CONSULTING ENGINEERS

Higher Standen Drive, Clitheroe

Lancashire County Council

Drainage Strategy & Maintenance Report

Client: Applethwaite Ltd

Our Ref: P26127-DGC-Z1-GF-REP-C-0001-P02

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1. Introduction

This report has been prepared by DGC Consulting Engineers in support of the proposed development at Higher Standen Drive, Clitheroe BB7 1RS.

The proposals comprise the construction of 60 no. of low-rise residential dwellings including associated garages, gardens, driveways and site access road.

The site has a total site area of 2.57 ha and is situated at the southwestern end of Higher Standen Drive (centre at grid reference: SD 74679 40663). It is solely comprised of agricultural fields.

The site is bordered to the North by green areas of Public Open Space (POS), to the East by residential development, to the South by agricultural fields and to the West by a tributary of the River Ribble.

Figure 1: Site Location

This report sets out the proposed surface water drainage strategy, foul drainage approach and, associated operation and maintenance principles for the development.

The drainage proposals have been developed in accordance with the following:

- National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG)
- National Standards for Sustainable Drainage Systems (SuDS) 2025
- CIRIA C753 SuDS Manual
- Building Regulations Part H3

These documents together form the basis of the current review framework adopted by the Lead Local Flood Authority (LLFA) who in the case of this site are Lancashire County Council.

The strategy provided within this report has been prepared based on the latest proposed drainage layout and site levels information. Surface water runoff is to be managed through a combination of plot level source control measures and an online attenuation basin. The collected surface water effluent will then be discharged via gravity, at restricted rate, to the adjacent ordinary watercourse.

The drainage strategy has been developed to provide a policy-compliant solution, ensuring that surface water runoff is managed on site without increasing flood risk elsewhere, whilst also delivering water quality, amenity and biodiversity benefits in line with current SuDS requirements.

2. Site Conditions and Infiltration Feasibility

A Phase II Geoenvironmental Site Assessment has been undertaken by E3P (ref: 17-912-R2-1, November 2024) to assess ground conditions, hydrogeology and the feasibility of infiltration-based drainage for the proposed development. The investigation comprised six window sample probeholes (WS101–WS106), eight mechanically excavated trial pits (TP101–TP108) and the construction of four groundwater and ground gas monitoring installations, advanced on 14th October 2024.

Ground Conditions

No Made Ground was encountered at any exploratory location. Topsoil comprising brown sandy CLAY was identified across the site to depths ranging from 0.15 m to 0.35 m below ground level (bgl).

Beneath the topsoil, superficial deposits were encountered at all exploratory locations to a proven depth of 5.45 m bgl, with the base of the superficial deposits not reached in any hole. The superficial deposits generally comprise brown slightly gravelly slightly sandy CLAY with fine to medium angular to subrounded gravel of sandstone and mudstone, becoming more gravelly with depth. Below approximately 1.20 m bgl, deposits are recorded as grey slightly sandy gravelly CLAY, increasing in stiffness with depth.

The drift geology is designated as a Secondary (Undifferentiated) Aquifer (Devensian Till), underlain by a Secondary A Aquifer in the bedrock geology (Clitheroe Limestone Formation and Hodder Mudstone Formation). The site is not located within a groundwater source protection zone, and no groundwater abstractions are recorded within 1 km of the site.

Groundwater

Groundwater strikes and seepages were recorded at the following locations during the investigation:

WS101: strikes at 1.00 m and 4.00 m bgl within CLAY
WS102: strike at 1.30 m bgl within CLAY
TP104: seepage at 1.00 m bgl, perched within CLAY
TP108: seepage at 1.50 m bgl, perched within CLAY

Subsequent groundwater monitoring (October to November 2024) recorded standing water levels between approximately 1.05 m and 1.64 m bgl across the four monitoring installations (WS101, WS102, WS104 and WS105). E3P note that due to the predominantly low permeability cohesive drift stratum, which is slow to recharge, water levels recorded within the standpipes may be representative of surface water collecting within the installations rather than a true representation of a continuous groundwater table.

Infiltration Feasibility

The E3P geotechnical assessment confirms that soakaway drainage is unlikely to be suitable due to the presence of low permeability cohesive deposits across the site. This conclusion is recorded explicitly within the Developed Geotechnical Risk Register (Section 5.17 of the E3P report), which identifies low permeability soils as a site-wide constraint affecting 100% of the site area.

