, and hence will not increase flooding adjacent to or downstream of the site for the lifetime of the development.

Residual Risks	The investigations carried out as part of this flood risk assessment and flood risk management measures proposed have demonstrated that the development will be safe, without increasing flood risk elsewhere.
Recommendations	• In accordance with best practice, external ground levels should comprise falls away from buildings and towards drainage features. The design of surface water drainage features should be such that any surface water flow paths within the site are maintained and/or accommodated while ensuring that buildings remain free from flooding without increasing risk elsewhere. • In accordance with best practice, external ground levels should comprise falls away from buildings and towards drainage features. The design of surface water drainage features should be such that any surface water flow paths within the site are maintained and/or accommodated while ensuring that buildings remain free from flooding without increasing risk elsewhere. • The proposed surface water drainage system should be designed to accommodate the 1 in 30-year rainfall event without any surface water flooding and should be capable of retaining the 1 in 100-year plus climate change (40%) storm event on site without flooding any buildings. • For the north of the proposed development it is proposed to discharge surface water runoff to ground via infiltration. To the centre and south of the site, where infiltration has been demonstrated to be infeasible, surface water runoff is proposed to discharge to the public surface water sewer pin Pump Hollow Lane. • It is proposed to restrict surface water runoff from the centre and south of the site to **3.1l/s** for all storms up to and including the 1 in 100-year (1% AEP) plus 40% climate change return periods. In order to achieve this discharge rate, an attenuation volume in the order of **478.9m³** will need to be provided. • It is recommended that source control methods should be utilised where possible. These include the use of permeable paving for car parking spaces, private shared driveways and private pedestrian footways and the creation of bioretention gardens along the curtilage of access roads where appropriate.

1.0 Introduction

1.1 Terms of Reference

1.1.1 BSP Consulting has been commissioned by arc partnership to undertake a Flood Risk Assessment and Drainage Strategy for a new residential development at Stuart Avenue, Mansfield, Nottinghamshire.

1.1.2 This Flood Risk Assessment has been prepared in accordance with the Department for Communities and Local Government (DCLG) Planning Practice Guidance website section on 'Flood Risk and Coastal Change' and the Site-Specific Flood Risk Assessment Checklist.

1.1.3 This report has been produced on behalf of the Client, arc partnership, and no responsibility is accepted to any third party for all or any part. This report should not be relied upon or transferred to any other parties without the express written authorisation of BSP Consulting. If any unauthorised third party comes into possession of this report, they rely on it at their own risk and the authors owe them no duty of care or skill.

1.2 Legislation & Guidance

National Planning Policy Framework

1.2.1 The National Planning Policy Framework (NPPF) was published on 27 March 2012, with the latest update published in July 2021. This replaces Planning Policy Statement 25: Development and Flood Risk.

1.2.2 Planning Practice Guidance to the NPPF regarding Flood Risk and Coastal Change has been published and this site-specific Flood Risk Assessment is written in compliance with this guidance.

1.2.3 The NPPF, and supporting technical guidance, can be downloaded free of charge from the internet at the following link:

http://www.communities.gov.uk/publications/planningandbuilding/nppf

Flood & Water Management Act

1.2.4 The Flood & Water Management Act (F&WMA) was passed in 2010, and aims to reduce the flood risk associated with extreme weather, compounded by climate change. This act established the EA as responsible for flood risk related to Main Rivers. In this instance, Nottinghamshire County Council, as Lead Local Flood Authority (LLFA), are responsible for local sources of flood risk (that being from ordinary watercourses, surface water run-off and groundwater). As Local Planning Authority, Mansfield District Council has due regard for drainage and flood risk in accordance with local and national guidance and responses from statutory consultees.

2.0 Background Information

2.1 Site Details

2.1.1 Figure 2.1 below indicates the location of the site. A range of sources have been used to assess the local topography, local watercourses and current site use.

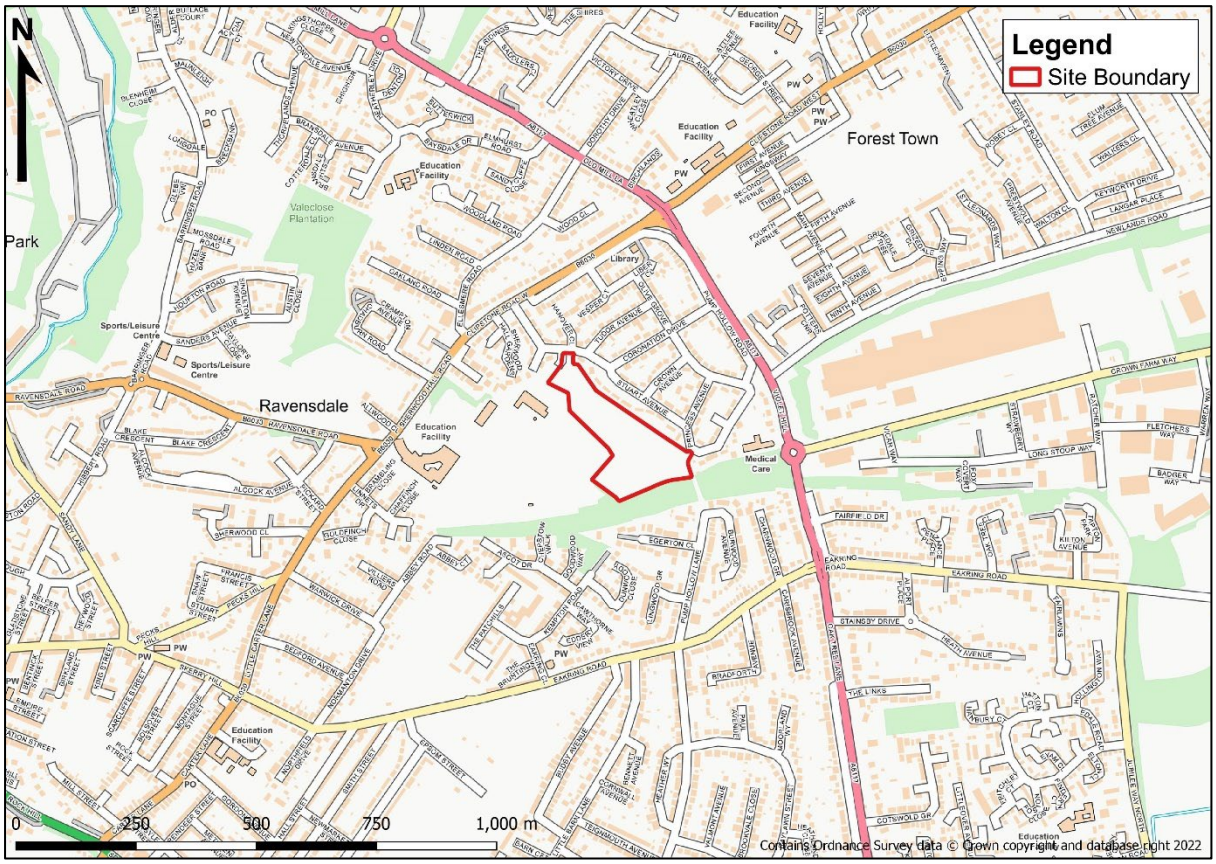

Figure 2.1 Stuart Avenue, Mansfield – Site Location Plan

2.1.2 The proposed development site is located to the east of Mansfield town centre, centred on OSNGR 455949E, 361515N, and occupies an area of approximately 3.34ha.

2.1.3 The site is bounded by Stuart Avenue to the north, existing residential developments along Stuart Avenue to the northeast, the end of Princess Avenue and start of Pump Hollow Lane to the southeast and Abbey Primary School and its associated playing fields to the west. To the south of the site is a former railway embankment; this embankment is now densely wooded and comprises a pedestrian footpath to the southeast of the site linking Pump Hollow Lane which is situated both to the north and to the south of the embankment.

2.1.4 The site currently comprises largely of greenfield land, with a small portion of the site to the north which comprising unused concrete hardstanding. A topographical survey of the site has been completed and is

included in **Appendix A**. The site is shown to comprise a general fall in levels in a south-easterly direction, with a peak on-site level of 113.97m AOD, down to a level of 103.30m AOD.

Table 2.1: Overall Catchment Context and Local Watercourse Classifications

Classification	Name	Description
Main Rivers	River Maun	The River Maun is a non-tidal EA Main River which flows in a north-easterly direction approx. 970m to the east of the site.
Ordinary Watercourses	N/A	There are no Ordinary Watercourses within close proximity to the site.
Manmade Watercourses	N/A	There are no manmade watercourses within close proximity to the site.

2.1.5 The locations of the above watercourses are indicated on Figure 2.1 above.

2.2 Approach to the Assessment

2.2.1 This study has been supplemented by information from the Environment Agency (EA), Severn Trent Water (STW) and additional information contained on the British Geological Society (BGS) website, the DEFRA MagicMap website and the Cranfield Soil and Agrifood Institute Soilscapes website.

2.2.2 This assessment seeks to draw together the relevant data information from these sources and to collate this with the findings of our investigations and discussions to assess the flood risk and drainage strategy for this site.

3.0 Flood Risk Assessment

3.1 Development Description and Planning Context

3.1.1 The development proposals are for the construction of approximately 90 residential dwellings, together with car parking, access, landscaping and supporting infrastructure. The proposed site plan is included in **Appendix B**.

3.1.2 The local area benefits from two Strategic Flood Risk Assessments (SFRA). These assessments are the Mansfield District Council SFRA (2008) and the Greater Nottingham SFRA (2017). Both SFRAs note the site to fall within Flood Zone 1.

3.1.3 In accordance with the NPPF, the proposed school car park and the residential dwellings fall under the **more vulnerable** category in terms of flood risk.

3.2 Sequential and Exception Tests

3.2.1 The Sequential Test is designed to steer development towards areas of lower flood risk and is required to be completed for development within Flood Zone 2 and 3. As the site is located within Flood Zone 1 the Sequential Test is not required.

3.2.2 The Exception Test is designed to require evidence of how flood risk will be managed on the proposed development site, ensuring that it is safe for its lifetime and will not increase flood risk elsewhere. Table 3.1 below indicates whether developments, based on their vulnerability classification, are permitted within each Flood Zone and whether the Exception Test is required. The NPPF states that developments of the more vulnerable category are suitable within Flood Zone 1 without the requirement of an Exception Test. In this case, this report, and particularly Section 4, will demonstrate that the development passes the Exception Test.

Table 3.1: Flood Risk Vulnerability and Flood Zone Compatibility (Source: NPPF)

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	✗	Exception Test Required	✓
	Zone 3b Functional Floodplain	Exception Test Required	✓	✗	✗	✗

3.3 Definition of Flood Hazard

The potential sources of flooding in the vicinity of the site are as detailed below:

Historic Flooding

3.3.1 The Environment Agency's Historic Flood Map indicates that the development site has not flooded previously. The dataset shows the maximum extent of all individual recorded flood outlines that have occurred as a result of flooding from rivers, the sea and groundwater sources since records began 1946. The dataset does not account for flooding from other sources, such as sewer flooding or surface water flooding, nor is it exhaustive as it may not include all previous flooding incidents and does not provide information regarding event dates. However, the dataset does provide an insight into the potential for flooding from nearby sources.

The potential sources of flooding in the vicinity of the site are as detailed below:

Fluvial Flood Risk

3.3.2 The EA Risk of Flooding from Rivers and Sea mapping, shown below in Figure 3.1, indicates that the proposed development site has less than a 1 in 1,000 annual probability of flooding from Rivers and Sea. This map shows the indicative extent of the natural floodplain, if there were no flood defences or certain other manmade structures, such as surface water sewers, and channel improvements.

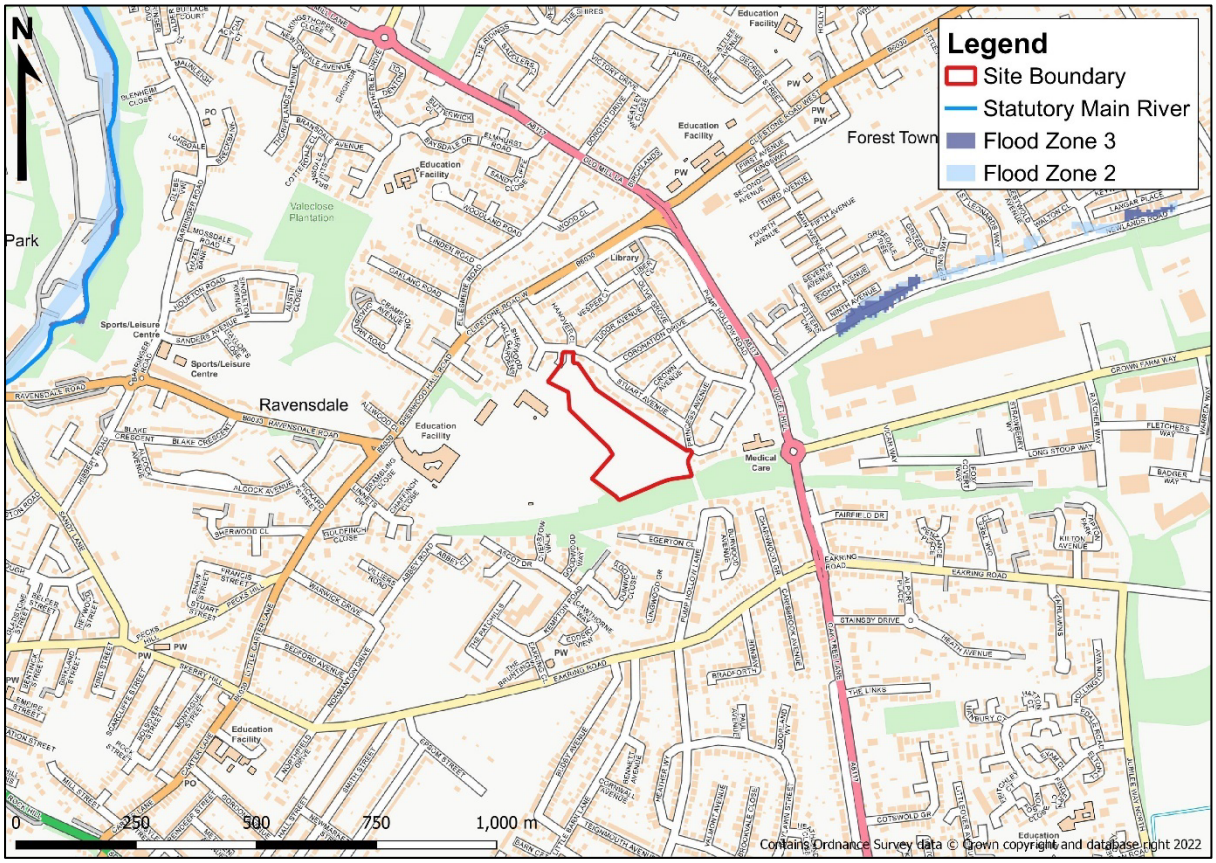

Figure 3.1 Stuart Avenue, Mansfield – Risk of Flooding from Rivers and Sea (Source: EA)

3.3.3 The only source of fluvial flooding locally is River Maun, an EA Main River which is located approximately 970m to the east of the site. However, given the scale of watercourse and its distance to the site, the River Maun does not present a risk of flooding to the site.

Tidal Flood Risk

3.3.4 The site is not within close proximity of any tidal watercourses.

Surface Water Flood Risk

3.3.5 Figure 3.2 below shows the Risk of Flooding from Surface Water mapping and indicates that the majority of the site is at very low risk (0.1% AEP) of surface water flooding. There is, however, a small surface water flood risk flow path indicated to run along the southern site boundary before spilling out of the site onto Pump Hollow Lane. This mapping does not include the public sewer network and is more representative of the natural catchment. Flood risk flow paths can also indicate exceedance flows in the event of sewer blockages. However, given that the only sewers running through the south of the site are rising mains heading in the opposite direction to the flow, it is unlikely that a blockage of local sewers would indeed result in the indicated flood flow path along the south of the site.

