Dice

Newcastle Avenue, Worksop
Flood Risk Assessment

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Flood Risk Assessment

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Executive Summary

Flood Risk

1. This Flood Risk Assessment has been carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) (Ref. 4), Planning Practice Guidance (PPG) (Ref. 17) and the Environment Agency's Flood Risk Assessment (EAFRA) Guidance Notes and the best practices in flood risk management.

2. An initial assessment indicates that the primary flood risk at the proposed development is from fluvial sources and surface water.

3. The Environment Agency's flood risk maps show that the site is located almost fully within Flood Zone 2 (medium risk), with the exception of a very narrow strip of land in the north-western corner of the site, adjacent to Newcastle Avenue, which falls within Flood Zone 3 (area of high risk).

4. The vulnerability of the development to flooding from all other sources, such as surface water, groundwater, sewerage and reservoir has been assessed. It is considered all these sources pose a low risk to the development, with the exception of surface water which poses a medium to high risk.

Drainage Strategy

5. Infiltration testing undertaken in January 2021 failed to record infiltration rates due to the water failing to dissipate sufficiently during the test period, deeming the ground impermeable. Furthermore, historic records show the presence of fuel tanks on site, which indicates potential for ground contamination, subject to further investigations. Based on the above information, infiltration type drainage is deemed unfeasible for this development. The infiltration tests and ground condition records can be found in **Appendix A.**

6. A below ground utility survey was undertaken by Survey Hub in November 2021 and indicates that the site is currently drained via two separate traditional surface water and a foul water drainage networks, discharging to the existing surface water and foul water sewers located within Newcastle Avenue. The private foul water network on site is shown to collect surface water from a couple of external hardstanding areas and discharging it to the public foul water sewers off site. As the site is to be redeveloped, all surface water discharging to foul drainage will be removed, therefore freeing capacity in Severn Trent Water's foul sewers.

7. The surface water system will provide attenuation for flows up to a 1 in 100-year storm event (+40% allowance for climate change). The proposed surface water strategy will not increase flood risk at the site or elsewhere.

8. The drainage strategy proposes to discharge the surface water from the newly proposed car park to the public surface water sewers within Newcastle Avenue via a new drainage network. The discharge rate from site is proposed to be restricted to brownfield run-off rates introducing 50% betterment to existing flows, prior to connecting to an existing surface water manhole on site.

1.0 Introduction

1.1 Dice Consulting Engineers Ltd (Dice) has been commissioned by BS^2 Ltd. to undertake a Flood Risk Assessment (FRA) for a proposed surface level car park at Newcastle Avenue, Worksop.

1.2 This FRA has been carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) (Ref. 4), Planning Practice Guidance (PPG) (Ref. 17) and the best practices in flood risk management.

1.3 The assessment has been prepared using our best engineering judgement but there are levels of uncertainty implicit in the historical data and methods of analysis. The report is based on the following information:

- Proposed Site Layout Plan;
- National Planning Policy Framework (NPPF);
- Practical Guidance to the NPPF;
- Nottinghamshire Preliminary Flood Risk Assessment 2011;
- Nottinghamshire Local Flood Risk Management Strategy 2016-2021;
- Strategic Flood Risk Assessment for Bassetlaw District Council – 2019;
- British Geological Survey Mapping;
- Indicative Flood Maps from Environment Agency (EA) website;
- Severn Trent Water (STW) public sewer records;
- Topographical Survey.

1.4 All comments and opinions contained in this report, including any conclusions, are based on the information available to Dice at the time of writing the report. The conclusions drawn by Dice could therefore differ if the information is found to be inaccurate, incomplete, or misleading. Dice accepts no liability should this prove to be the case, or, if additional information exists or becomes available with respect to this site.

1.5 Dice has completed this report for the benefit of the organisations/individuals referred to in paragraph 1.1; and any relevant Statutory Authority which may require reference in relation to approvals for the proposed redevelopment of the site. Other third parties should not use or rely upon the contents of the report unless written approval has been gained from Dice.

1.6 The objective of this assessment is to evaluate the following issues with regards to flood risk at the application site.

- Suitability of the proposed development in accordance with current planning policy.
- Identify the risk to both the proposed development and people from all forms of flooding.
- Provide a preliminary assessment of surface water management.
- Increasing the risk of flooding elsewhere e.g. surface water flows and flood routing.
- Recommendation of appropriate measures to mitigate against flooding both within the proposed development, and neighbouring land and property.

2.0 Site Description

Site Location & Surroundings

2.1 The application site is located in Worksop, approximately 24.5km north east of Sheffield City centre and covers an approximate area of 0.24ha. The National Grid Reference (NGR) for the approximate centre of the site is 458355, 378897.

Figure 1 – Site Location Plan

Site Description

2.2 The site is near rectangular in shape and consists of an existing motor vehicle garage and a car park. The site is bounded by Newcastle Avenue to the north, a motor garage to the west, commercial businesses to the east and there is an existing car park and vegetation to the south. The site is accessed directly off the adjacent Newcastle Avenue.

2.3 The site is located wholly within the Bassetlaw District Council and Nottinghamshire County Council (NCC) boundaries, with the NCC acting as the Lead Local Flood Authority (LLFA) for the site.

Topography

2.4 The site's topography is mostly flat, with levels varying between 32.2m above ordnance datum (AOD) and 32.5m AOD across the site, with the exception of the its south-western corner where the levels reach 34.2m AOD. A copy of the topographical survey is included in **Appendix B.**

Proposal

2.5 The development proposals comprise a new pay and display car park with associated parking meters, street lighting and other associated landscaping and infrastructure. The impermeable area of the proposed site is approximately 0.22ha. The proposed site layout is shown in **Appendix C.**

Geology

2.6 The British Geological Survey (BGS) maps show that the site is underlain by Edlington Formation – Sandstone with no record of Superficial Deposits being available.

2.7 The trial pit logs, produced by Ivy House Environmental in January 2021, recorded the presence of made ground on site at depths between 0.3m below ground level (bgl) and 1.0m bgl, underlain by brown, clayey and sandy silt. The trial pit logs can be found in **Appendix A.**

Hydrology and Hydrogeology

2.8 The closest main river to the site is the River Ryton, which is located approximately 180m north of the site boundary, with the Chesterfield Canal flowing parallel to it, approximately 160m to the north. The River Ryton flows northwards prior to joining the River Idle near the town of Bawtry on the South Yorkshire-Nottinghamshire border.

2.9 The nearest ordinary watercourse on site is located approximately 280m to the west of the site, flowing in northerly direction prior to joining the River Ryton.

2.10 The site is not located on any aquifers according to the EA groundwater map.

Existing Drainage

2.11 Severn Trent Water (STW) is responsible for the operation and maintenance of the public sewers within the local area. A copy of the available sewer records are provided in **Appendix D.**

2.12 Public sewer records indicate that there are no public sewers within the site boundary. However, there are both surface water and foul water public sewers running underneath Newcastle Avenue to the north of the site.

Artificial Water Bodies

2.13 The nearest standing water body to the site is the Sandhill Lake located approximately 410m north-west of the application site.

3.0 Policies

National Planning Policy Framework (NPPF)

3.1 The National Planning Policy Framework (Ref. 4) sets out the Government's objectives for the planning system and how there should be a 'Presumption in Favour of Sustainable Development' and the planning system should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. The document seeks to ensure that flood risk is considered at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Reference should also be made to the Planning Practice Guidance (Ref. 17) which provides additional guidance on flood risk.

3.2 For the purposes of applying the National Planning Policy Framework, areas at risk from all sources of flooding are included. For fluvial (river) and sea flooding, this is principally land within Flood Zones 2 and 3. It can also include an area within Flood Zone 1 which the Environment Agency has notified the local planning authority as having critical drainage problems.

3.3 The Flood and Water Management Act helps improve flood risk management and ensure the security of water supplies in England and Wales. The Act updates legislation to ensure better protection from flooding, manage water more sustainably, improve public services and secure water resources during periods of drought.

The Flood and Water Management Act helps to reduce flood risk by:

- Clarifying who is responsible for managing all sources of flood risk;
- Encourage more sustainable forms of drainage in new developments;
- Makes it easier to resolve misconnections to sewers.

3.4 The Flood and Water Management Act imparts significant new roles and responsibilities on local authorities. County or unitary authorities are now classed as lead local flood authorities (LLFAs) who have responsibilities for managing local flood risk.

The responsibilities of a LLFA include:

- Prepare and maintain a strategy for local flood risk management in their areas, coordinating views and activity with other local bodies and communities through public consultation and scrutiny, and delivery planning;
- Maintain a register of assets – these are physical features that have a significant effect on flooding in their area;
- Investigate significant local flooding incidents and publish the results of such investigations;
- Issue consents for altering, removing or replacing certain structures or features on ordinary watercourses;
- Play a lead role in emergency planning and recovery after a flood event.

Planning Practice Guidance on Flood Risk & Coastal Change - 2015

3.5 The Government's planning policy on sustainable drainage systems came into effect on 6 April 2015. It expects local planning policies and decisions on planning applications relating to major development (those of 10 dwellings or more; or equivalent non- residential or mixed development) to ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate. Lead Local Flood Authorities (LLFAs) have also been made statutory consultees and new non-statutory guidance has been published under the changes

3.6 The changes follow a joint Defra/DCLG consultation on delivering SuDS published in September 2014 in which the Government dropped all the key provisions of Schedule 3 of the Flood & Water Management Act 2010 and SuDS Approval Bodies (SABs) in favour of passing oversight of SuDS from county councils (who are also LLFAs) to local planning authorities. According to the new planning policy, local planning authorities are expected, when considering planning applications:

- To consult the relevant lead local flood authority on the management of surface water;
- To satisfy themselves that the proposed minimum standards of operation are appropriate;
- To ensure using planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

3.7 The policy also states that the sustainable drainage system should be designed to ensure that the maintenance and operation requirements are economically proportionate.

Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems – 2015

3.8 The non-statutory technical standards for the design, maintenance, and operation of sustainable drainage systems to drain surface water have been published by Defra. The standards apply to systems that drain surface water from housing, non-residential or mixed-use developments for the lifetime of the developments. The non-statutory technical standards are to be used in conjunction with the National Planning Policy Framework, and Planning Practice Guidance on Flood Risk & Coastal Change - 2015.

3.9 The National Planning Policy Framework (NPPF) requires that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA). The SFRA identifies areas that may flood, considering all potential sources of flooding. It is used to inform planning policies and assist Local Planning Authorities in directing new development to areas of lower flood risk and ensure that new development helps to manage flood risk.

Strategic Flood Risk assessment for Bassetlaw District Council – January 2019

3.10 Bassetlaw District Council commissioned JBA Consulting to undertake a Strategic Flood Risk Assessment (SFRA) for the District of Bassetlaw area. The SFRA mentions eight historical instances of sewer flooding occurring in the post-code area of the site but provides no record of any flooding occurring on site. The records have been supplied by STW in 2018.

Nottinghamshire County Council Preliminary Flood Risk Assessment - 2011

3.11 The Nottinghamshire County Council Preliminary Flood Risk Assessment has been prepared in accordance with the Flood Risk Regulations 2009, which implement the requirements of the European Union Floods Directive. The aim of the European Floods Directive is to provide a consistent approach to managing flood risk across Europe. It establishes four stages of activity within a six-year flood risk management cycle and the PFRA is the first stage of this cycle.

3.12 The primary purpose of the PFRA is to report 'Nationally Significant Areas of Flood Risk' to the EU from all flooding sources, except Main River and Reservoir which falls under the remit of the Environment Agency, and the adopted sewer network which falls under the remit of the water authority.

3.13 The PFRA has assessed historic and future flooding within Worksop and presents the results of a high-level screening exercise, identifying significant areas of flood risk.

3.14 The NCC PFRA shows a map of the locations where Canal Flooding has occurred within Nottinghamshire. The map identifies a couple of locations where the Chesterfield Canal overtopped, approximately 1.2km to the north-west of the site, and a couple of locations where canal breaches were experienced. The two canal breaches are located approximately 3.5km to the north-east of the site. Due to the distance between the site and the Chesterfield Canal and the presence of the River Ryton between the canal and the site boundary the risk of flooding to the site in the occasion of another breach is considered low as any overflow water will join the River Ryton and will be conveyed downstream, further to the east.

4.0 Flood Risk to the Site

Fluvial Sources

4.1 The site has been checked in accordance with the Environment Agency flood zone maps which give guidance for fluvial and tidal flood risk. The results are shown in Figure 2 below.

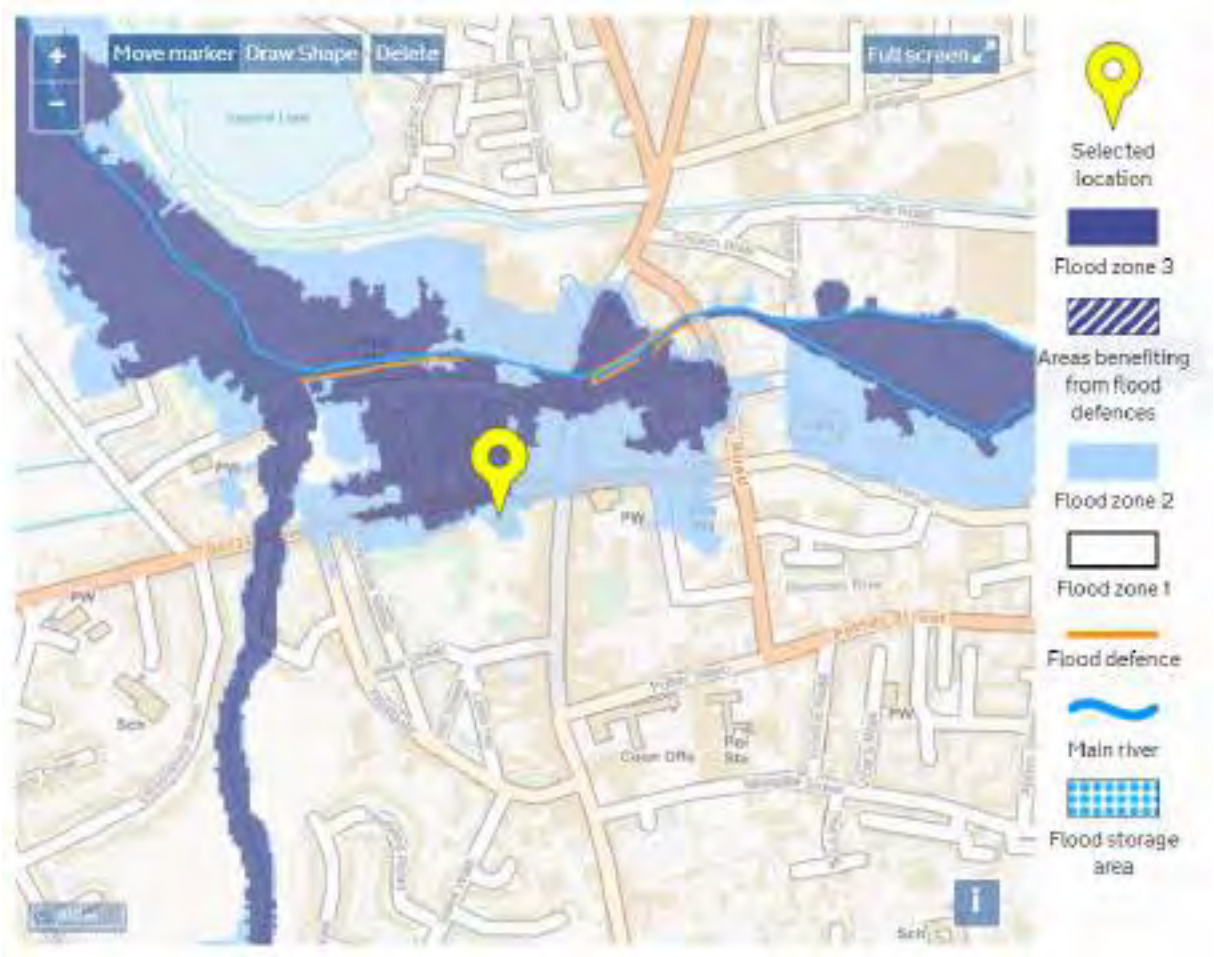


Figure 2 - Environment Agency Flood Map for Planning (Rivers and Sea)

Note: Environment Agency flood maps give guidance on fluvial flood risk only for watercourse with a catchment of greater than 3km². Other information should be checked for flood risk on ordinary watercourses with catchments less than 3km².