Particle size distribution testing on selected samples indicates that the near-surface materials comprise predominantly silt and clay fractions (75–78% fines content at TP105 and TP108), with limited sand and gravel. Atterberg limits testing confirmed the clay soils to be of low plasticity (Plasticity Index 14–21%), with low volume change potential.

The combination of cohesive low permeability superficial deposits, shallow perched groundwater and the absence of any permeable stratum within the investigation depth confirms that infiltration-based drainage is not feasible at this site. These findings are consistent with the published BGS drift geology, which identifies the superficial deposits as Devensian Till.

Notwithstanding this, shallow storage and natural losses may occur locally within permeable paving sub-bases and landscaped areas, providing secondary benefits in terms of runoff interception and water quality. These processes do not form part of the primary drainage strategy.

In accordance with the drainage hierarchy, infiltration has therefore been assessed and discounted on justified technical grounds, with the drainage strategy progressing to the next most sustainable discharge option, as detailed in Section 4.

3. Flood Risk Preview (Summary)

A Flood Risk Assessment (FRA) has been prepared separately by Sutcliffe (Ref: 35161-SUT-ZZ-00-RP-C-0001, Rev D, March 2026) for the proposed development at Higher Standen Drive, Clitheroe.

The FRA confirms that the development site is located entirely within Flood Zone 1 as defined by the Environment Agency, indicating a low probability of flooding from rivers or the sea. The site is not within any flood risk area for surface water, groundwater, reservoir or infrastructure failure, and no emergency access or escape routes are required.

Surface water flood risk can be mitigated through the careful consideration of finished floor levels (proposed at 150mm above existing ground levels) and the implementation of an appropriate SuDS drainage scheme. The development will not increase the risk of flooding off site.

This drainage strategy has been developed to align with the overarching conclusions of the FRA, ensuring that surface water runoff is managed on site in a manner consistent with the findings of the flood risk assessment and the requirements of the NPPF and local planning policy.

EA surface water flood mapping indicates a low risk of surface water flooding within the site boundary, limited to the northern and western extents. This risk is considered manageable through the implementation of an appropriate drainage strategy and careful consideration of finished floor levels.

The EA Flood Map for Planning confirms the site is not within a groundwater flood risk area, and the site topography provides sufficient relief to preclude any significant risk of groundwater emergence.

The Sutcliffe FRA should be read in conjunction with this report in the context of its flood risk assessment and evaluation only. The surface water drainage methodology, design standards and technical approach outlined within the FRA have been superseded by the detailed drainage strategy presented within this report, which represents the primary technical reference for drainage design purposes.

4. Drainage Hierarchy & Design Philosophy

4.1 Drainage Hierarchy Review

A full review of the surface water drainage hierarchy has been undertaken in accordance with Standard 1 of the National Standards for SuDS (2025), alongside current national planning policy and LLFA guidance.

The strategy prioritises the management of runoff at source through the use of multifunctional SuDS, before utilising an online attenuation basin to accommodate flows stored to facilitate the implementation of controlled discharge. This ensures that the most sustainable and practicable drainage solutions are adopted across the development.

The assessment of drainage options for the site is summarised below (continued overleaf):

Priority	Drainage Option	Feasibility	Design Response
1	Rainwater harvesting and reuse	Not viable as a site wide solution due to cost, complexity and long term maintenance requirements for domestic systems	Water butts proposed to larger dwellings (typically 4 bed and above) as a proportionate plot level non potable reuse measure
2	Infiltration to ground	Not feasible based on the Phase II Ground Investigation by E3P (ref: 17-912-R2-1), which confirmed the presence of low permeability cohesive deposits and shallow perched groundwater across the site	Excluded as a primary drainage solution on justified technical grounds
3	Source control and interception	Feasible across the development	Permeable paving to private drives and parking areas to provide interception of the first 5 mm of rainfall at source

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Priority	Drainage Option	Feasibility	Design Response
4	Online attenuation basin	Feasible and required to accommodate storage requirement.	Attenuation provided via an online attenuation basin integrated within the drainage network
5	Discharge to ordinary watercourse	Feasible and preferred in line with drainage hierarchy	Controlled discharge via one outfall to adjacent ordinary watercourse, a tributary of the River Ribble
6	Discharge to surface water sewer	Feasible if required as surface water sewer is located south of the site.	Not proposed
7	Discharge to combined sewer	Not likely to be feasible as a combined sewer has not been found to be within close proximity of the site.	Not proposed

The hierarchy review confirms that infiltration has been assessed and discounted on site-specific technical grounds, with the strategy adopting source control and controlled discharge to the receiving watercourse as the most sustainable practicable solution. Full design detail is set out in Section 5.