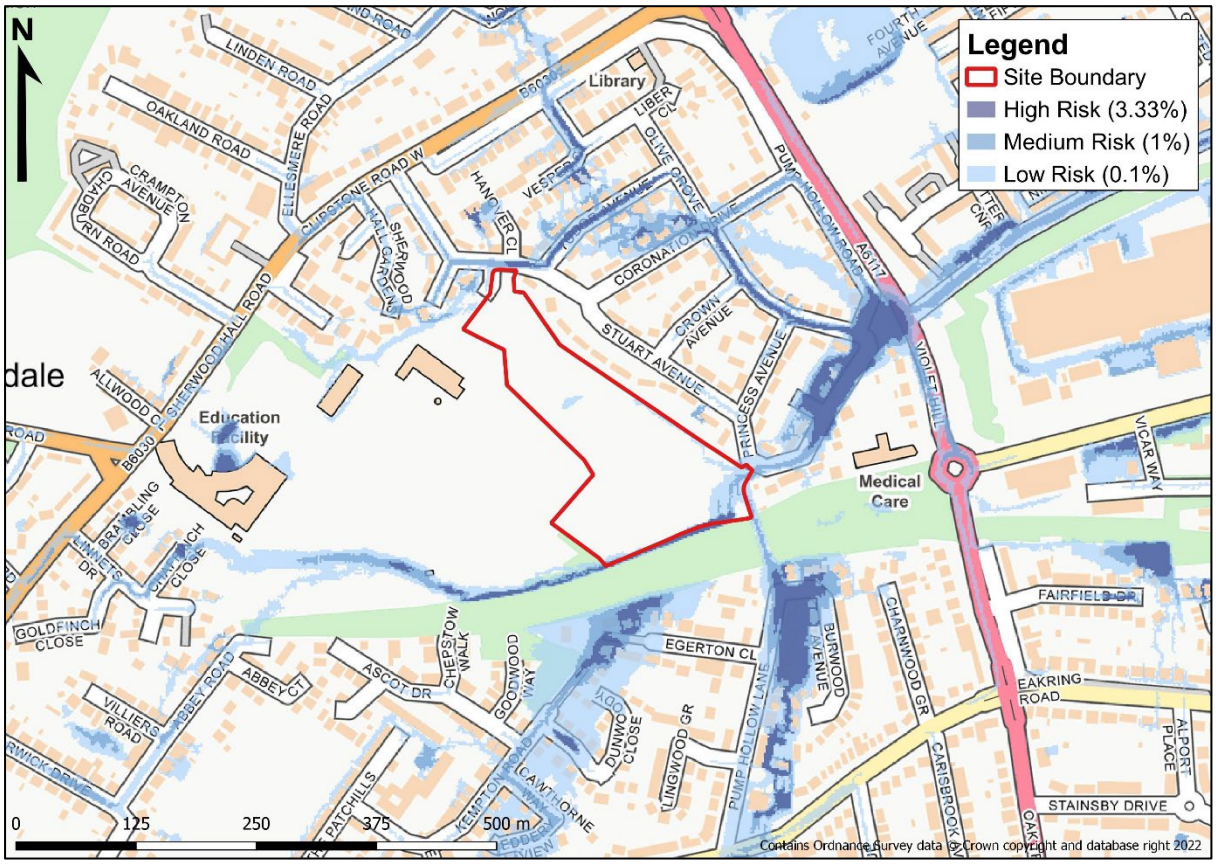

Figure 3.2 Stuart Avenue, Mansfield – Risk of Flooding from Surface Water (Source: EA)

3.3.6 The overall risk of surface water flooding to the site is considered to be low.

Flood Risk from Ground Water

3.3.7 The British Geological Survey's Geology of Britain mapping indicates that the site is situated upon bedrock geology consisting of Chester Formation – Sandstone, Pebbly (Gravelly). There are no records of superficial deposits at the site location. Chester Formation is generally classed as being highly productive aquifer.

3.3.8 The Environment Agency Aquifer Designation Map identifies the site as being situated on bedrock classed as Principal aquifer: geology that exhibit high permeability and/or provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

3.3.9 The Greater Nottingham SFRA (2017) includes mapping of areas that are susceptible to groundwater flooding on a 1km^2 grid scale. This mapping indicates that the site location is not susceptible to groundwater flooding.

3.3.10 Based on the information from the above sources, the site is considered to be at low risk of flooding from groundwater sources. Due to the nature of groundwater flooding, any risk associated with this source is likely to be heavily influenced by the local watercourses and primarily the River Maun. Given that the site is not within the natural floodplain of any nearby fluvial watercourses, the risk of groundwater flooding is expected to be minimal on-site.

Flood Risk from Sewers and Infrastructure

3.3.11 The local sewers are operated and maintained by Severn Trent Water (STW). STW sewer records indicate a number of public sewers located within the site boundary: firstly, a 225mm diameter combined sewer is shown to enter the site from the northwest, running adjacent to the boundary with Samworth Church Academy before turning and crossing the north of the site and exiting the at the rear of 38 Stuart Avenue; to the southeast of the site, a foul rising main (300mm diameter) and a separate combined rising main (300mm diameter) enter the site from Stuart Avenue and run in parallel across the south of the site, exiting to the southwest and continuing in a westerly direction. Outside of the site boundary, separate foul and surface water sewers are shown running in a northerly direction up Pump Hollow Lane, along the former railway embankment footpath and adjacent to the site's south-eastern boundary. Further combined sewers are located in Stuart Avenue and Crown Avenue to the north and east of the site running away from the site. STW have not raised any concerns regarding existing sewer flooding issues or capacity problems, though they have advised that the proposed development itself may have an adverse effect upon the local network, particularly in relation to a Combined Sewer Overflow (CSO) located in Pump Hollow Lane to the southeast of the site. Correspondence and copies of the sewer record plans from STW are included in **Appendix C**.

3.3.12 The EA's Flood Risk from Reservoir mapping indicates that the site lies outside of the predicted maximum flood extents in the unlikely event that all upstream large, raised reservoirs and dams simultaneously fail and release the water they hold; both on a 'dry day', if reservoir flooding were to occur when river levels are at normal levels, and on a 'wet day', should reservoir breach occur if a river is already experiencing an extreme natural flood. As such, the site is not considered to be at risk of flooding from reservoirs.

3.3.13 The site is not in close proximity to any Manmade Watercourses or wet process industry works.

3.3.14 The sewers and infrastructure flood risk source can therefore be discounted as a significant source of flood risk to the site.

3.4 Detailed Development Proposals

3.4.1 The proposed development and vulnerability classification are discussed in Section 3.1 above.

3.4.2 The technical guidance to the NPPF states that developments of a more vulnerable category such as the proposed school car parking and residential uses are appropriate within Flood Zone 1, without being subject to the application of the Sequential Test.

4.0 Flood Risk Management & Drainage Strategy

4.1 Surface Water Flood Risk Mitigation

4.1.1 The development proposals are for the construction of approximately 90 residential dwellings, together with car parking, access, landscaping and supporting infrastructure.

4.1.2 Although the proposed development will see the levelling of ground during construction, in accordance with best practice, external ground levels should comprise falls away from buildings and towards drainage features. The design of surface water drainage features should be such that any surface water flow paths within the site are maintained and/or accommodated while ensuring that buildings remain free from flooding without increasing risk elsewhere.

4.2 Surface Water Drainage

Climate Change

4.2.1 The implications of climate change should be taken into account in relation to surface water drainage. Guidance from the EA advises that the upper end allowances for both the 1 in 30-year (3.3% AEP) and 1 in 100-year (1% AEP) events should be assessed, with the development designed to ensure that there is no increase in flood risk elsewhere and the development will be safe from surface water flooding during the 1 in 100-year event when the upper end allowance for climate change is applied. In this instance, peak rainfall intensity for residential developments within the Idle and Torne Management Catchment are estimated to increase by 35% for the 3.3% AEP event and 40% for the 1% AEP event. Therefore, it is recommended that the upper end allowance of 40% is applied to design rainfall intensity to allow for the potential implications of climate change.

Sustainable Drainage Systems

4.2.2 Part H of the Building Regulations 2010 recommends that surface water run-off shall discharge to one of the following, listed in order of priority:

a) an adequate soakaway or some other adequate infiltration system, or where that is not reasonably practicable.

b) a watercourse, or, where that is not reasonably practicable.

c) a sewer.

4.2.3 It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak flow rates or positively impact on the existing flood profile.

Infiltration Based Systems

4.2.4 The British Geological Survey's Geology of Britain mapping indicates that the site is situated upon bedrock geology consisting of Chester Formation – Sandstone, Pebbly (Gravelly). There are no records of superficial deposits at the site location.

4.2.5 The Cranfield Soil and Agrifood Institute's Soilscapes mapping indicates the majority of the site to be situated on soils categorised as Soilscape 10: Freely draining slightly acid sandy soils.

4.2.6 A Site Investigation has been undertaken by Delta-Simons which included soakaway testing to BRE 365 specifications, conducted in December 2022, which comprised three infills at three different test locations. At locations SA101 (south of the site) and SA102 (centre of the site) the soakaway tests failed. However, at location SA103 to the north of the site, the testing was completed with rates of 2.5E-05m/s for the first infill, 1.8E^{-05}m/s for the second infill and 1.7E^{-05}m/s, resulting in a recommended infiltration rate for design of **1.7E^{-05}m/s**.

4.2.7 Based on the above information, it is likely that permeable ground conditions are present at the site but only within the north. As a result, infiltration-based systems should be used for the north of the site, but these techniques will not be possible for formal drainage to the centre and south of the site.

Open Watercourses

4.2.8 There are no open watercourses within close proximity to the site which could suitably receive surface water runoff from the proposed development.

Sewers

4.2.9 As infiltration is only feasible within the north of the site, and that there are no open watercourses locally that could receive runoff from the site, the only remaining option for the rest of the site is to discharge to the public surface water sewer located in Pump Hollow Lane. As STW have requested, any surface water connection to the public network will need to be downstream of the Combined Sewer Overflow (CSO at the proposed site access to Pump Hollow Lane.

SuDS Option Feasibility

4.2.10 A range of SuDS options have been considered for use within the context of the proposed development site, in-line with CIRIA guidance. Table 4.1 below provides a summary of the options considered for this site.

Table 4.1: Sustainable Urban Drainage Systems Options

	SuDS Technique		

SuDS Category		Viability	Explanation
Infiltration	Infiltration Trenches	✓	Based upon the results of the soakaway testing completed on-site, formal infiltration methods will only be possible for part of the development to the north of the site. This is to be achieved utilising individual on-plot soakaways for residential rooftops.
	Infiltration Basins	✓	
	Soakaways	✓	
	Bioretention/Filter Strips	✓	
Filtration	Bioretention/Rain Gardens	✓	Filtration devices should be incorporated within soft landscaped areas across the site, adjacent to impermeable roads and walkways where appropriate. These may need to be positively drained to the centre and south of the site. Public open spaces will also essentially act to harvest rainwater as opposed to resulting in runoff and these could potentially be further developed to include raingardens, which will specifically receive water from impermeable surfaces while also being maintenance free.
	Filter Strips	✓	
Source Control	Green Roofs	✗	As the development will consist of residential dwellings with pitched rooftops green roofs will not be feasible.
	Rainwater Harvesting	✗	Due to nature of the proposed development, the scope for rainwater harvesting is limited. Options such as water butts could be installed but their effectiveness will largely be dependent upon individual dwelling occupants. As such, other SuDS options are more favourable than rainwater harvesting.
	Pervious Pavements	✓	Pervious paving should be utilised for the external ground level car parking spaces, pedestrian footways and private shared access driveways. This will serve to increase the rainfall-runoff response time and provide water quality benefits.
Conveyance	Swales	✓	Where possible, surface level conveyance features, such as swales, should be utilised rather than sewers to convey water through the development. This will be subject to a detailed site layout plan and detailed drainage design.
	Filter Drains	✓	
	Channels/Rills	✓	
Retention/ Detention	Detention Basin	✓	Where appropriate, the proposed development surface water runoff should be attenuated by a
	Retention Pond	✓	

	Subsurface Storage	✗	detention basin or retention pond before a restricted discharge to the public sewer network.
	Wetlands	✗	

Runoff Assessment

4.2.11 The ICP SUDS and IH124 (Flood Studies Report) methods have been used to calculate the surface water runoff from a small (<50ha) greenfield site ($QBAR_{RURAL}$), which are detailed below:

$QBAR_{RURAL} = 0.00108 \times (0.01 \times AREA)^{0.89} \times SAAR^{1.17} \times SPR^{2.17}$

Where
AREA = Area (ha)
SAAR = Standard Average Annual Rainfall (mm, 1941-1970)
SPR = Standard Percentage Runoff Coefficient

4.2.12 With a site area of 3.34ha and using Flood Studies Report values for SAAR (700mm) and Soil (0.150), this results in a $QBAR_{RURAL}$ rate of 1.4l/s and discharge rates for the following return periods:

1 in 1-year	1.1l/s
1 in 30-year	2.7l/s
1 in 30-year + 35% Climate Change	3.65l/s
1 in 100-year	3.5l/s
1 in 100-year + 40% Climate Change	4.9l/s

4.2.13 The above greenfield runoff assessment is based upon the default Soil factor of 0.150. Based upon the infiltration testing completed by Delta-Simons, which demonstrates that infiltration is feasible to the north of the site, 0.150 is generally representative of the soils in this part of the site. However, the infiltration testing demonstrates that infiltration is infeasible in the centre and south of the site, though it is likely that percolation through the topsoil is still reasonably acceptable. As such, the above greenfield calculation method has been repeated with a modified Soil factor of 0.350 to be more closely representative of the ground conditions for the centre and south of the site, with the results as follows:

1 in 1-year	7.1l/s
QBAR	8.5l/s
1 in 30-year	16.7l/s
1 in 30-year + 35% Climate Change	22.55l/s

1 in 100-year	21.9l/s
1 in 100-year + 40% Climate Change	30.66l/s

4.2.14 Greenfield runoff calculations are provided in **Appendix D**.

Return Period Design

4.2.15 The proposed surface water drainage system should be designed to accommodate the 1 in 30-year rainfall event without any surface water flooding and should be capable of retaining the 1 in 100-year plus climate change (40%) storm event on site without flooding any buildings.

Discharge Rate

4.2.16 In accordance with DEFRA guidance (EA SCO30219), the peak surface water runoff rate for greenfield developments should be restricted to the pre-development discharge rate where reasonably practicable. Approximately 0.73ha of the developable area will discharge to ground via infiltration, with the remaining developable area of 1.23ha to the centre and south of the site unable to do so. Based upon a greenfield rate of 2.55l/s/ha, the 1.23ha developable area will need to be restricted to a rate of **3.14l/s**.

Drainage Proposals – Main Strategy

4.2.17 The proposed development will comprise on an impermeable footprint of approximately 1.19ha (including a 10% allowance for urban creep). Approximately 0.44ha of the impermeable area is proposed to discharge to ground via infiltration, which will primarily comprise individual on-plot soakaways for each dwelling. Shared private driveways are proposed to comprise permeable paving and will also drain via infiltration. Adopted public highway will be required to drain to a soakaway chamber located within the highway curtilage. The remaining 0.75ha of impermeable area, to the centre and south of the site, will not be able to discharge via infiltration and will instead require a restricted discharge to the 675mm diameter public surface water sewer located in Pump Hollow Lane. In order to maintain the discharge rate of **3.1l/s** for all storms up to and including the 100-year return period with a 40% allowance for climate change, attenuation is required which provides in the order of **478.9m³** of surface water storage.

4.2.18 The required surface water attenuation volume is proposed to be provisioned by a surface level detention basin. Due to a Combined Sewer Overflow being located at the proposed site access onto Pump Hollow Lane, STW have advised that connection should be made to the surface water sewer downstream of the CSO.

4.2.19 It is recommended that parking spaces and private pedestrian footways are constructed from permeable paving where appropriate and bioretention features, such as raingardens and verges, are utilised where

possible. Both above-mentioned source control methods will act to increase the rainfall-runoff response time by intercepting rainfall at source while also providing improvements to water quality.

4.2.20 Drainage strategy calculations are provided in **Appendix D**.

4.2.21 The surface water discharge rate will be subject to agreement with STW and the new public sewer connections will be subject to a Section 106 (Water Industry Act 1991) application to STW.

4.2.22 The proposed surface water drainage strategy and associated surface water discharge rate will be subject to Nottinghamshire as Lead Local Flood Authority.

