

Drainage Strategy and Water Quality Assessment (DSWQA)

8 Wood Lane, Atherstone

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AUTHOR:	Jasmine Gillatt Bsc(Hons)
REVIEWED BY:	Steven Jeffreys IEng MICE FIHE MInstLM MInstRE
COMPANY DETAILS:	Enviren Ltd, Programme, The Pithay, Bristol, BS1 2NB
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Executive Summary

This report has been prepared by Enviren Ltd solely for use as part of a planning application associated with the demolition of an existing warehouse and barn structure as well as the development of four residential dwellings in Norton-Juxta-Twycross (Address: 8 Wood Lane, Norton Juxta, CV9 3QB, Grid reference: SK 32529 06812). This report shall analyse the existing site use, flood risk potential and vulnerability classification and then discuss a suitable on-site drainage strategy with due consideration to flood risk, vulnerability classification and water quality.

The site is shown to be situated entirely within Flood Zone 1, not at high risk of river flooding and is not affected by any other identified form of flood risk. In accordance with flood risk planning guidance, the SFRA and the Non-statutory technical standards¹ there should be no increase in peak discharges from the site and discharge rates and discharge volumes should be constrained as close as reasonably practicable to greenfield runoff rates and volumes, but never exceed the existing discharge rate and volume. Where achieving greenfield runoff rates is not reasonably practicable a 30% betterment over brownfield runoff rates could reasonably be specified, providing confirmation is received from the council, with the volume of water not exceeding previous brownfield conditions. Where a betterment cannot be incorporated then the development must provide wider benefits to the downstream water network in line with the other three core pillars of SuDS (see [Figure 3.1](#)), being water quality, biodiversity and amenity.

The proposed development shall result in an increase in impermeable surface area as the proposals are for the development of four residential dwellings. Surface water runoff should discharge to ground where possible and where not runoff rates should be constrained to as close as greenfield runoff rate as possible. A review of British Geological Survey (BGS) mapping indicates that the strata underlying the site likely has unfavourable infiltration rates, as such a discharge strategy involving infiltration shall not be pursued. Foul water from the properties shall discharge to the main foul sewer to the north of the development along Wood Lane.

In compliance with the requirements of the National Planning Policy Framework, and subject to the mitigation measures proposed, the development could proceed without being subject to significant flood risk. Additionally the development will not increase flood risk to the wider catchment area owing to suitable management of surface water runoff.

¹ Department for Environment, Food and Rural Affairs – Sustainable Drainage Systems – Non-statutory technical standards for sustainable drainage systems (March 2015)

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1. Introduction

1.1. This report has been prepared in support of a planning application for the demolition of an existing warehouse and barn structure as well as the development of four residential dwellings in Norton-Juxta-Twycross. This Drainage Strategy and Water Quality Assessment (DSWQA) is compliant with the requirements of the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance along with other regional and national guidance.

Sources of Information

1.2. This report has been based on the following sources of information (this list is not exhaustive and comprises the major sources of background documentation):

Table 1.1 – Sources of Information	
Client Supplied Information	➤ Site Location Plan. ➤ Site Layout Plan. ➤ Topographical Survey Information.
GIS Mapping Data	➤ SCALGO Live GIS Modelling.
Local Authority Flood Information	➤ Local Authority Flood Mapping. ➤ Leicestershire County Council Local Flood Risk Management Strategy. ➤ Leicestershire County Council Strategic Flood Risk Assessment. ➤ Leicestershire County Council Preliminary Flood Risk Assessment. ➤ The Local Flood Risk Management Plan (FRMP).
Central Government Information	➤ Environment Agency Surface Water Flood Maps. ➤ Environment Agency Fluvial and Thalassic Flood Maps. ➤ Environment Agency Reservoir Flood Maps.
River/Coastal Management Information	➤ The River Mease Catchment Flood Management Plan (CFMP).
Catchment Data	➤ FEH Catchment Boundary Information.
Soil Data	➤ British Geological Survey (BGS) Drift & Geology Maps.
Applicable Legislation	➤ Land Drainage Act 1991. ➤ Water Industry Act 1991. ➤ Flood and Water Management Act 2010. ➤ The Building Regulations 2010. ➤ Environmental Permitting Regulations 2016.

Table 1.2 – Site Specific Information

Category		Site Specific Information	
Site Name		Wood Lane, Atherstone	
Site Location		8 Wood Ln, Norton-Juxta-Twycross, Atherstone	
Local Authority			
Overall Site Area		0.810 Hectares	
Existing NPPF Vulnerability		Less Vulnerable	
Proposed NPPF Vulnerability		More Vulnerable	
Design Return Period		100 years for on-site flooding	
Climate Change Allowance		40% - Rainfall intensity 22% - Peak river flow	
Infiltration viable		No	
Proposed surface water discharge method		Watercourse	
Proposed foul water discharge method		Sewer	
Flood Zone (Rivers and Sea)		Flood Zone 1 (FZ1)	
Risk of Surface Water Flooding		Low risk	
Risk of Reservoir Flooding		Very low risk	
Risk of Groundwater Flooding		Very low risk	
Risk of Sewer Flooding		Very low risk	
Critical Drainage Status		Not believed to be within a Critical Drainage Area	
High risk	Medium risk	Low risk	Very low risk

2. Background Information

Site Location

- 2.1. The site is located on the eastern side of Norton-Juxta-Twycross along Wood Lane and approximately 2.100 kilometres northeast of the neighbouring town of Twycross. The exact location can be found in [Figure 2.1](#):



Figure 2.1 – Site Location

Outline Site Hydrology

- 2.2. Interrogation of local topographical information around the development parcel identifies that runoff from the site flows north towards the Main Street watercourse, which runs northeast and discharges into the River Mease. The River Mease travels northwest to discharge into the River Trent, which then flows northeast into the River Humber, ultimately discharging into the sea.
- 2.3. Statutory Undertaker mapping ([Appendix 1](#)) also indicates that there is a foul water sewers located north of the site along Wood Lane.



Figure 2.2 – SCALGO Topographic Data – Site Hydrology

Site Description

- 2.4. The area to be developed currently constitutes an existing warehouse and barn complex with grassland to the south of the complex. The site is approximately 0.810 hectares in size when considering the areas in the site plan (see [Appendix 2](#)). The site parcel is bordered to the east, west and north by dwellings and by grassland to the south.



Figure 2.3 – Aerial Reconnaissance Photography

Geotechnical/Geological

- 2.5. BGS Mapping² indicates that the development is largely underlain by siltstone and sandstone of the Gunthorpe Member Formation. Details of the bedrock are found in [Figure 2.4](#). Local BGS Borehole Records³ confirm the maps findings.

² BGS Surface Geology – Geology of Britain Viewer

³ BGS – GeoIndex Onshore

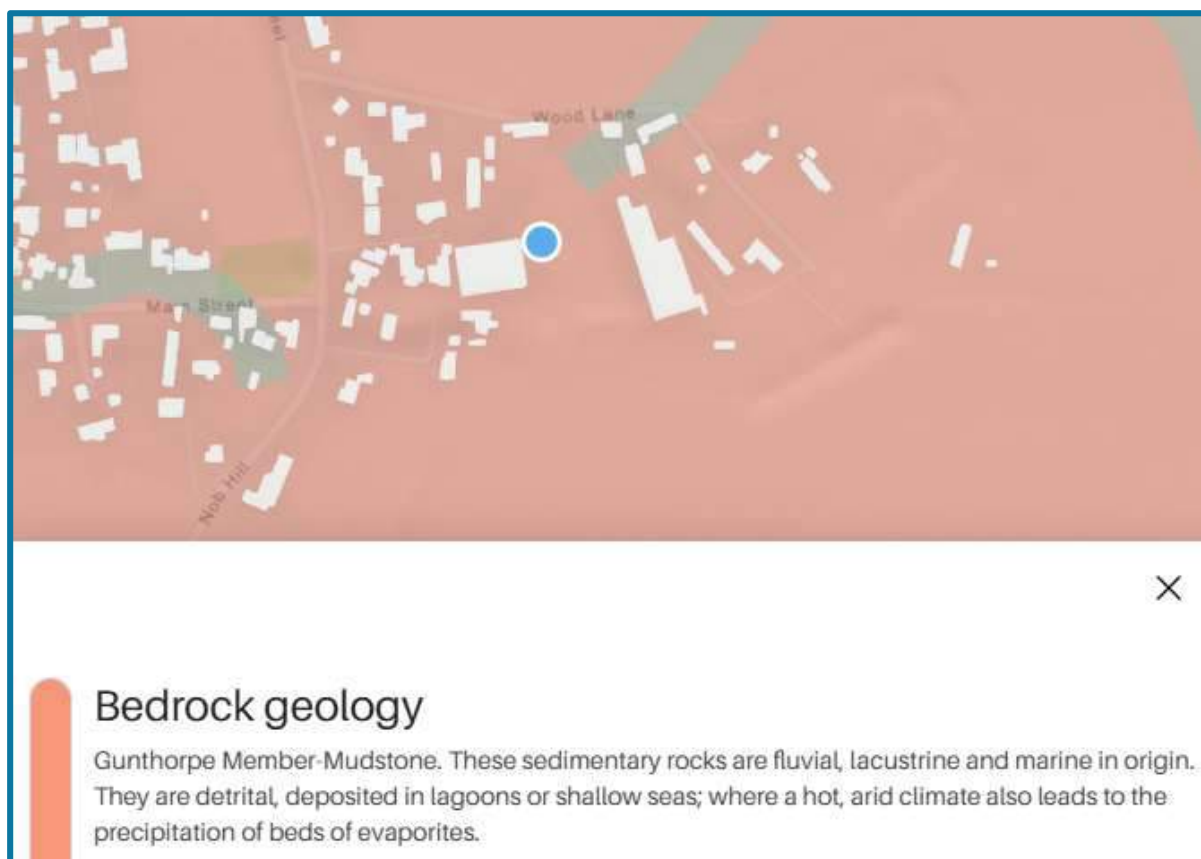


Figure 2.4 – Soilscape Mapping

Table 2.1 – Geological Stratum	
Underlying Geology	Description
Made Ground/Topsoil	Superficial made ground/topsoil to an anticipated depth of circa 0.3-0.5m.
Gunthorpe Member Formation	Mudstone, red-brown, with subordinate dolomitic siltstone and fine-grained sandstone, greenish grey, common gypsum veins and nodules.

3.Outline Surface Water Drainage Strategy

- 3.1. As described in the Level 1 Strategic Flood Risk Assessment, the Preliminary Flood Risk Assessment, the National Planning Policy Framework as well as the accompanying technical standards and planning policy guidance; new development should embrace the sustainability goals of SuDS, accommodating SuDS in development proposals where possible, particularly for major development as per policy 169 of the NPPF.

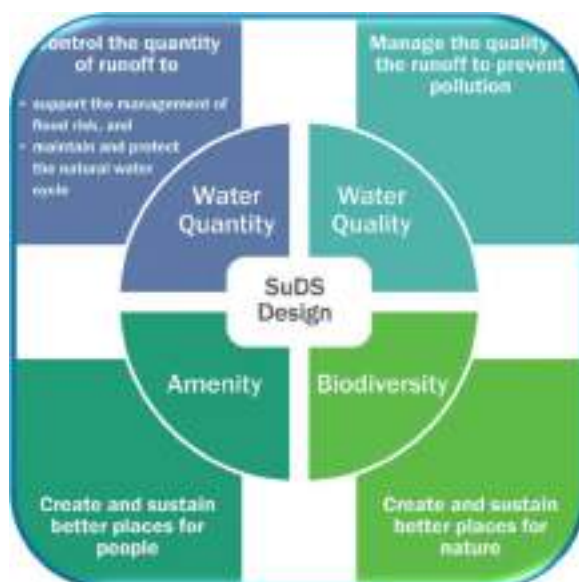


Figure 3.1 – Multiple benefits of SuDS

- 3.2. Proposed surface water drainage systems should also seek to provide a betterment in runoff rates and volumes when compared to existing conditions. Surface water arisings should be infiltrated to ground as far as reasonably practical; however, where this is not possible as per the non-statutory technical standards, post development runoff rates should be limited to the existing runoff rate for all events between the 1 in 1 year and the 1 in 100 year events, including an allowance for climate change.
- 3.3. However, for previously developed sites (brownfield sites), runoff rates should be limited to the equivalent greenfield runoff rates for all events between the 1 in 1 year and the 1 in 100 year events, including a suitable allowance for climate change. Where this is not practical a betterment over the existing situation is expected for all return period events (usually 30%). However, should betterment not be achievable this can be offset by improvements in relation to the other 'pillars of SuDS'.

National Standards for Sustainable Drainage System

- 3.4. The National Standards for Sustainable Drainage Systems (SuDS) are aimed at guiding designers, developers, local authorities, and environmental stakeholders in planning surface water drainage for new developments. They apply to greenfield and brownfield sites, but not directly to retrofit projects. These standards cover uncontaminated surface water runoff, mostly rainwater, and note that additional pollution controls or permits may be required for higher-risk land uses. They also exclude trunk roads, which are covered by the Design Manual for Roads and Bridges.

Requirements

Standard 1 – Discharge Hierarchy

- 3.5. The surface water drainage design follows the National SuDS Standards, which provide a framework for sustainable, resilient, and multi-functional drainage strategies. Designs are based on the following core principles:
- Prioritisation of source control and treatment trains, with emphasis on at-surface, vegetated features providing both treatment and amenity value.
 - Integration of SuDS early in the design process and in parallel with considerations such as water supply, ecology, site remediation, and green infrastructure.
 - Drainage strategies should align with local flood risk and river basin management plans, with early engagement with LPAs and statutory consultees.
 - Proposals must demonstrate conformance with the National Standards across all phases of development and include supporting evidence.
- 3.6. The hierarchy outlined in the NSSuDS emphasises the objective of reusing water onsite as far as reasonably possible, with justification required where this cannot be achieved.

Standards 2&3 – Water Quantity Management

- 3.7. Designs must address interception of at least 5mm rainfall (80% in summer, 50% in winter), excluding infiltration systems. Climate change allowances must be factored into both the 1:30 and 1:100 year storm events. Surface water runoff rates are to be restricted to QBAR or 3 l/s/ha, whichever is greater.
- 3.8. Greenfield runoff calculations must use full site area and be based on EA Flood Estimation Guidelines; permeable surfaces and wet features should be accounted as impermeable in runoff calculations. 24-hour drain-down times applies only to the 1:30 year event. Multiple attenuation points are preferred over single large basins to support resilience.
- 3.9. Flow controls and orifices (<50mm) require protection, and the impact of surcharged outfalls must be mitigated. Exceedance routes must be designed to avoid property damage and ensure access routes are protected (freeboard allowances and flood locking).
- 3.10. Soils with infiltration rates $<1 \times 10^{-6}$ m/s should not be relied on exclusively for discharge. Drainage design must include phased maintenance and flow control strategy.

Standard 4 – Water Quality and Environmental Considerations

- 3.11. The Simple Index Approach remains the standard for treatment; however, drainage strategies should demonstrate how nutrient neutrality, habitat enhancement, and water quality objectives are achieved, with direct reference to the River Basin Management Plans (RBMP) and Drainage and Wastewater Management Plans (DWMP).
- 3.12. A section should justify how the scheme meets the four pillars of SuDS: water quantity, water quality, amenity, and biodiversity. Use of Natural England's Green Infrastructure Framework is encouraged to inform the design of high-quality, multifunctional green SuDS.
- 3.13. All sites must include visible interpretation boards outlining water quality measures, ecological value, and public safety information. Ponds, swales and rain gardens should offer amenity and opportunities for walking, cycling, play, and biodiversity.

Standards 5&6 – Biodiversity and Habitat Integration

- 3.14. The designer should consider wildlife connectivity, mammal movement (e.g., culverts under roads), and Local Nature Recovery Strategies. SuDS features must promote habitat creation and should link directly to the Preliminary Ecological Appraisal (PEA).
- 3.15. Include a Biodiversity Risk and Opportunity Assessment covering risks to, and opportunities for, species and habitats. Include site-specific justification of proposed planting, referencing footnotes on appropriate tree species and Natural England's guidance.
- 3.16. A minimum 1m unsaturated zone is required between infiltration base and groundwater to allow for effective treatment.

Standard 7 – Construction and Management

- 3.17. SuDS should be robustly managed with reference to CIRIA C753, including a long-term maintenance plan and CDM Regulation-compliant construction notes. Maintenance plans must address oil spill response, telemetry requirements for proprietary systems, and silt management in line with EA RPS55.
- 3.18. Where plastic systems are proposed, specify due to durability and reduced embodied carbon; otherwise prioritise natural materials and earthen features. Designs should begin to consider embodied carbon and material choices as part of broader environmental assessment.

Practical Implications

- 3.19. The implications of the NSSuDS are that development should look to prioritise reuse of surface water as part of the design, pay particular attention to the wider impact of drainage proposals including; the implications on wider water quality and biodiversity, with more emphasis on deeper collaboration between ecology and engineering.

Discharge Method

- 3.20. To achieve the policy goals of both the NPPF, NSSuDS and the SFRA a discharge method should be sought that is compliant with the surface water discharge hierarchy which specifies discharge preferability. The hierarchy states that discharge should be:
- Reuse onsite.
 - Into the ground (infiltration);
 - To a surface water body;
 - To a surface water sewer, highway drain, or another drainage system; or
 - To a combined sewer

Reuse of Rainwater Onsite

- 3.21. Given the site constraints and the financial/maintenance implications of reusing water onsite, active rainwater harvesting systems have not been selected as part of the design.

Discharge to Ground

- 3.22. Review of the underlying strata, including information obtained from the British Geological Survey (BGS) and onsite infiltration testing, indicates that the ground conditions are unlikely to support effective infiltration. As such, soakaways would not provide a feasible means of discharge for extreme rainfall events.
- 3.23. Onsite ground investigation undertaken as part of the Phase 1 Land Contamination Risk Assessment ([Appendix 3](#)), prepared by Castledine Environmental, confirms the underlying strata to comprise the Gunthorpe Member Formation. The identified geological conditions are not considered suitable for infiltration, and therefore alternative surface water discharge methods will need to be considered.

Discharge to Watercourse

- 3.24. As infiltration is not a viable method of discharge of surface water disposal, surface water will need to be discharged to the wider water network. There is a watercourse to the south of the site (see [Figure 3.2](#)).
- 3.25. The adjacent watercourse presents an appropriate point of discharge. Land drainage consent will be required for such a connection with the Lead Local Flood Authority (LLFA) with attention to the requirements of any Internal Drainage Board (IDB) where appropriate. Based on this evidence, discharge of surface water to a watercourse is likely a viable method of surface water disposal and no other point of discharge need be explored further.