4.2 Rainwater Harvesting and Reuse Assessment

In accordance with the surface water drainage hierarchy, rainwater harvesting and reuse has been considered as the first stage in the management of runoff.

A site wide rainwater harvesting system has been reviewed, however this has been discounted due to the nature and scale of the proposed residential development. The inclusion of communal or building level reuse systems is not considered proportionate and would introduce additional complexity in terms of installation, operation and long-term maintenance.

Notwithstanding this, opportunities for small scale reuse have been incorporated within the scheme. Water butts are proposed to larger residential plots, typically four-bedroom dwellings and above, to allow for the capture and reuse of roof runoff for non-potable uses such as garden watering.

This approach provides a simple and proportionate source control measure which contributes to runoff reduction and supports the wider SuDS strategy.

Rainwater harvesting has therefore been considered in full and incorporated where practical, in line with current SuDS guidance.

4.3 Source Control and First 5 mm Interception Strategy

Lancashire County Council, as the Lead Local Flood Authority (LLFA), requires that the first 5 mm of rainfall is intercepted at source as a minimum standard for new residential development, in accordance with the National Standards for Sustainable Drainage Systems (2025) and the LLFA's expectations around source control and runoff reduction. This strategy has been designed to demonstrate clear compliance with this requirement.

The drainage strategy adopts a SuDS first approach, with surface water managed at source wherever practicable before entering the wider drainage network, in accordance with Standard 2 of the National Standards for Sustainable Drainage Systems (2025).

Source control is provided across the development through the use of permeable paving within private drives and individual parking spaces. These features are designed to intercept and manage the first 5 mm of rainfall falling directly onto the permeable paved surfaces at plot level. Permeable paving has not been applied to shared private drives. The total permeable paved area across the development is approximately 1,971.77 m^2, covering all private drives and parking spaces, which represent the predominant impermeable area at plot level.

The permeable paving systems are formed with unlined sub-bases, providing storage capacity for rainfall from frequent and lower intensity events. As confirmed by site investigation (see Section 2), infiltration rates into the underlying cohesive strata are low; however, stored water dissipates gradually over time through a combination of slow percolation into the underlying strata and evapotranspiration losses. Given the low permeability soils confirmed by the E3P Phase II investigation, this dissipation may be slow, but the sub-base storage volume is sufficient to ensure that the retained first 5 mm does not return to the piped network under normal operating conditions. For the majority of rainfall events, the first 5 mm is therefore retained at source and does not contribute to downstream flow.

Roof drainage discharges directly to the formal surface water drainage network as routing it through permeable paving would introduce sediment loading and clogging risk.

Where rainfall exceeds the interception threshold, excess runoff from permeable paved areas is conveyed via the piped surface water drainage network toward downstream attenuation features. These elements are designed to manage runoff from larger storm events only.

Due to practical and ownership constraints, interception of the first 5 mm of rainfall from adoptable highway areas is not considered feasible. Highway runoff is therefore conveyed directly to the piped drainage network via conventional drainage features. Notwithstanding this, the overall strategy maximises interception across private plots, which represent the majority of impermeable area.

4.4 Gravity Led Surface Water Appraisal

The proposed drainage strategy follows a clear SuDS management train, with surface water managed sequentially from source through to discharge. This approach provides interception, conveyance, attenuation and water quality treatment in accordance with current SuDS guidance.

The proposed SuDS principles are applied consistently across the drainage network.

The treatment and flow path can be summarised as follows (please see overleaf):

Stage	SuDS Component	Function
1	Permeable paving (private drives and parking areas)	Source control, interception of first 5 mm rainfall, initial water quality treatment
2	Conventional drainage network (pipes and chambers)	Conveyance of residual runoff exceeding interception threshold
4	Online attenuation basin	Primary storage, conveyance, water quality polishing and visual integration
5	Flow control (Hydro-Brake® or equivalent)	Restriction of discharge to greenfield equivalent rate
6	Outfall to receiving watercourse	Final discharge to tributary of River Ribble

This treatment train ensures that runoff is managed progressively, with the greatest level of control provided at source, followed by staged management through the drainage network prior to discharge.