4.2 The Environment Agency Flood Map shows the development site to be located predominantly within Flood Zone 2, which is defined as land having between 0.1% – 1% chance of flooding from rivers in any year (between 1:1000 and 1:100 chance) or between 0.1% – 0.5% chance of flooding from the sea in any year (between 1:1000 and 1:200 chance). A small section in the north-western corner of the site is identified to be in Flood Zone 3, therefore having an annual probability of fluvial and tidal flooding of more than 1 in 100 (>1.0%).

4.3 The proposed development is a commercial car park. Using Table 2 Flood Risk Vulnerability Classification from the National Planning Practice Guidance (Ref. 18) the development is classified as 'less vulnerable'.

4.4 In accordance with the National Planning Policy Framework (NPPF), the aim of a Sequential Test should be to direct any new development to Flood Zone 1. Should there be no reasonable sites available in Flood Zone 1, taking into consideration the flood risk vulnerability of land use, the Local Authority should consider reasonable sites available in Flood Zone 2,

where the Exception Test is applied if required. Should there be no reasonable sites available in Flood Zone 1 & 2, taking into consideration the flood risk vulnerability of land use, the Local Authority should consider reasonable sites available in Flood Zone 3, where the Exception Test is applied if required.

4.5 The NPPF states that the Exception Test is a method to help ensure and demonstrate that, where suitable sites at lower risk of flooding are not available, any flood risk to people and property will be managed without stopping the development from progressing on site. The two requirements that need to be met for the Exception Test are:

a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

4.6 As the proposal consists of the construction of a car park which is to be situated within Flood Zones 2 and 3, the Sequential and Exception Tests will not be required for this site.

Flood Risk Vulnerability classification (see Table 2)		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	x	Exception Test Required	✓
	Zone 3b 'Functional Floodplain'	Exception Test Required	✓	x	x	x

Key:

✓ Development is appropriate

x Development should not be permitted

Table 1 - Copy of Table 3 (Flood Risk Vulnerability and Flood Zone 'compatibility') from the Planning Practice Guidance (Ref. 17)

Pluvial Flooding

4.7 Pluvial flooding occurs when natural and engineered systems have insufficient capacity to deal with the volume of rainfall. Pluvial flooding can sometimes occur in urban areas during an extreme, high intensity, low duration summer rainfall event which overwhelms the local surface water drainage systems, or in rural areas during medium intensity, long duration events where saturated ground conditions prevent infiltration into the subsoil. This flood water would then be conveyed via overland flow routes dictated by the local topography.

4.8 The Environment Agency Risk of Flooding from Surface Water mapping for the site area is shown in Figure 3 below. The map indicates the site to be in areas of high probability (>1 in 30 years) and medium probability (between 1 in 30 year and 1 in 100years). However, flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

4.9 Inspection of the topographical survey indicates that the site's low point is its northern extremity, in the area of high risk of surface water flooding. Due to the site being located predominantly in Flood Zone 2 with parts of it in Flood Zone 3, lifting the site levels would be unacceptable without introducing flood compensation elsewhere, which is unviable for this development. However, a sustainable drainage system will reduce the flood risk from surface water on site. Furthermore, the site would be designed to convey any exceedance flows towards the existing highway or retain them within the site boundary, away from any existing adjacent properties, therefore not increasing flood risk elsewhere.

Figure 3 - Environment Agency Flood Mapping – Risk of Flooding from Surface Water

Tidal/Coastal

4.10 The site is not coastal and is not affected by coastal or tidal flooding.

Groundwater Sources

4.11 Groundwater flooding occurs as a result of water rising from the underlying aquifer or from water flowing from abnormal springs. This can occur after long periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at shallow depth. Groundwater flooding is known to occur in areas underlain by major aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels.

4.12 The British Geological Survey (BGS) viewer shows the site is underlain by Edlington Formation – Sandstone.

4.13 The SFRA identifies the majority of the district to be in area having less than 25% chance of groundwater emerging on site with areas of increased groundwater flooding susceptibility in the East along the River Trent and to the West over the Carlton Beck. There is increased risk of groundwater flooding throughout the district due to the history of mining in Bassetlaw.

4.14 The PFRA stipulates that the risk of groundwater flooding is low across Nottinghamshire. Relatively high groundwater levels have occurred in the Ashfield District. Incidents of groundwater flooding have also been recorded in Bleasby and Staythorpe as well as at Egmanton. The latter incidents coincided with wider flooding from other sources in 2007.

4.15 No groundwater levels were recorded as part of the site investigation undertaken by Ivy House Environmental in January 2021. Even if groundwater were to emerge on site, the proposed site levels would be designed to either convey exceedance flood flows towards the existing highway or to be retained on site.

Artificial Water Bodies

4.16 Environment Agency 'Risk of flooding from Reservoirs' maps indicate that the site sits in an area in risk of flooding from reservoirs.

4.17 Reservoir flooding may occur when a large reservoir fails and releases the water it holds. The Environment Agency defines a large reservoir as one that holds over 25,000m^3 of water and states that such a failure is extremely unlikely.

4.18 As reservoir failing is highly unlikely, it is concluded that the risk of reservoir flooding at the application site is low.

Historic Flooding

4.19 The SFRA mentions eight historical instances of sewer flooding occurring in the post-code area of the site but provides no record of any flooding occurring on site.

4.20 **Historical Flood Events**

An internet search of historical flooding in the local area showed that there have been a number of flooding incidents following heavy rainfall and river overtopping and resulting in significant flooding and damage to properties along Newcastle Avenue, with the most recent ones occurring in November 2019 and March 2020.

5.0 Flood Risk from the Development

5.1 The requirements of a Site-Specific Flood Risk Assessment, as outlined in the Planning Practice Guidance (Ref. 17), should assess the following off-site impacts:

- How will it be ensured that the proposed development and the measures to protect the site from flooding will not increase flood risk elsewhere?
- How will run-off from the completed development be prevented from causing an impact elsewhere?
- Are there any opportunities offered by the development to reduce flood risk elsewhere?

Existing Discharges

5.2 A below ground utility survey was undertaken by Survey Hub in November 2021 and indicates that the site is currently drained via two separate traditional surface water and a foul water drainage networks, discharging to the existing surface water and foul water sewers located within Newcastle Avenue. The private foul water network on site is shown to collect surface water from a couple of external hardstanding areas and discharging it to the public foul water sewers off site. As the site is to be redeveloped, all surface water discharging to foul drainage will be removed, therefore freeing capacity in Severn Trent Water's foul sewers. The existing utility survey can be seen in **Appendix E**.

5.3 The two surface water drainage networks on site collect run-off generated from an approximate existing impermeable area of 0.14ha consisting the existing garage building and external hardstanding areas to the north-east of the site.

5.4 Using the modified rational method, the existing surface water run-off rate from site, discharging to the public surface water sewer within Newcastle Avenue, has been estimated to be 19.2l/s.

Climate Change

5.5 Environment Agency 'Flood Risk Assessments – Climate Change Allowances' provides support to the National Planning Policy Framework (Ref. 4) on the impacts of climate change on flooding from the land, rivers and sea as part of a flood risk assessment. The recommended sensitivity ranges in Tables 1 to 4 provide an appropriate precautionary approach to the uncertainty about climate change impacts on rainfall intensities, river flow, wave height and wind speed.

5.6 **Table 2** shows anticipated changes in extreme rainfall intensity in small and urban catchments. For flood risk assessments and strategic flood risk assessments, both the central and upper end allowances should be assessed to understand the range of impact.

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Peak Rainfall Intensity	10%	20%	40%
Peak River Flow	5%	10%	20%

Table 2 - Copy of Table 2 peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline) from Environment Agency 'Flood Risk Assessments – Climate Change Allowances'

5.7 When considering the lifetime of car park type developments, up to a 40% climate change allowance is appropriate for peak rainfall intensities.

Proposed Discharge

5.8 The proposed site layout plan, included in **Appendix C**, shows the developed site would consist of approximately 0.22ha of impermeable area.

5.9 The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development.

5.10 The Lead Local Flood Authority (LLFA) Nottingham County Council (NCC) was contacted to determine the requirements for the acceptable discharge rates for brownfield sites. The LLFA has advised that a minimum of 50% reduction to existing Brownfield run-off rates must be adopted. Therefore, it is proposed to discharge the surface water from the proposed development to the public surface water sewers at 9.6l/s, corresponding to 50% betterment to existing flows from site.

5.11 The correspondence with the LLFA can be seen in **Appendix F.**

6.0 Consideration of Sustainable Drainage Systems

Surface Water

6.1 Surface water arising from a developed site should, as far as practical, be managed in a sustainable manner to mimic the surface water flows arising from the undeveloped site.

6.2 Part H of the Building Regulations 2015 recommends that surface water run-off shall discharge to one of the following, listed in order of priority:

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

6.3 Disposal of surface water run-off by the preferred method of infiltration is subject to verification of suitable ground soakage capacity and no contaminated ground issues. If the site is not suitable for infiltration drainage, evidence must be provided to the drainage authorities in the form of soakage test results or a statement from a suitable site investigation. If this is the case and no watercourses are within a reasonable distance from the site, the drainage authorities would consider a connection to the public sewer system.

6.4 It is usual for soakage testing to be undertaken in accordance with BRE Digest 365 (Ref. 12) and Figure 6 of BS8004:1986 (Ref. 11), to ascertain if soakaway's can be used as a viable method of draining the surface water from the site.

6.5 Infiltration testing undertaken in January 2021 failed to record infiltration rates due to the water failing to dissipate sufficiently during the test period, deeming the ground impermeable. Furthermore, historic records show the presence of fuel tanks on site, which indicates potential for ground contamination, subject to further investigations. Based on the above, infiltration type drainage is deemed unfeasible for this development.

6.6 The National Standards Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems – March 2015 (Ref. 16) that deals with SuDS which covers the whole range of sustainable approaches to surface water drainage management including:

- Source control measures including rainwater recycling and drainage;
- Infiltration devices to allow water to soak into ground, that can include individual soakaways and communal facilities;
- Filter strips and swales, which are vegetated features that hold and drain water downhill mimicking natural drainage patterns;
- Filter drains and porous pavements to allow rainwater and run-off to infiltrate into permeable material below ground and provide storage if needed; and
- Basins and ponds to hold excess water after rain and allow controlled discharge that avoids flooding.

6.7 Each of the SuDS considerations listed above are discussed below with reference to their suitability for the proposed development.

SuDS Measures	Component	Feasibility for the site	Issues/ Description
Source Control	Rainwater Harvesting	No	There is no feasible rainwater harvesting system for use with car parks.
Infiltration Devices	Soakaways	No	Ground deemed impermeable following infiltration testing.
	Infiltration trenches/ basins	No	Ground deemed impermeable following infiltration testing.
Filtration	Permeable Paving	Yes	Permeable paving lined with impermeable geomembrane can be used for attenuation purposes and water quality improvement in private car parking bays, but at increased maintenance cost. May be used for attenuation and water quality control but not as an infiltration feature.
	Open Swales	No	Due to lack of available space open swales are not be feasible at this site.
	Filter Strips	No	Due to lack of available space filter strips are not be feasible at this site.
Retention/ Detention	Detention Basin	No	Due to lack of available space detention basins are not be feasible at this site.
	Attenuation Pond	No	Attenuation Ponds are not be feasible at this site due to limited available space.

Table 3 – General Assessment of SuDS measures for the site

6.8 Based on the general assessment of the potential SuDS measures above, it is proposed that permeable paving is implemented on all car parking spaces to provide attenuation storage and surface water treatment on site.

6.9 It is proposed that flows generated by the new development shall be collected within suitably sized permeable paving and below ground geo-cellular storage prior to discharging into the existing surface water public sewers.

7.0 Drainage Strategy

7.1 The surface water run-off from the proposed site is proposed to be discharged to the existing public surface water sewers within Newcastle Avenue via an existing indirect connection.

7.2 Following correspondence with the LLFA, it is proposed to discharge the surface water from the proposed development to the public surface water sewers at 9.6l/s, representing a 50% betterment to existing flows from site. A copy of the correspondence from the LLFA can be found in **Appendix F**.

7.3 MicroDrainage design software was used to calculate the overall attenuation volume required for the 100 years plus 40% climate change storm event for the proposed impermeable area of 0.22ha. The attenuation volume was calculated to be approximately 96m^3 and is to be accommodated in an underground cellular attenuation tanks and permeable car park spaces.

7.4 The proposed drainage strategy aims to control surface water runoff to the above stipulated discharge rates via a Hydro-Brake flow control chamber downstream of the underground tank. MicroDrainage calculations are shown in **Appendix G.**

CIRIA Document C753

7.5 Table 26.2 of The SuDS Manual CIRIA document C753 (Ref. 7), as shown below, indicates the minimum treatment indices appropriate for contributing pollution hazards for different land use classifications (see Tables 4 & 5). To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index.