4.3 Water Quality

Simple Index Approach

4.3.1 In order to determine whether the proposed SuDS features for the development will be sufficient at removing pollutants from surface water runoff, the CIRIA SuDS Manual (2015) Simple Index Approach has been applied. This approach provides pollution hazard levels and indices to relevant pollutants based upon contributing hardstanding surfaces.

4.3.2 Table 4.2 below provides an extract of the land use types and pollutant indices from the CIRIA SuDS Manual which are relevant to the proposed development.

Table 4.2: Pollution hazard indices for different land use classifications (Source: CIRIA SuDS Manual 2015)

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change	Low	0.5	0.4	0.4

4.3.3 Based upon the above, the worst case indices for the development are 0.5 (Total Suspended Solids), 0.4 (Metals) and 0.4 (Hydrocarbons). Table 4.3 below indicates the mitigation indices for different types of SuDS components discharging to groundwater, with only those relevant to the development that will infiltrate in the north of the site included. Under the Simple Index Approach, in order to suitably mitigate surface water pollutants, the total combined indices for any SuDS components will need to be greater than the worst case indices above. Where multiple SuDS components are proposed, the primary component is given its full indices, while subsequent component indices are applied with a factor of 50%.

Table 4.3: Indicative SuDS mitigation indices for discharges to groundwater (Source: CIRIA SuDS Manual 2015)

Type of SuDS Component	Mitigation Indices		
	TSS	Metals	Hydrocarbons
Infiltration trench (where a suitable depth of filtration material is included that provides treatment) underlain by a soil with good containment attenuation potential of at least 300mm in depth	0.4	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good containment attenuation potential of at least 300mm in depth	0.7	0.6	0.7
Bioretention underlain by a soil with good containment attenuation potential of at least 300mm in depth	0.8	0.8	0.8

4.3.5 Based upon the above, the proposed soakaways have mitigation indices of 0.4 (Total Suspended Solids), 0.4 (Metals) and 0.4 (Hydrocarbons), which is sufficient in the mitigation of surface water runoff pollution from the proposed development rooftops but will be insufficient alone for the treatment of runoff from

highways and driveways. As such, these areas will need to include permeable paving or bioretention features first before discharging via soakaway to ensure full mitigation.

4.3.6 Table 4.4 below indicates the mitigation indices for different types of SuDS components discharging to surface waters, with only those relevant to the development that cannot infiltrate in the centre and south of the site included.

Table 4.4: Indicative SuDS mitigation indices for discharges to surface waters (Source: CIRIA SuDS Manual 2015)

Type of SuDS Component	Mitigation Indices		
	TSS	Metals	Hydrocarbons
Detention Basin	0.5	0.5	0.6
Permeable Pavement	0.7	0.6	0.7
Bioretention System	0.8	0.8	0.8

4.3.8 Based upon the above, the proposed detention basin has mitigation indices of 0.5 (Total Suspended Solids), 0.5 (Metals) and 0.6 (Hydrocarbons), demonstrating that this component alone will be sufficient in mitigation surface water runoff pollution from the proposed development. Where further SuDS components are included in the development proposals these will offer even greater mitigation against surface water runoff pollution.

4.4 Maintenance

4.4.1 The proposed surface water drainage system will require routine maintenance to ensure it remains fully operational and effective. The proposed permeable paving and areas of bioretention within private shared areas will be maintained by a private management company and should be inspected and maintained regularly. The proposed attenuation basin should be built to adoptable standards and offered to the appropriate authority at the time of construction. Private residential features, such as permeable paved driveways/car parking and on-plot soakaways will fall under the responsibility of the appropriate plot owner.

4.5 Foul Water Drainage

4.5.1 Due to the natural fall of the site in a south-easterly direction towards Pump Hollow Lane, the proposed development will be able to discharge foul flows via gravity to the public sewer network located in Pump Hollow Lane. STW have raised concerns over a Combined Sewer Overflow (CSO) located at the corner

of Pump Hollow Lane and Princess Avenue and have requested that any foul connection be made to the 300mm diameter combined sewer downstream of the CSO at manhole 1401.

4.5.2 New foul public sewer connections will be subject to agreement with STW via a Section 106 (Water Industry Act 1991) application.

5.0 Off-Site Impacts

5.1.1 The proposed development surface water will discharge at reduced rates via the provision of attenuation, with part of the development discharging to ground via infiltration. Therefore, the development will bring about improvements to the surface water regime in the area, and hence will not increase flooding adjacent to or downstream of the site for the lifetime of the development.

6.0 Overland Flow & Flood Routing Considerations

6.1.1 The routing of potential surface water runoff, should the capacity of the proposed drainage system be exceeded, needs to be built into the layout of the site such that the residual risk of flooding from this element can be easily mitigated.

6.1.2 Careful attention will need to be paid to the proposed site levels to ensure that overland flow routes are maintained, and localised low spots are not created.

7.0 Residual Risks

7.1.1 The investigations carried out as part of this flood risk assessment and flood risk management measures proposed have demonstrated that the development will be safe, without increasing flood risk elsewhere.

8.0 Recommendations

The following recommendations are made to ensure flood risk at this site is minimised:

- In accordance with best practice, external ground levels should comprise falls away from buildings and towards drainage features. The design of surface water drainage features should be such that any surface water flow paths within the site are maintained and/or accommodated while ensuring that buildings remain free from flooding without increasing risk elsewhere.
- The proposed surface water drainage system should be designed to accommodate the 1 in 30-year rainfall event without any surface water flooding and should be capable of retaining the 1 in 100-year plus climate change (40%) storm event on site without flooding any buildings.
- For the north of the proposed development it is proposed to discharge surface water runoff to ground via infiltration. To the centre and south of the site, where infiltration has been demonstrated to be infeasible, surface water runoff is proposed to discharge to the public surface water sewer pin Pump Hollow Lane.
- It is proposed to restrict surface water runoff from the centre and south of the site to **3.1l/s** for all storms up to and including the 1 in 100-year (1% AEP) plus 40% climate change return periods. In order to achieve this discharge rate, an attenuation volume in the order of **478.9m³** will need to be provided.
- It is recommended that source control methods should be utilised where possible. These include the use of permeable paving for car parking spaces, private shared driveways and private pedestrian footways and the creation of bioretention gardens along the curtilage of access roads where appropriate.

Disclaimer

We would note that all comments made in this report are based on the sources stated in Section 1.1. This report and its recommendations are intended for the use of arc partnership for the above site only.

Appendix A

Site Location Plan

KEY

TOPOGRAPHICAL KEY

SURVEY STATION — FENCE

WALL

BANKING (TOP / BOTTOM) — BUILDING

OPEN SIDED BUILDING

HEDGE SPREADS — OVERHANG / CANOPY

WOODLAND CANOPY — GLASSHOUSE

ARROW ON STEPS / RAMPS INDICATES DIRECTION UPWARDS — CONTOUR 25.50

TREES — SPREAD & GIRTH SHOWN TO SCALE — SPOT LEVEL + 127.13 — SONAR LEVEL 127.13

BORE HOLE — BH

GATE — TRIAL HOLE — TH

KERB CHANNEL — FOOTPATH

ROAD UNKERBED — CHANGE IN SURFACE

GENERAL

Av.	AVERAGE
COW	CABLE ON WALL
CW	COMBINED WATER
DIS	DISUSED
DK	DROP KERB
EML	ELECTROMAGNETIC LOCATOR
EOT	END OF TRACE
FO	FIBRE OPTIC
FP	FOOTPATH
FW	FOUL WATER
GP	GATE POST
GPR	GROUND PENETRATING RADAR
HB	HARD BED
H/P	HIGH PRESSURE
HV	HIGH VOLTAGE
KV	KILO VOLT
I/P	INTERMEDIATE PRESSURE
L/P	LOW PRESSURE
LV	LOW VOLTAGE
M/P	MEDIUM PRESSURE
NDI	NO DEPTH INFORMATION
NFI	NO FURTHER INFORMATION
NDV	NO DUCTS VISIBLE
NPV	NO PIPES VISIBLE
OSBM	ORDNANCE SURVEY BENCHMARK
POW	PIPE ON WALL
P.BOX	POST BOX
RED	REDUNDANT SERVICE
RW	RETAINING WALL
SB	SOFT BED
SNP	STREET NAME PLATE
SW	SURFACE WATER
TAC	TACTILE PAVING
TOW	TOP OF WALL
TW	TRADE EFFLUENT WATER
UTL	UNABLE TO LOCATE
UTR	UNABLE TO RAISE
UTS	UNABLE TO SURVEY

APPARATUS

ACU	AIR CONDITIONING UNIT
AV	AIR VALVE
BB	BELISHA BEACON
BO	BOLLARD
BOL	BOLLARD LIGHT
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CATV	CABLE TELEVISION
CB	CONTROL BOX
CCB	CROSSING CONTROL BUTTON
CP	CATCH PIT
CR	CABLE RISER
DCH	DRAINAGE CHANNEL
EB	ELECTRIC CONTROL BOX
EP	ELECTRIC POLE
ER	EARTH ROD
FD	FILTER DRAIN
FFP	FUEL TANK FILL POINT
FH	FIRE HYDRANT
GR	GAS RISER
GV	GAS VALVE
GY	GULLY
IC	INSPECTION COVER
INT	INTERCEPTOR
IT	INLET
KO	KERB OUTLET
LD	LOOP DETECTOR
LH	LAMP HOLE
LP	LAMP POST
MH	MANHOLE
MK	MARKER POST / PLATE
MT	METER
MW	MONITORING WELL
OL	OUTLET
OU	OUTFALL
PO	POST
PTG	PIPE TO GROUND
PTS	PIPE TO SURFACE
PU	PUMP
RE	RODDING EYE
RS	ROAD SIGN
RM	RISING MAIN
RWP	RAIN WATER PIPE
SC	STOP COCK
SO	SOAKAWAY
SP	SOIL PIPE
ST	STAY CABLE
SV	STOP / SLUICE VALVE
SVP	SOIL VENT PIPE
TCB	TELEPHONE CALL BOX
TEL	TELECOM INSPECTION COVER
TL	TRAFFIC LIGHT
TLC	TRAFFIC LIGHT COVER
TM	TICKET MACHINE
TP	TELECOM POLE
VP	VENT PIPE
WM	WATER METER
WO	WASH OUT
WR	WATER RISER
WT	WATER TAP
WW	WET WELL

DEPTHS

d	ELECTRONICALLY DERIVED
Pd	PASSIVELY DERIVED
Bd	BASE DEPTH
Cd	DEPTH TO CROWN
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CO	CONCRETE
DI	DUCTILE IRON
HDPE	HIGH DENSITY PE
MDPE	MEDIUM DENSITY PE
PE	POLYETHYLENE
PF	PITCH FIBRE
PP	POLYPROPYLENE
PVC	POLYVINYL CHLORIDE
PVC-U	ULTRA RIB (PVC)
SI	SPUN IRON
ST	STEEL
VC	VITRIFIED CLAY

FENCES

B/W	BARBED WIRE FENCE
C/B	CLOSED BOARDED FENCE
CPL	CONCRETE PANEL FENCE
C/I	CORRUGATED IRON FENCE
CNP	CHESTNUT PAILING
C/L	CHAIN LINK FENCE
I/R	IRON RAILINGS
L/L	LARCH LAP FENCE
P/R	POST AND RAIL FENCE
P/W	POST AND WIRE FENCE
W/M	WIRE MESH FENCE

LEVELS

BD	BACKDROP LEVEL
BL	BASE LEVEL
CL	COVER LEVEL
CWL	CROWN LEVEL
DPC	DAMP PROOF COURSE
FL	FLOOR LEVEL
IL	INVERT LEVEL
PT	P TRAP LEVEL
RL	ROOF LEVEL
SL	SILT LEVEL
SOF	SOFFIT LEVEL
THL	THRESHOLD LEVEL
WL	WATER LEVEL

LINESTYLE

INTERNAL METER (MT)
POT ENDED SERVICE
SEWER CAPPED RUN
SURVEY ABANDONED
INTERNAL VALVE
UNKNOWN UNDERGROUND ANOMALY
UNDERGROUND CHAMBERS
POST PROCESSING AREA (FROZEN LAYER)
VERIFICATION TRIAL HOLE/EXCAVATION
ABOVE GROUND (AG)
ASSUMED ROUTE QB4(AR)
EMPTY DUCTS (E)
OVERHEAD (OH)
BACK DROP
P TRAP
UTILITY CROSSOVER
SURVEY BOUNDARY
VERBAL INFORMATION QB4(VI)
RECORD INFORMATION QB4(R)
REDUNDANT SERVICE
RISING MAIN

CCTV SECTION 4 AND 5 FAULTS ARE SHOWN IN RED

SERVICE TYPE

CATV / DATA
ELECTRICITY (HV)
ELECTRICITY (LV)
FUEL
GAS
HEATING
OVERHEAD ELECTRIC
OVERHEAD TELECOM
TRADE EFFLUENT
COMBINED SEWER
FOUL SEWER
SURFACE SEWER
UNIDENTIFIED SEWER
TELECOM
UNKNOWN SERVICE
WATER