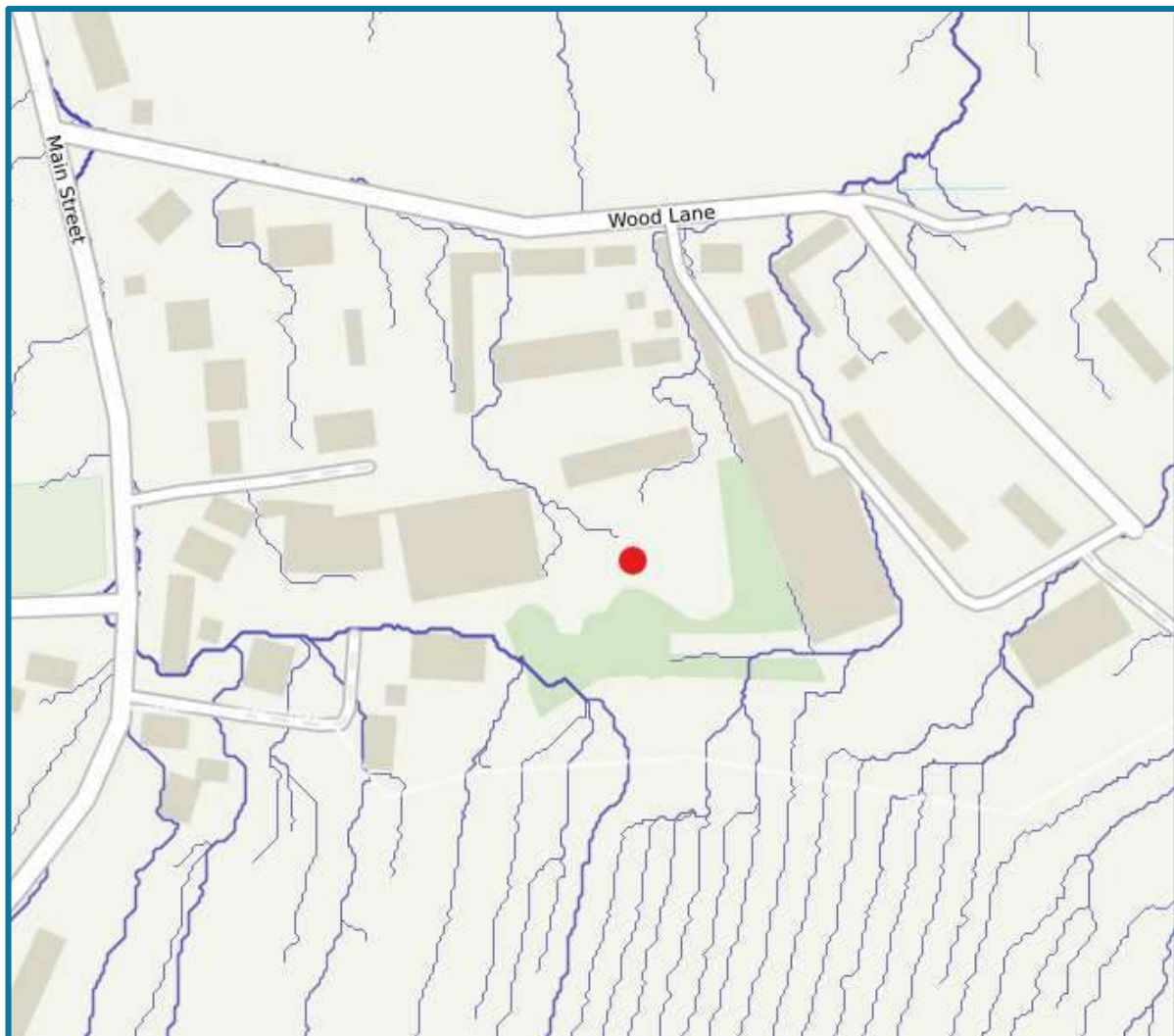


Figure 3.2 – SCALGO Surface Water Flow Pathways

Table 3.1 – Discharge Hierarchy Fulfilment	
Discharge Method	Viability
Water Reuse Onsite	Unviable
Discharge to ground	Unviable
Discharge to watercourse	Viable
Discharge to surface water sewer	Not considered
Discharge to combined sewer	Not considered

Hydraulic and SuDS Design – Infiltration

3.26. The proposed surface water drainage solution will provide a significant betterment over existing discharge rates, not increasing runoff rates and discharging all surface water to the watercourse.

Existing Hydraulic Flow Regime – Conveyance

- 3.27. To ensure that the development achieves maximum benefit to the surrounding catchment the development shall constrain discharge rates as close as practical to greenfield runoff rate (QBAR). Greenfield runoff rates (see [Appendix 7](#)) are presented in [Table 3.2](#) as are brownfield runoff rates (see [Appendix 8](#)):

Table 3.2 – Existing Development Runoff Rates				
Storm Event	QBAR	1:2 year event	1:30 year event	1:100 year event + 45% Climate Change
Greenfield Runoff Rates (l/s)	1.7	1.5	3.3	6.02 (4.3x1.4*Climate change)
Brownfield Runoff Rates (l/s)	N/A	46.1	116.7	210.98 (150.7x1.4*Climate change)

- 3.28. The Flood Estimation Handbook (FEH-22) method has been used to calculate the greenfield runoff rate; which is suitable for catchments below 50 hectares. The method uses linear interpolation to calculate likely flow conditions for smaller site areas.
- 3.29. As per Industry Guidance (see CIRIA C753 Section 3.3.2) where target discharge rates are too low there is an increased risk of blockage of the flow control device, endangering onsite flooding, therefore a minimum discharge rate of 2l/s shall be used as per sewerage sector best practice (as specified in CIRIA C753). To ensure this discharge rate can be achieved a suitable quantity of attenuation should be provided.

Sustainable Drainage Systems

- 3.30. As per UK government flood risk and coastal change guidance⁴, the NPPF, the Regional SuDS Guidance (Leicestershire County Council – Surface Water Drainage for Developments⁵) and Hinckley & Bosworth Borough Council guidance⁶ Sustainable Drainage Systems (SuDS) should be considered as part of new development, particularly major development. SuDS can provide various benefits, as outlined in [Figure 3.1](#). As well as providing storage, SuDS can also provide pollution control at source (Source Control) and in some instance Interception, leading to significant water quality benefits.
- 3.31. With due regard to the water quality, biodiversity and amenity conditions of the application site, as well as the geophysical characteristics, a drainage strategy shall be pursued which utilises Type C porous paving to serve the

⁴ Development for Levelling Up, Housing and Communities and Ministry of Housing Communities and Local Government – Flood risk and coastal change 25 August 2022.

⁵ Leicestershire County Council – Surface Water Drainage for Developments

⁶ Hinckley & Bosworth Borough Council – Sustainable Drainage Systems

proposed driveways and associated parking as well as rainwater gardens serving the residential roofs.

- 3.32. This should be provided as a minimum and the development should look to achieve source control and interception through the incorporation of localised green SuDS features such as: tree pits, rain gardens and bioretention beds. The components must be designed such that cleansing can be provided for the frequent, high pollutant runoff events or “first flush” events, this is typically defined as the 1 in 1 year return period events.

Source Control Measures and Rainwater Harvesting

- 3.33. To aid towards water security it is recommended that water butts are provided. This should consist of a single butt located on a well-drained downpipe and placed in the garden or other shielded location.
- 3.34. Source control measures are defined in CIRIA C753⁷ as the control of runoff at or near its source, so that it does not enter the drainage system or is delayed and attenuated before it enters the drainage system. Typical source control components include:
 - Green roofs
 - Permeable surfaces
 - Rainwater harvesting
 - Water butts
 - Rain gardens
 - Filter strips
 - Filter trenches
- 3.35. As described in this chapter the development shall incorporate porous paving and rainwater gardens which shall act as source control/interception for surface water runoff. However, the developer should consider the use of other source control components as part of the detailed design such as rain gardens and filter trenches for increased amenity, biodiversity and water quality benefits.

Hydraulic Design

- 3.36. The results of the calculations for the proposed onsite network are presented in **Table 3.4**. The proposed drainage network is to consist of Type C porous paving to serve the proposed driveways and associated parking as well as rainwater gardens serving the residential roofs. This shall then be connected to a flow control chamber fitted with a Hydro International Hydrobrake Optimum flow control unit.

Notes on Surcharging

- 3.37. The results show that the onsite system does not surcharge during sub 1-2 year events (see **Appendix 4**).

⁷ CIRIA C753 – The SuDS Manual – Chapter 26

Urban Creep

3.38. A 10% allowance for urban creep has been made as per Leicestershire County Council guidance.

FEH Rainfall Data

3.39. FEH (rather than FSR) rainfall data has been used in the hydraulic model to more accurately reflect current rainfall rates, owing to the updated dataset.

Table 3.4 – Development Proposed Discharge Rates			
Storm Event	1:2 year event	1:30 year event	1:100 year event + 40% Climate Change
Proposed Discharge Rate (l/s)	2.0	2.0	2.0
Greenfield Runoff Rate (l/s)	1.5	3.3	6.02 (4.3x1.4*Climate change)
Existing Brownfield Runoff Rate (l/s)	46.1	116.7	210.98 (150.7x1.4*Climate change)

3.40. The proposed surface water drainage solution will provide a significant betterment over existing discharge rates whilst protecting the development from flooding onsite through avoiding blockages.

Notes on Construction

- 3.41. Temporary attenuation will be required during construction works to ensure that surface water arisings during construction do not exacerbate flood risk further downstream. It is recommended that a temporary sump is installed upstream of the flow control device to attenuate these arisings and the flow control device should be installed as a priority as part of the construction works.
- 3.42. To mitigate silt arisings during construction suitable silt control measures, such as silt fences, will need to be implemented prior to the final point of discharge. Straw bales should be avoided owing to the potential for nutrient loadings through biodegradation.

Surcharged Conditions

3.43. The results show that the onsite system does not surcharge during sub 1-2 year events (see [Appendix 4](#)).

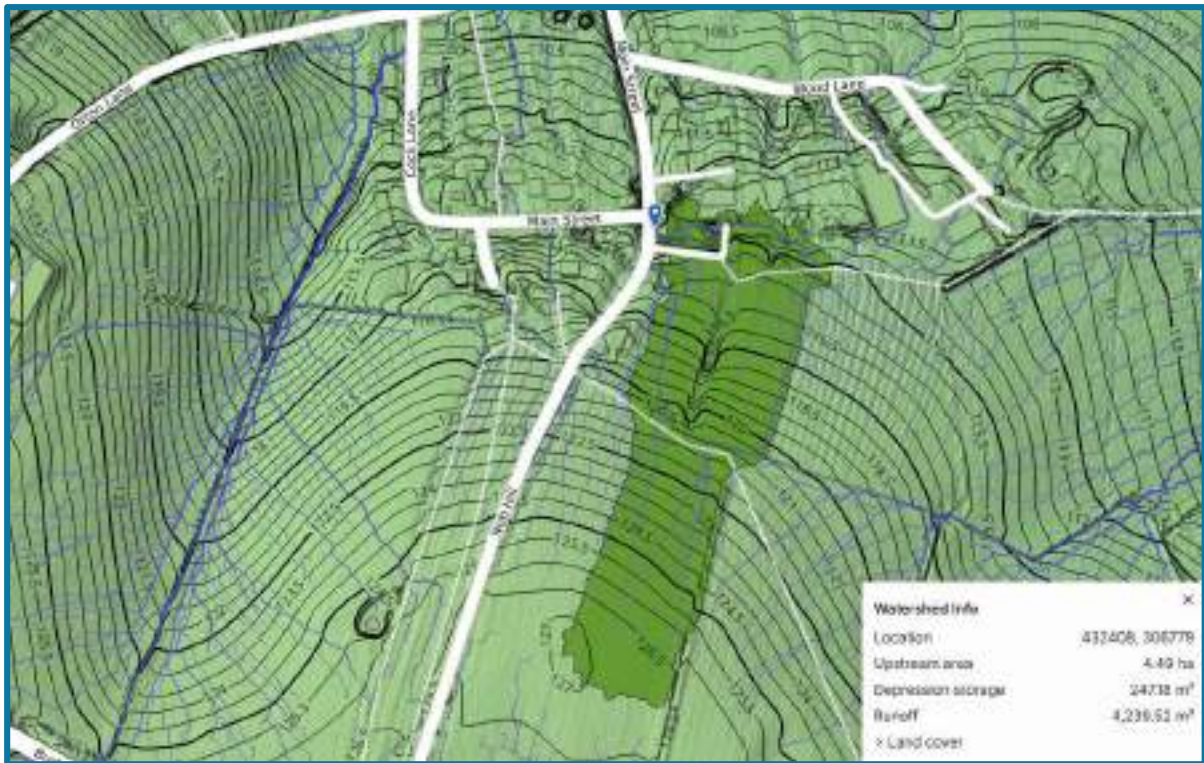


Figure 3.3 – SCALGO Contributing Watershed

Notes on Existing Watercourse

- 3.44. Land Drainage Consent will be required from the LLFA for the placement of a headwall in the banks of the existing watercourse through the Lead Local Flood Authority (LLFA) post planning permission. Further discussion may also be needed from the internal Drainage Board (IDB).

4. Wider Water Quality Assessment

- 4.1. To ensure that the surface water arisings from the proposed development do not detrimentally effect water resources downstream an analysis has been undertaken to demonstrate that the proposed SuDS measures will be sufficient to provide the necessary cleansing.

Simple Index Water Quality Assessment

- 4.2. The analysis has been carried out in accordance with the Simple Index Approach as described in CIRIA C7538. The Simple Index Approach compares the combined pollutant index from a site to the SuDS mitigation index provided through the treatment train(s). This is a qualitative approach based on the observed effectiveness of similar systems. The approach relies on the SuDS components being designed to the criteria outlined in the SuDS Manual. To ensure that the SuDS treatment train is adequate the total SuDS Mitigation Index must exceed or be equal to the Pollutant Hazard Index:

$$\text{Total SuDS Mitigation Index} \geq \text{Pollution Hazard Index}$$

- 4.3. Firstly, one must consider Table 26.2 of the SuDS Manual which generates a Pollution Hazard Index based on proposed land use:

⁸ CIRIA C753 – The SuDS Manual – Chapter 26

Table 4.1 – Pollution Hazard Indices for Different Land Use Classifications

Land use	Pollution hazard level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.20	0.20	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.30	0.20 (up to 0.8)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day.	Low	0.50	0.40	0.40
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways.	Medium	0.70	0.60	0.70
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways.	High	0.80	0.80	0.90

- 4.4. The development proposal is for a residential development served by rainwater gardens and Type C porous paving. The total pollution hazard index needs to consider the proposed residential roofs and associated driveways and parking. The Total Pollution Hazard Index is displayed in [Table 4.2](#).

Table 4.2 – Total Pollution Hazard Index

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.20	0.20	0.05
Individual property driveways and general access road	Low	0.50	0.40	0.40

3.45. One must then consider Table 26.4 of the SuDS Manual which generates a SuDS Mitigation Index dependent on SuDS components utilised when discharging to watercourse:

Table 4.3 – SuDS Mitigation Index

Type of SuDS component	Mitigation indices		
	TSS	Metals	Hydrocarbons
Filter strip	0.40	0.40	0.50
Filter drain	0.40	0.40	0.40
Swale	0.50	0.60	0.60
Bioretention system	0.80	0.80	0.80
Permeable pavement	0.70	0.60	0.70
Detention basin	0.50	0.50	0.60
Pond	0.70	0.70	0.50

Wetland	0.80	0.80	0.80
Proprietary treatment system	<i>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.</i>		

4.5. The mitigation indices for the proposed onsite treatment train are presented in **Table 4.4**:

Table 4.4 – Individual SuDS Mitigation Indices			
SuDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Bioretention system	0.80	0.80	0.80
Permeable pavement	0.70	0.60	0.70

4.6. Therefore, the combined SuDS Mitigation Index and the Pollutant Hazard Index can be tabulated to prove that the specific SuDS treatment train is acceptable:

Table 4.5 – Total SuDS Mitigation Index			
Scenario	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	0.20	0.20	0.05
Bioretention system	0.80	0.80	0.80
Permeable pavement	0.35	0.30	0.35

Table 4.5 – Total SuDS Mitigation Index			
Scenario	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Individual property driveways and general access road	0.50	0.40	0.40
Permeable pavement	0.70	0.60	0.70

- 4.7. As can be shown in this section the SuDS components are more than capable of mitigating potential contaminant arisings when compared to the relevant assessment criteria currently issued for the water industry.

5. Maintenance of Attenuation/SuDS Measures

- 5.1. The following SuDS components are capable of being adopted by the statutory undertaker as outlined in the Sewerage Sector Guidance (SSG) with the necessary design requirements contained in the Design and Construction Guidance (DCG):

Table 5.1 – Eligible SuDS Components for Adoption	
SuDS Component	Capable of Adoption
Infiltration Trench	✓
Porous Pavement	✗
Soakaway	✓
Infiltration Basin	✓
Swale	✓
Green Roof	✗
Filtration	✓
Pond/Wetland	✓
Detention Basin	✓
Subsurface Storage	✓
Proprietary Tank	✓
Infiltration Trench	✓

- 5.2. It is understood the applicant shall not pursue adoption of the eligible SuDS components through the sewerage undertaker; however, in the event this is not pursued the applicant shall pursue private management through a management company as detailed below.

Management Company Custodianship

- 5.3. If the applicant chooses not to proceed with adoption the proposed drainage network shall be maintained by a management company which shall be funded by the owners/occupiers of the proposed residential development based on a proportional share of the maintenance liability. This shall be the responsibility of who shall be registered under the following details:

Contact name:

Jaz Sahota – Partnership Homes Ltd

Address:

50 Friars Gate,
Derby,
Derbyshire,
DE1 1DF.

- 5.4. The maintenance schedules outlined in this report shall be forwarded to future owners/occupants to make them aware of the associated liabilities of the onsite drainage network. This document should be forwarded onto any successive management company so that they may understand their liabilities.

Maintenance of SuDS components

- 5.5. The Permeable Paving should comprise upstream silt traps on all inlets which should be monitored every six months for signs of sediment build up with deposits disposed of appropriately. The minimum maintenance expectations are provided in [Table 5.2](#) which are as per Table 20.15 of the SuDS Manual.

Table 5.2 – SuDS Maintenance Requirements – Permeable Paving		
CIRIA C753 Maintenance Requirement		
Maintenance schedule	Typical Frequency	Required action
Regular Maintenance	Annually	Brushing and vacuuming (standard cosmetic sweep over whole surface)
Occasional Maintenance	As necessary	Stabilise and mow contributing and adjacent areas.
	As necessary	Removal of weeds
Regular Maintenance	As necessary	Remediate any landscaping which through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving
	As necessary	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material

	Every 10-15 years	Rehabilitation of surface and upper substructure by remedial sweeping
CIRIA C808 Maintenance Requirement		
It is unlikely that the permeable paving will be lifted to replace the subsurface layers. The only maintenance activity that is required is sweeping the surface when needed.		