4.5 Climate Change and Design Standards

The proposed drainage strategy has been developed to account for the long-term impacts of climate change and urban creep, in accordance with current national guidance and Environment Agency (EA) climate change allowances.

The site is located within the Ribble Management Catchment, where peak rainfall allowances have been applied based on the latest EA guidance. For residential development with a design life of 100 years, the upper end climate change allowance has been adopted to ensure a precautionary design approach.

In accordance with current guidance, this equates to:

- 40% increase in rainfall intensity for the 1 in 30 yr storm event
- 50% increase in rainfall intensity for the 1 in 100 yr storm event

These allowances reflect the anticipated increase in storm intensity over the lifetime of the development and ensure that the drainage strategy remains resilient under future climate conditions.

In addition, a 10% allowance for urban creep* has been incorporated to account for potential increases in impermeable area over time, including extensions, hardstanding and changes to private plots.

** The 10% urban creep allowance has been applied to dwellings and associated garages only, in accordance with established design principles for residential development and consistent with Lancashire County Council (LCC) LLFA expectations and, has not been applied to highway or other adoptable areas.*

The inclusion of both climate change and urban creep allowances ensures that the proposed drainage strategy provides a future-proof solution, maintaining performance and preventing increased flood risk both on site and elsewhere over the lifetime of the development.

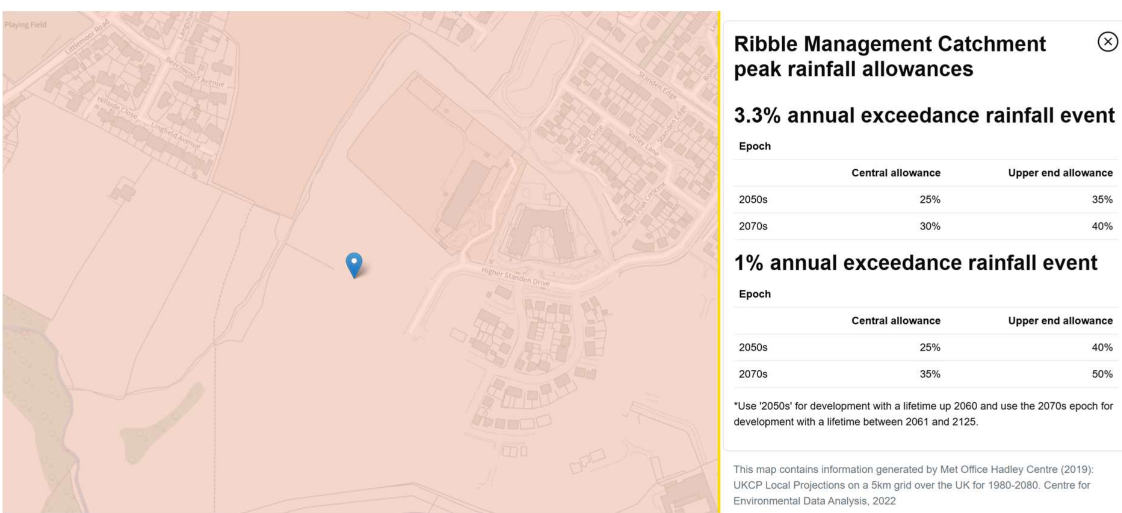

Figure 2: Climate Change Allowances

5. Hydraulic Design and Surface Water Management

5.1 Design Inputs and Catchment

The proposed surface water drainage design has been developed in accordance with the National Standards for Sustainable Drainage Systems (2025) and supporting CIRIA C753 guidance, consistent with the review framework currently applied by the LLFA.

Hydraulic simulations have been undertaken using Site3D, adopting a precautionary runoff methodology based on the defined impermeable contributing areas across the drainage network.