SERVICES SURVEY WARNING

CAUTIONARY NOTES

1. EML techniques have been used in the detection of underground utilities as outlined in Table 2 of PAS 128:2014, the results are not infallible and trial excavations must be carried out in order to confirm identification, position and in particular depth of the utility.
2. GPR techniques has been used in the detection of non-metallic utilities as outlined in Table 2 of PAS 128:2014. The interpretation of these results is not infallible and success will depend on a number of factors including soil type, ground water levels and surface conditions, hence trial excavations must be carried out in order to confirm identification, position and in particular depth of the utility.
3. Depths derived via EML are taken to the centre of the conductor (cable, metallic pipe) and those derived via GPR are usually to the crown of the utility unless otherwise indicated.
4. Where cables cannot be detected individually an average depth has been obtained and trial excavations are recommended to confirm number and depths of cables banded together.
5. 'Pot-ended' cables are often difficult to detect and although we have made all reasonable efforts to locate or transpose this information from records, we cannot guarantee that all 'pot-ended' cables have been located.
6. Fibre optic cables are often difficult to detect, and commonly access chambers can be locked and thereby made inaccessible by the utility provider. All reasonable efforts have been made to locate these ducts using GPR. Cables not located have been transposed from records.
7. Within close proximity of electric substations and similar structures results using EML may become distorted. All reasonable efforts have been made to verify our results using GPR wherever conditions permitted.
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9. Drainage information has been obtained without man entry into the chamber.
10. Wherever possible we have attempted to locate the route of the sewer. Issues such as blockages, surcharging, flooding, sedimentation, sewer collapse, root ingress, excessive depth, obstructions or heavy traffic flow may have affected our ability to obtain meaningful results. In these cases recommendations have been made for further survey or maintenance work.
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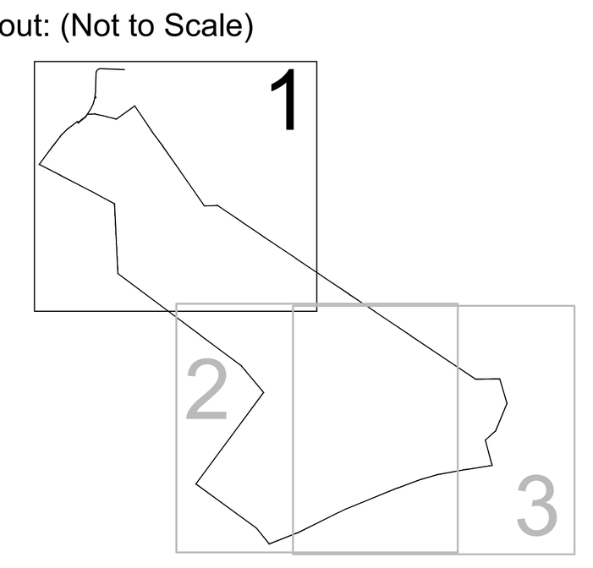
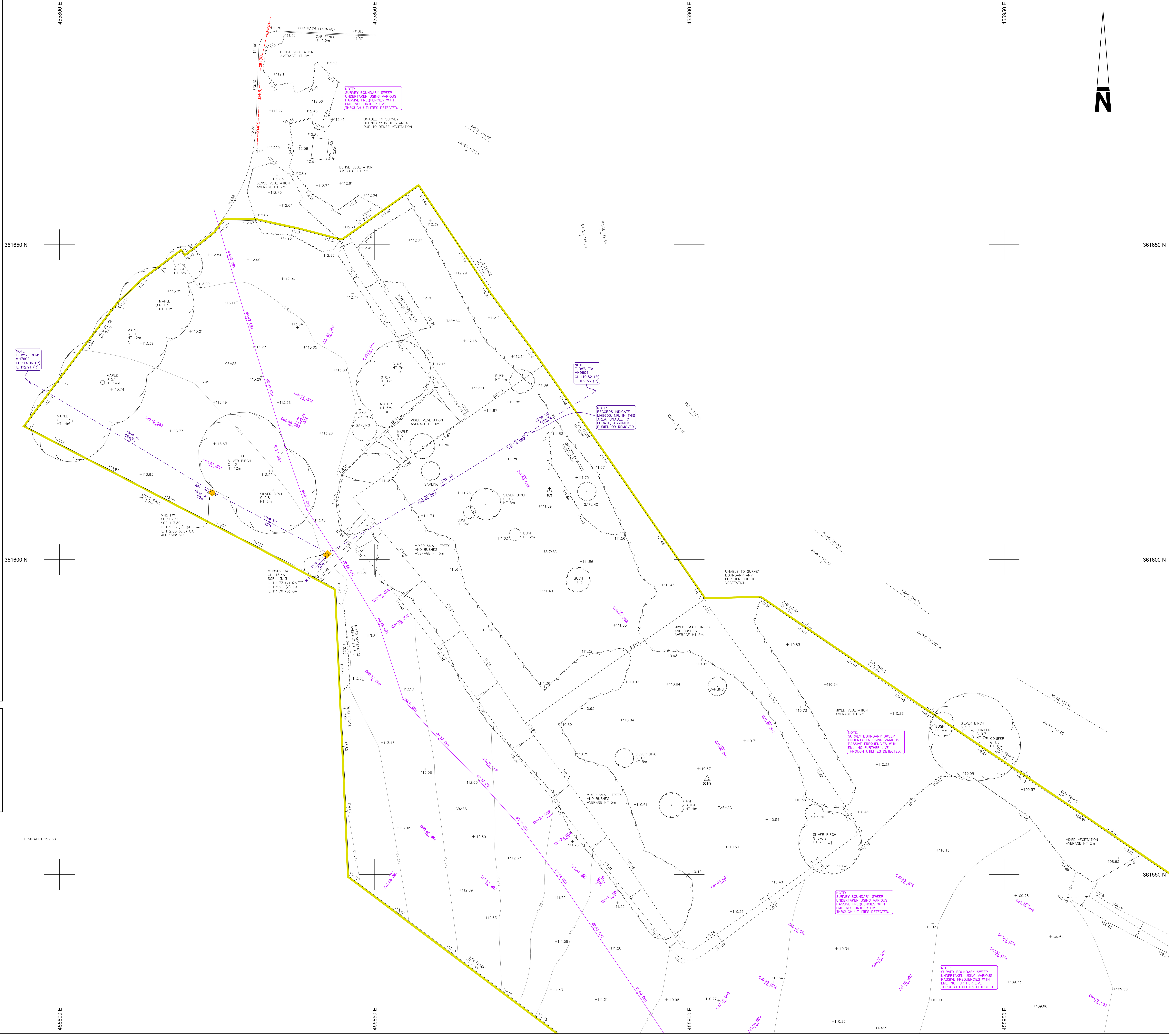
13. All utilities detected by MK Surveys should be considered live unless confirmed otherwise by client or service provider.
14. MK Surveys cannot confirm when utilities are redundant unless there is visual or record evidence to indicate this. In addition MK Surveys cannot guarantee being able to detect all redundant utilities.
15. Wherever available the results of our investigations have been cross referenced with record information. If a utility shown on the records cannot be detected on site, the information has been added to the drawing and indicated as QB4 (R). However it should be noted that the completeness and accuracy of the records cannot be guaranteed.
16. The utility information has been obtained from non-intrusive survey techniques; it always remains possible that there are additional utilities within the survey boundary that we have not been able to detect. We recommend that care is taken on site and that all utility records are used in conjunction with this survey.
17. The responsibility for avoiding damage to assets and utilities on site shall be that of the persons proposing to excavate within the surveyed area, who shall be liable to the asset owner and any third party who may be affected in any way for any loss or damage.

ALWAYS EXERCISE CAUTION WHEN EXCAVATING.

Sheet Layout: (Not to Scale)





Notes :

1. GRID AND LEVELS BASED ON ORDNANCE DATUM, DERIVED FROM THE NATIONAL GNSS NETWORK. LOCAL SCALE FACTOR APPLIED (0.99964).
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CROSS CHECKED IN CRITICAL AREAS.
3. THIS SURVEY SHOULD ALWAYS BE READ IN CONJUNCTION WITH THE DESKTOP UTILITY REPORT, THAT WAS CARRIED OUT AS A PREREQUISITE TO THIS DETECTION SURVEY.

Coordinate Table

Station	Description	Easting	Northing	Level
S1	ROAD NAIL	456088.344	361529.513	105.321
S2	ROAD NAIL	456091.030	361465.472	103.320
S9	ROAD NAIL	455877.807	361610.981	111.694
S10	ROAD NAIL	455902.846	361565.194	110.691

Equipment Information

Equipment	Manufacturer	Model	Serial Number	MKS REF	Date of Calibration
EML Tx Transmitter	SPX Radiodetection	TX-10	10/TX-10-GB-923	RD26	08/02/2022
EML Rx Receiver	SPX Radiodetection	RD8200	10/82-GB-41	RD26	08/02/2022
GPR	Leica	DS2000	SN-010-18-000290	GPR17	Day of Survey

DETECTION SURVEY REPORT

GENERAL
This survey was carried out in accordance with PAS 128:2014 (Publicly Available Specification from BSI). After a pre-survey consultation with the client it was agreed to carry out the detection survey using methodology M1 as per Table 2 of the PAS 128:2014. The survey boundary has been shown on the drawing; please see linestyle section of the key for reference.

DESKTOP UTILITY REPORT
Prior to the survey commencing record information was gathered and compiled in a separate desktop utility report. This report should be read in conjunction with the information contained in this utility detection survey. Record information was at the time of the survey less than 90 days old in accordance with the requirements of the PAS 128:2014. For a full list of the providers searched, records received and the dates the information was obtained, please refer to the attachments page of the desktop utility report.

DETECTION SURVEY

DRAINAGE
Drainage was lifted with pipe sizes and invert levels recorded. Wherever possible the chamber sizes have been recorded and positioned on the drawing. All connections from gullies, external rainwater pipes and external soil stacks have been proven wherever possible into manholes and sewer runs by radio sonde location and/or GPR. Where a saddle connection is present the position is assumed only until proven to QB2 or above. In instances where other detection methods were unsuccessful connections between manholes have been assumed to be straight and labelled as QB4. All drainage should be cross checked in critical areas by CCTV survey or verification survey type A.

WATER
No water were located within the survey area. Record information confirms this. Unable to survey a water meter on site.

GAS
No gas or any indications of water were located within the survey area. Record information confirms this.

ELECTRICITY
Electric cables were located utilising EML and GPR methods to quality level QB2, where GPR results confirmed EML findings the quality level has been increased to QB1. Where records show cables to exist but we were unable to locate them, the record information has been transcribed to the drawing to quality level QB4.

TELECOM
No telecom ducts have been located within the survey boundary. Record information confirms this. For further information regarding BT apparatus please contact Openreach directly.

CATV
No evidence of CATV was located within the survey area, record information confirms no CATV infrastructure resides or runs through the survey area.

UNKNOWNS
Some unknown targets identified on the drawing using GPR are classified as “non-linear targets”. These are not consistent with what we expect to see when identifying a buried utility, and appear on the drawing as single targets with depths (i.e. not linking two or more depth readings). This does not mean they are not utilities, we are just unable to positively identify them as a utility. We would strongly recommend that further verification surveys (PAS 128:2014 survey type A) are carried out to identify these targets in critical areas. There is one linear target that has been located on the north west area of the survey boundary travelling east and ending abruptly near the school's peremiter fence. Where GPR results confirmed EML findings the quality level has been increased to QB1.

SEE CAUTIONARY NOTES WITHIN THE UTILITY KEY

PAS 128:2014 Quality Level Guide

Quality Level	Description	Accuracy
QB4	A utility is expected to exist but cannot be detected - (AR), (R), (VI)	Undefined
QB3 QB3P	Horizontal location only using one geophysical technique. No depth information - NDI.	+/- 500mm Horizontal Undefined Vertical
QB2 QB2P	Horizontal and vertical location only using one geophysical technique.	+/- 250mm or +/- 40% of depth whichever is greater
QB1 QB1P	Horizontal and vertical location only using two geophysical techniques.	+/- 150mm or +/- 15% of depth whichever is greater
QA	Service verified in an open excavation, inside an inspection chamber / draw pit, or at the point the service enters / exits the ground.	+/- 50mm Horizontal +/- 25mm Vertical

Desktop Utility Records

Utility Type	Provider Details	Date Acquired
Drainage	Severn Trent Water	27/05/2022
Water	Severn Trent Water	27/05/2022
Gas	Cadent	28/05/2022
Gas	ESP Utilities	28/05/2022
Telecom	Openreach	27/05/2022
CATV	Virgin Media	27/05/2022
Electricity	Western Power Distribution	28/05/2022
Tunnels & Pipelines	LinesearchbeforeUdig	28/05/2022

Revision	Description	Surv. by	Check. by	Appr. by	Date

0m 2 4 6 8 10 12 14 16 18 20 22

Topographical and PAS 128:2014 Utility Survey

Client:

Perfect Circle

Stuart Avenue
Forest Town
Mansfield
Nottinghamshire

Scale:	Sheet Size:	Sheet Number:	Date:
1:200	A0	1	July 2022

Project Number:	Rev:	Surveyed by:	Checked by:	Approved by:
31421	-	JH/JKH	AJ/TW	TS/NF

mksurveys
www.mksurveys.com www.surveys4bim.co.uk
Head Office: Milton Keynes t: 01908 565561 e: mail@mksurveys.co.uk

KEY

TOPOGRAPHICAL KEY

SURVEY STATION — 5
BANKING — TOP / BOTTOM
HEDGE SPREADS
WOODLAND CANOPY
ARROW ON STEPS / RAMPS INDICATES DIRECTION UP/WARDS
TREES — SPREAD & GIRTH SHOWN TO SCALE
GATE
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FENCE
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SI	SPUN IRON
ST	STEEL
VC	VITRIFIED CLAY

FENCES

B/W	BARBED WIRE FENCE
C/B	CLOSED BOARDED FENCE
CPL	CONCRETE PANEL FENCE
CF	CORRUGATED IRON FENCE
CNF	CHESTNUT PAILING
CL	CHAIN LINK FENCE
I/R	IRON RAILINGS
L/L	LARCH LAP FENCE
P/R	POST AND RAIL FENCE
W/M	WIRE MESH AND WIRE FENCE
W/M	WIRE MESH FENCE

LEVELS

BD	BACKDROP LEVEL
BL	BASE LEVEL
CL	COVER LEVEL
DL	DRAIN LEVEL
DPC	DAMP PROOF COURSE
FL	FLOOR LEVEL
IL	INVERT LEVEL
PT	P TRAP LEVEL
RL	ROOF LEVEL
SL	SILT LEVEL
TL	TOP LEVEL
THL	THRESHOLD LEVEL
WL	WATER LEVEL

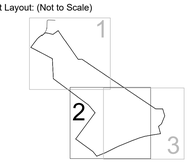
LINESTYLE

INTERNAL METER — MT
POT ENDED SERVICE
SEWER CAPPED RUN
SURVEY ABANDONED
INTERNAL VALVE
UNKNOWN UNDERGROUND ANOMALY
UNDERGROUND CHAMBERS
POST PROCESSING AREA — PINK/BLANK
VERIFICATION TRIAL HOLE/EXCAVATION
ABOVE GROUND — (AG)
ASSUMED ROUTE — QB4(AR)
EMPTY DUCTS — (E)
OVERHEAD — (OH)
BACK DROP
P TRAP
UTILITY CROSSOVER
SURVEY BOUNDARY
VERBAL INFORMATION — QB4(V)
RECORD INFORMATION — QB4(R)
REDUNDANT SERVICE
RISING MAIN
CCTV SECTION 4 AND 5 HULTS ARE SHOWN IN RED

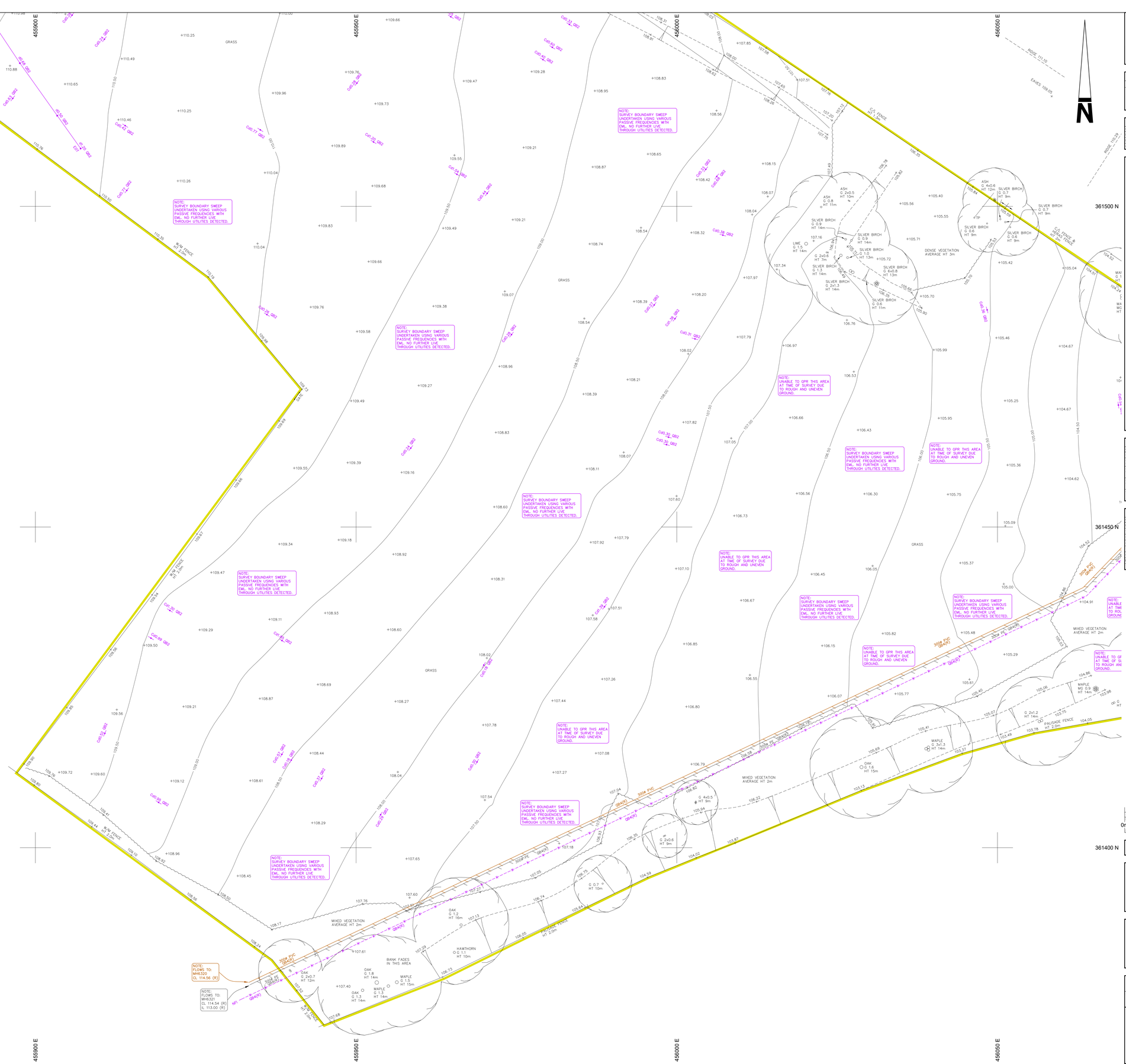
SERVICE TYPE

CATV / DATA
ELECTRICITY (HV)
ELECTRICITY (LV)
FUEL
GAS
HEATING
OVERHEAD ELECTRIC
OVERHEAD TELECOM
TRADE EFFLUENT
COMBINED SEWER
FOUL SEWER
SURFACE SEWER
UNIDENTIFIED SEWER
TELECOM
UNKNOWN SERVICE
WATER
SERVICES SURVEY WARNING

Sheet Layout: (Not to Scale)



361400 N



Notes :

1. GRID AND LEVELS BASED ON ORDNANCE DATUM, DERIVED FROM THE NATIONAL GNSS NETWORK. LOCAL SCALE FACTOR APPLIED (0.99964).
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CROSS CHECKED IN CRITICAL AREAS.
3. THIS SURVEY SHOULD ALWAYS BE READ IN CONJUNCTION WITH THE DESKTOP UTILITY REPORT, THAT WAS CARRIED OUT AS A PREREQUISITE TO THIS DETECTION SURVEY.