7.6 For a non-residential car parking with frequent change, water requires a medium treatment, 0.7 for total suspended solids, 0.6 for heavy metals and 0.7 for hydrocarbons.

7.7 To provide the correct level of treatment, an assessment needs to be made of the mitigation provided by each SuDS feature. Table 26.3 of The SuDS Manual CIRIA document C753 shown below indicates the treatment provided by each SuDS feature.

7.8 The treatment train combination will be determined at detailed design stage but is likely to incorporate the following components and will provide sufficient mitigation to negate the site designed pollution indices.

- Permeable paving will be provided in all parking spaces throughout the site.

Maintenance

7.9 A maintenance agreement for the site will be formulated with an approved Management Company for the SuDS features and sewer system. In any eventuality, it is considered the SuDS features will be adopted and maintained in perpetuity.

Type of SuDS component	Total Suspended Solids	Metals	Hydrocarbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bio-retention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1-year return period event, for inflow concentrations relevant to the contributing drainage area.		

Table 4 – CIRIA 753 Table 26.3 Indicative SuDS Mitigation Indices

8.0 Flood Mitigation Measures

8.1 Due to the site being located predominantly in Flood Zone 2 with parts of it in Flood Zone 3, no increase of the existing site levels must be proposed.

8.2 The site levels must be designed to convey any exceedance flows towards the existing highway or retain them within the site boundary, away from any existing adjacent properties, therefore not increasing flood risk elsewhere.

8.3 A detailed layout and levels design will play a significant part in the management of any residual risk of flooding both on and off site.

8.4 The proposed development will include permeable car parking spaces and a sustainable surface water drainage system that will intercept the majority of the run-off generated within the development boundary. This will reduce the incidence of overland flows. Storage will be provided up to the 1 in 100-year critical storm event +40% climate change allowance through permeable car park spaces and an underground geo-cellular storage system.

8.5 In line with the recommendations outlined in the correspondence with the LLFA NCC, it is proposed to construct a dwarf wall around the perimeter of the site to contain any flood water and prevent it from flooding neighbouring properties.

9.0 Conclusion

9.1 Dice Consulting Engineers Ltd (Dice) has been commissioned by BS^2 Ltd. to undertake a Flood Risk Assessment (FRA) for a proposed redevelopment of a site off Newcastle Avenue, Worksop.

9.2 The Environment Agency Flood Map shows the development site to be located predominantly within Flood Zone 2, with the exception of a small section in the north-western corner of the site, which is identified to be in Flood Zone 3, therefore having an annual probability of fluvial and tidal flooding of more than 1 in 100 (>1.0%).

9.3 The vulnerability of the development to flooding from all other sources, such as fluvial, groundwater, sewerage and reservoir has been assessed. It is considered all these sources pose a low risk to the development, with the exception of surface water flooding and fluvial flooding, which pose medium to high risk.

9.4 Public sewer records indicate that there are no public sewers within the site boundary. However, there are both surface water and foul water public sewers running underneath Newcastle Avenue to the north of the site.

9.5 Infiltration testing undertaken in January 2021 failed to record infiltration rates due to the water failing to dissipate sufficiently during the test period, deeming the ground impermeable.

9.6 The surface water strategy proposes that run off arising from the new proposed hardstanding areas will be managed in a sustainable manner incorporating permeable paving and underground attenuation to restrict run-off rates for storms up to the 1 in 100 year (+40% allowance for climate change) return period event.

9.7 The drainage strategy proposes to discharge the surface water from the proposed development to the public surface water sewers at 9.6l/s, representing a 50% betterment to existing run-off rates from site.

10.0 References

The following documents have been referred to in this report:

1. The Building Regulations 2015 Approved Document H
2. Sewers for Adoption 8th Edition
3. Civil Engineering Specification for the Water Industry, 7th Edition
4. National Planning Policy Framework – March 2012
5. Environment Agency Flood Risk Standing Advice
6. Environment Agency 'Flood Risk Assessments – Climate Change Allowances' - February 2016
7. The SuDS Manual – CIRIA C753
8. Interim Code of Practice for Sustainable Drainage Systems – National SuDS Working Group, July 2004
9. British Geological Survey – Geology of Britain viewer http://mapapps.bgs.ac.uk /geologyofbritain/home.html
10. Design and analysis of urban storm drainage. The Wallingford Procedure Vol.1
11. Institute of Hydrology Report No. 124 – Flood Estimation for small catchments
12. BS 8004: 1986 – Foundations
13. BRE Digest 365: 2007 – Soakaways
14. Flood and Water Management Act 2010
15. Water Industry Act 1999
16. Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems – March 2015
17. Planning Practice Guidance – Flood Risk and Coastal Change, updated April 2015.
18. The National Strategy on Sea Defences, Flooding and Coastal Erosion 2016.
19. Environment Agency Coastal Flood Boundary Conditions and Island Project 2011
20. Environment Agency web based interactive maps, http://maps.environemt-agency.gov.uk

Appendices

Appendix A

IV.323.20.Let.1
Date: 12th January 2021

Wayne Oakes
Dice Consult
Desai House 9-13
Holbrook Lane
COVENTRY
West Midlands
CV6 4AD

Dear Wayne,

RE: Soakaway Testing Letter Report – Castle Hill Motors, Newcastle Avenue, Worksop

Introduction

As per your instruction, Ivy House Environmental attended the site known as Castle Hill Motors, Newcastle Avenue, Worksop, on 7th January 2021 in order to undertake a soakaway assessment. It is proposed that the site is to be redeveloped into a car park.

We were informed by the client that the site has been used as a petrol filling station and several fuel tanks have been backfilled, however the locations were not known. Historical map searches show the site to have been occupied by a row of terraced houses aligned west to east through the middle of the site, which have been demolished and possibly had basements which have been backfilled with demolition materials.

Site works

At the time of the site investigation, an on-site van sales business was operating with vans parked across most of the front of the site, therefore, limiting access in the eastern portions of the site. A slight slope to the west of the site building, and electricity cables and drains across the site inhibited access for test pitting purposes within most areas of the site. See **Appendix A** (Figure 7) for access restrictions during the works.

In total, 2No. shallow trial pits (SA01 & SA02) were excavated with a JCB excavator, following breaking out the tarmac and hardstanding surface, and filled with water where possible to enable soakaway tests. The rate at which water dissipated was then recorded. The works were completed on the day. Refer to **Appendix A** for the Trial Pit Location Plan and logs of the ground encountered (see **Appendix B**),

Ground conditions encountered

Geological mapping of the area shows no superficial deposits to be recorded and the bedrock beneath the site as the Edlington Formation (Sandstone). However, superficial deposits of Alluvium (clay, silt, sand and gravel), are recorded approximately 20m to the north of the site. The intrusive investigation has revealed that Made Ground across the site overlies superficial stratum (Alluvium - Silt). Bedrock (Edlington Formation sandstone) was not encountered during the site investigation.

Made Ground was noted to comprise of asphalt, underlain by brownish orange clayey silty gravelly SAND, with brick fragments and ash. Alluvium was observed as brown clayey sandy SILT and brown sandy gravelly SILT. Soakaway pit logs are included in **Appendix B**.

Soakaway tests

Within soakaway pit SA01 during soakaway testing, wall collapse and pit failure was recorded, therefore altering the volumes of the pit and hence causing a testing failure. Pit wall collapse was noted within the loose Made Ground deposits from 0.30-1.00mbgl, whereby perched water was also noted. As a result, the soakaway test could not be continued.

A further two test pits were also undertaken unsuccessfully, as SA01-A and SA01-B. In the western area of site, the two pits (SA01-A & SA01-B) were unable to be completed, due to perched water, and concrete encountered at shallow depth (0.50mbgl & 0.30mbgl). Anecdotal evidence suggests that unmapped historic underground storage

tanks are present on site. The tanks are reported to have been backfilled with concrete and it is possible this is what was encountered in these locations.

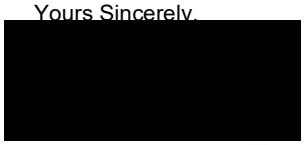
Soakaway pit SA02 remained stable throughout the test, although also encountering some perched water in the Made Ground material beneath the asphalt. Water contents of SA02 were deemed to not have drained sufficiently during the test period. Therefore, soakaway drainage in this location is not considered to be suitable. The soakaway test information and methods are detailed in **Appendix C**.

Locations were backfilled with arisings and compacted by tracking with the excavator wheels, and SA01 was also backfilled with additional Type 1 materials due to minor settlement of backfill materials.

Conclusions
The underlying soils comprised of Alluvium are believed to be representative of shallow soils across the site. Soakaway tests SA01 and SA02 were targeted at the shallow Alluvium deposits.

Considering the above soakaway test information, the drainage properties of the soils exhibited in SA01 and SA02 should be assumed as representative for the site. The Alluvium deposits at the site are therefore considered to be impermeable and are deemed to be unsuitable for soakaway drainage.

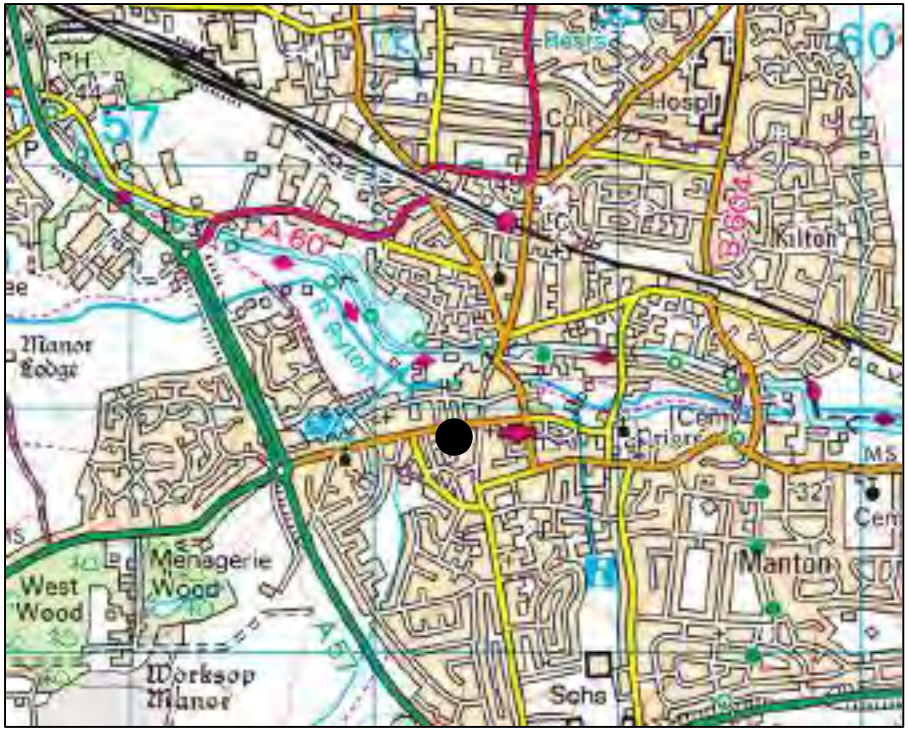
Yours Sincerely,

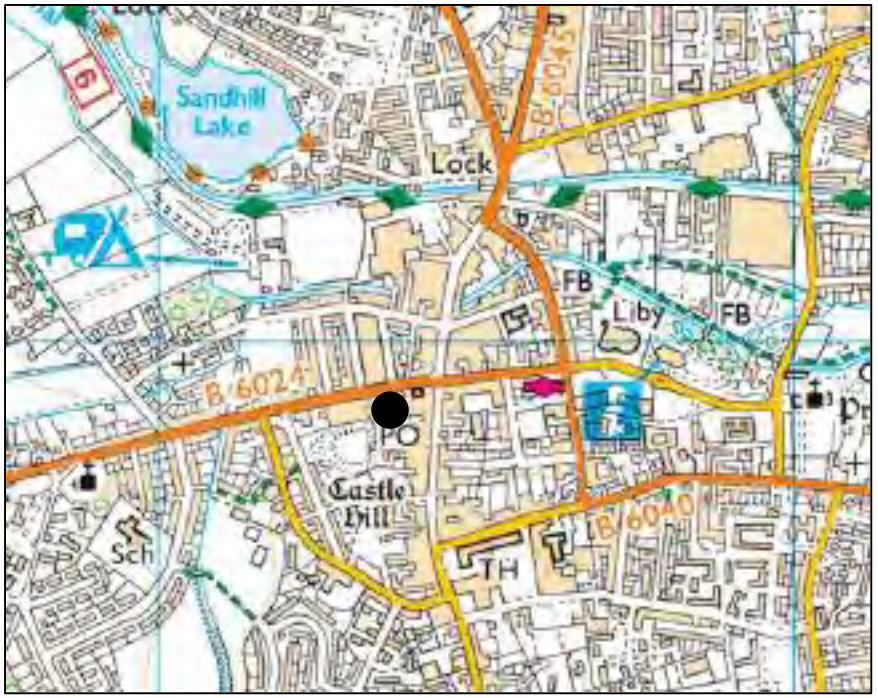


Daniel Heywood BSc (Hons) FGS
Geotechnical Consultant

Encl.
Figures
Logs
Soakaway Drainage Data

APPENDIX A





N

Post Code: S80 1EY

KEY:

● Approximate Site Location

DO NOT SCALE

IVY HOUSE environmental

Scotland Farm, Ockbrook, Derby, DE72 3RX

TITLE:	Site Location Plan
PROJECT:	Castle Hill Motors, Newcastle Avenue, Worksop
PROJECT No:	IV.323.20
DATE:	01/2021
SCALE :	NTS
DRAWN :	DH
DWG No:	Figure 1

N

KEY:

Site Boundary

DO NOT SCALE

IVY HOUSE environmental

Scotland Farm, Ockbrook, Derby, DE72 3RX

TITLE: Site Layout

PROJECT: Castle Hill Motors, Newcastle Avenue, Worksop

PROJECT No:	DATE:
IV.323.20	01/2021

SCALE :	DRAWN :	DWG No:
NTS	DH	Figure 2

N

KEY:

DO NOT SCALE

IVY HOUSE environmental

Scotland Farm, Ockbrook, Derby, DE72 3RX

TITLE: Site Layout		
PROJECT: Castle Hill Motors, Newcastle Avenue, Worksop		
PROJECT No: IV.323.20	DATE: 01/2021	
SCALE : NTS	DRAWN : DH	DWG No: Figure 3

N

KEY:

DO NOT SCALE

IVY HOUSE environmental

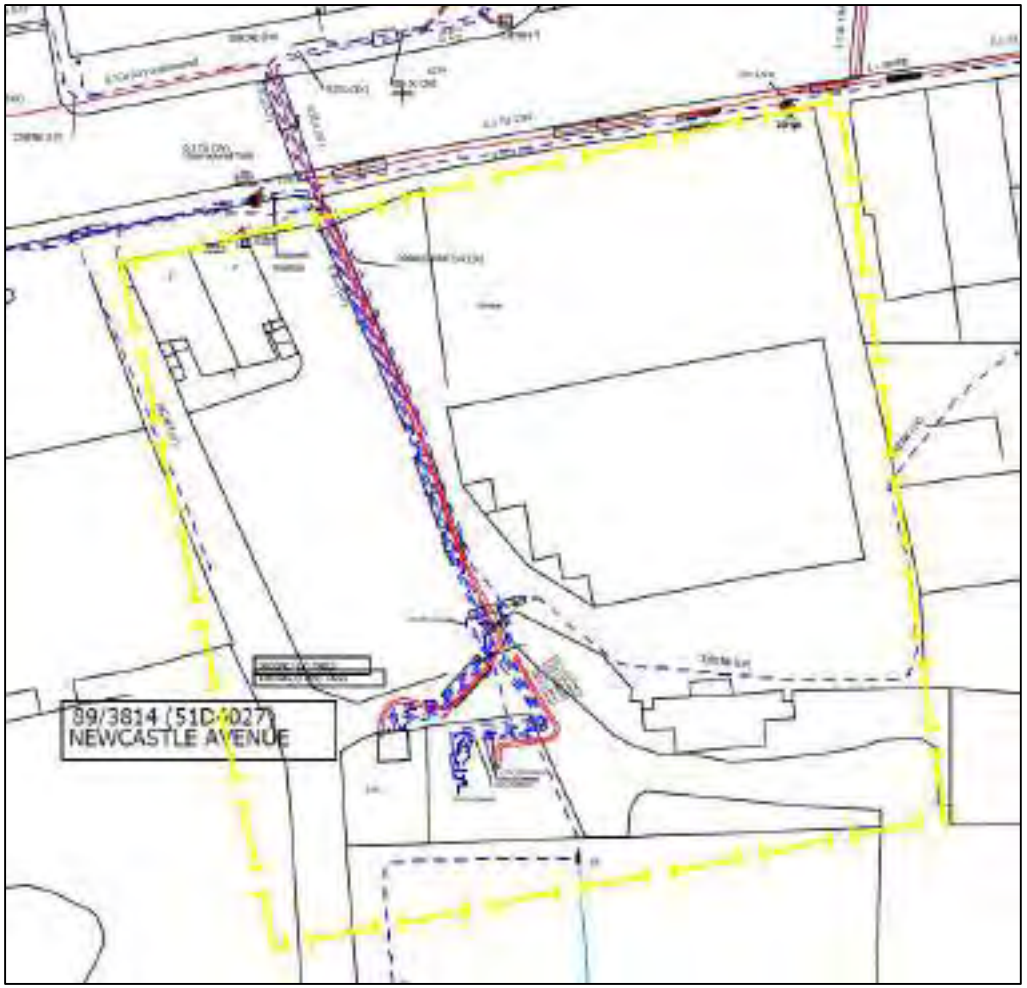
Scotland Farm, Ockbrook, Derby, DE72 3RX

TITLE: Development Proposal

PROJECT: Castle Hill Motors, Newcastle Avenue, Worksop

PROJECT No:	DATE:
IV.323.20	01/2021

SCALE :	DRAWN :	DWG No:
NTS	DH	Figure 4



N

Overhead Line

PL
Service
LV
HV (11kV)
HV (33kV)
HV (66kV)
HV (132kV)

Underground Cable

SURF Telecoms

Pilot Cables

Link Box

PME Earth

Pole Mounted Transformer

Site Location

KEY:

DO NOT SCALE

IVY HOUSE environmental

Scotland Farm, Ockbrook, Derby, DE72 3RX

TITLE: Western Power

PROJECT: Castle Hill Motors, Newcastle Avenue, Worksop

PROJECT No: IV.323.20

DATE: 01/2021

SCALE : NTS

DRAWN : DH

DWG No: Figure 6

KEY:

DO NOT SCALE

IVY HOUSE environmental

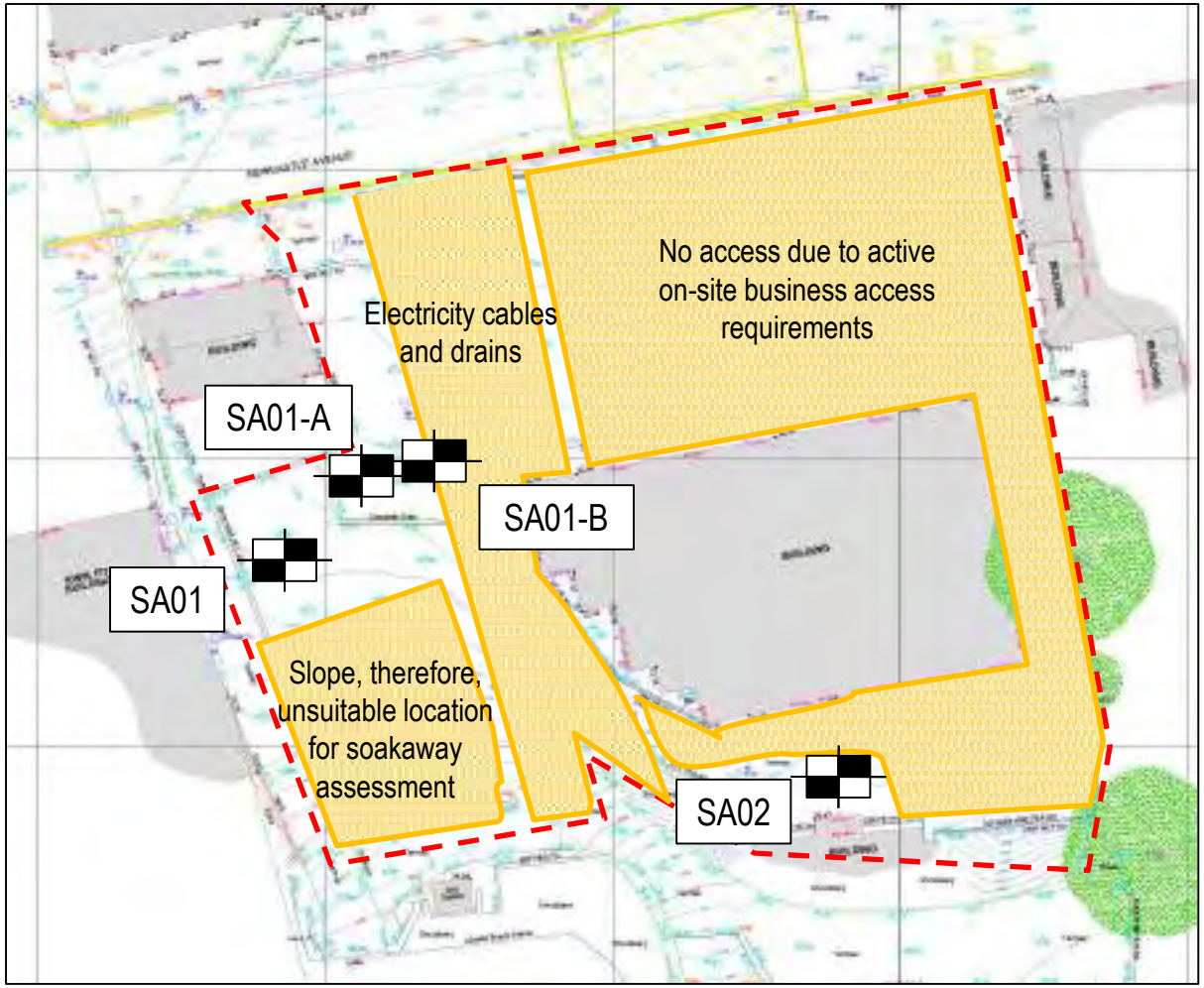
Scotland Farm, Ockbrook, Derby, DE72 3RX

TITLE: Drainage

PROJECT: Castle Hill Motors, Newcastle Avenue, Worksop

PROJECT No:	DATE:
IV.323.20	01/2021

SCALE :	DRAWN :	DWG No:
NTS	DH	Figure 6



KEY:

Soakaway Test Pit

Inhibited Access

DO NOT SCALE

IVY HOUSE environmental

Scotland Farm, Ockbrook, Derby, DE72 3RX

TITLE: Soakaway Test Pit Location Plan

PROJECT: Castle Hill Motors, Newcastle Avenue, Worksop

PROJECT No:	DATE:
IV.323.20	01/2021

SCALE :	DRAWN :	DWG No:
NTS	DH	Figure 7

1.

2.

3.

KEY:

1. SA01-A showing abandoned brick drain and concrete slab encountered.
2. SA01-B showing concrete.
3. SA02

DO NOT SCALE

IVY HOUSE environmental

Scotland Farm, Ockbrook, Derby, DE72 3RX

TITLE:	Site Photographs
PROJECT:	Castle Hill Motors, Newcastle Avenue, Worksop
PROJECT No:	IV.323.20
DATE:	01/2021
SCALE :	NTS
DRAWN :	DH
DWG No:	Figure 8

1.

2.

KEY:

1. SA01 during soakaway testing showing significant wall collapse and subsequent test failure.

2. SA02 during soakaway testing.

DO NOT SCALE

IVY HOUSE environmental
Scotland Farm, Ockbrook, Derby, DE72 3RX

TITLE: Site Photographs		
PROJECT: Castle Hill Motors, Newcastle Avenue, Worksop		
PROJECT No: IV.323.20	DATE: 01/2021	
SCALE : NTS	DRAWN : DH	DWG No: Figure 9

APPENDIX B

IVY HOUSE environmental

Trial Pit No.

SA01-A

Sheet 1 of 1

Project No:	IV.323.20	**Method:**	Trial Pit Excavation	**Co-ordinates:**	N/R
				Ground Level:	N/R
Site:	Castle Hill Motors, Newcastle Avenue, Worksop	**Plant:**	JCB 3CX	**Start Date:**	07.01.21
				Finish Date:	07.01.21
Client:	Dice Consult				

Description of Strata	Depth (mbgl)	Sampling Type & Depth (m)		Legend	U100 / N Value Field / Lab. Testing
MADE GROUND: Asphalt.	0.05				
MADE GROUND: Greyish brown sandy gravel (sub-base material).	0.30				
MADE GROUND: Brownish orange clayey silty gravelly SAND with frequent brick fragments and ash.	0.50				
MADE GROUND: Concrete.	0.55				

Trial pit terminated at 0.55mbgl

Key:			
	Bulk (Bulk Bag)	D. Disturbed	V. 40ml Glass Vial
	W. Water	G. Amber Glass Jar / Bottle	N. 'N' value
	PID. Photo Ionisation Detector (ppm)	T. Plastic Tub	HP. Hand Penetrometer

Contamination Observations During Excavation		PID Monitoring		
Depth Observed	No visual or olfactory evidence of contamination.	Depth: PPM:	Depth: PPM:	Depth: PPM:
No groundwater encountered.		n/a	n/a	n/a
Good stability noted.				

NOTES:

Services: Prior to excavation, the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Backfill: The trial pit was backfilled on completion with arisings and levelled to existing ground level.

N/R - Not Required N/A - Not Applicable Logged By: DH

All depths in metres below ground level; Approved By: RS

IVY HOUSE environmental

Trial Pit No.

SA01-B

Sheet 1 of 1

Project No:	IV.323.20	**Method:**	Trial Pit Excavation	**Co-ordinates:**	N/R
				Ground Level:	N/R
Site:	Castle Hill Motors, Newcastle Avenue, Worksop	**Plant:**	JCB 3CX	**Start Date:**	07.01.21
				Finish Date:	07.01.21
Client:	Dice Consult				

Description of Strata	Depth (mbgl)	Sampling Type & Depth (m)		Legend	U100 / N Value Field / Lab. Testing
MADE GROUND: Asphalt.	0.05				
MADE GROUND: Greyish brown sandy gravel (sub-base material).	0.30				
MADE GROUND: Concrete.	0.35				

Trial pit terminated at 0.35mbgl

Key:			
	Bulk (Bulk Bag)	D. Disturbed	V. 40ml Glass Vial
	W. Water	G. Amber Glass Jar / Bottle	N. 'N' value
	PID. Photo Ionisation Detector (ppm)	T. Plastic Tub	HP. Hand Penetrometer

Contamination Observations During Excavation		PID Monitoring		
Depth Observed	No visual or olfactory evidence of contamination.	Depth: PPM:	Depth: PPM:	Depth: PPM:
No groundwater encountered.		n/a	n/a	n/a
Good stability noted.				

NOTES:

Services: Prior to excavation, the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Backfill: The trial pit was backfilled on completion with arisings and levelled to existing ground level.

N/R - Not Required N/A - Not Applicable Logged By: DH

All depths in metres below ground level; Approved By: RS

IVY HOUSE environmental

Trial Pit No.

SA01

Sheet 1 of 1

Project No:	IV.323.20	**Method:**	Trial Pit Excavation	**Co-ordinates:**	N/R
				Ground Level:	N/R
Site:	Castle Hill Motors, Newcastle Avenue, Worksop	**Plant:**	JCB 3CX	**Start Date:**	07.01.21
				Finish Date:	07.01.21
Client:	Dice Consult				

Description of Strata	Depth (mbgl)	Sampling Type & Depth (m)		Legend	U100 / N Value Field / Lab. Testing
MADE GROUND: Asphalt.	0.05				
MADE GROUND: Greyish brown sandy gravel (sub-base material).	0.30				
MADE GROUND: Brownish orange clayey silty gravelly SAND with frequent brick fragments and ash.	1.00				
Brown clayey sandy SILT	2.15				

Trial pit terminated at 2.15mbgl

Key:			
	Bulk (Bulk Bag)	D. Disturbed	V. 40ml Glass Vial
	W. Water	G. Amber Glass Jar / Bottle	N. 'N' value
	PID. Photo Ionisation Detector (ppm)	T. Plastic Tub	HP. Hand Penetrometer

Contamination Observations During Excavation		PID Monitoring		
Depth Observed	No visual or olfactory evidence of contamination.	Depth: PPM:	Depth: PPM:	Depth: PPM:
Water noted at 2.10mbgl, seeping in from perched groundwater in Made Ground (0.30-1.00mbgl).		n/a	n/a	n/a
Slight pit wall collapse noted and pit collapse during soakaway testing in wet Made Ground (0.30-1.00mbgl).				

NOTES:

Services: Prior to excavation, the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Backfill: The trial pit was backfilled on completion with arisings and levelled to existing ground level.