The hydraulic model applies the following conservative input assumptions:

- Volumetric runoff coefficient (C_v) = 1.0 (summer and winter)
- 10% urban creep allowance*
- Critical duration testing across all required design storm events

A volumetric runoff coefficient (Cv) of 1.0 has been applied to all impermeable contributing areas in both summer and winter conditions. This is a conservative assumption that assumes a 100% runoff response with no losses, providing a robust and precautionary basis for storage sizing and network design.

Site3D employs a runoff routing methodology based on contributing impermeable areas and defined invert levels, applying rational method principles and critical duration storm testing to size storage volumes and confirm hydraulic performance across the network. The software does not utilise a separate user-defined MADD (Maximum Allowable Discharge Deviation) factor input; losses are inherently incorporated within its runoff calculation process and therefore no additional reduction in runoff volume has been applied.

The site drains via a single gravity drainage network to its outfall. The contributing impermeable area is summarised as follows:

- Contributing impermeable area: 2.05 ha (including 10% urban creep*)

The network has its own attenuation provision and flow control arrangement prior to discharge to the receiving watercourse.

This catchment approach ensures that runoff is managed efficiently in accordance with the natural fall of the site, allowing attenuation features, comprising an online attenuation basin and treatment features, to be optimised locally within the network.

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Full design standards and climate change allowances are set out in Section 4.5. Detailed hydraulic results are presented in Sections 5.2 and 5.3.

Hydraulic modelling confirms that no flooding occurs within the drainage system for all design events up to and including the 1 in 100 yr plus 50% climate change storm. All pipe and chamber levels, storage volumes and flow control settings have been verified through critical duration storm testing, with results presented in Appendix D.

5.2 Greenfield Runoff and Flow Control

Greenfield runoff for the site has been established using the IH124 method, based on the defined site characteristics and the total contributing development catchment areas for the network.

The allowable greenfield discharge rate has been derived based on the contributing catchment area draining to the single site outfall. The QBAR value of 9.38 l/s/ha has been derived using the IH124 method, based on the relevant hydrological descriptors for the site catchment. Full IH124 calculations are included in Appendix D.

It is noted that the total gross site area is 2.57 ha; however, the contributing impermeable catchment area to the outfall is 2.05 ha (including 10% urban creep*). This reflects the exclusion of the online attenuation basin and areas of public open space (POS) from the impermeable runoff calculation, as these areas do not generate meaningful impermeable runoff. QBAR has therefore been applied to the contributing development area only, representing the portion of the site draining to the single outfall, which is considered the appropriate and conservative basis for flow control sizing.

A QBAR value of 9.38 l/s/ha has been applied across the site. Based on the contributing development catchment areas, the greenfield runoff rate has been calculated as follows:

Development Catchment Area	**QBAR**	**Calculated Greenfield Rate**	**Proposed Discharge Rate**
2.05 ha	9.38 l/s/ha	19.229 l/s	18.5 l/s

The proposed discharge rates therefore align with the calculated greenfield QBAR rate with flows restricted prior to discharge to the receiving ordinary watercourse.

Hydraulic modelling confirms that the drainage networks and attenuation features are designed to accommodate all events up to and including the 1 in 100 yr storm event with 50% climate change, with no flooding within the system.

Overall, the proposed drainage strategy restricts discharge to greenfield equivalent rates, provides betterment during extreme rainfall events and ensures that runoff is managed on site without increasing flood risk elsewhere.

Figure 3: Greenfield Runoff

5.3 Attenuation Provision

The proposed surface water drainage strategy incorporates an online attenuation basin and treatment features to manage runoff from the development.

Attenuation has been provided in accordance with the contributing impermeable area and discharge requirements.

<u>Network</u>

Attenuation for the network is based on a contributing impermeable area of 2.05 ha, including a 10% allowance for urban creep*.

Attenuation storage is provided via an online attenuation basin, which accommodates a storage volume of approximately 735 m^3, sized to accommodate all storm events up to and including the 1 in 100 yr return period event with 50% climate change, in accordance with current design standards.

<u>Overall Attenuation Strategy</u>

The attenuation strategy has been developed to ensure that runoff from the development is effectively managed on site, with flows attenuated prior to discharge and restricted to the calculated greenfield runoff rate.

The online attenuation basin accommodates the required attenuation volume, whilst providing water treatment within the system.

Hydraulic modelling confirms that the attenuation provision ensures no flooding occurs within the drainage system for all events up to and including the 1 in 100 yr storm event return period with 50% climate change.