Coordinate Table

Station	Description	Easting	Northing	Level
S1	ROAD NAIL	456088.344	361529.513	105.321
S2	ROAD NAIL	456091.030	361465.472	103.320
S9	ROAD NAIL	455877.807	361610.981	111.694
S10	ROAD NAIL	455902.846	361565.194	110.691

Equipment Information

Equipment	Manufacturer	Model	Serial Number	MKS REF	Date of Calibration
EML Tx Transmitter	SPX Radiodetection	TX-10	10/TX-10-QB-923	RD26	08/02/2022
EML Rx Receiver	SPX Radiodetection	RD8200	10/SD-QB-41	RD26	08/02/2022
GPR	Leica	DS2000	SN-010-16-000290	GPR17	Day of Survey

DETECTION SURVEY REPORT

GENERAL
This survey was carried out in accordance with PAS 128:2014 (Publicly Available Specification from BSI). After a pre-survey consultation with the client it was agreed to carry out the detection survey using methodology M1 as per Table 2 of the PAS 128:2014. The survey boundary has been shown on the drawing; please see linestyle section of the key for reference.

DESKTOP UTILITY REPORT
Prior to the survey commencing record information was gathered and compiled in a separate desktop utility report. This report should be read in conjunction with the information contained in this utility detection survey. Record information was at the time of the survey less than 90 days old in accordance with the requirements of the PAS 128:2014. For a full list of the providers searched, records received and the dates the information was obtained, please refer to the attachments page of the desktop utility report.

DETECTION SURVEY
DRAINAGE
Drainage was lifted with pipe sizes and invert levels recorded. Wherever possible the chamber sizes have been recorded and positioned on the drawing. All connections from gullies, external rainwater pipes and external soil stacks have been proven wherever possible into manholes and sewer runs by radio sonde location and/or GPR. Where a saddle connection is present the position is assumed only until proven to QB2 or above. In instances where other detection methods were unsuccessful connections between manholes have been assumed to be straight and labelled as QB4. All drainage should be cross checked in critical areas by CCTV survey or verification survey type A.

WATER
No water were located within the survey area. Record information confirms this. Unable to survey a water meter on site.

GAS
No gas or any indications of water were located within the survey area. Record information confirms this.

ELECTRICITY
Electric cables were located utilising EML and GPR methods to quality level QB2, where GPR results confirmed EML findings the quality level has been increased to QB1. Where records show cables to exist but we were unable to locate them, the record information has been transcribed to the drawing to quality level QB4.

TELECOM
No telecom ducts have been located within the survey boundary. Record information confirms this. For further information regarding BT apparatus please contact Openreach directly.

CATV
No evidence of CATV was located within the survey area, record information confirms no CATV infrastructure resides or runs through the survey area.

UNKNOWNS
Some unknown targets identified on the drawing using GPR are classified as "non-linear targets". These are not consistent with what we expect to see when identifying a buried utility, and appear on the drawing as single targets with depths (i.e. not linking two or more depth ranges). This does not mean they are not utilities, we are just unable to positively identify them as a utility. We would strongly recommend that further verification surveys (PAS 128:2014 survey type A) are carried out to identify these targets in critical areas. There is one linear target that has been located on the north west area of the survey boundary travelling east and ending abruptly near the school's perimiter fence. Where GPR results confirmed EML findings the quality level has been increased to QB1.

SEE CAUTIONARY NOTES WITHIN THE UTILITY KEY

PAS 128:2014 Quality Level Guide

Quality Level	Description	Accuracy
QB4	A utility is expected to exist but cannot be detected - (AR), (R), (V).	Undefined
QB3 QB3P	Horizontal location only using one geophysical technique. No depth information - NDI	+/- 500mm Horizontal Undefined Vertical
QB2 QB2P	Horizontal and vertical location only using one geophysical technique.	+/- 250mm or +/- 40% of depth whichever is greater
QB1 QB1P	Horizontal and vertical location only using two geophysical techniques.	+/- 150mm or +/- 15% of depth whichever is greater
QA	Service verified in an open excavation, inside an inspection chamber / draw pit, or at the point the service enters / exits the ground	+/- 50mm Horizontal +/- 25mm Vertical

Desktop Utility Records

Utility Type	Provider Details	Date Acquired
Drainage	Severn Trent Water	27/05/2022
Water	Severn Trent Water	27/05/2022
Gas	Cadent	28/05/2022
Gas	ESP Utilities	28/05/2022
Telecom	Openreach	27/05/2022
CATV	Virgin Media	27/05/2022
Electricity	Western Power Distribution	28/05/2022
Tunnels & Pipelines	LinesearchbeforeUdig	28/05/2022

Revision	Description	Surv by	Check by	Appr by	Date

0m 2 4 6 8 10 12 14 16 18 20 22

Topographical and PAS 128:2014 Utility Survey

Client:

Perfect Circle

Stuart Avenue
Forest Town
Mansfield
Nottinghamshire

Scale:	Sheet Size:	Sheet Number:	Date:
1:200	A0	2	July 2022

Project Number:	Rev:	Surveyed by:	Checked by:	Approved by:
31421	-	JH/JKH	AJ/TW	TS/NF

mksurveys
www.mksurveys.com www.surveys4bim.co.uk
Head Office: Milton Keynes t: 01908 565561 e: mail@mksurveys.co.uk

KEY

TOPOGRAPHICAL KEY

SURVEY STATION 5
BANKING TOP / BOTTOM
HEDGE SPREADS
WOODLAND CANOPY
ARROW ON STEPS / RAMPS INDICATES DIRECTION UP/WARDS
TREES SPREAD & GIRTH SHOWN TO SCALE
GATE
KERB CHANNEL
ROAD UNKERBED
FENCE
WALL
BUILDING
OPEN SIDED BUILDING
OVERHANG / CANOPY
GLASSHOUSE
CONTOUR 25.00
SPOT LEVEL + 127.13 SONAR LEVEL ⊙ 127.13
BORE HOLE BH
TRIAL HOLE TH
FOOTPATH
CHANGE IN SURFACE

GENERAL

Av	AVERAGE
COW	CABLE ON WALL
CW	COMBINED WATER
DIS	DISUSED
EC	ELECTRICS
EML	ELECTROMAGNETIC LOCATOR
EOT	END OF TRACE
FO	FIBRE OPTIC
FP	FOOTPATH
FW	FOUL WATER
GP	GATE POST
GPR	GROUND PENETRATING RADAR
HB	HARD BED
HP	HIGH PRESSURE
HV	HIGH VOLTAGE
KV	KILO VOLT
LP	INTERMEDIATE PRESSURE
LP	LOW PRESSURE
M	MEASURED
MP	MEDIUM PRESSURE
NDI	NO DEPTH INFORMATION
NFI	NO FURTHER INFORMATION
NDV	NO DUCTS VISIBLE
NPV	NO PIPES VISIBLE
OSBM	ORDNANCE SURVEY BENCHMARK
POW	POST ON WALL
PSOX	POST BOX
RBS	RED BOUGHT SERVICE
RW	RETAINING WALL
SB	SOFT BED
SNP	STREET NAME PLATE
SW	SURFACE WATER
TAC	TACTILE PAVING
TOW	TOP OF WALL
UW	UNDERGROUND CABLE WATER
UTL	UNABLE TO LOCATE
UTR	UNABLE TO RAISE
UTS	UNABLE TO SURVEY

APPARATUS

ACU	AIR CONDITIONING UNIT
AV	AIR VALVE
BE	BELISHA BEACON
BO	BOLLARD
BOL	BOLLARD LIGHT
BS	BUS STOP
CATV	CABLE TELEVISION
CB	CONTROL BOX
CCB	CROSSING CONTROL BUTTON
CH	CATCH PIT
CR	CABLE RISER
DCH	DRAINAGE CHANNEL
EB	ELECTRIC CONTROL BOX
EP	ELECTRIC POLE
ER	EARTH ROD
FD	FILTER DRAIN
FHP	FIRE HYDRANT, SIL POINT
FH	FIRE HYDRANT
GR	GAS RISER
GV	GAS VALVE
GY	GULLY
IC	INSPECTION COVER
INT	INTERCEPTOR
KO	KERB OUTLET
LD	LOOP DETECTOR
LH	LAMP HOLE
LP	LAMP POST
MH	MANHOLE
MK	MARKER POST / PLATE
MT	METER
MW	MONITORING WELL
OG	OPEN GRID
OU	OUTFALL
PO	POST
PTG	PIPE TO GROUND
PTS	PIPE TO SURFACE
PU	PUMP
RE	RODDING EYE
RG	ROAD GULLY
RM	RISING MAIN
RWP	RAIN WATER PIPE
SC	STOP COCK
SO	SOAKAWAY
SP	SOIL PIPE
ST	STAY CABLE
SVP	SOIL VENT PIPE
TCB	TELEPHONE CALL BOX
TEL	TELECOM INSPECTION COVER
TL	TRAFFIC LIGHT
TLC	TRAFFIC LIGHT COVER
TM	TICKET MACHINE
TP	TELEPHONE POLE
VP	VENT PIPE
WM	WATER METER
WO	WASH OUT
WR	WATER RISER
WT	WATER TAP
WW	WET WELL

DEPTHS

d	ELECTRONICALLY DERIVED
Pd	PASSIVELY DERIVED
Bd	BASE DEPTH
Cd	DEPTH TO CROWN
Id	DEPTH TO INVERT
Sd	DEPTH TO SOFFIT

PIPE MATERIALS

AC	ASBESTOS CEMENT
ALK	ALKATHENE
BK	BRICK
CI	CAST IRON
CO	CONCRETE
DI	DUCTILE IRON
HDPE	HIGH DENSITY PE
MDPE	MEDIUM DENSITY PE
PE	POLYETHYLENE
PF	PITCH FIBRE
PP	POLYPROPYLENE
PVC	POLYVINYL CHLORIDE
PVCU	ULTRA RIB (PVC)
SI	SPUN IRON
ST	STEEL
VC	VITRIFIED CLAY

FENCES

B/W	BARBED WIRE FENCE
C/B	CLOSED BOARDED FENCE
CPL	CONCRETE PANEL FENCE
C/I	CORRUGATED IRON FENCE
CNF	CHESTNUT PAILING
C/L	CHAIN LINK FENCE
I/R	IRON RAILINGS
L/L	LARCH LAP FENCE
P/R	POST AND RAIL FENCE
P/W	POST AND WIRE FENCE
W/M	WIRE MESH FENCE

LEVELS

BD	BACKDROP LEVEL
BL	BASE LEVEL
CL	COVER LEVEL
DPC	DAMP COURSE
DPC	DAMP PROOF COURSE
FL	FLOOR LEVEL
IL	INVERT LEVEL
PT	P TRAP LEVEL
RL	ROOF LEVEL
SL	SILT LEVEL
TL	TOP WATER LEVEL
TAL	THRESHOLD LEVEL
WL	WATER LEVEL

LINESTYLE

INTERNAL METER (MT)
POT ENDED SERVICE
SEWER CAPPED RUN
SURVEY ABANDONED
INTERNAL VALVE
UNKNOWN UNDERGROUND ANOMALY
UNDERGROUND CHAMBERS
POST PROCESSING AREA (HIGHLIGHT)
VERIFICATION TRIAL HOLE/EXCAVATION
ABOVE GROUND (AG)
ASSUMED ROUTE (QB4(AR))
EMPTY DUCTS (E)
OVERHEAD (OH)
BACK DROP
P TRAP
UTILITY CROSSOVER
SURVEY BOUNDARY
VERBAL INFORMATION (QB4(V))
RECORD INFORMATION (QB4(R))
REDUNDANT SERVICE
RISING MAIN

CCTV SECTION 4 AND 5 NUL75 ARE SHOWN IN RED

SERVICE TYPE

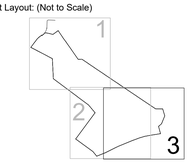
CATV / DATA
ELECTRICITY (HV)
ELECTRICITY (LV)
FUEL
GAS
HEATING
OVERHEAD ELECTRIC
OVERHEAD TELECOM
TRADE EFFLUENT
COMBINED SEWER
FOUL SEWER
SURFACE SEWER
UNIDENTIFIED SEWER
TELECOM
UNKNOWN SERVICE
WATER
SERVICES SURVEY WARNING

CAUTIONARY NOTES

1. EML techniques have been used in the detection of underground utilities as outlined in Table 2 of PAS 128:2014, the limitations of these methods and that excavations must be carried out in order to confirm identification, position and in particular depth of the utility.
2. GPR techniques has been used in the detection of non-metallic utilities as outlined in Table 2 of PAS 128:2014. The interpretation of these results is not infallible and success will depend on a number of factors including soil type, ground water levels and surface conditions, hence trial excavations must be carried out in order to confirm identification, position and in particular depth of the utility.
3. Depths derived via EML are taken to the centre of the conductor (cable, metallic pipe) and those derived via GPR are usually to the crown of the utility unless otherwise indicated.
4. Where cables cannot be detected individually an average depth has been obtained and trial excavations are recommended to confirm number and depths of cables bundled together.
5. 'Pot-ended' cables are often difficult to detect and although we have made all reasonable efforts to locate or transpose this information from records, we cannot guarantee that all 'pot-ended' cables have been located.
6. Fibre optic cables are often difficult to detect, and commonly access chambers can be locked and thereby made inaccessible by the utility provider. All reasonable efforts have been made to locate these ducts using GPR. Cables not located have been transposed from records.
7. Within close proximity of electric substations and similar structures results using EML may become distorted. All reasonable efforts have been made to verify our results using GPR wherever conditions permitted.
8. Underneath overhead power lines results using EML may become distorted. All reasonable efforts have been made to verify our results using GPR wherever conditions permitted.
9. Drainage information has been obtained without man entry into the chamber.
10. Wherever possible we have attempted to locate the route of the sewer, issues such as blockages, surcharging, collapses, infiltration, sewer collapsed or not ingress, excessive depth, obstructions or heavy traffic flow may have affected our ability to obtain meaningful results. In these cases recommendations have been made for further survey or maintenance work.
11. Pipe / duct sizes have been recorded from surface inspection or taken from record information. Pipe sizes have been recorded in millimetres and depths in metres, except in instances where sizes are indicated in imperial units on the record information.
12. Water and Gas utilities to individual properties are often of a size that cannot be detected using EML or GPR investigation, wherever possible the route has been added from surface evidence (pipe risers, valves, etc), but this should be viewed as a guide only.
13. All utilities detected by MK Surveys should be considered live unless confirmed otherwise by client or service provider.
14. MK Surveys cannot confirm when utilities are redundant unless there is visual or record evidence to indicate this. In addition MK Surveys cannot guarantee being able to detect all redundant utilities.
15. Wherever available the results of our investigations have been cross referenced with record information. If a utility shown on the records cannot be detected on site, the information has been added to the drawing and indicated as QB4 (R). However it should be noted that the completeness and accuracy of the records cannot be guaranteed.
16. The utility information has been obtained from non-intrusive survey techniques; it always remains possible that there are additional utilities within the survey boundary that we have not been able to detect. We recommend that care is taken on site and that all utility records are used in conjunction with this survey.
17. The responsibility for avoiding damage to assets and utilities on site shall be that of the persons proposing to excavate within the surveyed area, who shall be liable to the asset owner and any third party who may be affected in any way for any loss or damage.

ALWAYS EXERCISE CAUTION WHEN EXCAVATING.