- 5.6. The sub-surface attenuation tank should comprise upstream silt traps on all inlets which should be monitored every six months for signs of sediment build up with deposits disposed of appropriately. The minimum maintenance expectations are provided in [Table 5.3](#) which are as per Table 21.3 of the SuDS Manual.

Table 5.3 – SuDS Maintenance Requirements – Attenuation Storage Tanks		
CIRIA C753 Maintenance Requirement		
Maintenance schedule	Typical Frequency	Required action
Regular Maintenance	Monthly	Inspect and identify any areas that are not operating correctly. If required, take remedial action.
		Remove debris from the catchment surface (where it may cause risks to performance).
	Annually	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.
		Remove sediment from pre-treatment structures and/or internal forebays.
Remedial Actions	As required	Repair/rehabilitate inlets, outlet, overflows and vents.
Monitoring	Annually	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.
	Every 5 years or as required	Survey inside of tank for sediment build-up and remove if necessary

- 5.7. The rain water gardens should comprise upstream silt traps on all inlets which should be monitored every six months for signs of sediment build up with deposits disposed of appropriately. The minimum maintenance expectations are provided in [Table 5.4](#) which are as per Table 18.3 of the SuDS Manual.

Table 5.4– SuDS Maintenance Requirements – Bioretention Systems

CIRIA C753 Maintenance Requirement		
Maintenance schedule	Required action	Typical Frequency
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary.	Quarterly.
	Check operation of underdrains by inspection of flows after rain.	Annually.
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary.	Quarterly
	Inspect inlets and outlets for blockage.	Quarterly
Regular Maintenance	Remove litter and surface debris and weeds.	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density.	As required

	Remove sediment, litter and debris build-up from around inlets or from forebays.	Quarterly to biannually
Occasional Maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required.	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch.	As required
Remedial Actions	Remove and replace filter medium and vegetation above.	As required but likely to be > 20 years

CIRIA C808 Maintenance Requirement

Usually, maintenance of these devices simply includes scraping away any built-up sediment at the inlet or on the surface and litter picking. Vegetation may be harvested and pruned at the end of the growing season and devices may be weeded too.

If the treatment media is included in the design, it is likely to become exhausted after a number of years and will need to be removed and replaced. This can be facilitated by locating in a basket near the inlet to the device. However, simple soil amendments to enhance P sorption typically do not increase bioretention maintenance needs.

6.Foul Water Drainage Strategy

Discharge to Main Sewer

- 6.1. There is a foul sewer located to the north of the site located within the highway of Wood Lane which would provide an appropriate point of connection and discharge of foul water.

Likely Flows

- 6.2. The proposed dwelling shall discharge approximately 16000 litres per day (based on 0.05 litres per second per dwelling), as outlined in the Sewerage Sector Guidance (SSG) Appendix C.

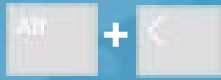
7. Conclusion

- 7.1. This report is compliant with the NPPF and the associated Planning Practice Guidance as well as the Leicestershire County Council Strategic Flood Risk Assessment and the Leicestershire County Council Preliminary Flood Risk Assessment. This report demonstrates that the proposals will appropriately mitigate surface water and foul water arisings associated with the demolition of an existing warehouse and barn structure as well as the development of four residential dwellings in Norton-Juxta-Twycross (see [Appendix 5](#)). This shall be achieved through the use of Type C porous paving to serve the proposed driveways and associated parking as well as rainwater gardens serving the residential roofs.
- 7.2. The foul water from the site shall be discharged to the existing public foul water sewer to the north of the site along Wood Lane.
- 7.3. The development will also not be at significant flood risk for the entirety of its design life through the incorporation of an appropriately designed drainage system. Providing the surface water and foul water control strategies in this document are implemented flood risk and water quality concerns should not prevent approval being granted.

Appendix 1

Severn Trent Water Asset Map

For convenience – press “Alt + Left Arrow” to return to the section of the report





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Scale: 1:1250
Map Centre: 432545.306814

Date: 07/01/25
Our Ref: 1653380 - 2

Clean Water Plan A3
Powered by digdat

Pattern	Red dot	Notes	Vertical line	Appointed	Dashed line
Water Main	Black dot	Water Main	Thick line	Out	Thin line
Manhole	Black square	Manhole Pipe	Thin line	Service Pipe	Thin line

oliver.allman@stantec.com
Twycross



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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 May 2014

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 or 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.



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Data updated: 14/12/24

Scale: 1:1250
Map Centre: 432545.306814

Date: 07/01/25
Our Ref: 1653380 - 3

Wastewater Plan A3
Powered by digdat

Public Footway/Highway Drain	Highway Drain	Manhole Point
Public (Contaminated) Sewer/Lateral or Branch	Overflow Pipe	Manhole Surface
Public (Uncontaminated) Sewer/Lateral or Branch	Disposal Pipe	Manhole Pipe
Pressure Foot	Disposal Water Source	Chamber
Pressure Contained	Pumping Station	Manhole (100) Lateral or Branch to public
Pressure Surface Water	Paving	Public (100) Lateral or Branch to public

oliver.allman@stantec.com
Twycross



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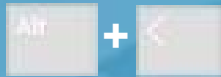
STW Apparatus.

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Appendix 2

Proposed Site Plan

For convenience – press “Alt + Left Arrow” to return to the section of the report

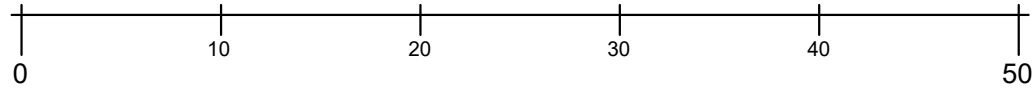




Proposed Site Plan

Scale: 1:500

Scale (m)



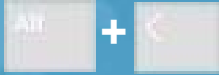
LEGEND

In Timber Fence 2.0m		Hedges	
Steel Post and rail with Hedge		Silver Birch	
900mm High Wall in stone		Apple	
Tegula Paved area		Orchard	
Parking		English Oak	
Patio		Pear Tree	
5 Bar Timber Gate Main Gate			
Timber Gate			
EV Car Charger			

Appendix 3

Phase 1 Land Contamination Risk Assessment

For convenience – press “Alt + Left Arrow” to return to the section of the report





**Castledine
Environmental**

LAND CONTAMINATION SURVEYS

**Phase 1 Land Contamination
Risk Assessment
for
Change of Use from Agricultural
to Residential Usage
on the site of
Manor Farm, No.8 Wood Lane,
Norton-Juxta-Twycross,
Leicestershire CV9 3QB**

Date: February 2026

Status:

Final Report

Reference:

4034D P1 LonXThree – Norton-Juxta-Twycross

Date:

23/02/2026

EXECUTIVE SUMMARY

The site is currently occupied by two large adjoined agricultural barns with a hardstanding access route to the front (north) and a very limited exterior space to the rear (south) of the barns. Historically, the site has been occupied by agricultural features since the earliest mapping reviewed (circa.1885) through until the present-day; however, the earliest barns on site remained present until around circa.1989, when the present-day barns were erected on site. The site then sees little change on historical mapping until the present-day, nor were any significant changes noted on historical satellite imagery, beyond the location of a farmyard north, north east and east of site (also present from the earliest mapping), which has been largely demolished and replaced by a residential estate in the present-day. On the day of the site walkover, a number of potentially contaminative sources were identified including PACM cladding and roofing (broken in areas and in pieces in others), significant made ground deposits site-wide and the storage of containers and tanks in the westernmost barn.

The historical agricultural usage of the site (including various erections and demolitions on site, likely extensive made ground associated with such usages and storage of machinery, agrichemicals and fuels within the barns); alongside the present-day state of the site (i.e. significant made ground deposits, PACM cladding and roofing – broken in areas, fuel and chemical storage) has the potential to have impacted site with various contaminants listed below in Section 7.1 via potential pathways listed in Section 7.2 with potential impact Receptors outlined in Section 7.3.

Based on the information contained in this report, it is the opinion of Castledine Environmental that the site represents a **MODERATE** to **HIGH** level of risk with respect to the proposed residential development.

It is recommended that further investigation inline with Section 15.0 is planned and carried out on site.

It is recommended that the structures on site be subject to an asbestos survey (and subsequent removal, if required) by appropriately qualified personnel. This should be carried out prior to any demolition or redevelopment occurring in order to ensure site works do not cause future contamination of the site.

This report should be submitted to your Local Planning Authority for agreement to allow the Phase 2 intrusive testing to be undertaken.

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1.0 QUALITY ASSURANCE

Castledine Environmental confirm that all reasonable efforts have been made to ensure that the information outlined within this report is accurate.

Castledine Environmental would further confirm that due care, attention and technical skill were used in the creation of this report.

2.0 LIMITATIONS

The conclusions and recommendations made in this report are limited to those based on the findings of the investigation. Where comments are made based on information obtained from third parties, Castledine Environmental assumes that all third-party information is true and correct. No independent action has been undertaken to validate the findings of third parties. The assessments and interpretation have been made in line with legislation and guidelines in force at the time of writing, representing best practice at the time.

This survey has not included asbestos within existing structures, invasive plant species, geotechnical considerations or any elements unconnected with potential ground contamination at the site. If required, such surveys should be undertaken by suitably accredited organisations.

There may be other conditions prevailing at the site which have not been disclosed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for conditions not revealed by the investigation.

3.0 INTRODUCTION AND SITE PROPOSALS

Castledine Environmental have been appointed by LonXthree (c/o 2012 Partnership Homes Ltd) to undertake a Phase 1 Desk study on a site to the rear of No.8 Wood Lane, Norton-Juxta-Twycross, Leicestershire CV9 3QB.

The site proposals consist of the change of use from agricultural usage to residential usage, including the erection of dwellings with associated landscaping and access works.

4.0 SCOPE

Castledine Environmental have prepared this report for the sole use and reliance of LonXThree and associated appointees for the purpose of ensuring compliance with:

- National Planning Policy Framework (NPPF) December 2024;
- Part C1 of the building regulations;
- Support of a Planning Application.

This report may not be used or relied upon by any unauthorised third party, or for any other proposed use than that specified above, without the explicit written agreement of Castledine Environmental.

This report is to be regarded as a Preliminary Risk Assessment in accordance with the Environment Agency's Land Contamination Risk Management (LCRM – 2021), which replaces CLR11 *“Model Procedures for the Management of Land Contamination”*, carried out in accordance with BS 10175:2011+A2:2017, *“Investigation of Potentially Contaminated Land - Code of Practice”* and relevant sections of BS5930:2015+A1:2020, *“Code of Practice for Ground Investigations”*.

The objectives of the report are:-

- To assess historical activities at the site with respect to their potential impact on the site environment;

- To assess historical and current surrounding land use in relation to known or potential off-site contamination issues that may impact on the subject site;
- Review of geological, hydrogeological and hydrological conditions at the site, pertaining to land contamination issues;
- To characterise the environmental setting of the site, identify migration pathways and vulnerable receptors for contamination originating at the site, focusing on potential soil and groundwater liabilities; and
- To develop a preliminary conceptual site model (CSM).

This report has been produced in order to discharge any relevant planning conditions outlined by the Local Authority and Environment Agency; however, further requirements may be imposed after the findings of this report that may need to be addressed at a later date.

5.0 SITE DESCRIPTION

The site is located in Norton-Juxta-Twycross, Leicestershire at National Grid Reference: 432531,306813 and is approximately 0.81ha in area.

The site is irregular in shape and located in the centre of the wider village of Norton-Juxta-Twycross, being directly bounded by newly constructed dwellings and their associated garden areas to the north, a commercial area with dwellings beyond to the east and housing to the south and west of site. The areas beyond the wider village are predominantly rural and comprise open field in all directions.

The site interior comprises two large adjoining barns, hardstanding areas and access routes, a third, linear barn and an extensive area of exterior space.

The access route then terminates at the front of site after turning eastwards, providing access to the two barns on site. The barns themselves were seen to be large in scale and constructed of brick

walling, concrete flooring and potentially asbestos containing corrugated roofing and cladding materials.

The westernmost barn was seen to be in a better state-of-repair than that adjoined to the eastern face of the barn. The interior of the westernmost barn was inaccessible on the day of the walkover (circa. July 2025); however, Castledine Environmental had attended site previously (circa. March 2025) at which time, the interior of the barn was seen to be occupied by general construction materials i.e. wheelbarrows, timbers, pallets, bricks, stone, plasterboard, a container and at least 3 No. tanks (comprising square diesel tanks and a self-bunded, plastic tank). The flooring within this unit appeared to possess inherent ventilation, associated with a fan-system on the southern face of the barn (likely for grain drying purposes).

The easternmost barn, adjoined to that in the west, was then seen to be in a state of heavy disrepair, with the prior concrete flooring having been removed and made ground deposits (i.e. rubbles, some ash, road planings, brick and metal fragments) remaining insitu. Heaped stone, rubble, timber and Heras fencing were noted throughout this barn, alongside a heap of chemical containers (former contents and labelling largely obscured) located inside the north eastern corner of the barn.

The remaining areas on site comprise the hardstanding area to the north of the barns, where a further container, skips (occupied by empty cardboard boxes), a damaged IBC and further heaps of made ground and rubble; with areas to the south remaining overgrown and grassed, with a small structure (with large fan apparatus within); a dilapidated, linear barn located in the north east of site and heavily vegetated, overgrown areas of heaps forming the remaining eastern and south eastern extents of site. The linear barn was seen to largely constructed of timber with some PACM cladding and was seen to be in a heavy state of disrepair. The vegetated heaps to the south of this were then seen to comprise mixtures of soils, gravels and refuses (i.e. timbers, wire, concrete, demolition rubbles).

Potential sources of contamination noted on the walkover include PACM cladding and roofing (broken in areas and in pieces in others), significant made ground deposits site-wide and the storage of containers and tanks in the westernmost barn.

Topographically, the site is largely level beyond a slight dip from the south to the north, with the surrounding areas also dipping off in this direction (with the new residential development north of site slightly downgradient from the site under review).

Photos of the site are present in Appendix D.

6.0 REGULATORY AUTHORITY AND OTHER ENVIRONMENTAL DATA

An environmental search listing historical and environmental factors likely to affect the property has been reviewed.

The most pertinent information is summarised in the following sections.

A copy is presented in Appendix A.

Additional geological and hydrological data was obtained from the British Geological Survey.

6.1 HYDROLOGICAL

6.1.1 AQUIFER

6.1.1.1 SUPERFICIAL GEOLOGY

ID	Distance (m)	Direction	Designation	Description
1	0	On Site	Secondary (Undifferentiated)	Assigned where it is not possible to attribute either category A or B to a rock type. In general, these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type

6.1.1.2 BEDROCK GEOLOGY

ID	Distance (m)	Direction	Designation	Description
1	0	On Site	Secondary B	Predominantly lower permeability layers which may store/yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers

6.1.2 ABSTRACTIONS AND PRIVATE WATER SUPPLIES

The Groundsure report records an active groundwater abstraction site located 757m south west of site at Twycross Zoo. The record relates to a heat pump with waters sourced via a borehole (effective circa.2010 onwards).

6.1.3 SOURCE PROTECTION ZONE

Site is not in a source protection zone (SPZ).

6.1.4 GROUNDWATER VULNERABILITY AND SOIL LEACHING POTENTIAL

An assessment of the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a one-kilometre square grid. Groundwater vulnerability is described as High, Medium or Low as follows:

- High - Areas able to easily transmit pollution to groundwater. They are likely to be characterised by high leaching soils and the absence of low permeability superficial deposits.
- Medium - Intermediate between high and low vulnerability.
- Low - Areas that provide the greatest protection from pollution. They are likely to be characterised by low leaching soils and/or the presence of superficial deposits characterised by a low permeability.

ID	Location	Summary	Soil / Surface	Superficial Geology	Bedrock Geology
1	On site	Summary Classification: Secondary superficial aquifer - Medium Vulnerability Combined classification: Productive Bedrock Aquifer, Productive Superficial Aquifer	Leaching class: Low Infiltration value: 40-70% Dilution value: <300mm/year	Vulnerability: Medium Aquifer type: Secondary Thickness: 3-10m Patchiness value: <90% Recharge potential: No Data	Vulnerability: Medium Aquifer type: Secondary Flow mechanism: Well connected fractures
2	On site	Summary Classification: Secondary bedrock aquifer - Medium Vulnerability Combined classification: Productive Bedrock Aquifer, No Superficial Aquifer	Leaching class: Low Infiltration value: 40-70% Dilution value: <300mm/year	Vulnerability: - Aquifer type: - Thickness: 3-10m Patchiness value: <90% Recharge potential: No Data	Vulnerability: Medium Aquifer type: Secondary Flow mechanism: Well connected fractures

6.1.5 POTENTIAL SURFACE WATER

The Groundsure report records an unnamed, surface level watercourse located 79m north east of site at its most proximate point to site with a second located 169m south of site at its most proximate point.

6.1.6 DISCHARGE CONSENTS

The Groundsure report records a total of 19 No. licenced discharge consents formerly located 386-387m north of site, all of which were revoked or surrendered and related to final/treated sewage effluent discharges (on behalf of the local water supplier) direct into Norton Brook.

6.2 PERMITTED PROCESSES

None recorded within 500m of site.

6.3 POLLUTION INCIDENTS

The Groundsure report records:

- An incident located 62m east, dated circa.2001 and relating to smoke effects with a minor impact to air quality and no impact to land or water qualities;
- Two incidents located 199-200m north, dated circa.2003 and relating to effluent materials with a minor impact to both water and air qualities and no impact to land quality.

No further pollution incidents are located within 250m of site and no significant impact incidents are recorded within 500m of site.

6.4 RADIOACTIVE SUBSTANCES REGISTRATIONS

None recorded within 500m of site.

6.5 WASTE

6.5.1 LICENSED WASTE MANAGEMENT FACILITIES (LOCATIONS)

None recorded within 500m of site.

6.5.2 LANDFILL SITES

The Groundsure report records a historical and unlicensed landfill formerly located 178m south west of site; however, no waste type nor first or last date of entry is recorded.

6.6 HAZARDOUS SUBSTANCES

None recorded within 500m of site.

6.7 ECOLOGICAL RECEPTORS

The Groundsure report records the site as being located within the River Trent (from confluence with the River Derwent) surface waters Nitrate Vulnerable Zone (NVZ) with a second record of the NVZ then located 779m south of site.

No further sensitive land usages are recorded within 1000m of site.

6.8 SOILS AND GEOLOGY

"Contains British Geological Survey materials © NERC 2026" obtained from <http://www.bgs.ac.uk/data/mapViewers/home.html> under the [Open Government Licence](#)

6.8.1 SUPERFICIAL DEPOSITS

Both BGS geological mapping and the Groundsure report record superficial geological deposits of the Thrussington Member on site, comprising a brown to reddish-brown diamicton (poorly sorted, terrigenous sediments containing a wide range of particle sizes, often associated with Glacial environmental), i.e. sands, gravels, stoneless clays and silts.