This approach provides a deliverable, policy-compliant solution, balancing site constraints with the requirements for effective surface water management, water quality treatment and long-term system resilience.

5.4 Conveyance and Watercourse Outfall

Surface water runoff is conveyed through the development via a gravity-fed drainage network, reflecting the natural east-to-west topography of the site and the proposed layout. The network has been designed to provide efficient and controlled conveyance of runoff from source through to the point of discharge.

Runoff from roof drainage is collected via conventional guttering and downpipes, discharging directly into the piped surface water network. Runoff from permeable paved private drives and parking spaces is collected via the sub-base drainage layer, entering the piped network only once the interception threshold has been exceeded. Highway runoff is intercepted via gully pots located at regular intervals along the adopted road corridors, connecting to the piped drainage network.

The piped network follows the natural topography of the site, with flows directed generally from east to west toward the online attenuation basin located at the western end of the site. The network has been designed with continuous positive gravity falls throughout, ensuring reliable operation without the need for any pumped surface water infrastructure and avoiding localised low points, surcharging or ponding under design conditions.

The attenuation basin acts as the primary storage and control point for the entire site catchment, with all flows passing through the basin prior to restricted discharge to the receiving watercourse.

Runoff from private and adoptable areas is collected via conventional drainage infrastructure, including gullies, pipes and manholes, before being directed toward the downstream attenuation feature. The drainage system has been designed to maintain positive gravity falls throughout, ensuring reliable operation without the need for pumped surface water infrastructure.

Following attenuation, flows are conveyed to the proposed point of connection at the adjacent ordinary watercourse to the West of the site.

Discharge is controlled via a Hydro-Brake® flow control device located downstream of the attenuation feature, ensuring that runoff is restricted to the calculated greenfield runoff rate prior to entering the receiving watercourse.

The outfall is formed as a headwall structure, providing a stable interface between the drainage network and the receiving watercourse. These structures are designed to prevent erosion, control flow conditions and ensure long term operational performance.

The receiving watercourses has been identified as the most appropriate discharge point in accordance with the drainage hierarchy, representing the highest practicable tier following the demonstrated infeasibility of infiltration.

All outfalls will be subject to the relevant land drainage consents and approvals from the LLFA and associated regulatory bodies. Detailed outfall design, including headwall specification and erosion protection measures, will be confirmed at the detailed design stage.

This approach ensures that surface water runoff is conveyed efficiently through the site and discharged in a controlled manner, without increasing flood risk elsewhere, in accordance with current policy and SuDS guidance.

5.5 Exceedance and Overland Flow

The surface water drainage strategy has been developed to ensure that all runoff from events up to and including the 1 in 100 yr storm event return period with 50% climate change is contained within the drainage system, with no flooding predicted.

For events exceeding the design capacity of the system, exceedance flows have been considered and managed through the proposed site layout and levels strategy.

The site levels have been designed to direct exceedance flows away from built development and toward designated low points within the site, including road corridors and landscaped areas. These routes provide safe overland flow pathways, ensuring that any excess water is conveyed without risk to property.

Finished floor levels are set above surrounding ground levels, providing an appropriate freeboard and ensuring that properties remain protected during extreme rainfall events.

Exceedance flows follow the natural topography of the site, ultimately routing toward the downstream attenuation feature and receiving ordinary watercourse. This ensures continuity of flow paths and avoids uncontrolled ponding within developed areas.

The proposed approach ensures that:

- no flooding occurs for all events up to and including the 1 in 100 yr plus 50% climate change storm event
- exceedance flows are safely managed on the surface for more extreme events
- runoff is directed away from properties and critical infrastructure
- flow routes remain consistent with the overall drainage strategy

This provides a resilient drainage design, ensuring that flood risk is appropriately managed both within the site and for the surrounding area.

5.6 SuDS Integration, Amenity and Biodiversity

The proposed drainage strategy has been developed to provide a multifunctional SuDS solution that delivers not only attenuation and runoff control, but also wider water quality, amenity and biodiversity benefits in accordance with CIRIA C753 and current LLFA requirements.

Source control is provided through permeable paving to private drives and parking areas, intercepting and treating runoff at plot level as described in Section 4.3.