Sheet Layout: (Not to Scale)



Notes :

1. GRID AND LEVELS BASED ON ORDNANCE DATUM, DERIVED FROM THE NATIONAL GNSS NETWORK. LOCAL SCALE FACTOR APPLIED (0.999941).
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CROSS CHECKED IN CRITICAL AREAS.
3. THIS SURVEY SHOULD ALWAYS BE READ IN CONJUNCTION WITH THE DESKTOP UTILITY REPORT, THAT WAS CARRIED OUT AS A PREREQUISITE TO THIS DETECTION SURVEY.

Coordinate Table

Station	Description	Easting	Northing	Level
S1	ROAD NAIL	456088.344	361529.513	105.321
S2	ROAD NAIL	456091.030	361465.472	103.320
S9	ROAD NAIL	455877.807	361610.981	111.694
S10	ROAD NAIL	455902.846	361565.194	110.691

Equipment Information

Equipment	Manufacturer	Model	Serial Number	MKS REF	Date of Calibration
EML Tx Transmitter	SPX Radiodetection	TX-10	10/TX-10-GB-923	RD26	08/02/2022
EML Rx Receiver	SPX Radiodetection	RD8200	10/SD-GB-41	RD26	08/02/2022
GPR	Leica	DS2000	SN-010-18-000290	GPR17	Day of Survey

DETECTION SURVEY REPORT

GENERAL
This survey was carried out in accordance with PAS 128:2014 (Publicly Available Specification from BSI). After a pre-survey consultation with the client it was agreed to carry out the detection survey using methodology M1 as per Table 2 of the PAS 128:2014. The survey boundary has been shown on the drawing; please see linestyle section of the key for reference.

DESKTOP UTILITY REPORT
Prior to the survey commencing record information was gathered and compiled in a separate desktop utility report. This report should be read in conjunction with the information contained in this utility detection survey. Record information was at the time of the survey less than 90 days old in accordance with the requirements of the PAS 128:2014. For a full list of the providers searched, records received and the dates the information was obtained, please refer to the attachments page of the desktop utility report.

DETECTION SURVEY
DRAINAGE
Drainage was lifted with pipe sizes and invert levels recorded. Wherever possible the chamber sizes have been recorded and positioned on the drawing. All connections from gullies, external rainwater pipes and external soil stacks have been proven wherever possible into manholes and sewer runs by radio sonde location and/or GPR. Where a saddle connection is present the position is assumed only until proven to QB2 or above. In instances where other detection methods were unsuccessful connections between manholes have been assumed to be straight and labelled as QB4. All drainage should be cross checked in critical areas by CCTV survey or verification survey type A.

WATER
No water were located within the survey area. Record information confirms this. Unable to survey a water meter on site.

GAS
No gas or any indications of water were located within the survey area. Record information confirms this.

ELECTRICITY
Electric cables were located utilising EML and GPR methods to quality level QB2, where GPR results confirmed EML findings the quality level has been increased to QB1. Where records show cables to exist but we were unable to locate them, the record information has been transcribed to the drawing to quality level QB4.

TELECOM
No telecom ducts have been located within the survey boundary. Record information confirms this. For further information regarding BT apparatus please contact Openreach directly.

CATV
No evidence of CATV was located within the survey area, record information confirms no CATV infrastructure resides or runs through the survey area.

UNKNOWNS
Some unknown targets identified on the drawing using GPR are classified as "non-linear targets". These are not consistent with what we expect to see when identifying a buried utility, and appear on the drawing as single targets with depths (i.e. not linking two or more depth readings). This does not mean they are not utilities, we are just unable to positively identify them as a utility. We would strongly recommend that further verification surveys (PAS 128:2014 survey type A) are carried out to identify these targets in critical areas. There is one linear target that has been located on the north west area of the survey boundary travelling east and ending abruptly near the school's perimeter fence. Where GPR results confirmed EML findings the quality level has been increased to QB1.

SEE CAUTIONARY NOTES WITHIN THE UTILITY KEY

PAS 128:2014 Quality Level Guide

Quality Level	Description	Accuracy
QB4	A utility is expected to exist but cannot be detected - (AR), (R), (V).	Undefined.
QB3 QB3P	Horizontal location only using one geophysical technique. No depth information - NDI.	+/- 500mm Horizontal Undefined Vertical
QB2 QB2P	Horizontal and vertical location only using one geophysical technique.	+/- 250mm or +/- 40% of depth whichever is greater
QB1 QB1P	Horizontal and vertical location only using two geophysical techniques.	+/- 150mm or +/- 15% of depth whichever is greater
QA	Service verified in an open excavation, inside an inspection chamber / draw pit, or at the point the service enters / exits the ground.	+/- 50mm Horizontal +/- 25mm Vertical

Desktop Utility Records

Utility Type	Provider Details	Date Acquired
Drainage	Severn Trent Water	27/05/2022
Water	Severn Trent Water	27/05/2022
Gas	Cadent	28/05/2022
Gas	ESP Utilities	28/05/2022
Telecom	Openreach	27/05/2022
CATV	Virgin Media	27/05/2022
Electricity	Western Power Distribution	28/05/2022
Tunnels & Pipelines	LinesearchbeforeUdig	28/05/2022

Revision	Description	Surv by	Check by	Appr by	Date

0m 2 4 6 8 10 12 14 16 18 20 22

Topographical and PAS 128:2014 Utility Survey

Client:

Perfect Circle

Stuart Avenue
Forest Town
Mansfield
Nottinghamshire

Scale:	Sheet Size:	Sheet Number:	Date:
1:200	A0	3	July 2022
Project Number:	Rev.	Surveyed by:	Checked by:	Approved by:
31421	-	JH/JKH	AJ/TW	TS/NF

mksurveys
www.mksurveys.com www.surveys4bim.co.uk
Head Office: Milton Keynes t: 01908 565561 e: mail@mksurveys.co.uk

Appendix B

Proposed Site Plan

Schedule of Accomodation

3 Bed Detached with Garage	8
3 Bed Semi-Detached with Garage	36
2 Bed Semi-Detached	8
Total	52

Proposed Site Plan - Pump Hollow Lane Access

1 : 1000

Scale 1:1000

0 10 100 m

NB site layout shown indicatively only and is subject to consultation with and approval from relevant authorities, as well as results of all site surveys and investigations.

Rev:	Date:	Description:	Drn:	Chk:
P02	13.03.23	Annotation revisions	BAY	PGM
P01	24.02.23	First Issue	BAY	PGM

Client: Nottinghamshire County Council

Project Name: Land At Stuart Avenue, Mansfield

Site Address: Stuart Avenue, Mansfield, NG19 0AE

Project No: 230383

Prop Ref:

Drawing Title: Proposed Sketch Site Plan - Pump Hollow Lane Access Option

Project - Originator - Functional - Spatial - Form - Discipline - Number: 230383-ARC-A01-XX-D-A-010006

Status Code: S0 : Initial Status

Revision: P02

Sheet Size: A2

Scale: 1 : 1000

arcpartnership
2nd Floor, East West Building, 1 Tollhouse Hill, Nottingham, NG1 5AT
0115 838 4844 | arc-partnership.co.uk

Appendix C

Severn Trent Water Correspondence & Sewer Records

WONDERFUL ON TAP

Severn Trent Water Ltd
Oxley Moor Road
Wolverhampton
WV9 5HN

Tel: 07976 449091
www.stwater.co.uk
network.solutions@severntrent.co.uk

Contact: Pierce Meguer

Reference: 1071487

26th January 2023

BSP Consulting
12 Oxford Street
Nottingham
NG1 5BG

FAO: s.bond@bsp-consulting.co.uk

Dear Simon,

Proposed development: 90 residential properties at land North of Abbey Primary School, Stuart Avenue, Mansfield, Nottinghamshire

X: 455938 / Y: 361527

I refer to your 'Development Enquiry Request' in respect of the above site. Please find enclosed the sewer records that are included in the fee together with the Supplementary Guidance Notes which refer to surface water disposal from development sites.

Public Sewers in Site – Required Protection

Having viewed our statutory sewer records, they demonstrate the following sewers passing through the site, with associated protection/no build zones:

- The 300mm pressurised combined water sewer within the site requires a 15-metre easement across it, 5 metres from the centreline of the pipe.
- The 300mm pressurised foul water sewer within the site requires a 10-metre easement across it, 5 metres from the centreline of the pipe.
- The 225mm combined water sewer within the site requires a 6-metre easement across it, 3 metres from the centreline of the pipe.

Due to the strategic importance of the sewer a diversion or build over/ close too applications will not be considered under any circumstance. If the full easement has not been provided, then the layout should be amended to accommodate the easement strip.

You may want to consider applying for the sewers within the site to be diverted, however, due to the strategic importance of the two rising mains if a diversion is accepted then Severn Trent Water will need to carry out the work at your client's cost. Further information can be viewed here;

https://www.stwater.co.uk/content/dam/stw/stw_buildinganddeveloping/Sewer-diversion-guidance-GN6.pdf

https://www.stwater.co.uk/content/dam/stw/stw_buildinganddeveloping/st-section-185-flow-chart.pdf

Please consider, due to a change in legislation on 1 October 2011, there may be former private sewers on the site which have transferred to the responsibility of Severn Trent Water Ltd, which are not shown on the statutory sewer records but are located in your client's land. These sewers would also have protective strips that we will not allow to be built over. If such sewers are identified to be present on the site, please contact us for further guidance.

Foul Water Drainage

The sewer records show a 300mm combined sewer and a 150mm foul network on Stuart Ave and Pump Hollow Lane as the closest point of connection for the site. These networks are located a couple of metres upstream of the Pump Hollow Lane CSO chamber and as such a connection into either network is not advised.

Instead, Severn Trent Water would suggest a connection into the 300mm combined sewer, downstream of the CSO chamber, at manhole SK56611401 should be explored.

It is anticipated that the additional foul flows (approx. 1.41 l/s at 2 x DWF) may have an adverse effect on the existing network. As such Modelling will be required to be better understand the impact. Severn Trent propose that two scenarios are modelled, the first being a connection upstream of the CSO chamber on the 300mm combined network and the other at manhole SK56611401.

To enable STW to determine the impact on the works modelling will be required to better understand it. In a change to our previous process, we no longer charge developers for the hydraulic modelling service. We will liaise with you over time with regards to the outcome of our investigations and any impact that may have on the planning status, occupation, or phasing of the site. However, while we can provide a brief summary of our findings if you need us to, we will no longer provide the full external capacity assessment report.

From the application you have submitted, I am assuming that the development has not been granted planning approval. Please inform us as and when planning has progressed as this will help determine how quick we carry out the modelling exercise. In the meantime, the site will be added to our modelling tracker and reviewed regularly until the site can be progressed for sewer modelling. I would therefore be grateful if you would forward as soon as possible the following details:

- Proposed submission of your Planning Application
- Confirmation whether a pumped solution is required.
- Proposed planned start and completion date.
- Any phasing details of the proposed development.
- Confirm how many properties will discharge into each of the connections to the public sewer.
- Planned occupation date.

Surface Water Drainage

Under the terms of Section H of the Building Regulations 2000, the disposal of surface water by means of soakaways should be considered as the primary method. If these are found to be unsuitable, satisfactory evidence will need to be submitted. The evidence should be either percolation test results or by the submission of a statement from the SI consultant (extract or a supplementary letter).

Subject to above Severn Trent Water expects all surface water from the development to be drained in a sustainable way to the nearest watercourse or land drainage channel, subject to the developer discussing all aspects of the developments surface water drainage with the Local Lead Flood Authority (LLFA). Any discharge rate to a watercourse or drainage ditch will be determined by the LLFA / EA.

As noted within the supporting information preliminary percolation tests suggest that the use of soakaways is likely on site. Therefore a connection to the public network should not be required.

Please note, STW and the LPA have determined that no surface water connections to the combined network will be considered for any new site within Mansfield. As a last resort STW may consider allowing a surface water connection to the 675mm surface water sewer on Pump Hollow Lane at greenfield or Q-bar rates, dependant at which rate is lower during a 1 in 100 year (+40%) storm event.

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SEVERN TRENT

New Connections

For any new connections (including the re-use of existing connections) to the public sewerage system, the developer will need to submit Section 106 application forms. Our New Connections department are responsible for handling all such enquiries and applications. To contact them for an application form and associated guidance notes please call 0800 707 6600 or download from www.stwater.co.uk.

Please quote is 1071487 in any future correspondence (including e-mails) with STW Limited. Please note that 'Development Enquiry' responses are only valid for 6 months from the date of this letter.

Yours sincerely,

Pierce Meguer
Senior Evaluation Technician
Network Solutions
Developer Services

SUPPLEMENTARY GUIDANCE NOTES RELATING TO DISPOSAL OF SURFACE WATER

Introduction

The purpose of this guidance note is to provide advice to applicants when completing the surface water drainage design for a new development, both for Greenfield and Brownfield sites. This does not affect foul drainage disposal which should be discussed with Severn Trent as early as possible to ensure additional flows can be accommodated without undue delay to the development.

Lead Local Flood Authority (LLFA) Consultation

Since April 2015, the LLFA have assumed the role of being a statutory consultee in the planning process for developments of 10 dwellings or more: or equivalent non-residential and/or mixed development. The LLFAs role is vital to ensure that surface water disposal on new development is adequately assessed so that the local planning authority can satisfy themselves that drainage proposals are satisfactory and to make sure, through the use of planning conditions or planning obligations, that there are clear arrangements in place for future maintenance of sustainable drainage systems (SuDS) over the lifetime of the development. This will also ensure surface water disposal aligns with local planning policies, flood risk strategies and national policies, such as the National Planning Policy Framework (NPPF).

It is strongly recommended that the LLFA are involved in early pre-application discussions when the development of a site is initially being considered. Pre-application discussions will help to ensure that SuDS are appropriately considered ahead of or as part of preliminary development layouts, and that they are fully integrated into the final development layout. Whilst Severn Trent are willing to advise on sewerage availability this does to negate the planning requirement relating to adequacy of SuDS on new development.

Council Guidance

Specific guidance has been published by each of the Councils, within the Severn Trent area, for the purpose of providing guidance to all persons involved in the design, construction, operation and future maintenance of all SuDs features within their jurisdiction.

The purpose of the council producing this guidance is to unite all stakeholders to embrace a new attitude to SuDs to respond to the pressures to the changing climate as well as the need to better under area's ground conditions, greenfield, urbanised environment, and watercourses. Each Council's guidance has been published on their websites which we encourage developers to use as a resource before considering a surface water connection to the Severn Trent Water network.

Links to the council specific guidance can be found on the accompanying spreadsheet.

SuDS Hierarchy

Severn Trent is fully supportive of the fundamental SuDS principle that priority should be given to managing surface water as close to source as possible. In accordance with national standards and guidance a sequential series of checks should be undertaken to ensure the relevant SuDS features are being proposed whereby (in order of priority) rainwater re-use, infiltration to ground and controlled discharge to a water body are properly considered ahead of any controlled connection to a culverted watercourse/other drainage system or public surface water sewer.

A controlled connection to a public combined/foul sewer would only be considered under rare exceptional circumstances where all other options have been completely exhausted. Acceptance of surface water into a combined sewer is not only unsustainable because of the need to convey/treat rainwater but is also takes away existing capacity which could constrain the connection of foul flows on future development. It is also possible that connection of additional surface water flows will require capacity upgrades to the existing sewerage system which may delay development.

Severn Trent consider the CIRIA 'The SuDs Manual' (C753F) guidance to the most comprehensive study that provides bets practice guidance on how to ensure the effective delivery of surface water management. A free copy of the guidance can be downloaded from the CIRIA, here:
https://www.ciria.org/ItemDetail?iProductCode=C753F&Category=FREEPUBS

Connection to a Public Sewer

Whilst Severn Trent will be able to provide advice on potential public surface water sewer connection options, it is essential that a developer contacts the LLFA as early as possible to discuss surface water disposal as they will be able to provide guidance on surface water flood risk policy which may influence SuDS requirements. It is strongly recommended that LLFA discussions take place before contacting Severn Trent. Where the outcome of LLFA discussions concludes that a controlled discharge to the public sewerage system is the only viable option then Severn Trent would be pleased to discuss sewer connection options, satisfied that the LLFA have been consulted in line with their surface water management role and in their capacity as statutory consultee.