6.8.2 SUPERFICIAL DEPOSITS PERMEABILITY

The Groundsure report records the site as being within an area where the maximum permeability of superficial deposits is recorded as 'high' and the minimum permeability as 'low' and facilitated by mixed flow mechanisms.

This is a qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any superficial deposits (the zone between the land surface and the water table).

6.8.3 BEDROCK DEPOSITS

Both BGS geological mapping and the Groundsure report records bedrock geology of the Gunthorpe Member underlying site, comprising a red-brown mudstone with subordinate dolomitic siltstones and fine-grained sandstones.

6.8.4 BEDROCK PERMEABILITY

The Groundsure report records the site as being within an area where the maximum permeability of bedrock geology is recorded as 'low' and the minimum permeability as 'low' and facilitated by fracture flow mechanisms.

6.8.5 ARTIFICIAL GROUND

BGS geological mapping records no artificial deposits located on or within 500m of site, however made ground deposits were noted on the day of the site walkover.

6.8.6 COAL MINING

The site is not located in a coal mining reporting area and the local geology is not considered appropriate for such extraction. As such the risk from coal mining activities is considered to be negligible.

6.8.7 NON-COAL MINING

The Groundsure report records no non-coal mining operations, activities or features located within 500m of site.

6.8.8 SURFACE WORKINGS

ID	Distance (m)	Direction	Land Usage	Year of Mapping
A	0	On site	Pond	1924
A	0	On site	Pond	1885
A	0	On site	Pond	1950
B	92	W	Pond	1855
B	95	W	Pond	1966
B	96	W	Pond	1950

6.8.9 RADON

The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level. No radon protective measures are necessary as described in publication BR211:2015 by the Building Research Establishment.

6.9 AERIAL PHOTOGRAPHY

Aerial photography shows the following:

6.9.1 GOOGLE EARTH

13 No. images are held in the historic imagery dataset, as follows:

Date	Description
December 1999	The site is shown as occupied by the two large barns seen in the present-day, which appear to remain in use at this time as part of a wider farmyard located directly north, north east and east of site (comprising barns, a courtyard etc). The area forming the eastern extent of site is shown as occupied by what appears to be a silage pit, hardstanding, a linear barn, parking / storage areas and a possible bund or heap. Areas in the north of site and extending northwards occupied by bales.
December 2000	No discernible change on site nor site relevant change to the surrounding areas.
July 2006	The silage pit in east of site now appears to have been excavated and machinery is located within the area. A barn directly west of site has been demolished in place of the present-day residential dwellings here, with new residential dwellings directly south of site. The farmyard north and east of site appears slightly more disused than previously.
December 2010	No discernible change on site nor site relevant change to the surrounding areas – imagery is the same as the previous date (i.e. ongoing adjacent developments are unchanged).
September 2011	The eastern extent of site is now overgrown once again with heavy machinery and heaps (appearing to be refuse) noted in the area.
April 2015	The barns north of site now appear dilapidated and disused, with areas of roofing missing or damaged. The eastern extent of site is now shown as rough ground and occupied by heaps, vehicle tracks and indiscernible debris. The linear barn forming the NE extent of site also appear dilapidated at this time.
April 2016	No discernible change on site nor site relevant change to the surrounding areas.
April 2018	No discernible change on site nor site relevant change to the surrounding areas.

Date	Description
April 2020	The former farmyard to the north and NE of site is now shown as under demolition with a number of structures removed and demolished, heaps of debris are now located in the east of site and scattered around the areas north of site (including directly north). The area forming the eastern extent of site now appears heavily occupied by debris, refuse, heaps and made ground deposits. The linear barn in the NE of site (with possible PACM roofing) is now dilapidated and the roofing broken in areas.
June 2021	Areas to the north and NE along with the eastern extent of site remain partially demolished and scattered with heaps and debris, the eastern area of site shows further movements of heaps / mounds, some of which are fresh, some of which are vegetated.
January 2022	Imagery is indistinct; however, there appears no discernible change on site. Areas north of site now appear to be under development. Areas east of site heavily vegetated and overgrown once again.
May 2023	No discernible change on site nor site relevant change to the surrounding areas (a new residential development is known to be located directly north, atop the former farmyard area, in the present-day).
May 2025	Cloud obscures the site but it would appear the linear barn in the NE of site is now further dilapidated and/or partially demolished and the new housing development north of site is established and completed.

6.9.2 GOOGLE STREET VIEW

Google Street View imagery is unavailable for the site due to the site's location at the termination of a private access route and away from the public roadside.

6.10 HISTORIC MAPPING

The following historic maps have been reviewed as part of this assessment:

Map	Onsite	Offsite
OS County Series: 1885, 1:10,560	The site is shown as largely unoccupied beyond a small, linear structure in the NW of site and a second linear barn structure in the NE of site (extending into site from offsite and directly north). The eastern and SE extents of site appear to remain as open field, possibly with a depression or unspecified earth work in the far SE of site.	A farmyard remains located directly north of site with a long, linear pond located directly south, a circular pond approx.50m NW, a second linear pond approx.115m NW and a further 2 No. approx.110-120m NE
OS County Series: 1886, 1:2,500	No discernible change on site.	Surrounding areas see little site relevant change.
OS County Series: 1901, 1:10,560	No discernible change on site.	Surrounding areas see little site relevant change.
OS County Series: 1901-1903, 1:10,560	No discernible change on site.	Surrounding areas see little site relevant change.
OS County Series: 1903, 1:2,500	No discernible change on site.	Far (eastern) end of the linear pond approx.33m east of site (i.e. approx.110m east) is now shown as marshy.
OS County Series: 1924, 1:2,500 & 1:10,560	Far SE extent of site (possible depression or earth working) may also be marked as orchard at this time.	Surrounding areas see little site relevant change.
Provisional: 1950, 1:10,560	No discernible change on site.	Surrounding areas see little site relevant change.
National Grid: 1957, 1:2,500	Possible animal pens are located in the west of site. Earth working and orchard markings in the SE extent of site no longer marked on mapping.	New barns directly west of site.
Provisional: 1966, 1:10,560	No discernible change on site.	Ponds formerly located approx.50m NW, 110-120m NE now removed and assumed infilled, linear pond SE of site now halved in size, linear pond to the NW remains. Minor residential development in the surrounding village.

Map	Onsite	Offsite
National Grid: 1989, 1:2,500 & 1:10,560	Site now occupied by the two barns seen in the present-day.	New dwellings and / or barns directly NW, barn west of site now removed and replaced with smaller barn, new larger works now located approx.70m east of site. Linear pond and a new, smaller pond east / SE of site now removed. Linear pond NW of site also removed.
National Grid: 1989-1994, 1:2,500	No discernible change on site.	Surrounding areas see little site relevant change.
National Grid: 1994, 1:2,500	No discernible change on site.	Surrounding areas see little site relevant change.
National Grid: 2001, 1:10,000	No discernible change on site.	Surrounding areas see little site relevant change.
Landline: 2003, 1:1,250	No discernible change on site.	Surrounding areas see little site relevant change.
National Grid: 2010, 1:10,000	No discernible change on site.	Housing erected directly west, following demolition of barns.
National Grid: 2025 1:10,000	Central, eastern and SE extents of site now marked as green and heavily vegetated, as in the present-day.	Farmyard and barn features etc located north, NE and east of site now removed (beyond linear barn east of site). Narrow gauge hobbyist railway now located approx.210m east of site.

6.11 CURRENT LAND USE DATA

ID	Distance (m)	Direction	Company	Activity	Category
1	9	E	Works	Unspecified works or factories	Industrial features
2	40	N	Overhead Line Fittings UK Ltd	Metals manufacturers, fabricators and stockholders	Industrial products
4	172	NE	Model Passenger Railway	Railways (heritage, steam and miniature)	Tourism

6.12 PETROL AND FUEL SITES

None recorded within 500m of site.

6.13 HISTORICAL PETROL AND FUEL SITE DATABASE

None recorded within 500m of site.

6.14 POTENTIAL CONTAMINATIVE LAND USES IDENTIFIED ON MAPPING

ID	Distance (m)	Direction	Use	Date
1	0	On site	Unspecified works	1989
2	241	W	Smithy	1901

6.15 HISTORICAL TANK DATABASE

None recorded within 500m of site

6.16 HISTORICAL ENERGY FACILITIES

None recorded within 500m of site.

6.17 HISTORICAL GARAGE DATABASE

None recorded within 500m of site.

7.0 PRELIMINARY CONCEPTUAL SITE MODEL

The risk posed by any contaminants in soil or groundwater will depend on the nature of the hazard, the probability of exposure, the pathway by which exposure occurs, and the likely effects on the receptors. A contaminant is defined as a substance in, on or under land (or within groundwaters) that has the potential to cause harm, while a risk is considered to exist if such a substance is present in sufficient concentration to cause harm and a pathway exists for a receptor to be exposed to the substance. The following sections discuss all the identified potential on and off-site sources, pathways and receptors in the context of the proposed development and plausible pollutant linkages which may represent a risk to identified receptors from the data gained from the desk study. At this stage the assessment is qualitative and aimed to determine all pollutant linkages, irrespective of significance or allowing for uncertainty.

Source	A contaminant or pollutant that is in, on or under land that has the potential for cause harm or pollution to a receptor.
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Pathway	The physical route by which a receptor is or could be affected by a contaminant or pollutant.
Receptor	Something or someone that could be adversely affected by a contaminant, i.e. people, controlled waters, ecological systems, buildings, crops, livestock.

By considering each of the three elements above, an assessment of actual and potential hazards to receptors can be carried out, taking into account the significance and degree of risk of each. The three elements above can exist separately; however, they only create a risk where they are linked together, thus creating a contaminant linkage. During the Preliminary Risk Assessment Stage, the linkages are referred to as 'Potential Contaminant Linkages', until they are confirmed via intrusive sampling, thus becoming 'Relevant Contaminant Linkages'.

A tabled, diagrammatic or matrix of pollutant linkages is considered to be a Conceptual Site Model (CSM), the source-pathway-receptor linkages are reviewed and displayed, apportioning a risk-rating and mitigation suggestion after each summary.

Three impact potentials exist for any given site, these are:

- The site impacting upon itself;
- The site impacting on its surroundings; and
- The surroundings impacting on the site.

All three impacts need to be considered in a risk assessment.

7.1 SOURCES

The following potential sources of contamination have been identified:

7.1.1 ONSITE

- Agricultural use of the site (at least circa.1885 through until the present-day or recent times);

- Various erections and demolitions of barns on site (circa.1885 and demolished and replaced by circa.1989);
- Likely historical storage / usage of machinery and associated fuels on site (circa.1885-1989);
- Subsequent, contemporary usage of large-barns for fuel, chemical, machinery storage (circa.1989 until the present-day – including at least 3 No. tanks noted on the site walkover);
- PACM cladding and roofing (noted broken in areas on the site walkover, including lagging and piping);
- Significant made ground deposits on site (likely arising from historical usage and noted on site walkover – site-wide);
- Historical landfill (approx.178m SW of site, no waste type recorded nor first or last entry of waste).

Potential Sources and Associated Contaminants Identified	
Source	Potential Contaminants of Concern
Agricultural use of the site (at least circa.1885 through until the present-day or recent times) – including silage pit	Agrichemicals (i.e. SVOC / VOC), heavy metals, metalloids, PAHs, TPH CWG, BTEX / MTBE (within age of usage), asbestos
Various erections and demolitions of barns on site (circa.1885 and demolished and replaced by circa.1989)	Agrichemicals (i.e. SVOC / VOC), heavy metals, metalloids, PAHs, TPH CWG, BTEX / MTBE (within age of usage), asbestos
Likely historical storage / usage of machinery and associated fuels on site (circa.1885-1989)	Heavy metals, metalloids, PAHs, TPH CWG, BTEX / MTBE (within age of usage)
Subsequent, contemporary usage of large-barns for fuel, chemical, machinery storage (circa.1989 until the present-day – including at least 3 No. tanks noted on the site walkover)	Agrichemicals (i.e. SVOC / VOC), heavy metals, metalloids, PAHs, TPH CWG, BTEX / MTBE (within age of usage), asbestos
PACM cladding and roofing (noted broken in areas on the site walkover, including lagging and piping)	Asbestos (various forms)
Significant made ground deposits on site (likely arising from historical usage and noted on site walkover – site-wide) i.e. large, overgrown vegetated heaps	Agrichemicals (i.e. SVOC / VOC), heavy metals, metalloids, PAHs, TPH CWG, BTEX / MTBE (within age of usage), asbestos

7.1.2 OFFSITE

- Adjacent farmyard (present from the earliest mapping reviewed until circa.2023 when the area is known to have been redeveloped into a residential area);

- Numerous infilled ponds in the local area (approx. approx.33m SE, a circular pond approx.50m NW, a second linear pond approx.115m NW and a further 2 No. approx.110-120m NE and infilled by circa.1966/1989);
- Historical landfill (approx.178m SE of site, no waste types nor first or last date of entry recorded).

Potential Sources and Associated Contaminants Identified	
Source	Potential Contaminants of Concern
Adjacent farmyard (present from the earliest mapping reviewed until circa.2023 when the area is known to have been redeveloped into a residential area)	Agrichemicals (i.e. SVOC / VOC), PAHs, TPH CWG, BTEX / MTBE (within age of usage) – physical contamination (i.e. heavy metals etc) considered unlikely due to adj. farmyard being topographically below site level
Numerous infilled ponds in the local area (approx. approx.33m SE, a circular pond approx.50m NW, a second linear pond approx.115m NW and a further 2 No. approx.110-120m NE and infilled by circa.1966/1989)	Ground gases (CO ₂ , CH ₄ , CO)
Historical landfill (approx.178m SW of site, no waste type recorded nor first or last entry of waste)	Ground gases (CO ₂ , CH ₄ , CO)

7.2 PATHWAYS

A pathway is defined as a mechanism or route by which a contaminant comes into contact with, or otherwise affects a receptor. Pathways by which the identified receptors may be impacted upon in the context of the proposed development are identified as follows:

- Ingestion (direct and indirect via crop uptake);
- Dermal contact;
- Inhalation;
- Plant uptake;
- Direct contact by buried structures (i.e. pipe degradation and leaching, pH & Sulphate attack on concrete); and
- Leaching of soluble contamination into groundwater.

7.3 RECEPTORS

Receptors are defined as people, living organisms, ecological systems, controlled waters, atmosphere, structures and utilities that could be adversely affected by contaminant(s).

- Human Health;
 - o Current users of the site;
 - o Future users of the site;
 - o Users of neighbouring sites;
 - o Construction workers;
 - o Services personnel working in trenches;
- Buried concrete, which may be affected by high concentrations of sulphate and/or low pH, in the soils and groundwater underlying the site;
- Construction Materials;
- Buried water pipes;
- Controlled Waters;
- Ecological Receptors; and
- Flora and fauna using the proposed development.

8.0 CONCEPTUAL SITE MODEL

The Conceptual Site Model (CSM) is a hypothesis of the nature and sources of contamination, potential receptors that may be the recipient of contamination arising from those sources and any pathways that may exist. It creates a plausible source-pathway-receptor pollutant linkage (hazard), set within the context of the ground and proposed end use of the site.

8.1 PRELIMINARY CONCEPTUAL SITE MODEL

8.1.1 SOIL CONTAMINATION

The site is currently occupied by two large adjoined agricultural barns with a hardstanding access route to the front (north) and extensive exterior space to the east and south east of the barns (now occupied by overgrown heaps). Historically, the site has been occupied by agricultural features since the earliest mapping reviewed (circa.1885) through until the present-day; however, the earliest barns on site remained present until around circa.1989, when the present-day barns were erected on site. The site then sees little change on historical mapping until the present-day, nor

were any significant changes noted on historical satellite imagery, beyond the location of a farmyard north, north east and east of site (also present from the earliest mapping), which has been largely demolished and replaced by a residential estate in the present-day. On the day of the site walkover, a number of potentially contaminative sources were identified including PACM cladding and roofing (broken in areas and in pieces in others), significant made ground deposits site-wide and the storage of containers and tanks in the westernmost barn.

The historied agricultural usage of the site (including various erections and demolitions on site, likely extensive made ground associated with such usages and storage of machinery, agrichemicals and fuels within the barns); alongside the present-day state of the site (i.e. significant made ground deposits, PACM cladding and roofing – broken in areas, fuel and chemical storage) are considered potential sources of soil contamination, which should be investigated further.

8.1.2 GROUND GAS AND HAZARDOUS VAPOURS

Potential sources of both ground gas and hazardous vapours have been identified, which should be investigated further. Potential sources of ground gas generation include an unlicensed landfill formerly located 178m south west of site (no waste type recorded nor first or last date of waste entry), the potential for significant made ground deposits on site, the potential for prior hydrocarbon spillages and their associated breakdown on site and a number of nearby, infilled ponds (infilled by circa.1966/1989 and thus potentially remaining gaseous). Potential sources of hazardous vapours include the general agricultural usage of the site (i.e. heavy plant machinery usage, storage, maintenance and storage of associated fuels, lubricants, greases and oils), the noted 3 No. tanks on site and various areas of made ground, heaped debris and chemical containers.