N/R - Not Required N/A - Not Applicable Logged By: DH

All depths in metres below ground level; Approved By: RS

IVY HOUSE environmental

Trial Pit No.

SA02

Sheet 1 of 1

Project No:	IV.323.20	**Method:**	Trial Pit Excavation	**Co-ordinates:**	N/R
				Ground Level:	N/R
Site:	Castle Hill Motors, Newcastle Avenue, Worksop	**Plant:**	JCB 3CX	**Start Date:**	07.01.21
				Finish Date:	07.01.21
Client:	Dice Consult				

Description of Strata	Depth (mbgl)	Sampling Type & Depth (m)		Legend	U100 / N Value Field / Lab. Testing
MADE GROUND: Asphalt.	0.05				
MADE GROUND: Greyish brown sandy gravel (sub-base material).	0.30				
Brown sandy gravelly SILT. Gravel is medium to coarse rounded to sub-rounded mixed lithologies.	1.30				
Trial pit terminated at 1.30mbgl					

Key:			
	Bulk (Bulk Bag)	D. Disturbed	V. 40ml Glass Vial
	W. Water	G. Amber Glass Jar / Bottle	N. 'N' value
	PID. Photo Ionisation Detector (ppm)	T. Plastic Tub	HP. Hand Penetrometer

Contamination Observations During Excavation		PID Monitoring		
Depth Observed	No visual or olfactory evidence of contamination.	Depth: PPM:	Depth: PPM:	Depth: PPM:
Water noted in the base of the pit, from perched groundwater in Made Ground (0.05-0.30mbgl), 5cm deep in 20 minutes.		n/a	n/a	n/a
Good stability noted.				

NOTES:

Services: Prior to excavation, the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Backfill: The trial pit was backfilled on completion with arisings and levelled to existing ground level.

N/R - Not Required N/A - Not Applicable Logged By: DH

All depths in metres below ground level; Approved By: RS

APPENDIX C

INSITU SOAKAWAY TEST RESULTS

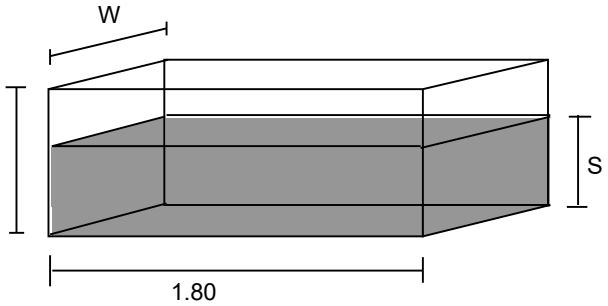
Trial pit No.: SA02

Soil Profile:

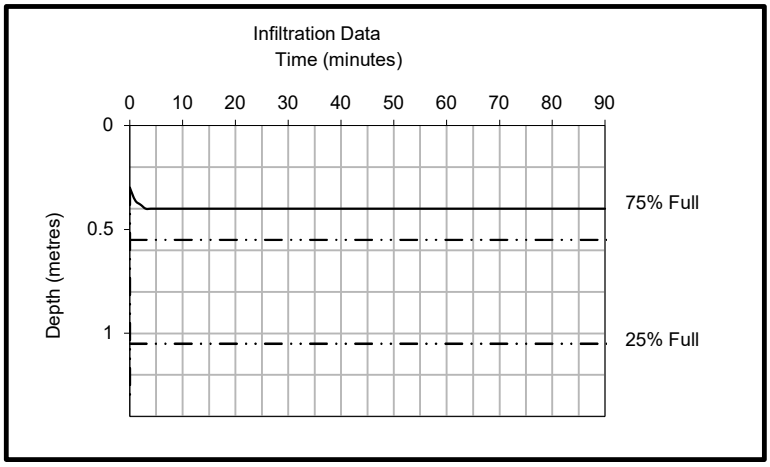
Depth (m) From:	To:	Description
0.00	0.05	Made Ground: Asphalt.
0.05	0.30	Made Ground: Greyish brown sandy gravel (sub-base material).
0.30	1.30	Brown sandy gravelly SILT. Gravel is medium to coarse rounded to sub-rounded mixed lithologies.

Sketch plan of test zone

Not to scale
All dimensions in metres.
D = Depth of test pit = 1.30
W = Width of test pit = 0.70
L = Length of test pit = 1.80
S= Storage depth (of water)
1



Soakaway Test Run 1 **Test Date: 07-01-21**



Time (minutes)	Depth (m)
0	0.30
1	0.36
2	0.38
3	0.40
4	0.40
5	0.40
6	0.40
7	0.40
8	0.40
9	0.40
10	0.40
48	0.40
60	0.40
80	0.40
90	0.40

Notes:

Water did not sufficiently dissipate during test period.
The soils at this location are therefore considered to be impermeable.

Test and analysis carried out in general accordance with BRE Digest 365 : 2007

Job No.: **IV.323.20**
Site: **Castle Hill Motors, Newcastle Avenue, Worksop**
Client: **Dice Consult**

IVY HOUSE environmental

Appendix B

458300E 458320E 458340E 458360E 458380E 458400E 458420E

378940N 378920N 378900N 378880N 378860N

KEY:

BL	Bollard Level	ACU	Air Conditioning Unit	LR	Life Preserver
CL	Circular Vent	ANT	Antenna	MM	Service Marker
DP	Down Pipe	AV	Air Valve	PB	Post Box
DPG	Down Pipe/ Gully	BB	Bellaire Beacon	PM	Parking Meter
Gy	Gully	BM	Benchmark	PO	Post
IL	Invert level	BO	Bollard	PX	Crossing Control
KO	Kerb Outlet	Box	Cable Box	RF	Reflective Post
MH	Manhole	BS	Bus Stop	RS	Road Sign
RE	Rodding Eye	BT	British Telecom	SC	Speed Camera
WL	Water level	CATV	Cable Television	SP	Sign Post
BH	Bore Hole	CD	Cigarette Bin	SV	Stop Valve
EL	Ecrres Level	COMS	Communication Cover	SY	Stay
Flats	Flat Roof Level	DNB	Dog Waste Bin	TEL	Telecomms Cover
PL	Parapet Level	EL	Electric Cover	TL	Traffic Light
RL	Ridge Level	EP	Electric Pole	TP	Telegraph Pole
Spr. Lvl.	Arch Springing Level	ER	Earth rod	TS	Traffic Signal Cover
Und'ln	Underside of Beam	FH	Fire Hydrant	VP	Vent Pipe
Und'v	Underside of Feature	FLT	Flood Light	WM	Water Meter
ø	Trunk Diameter	Plug	Plug Hole	WO	Wash Out
GP	Gate Post	GL	Ground Light	WV	Water Valve
WL/WD	Wall, Bollz Trunk	GV	Gas valve	FFL	Finished Floor Level
TCL	Tree Canopy Level	IC	Inspection Cover	THL	Threshold Level
TT	Tactile Paving	LP	Lamp Post		Gate

Boundary Line		Fence	
Building Roof Line		OS Detail	
Building		Steps	
Building Canopy		Trackway	
Edge of Scrub		Tree Canopy	
Edge of Vegetation		Verge	
Embankment Bottom		Verge Concrete	
Embankment Top		Verge Grass	
Kerb		Verge Tarmac	
Kerb - Drop		Wall	
Kerb - Top		Water Edge	

Suffixes
(D) - Dilapidated (L) - Illuminated (R) - Retractable (RF) - Reflective

Station	Easting (m)	Northing (m)	Level (m)
SH01	458370.672	378933.709	32.216
SH02	458311.555	378922.611	32.320
SH03	458347.661	378916.177	32.267
SH04	458345.581	378882.941	33.750
SH05	458369.975	378880.450	32.424

Survey Coordinates and Grid
Please note that the grid shown on this drawing is as follows;
- ☐ *Arbitrary*
- ☐ *Arbitrary but approx. related to North*
- ☐ *Best fit to an Ordnance Survey Digital Sheet*
- ■ *Related to the Ordnance Survey National GPS Network*

Levels
Please note that the levels shown on this drawing are as follows;
- ☐ *Arbitrary*
- ☐ *Related to an Ordnance Survey Bench Mark*
- ■ *Related to the Ordnance Survey National GPS Network*

Survey Hub
Nottingham | Manchester | London
Head Office: 0115 7141123
mail@surveyhub.co.uk
www.surveyhub.co.uk

Client: BS Squared Ltd

Project: 7-15 Newcastle Avenue
Worksop, S80 1EU

Title: Topographical Survey - 2D

Surveyed JS Checked NS Date 23/11/2020
Sheet No 1 of 1 Scale 1:200@A1

Job No. 4559 Rev. -

NOTES:
All critical measurements should be checked on site prior to design.
No liability will be taken for this plan if passed on to 3rd parties.
Some services/data may be omitted in areas of parked vehicles and vegetation.

THIS SURVEY HAS BEEN ORIENTATED TO THE ORDNANCE SURVEY (OS) NATIONAL GRID (OSGB36) VIA A GLOBAL POSITION SYSTEM (GPS) AND THE O.S. ACTIVE NETWORK (OS NET). THE GPS DATA HAS BEEN CONVERTED TO OSGB36 USING THE OSTN15 & OSGM15 TRANSFORMATION MODELS.
THE SURVEY HAS BEEN CORRELATED TO THIS POINT AND A FURTHER ONE OR MORE CONTROL STATIONS ESTABLISHED ON SITE TO ENABLE ESTABLISHMENT OF THE ON-SITE GRID.
NO SCALE FACTOR HAS BEEN APPLIED TO THE SURVEY THEREFORE THE COORDINATES ARE GRID COORDINATES.
PLEASE REFER TO SURVEY STATION TABLE TO ENABLE ESTABLISHMENT OF THE ON-SITE GRID.

Appendix C

BS SQUARED LTD
ORCHARD HOUSE
OLD MAIN ROAD,
BULCOTE,
NOTTINGHAM,
NG14 5GU

PROJECT : WORKSOP CAR PARK

DRAWING : SITE PLAN

REF NO. : GE741190 - E

NORTH

1.200@ A2

PROPOSED SITE PLAN :
1.200 @ A2

LANDSCAPING

TO BE A MIXTURE OF:
SENECIO SQUALIDUS (OXFORD RAGWORT)
EUONYMUS EUROPAEUS (EUROPEAN SPINDLE)
LIGUSTRUM VULGARE (WILD PRIVET)
CORNUS SANGUINEA DOGWOOD (COMMON DOGWOOD)
VIBURNUM OPULUS (GUELDER ROSE)
YEW TAXUS BACCATA (ENGLISH YEW)

TREES TO BE :
SORBUS ' GLOWING PINK' (MOUNTAIN ASH)

Appendix D

(c) Crown copyright and database rights 2020 Ordnance Survey 100031673 | Date: 30/11/20 | Scale: 1:500 | Map Centre: 458365,378901 | Data updated: 14/11/20 | Our Ref: 463567 - 1 | Wastewater Plan A4

Do not scale off this Map. 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. 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 assess complete records of these assets. These assets may not be displayed on the map. Reproduction by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and database right 2004. All rights reserved. Ordnance Survey licence number: 100031673. Document users other than SEVERN TRENT WATER business users are advised that thi

craig@surveyhub.co.uk

4559 Worksop

SEVERN TRENT

GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on:
0800 783 4444 (24 hours)

a) These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991(a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as "STW Apparatus" in these general conditions and precautions.

b) Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.

c) On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.

d) STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.

e) The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).

f) No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.

2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus. You or your contractor must ensure the safety of STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).

3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.

4. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.

5. Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.

6. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.

7. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.

8. No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.

9. A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.

10. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.

11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.

12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.

13. You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants,

14. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

15. Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.

16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.

17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May2014

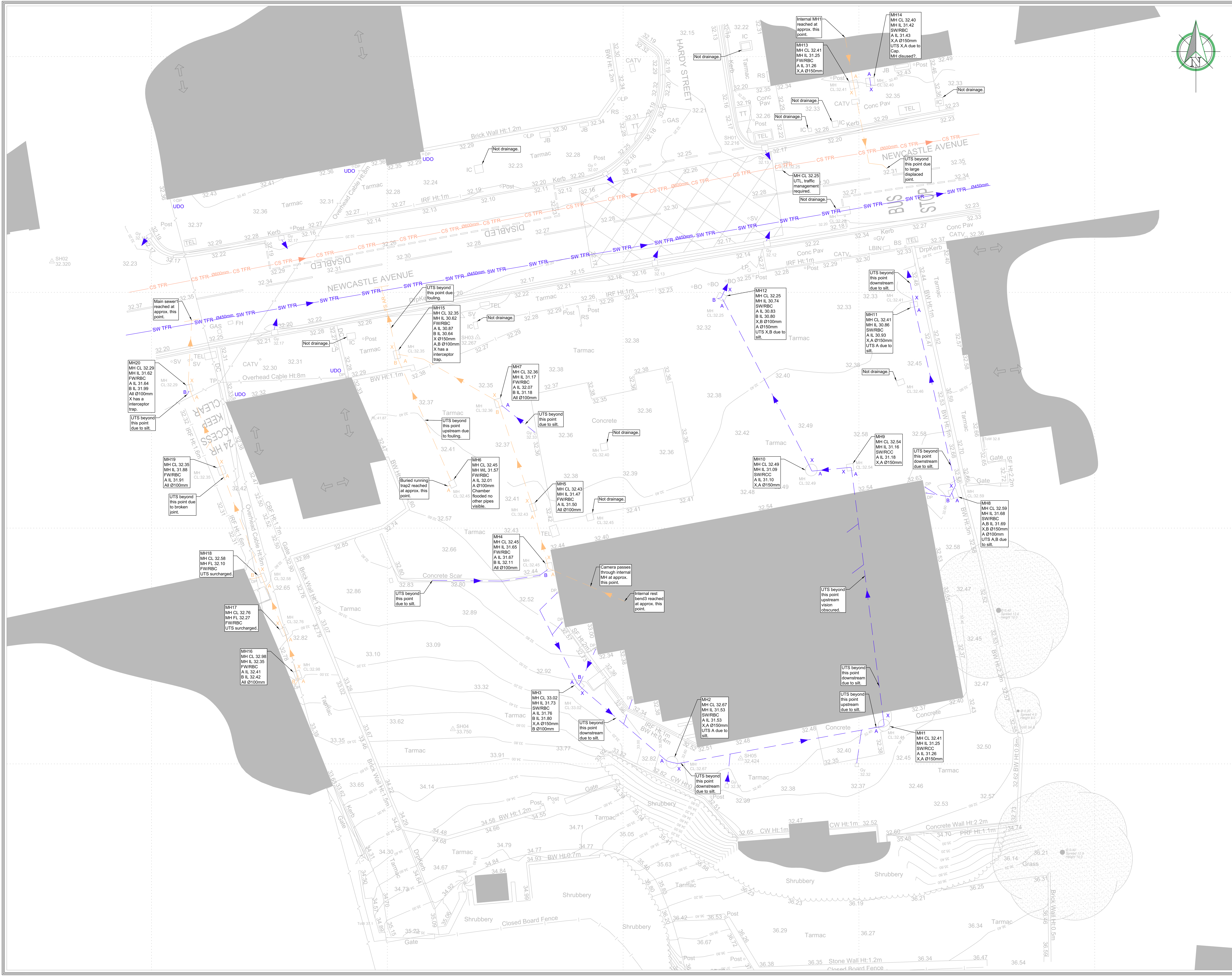
18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW Apparatus.