Evidence must be provided to demonstrate why the sequential SuDS checks have concluded that a connection to the public sewer is required. This must include a Site Investigation Report including percolation test data/graphs/calculations/results together with relevant correspondence with the LLFA.

Design Standards

Surface water disposal design should consider the interactions between the adoptable sewer design criteria based on a 30-year design storm (outlined in ‘Design and Construction Guidance') and the “Non-statutory technical standards for SuDS” requirement to restrict discharge from a site up to and including the 1 in 100 year critical storm event plus an allowance for climate change as required by the LLFA.

For Greenfield development, the peak runoff rate should never exceed the peak pre-development run-off rates/volumes for the same rainfall event irrespective of the design storm duration consistent with the national non-statutory technical standards. For developments which were previously developed (Brownfield), the peak runoff rate must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event but should never exceed the rate of discharge from the development prior to redevelopment again for the same rainfall event. This requirement to remove pre-development surface water discharges to the sewerage system will help remove capacity constraints and aid future development.

To establish the pre-development run-off rates a detailed existing drainage survey will be required indicating pipe locations including sizes and levels, impermeable area connectivity to each pipe and topographical information to support existing drainage assumptions. Photographs of the existing buildings and surface features should be provided and where necessary a CCTV sewer survey should be provided to support the drainage survey to demonstrate connectivity.

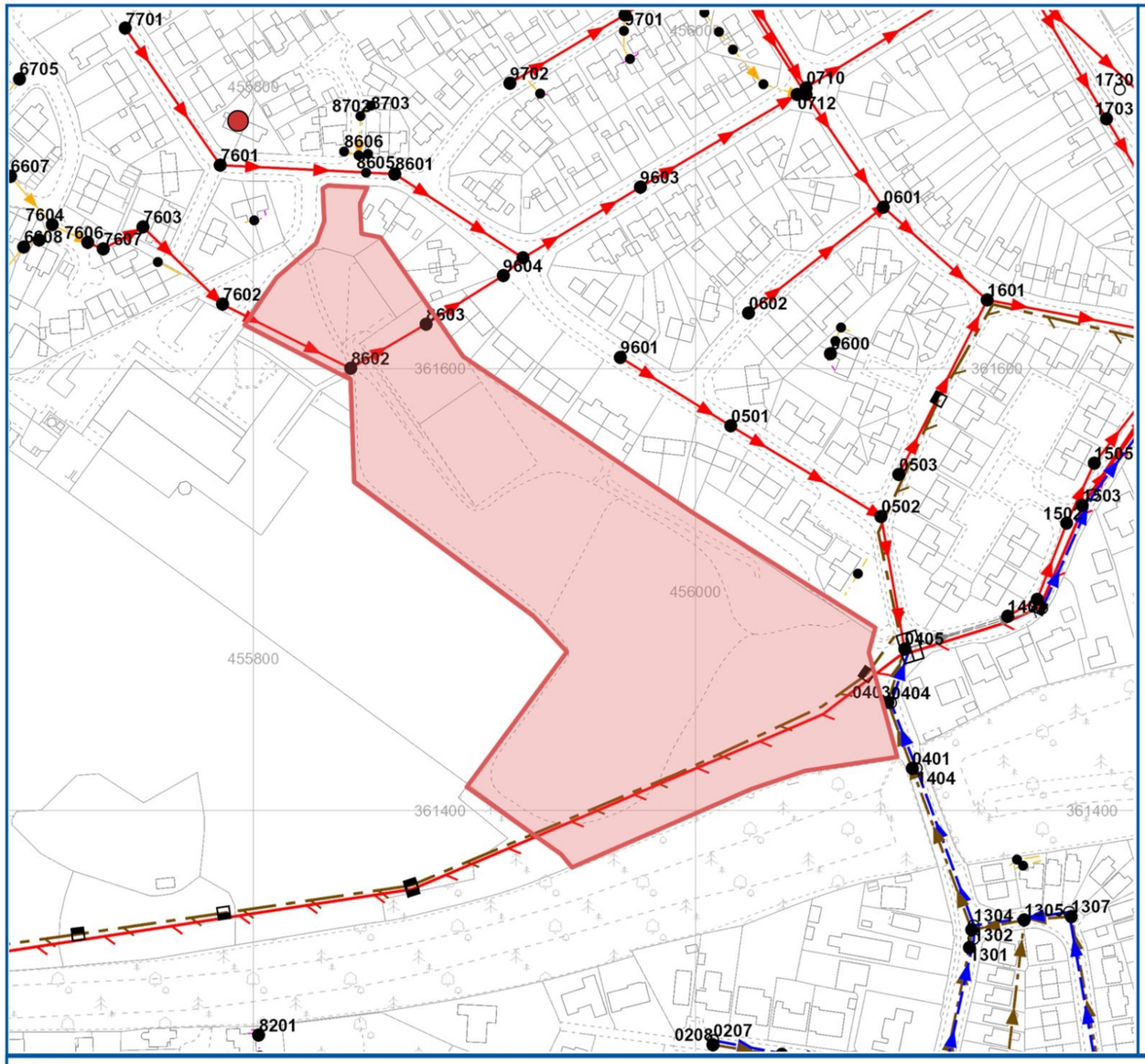
In line with 'Design and Construction Guidance', the drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30-year rainfall event. For higher storm return periods the drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100-year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station, electricity substation, water booster station) within the development.

Small Developments

Whilst developments of fewer than 10 dwellings (or their equivalent) are excluded from the post April 2015 planning requirements the underlying principles regarding sustainable surface water management are still valid. The collective impacts of surface water discharges from smaller developments can have an adverse impact on flood risk, especially in smaller rural catchments where smaller sewerage systems are more susceptible to increases in surface water inflow. On small developments infiltration to ground and peak flow attenuation must be considered to mitigate flood risk in the community but where a sewer connection is envisaged then the developer is recommended to discuss surface water disposal options with Severn Trent as early as possible.

Contact

For further assistance please contact our Network Solutions team via: network.solutions@severntrent.co.uk



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LEGEND

Ancillary
- Balancing Lagoon
- Grease Trap
- Interceptor
- Screen

Chamber
- Flushing Chamber
- Scalaway
- Overflow

Fitting
- Blind Shaft
- Facility Connector
- Head Node
- Lamphole
- Sewerage Air Valve
- Sewerage Chemical Injection Point
- Sewerage Hatch Box
- Sewerage Pressure Washout
- Vent Column
- Waste Water Outfall

Control Valve
- Hydrobrake
- Penstock

- Sewerage Isolation Valve
- Sewerage Non Return Valve

Manhole
- Foul Bifurcation Manhole
- Combined Bifurcation Manhole
- Surface Water Bifurcation Manhole
- Dual Manhole
- Foul Single Manhole
- Combined Single Manhole
- Surface Water Single Manhole
- Twin Manhole
- Foul Adopted Manhole
- Combined Adopted Manhole
- Surface Adopted Manhole
- Transferred Manhole
- Unsurveyed Manhole

Operational Site

Waste Water Pump
- Transferred Asset
- S24
- S104
- S102
- Null Private

- Null
- None
- Highway Drain
- Adopted Sewer

Storage
- Disposal Site
- Off-Line Waste Water Storage
- On-Line Waste Water Storage
- Wet Well

Waste Water Process Structure
- Sewage Treatment Point
- Sewage Treatment Structure
- Sludge Treatment Point
- Sludge Treatment Structure

Gravity Sewer Pipe
- Foul Gravity Sewer
- Combined Gravity Sewer
- Surface Water Gravity Sewer
- S104 Surface Water Gravity Sewer
- S104 Combined Gravity Sewer
- S104 Foul Gravity Sewer
- Private Surface Water Gravity Sewer
- Private Combined Gravity Sewer

- Private Foul Gravity Sewer
- Surface Water Unsurveyed Pipe
- Combined Unsurveyed Pipe
- Foul Unsurveyed Pipe
- Transferred Surface Water Sewer
- Transferred Combined Sewer
- Transferred Foul Sewer
- Disposal Pipe
- Overflow Pipe
- Culverted Water Course
- Waste Internal Site Pipe
- Sewer Service Connection
- Gravity Sewer Others

Pressure Sewer Pipe
- Surface Water Pressure Sewer
- Combined Pressure Sewer
- Foul Pressure Sewer
- S104 Surface Water Pressure Sewer
- S104 Combined Pressure Sewer
- S104 Foul Pressure Sewer
- Private Surface Water Pressure Sewer
- Private Combined Pressure Sewer
- Private Foul Pressure Sewer

- Surface Water Vacuum Sewer
- Foul Vacuum Sewer
- Combined Vacuum Sewer
- S104 Surface Water Vacuum Sewer
- S104 Combined Vacuum Sewer
- S104 Foul Vacuum Sewer
- Private Surface Water Vaccum Sewer
- Private Combined Vacuum Sewer
- Private Foul Vacuum Sewer
- Surface Water Siphon
- Combined Siphon
- Foul Siphon
- Private Surface Water Siphon
- Private Combined Siphon
- Private Foul Siphon
- S104 Surface Water Siphon
- S104 Combined Siphon
- S104 Foul Siphon
- Surface Water Unsurveyed Pipe
- Combined Unsurveyed Pipe
- Foul Unsurveyed Pipe
- Disposal Pipe

Service Pipe
- Surface Water Lateral Drain
- Combined Lateral Drain
- Foul Lateral Drain
- S104 Surface Water Lateral Drain
- S104 Combined Lateral Drain
- S104 Foul Lateral Drain
- Private Surface Water Lateral Drain
- Private Combined Lateral Drain
- Private Foul Lateral Drain
- Transferred Surface Water Lateral Dra
- Transferred Combined Lateral Drain
- Transferred Foul Lateral Drain

Print200mLine

MATERIALS

-	NONE
AC	ASBESTOS CEME
BR	BRICK
CC	CONCRETE BOX CULVERT
CI	CAST IRON
CO	CONCRETE
CSB	CONCRETE SEGMENTS (BOLTED)
CSU	CONCRETE SEGMENTS (UNBOLTED)
DI	DUCTILE IRON
GRP	GLASS REINFORCED PLASTIC
MAC	MASONRY IN REGULAR COURSES
MAR	MASONRY RANDOMLY COURSED
PE	POLYETHLENE
PF	PITCH
PP	POLYPROPYLENE
PSC	PLASTIC STEEL COMPOSITE
PVC	POLYVINYL CHLORIDE
RPM	REINFORCED PLASTIC MATRIX
SI	SPUN (GREY) IRON
ST	STEEL
U	UNKNOWN
VC	VITRIFIED CLAY
XXX	OTHER

CATEGORIES

W	WEIR
C	CASCADE
DB	DAMBOARD
SE	SIDE ENTRY
FV	FLAP VALVE
BD	BACK DROP
S	SIPHON
D	HIGHWAY DRAIN
S104	SECTION 104

SHAPE

C	CIRCULAR
E	EGG SHAPED
O	OTHER
R	RECTANGLE
S	SQUARE
T	TRAPEZOIDAL
U	UNKNOWN

PURPOSE

C	COMBINED
E	FINAL EFFLUENT
F	FOUL
L	SLUDGE
S	SURFACE WATER

N W E S

SEVERN TRENT

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0345 601 6616

SEWER RECORD (Tabular)

O/S Map Scale: 1:2,500 **This map is centred upon:**

Date of Issue: 26-01-23 **X:** 455943.81 **Y:** 361526.64

Disclaimer Statement:

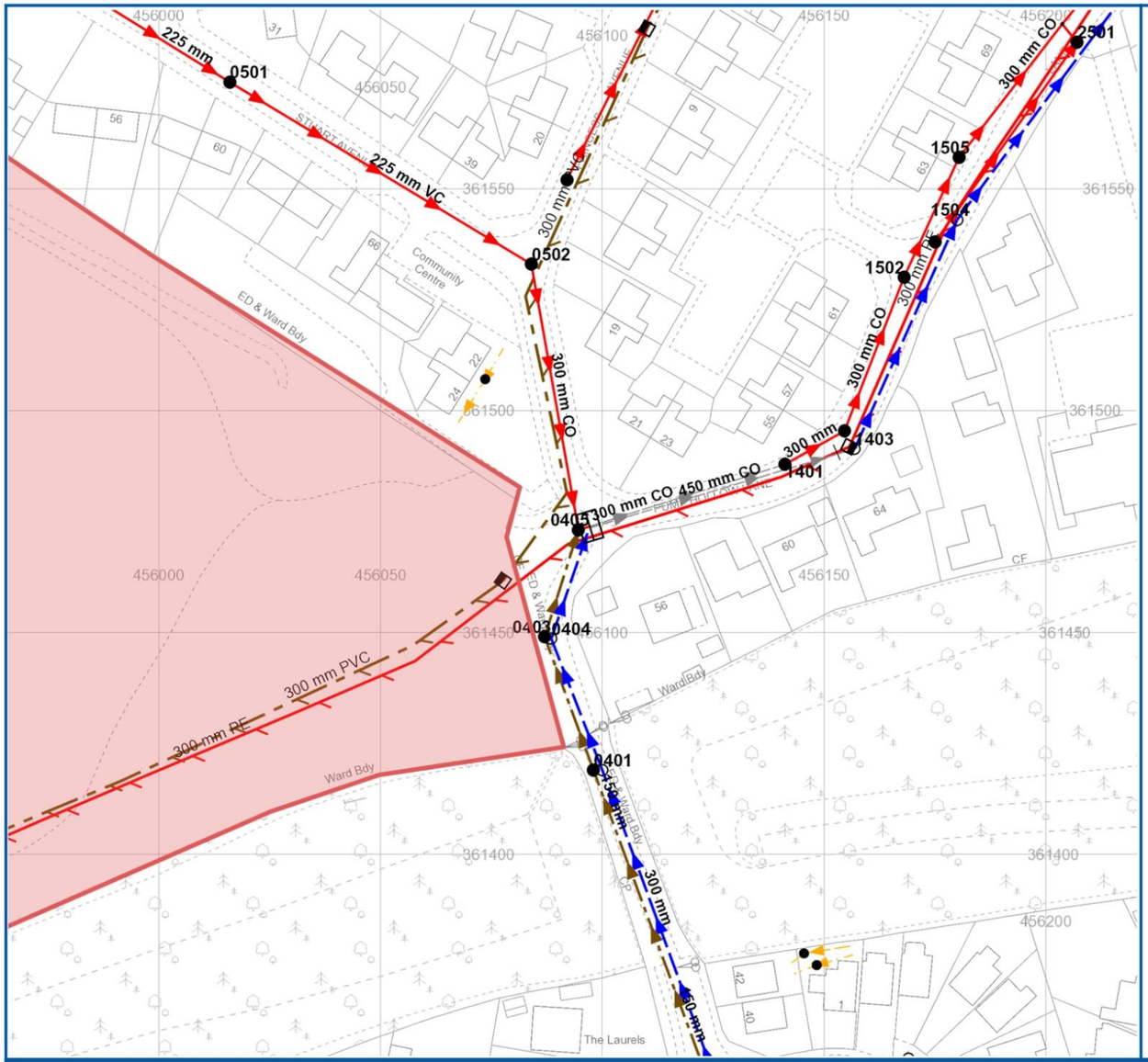
1 Do not scale off this Map.

2 This plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this plan and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of SEVERN TRENT WATER assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems.

3 On 1 October 2011 most private sewers and private lateral drains in Severn Trent Water's sewerage area, which were connected to a public sewer as at 1 July 2011, transferred to the ownership of Severn Trent Water and became public sewers and public lateral drains. A further transfer takes place on 1 October 2012. Private pumping stations, which form part of these sewers or lateral drains, will transfer to ownership of Severn Trent Water on or before 1 October 2016. Severn Trent Water does not possess complete records of these assets. These assets may not be displayed on the map.

5 Ordnance Survey licence number: **100031673**

6 Document users other than SEVERN TRENT WATER business users are advised that this document is provided for reference purpose only and is subject to copyright, therefore, no further copies should be made from it.