At site control level, the online attenuation basin and shallow SuDS treatment features (see Section 5.3) integrate with the wider landscape strategy through shallow side slopes, accessible maintenance margins and opportunities for marginal planting and native landscaping, contributing positively to visual amenity, habitat creation and biodiversity.

Rainwater harvesting has been assessed and addressed in Section 4.2.

The proposed SuDS measures and wider multifunctional benefits are summarised overleaf.

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SuDS Compliance and Multifunctional Benefits

SuDS Requirement	Design Response	Compliance
Runoff destination hierarchy	Infiltration ruled out by E3P Phase II Ground Investigation — low permeability Devensian Till confirmed across the full investigation depth. Controlled discharge to adjacent ordinary watercourse.	✓ Compliant
First 5 mm interception	Plot level interception via permeable paving to private hardstanding areas	✓ Compliant
Peak flow control	Restricted to 19.0 l/s via a Hydro-Brake® flow control device	✓ Compliant
Volume control	Attenuation provided via an online attenuation basin with supplementary SuDS attenuation and treatment features	✓ Compliant
Water quality	Treatment train via permeable paving, conveyance network, SuDS features and controlled discharge	✓ Compliant
Amenity	SuDS features integrated within landscaped areas with accessible and visually positive design	✓ Compliant
Biodiversity	Opportunity for native planting and habitat creation within SuDS feature margins	✓ Compliant
Water reuse	Formal harvesting not proportionate, water butts can be incorporated to larger dwellings where appropriate	✓ Compliant

5.7 Water Quality Management

A water quality assessment has been undertaken in accordance with the Simple Index Approach (SIA) set out in CIRIA C753. The site is classified as Low pollution hazard land use (residential roofs and low-traffic driveways/access roads), with the treatment train comprising an online attenuation basin as the primary SuDS component and pervious paving as the secondary component. The SIA confirms that all total mitigation indices meet or exceed the required pollution hazard indices for TSS, metals and hydrocarbons, demonstrating sufficient water quality mitigation. The full SIA calculations are included in Appendix b.

6. Foul Water Drainage

The proposed foul water drainage strategy has been developed in accordance with current standards and in consultation with the statutory undertaker.

Foul flows from the development will be collected via a conventional gravity drainage network serving the proposed dwellings. Due to site levels and the location of the receiving public sewer, a fully gravity discharge is not achievable across the site.

A foul pumping station is therefore proposed to serve the development. The system will operate as follows:

- Foul flows are conveyed via gravity to a central pumping station
- The pumping station will comprise duty and standby pumps to ensure operational resilience
- Flows will be pumped via a rising main to a downstream connection point
- Discharge will then continue via gravity to the existing public foul sewer

The final connection to the public sewer will be made via a Section106 agreement with the statutory undertaker.

The pumping station will be designed in accordance with current industry standards and will include appropriate emergency storage capacity to accommodate flows in the event of pump failure. Ancillary infrastructure such as non-return valves, isolation valves and air release valves will be incorporated as required.

At this stage, the foul drainage strategy is considered feasible based on the available information. Detailed design, including confirmation of pipe levels, pumping station specification and connection details, will be undertaken at the detailed design stage in agreement with the statutory undertaker.

This approach ensures that foul flows from the development are managed effectively and discharged to the public sewer network in a safe and controlled manner.

7. Construction Phase Surface Water Management

Surface water management during the construction phase will be undertaken in accordance with best practice and will form part of the Construction Environmental Management Plan.

The objective during construction is to ensure that surface water runoff is managed in a controlled manner, preventing sediment laden flows, debris and pollutants from entering the receiving watercourses or existing drainage infrastructure.

During the construction phase, the drainage strategy will be implemented in a staged manner, with temporary measures introduced early in the programme to manage runoff prior to completion of the permanent system.

The following principles will be adopted:

- <u>Minimisation of runoff generation</u>
  Construction activities will be phased where practicable to limit exposed areas and reduce runoff volumes.

- <u>Temporary surface water management</u>
  Temporary drainage measures, including cut off ditches, swales and settlement areas, will be utilised to intercept and control runoff.

- <u>Sediment control</u>
  Silt fences, straw bales or equivalent measures will be installed where required to prevent migration of suspended solids.

- <u>Protection of watercourses</u>
  Measures will be implemented to ensure that no direct discharge of untreated runoff enters the adjacent ditch or Fine Janes Brook.