19. In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
	C			
3901	C	32.46	29.91	2.55
3907	C	32.36	29.65	2.71
4909	C	32.97	29.54	3.43
4901	S	32.69	30.43	2.26

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix E



Electromagnetic and/or Ground Penetrating Radar techniques have been used to locate/map underground utilities and features on this drawing. SurveyHub Ltd has made every endeavour to make sure that the information contained within this drawing is accurate and of the highest quality. SurveyHub Ltd has used any record drawings provided by the client or by the Statutory Utility Providers, at the client's request, at the time of the survey. Any information taken from these drawings (e.g. pipe sizes and position) is not guaranteed. Historic record information is often incomplete and inaccurate and cannot be relied upon. SurveyHub Ltd is not liable for any topographical survey that has not been undertaken by us. Any inaccuracies relating to topographical plans/development plans/Ordnance Survey data that we have no control over is the liability of the customer. Where quoted, depth information of underground services/features is stated. Depths are generally within +/10% accurate, but cannot be guaranteed. Any depths shown on drains are usually to invert (base of drainage channel) unless otherwise stated. At SurveyHub Ltd we use skilled staff and modern, calibrated equipment to perform our surveys. However, the completeness of any underground survey cannot be 100% guaranteed and the results from these types of surveys are not infallible. If the location or depth of services/features is of particular importance to a project then it is strongly recommended that discussions are held with SurveyHub Ltd regarding any possible limitations or anomalies. It is also strongly advised that trial excavations should be undertaken to confirm survey results. We cannot be held responsible for any inaccuracies beyond those that could be reasonably expected by a competent company.

ABBREVIATIONS (Land & Utilities)

Survey Coordinates and Grid

Please note that the grid shown on this drawing is as follows;

- ☐ *Arbitrary*
- ☐ *Arbitrary but approx. related to North*
- ☐ *Best fit to an Ordnance Survey Digital Sheet*
- ■ *Related to the Ordnance Survey National GPS Network*

Levels

Please note that the levels shown on this drawing are as follows;

- ☐ *Arbitrary*
- ☐ *Related to an Ordnance Survey Bench Mark*
- ■ *Related to the Ordnance Survey National GPS Network*

SurveyHub
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www.surveyhub.co.uk

Client	BS Squared Ltd		
Project	Newcastle Avenue Workosp		
Title	CCTV Drainage Condition Survey		
Surveyed ED	Checked LP	Survey date	30/11/2020
Sheet No	1 of 1	DrawingScale	1:100@A0
Job No.	4559	Issue date	07/12/2020

NOTES:

All critical measurements should be checked on site prior to design.
No liability will be taken for this plan if passed on to 3rd parties.
Some services/data may be omitted in areas of parked vehicles and vegetation.

THIS SURVEY HAS BEEN ORIENTATED TO THE ORDNANCE SURVEY (O.S) NATIONAL GRID (OSGB36) VIA A GLOBAL POSITION SYSTEM (GPS) AND THE O.S. ACTIVE NETWORK (OS NET). A TRUE OSGB36 COORDINATE HAS BEEN ESTABLISHED NEAR TO THE SITE CENTRE VIA A TRANSFORMATION USING THE OSTN02 & OSGM02 TRANSFORMATION MODELS. THE SURVEY HAS BEEN CORRELATED TO THIS POINT AND A FURTHER ONE OR MORE OSGB36 POINTS ESTABLISHED TO CREATE A TRUE O.S. BEARING FOR ANGLE ORIENTATION. NO SCALE FACTOR HAS BEEN APPLIED TO THE SURVEY THEREFORE THE COORDINATES SHOWN ARE ARBITRARY & NOT TRUE O.S. COORDINATES WHICH HAVE A SCALE FACTOR APPLIED. PLEASE REFER TO SURVEY STATION TABLE TO ENABLE ESTABLISHMENT OF THE ON-SITE GRID.

Appendix F

iva@diceconsult.co.uk

From: Graham Smith <Graham.Smith@nottscc.gov.uk>
Sent: 08 January 2021 08:27
To: iva@diceconsult.co.uk
Cc: laura.dance@diceconsult.co.uk; wayne.oakes@diceconsult.co.uk; Flood Team
Subject: RE: Newcastle Avenue, Worksop, site address 7-15 Newcastle Avenue, Worksop, S80 1EY

Good Morning Iva,

I am sure you are aware that this development is in an area of considerable flood risk, and when it floods it will be under water. Though this is only a carpark, it may still attract attention and objections from the local community. That said, I believe the site is currently a car sales business so there is not much change in use, there is no risk to new property?

Regards your question about Climate Change allowance, 40% is what we would ask for, we would also request a minimum 50% reduction to existing Brownfield rates because of the continuing impermeable area. Regards SUDS, I am aware that it would be difficult for above ground SUDS on a site of this size. However if you don't want to use an oil interceptor you would need a treatment chain for your run-off so you could consider green areas (planters, buffer strips) to capture and filter oily run-off within the site, with French drains discharging to your underground storage. Either way you would need to have something in place to show future maintenance has been accounted for.

Google view shows a building on the site currently; if this is the case and it is being knocked down you should consider the role it currently plays in protecting neighbouring properties from flood water. My suggestion would be that you propose putting a dwarf wall around the site to contain flood water and not let it flow over your new flat impermeable site straight into the neighbours properties.

I hope this helps, please get back in touch if you have any other questions.

Kind regards

Graham Smith
Principal Officer – Flood Risk Management
Highways and Transport
Nottinghamshire County Council
0115 9774526
07580979957

graham.smith@nottscc.gov.uk | flood.team@nottscc.gov.uk | www.nottinghamshire.gov.uk

Flood Risk Management Team, Nottinghamshire County Council,
County Hall, Loughborough Road, West Bridgford, Nottingham, NG2 7QP

Nottinghamshire County Council

From: iva@diceconsult.co.uk <iva@diceconsult.co.uk>
Sent: 06 January 2021 11:15
To: Graham Smith <Graham.Smith@nottscc.gov.uk>
Cc: laura.dance@diceconsult.co.uk; wayne.oakes@diceconsult.co.uk; Flood Team <flood.team@nottscc.gov.uk>
Subject: Newcastle Avenue, Worksop, site address 7-15 Newcastle Avenue, Worksop, S80 1EY

Dear Graham,

I am writing to you as I need advice regarding a site in Worksop, site address 7-15 Newcastle Avenue, Worksop and I was hoping that you may be able to help me? The site is currently brownfield and is proposed for demolition. The site covers an approximate area of 0.24ha, of which approximately 0.1385ha is existing impermeable area draining to the public surface water sewers. The proposal for the site consist of the construction of a new car park of approximately 70 spaces.
I tried finding information on the Nottinghamshire County Council in regards to the design parameters for sites in Worksop, however I could not find anything relevant. Please can you advise on what climate change needs to be used for the surface water drainage calculations and whether a betterment to brownfield run-off rates will be acceptable, taking into account that the site is brownfield?
Using the modified rational method, I have calculated the existing surface water discharge rate from site to be 19.2l/s. If a 30% betterment is to be applied, this gives a rate of 13.4l/s. Please can you advise if discharging at 13.4l/s from the site will be acceptable?

Additionally, please can you give me an indication of what SuDS you would expect to be incorporated on site and whether an oil interceptor will be required?

Any advise you may be able to give me will be really appreciated.

Kind regards,
Iva

—

Iva Dimitrov
Senior Civil Engineer

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diceconsult.co.uk

Dice

—
Design
Infrastructure
Consulting
Engineers

Appendix G

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 458355 378897 SK 58355 78897
Data Type	Point
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Surface Network 1

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.187	4-8	0.032

Total Area Contributing (ha) = 0.218

Total Pipe Volume (m^3) = 2.869

Network Design Table for Surface Network 1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

Network Design Table for Surface Network 1

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	1.174	0.008	150.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	6.949	0.131	52.9	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	1.197	0.008	150.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	4.693	0.031	150.0	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	10.227	0.297	34.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	0.881	0.006	146.8	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	5.235	0.035	150.0	0.009	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	5.379	0.036	149.4	0.007	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	20.306	0.135	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	1.527	0.010	150.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
5.001	7.622	0.051	150.0	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.000	1.347	0.009	149.7	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	1.708	0.017	100.0	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.02	31.800	0.000	0.0	0.0	0.0	0.82	14.5	0.0
1.001	50.00	5.11	31.792	0.018	0.0	0.0	0.0	1.39	24.5	2.4
2.000	50.00	5.02	31.700	0.000	0.0	0.0	0.0	0.82	14.5	0.0
2.001	50.00	5.12	31.692	0.018	0.0	0.0	0.0	0.82	14.5	2.4
1.002	50.00	5.22	31.661	0.035	0.0	0.0	0.0	1.72	30.4	4.8
3.000	50.00	5.02	31.610	0.000	0.0	0.0	0.0	0.83	14.6	0.0
3.001	50.00	5.12	31.604	0.009	0.0	0.0	0.0	0.82	14.5	1.3
4.000	50.00	5.11	31.400	0.007	0.0	0.0	0.0	0.82	14.5	1.0
1.003	50.00	5.63	31.364	0.052	0.0	0.0	0.0	0.82	14.5	7.0
5.000	50.00	5.03	31.700	0.000	0.0	0.0	0.0	0.82	14.5	0.0
5.001	50.00	5.19	31.690	0.007	0.0	0.0	0.0	0.82	14.5	0.9
6.000	50.00	5.03	31.600	0.000	0.0	0.0	0.0	0.82	14.5	0.0
6.001	50.00	5.06	31.591	0.011	0.0	0.0	0.0	1.00	17.8	1.5

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.002	6.196	0.062	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
7.000	1.121	0.007	150.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	13.022	0.334	39.0	0.017	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.003	22.109	0.164	134.9	0.006	0.00	0.0	0.600	o	150	Pipe/Conduit	
8.000	0.935	0.006	150.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	9.843	0.066	150.0	0.030	0.00	0.0	0.600	o	150	Pipe/Conduit	
9.000	0.925	0.006	150.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
9.001	2.963	0.020	150.0	0.045	0.00	0.0	0.600	o	150	Pipe/Conduit	
10.000	0.915	0.006	150.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
10.001	2.776	0.019	150.0	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	10.673	0.071	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
11.000	1.125	0.011	102.3	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.002	50.00	5.29	31.574	0.018	0.0	0.0	0.0	1.00	17.8	2.4
7.000	50.00	5.02	31.500	0.000	0.0	0.0	0.0	0.82	14.5	0.0
7.001	50.00	5.16	31.493	0.017	0.0	0.0	0.0	1.62	28.6	2.3
5.003	50.00	5.72	31.159	0.041	0.0	0.0	0.0	0.86	15.3	5.5
8.000	50.00	5.02	31.400	0.000	0.0	0.0	0.0	0.82	14.5	0.0
8.001	50.00	5.22	31.394	0.030	0.0	0.0	0.0	0.82	14.5	4.0
9.000	50.00	5.02	31.287	0.000	0.0	0.0	0.0	0.82	14.5	0.0
9.001	50.00	5.08	31.281	0.045	0.0	0.0	0.0	0.82	14.5	6.1
10.000	50.00	5.02	31.400	0.000	0.0	0.0	0.0	0.82	14.5	0.0
10.001	50.00	5.08	31.394	0.025	0.0	0.0	0.0	0.82	14.5	3.3
1.004	50.00	5.88	31.229	0.192	0.0	0.0	0.0	1.07	42.4	26.0
11.000	50.00	5.02	31.200	0.000	0.0	0.0	0.0	0.99	17.6	0.0

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
11.001	2.163	0.048	45.1	0.026	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	6.017	0.040	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
11.001	50.00	5.04	31.189	0.026	0.0	0.0	0.0	1.50	26.6	3.6
1.005	50.00	6.01	30.990	0.218	0.0	0.0	0.0	0.82	14.5«	29.6

PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	S12	32.854	31.800	0.904	Open Manhole	450
1.001	o	150	S13	32.826	31.792	0.884	Open Manhole	450
2.000	o	150	S19	32.809	31.700	0.959	Open Manhole	450
2.001	o	150	S20	32.658	31.692	0.816	Open Manhole	450
1.002	o	150	S14	32.625	31.661	0.814	Open Manhole	450
3.000	o	150	S16	32.386	31.610	0.626	Open Manhole	450
3.001	o	150	S17	32.382	31.604	0.628	Open Manhole	450
4.000	o	150	S18	32.326	31.400	0.776	Open Manhole	450
1.003	o	150	S15	32.367	31.364	0.853	Open Manhole	450
5.000	o	150	S7	32.600	31.700	0.750	Open Manhole	450
5.001	o	150	S8	32.600	31.690	0.760	Open Manhole	450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	1.174	150.0	S13	32.826	31.792	0.884	Open Manhole	450
1.001	6.949	52.9	S14	32.625	31.661	0.814	Open Manhole	450
2.000	1.197	150.0	S20	32.658	31.692	0.816	Open Manhole	450
2.001	4.693	150.0	S14	32.625	31.661	0.814	Open Manhole	450
1.002	10.227	34.5	S15	32.367	31.364	0.853	Open Manhole	450
3.000	0.881	146.8	S17	32.382	31.604	0.628	Open Manhole	450
3.001	5.235	150.0	S15	32.367	31.569	0.648	Open Manhole	450
4.000	5.379	149.4	S15	32.367	31.364	0.853	Open Manhole	450
1.003	20.306	150.0	S28	32.376	31.229	0.997	Open Manhole	1200
5.000	1.527	150.0	S8	32.600	31.690	0.760	Open Manhole	450
5.001	7.622	150.0	S11	32.500	31.639	0.711	Open Manhole	450

PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
6.000	o	150	S9	32.500	31.600	0.750	Open Manhole	450
6.001	o	150	S10	32.500	31.591	0.759	Open Manhole	450
5.002	o	150	S11	32.500	31.574	0.776	Open Manhole	450
7.000	o	150	S1	32.381	31.500	0.731	Open Manhole	450
7.001	o	150	S2	32.413	31.493	0.770	Open Manhole	450
5.003	o	150	S3	32.469	31.159	1.160	Open Manhole	600
8.000	o	150	S21	32.374	31.400	0.824	Open Manhole	450
8.001	o	150	S22	32.373	31.394	0.829	Open Manhole	450
9.000	o	150	S32	32.417	31.287	0.980	Open Manhole	450
9.001	o	150	S33	32.407	31.281	0.976	Open Manhole	450
10.000	o	150	S30	32.334	31.400	0.784	Open Manhole	450
10.001	o	150	S31	32.345	31.394	0.801	Open Manhole	450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
6.000	1.347	149.7	S10	32.500	31.591	0.759	Open Manhole	450
6.001	1.708	100.0	S11	32.500	31.574	0.776	Open Manhole	450
5.002	6.196	100.0	S3	32.469	31.512	0.807	Open Manhole	600
7.000	1.121	150.0	S2	32.413	31.493	0.770	Open Manhole	450
7.001	13.022	39.0	S3	32.469	31.159	1.160	Open Manhole	600
5.003	22.109	134.9	S28	32.376	30.995	1.231	Open Manhole	1200
8.000	0.935	150.0	S22	32.373	31.394	0.829	Open Manhole	450
8.001	9.843	150.0	S28	32.376	31.328	0.898	Open Manhole	1200
9.000	0.925	150.0	S33	32.407	31.281	0.976	Open Manhole	450
9.001	2.963	150.0	S28	32.376	31.261	0.965	Open Manhole	1200
10.000	0.915	150.0	S31	32.345	31.394	0.801	Open Manhole	450
10.001	2.776	150.0	S28	32.376	31.375	0.851	Open Manhole	1200

PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.004	o	225	S28	32.376	31.229	0.922	Open Manhole	1200
11.000	o	150	S26	32.400	31.200	1.050	Open Manhole	450
11.001	o	150	S27	32.389	31.189	1.050	Open Manhole	450
1.005	o	150	S29	32.356	30.990	1.216	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.004	10.673	150.0	S29	32.356	31.158	0.973	Open Manhole	1200
11.000	1.125	102.3	S27	32.389	31.189	1.050	Open Manhole	450
11.001	2.163	45.1	S29	32.356	31.141	1.065	Open Manhole	1200
1.005	6.017	150.0	S34	32.468	30.950	1.368	Open Manhole	1200

Network Classifications for Surface Network 1

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	S12	150	0.884	0.904	Unclassified	450	0	0.904	Unclassified
1.001	S13	150	0.814	0.884	Unclassified	450	0	0.884	Unclassified
2.000	S19	150	0.816	0.959	Unclassified	450	0	0.959	Unclassified
2.001	S20	150	0.814	0.816	Unclassified	450	0	0.816	Unclassified
1.002	S14	150	0.814	0.853	Unclassified	450	0	0.814	Unclassified
3.000	S16	150	0.626	0.628	Unclassified	450	0	0.626	Unclassified
3.001	S17	150	0.628	0.648	Unclassified	450	0	0.628	Unclassified
4.000	S18	150	0.776	0.853	Unclassified	450	0	0.776	Unclassified
1.003	S15	150	0.853	0.997	Unclassified	450	0	0.853	Unclassified
5.000	S7	150	0.750	0.760	Unclassified	450	0	0.750	Unclassified
5.001	S8	150	0.711	0.760	Unclassified	450	0	0.760	Unclassified
6.000	S9	150	0.750	0.759	Unclassified	450	0	0.750	Unclassified
6.001	S10	150	0.759	0.776	Unclassified	450	0	0.759	Unclassified
5.002	S11	150	0.776	0.807	Unclassified	450	0	0.776	Unclassified
7.000	S1	150	0.731	0.770	Unclassified	450	0	0.731	Unclassified
7.001	S2	150	0.770	1.160	Unclassified	450	0	0.770	Unclassified
5.003	S3	150	1.160	1.231	Unclassified	600	0	1.160	Unclassified
8.000	S21	150	0.824	0.829	Unclassified	450	0	0.824	Unclassified
8.001	S22	150	0.829	0.898	Unclassified	450	0	0.829	Unclassified
9.000	S32	150	0.976	0.980	Unclassified	450	0	0.980	Unclassified
9.001	S33	150	0.965	0.976	Unclassified	450	0	0.976	Unclassified
10.000	S30	150	0.784	0.801	Unclassified	450	0	0.784	Unclassified
10.001	S31	150	0.801	0.851	Unclassified	450	0	0.801	Unclassified
1.004	S28	225	0.922	0.973	Unclassified	1200	0	0.922	Unclassified
11.000	S26	150	1.050	1.050	Unclassified	450	0	1.050	Unclassified
11.001	S27	150	1.050	1.065	Unclassified	450	0	1.050	Unclassified
1.005	S29	150	1.216	1.368	Unclassified	1200	0	1.216	Unclassified

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005	S34	32.468	30.950	0.000	1200	0

Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 7	Number of Storage Structures 7	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 458355 378897 SK 58355 78897
Data Type	Point
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Surface Network 1

Orifice Manhole: S13, DS/PN: 1.001, Volume (m³): 0.2

Diameter (m) 0.060 Discharge Coefficient 0.600 Invert Level (m) 31.792

Orifice Manhole: S20, DS/PN: 2.001, Volume (m³): 0.2

Diameter (m) 0.030 Discharge Coefficient 0.600 Invert Level (m) 31.692

Orifice Manhole: S2, DS/PN: 7.001, Volume (m³): 0.2

Diameter (m) 0.040 Discharge Coefficient 0.600 Invert Level (m) 31.493

Orifice Manhole: S33, DS/PN: 9.001, Volume (m³): 0.2

Diameter (m) 0.070 Discharge Coefficient 0.600 Invert Level (m) 31.281

Orifice Manhole: S31, DS/PN: 10.001, Volume (m³): 0.2

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 31.394

Orifice Manhole: S27, DS/PN: 11.001, Volume (m³): 0.2

Diameter (m) 0.060 Discharge Coefficient 0.600 Invert Level (m) 31.189

Hydro-Brake® Optimum Manhole: S29, DS/PN: 1.005, Volume (m³): 1.9

Unit Reference	MD-SHE-0149-9600-0500-9600
Design Head (m)	0.500
Design Flow (l/s)	9.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	149
Invert Level (m)	30.990
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	9.6	Kick-Flo®	0.395	8.6
Flush-Flo™	0.224	9.6	Mean Flow over Head Range	-	7.6

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 Manhole: S29, DS/PN: 1.005, Volume (m³): 1.9

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	5.4	1.200	14.5	3.000	22.5	7.000	33.8
0.200	9.6	1.400	15.6	3.500	24.2	7.500	35.0
0.300	9.4	1.600	16.6	4.000	25.8	8.000	36.2
0.400	8.6	1.800	17.6	4.500	27.3	8.500	37.3
0.500	9.6	2.000	18.5	5.000	28.8	9.000	38.4
0.600	10.5	2.200	19.4	5.500	30.0	9.500	39.5
0.800	12.0	2.400	20.2	6.000	31.3		
1.000	13.3	2.600	21.0	6.500	32.6		

Storage Structures for Surface Network 1

Porous Car Park Manhole: S13, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	21.6
Max Percolation (l/s)	28.8	Slope (1:X)	10.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	32.476	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: S20, DS/PN: 2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.7
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	18.9	Slope (1:X)	30.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	31.308	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: S2, DS/PN: 7.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	16.0
Max Percolation (l/s)	21.3	Slope (1:X)	30.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	32.063	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: S33, DS/PN: 9.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	40.0
Membrane Percolation (mm/hr)	1000	Length (m)	21.0
Max Percolation (l/s)	233.3	Slope (1:X)	9.6
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	32.057	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: S31, DS/PN: 10.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	28.6
Max Percolation (l/s)	38.1	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	32.000	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: S27, DS/PN: 11.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	33.0
Max Percolation (l/s)	44.0	Slope (1:X)	30.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	32.039	Cap Volume Depth (m)	0.350

Cellular Storage Manhole: S29, DS/PN: 1.005

Invert Level (m)	30.990	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	185.0	0.0	0.401	0.0	0.0
0.400	185.0	0.0			

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Total Volume (m³)
1.000	S12	0.168	0.168
1.001	S13	0.164	0.164
2.000	S19	0.176	0.176
2.001	S20	0.154	0.154
1.002	S14	0.153	0.153
3.000	S16	0.123	0.123
3.001	S17	0.124	0.124
4.000	S18	0.147	0.147
1.003	S15	0.160	0.160
5.000	S7	0.143	0.143
5.001	S8	0.145	0.145
6.000	S9	0.143	0.143
6.001	S10	0.145	0.145
5.002	S11	0.147	0.147
7.000	S1	0.140	0.140
7.001	S2	0.146	0.146
5.003	S3	0.371	0.371
8.000	S21	0.155	0.155
8.001	S22	0.156	0.156
9.000	S32	0.180	0.180
9.001	S33	0.179	0.179
10.000	S30	0.149	0.149
10.001	S31	0.151	0.151
1.004	S28	1.297	1.297
11.000	S26	0.191	0.191
11.001	S27	0.191	0.191
1.005	S29	1.545	1.545
Total		6.943	6.943

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Total Volume (m³)
1.000	S12	0.168	0.168
1.001	S13	0.164	0.164
2.000	S19	0.176	0.176
2.001	S20	0.154	0.154
1.002	S14	0.153	0.153
3.000	S16	0.123	0.123
3.001	S17	0.124	0.124
4.000	S18	0.147	0.147
1.003	S15	0.160	0.160
5.000	S7	0.143	0.143
5.001	S8	0.145	0.145
6.000	S9	0.143	0.143
6.001	S10	0.145	0.145
5.002	S11	0.147	0.147
7.000	S1	0.140	0.140
7.001	S2	0.146	0.146
5.003	S3	0.371	0.371
8.000	S21	0.155	0.155
8.001	S22	0.156	0.156
9.000	S32	0.180	0.180
9.001	S33	0.179	0.179
10.000	S30	0.149	0.149
10.001	S31	0.151	0.151
1.004	S28	1.297	1.297
11.000	S26	0.191	0.191
11.001	S27	0.191	0.191
1.005	S29	1.545	1.545
Total		6.943	6.943

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 7 Number of Storage Structures 7 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 458355 378897 SK 58355 78897
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	S12	15 Winter	2	+0%	30/15 Summer			
1.001	S13	15 Winter	2	+0%	30/15 Summer	100/15 Summer		
2.000	S19	8640 Winter	2	+0%	100/60 Summer			
2.001	S20	5760 Winter	2	+0%	100/60 Summer	100/120 Winter		
1.002	S14	15 Winter	2	+0%	100/15 Summer			
3.000	S16	15 Winter	2	+0%	100/15 Summer			
3.001	S17	15 Winter	2	+0%	100/15 Summer			
4.000	S18	15 Winter	2	+0%	30/15 Summer			
1.003	S15	15 Winter	2	+0%	30/15 Summer			
5.000	S7	15 Winter	2	+0%	100/15 Summer			
5.001	S8	15 Winter	2	+0%	100/15 Summer			
6.000	S9	15 Winter	2	+0%	100/15 Summer			

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S12	31.922	-0.028	0.000	0.00			0.0	OK	
1.001	S13	31.922	-0.020	0.000	0.11		6	2.3	OK	2
2.000	S19	31.705	-0.145	0.000	0.00			0.0	OK	
2.001	S20	31.704	-0.138	0.000	0.00			0.0	OK	2
1.002	S14	31.690	-0.120	0.000	0.09			2.3	OK	
3.000	S16	31.637	-0.123	0.000	0.00			0.0	OK	
3.001	S17	31.637	-0.117	0.000	0.11			1.3	OK	
4.000	S18	31.435	-0.115	0.000	0.10			1.1	OK	
1.003	S15	31.424	-0.090	0.000	0.33			4.5	OK	
5.000	S7	31.716	-0.134	0.000	0.00			0.0	OK	
5.001	S8	31.717	-0.123	0.000	0.07			0.9	OK	
6.000	S9	31.628	-0.122	0.000	0.00			0.0	OK	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.001	S10	15 Winter	2	+0%	100/15 Summer				31.628
5.002	S11	15 Winter	2	+0%	100/15 Summer				31.614
7.000	S1	15 Winter	2	+0%	2/15 Summer				31.842
7.001	S2	15 Winter	2	+0%	2/15 Summer				31.843
5.003	S3	15 Winter	2	+0%	2/15 Summer				31.350
8.000	S21	15 Winter	2	+0%	100/15 Summer				31.452
8.001	S22	15 Winter	2	+0%	100/15 Summer				31.452
9.000	S32	120 Winter	2	+0%	2/60 Winter				31.468
9.001	S33	120 Winter	2	+0%	2/60 Winter				31.468
10.000	S30	60 Winter	2	+0%	2/15 Summer				32.104
10.001	S31	60 Winter	2	+0%	2/15 Summer				32.104
1.004	S28	15 Winter	2	+0%	30/15 Summer				31.325
11.000	S26	15 Winter	2	+0%	2/15 Summer				31.420
11.001	S27	15 Winter	2	+0%	2/15 Summer	100/15 Winter			31.420
1.005	S29	240 Winter	2	+0%	30/30 Winter				31.074

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.001	S10	-0.113	0.000	0.14			1.5	OK	
5.002	S11	-0.110	0.000	0.16			2.4	OK	
7.000	S1	0.192	0.000	0.02			0.2	SURCHARGED	
7.001	S2	0.200	0.000	0.07		6	1.9	SURCHARGED	
5.003	S3	0.041	0.000	0.34			4.9	SURCHARGED	
8.000	S21	-0.098	0.000	0.00			0.0	OK	
8.001	S22	-0.092	0.000	0.32			4.1	OK	
9.000	S32	0.031	0.000	0.01			0.1	SURCHARGED	
9.001	S33	0.038	0.000	0.20		24	2.1	SURCHARGED	
10.000	S30	0.554	0.000	0.02			0.2	FLOOD RISK	
10.001	S31	0.561	0.000	0.06		24	0.7	FLOOD RISK	
1.004	S28	-0.129	0.000	0.38			13.6	OK	
11.000	S26	0.070	0.000	0.01			0.1	SURCHARGED	
11.001	S27	0.081	0.000	0.24		5	3.3	SURCHARGED	1
1.005	S29	-0.066	0.000	0.33		116	4.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 7 Number of Storage Structures 7 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 458355 378897 SK 58355 78897
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S12	15 Winter	30	+0%	30/15 Summer				32.547
1.001	S13	15 Winter	30	+0%	30/15 Summer	100/15 Summer			32.547
2.000	S19	720 Winter	30	+0%	100/60 Summer				31.732
2.001	S20	720 Winter	30	+0%	100/60 Summer	100/120 Winter			31.732
1.002	S14	15 Winter	30	+0%	100/15 Summer				31.710
3.000	S16	15 Winter	30	+0%	100/15 Summer				31.662
3.001	S17	15 Winter	30	+0%	100/15 Summer				31.662
4.000	S18	15 Winter	30	+0%	30/15 Summer				31.579
1.003	S15	15 Winter	30	+0%	30/15 Summer				31.574
5.000	S7	15 Winter	30	+0%	100/15 Summer				31.737
5.001	S8	15 Summer	30	+0%	100/15 Summer				31.737
6.000	S9	15 Winter	30	+0%	100/15 Summer				31.657