Reference	Cover Level	Invert Level Upstream	Invert Level Downstream	Purpose	Material	Pipe Shape	Max Size	Min Size	Gradient	Year Laid
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SK56610501	107.901	106.24	102.83	C	VC	C	225	<UNK>	23.28	31/12/1899 00:00:00
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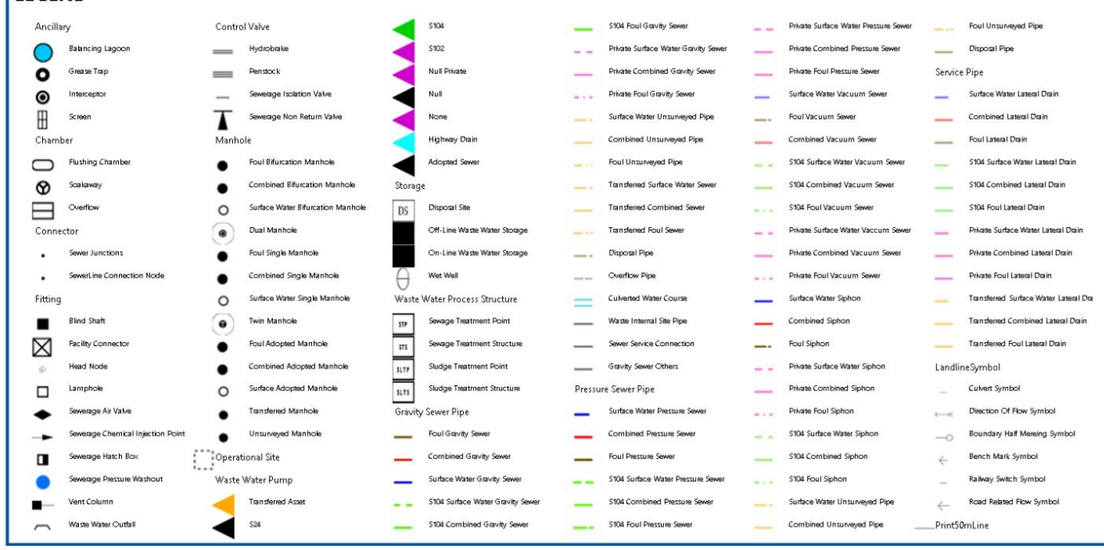
LEGEND



MATERIALS

- - NONE
- AC - ASBESTOS CEME
- BR - BRICK
- CC - CONCRETE BOX CULVERT
- CI - CAST IRON
- CO - CONCRETE
- CSB - CONCRETE SEGMENTS (BOLTED)
- CSU - CONCRETE SEGMENTS (UNBOLTED)
- DI - DUCTILE IRON
- GRP - GLASS REINFORCED PLASTIC
- MAC - MASONRY IN REGULAR COURSES
- MAR - MASONRY RANDOMLY COURSED
- PE - POLYETHLENE
- PF - PITCH
- PP - POLYPROPYLENE
- PSC - PLASTIC STEEL COMPOSITE
- PVC - POLYVINYL CHLORIDE
- RPM - REINFORCED PLASTIC MATRIX
- SI - SPUN (GREY) IRON
- ST - STEEL
- U - UNKNOWN
- VC - VITRIFIED CLAY
- XXX - OTHER

CATEGORIES

- W - WEIR
- C - CASCADE
- DB - DAMBOARD
- SE - SIDE ENTRY
- FV - FLAP VALVE
- BD - BACK DROP
- S - SIPHON
- D - HIGHWAY DRAIN
- S104 - SECTION 104

SHAPE

- C - CIRCULAR
- E - EGG SHAPED
- O - OTHER
- R - RECTANGLE
- S - SQUARE
- T - TRAPEZOIDAL
- U - UNKNOWN

PURPOSE

- C - COMBINED
- E - FINAL EFFLUENT
- F - FOUL
- L - SLUDGE
- S - SURFACE WATER

SEVERN TRENT

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0345 601 6616

SEWER RECORD (Tabular)

O/S Map Scale: 1:1,250

This map is centred upon:

Date of Issue: 26-01-23

X: 456093.23 **Y:** 361472.46

Disclaimer Statement:

1 Do not scale off this Map.

2 This plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this plan and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of SEVERN TRENT WATER assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems.

3 On 1 October 2011 most private sewers and private lateral drains in Severn Trent Water's sewerage area, which were connected to a public sewer as at 1 July 2011, transferred to the ownership of Severn Trent Water and became public sewers and public lateral drains. A further transfer takes place on 1 October 2012. Private pumping stations, which form part of these sewers or lateral drains, will transfer to ownership of Severn Trent Water on or before 1 October 2016. Severn Trent Water does not possess complete records of these assets. These assets may not be displayed on the map.

5 Ordnance Survey licence number: **100031673**

6 Document users other than SEVERN TRENT WATER business users are advised that this document is provided for reference purpose only and is subject to copyright, therefore, no further copies should be made from it.

Appendix D

Proposed Drainage Strategy Supporting Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.150
Area (ha)	3.340	Urban	0.000
SAAR (mm)	700	Region Number	Region 4

Results l/s

QBAR Rural	1.4
QBAR Urban	1.4
Q1 year	1.1
Q1 year	1.1
Q30 years	2.7
Q100 years	3.5

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.350
Area (ha)	3.340	Urban	0.000
SAAR (mm)	700	Region Number	Region 4

Results l/s

QBAR Rural	8.5
QBAR Urban	8.5
Q1 year	7.1
Q1 year	7.1
Q30 years	16.7
Q100 years	21.9

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 690 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	110.048	0.318	0.1	3.3	O K
30 min Summer	110.143	0.413	0.1	4.3	O K
60 min Summer	110.238	0.508	0.1	5.3	O K
120 min Summer	110.326	0.596	0.1	6.2	O K
180 min Summer	110.368	0.638	0.1	6.7	O K
240 min Summer	110.391	0.661	0.1	6.9	O K
360 min Summer	110.413	0.683	0.1	7.1	O K
480 min Summer	110.419	0.689	0.1	7.2	O K
600 min Summer	110.418	0.688	0.1	7.2	O K
720 min Summer	110.416	0.686	0.1	7.2	O K
960 min Summer	110.408	0.678	0.1	7.1	O K
1440 min Summer	110.384	0.654	0.1	6.8	O K
2160 min Summer	110.338	0.608	0.1	6.4	O K
2880 min Summer	110.290	0.560	0.1	5.8	O K
4320 min Summer	110.202	0.472	0.1	4.9	O K
5760 min Summer	110.136	0.406	0.1	4.2	O K
7200 min Summer	110.096	0.366	0.1	3.8	O K
8640 min Summer	110.064	0.334	0.1	3.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	19
30 min Summer	90.705	0.0	33
60 min Summer	56.713	0.0	64
120 min Summer	34.246	0.0	122
180 min Summer	25.149	0.0	182
240 min Summer	20.078	0.0	242
360 min Summer	14.585	0.0	360
480 min Summer	11.622	0.0	478
600 min Summer	9.738	0.0	524
720 min Summer	8.424	0.0	584
960 min Summer	6.697	0.0	704
1440 min Summer	4.839	0.0	978
2160 min Summer	3.490	0.0	1380
2880 min Summer	2.766	0.0	1764
4320 min Summer	1.989	0.0	2512
5760 min Summer	1.573	0.0	3232
7200 min Summer	1.311	0.0	3960
8640 min Summer	1.129	0.0	4672

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
10080 min Summer	110.038	0.308	0.1	3.2	O K
15 min Winter	110.086	0.356	0.1	3.7	O K
30 min Winter	110.193	0.463	0.1	4.8	O K
60 min Winter	110.301	0.571	0.1	6.0	O K
120 min Winter	110.401	0.671	0.1	7.0	O K
180 min Winter	110.451	0.721	0.1	7.5	O K
240 min Winter	110.479	0.749	0.1	7.8	O K
360 min Winter	110.508	0.778	0.1	8.1	O K
480 min Winter	110.519	0.789	0.1	8.2	O K
600 min Winter	110.520	0.790	0.1	8.3	O K
720 min Winter	110.514	0.784	0.1	8.2	O K
960 min Winter	110.499	0.769	0.1	8.0	O K
1440 min Winter	110.461	0.731	0.1	7.6	O K
2160 min Winter	110.388	0.658	0.1	6.9	O K
2880 min Winter	110.314	0.584	0.1	6.1	O K
4320 min Winter	110.185	0.455	0.1	4.8	O K
5760 min Winter	110.109	0.379	0.1	4.0	O K
7200 min Winter	110.062	0.332	0.1	3.5	O K
8640 min Winter	110.026	0.296	0.1	3.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
10080 min Summer	0.994	0.0	5448
15 min Winter	138.153	0.0	19
30 min Winter	90.705	0.0	33
60 min Winter	56.713	0.0	62
120 min Winter	34.246	0.0	120
180 min Winter	25.149	0.0	180
240 min Winter	20.078	0.0	238
360 min Winter	14.585	0.0	352
480 min Winter	11.622	0.0	464
600 min Winter	9.738	0.0	572
720 min Winter	8.424	0.0	672
960 min Winter	6.697	0.0	760
1440 min Winter	4.839	0.0	1066
2160 min Winter	3.490	0.0	1496
2880 min Winter	2.766	0.0	1904
4320 min Winter	1.989	0.0	2640
5760 min Winter	1.573	0.0	3344
7200 min Winter	1.311	0.0	4104
8640 min Winter	1.129	0.0	4840

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
10080 min Winter	109.998	0.268	0.1	2.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
10080 min Winter	0.994	0.0	5552

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.013

Time (mins) From:	To:	Area (ha)
0	4	0.013

Model Details

Storage is Online Cover Level (m) 111.730

Trench Soakaway Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	2.0
Infiltration Coefficient Side (m/hr)	0.06120	Trench Length (m)	5.5
Safety Factor	1.0	Slope (1:X)	0.0
Porosity	0.95	Cap Volume Depth (m)	0.800
Invert Level (m)	109.730	Cap Infiltration Depth (m)	0.400

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	104.875	0.575	3.1	0.0	3.1	176.2	O K
30 min Summer	104.967	0.667	3.1	0.0	3.1	230.6	O K
60 min Summer	105.052	0.752	3.1	0.0	3.1	285.5	O K
120 min Summer	105.126	0.826	3.1	0.0	3.1	338.6	O K
180 min Summer	105.162	0.862	3.1	0.0	3.1	366.5	O K
240 min Summer	105.184	0.884	3.1	0.0	3.1	383.6	O K
360 min Summer	105.206	0.906	3.1	0.0	3.1	401.2	O K
480 min Summer	105.217	0.917	3.1	0.0	3.1	410.0	O K
600 min Summer	105.221	0.921	3.1	0.0	3.1	413.4	O K
720 min Summer	105.221	0.921	3.1	0.0	3.1	413.4	O K
960 min Summer	105.213	0.913	3.1	0.0	3.1	406.8	O K
1440 min Summer	105.187	0.887	3.1	0.0	3.1	385.8	O K
2160 min Summer	105.153	0.853	3.1	0.0	3.1	359.4	O K
2880 min Summer	105.124	0.824	3.1	0.0	3.1	337.0	O K
4320 min Summer	105.067	0.767	3.1	0.0	3.1	295.9	O K
5760 min Summer	105.009	0.709	3.1	0.0	3.1	257.2	O K
7200 min Summer	104.949	0.649	3.1	0.0	3.1	219.0	O K
8640 min Summer	104.875	0.575	3.1	0.0	3.1	176.3	O K
10080 min Summer	104.806	0.506	3.1	0.0	3.1	140.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	127.917	0.0	179.1	0.0	27
30 min Summer	83.984	0.0	233.0	0.0	41
60 min Summer	52.595	0.0	295.6	0.0	70
120 min Summer	31.881	0.0	358.2	0.0	130
180 min Summer	23.498	0.0	395.9	0.0	190
240 min Summer	18.825	0.0	422.7	0.0	248
360 min Summer	13.664	0.0	459.3	0.0	366
480 min Summer	10.886	0.0	482.9	0.0	486
600 min Summer	9.123	0.0	485.3	0.0	604
720 min Summer	7.893	0.0	483.2	0.0	722
960 min Summer	6.276	0.0	477.9	0.0	960
1440 min Summer	4.537	0.0	466.0	0.0	1218
2160 min Summer	3.274	0.0	662.8	0.0	1588
2880 min Summer	2.595	0.0	700.5	0.0	1992
4320 min Summer	1.868	0.0	755.7	0.0	2816
5760 min Summer	1.478	0.0	798.0	0.0	3640
7200 min Summer	1.232	0.0	831.3	0.0	4464
8640 min Summer	1.061	0.0	859.2	0.0	5184
10080 min Summer	0.935	0.0	883.2	0.0	5856

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	104.913	0.613	3.1	0.0	3.1	197.8	O K
30 min Winter	105.012	0.712	3.1	0.0	3.1	258.9	O K
60 min Winter	105.102	0.802	3.1	0.0	3.1	321.1	O K
120 min Winter	105.182	0.882	3.1	0.0	3.1	381.9	O K
180 min Winter	105.222	0.922	3.1	0.0	3.1	414.6	O K
240 min Winter	105.247	0.947	3.1	0.0	3.1	435.0	O K
360 min Winter	105.273	0.973	3.1	0.0	3.1	457.5	O K
480 min Winter	105.287	0.987	3.1	0.0	3.1	469.9	O K
600 min Winter	105.294	0.994	3.1	0.0	3.1	476.4	O K
720 min Winter	105.297	0.997	3.1	0.0	3.1	478.9	O K
960 min Winter	105.294	0.994	3.1	0.0	3.1	476.4	O K
1440 min Winter	105.271	0.971	3.1	0.0	3.1	456.1	O K
2160 min Winter	105.229	0.929	3.1	0.0	3.1	420.5	O K
2880 min Winter	105.192	0.892	3.1	0.0	3.1	389.8	O K
4320 min Winter	105.114	0.814	3.1	0.0	3.1	329.6	O K
5760 min Winter	105.030	0.730	3.1	0.0	3.1	271.0	O K
7200 min Winter	104.935	0.635	3.1	0.0	3.1	211.0	O K
8640 min Winter	104.814	0.514	3.1	0.0	3.1	144.0	O K
10080 min Winter	104.708	0.408	3.1	0.0	3.1	95.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Winter	127.917	0.0	200.4	0.0	26
30 min Winter	83.984	0.0	243.3	0.0	41
60 min Winter	52.595	0.0	331.0	0.0	70
120 min Winter	31.881	0.0	401.1	0.0	128
180 min Winter	23.498	0.0	442.9	0.0	186
240 min Winter	18.825	0.0	471.7	0.0	244
360 min Winter	13.664	0.0	488.8	0.0	360
480 min Winter	10.886	0.0	486.9	0.0	476
600 min Winter	9.123	0.0	484.9	0.0	592
720 min Winter	7.893	0.0	483.2	0.0	706
960 min Winter	6.276	0.0	480.4	0.0	930
1440 min Winter	4.537	0.0	477.5	0.0	1356
2160 min Winter	3.274	0.0	742.3	0.0	1692
2880 min Winter	2.595	0.0	784.4	0.0	2160
4320 min Winter	1.868	0.0	844.3	0.0	3072
5760 min Winter	1.478	0.0	893.7	0.0	3936
7200 min Winter	1.232	0.0	931.0	0.0	4832
8640 min Winter	1.061	0.0	962.3	0.0	5448
10080 min Winter	0.935	0.0	989.2	0.0	6048

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.600	Shortest Storm (mins)	15
Ratio R	0.403	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.750

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.250	4	8	0.250	8	12	0.250

Model Details

Storage is Online Cover Level (m) 105.700

Tank or Pond Structure

Invert Level (m) 104.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	99.8	0.500	499.2	1.000	898.6	1.400	1198.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0084-3100-1000-3100
Design Head (m)	1.000
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	84
Invert Level (m)	104.300
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.1	Kick-Flo®	0.623	2.5
Flush-Flo™	0.297	3.1	Mean Flow over Head Range	-	2.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.5	1.200	3.4	3.000	5.2	7.000	7.7
0.200	3.0	1.400	3.6	3.500	5.5	7.500	7.9
0.300	3.1	1.600	3.8	4.000	5.9	8.000	8.2
0.400	3.0	1.800	4.1	4.500	6.2	8.500	8.4
0.500	2.9	2.000	4.3	5.000	6.6	9.000	8.7
0.600	2.6	2.200	4.5	5.500	6.9	9.500	8.9
0.800	2.8	2.400	4.6	6.000	7.1		
1.000	3.1	2.600	4.8	6.500	7.4		

Orifice Overflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 105.300

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