TABLE 1. SUMMARY OF SIGNIFICANT POLLUTION LINKAGES

Source	Pathway	Receptor	Probability of Pollutant Linkage	Conseq.	Risk	Possible Mitigation
Contaminated Soils (<i>historied agricultural usage, various erections & demolitions on site inc. tanks, likely machinery storage, fragmented PACM, extensive made ground deposits – noted on site walkover</i>)	Direct Ingestion & Direct Contact	Site Workers (<i>during site works, excavations, eating and drinking</i>)	Li	Md	M	Site workers to wear appropriate PPE for health and safety reasons, suitable usage of PPE, adherence to relevant HSE guidance, provision of an asbestos survey (prior to works and investigation) considered sufficient to mitigate hazards to LOW – following confirmation via intrusive Phase II SI.
Contaminated Soils (<i>historied agricultural usage, various erections & demolitions on site inc. tanks, likely machinery storage, fragmented PACM, extensive made ground deposits – noted on site walkover</i>)	Inhalation of Dust, Dry Arisings	Site Workers (<i>during site works, excavations, eating and drinking</i>)	Li	Md	M	
Contaminated Soils (<i>historied agricultural usage, various erections & demolitions on site inc. tanks, likely machinery storage, fragmented PACM, extensive made ground deposits – noted on site walkover</i>)	Crop Uptake & Direct Ingestion, Direct Contact	End Users (<i>residents / tenants, children, visitors, service personnel</i>)	Li	Sv	H	Potentially significant sources of contamination have been identified on and directly adjacent to site including a historical agricultural usage (and inherent heavy plant machinery usage, storage, associated fuels, lubricants, oils and grease), various erections and demolitions on site, likely and noted significant made ground deposits, fragmented PACM and a number of noted fuel tanks, vegetated heaps and mounds. Due to the sensitive residential end-usage of the site and the potential hazards identified (i.e. likely asbestos presence on site alongside a significant depth and extent of made ground), the risks to end-users of site are considered to be HIGH. As such, it is recommended that a Phase II Site Investigation comprising both trial pit and borehole formation is planned and carried out on site. A subsequent regime of ground gas and vapour monitoring should then be carried out.
Contaminated Soils (<i>historied agricultural usage, various erections & demolitions on site inc. tanks, likely machinery storage, fragmented PACM, extensive made ground deposits – noted on site walkover</i>)	Inhalation of Dust, Dry Arisings	End Users (<i>residents / tenants, children, visitors, service personnel</i>)	Li	Sv	H	
Contaminated Soils (<i>historied agricultural usage, various erections & demolitions on site inc. tanks, likely machinery storage, fragmented PACM, extensive made ground deposits – noted on site walkover</i>)	Crop Uptake & Direct Ingestion, Direct Contact	Flora and Fauna (<i>on and offsite</i>)	Li	Md	M	
Contaminated Soils (<i>historied agricultural usage, various erections & demolitions on site inc. tanks, likely machinery storage, fragmented PACM, extensive made ground deposits – noted on site walkover</i>)	Vertical and lateral migration (<i>superficial geology potentially highly permeable, bedrock predominantly low</i>)	Controlled Waters (<i>Secondary Undifferentiated & B Aquifers</i>)	Li	Md	M	
Contaminated Soils (<i>historied agricultural usage, various erections & demolitions on site inc. tanks, likely machinery storage, fragmented PACM, extensive made ground deposits – noted on site walkover</i>)	Direct contact (<i>pipe degradation and leaching</i>)	Services (<i>impacted new potable supply piping</i>)	Li	Md	M	
Ground Gases (Methane and CO ₂) (<i>potential for significant made ground deposits, hydrocarbon break-down, silage pit and numerous infilled ponds, historical landfill</i>)	Vertical and lateral migration (<i>superficial geology potentially highly permeable, bedrock predominantly low</i>)	Site Workers & Excavations, End Users & Building Envelope (<i>ingress and build-up</i>)	Lw	Sv	M	
Volatile and Semi-volatile Organic Compounds (<i>historied agricultural usage of site inc. 3 No. known tanks, machinery storage, extensive made ground</i>)	Vertical and lateral migration (<i>superficial geology potentially highly permeable, bedrock predominantly low</i>)	Site Workers & Excavations, End Users & Building Envelope (<i>ingress and build-up</i>)	Li	Md	M	
Radon	Vertical and lateral migration	End Users & Building Envelope	UI	Md	L	Site is not located in a Radon Affected Area.

KEY: Probability of pollutant linkage Hi = Highly likely, Li = Likely, Lw = Low Likelihood, UI = Unlikely
Consequence Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor,
Overall Risk VH = Very High, H = High, M = Moderate, M/L = Moderate/Low, L = Low, VL = Very Low

Based on the preliminary CSM for the site, an environmental risk assessment has been undertaken. A simple matrix can provide a consistent basis for decision making. It should be used with caution, recognising the over-simplification that it will normally represent. The probability and consequences are defined according to parameters relevant to the situation; the boundaries of risk acceptability (and tolerability, where relevant) indicated on the matrix provided in Table 2, can be tailored to the factors influencing the significance of the risk. Individual situations are mapped onto the matrix to provide a ready and consistent indication of their acceptability or tolerability.

TABLE 2. RISK CLASSIFICATION MATRIX

		Consequence			
		Severe (Sv)	Medium (Md)	Mild (Mi)	Minor (Mr)
Probability	High (Hi)	Very high risk	High risk	Moderate Risk	Moderate/ Low Risk
	Likely (Li)	High risk	Moderate Risk	Moderate/ Low Risk	Low Risk
	Low Likelihood (Lw)	Moderate Risk	Moderate/ Low Risk	Low Risk	Very Low Risk
	Unlikely (Ul)	Moderate/ Low Risk	Low Risk	Very Low Risk	Very Low Risk

Source: CIRIA Report C552, Contaminated Land Risk Assessment. A Guide to Good Practice, 2001

These attributes are evaluated qualitatively against individual hazard assessments to determine the likelihood of a given hazard occurring. The risk evaluations for each plausible pollutant linkage are given in the last three columns of Table 1.

TABLE 3. CLASSIFICATION OF RISK

Very high risk (Vh)	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High risk (Hi)	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer term.
Moderate risk (Md)	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
Low risk (Lw)	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk (VI)	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Source: CIRIA Report C552, Contaminated Land Risk Assessment. A Guide to Good Practice, 2001

9.0 ENVIRONMENTAL RISK ASSESSMENT

Based on the information contained in this report, it is the opinion of Castledine Environmental that the site represents a **HIGH** level of risk with respect to the proposed development.

It is recommended that further investigation inline with Section 15.0 is planned and carried out on site.

It is recommended that the structures on site be subject to an asbestos survey (and subsequent removal, if required) by appropriately qualified personnel. This should be carried out prior to any demolition or redevelopment occurring in order to ensure site works do not cause future contamination of the site.

This report should be submitted to your Local Planning Authority for agreement to allow the Phase 2 intrusive testing to be undertaken.

10.0 SUMMARY OF RISKS**11.0 HUMAN HEALTH****11.1.1 RESIDENTS / END-USERS**

The risks to end-users of the site are considered to be high due to the sensitive residential end-usage of the site proposals, the historical agricultural usage of the site and the potentially contaminative features noted on the site walkover. Areas of soft-landscaping may be established in areas of contaminated soil which would be a pathways for contamination to impact end-users.

11.1.2 SITE WORKERS

The risks to site workers during site works are considered to be moderate, due to the potential for asbestos contamination along with a significant depth of made ground. The potential for the inhalation of asbestos fibres, direct contact with contaminated made ground or the build-up of vapours / ground gases in excavations are considered risks to site workers. The provision for considered usage of PPE and adherence to relevant HSE guidance would be sufficient to mitigate the risks to low, following confirmation of both soil and ground gas / vapour hazards on site via an intrusive Phase II Site Investigation.

- Site workers are to maintain good hygiene standards during site works.
- If access to deep excavations is required, pre-monitoring should be carried out.
- In accordance with Control of Asbestos Regulation (CAR) 2012, a provision for RPE/PPE and suitable working protocol should be provided during any works with asbestos containing materials.

12.0 CONTROLLED WATERS

The risks to controlled waters are considered to be moderate due to the potential for contamination on site to be in direct contact with highly permeable superficial deposits, within which a Secondary Undifferentiated Aquifer is located, below which a Secondary B is present within bedrock

deposits; however, no abstraction sites are located within 500m of site and the site is not located in a Source Protection Zone, which reduces the risk somewhat. It is recommended that the extent, nature of potential mobility of contamination on site is assessed, alongside the ground conditions (and their potential permeability).

13.0 STRUCTURES

13.1.1 GROUND GASES & VAPOURS

Potential sources of both ground gas and hazardous vapours have been identified, which should be investigated further. Potential sources of ground gas generation include a unlicensed landfill formerly located 178m south west of site (no waste type recorded nor first or last date of waste entry). the potential for significant made ground deposits on site, the potential for prior hydrocarbon spillages and their associated breakdown on site and a number of nearby, infilled ponds (infilled by circa.1966/1989 and thus potentially remaining gaseous). Potential sources of hazardous vapours include the general agricultural usage of the site (i.e. heavy plant machinery usage, storage, maintenance and storage of associated fuels, lubricants, greases and oils), the noted 3 No. tanks on site and various areas of made ground, heaped debris and chemical containers.

14.0 OFFSITE RECEPTORS

The site is located north of and topographically above a new residential estate and within a wider, predominantly residential area. Should significant contamination exist on site, there exists the credible potential for impact to offsite receptors from onsite features such as the scattered refuse and debris, fragmented asbestos and liquid contamination (i.e. hydrocarbons), which may present an impact to the new residential estate directly north of and downgradient from site.

15.0 RECOMMENDATIONS

At this stage, based on the desk study information collected, it is considered that allowance be made for the following:

- A ground investigation designed to BS10175:2011 and BS5930:2015 and comprising both window sampling and trial pitting will be required to confirm ground conditions, assess deeper and relict ground conditions (i.e. made ground, former silage pit), to collect samples for chemical analysis and to form groundwater and ground gas monitoring installations.
- A range of environmental sampling comprising the contaminants outline in Section(s) 7.1.1. & 7.1.2.
- A ground gas, groundwater and vapour monitoring regime.

If point sources have been identified e.g. buried tanks, significant wastes, liquid wastes / contamination, then allow for specific remediation.

16.0 REFERENCES

16.1 LEGISLATION AND REGULATIONS

16.1.1 ACTS

- [1] Environmental Protection Act 1990, Part IIA: inserted by Environment Act 1995, Section 57. See Environment Act 1995 for text of Part IIA.

16.1.2 PLANNING REGULATIONS

- [2] The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 SI1999/No.293
- [3] The Town and Country Planning (Environmental Impact Assessment) (England and Wales) (Amendment) Regulations 2000 SI2000/No.2867
- [4] The Town and Country Planning (Environmental Impact Assessment) (England and Wales) (Amendment) Regulations 2017 SI2017/No.571

16.1.3 CONTAMINATED LAND REGULATIONS

- [5] The Contaminated Land (England) Regulations 2000. SI2000/No.227
- [6] The Contaminated Land (England) (Amendment) Regulations 2001 SI2001/No.663

- [7] The Contaminated Land (England) Regulations 2006
SI2006/No.1380

16.2 STATUTORY GUIDANCE

- [8] Department of Environment, Food and Rural Affairs. 2012.
*Environmental Protection Act 1990: Part 2A Contaminated Land
Statutory Guidance*. Department of Environment, Food and Rural
Affairs
- [9] Communities and local Government, 2024: National Planning Policy
Framework.

16.3 BRITISH STANDARDS

- [10] BS 5930:2015+A1:2020 Code of practice for site investigations
- [11] BS 10175:2011+A2:2017 Investigation of potentially contaminated
sites - Code of practice
- [12] BS 8485:2015+A1:2019 Code of practice for the design of protective
measures for methane and carbon dioxide ground gases for new
buildings
- [13] BS 8576:2013 Guidance on investigations for ground gas.
Permanent gases and Volatile Organic Compounds (VOCs)
- [14] Bs 10176:2020 Taking Soil Sample for Determination of Volatile
Organic Compounds (VOCs)

16.4 NON-STATUTORY TECHNICAL GUIDANCE

16.4.1 ENVIRONMENT AGENCY

- [15] Land Contamination Risk Management (LCRM) 2020, updated 2023

16.4.2 CIRIA PUBLICATIONS

- [16] Wilson, S., Oliver, S., Mallett, H., Hutchings, H., and Card, G.. 2007,
*C 665 Assessing risks posed by hazardous ground gases to
buildings* London: Construction Industry Research and Information
Association

- [17] Mallett, H., Cox, L., Wilson, S. and Corban, M... 2014, *C 735 Good practice on the testing and verification of protection systems for buildings against hazardous ground gases* London: Construction Industry Research and Information Association

16.4.3 CL:AIRE

- [18] Card G, Wilson S, Mortimer S. 2012. *A Pragmatic Approach to Ground Gas Risk Assessment*. CL:AIRE Research Bulletin RB17. CL:AIRE, London, UK. ISSN 2047- 6450 (Online)

17.0 APPENDICES

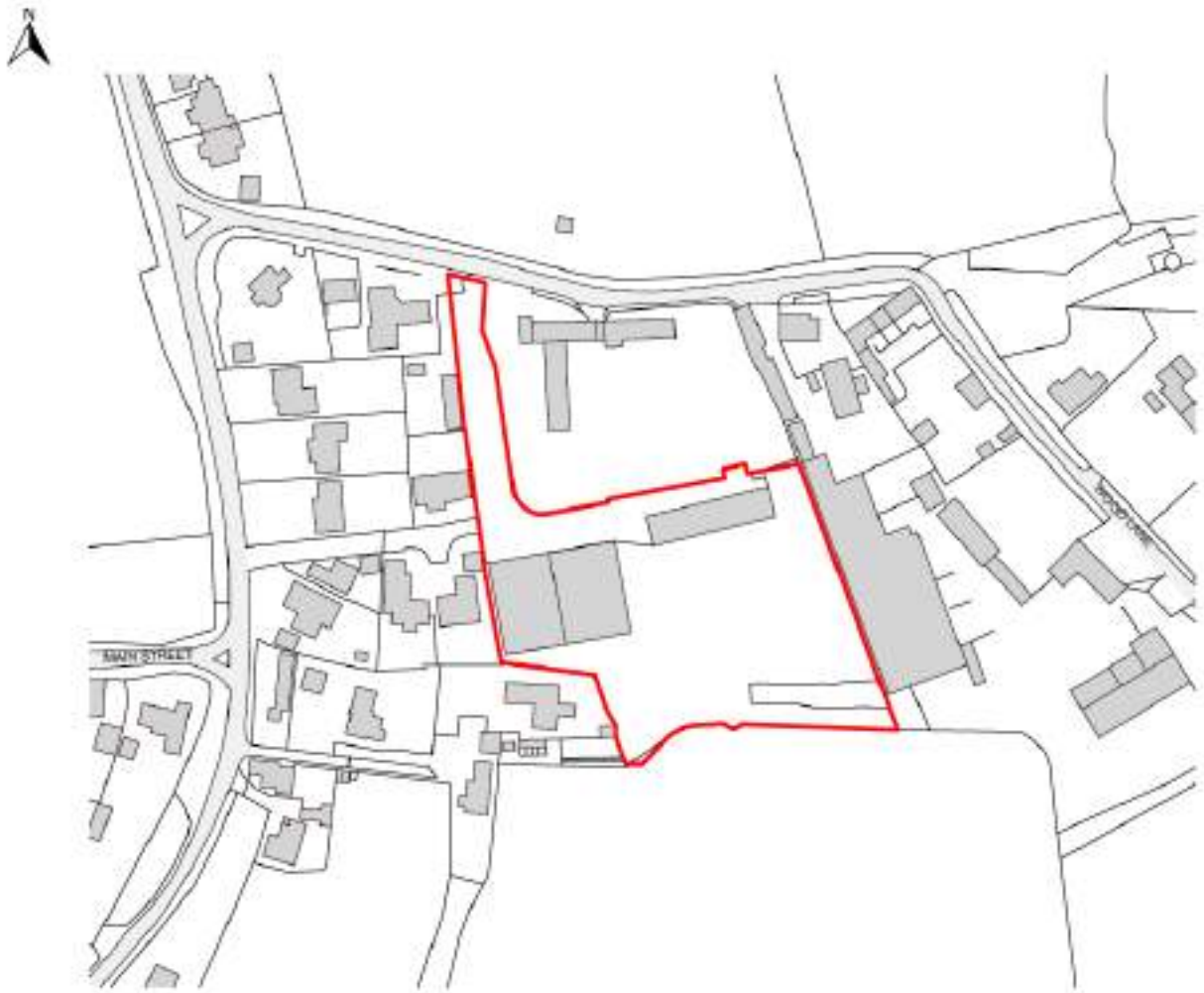
APPENDIX A ENVIRONMENTAL SEARCH

Separate Groundsure Report

APPENDIX B HISTORICAL MAPPING

Separate Map Packs (2 No. files)

APPENDIX C CURRENT AND PROPOSED SITE PLANS



Site Location Plan
1 : 1250



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Longleat, 4034D P1 LonXThree – Norton-Juxta-Twycross – 8 Wood Lane, Norton-Juxta-Twycross - Drawing
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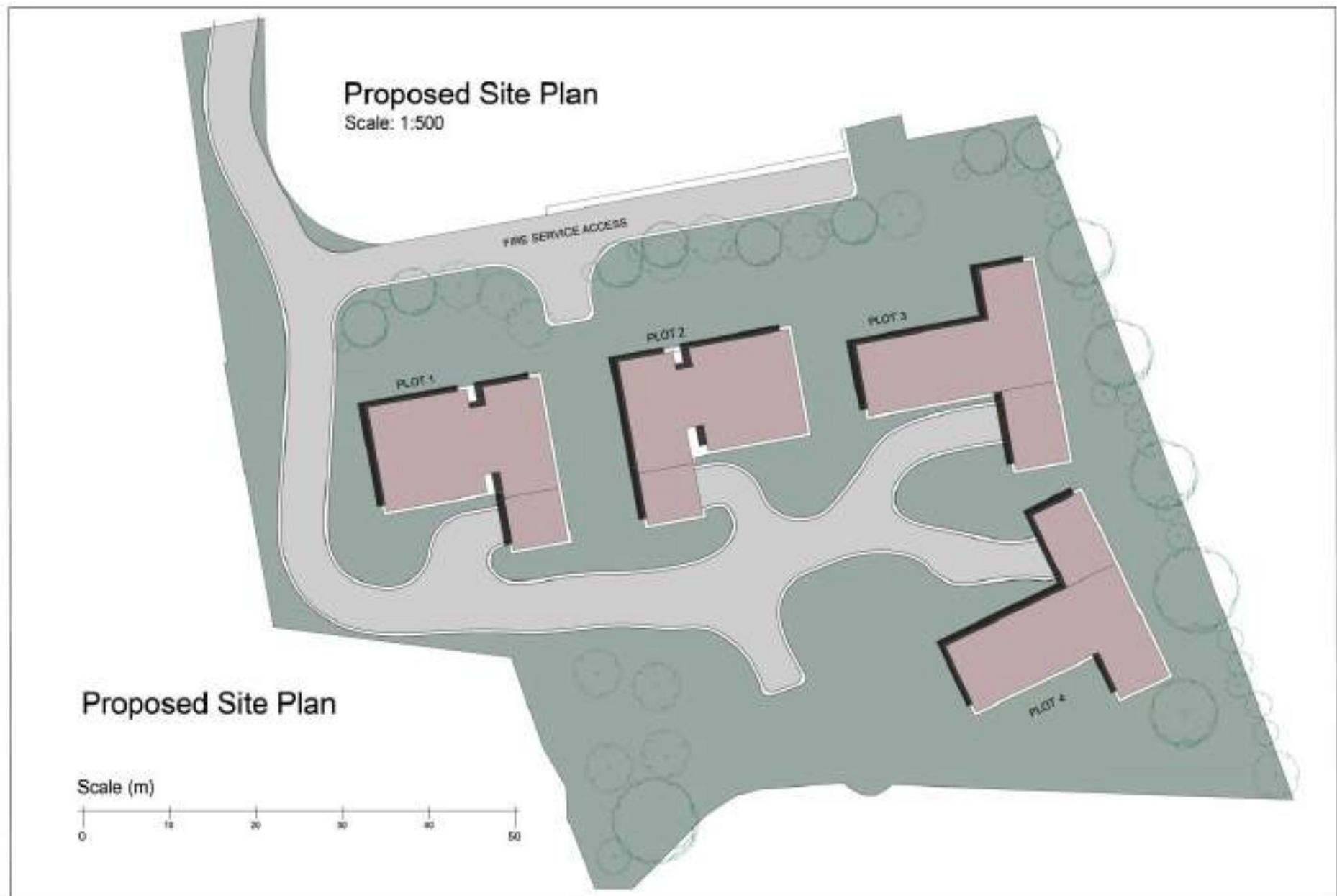
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Revision Date Dm Cld

status	PLANNING		
Project Number	2501587.7		
Project	8 Wood Lane Norton-Juxta-Twycross		
Drawing Title	Site Location Plan		
Drawn by	SL	Dwg No	A-E10-001
Check by	CW	Scale	1 : 1250 @ A3
Revision	Date		22.07.25