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S12	0.597	0.000	0.06			0.7	SURCHARGED	
1.001	S13	0.605	0.000	0.31		4	6.4	FLOOD RISK	2
2.000	S19	-0.118	0.000	0.00			0.0	OK	
2.001	S20	-0.110	0.000	0.03			0.3	OK	2
1.002	S14	-0.101	0.000	0.23			6.4	OK	
3.000	S16	-0.098	0.000	0.00			0.0	OK	
3.001	S17	-0.092	0.000	0.32			3.7	OK	
4.000	S18	0.029	0.000	0.21			2.5	SURCHARGED	
1.003	S15	0.060	0.000	0.86			11.7	SURCHARGED	
5.000	S7	-0.113	0.000	0.00			0.0	OK	
5.001	S8	-0.103	0.000	0.22			2.7	OK	
6.000	S9	-0.093	0.000	0.00			0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.001	S10	15 Winter	30	+0%	100/15 Summer				31.657
5.002	S11	15 Winter	30	+0%	100/15 Summer				31.646
7.000	S1	15 Winter	30	+0%	2/15 Summer				32.257
7.001	S2	15 Winter	30	+0%	2/15 Summer				32.257
5.003	S3	15 Winter	30	+0%	2/15 Summer				31.565
8.000	S21	15 Winter	30	+0%	100/15 Summer				31.510
8.001	S22	15 Winter	30	+0%	100/15 Summer				31.510
9.000	S32	30 Winter	30	+0%	2/60 Winter				32.176
9.001	S33	30 Winter	30	+0%	2/60 Winter				32.176
10.000	S30	60 Winter	30	+0%	2/15 Summer				32.237
10.001	S31	60 Winter	30	+0%	2/15 Summer				32.237
1.004	S28	15 Winter	30	+0%	30/15 Summer				31.470
11.000	S26	15 Winter	30	+0%	2/15 Summer				32.184
11.001	S27	15 Winter	30	+0%	2/15 Summer	100/15 Winter			32.184
1.005	S29	60 Winter	30	+0%	30/30 Winter				31.164

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.001	S10	-0.084	0.000	0.40			4.3	OK	
5.002	S11	-0.078	0.000	0.47			7.0	OK	
7.000	S1	0.607	0.000	0.07			0.8	FLOOD RISK	
7.001	S2	0.614	0.000	0.11		7	2.9	FLOOD RISK	
5.003	S3	0.256	0.000	0.80			11.6	SURCHARGED	
8.000	S21	-0.040	0.000	0.01			0.1	OK	
8.001	S22	-0.033	0.000	0.92			11.8	OK	
9.000	S32	0.739	0.000	0.10			1.1	FLOOD RISK	
9.001	S33	0.745	0.000	0.84		5	8.9	FLOOD RISK	
10.000	S30	0.687	0.000	0.00			0.0	FLOOD RISK	
10.001	S31	0.693	0.000	0.07		54	0.8	FLOOD RISK	
1.004	S28	0.016	0.000	1.15			40.9	SURCHARGED	
11.000	S26	0.834	0.000	0.11			1.1	FLOOD RISK	
11.001	S27	0.845	0.000	0.54		4	7.4	FLOOD RISK	1
1.005	S29	0.024	0.000	0.75		56	9.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 7 Number of Storage Structures 7 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 458355 378897 SK 58355 78897
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S12	15 Winter	100	+40%	30/15 Summer				32.826
1.001	S13	15 Winter	100	+40%	30/15 Summer	100/15 Summer			32.826
2.000	S19	180 Winter	100	+40%	100/60 Summer				32.658
2.001	S20	120 Winter	100	+40%	100/60 Summer	100/120 Winter			32.658
1.002	S14	15 Winter	100	+40%	100/15 Summer				31.843
3.000	S16	15 Winter	100	+40%	100/15 Summer				31.836
3.001	S17	15 Winter	100	+40%	100/15 Summer				31.836
4.000	S18	15 Winter	100	+40%	30/15 Summer				31.833
1.003	S15	15 Winter	100	+40%	30/15 Summer				31.822
5.000	S7	15 Winter	100	+40%	100/15 Summer				31.933
5.001	S8	15 Winter	100	+40%	100/15 Summer				31.933
6.000	S9	15 Winter	100	+40%	100/15 Summer				31.927

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

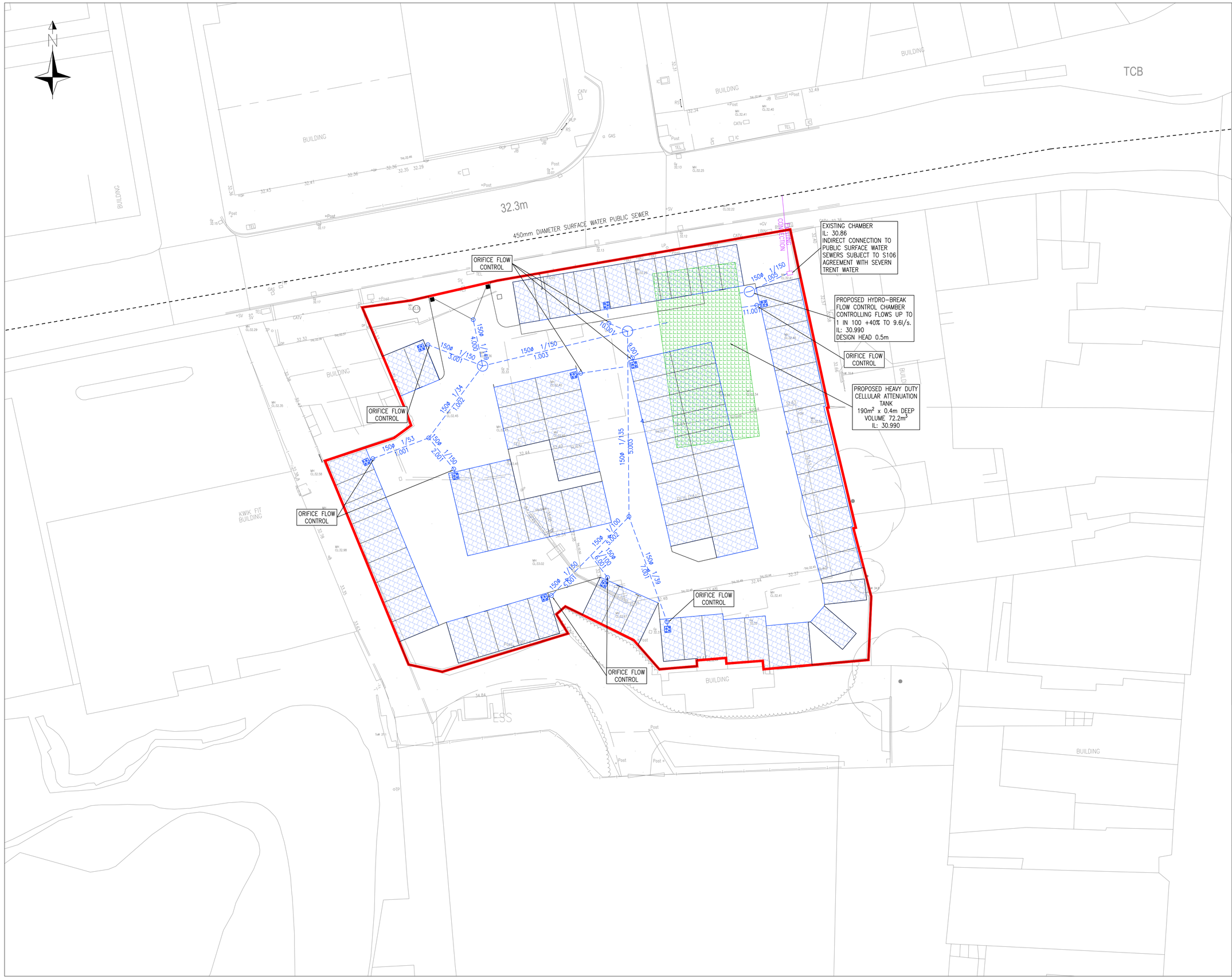
PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S12	0.876	0.000	0.14			1.5	FLOOD RISK	
1.001	S13	0.884	0.309	0.36		5	7.5	FLOOD	2
2.000	S19	0.808	0.000	0.02			0.2	FLOOD RISK	
2.001	S20	0.816	0.172	0.16			1.7	FLOOD	2
1.002	S14	0.033	0.000	0.31			8.4	SURCHARGED	
3.000	S16	0.076	0.000	0.02			0.2	SURCHARGED	
3.001	S17	0.082	0.000	0.55			6.4	SURCHARGED	
4.000	S18	0.283	0.000	0.40			4.7	SURCHARGED	
1.003	S15	0.308	0.000	1.27			17.2	SURCHARGED	
5.000	S7	0.083	0.000	0.03			0.3	SURCHARGED	
5.001	S8	0.093	0.000	0.36			4.4	SURCHARGED	
6.000	S9	0.177	0.000	0.03			0.3	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.001	S10	15 Winter	100	+40%	100/15 Summer				31.928
5.002	S11	15 Winter	100	+40%	100/15 Summer				31.920
7.000	S1	30 Winter	100	+40%	2/15 Summer				32.381
7.001	S2	15 Winter	100	+40%	2/15 Summer				32.399
5.003	S3	15 Winter	100	+40%	2/15 Summer				31.880
8.000	S21	15 Winter	100	+40%	100/15 Summer				31.796
8.001	S22	15 Winter	100	+40%	100/15 Summer				31.796
9.000	S32	30 Winter	100	+40%	2/60 Winter				32.391
9.001	S33	30 Winter	100	+40%	2/60 Winter				32.391
10.000	S30	120 Winter	100	+40%	2/15 Summer				32.334
10.001	S31	60 Winter	100	+40%	2/15 Summer				32.342
1.004	S28	15 Winter	100	+40%	30/15 Summer				31.609
11.000	S26	15 Winter	100	+40%	2/15 Summer				32.389
11.001	S27	15 Winter	100	+40%	2/15 Summer	100/15 Winter			32.389
1.005	S29	120 Winter	100	+40%	30/30 Winter				31.454

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.001	S10	0.187	0.000	0.68			7.4	SURCHARGED	
5.002	S11	0.196	0.000	0.78			11.7	SURCHARGED	
7.000	S1	0.731	0.000	0.23			2.5	FLOOD RISK	
7.001	S2	0.756	0.000	0.12		15	3.1	FLOOD RISK	
5.003	S3	0.571	0.000	1.26			18.2	SURCHARGED	
8.000	S21	0.246	0.000	0.03			0.3	SURCHARGED	
8.001	S22	0.252	0.000	1.68			21.6	SURCHARGED	
9.000	S32	0.954	0.000	0.12			1.3	FLOOD RISK	
9.001	S33	0.960	0.000	0.95		11	10.0	FLOOD RISK	
10.000	S30	0.784	0.000	0.07			0.8	FLOOD RISK	
10.001	S31	0.798	0.000	0.07			0.8	FLOOD RISK	
1.004	S28	0.155	0.000	1.81			64.4	SURCHARGED	
11.000	S26	1.039	0.000	0.12			1.4	FLOOD RISK	
11.001	S27	1.050	0.192	0.59		7	8.1	FLOOD	1
1.005	S29	0.314	0.000	0.79		104	9.5	SURCHARGED	

Appendix H



NOTES:

1. DO NOT SCALE FROM THIS DRAWING.
2. THIS DRAWING SHOULD ONLY BE USED FOR ITS INTENDED PURPOSE.
3. DIMENSIONS SHOWN ARE IN METRES UNLESS OTHERWISE STATED.

DESIGN NOTES:

1. SURFACE WATER ATTENUATION BASED ON 100 YEARS PLUS 40% CLIMATE CHANGE
2. PROPOSED DISCHARGE RATE OF 9.6L/S SUBJECT TO AGREEMENT WITH THE LEAD LOCAL FLOOD AUTHORITY, THE PLANNING AUTHORITY AND SEVERN TRENT WATER.
3. ALL INSPECTION CHAMBERS WITHIN GROUNDWATER TO BE CONCRETE ENCASED TO PREVENT FLOATATION.
4. INVERT LEVELS AT POINT OF CONNECTION BASED ON THIRD PARTY CCTV SURVEY BY SURVEY HUB, UNDERTAKEN IN NOVEMBER 2020.
5. ALL DRAINAGE FEATURES INDICATIVE ONLY AND SUBJECT TO CHANGE AT DETAILED DESIGN STAGE.

KEY

- ROAD GULLY
- SURFACE WATER PIPE
- SURFACE WATER INSPECTION CHAMBER/ MANHOLE
- SURFACE WATER ATTENUATION TANK
- SURFACE WATER DIFFUSER UNIT
- PERMEABLE BLOCK PAVING

PROPOSED DRAINAGE STRATEGY TO BE USED FOR PLANNING PURPOSES ONLY AND IS SUBJECT TO CHANGE AT DETAILED DESIGN STAGE

REV:	AMENDMENTS:	DRN:	CHK:	DATE:
P03	DESIGN UPDATED TO SUIT NEW LAYOUT	HC	WAO	01.02.21
P02	DESIGN UPDATED TO SUIT NEW LAYOUT	ID	WAO	28.01.21
P01	PLANNING ISSUE	ID	WAO	15.01.21

Project:
NEWCASTLE AVENUE
WORKSOP

Drawing title:
PROPOSED
DRAINAGE STRATEGY
SHEET 1 OF 1

Client:
BS SQUARED LTD.

Drawing number:
100525_03_0500_01

Revision:	Sheet size:	Scale:
P03	A1	1:200
Drawn by:	Checked by:	Date:
ID	WAO	15.01.2021

Status:
FOR INFORMATION / APPROVAL

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