No 8 Queen Square, Bristol, BS1 4JF
www.marrons-planning.co.uk
0117 210 0000
info@marrons-planning.co.uk



APPENDIX D

SITE PHOTOS AND LOCATIONS



Site Walkover Photos

Photo No.1: Facing north from the site access route back towards Wood Lane



Address: Site to rear of No.8 Wood Lane, Norton-Juxta-Twycross
Client: LonXthree (c/o 2012 Partnership Homes Ltd)

Photo No.2: Facing south from the site access showing the large barns forming the western extent of site





Site Walkover Photos

Photo No.3: Facing SE from the site access showing continuation of the large barns forming the west of site



Address: Site to rear of No.8 Wood Lane, Norton-Juxta-Twycross
Client: LonXthree (c/o 2012 Partnership Homes Ltd)

Photo No.4: Heaped gravels and arisings adj. to site access





Site Walkover Photos

Photo No.5: Heaped debris and refuse noted in west of site



Address: Site to rear of No.8 Wood Lane, Norton-Juxta-Twycross
Client: LonXthree (c/o 2012 Partnership Homes Ltd)

Photo No.6: Facing SE showing front (northern) faces of barns and PACM-cladding





Site Walkover Photos

Photo No.7: Facing south showing interior of westernmost barn with miscellaneous storages (i.e. construction materials)



Address: Site to rear of No.8 Wood Lane, Norton-Juxta-Twycross
Client: LonXthree (c/o 2012 Partnership Homes Ltd)

Photo No.8: Further shot of interior of westernmost barn





Site Walkover Photos

Photo No.9: Showing PACM cladding on barns



Address: Site to rear of No.8 Wood Lane, Norton-Juxta-Twycross
Client: LonXthree (c/o 2012 Partnership Homes Ltd)

Photo No.10: facing south inside the eastern barn adjoined to that in the far west of site





Site Walkover Photos

Photo No.11: Containers noted stored in open-sided barn



Address: Site to rear of No.8 Wood Lane, Norton-Juxta-Twycross
Client: LonXthree (c/o 2012 Partnership Homes Ltd)

Photo No.12: Further shot of interior of westernmost barn





Site Walkover Photos

Address: Site to rear of No.8 Wood Lane, Norton-Juxta-Twycross
Client: LonXthree (c/o 2012 Partnership Homes Ltd)

Photo No.13: Facing NE from outside the eastern face of the barns showing remained of site and further linear barn



Photo No.14: Facing east towards the eastern extent of site showing further heaps and vegetated heaps





Site Walkover Photos

Photo No.15: Facing NW in the east of site back towards the large barns and site access (further heaps noted)



Address: Site to rear of No.8 Wood Lane, Norton-Juxta-Twycross
Client: LonXthree (c/o 2012 Partnership Homes Ltd)

Photo No.16: Facing west from outside the eastern face of the dilapidated linear barn forming the NE extent of site





Site Walkover Photos

Photo No.17: Facing west along and inside the northern boundary of site (right) with linear barn to left of photo



Address: Site to rear of No.8 Wood Lane, Norton-Juxta-Twycross
Client: LonXthree (c/o 2012 Partnership Homes Ltd)

Photo No.18: Facing east showing the rear (southern) face of the linear barn, dilapidated state and further PACM





Site Walkover Photos

Photo No.19: Facing east from the centre of site showing further heaped refuse and vegetated heaps forming SE of site



Address: Site to rear of No.8 Wood Lane, Norton-Juxta-Twycross
Client: LonXthree (c/o 2012 Partnership Homes Ltd)

Photo No.20: Overgrown vegetated heaps forming the eastern and SE extents of site



APPENDIX E**WATCHING BRIEF**

It remains possible that previously unexpected soil conditions may be encountered during the construction process. Examples may include oily pockets within the soil, potential for asbestos containing materials, black ashy materials, soils exhibiting strong odours, brightly coloured materials, and former demolition materials.

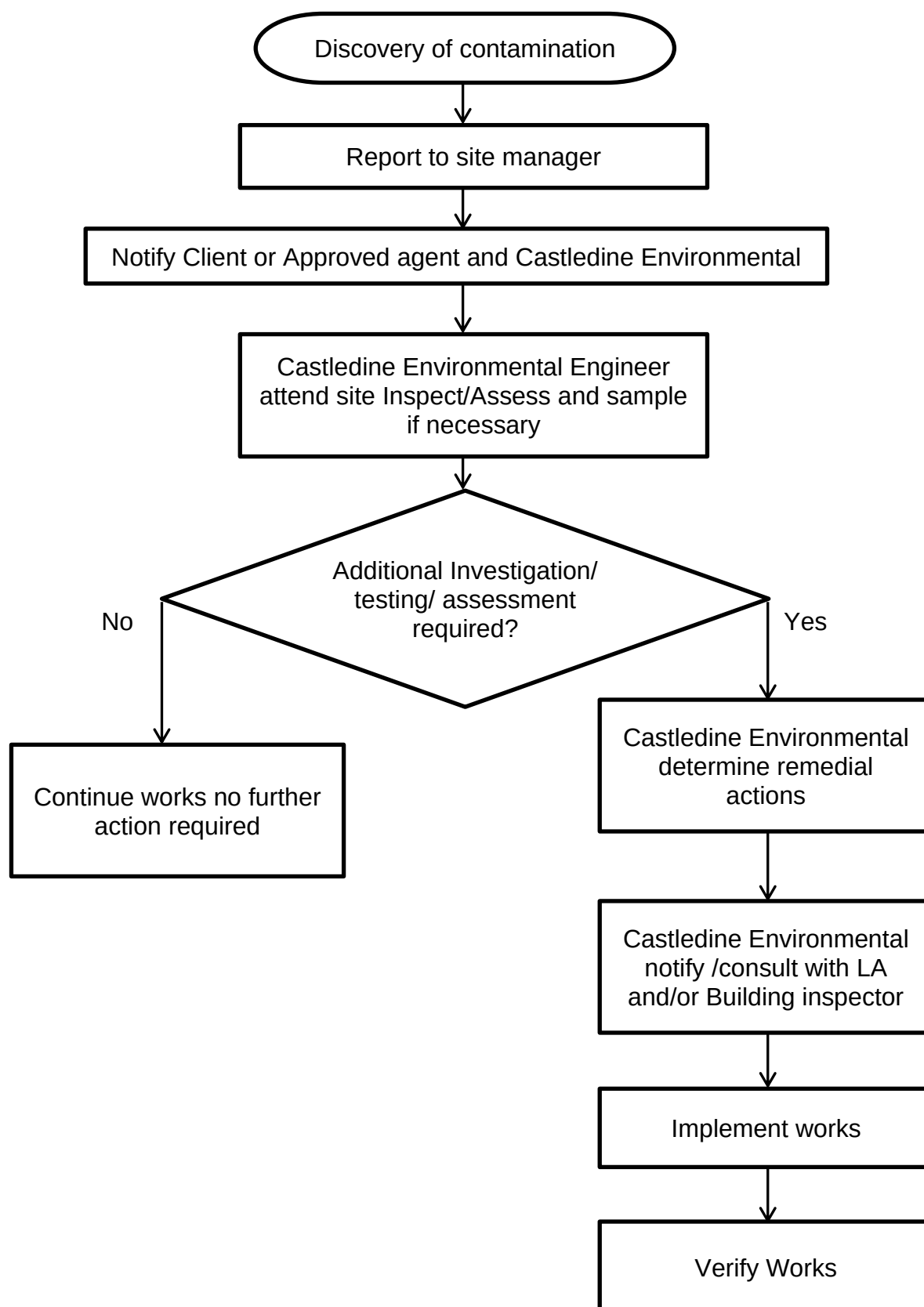
Should previously undiscovered contamination be encountered during the demolition/construction of the new buildings the following course of action should be adhered to:

1. The ground workers should report any suspected contamination immediately to the Client's site supervisor. The supervisor should contact the Client or their appointed agent who will in turn contact Castledine Environmental to request an engineer to visit the site to assess the extent of the 'contamination'.
2. Castledine Environmental shall make records of their inspection, and pass details of these to the Local Authority.
3. Where the conditions revealed differ from those previously anticipated, the Castledine Environmental shall take samples as deemed appropriate to be dispatched for appropriate chemical testing.
4. Depending on the results of the testing either:
 - a. no further work will be required;
 - b. a further detailed risk assessment will be required; and/or
 - c. Localised specific remedial measures will be necessary.
Appraisal criteria will vary depending on the nature of the assessment.
5. The results of any such testing will be sent to the Local Authority Pollution Control Section, Local Authority development control section, and the appointed building inspector. If remediation is required, the LA/Building inspector will be informed of the date and time of the proposed works.

6. Remediation will be undertaken in accordance with a method statement submitted for approval. The works shall be supervised where necessary by Castledine Environmental who shall provide a Verification Report for the Local Authorities.
7. A copy of the discovery strategy should be lodged on site and provisions made to ensure that all workers are made aware of their responsibility to observe, report and act on any potentially suspicious or contaminated materials they may encounter.

APPENDIX F

DISCOVERY STRATEGY



Appendix 4

Surface Water Drainage Calculations

For convenience – press “Alt + Left Arrow” to return to the section of the report



Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	x
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	0.750	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
S1.0	0.008	5.00	113.400	450	432401.243	306809.565	0.815	112.585
S1.1	0.007	5.00	113.300	450	432421.073	306826.434	0.660	112.640
S1.2			113.610	450	432424.844	306806.106	1.140	112.470
S1.3	0.007	5.00	113.120	450	432427.360	306827.532	0.455	112.665
S1.4			113.610	450	432431.151	306807.067	1.172	112.438
S1.5	0.008	5.00	113.500	450	432452.875	306819.124	1.135	112.365
S1.6	0.006	5.00	113.300	450	432455.423	306830.748	0.865	112.435
S1.7	0.002	5.00	113.400	450	432457.287	306819.993	1.035	112.365
S1.8	0.003	5.00	113.300	450	432470.366	306838.719	0.755	112.545
S1.9	0.006	5.00	113.400	450	432464.873	306821.328	0.600	112.800
S1.10	0.004	5.00	114.000	450	432474.538	306813.739	0.600	113.400
S1.11	0.004	5.00	114.000	450	432476.352	306810.017	0.600	113.400
S1.12	0.006	5.00	114.000	450	432472.589	306797.861	1.530	112.470
S1.13	0.002	5.00	114.000	450	432465.773	306794.649	1.580	112.420
S1.14	0.006	5.00	114.300	450	432469.772	306786.313	1.480	112.820
S1.15	0.003	5.00	114.300	450	432487.113	306787.410	0.725	113.575
S1.16		5.00	115.000	450	432461.981	306808.439	2.625	112.375
S1.17_PERM PAVE	0.127	5.00	113.320	1200	432454.460	306810.837	1.000	112.320
S1.18			114.300	1200	432455.719	306780.239	2.185	112.115
RE1.0	0.008	5.00	113.400	150	432399.075	306821.640	0.700	112.700
RE1.1	0.005	5.00	113.300	150	432413.725	306825.002	0.600	112.700
RE1.2	0.005	5.00	113.300	150	432434.981	306828.947	0.550	112.750
RE1.3	0.008	5.00	113.300	150	432450.599	306831.232	0.500	112.800

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
RE1.4	0.008	5.00	113.350	150	432476.237	306839.791	0.765	112.585
RE1.5		5.00	115.000	150	432481.099	306814.863	0.650	114.350
RE1.6		5.00	115.000	150	432481.716	306812.512	0.450	114.550
RE1.7	0.008	5.00	114.300	150	432492.805	306790.141	0.450	113.850
TANK			115.000	1	432454.792	306793.708	2.795	112.205
HEADWALL			114.300	1	432460.913	306773.351	2.240	112.060

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	RE1.0	S1.0	12.268	0.600	112.700	112.585	0.115	106.7	150	5.21	50.0
1.001	S1.0	S1.17_PERM PAVE	53.232	0.600	112.585	112.320	0.265	200.9	150	6.47	48.1
2.000	RE1.1	S1.1	7.486	0.600	112.700	112.640	0.060	124.8	150	5.14	50.0
2.001	S1.1	S1.2	20.675	0.600	112.640	112.470	0.170	121.6	150	5.52	50.0
2.002	S1.2	S1.17_PERM PAVE	29.991	0.600	112.470	112.320	0.150	199.9	150	6.22	48.9

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.972	17.2	1.1	0.550	0.665	0.008	0.0	25	0.542
1.001	0.705	12.5	2.1	0.665	0.850	0.016	0.0	41	0.523
2.000	0.898	15.9	0.7	0.450	0.510	0.005	0.0	21	0.448
2.001	0.910	16.1	1.6	0.510	0.990	0.012	0.0	32	0.581
2.002	0.707	12.5	1.6	0.990	0.850	0.012	0.0	36	0.484

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
4.000	RE1.2	S1.3	7.751	0.600	112.750	112.665	0.085	91.2	150	5.12	50.0
4.001	S1.3	S1.4	20.813	0.600	112.665	112.438	0.227	91.7	150	5.45	50.0
4.002	S1.4	S1.17_PERM PAVE	23.612	0.600	112.438	112.320	0.118	200.1	150	6.01	49.7
9.000	RE1.3	S1.5	12.320	0.600	112.800	112.365	0.435	28.3	150	5.11	50.0
9.001	S1.5	S1.17_PERM PAVE	8.437	0.600	112.365	112.320	0.045	187.5	150	5.30	50.0
5.000	RE1.4	S1.8	5.968	0.600	112.585	112.545	0.040	149.2	150	5.12	50.0
5.001	S1.8	S1.6	16.936	0.600	112.545	112.435	0.110	154.0	150	5.47	50.0
5.002	S1.6	S1.7	10.915	0.600	112.435	112.365	0.070	155.9	150	5.70	50.0
5.003	S1.7	S1.17_PERM PAVE	9.582	0.600	112.365	112.320	0.045	212.9	150	5.93	50.0
10.000	S1.9	S1.17_PERM PAVE	14.781	0.600	112.800	112.320	0.480	30.8	150	5.14	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
4.000	1.053	18.6	0.7	0.400	0.305	0.005	0.0	20	0.497
4.001	1.050	18.5	1.6	0.305	1.022	0.012	0.0	30	0.649
4.002	0.707	12.5	1.6	1.022	0.850	0.012	0.0	37	0.489
9.000	1.899	33.6	1.1	0.350	0.985	0.008	0.0	18	0.867
9.001	0.730	12.9	2.2	0.985	0.850	0.016	0.0	41	0.541
5.000	0.820	14.5	1.1	0.615	0.605	0.008	0.0	28	0.482
5.001	0.807	14.3	1.5	0.605	0.715	0.011	0.0	33	0.521
5.002	0.802	14.2	2.3	0.715	0.885	0.017	0.0	41	0.590
5.003	0.685	12.1	2.6	0.885	0.850	0.019	0.0	47	0.546
10.000	1.820	32.2	0.8	0.450	0.850	0.006	0.0	17	0.779

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
7.000	RE1.5	S1.10	6.657	0.600	114.350	113.400	0.950	7.0	150	5.03	50.0
7.001	S1.10	S1.17_PERM PAVE	20.287	0.600	113.400	112.320	1.080	18.8	150	5.17	50.0
6.000	RE1.6	S1.11	5.916	0.600	114.550	113.400	1.150	5.1	150	5.02	50.0
6.001	S1.11	S1.17_PERM PAVE	21.907	0.600	113.400	112.320	1.080	20.3	150	5.18	50.0
8.000	S1.12	S1.17_PERM PAVE	22.294	0.600	112.470	112.320	0.150	148.6	150	5.45	50.0
3.000	RE1.7	S1.15	6.313	0.600	113.850	113.575	0.275	23.0	150	5.05	50.0
3.001	S1.15	S1.14	17.376	0.600	113.575	112.820	0.755	23.0	150	5.19	50.0
3.002	S1.14	S1.13	9.246	0.600	112.820	112.420	0.400	23.1	150	5.26	50.0
3.003	S1.13	S1.17_PERM PAVE	19.749	0.600	112.420	112.320	0.100	197.5	150	5.72	50.0
1.002	S1.17_PERM PAVE	TANK	17.132	0.600	112.320	112.205	0.115	149.0	225	6.74	47.1

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
7.000	3.831	67.7	0.0	0.500	0.450	0.000	0.0	0	0.000
7.001	2.334	41.3	0.5	0.450	0.850	0.004	0.0	12	0.805
6.000	4.473	79.0	0.0	0.300	0.450	0.000	0.0	0	0.000
6.001	2.246	39.7	0.5	0.450	0.850	0.004	0.0	13	0.799
8.000	0.822	14.5	0.8	1.380	0.850	0.006	0.0	24	0.444
3.000	2.110	37.3	1.1	0.300	0.575	0.008	0.0	17	0.925
3.001	2.108	37.2	1.5	0.575	1.330	0.011	0.0	20	1.021
3.002	2.103	37.2	2.3	1.330	1.430	0.017	0.0	25	1.178
3.003	0.711	12.6	2.6	1.430	0.850	0.019	0.0	46	0.560
1.002	1.069	42.5	30.8	0.775	2.570	0.241	0.0	142	1.161

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.003	TANK	S1.18	13.501	0.600	112.205	112.115	0.090	150.0	225	6.95	46.4
1.004	S1.18	HEADWALL	8.627	0.600	112.115	112.060	0.055	156.9	300	7.06	46.0
11.000	S1.16	S1.17_PERM PAVE	7.894	0.600	112.375	112.320	0.055	143.5	150	5.16	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.003	1.065	42.3	30.3	2.570	1.960	0.241	0.0	141	1.155
1.004	1.253	88.5	30.0	1.885	1.940	0.241	0.0	120	1.136
11.000	0.837	14.8	0.0	2.475	0.850	0.000	0.0	0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	12.268	106.7	150	CIRCULAR	113.400	112.700	0.550	113.400	112.585	0.665
1.001	53.232	200.9	150	CIRCULAR	113.400	112.585	0.665	113.320	112.320	0.850
2.000	7.486	124.8	150	CIRCULAR	113.300	112.700	0.450	113.300	112.640	0.510
2.001	20.675	121.6	150	CIRCULAR	113.300	112.640	0.510	113.610	112.470	0.990
2.002	29.991	199.9	150	CIRCULAR	113.610	112.470	0.990	113.320	112.320	0.850

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	RE1.0	150	Manhole	Adoptable	S1.0	450	Manhole	Adoptable
1.001	S1.0	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable
2.000	RE1.1	150	Manhole	Adoptable	S1.1	450	Manhole	Adoptable
2.001	S1.1	450	Manhole	Adoptable	S1.2	450	Manhole	Adoptable
2.002	S1.2	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
4.000	7.751	91.2	150	CIRCULAR	113.300	112.750	0.400	113.120	112.665	0.305
4.001	20.813	91.7	150	CIRCULAR	113.120	112.665	0.305	113.610	112.438	1.022
4.002	23.612	200.1	150	CIRCULAR	113.610	112.438	1.022	113.320	112.320	0.850
9.000	12.320	28.3	150	CIRCULAR	113.300	112.800	0.350	113.500	112.365	0.985
9.001	8.437	187.5	150	CIRCULAR	113.500	112.365	0.985	113.320	112.320	0.850
5.000	5.968	149.2	150	CIRCULAR	113.350	112.585	0.615	113.300	112.545	0.605
5.001	16.936	154.0	150	CIRCULAR	113.300	112.545	0.605	113.300	112.435	0.715
5.002	10.915	155.9	150	CIRCULAR	113.300	112.435	0.715	113.400	112.365	0.885
5.003	9.582	212.9	150	CIRCULAR	113.400	112.365	0.885	113.320	112.320	0.850
10.000	14.781	30.8	150	CIRCULAR	113.400	112.800	0.450	113.320	112.320	0.850

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
4.000	RE1.2	150	Manhole	Adoptable	S1.3	450	Manhole	Adoptable
4.001	S1.3	450	Manhole	Adoptable	S1.4	450	Manhole	Adoptable
4.002	S1.4	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable
9.000	RE1.3	150	Manhole	Adoptable	S1.5	450	Manhole	Adoptable
9.001	S1.5	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable
5.000	RE1.4	150	Manhole	Adoptable	S1.8	450	Manhole	Adoptable
5.001	S1.8	450	Manhole	Adoptable	S1.6	450	Manhole	Adoptable
5.002	S1.6	450	Manhole	Adoptable	S1.7	450	Manhole	Adoptable
5.003	S1.7	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable
10.000	S1.9	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
7.000	6.657	7.0	150	CIRCULAR	115.000	114.350	0.500	114.000	113.400	0.450
7.001	20.287	18.8	150	CIRCULAR	114.000	113.400	0.450	113.320	112.320	0.850
6.000	5.916	5.1	150	CIRCULAR	115.000	114.550	0.300	114.000	113.400	0.450
6.001	21.907	20.3	150	CIRCULAR	114.000	113.400	0.450	113.320	112.320	0.850
8.000	22.294	148.6	150	CIRCULAR	114.000	112.470	1.380	113.320	112.320	0.850
3.000	6.313	23.0	150	CIRCULAR	114.300	113.850	0.300	114.300	113.575	0.575
3.001	17.376	23.0	150	CIRCULAR	114.300	113.575	0.575	114.300	112.820	1.330
3.002	9.246	23.1	150	CIRCULAR	114.300	112.820	1.330	114.000	112.420	1.430
3.003	19.749	197.5	150	CIRCULAR	114.000	112.420	1.430	113.320	112.320	0.850
1.002	17.132	149.0	225	CIRCULAR	113.320	112.320	0.775	115.000	112.205	2.570
1.003	13.501	150.0	225	CIRCULAR	115.000	112.205	2.570	114.300	112.115	1.960

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
7.000	RE1.5	150	Manhole	Adoptable	S1.10	450	Manhole	Adoptable
7.001	S1.10	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable
6.000	RE1.6	150	Manhole	Adoptable	S1.11	450	Manhole	Adoptable
6.001	S1.11	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable
8.000	S1.12	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable
3.000	RE1.7	150	Manhole	Adoptable	S1.15	450	Manhole	Adoptable
3.001	S1.15	450	Manhole	Adoptable	S1.14	450	Manhole	Adoptable
3.002	S1.14	450	Manhole	Adoptable	S1.13	450	Manhole	Adoptable
3.003	S1.13	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable
1.002	S1.17_PERM PAVE	1200	Manhole	Adoptable	TANK	1	Manhole	Adoptable
1.003	TANK	1	Manhole	Adoptable	S1.18	1200	Manhole	Adoptable

Pipeline Schedule

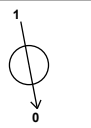
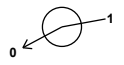
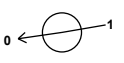
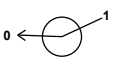
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	8.627	156.9	300	CIRCULAR	114.300	112.115	1.885	114.300	112.060	1.940
11.000	7.894	143.5	150	CIRCULAR	115.000	112.375	2.475	113.320	112.320	0.850

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	S1.18	1200	Manhole	Adoptable	HEADWALL	1	Manhole	Adoptable
11.000	S1.16	450	Manhole	Adoptable	S1.17_PERM PAVE	1200	Manhole	Adoptable

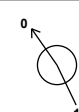
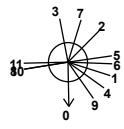
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
S1.0	432401.243	306809.565	113.400	0.815	450		1	1.000	112.585	150
						0	1.001	112.585	150	
S1.1	432421.073	306826.434	113.300	0.660	450		1	2.000	112.640	150
						0	2.001	112.640	150	
S1.2	432424.844	306806.106	113.610	1.140	450		1	2.001	112.470	150
						0	2.002	112.470	150	
S1.3	432427.360	306827.532	113.120	0.455	450		1	4.000	112.665	150
						0	4.001	112.665	150	

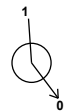
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1.4	432431.151	306807.067	113.610	1.172	450		1 4.001	112.438	150
						0	4.002	112.438	150
S1.5	432452.875	306819.124	113.500	1.135	450		1 9.000	112.365	150
						0	9.001	112.365	150
S1.6	432455.423	306830.748	113.300	0.865	450		1 5.001	112.435	150
						0	5.002	112.435	150
S1.7	432457.287	306819.993	113.400	1.035	450		1 5.002	112.365	150
						0	5.003	112.365	150
S1.8	432470.366	306838.719	113.300	0.755	450		1 5.000	112.545	150
						0	5.001	112.545	150
S1.9	432464.873	306821.328	113.400	0.600	450		0 10.000	112.800	150
S1.10	432474.538	306813.739	114.000	0.600	450		1 7.000	113.400	150
						0	7.001	113.400	150
S1.11	432476.352	306810.017	114.000	0.600	450		1 6.000	113.400	150
						0	6.001	113.400	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1.12	432472.589	306797.861	114.000	1.530	450				
						0	8.000	112.470	150
S1.13	432465.773	306794.649	114.000	1.580	450		1	3.002	112.420
						0	3.003	112.420	150
S1.14	432469.772	306786.313	114.300	1.480	450		1	3.001	112.820
						0	3.002	112.820	150
S1.15	432487.113	306787.410	114.300	0.725	450		1	3.000	113.575
						0	3.001	113.575	150
S1.16	432461.981	306808.439	115.000	2.625	450				
						0	11.000	112.375	150
S1.17_PERM PAVE	432454.460	306810.837	113.320	1.000	1200		1	11.000	112.320
						2	10.000	112.320	150
						3	9.001	112.320	150
						4	8.000	112.320	150
						5	7.001	112.320	150
						6	6.001	112.320	150
						7	5.003	112.320	150
						8	4.002	112.320	150
						9	3.003	112.320	150
						10	2.002	112.320	150
						11	1.001	112.320	150
						0	1.002	112.320	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
S1.18	432455.719	306780.239	114.300	2.185	1200		1	1.003	112.115	225
							0	1.004	112.115	300
RE1.0	432399.075	306821.640	113.400	0.700	150		0	1.000	112.700	150
RE1.1	432413.725	306825.002	113.300	0.600	150		0	2.000	112.700	150
RE1.2	432434.981	306828.947	113.300	0.550	150		0	4.000	112.750	150
RE1.3	432450.599	306831.232	113.300	0.500	150		0	9.000	112.800	150
RE1.4	432476.237	306839.791	113.350	0.765	150		0	5.000	112.585	150
RE1.5	432481.099	306814.863	115.000	0.650	150		0	7.000	114.350	150
RE1.6	432481.716	306812.512	115.000	0.450	150		0	6.000	114.550	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
RE1.7	432492.805	306790.141	114.300	0.450	150		0	3.000	113.850	150
TANK	432454.792	306793.708	115.000	2.795	1		1	1.002	112.205	225
							0	1.003	112.205	225
HEADWALL	432460.913	306773.351	114.300	2.240	1		1	1.004	112.060	300

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)		100 year (l/s)	150.7
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	✓	Check Discharge Volume	x
Summer CV	0.750	Drain Down Time (mins)	240	2 year (l/s)	46.1		
Winter CV	0.840	Additional Storage (m³/ha)	20.0	30 year (l/s)	116.7		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	10	0	100	40	10	0
30	40	10	0				

Pre-development Discharge Rate

Site Makeup	Brownfield	PIMP (%)	100	Betterment (%)	0	Q 100 year (l/s)	150.7
Brownfield Method	MRM	CV	0.900	Q 2 year (l/s)	46.1		
Contributing Area (ha)	0.730	Time of Concentration (mins)	30.00	Q 30 year (l/s)	116.7		

Node S1.18 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	112.115	Product Number	CTL-SHE-0070-2000-0800-2000
Design Depth (m)	0.800	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node S1.17 PERM PAVE Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.33	Width (m)	10.407	Depth (m)	1.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	112.320	Length (m)	116.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	176	Slope (1:X)	125.0		

Node TANK Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	112.205
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	150.0	0.0	0.800	150.0	0.0	0.801	0.0	0.0

Results for 2 year +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1.0	11	112.628	0.043	2.4	0.0161	0.0000	OK
15 minute winter	S1.1	10	112.674	0.034	1.9	0.0134	0.0000	OK
15 minute winter	S1.2	11	112.508	0.038	1.8	0.0061	0.0000	OK
15 minute winter	S1.3	10	112.697	0.032	1.9	0.0157	0.0000	OK
15 minute winter	S1.4	11	112.476	0.038	1.8	0.0061	0.0000	OK
15 minute winter	S1.5	13	112.470	0.105	2.4	0.0331	0.0000	OK
15 minute winter	S1.6	11	112.478	0.043	2.5	0.0133	0.0000	OK
15 minute winter	S1.7	13	112.471	0.106	2.8	0.0214	0.0000	OK
15 minute winter	S1.8	10	112.579	0.034	1.7	0.0084	0.0000	OK
15 minute winter	S1.9	11	112.817	0.017	0.9	0.0066	0.0000	OK
15 minute winter	S1.10	11	113.413	0.013	0.6	0.0039	0.0000	OK
15 minute winter	S1.11	11	113.413	0.013	0.6	0.0040	0.0000	OK
15 minute winter	S1.12	11	112.495	0.025	0.9	0.0062	0.0000	OK
15 minute winter	S1.13	13	112.474	0.053	2.8	0.0100	0.0000	OK
15 minute winter	S1.14	10	112.847	0.027	2.5	0.0066	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1.0	1.001	S1.17_PERM PAVE	2.3	0.212	0.181	0.5729	
15 minute winter	S1.1	2.001	S1.2	1.8	0.572	0.112	0.0671	
15 minute winter	S1.2	2.002	S1.17_PERM PAVE	1.8	0.168	0.144	0.3142	
15 minute winter	S1.3	4.001	S1.4	1.8	0.598	0.097	0.0646	
15 minute winter	S1.4	4.002	S1.17_PERM PAVE	1.8	0.171	0.144	0.2471	
15 minute summer	S1.5	9.001	S1.17_PERM PAVE	1.9	0.264	0.148	0.1262	
15 minute winter	S1.6	5.002	S1.7	2.5	0.482	0.178	0.0925	
15 minute winter	S1.7	5.003	S1.17_PERM PAVE	2.4	0.233	0.202	0.1480	
15 minute winter	S1.8	5.001	S1.6	1.6	0.459	0.113	0.0598	
15 minute winter	S1.9	10.000	S1.17_PERM PAVE	0.9	0.187	0.028	0.1373	
15 minute winter	S1.10	7.001	S1.17_PERM PAVE	0.6	0.116	0.015	0.1850	
15 minute winter	S1.11	6.001	S1.17_PERM PAVE	0.6	0.113	0.015	0.2000	
15 minute winter	S1.12	8.000	S1.17_PERM PAVE	0.9	0.132	0.062	0.2157	
15 minute winter	S1.13	3.003	S1.17_PERM PAVE	2.8	0.271	0.225	0.2293	
15 minute winter	S1.14	3.002	S1.13	2.5	0.747	0.068	0.0333	

Results for 2 year +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1.15	10	113.597	0.022	1.7	0.0054	0.0000	OK
15 minute winter	S1.16	13	112.470	0.095	0.5	0.0151	0.0000	OK
15 minute winter	S1.17_PERM PAVE	13	112.470	0.150	34.1	5.4352	0.0000	OK
240 minute winter	S1.18	188	112.397	0.282	4.8	0.3189	0.0000	OK
15 minute summer	RE1.0	10	112.727	0.027	1.2	0.0072	0.0000	OK
15 minute winter	RE1.1	10	112.723	0.023	0.8	0.0045	0.0000	OK
15 minute winter	RE1.2	10	112.771	0.021	0.8	0.0046	0.0000	OK
15 minute summer	RE1.3	10	112.819	0.019	1.2	0.0072	0.0000	OK
15 minute summer	RE1.4	10	112.615	0.030	1.2	0.0074	0.0000	OK
15 minute summer	RE1.5	1	114.350	0.000	0.0	0.0000	0.0000	OK
15 minute summer	RE1.6	1	114.550	0.000	0.0	0.0000	0.0000	OK
15 minute summer	RE1.7	10	113.868	0.018	1.2	0.0075	0.0000	OK
240 minute winter	TANK	188	112.397	0.192	9.1	27.3913	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1.15	3.001	S1.14	1.6	0.904	0.044	0.0317	
15 minute winter	S1.16	11.000	S1.17_PERM PAVE	-0.5	-0.090	-0.036	0.1157	
15 minute winter	S1.17_PERM PAVE	1.002	TANK	27.1	1.745	0.637	0.2763	
240 minute winter	S1.18	1.004	HEADWALL	2.0	0.512	0.023	0.0338	46.1
15 minute summer	RE1.0	1.000	S1.0	1.2	0.397	0.068	0.0380	
15 minute winter	RE1.1	2.000	S1.1	0.8	0.334	0.049	0.0174	
15 minute winter	RE1.2	4.000	S1.3	0.8	0.375	0.042	0.0162	
15 minute summer	RE1.3	9.000	S1.5	1.2	0.416	0.035	0.0826	
15 minute winter	RE1.4	5.000	S1.8	1.2	0.431	0.081	0.0163	
15 minute summer	RE1.5	7.000	S1.10	0.0	0.000	0.000	0.0023	
15 minute summer	RE1.6	6.000	S1.11	0.0	0.000	0.000	0.0021	
15 minute summer	RE1.7	3.000	S1.15	1.2	0.868	0.032	0.0086	
30 minute summer	TANK	1.003	S1.18	5.6	0.330	0.132	0.3868	

Results for 2 year +10% A Critical Storm Duration. Lowest mass balance: 100.00%									
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	
240 minute winter	HEADWALL	236	112.091	0.031	2.0	0.0000	0.0000	OK	
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)	

Results for 30 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 98.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	S1.0	352	112.743	0.158	1.2	0.0591	0.0000	SURCHARGED
360 minute winter	S1.1	352	112.742	0.102	1.0	0.0401	0.0000	OK
360 minute winter	S1.2	352	112.742	0.272	1.0	0.0433	0.0000	SURCHARGED
360 minute winter	S1.3	352	112.742	0.077	1.0	0.0385	0.0000	OK
360 minute winter	S1.4	352	112.742	0.304	1.0	0.0484	0.0000	SURCHARGED
360 minute winter	S1.5	352	112.742	0.377	1.2	0.1185	0.0000	SURCHARGED
360 minute winter	S1.6	352	112.742	0.307	1.3	0.0959	0.0000	SURCHARGED
360 minute winter	S1.7	352	112.742	0.377	1.4	0.0762	0.0000	SURCHARGED
360 minute winter	S1.8	352	112.742	0.197	0.8	0.0486	0.0000	SURCHARGED
15 minute winter	S1.9	10	112.832	0.032	3.2	0.0121	0.0000	OK
15 minute winter	S1.10	10	113.423	0.023	2.1	0.0070	0.0000	OK
15 minute winter	S1.11	10	113.423	0.023	2.1	0.0072	0.0000	OK
360 minute winter	S1.12	352	112.742	0.272	0.5	0.0667	0.0000	SURCHARGED
360 minute winter	S1.13	352	112.742	0.322	1.5	0.0603	0.0000	SURCHARGED
15 minute winter	S1.14	10	112.870	0.050	8.9	0.0124	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1.0	1.001	S1.17_PERM PAVE	7.8	0.491	0.623	0.8375	
15 minute winter	S1.1	2.001	S1.2	6.3	0.740	0.390	0.2560	
15 minute winter	S1.2	2.002	S1.17_PERM PAVE	6.0	0.342	0.482	0.5280	
15 minute winter	S1.3	4.001	S1.4	6.3	0.727	0.338	0.2516	
15 minute winter	S1.4	4.002	S1.17_PERM PAVE	5.8	0.330	0.465	0.4157	
15 minute winter	S1.5	9.001	S1.17_PERM PAVE	7.7	0.438	0.597	0.1485	
15 minute winter	S1.6	5.002	S1.7	7.0	0.501	0.497	0.1922	
15 minute summer	S1.7	5.003	S1.17_PERM PAVE	7.7	0.439	0.639	0.1687	
15 minute winter	S1.8	5.001	S1.6	5.1	0.543	0.360	0.2972	
15 minute winter	S1.9	10.000	S1.17_PERM PAVE	3.2	0.259	0.099	0.1503	
15 minute winter	S1.10	7.001	S1.17_PERM PAVE	2.1	0.179	0.050	0.1958	
15 minute winter	S1.11	6.001	S1.17_PERM PAVE	2.1	0.178	0.052	0.2120	
15 minute winter	S1.12	8.000	S1.17_PERM PAVE	2.7	0.176	0.185	0.3925	
15 minute winter	S1.13	3.003	S1.17_PERM PAVE	9.3	0.526	0.737	0.3477	
15 minute winter	S1.14	3.002	S1.13	8.9	0.906	0.239	0.1051	

Results for 30 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 98.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1.15	10	113.615	0.040	5.8	0.0100	0.0000	OK
360 minute winter	S1.16	352	112.742	0.367	0.1	0.0584	0.0000	SURCHARGED
360 minute winter	S1.17_PERM PAVE	352	112.742	0.422	18.0	39.9937	0.0000	SURCHARGED
360 minute winter	S1.18	352	112.742	0.627	5.3	0.7091	0.0000	SURCHARGED
15 minute winter	RE1.0	10	112.750	0.050	4.2	0.0135	0.0000	OK
360 minute winter	RE1.1	352	112.742	0.042	0.4	0.0085	0.0000	OK
15 minute winter	RE1.2	10	112.788	0.038	2.7	0.0084	0.0000	OK
15 minute winter	RE1.3	10	112.836	0.036	4.2	0.0132	0.0000	OK
360 minute winter	RE1.4	352	112.742	0.157	0.6	0.0390	0.0000	SURCHARGED
15 minute summer	RE1.5	1	114.350	0.000	0.0	0.0000	0.0000	OK
15 minute summer	RE1.6	1	114.550	0.000	0.0	0.0000	0.0000	OK
15 minute winter	RE1.7	10	113.885	0.035	4.2	0.0142	0.0000	OK
360 minute winter	TANK	352	112.742	0.537	12.0	76.5498	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1.15	3.001	S1.14	5.7	1.296	0.154	0.0772	
15 minute winter	S1.16	11.000	S1.17_PERM PAVE	-0.9	-0.146	-0.058	0.1390	
15 minute winter	S1.17_PERM PAVE	1.002	TANK	58.0	1.767	1.365	0.6814	
15 minute winter	S1.18	1.004	HEADWALL	2.0	0.512	0.023	0.0338	29.0
15 minute winter	RE1.0	1.000	S1.0	4.2	0.539	0.243	0.1124	
15 minute winter	RE1.1	2.000	S1.1	2.7	0.477	0.168	0.0421	
15 minute winter	RE1.2	4.000	S1.3	2.7	0.532	0.143	0.0392	
15 minute winter	RE1.3	9.000	S1.5	4.2	0.441	0.124	0.1283	
15 minute winter	RE1.4	5.000	S1.8	4.1	0.588	0.282	0.0926	
15 minute summer	RE1.5	7.000	S1.10	0.0	0.000	0.000	0.0055	
15 minute summer	RE1.6	6.000	S1.11	0.0	0.000	0.000	0.0050	
15 minute winter	RE1.7	3.000	S1.15	4.2	1.224	0.112	0.0216	
15 minute summer	TANK	1.003	S1.18	8.1	0.469	0.191	0.5369	

Results for 30 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 98.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	HEADWALL	16	112.091	0.031	2.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
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Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 98.45%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	S1.0	352	112.861	0.276	1.6	0.1036	0.0000	SURCHARGED
360 minute winter	S1.1	352	112.861	0.221	1.2	0.0867	0.0000	SURCHARGED
360 minute winter	S1.2	352	112.861	0.391	1.2	0.0622	0.0000	SURCHARGED
360 minute winter	S1.3	352	112.861	0.196	1.2	0.0977	0.0000	FLOOD RISK
360 minute winter	S1.4	352	112.861	0.423	1.2	0.0673	0.0000	SURCHARGED
360 minute winter	S1.5	352	112.861	0.496	1.6	0.1558	0.0000	SURCHARGED
360 minute winter	S1.6	352	112.861	0.426	1.6	0.1329	0.0000	SURCHARGED
360 minute winter	S1.7	352	112.861	0.496	1.7	0.1002	0.0000	SURCHARGED
360 minute winter	S1.8	352	112.861	0.316	1.1	0.0778	0.0000	SURCHARGED
360 minute winter	S1.9	352	112.861	0.061	0.6	0.0231	0.0000	OK
15 minute winter	S1.10	10	113.426	0.026	2.7	0.0079	0.0000	OK
15 minute winter	S1.11	10	113.426	0.026	2.7	0.0081	0.0000	OK
360 minute winter	S1.12	352	112.861	0.391	0.6	0.0958	0.0000	SURCHARGED
360 minute winter	S1.13	352	112.861	0.441	1.9	0.0825	0.0000	SURCHARGED
15 minute winter	S1.14	10	112.877	0.057	11.4	0.0141	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	S1.0	1.001	S1.17_PERM PAVE	8.5	0.530	0.680	0.9371	
15 minute summer	S1.1	2.001	S1.2	7.6	0.779	0.473	0.2917	
15 minute winter	S1.2	2.002	S1.17_PERM PAVE	7.2	0.408	0.576	0.5280	
15 minute winter	S1.3	4.001	S1.4	8.0	0.758	0.430	0.2915	
15 minute winter	S1.4	4.002	S1.17_PERM PAVE	7.2	0.407	0.574	0.4157	
15 minute winter	S1.5	9.001	S1.17_PERM PAVE	9.9	0.565	0.771	0.1485	
15 minute winter	S1.6	5.002	S1.7	8.9	0.529	0.626	0.1922	
15 minute winter	S1.7	5.003	S1.17_PERM PAVE	9.6	0.543	0.790	0.1687	
15 minute winter	S1.8	5.001	S1.6	5.7	0.577	0.399	0.2982	
15 minute winter	S1.9	10.000	S1.17_PERM PAVE	4.1	0.324	0.126	0.1541	
15 minute winter	S1.10	7.001	S1.17_PERM PAVE	2.7	0.225	0.065	0.1991	
15 minute winter	S1.11	6.001	S1.17_PERM PAVE	2.7	0.224	0.067	0.2156	
15 minute winter	S1.12	8.000	S1.17_PERM PAVE	3.4	0.193	0.234	0.3925	
15 minute winter	S1.13	3.003	S1.17_PERM PAVE	11.9	0.676	0.946	0.3477	
15 minute winter	S1.14	3.002	S1.13	11.4	0.897	0.305	0.1097	

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 98.45%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1.15	10	113.620	0.045	7.4	0.0113	0.0000	OK
360 minute winter	S1.16	352	112.861	0.486	0.1	0.0773	0.0000	SURCHARGED
360 minute winter	S1.17_PERM PAVE	352	112.861	0.541	23.1	65.0006	0.0000	SURCHARGED
360 minute winter	S1.18	352	112.860	0.745	5.0	0.8431	0.0000	SURCHARGED
360 minute winter	RE1.0	352	112.861	0.161	0.8	0.0433	0.0000	SURCHARGED
360 minute winter	RE1.1	352	112.861	0.161	0.5	0.0324	0.0000	SURCHARGED
360 minute winter	RE1.2	352	112.861	0.111	0.5	0.0242	0.0000	OK
360 minute winter	RE1.3	352	112.861	0.061	0.8	0.0226	0.0000	OK
360 minute winter	RE1.4	352	112.861	0.276	0.8	0.0685	0.0000	SURCHARGED
15 minute summer	RE1.5	1	114.350	0.000	0.0	0.0000	0.0000	OK
15 minute summer	RE1.6	1	114.550	0.000	0.0	0.0000	0.0000	OK
15 minute winter	RE1.7	10	113.890	0.040	5.4	0.0163	0.0000	OK
360 minute winter	TANK	352	112.861	0.656	13.1	93.4351	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1.15	3.001	S1.14	7.3	1.387	0.197	0.0920	
15 minute winter	S1.16	11.000	S1.17_PERM PAVE	-1.0	-0.147	-0.067	0.1390	
15 minute winter	S1.17_PERM PAVE	1.002	TANK	64.0	1.897	1.506	0.6814	
30 minute summer	S1.18	1.004	HEADWALL	2.0	0.512	0.023	0.0338	28.8
15 minute winter	RE1.0	1.000	S1.0	5.4	0.557	0.312	0.2147	
15 minute winter	RE1.1	2.000	S1.1	3.4	0.498	0.212	0.0774	
15 minute winter	RE1.2	4.000	S1.3	3.4	0.564	0.181	0.0535	
15 minute winter	RE1.3	9.000	S1.5	5.4	0.476	0.160	0.1321	
15 minute summer	RE1.4	5.000	S1.8	4.8	0.588	0.329	0.1051	
15 minute summer	RE1.5	7.000	S1.10	0.0	0.000	0.000	0.0066	
15 minute summer	RE1.6	6.000	S1.11	0.0	0.000	0.000	0.0060	
15 minute winter	RE1.7	3.000	S1.15	5.4	1.311	0.144	0.0259	
30 minute winter	TANK	1.003	S1.18	6.7	0.405	0.159	0.5369	

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 98.45%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	HEADWALL	20	112.091	0.031	2.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
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Appendix 5

Drainage Strategy Layout

For convenience – press “Alt + Left Arrow” to return to the section of the report

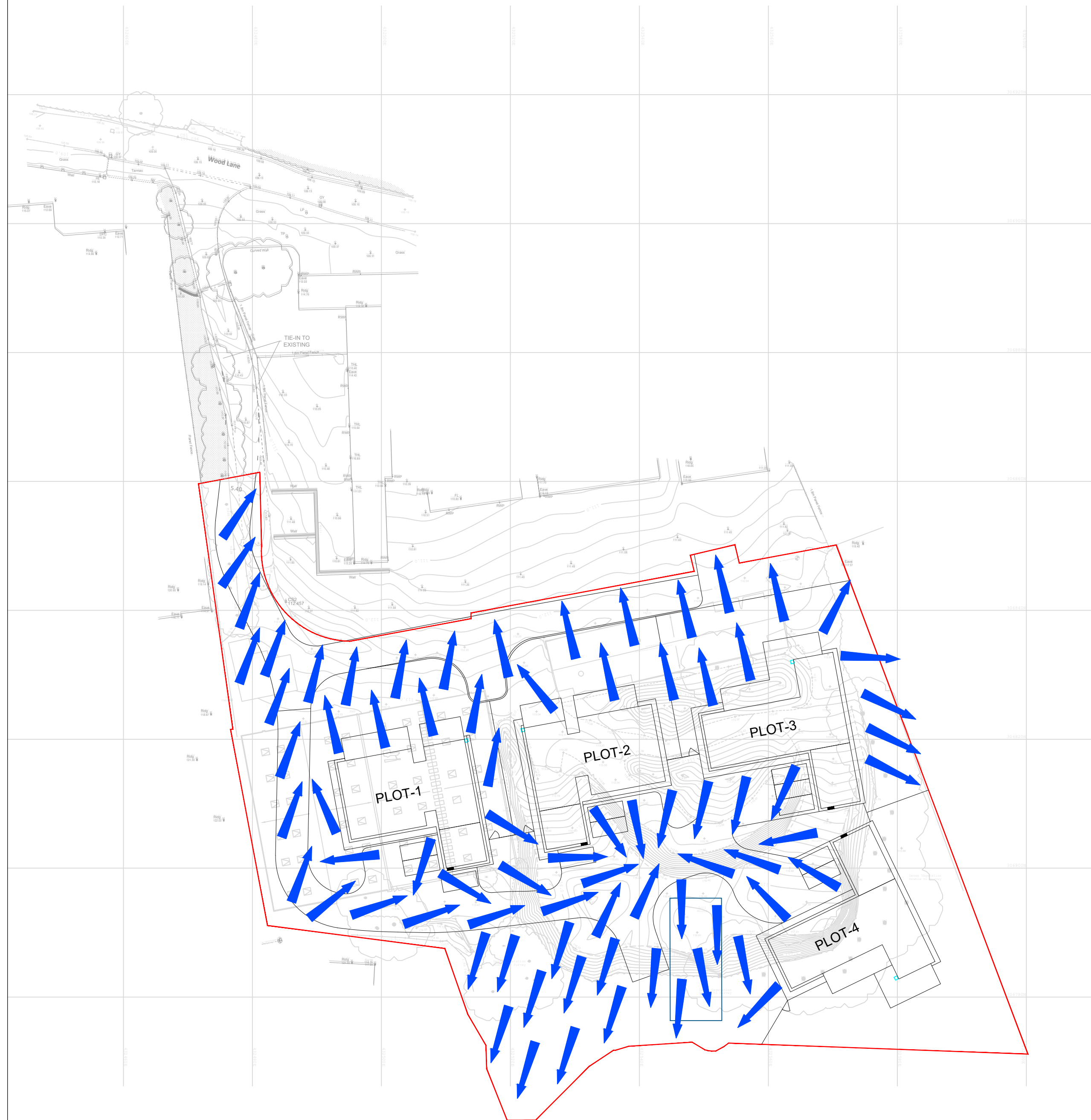


Appendix 6

Flow Routing

For convenience – press “Alt + Left Arrow” to return to the section of the report



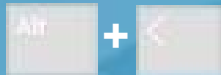


DRAFT	JG Drawn by
1:500 Drawing Scale	19.03.2026 First issued
2600183-ENV-S1-SW-DR-C-0002 Drawing No.	1.2 Revision Letter

Appendix 7

Greenfield Runoff Rate Calculations

For convenience – press “Alt + Left Arrow” to return to the section of the report



Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	100 year (l/s)	4.3	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	✓	Check Discharge Volume	x
Summer CV	0.750	Drain Down Time (mins)	240	2 year (l/s)	1.5		
Winter CV	0.840	Additional Storage (m³/ha)	20.0	30 year (l/s)	3.3		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	10	0	100	40	10	0
30	40	10	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	BFIHost	0.520	Growth Factor 100 year	2.57	Q 30 year (l/s)	3.3
Greenfield Method	FEH	Region	4	Betterment (%)	0	Q 100 year (l/s)	4.3
Positively Drained Area (ha)	0.730	QBar/QMed conversion factor	1.124	QMed	1.5		
SAAR (mm)	629	Growth Factor 2 year	0.89	QBar	1.7		
Host	18	Growth Factor 30 year	1.99	Q 2 year (l/s)	1.5		

Appendix 8

Brownfield Runoff Rate Calculations

For convenience – press “Alt + Left Arrow” to return to the section of the report



Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	100 year (l/s)	150.7	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	✓	Check Discharge Volume	x
Summer CV	0.750	Drain Down Time (mins)	240	2 year (l/s)	46.1		
Winter CV	0.840	Additional Storage (m³/ha)	20.0	30 year (l/s)	116.7		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	10	0	100	40	10	0
30	40	10	0				

Pre-development Discharge Rate

Site Makeup	Brownfield	PIMP (%)	100	Betterment (%)	0	Q 100 year (l/s)	150.7
Brownfield Method	MRM	CV	0.900	Q 2 year (l/s)	46.1		
Contributing Area (ha)	0.730	Time of Concentration (mins)	30.00	Q 30 year (l/s)	116.7		

Appendix 9

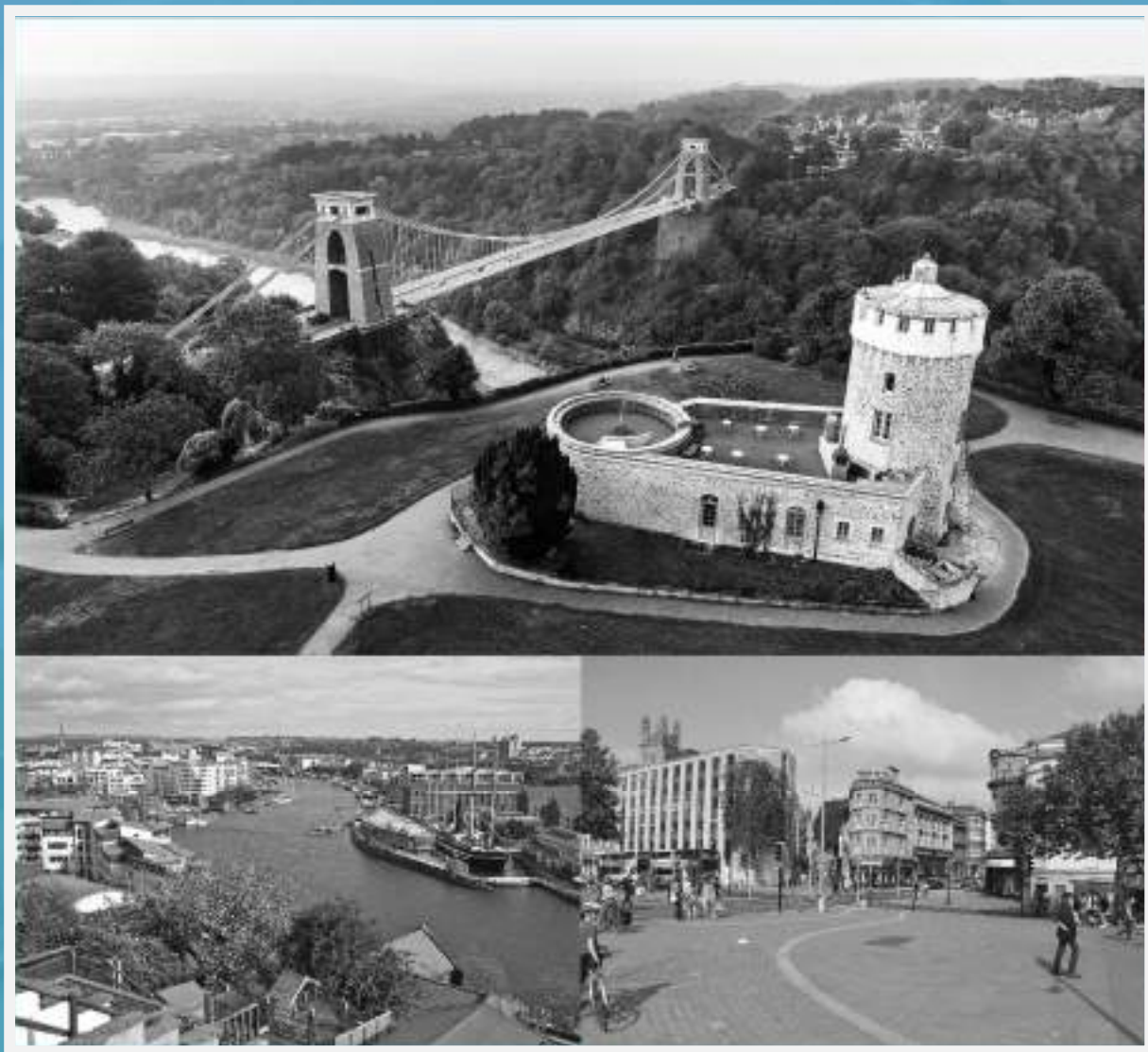
Impermeable Areas Plan

For convenience – press “Alt + Left Arrow” to return to the section of the report



ISO 19650 Filing Notation

Project	
0XXX	Project Number
Originator	
ENV	Enviren
Functional Breakdown	
S1	Planning submission
S2	Technical submission
S3	Construction Information
S4	As built details
Spatial Breakdown	
SW	Southwest
EE	East of England
SE	South East
WM	West Midlands
EM	East Midlands
YO	Yorkshire
NW	North West
NE	North East
LO	London
OT	Other
Form	
DR	Drawing
GR	Diagram
TR	Textual Report
Discipline (relevant)	
C	Civil Engineering
E	Environmental Engineering
G	Ground Engineering
O	Other Discipline
T	Town and Country Planning and Building Control
W	Water Engineering
Z	Multiple Discipline
Number	
000X	Report number



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