- <u>Pollution prevention</u>
  Storage of fuels, oils and chemicals will be undertaken in designated areas with appropriate containment to prevent accidental spillage.

- <u>Wheel washing and site access control</u>
  Where required, wheel washing facilities will be provided to reduce tracking of sediment onto the public highway.

Temporary drainage measures will be regularly inspected and maintained throughout the construction period to ensure their continued effectiveness.

The detailed construction phase surface water management strategy will be developed by the appointed contractor and agreed with the relevant stakeholders prior to commencement of works.

This approach ensures that surface water runoff is appropriately managed during construction, minimising environmental impact and preventing increased flood risk both on site and downstream.

8. Operation and Maintenance Manual

A long-term maintenance regime will be implemented for all private, shared and adoptable drainage features to ensure the continued hydraulic, environmental and operational performance of the proposed drainage infrastructure for the lifetime of the development.

The proposed drainage system includes plot level source control features, surface water and foul sewer networks, site control SuDS infrastructure and an online attenuation basin. Each element will require routine inspection and maintenance to preserve hydraulic performance, water quality treatment, amenity value and biodiversity function.

The responsibilities identified below reflect the current anticipated adoption strategy. Final ownership and maintenance responsibilities will be confirmed at detailed design stage through agreement with the relevant adopting authority, highway authority, management company and, where applicable, any NAV provider.

All maintenance activities should be undertaken in accordance with CIRIA C753 The SuDS Manual to ensure long term performance of the drainage system. See below and continued overleaf, the associated maintenance schedule.

Maintenance Schedule

Drainage Asset	Maintenance Activity	Frequency	Responsibility
Permeable paving to private drives	Inspect for clogging, debris, ponding and surface wear. Sweep or vacuum clean to maintain permeability	Twice yearly and after severe storms	Private homeowner / management company
Water butts, where provided	Inspect outlets, overflows and condition, remove debris and confirm operation	Twice yearly	Private homeowner
Surface water sewer network	Inspect manholes and pipework, remove blockages, CCTV where required	Annually and after severe storms	Relevant adopting authority / management company
Highway gullies	Gully cleansing, silt removal and outlet checks	Every 6 months and after severe storms	Highway authority / adopting authority

Drainage Asset	**Maintenance Activity**	**Frequency**	**Responsibility**
Hydro-Brake® flow control chamber	Inspect control unit, remove debris and confirm operation	Annually and after severe storms	Relevant adopting authority / management company
Shallow SuDS attenuation and treatment features	Inspect inlets and outlets, remove silt, manage vegetation, maintain side slopes and confirm freeboard	Quarterly and after severe storms	Relevant adopting authority / management company
Outfall to watercourses	Inspect for blockage, scour and structural condition	Every 6 months and after severe storms	Relevant adopting authority / management company
Online attenuation basin	Inspect basin inlet and outlet structures, remove silt and debris, manage vegetation, maintain side slopes and confirm freeboard. Check flow control device operation.	Annually	Management company / adopting authority
Foul sewer network	Routine inspection and blockage clearance	Annually and as required	Relevant sewerage undertaker / NAV
Foul connection chamber	Inspect structure and flow conditions	Annually	Relevant sewerage undertaker / NAV

The above maintenance regime ensures that the hydraulic, water quality, amenity and biodiversity performance of the drainage system is retained for the long term, whilst providing a clear and practical framework for future adoption and site management.

Overall, the proposed maintenance strategy is considered proportionate, maintainable and aligned with current LLFA expectations.

9. Conclusion

The proposed surface water and foul water drainage strategy for the residential development at Higher Standen Drive, Clitheroe has been developed as a sustainable, site-specific and policy-compliant solution in support of the planning submission.

Ground conditions and infiltration feasibility have been assessed by E3P as part of the Phase II Geoenvironmental Site Assessment (ref: 17-912-R2-1, November 2024), which confirmed that infiltration-based drainage is not feasible due to the prevailing low permeability Devensian Till deposits and shallow perched groundwater conditions (see Section 2). The strategy therefore follows the drainage hierarchy by maximising source control and attenuation prior to controlled discharge.

Plot level interception of the first 5 mm of rainfall is provided through permeable paving to private drives and water butts to larger dwellings, as described in Sections 4.2 and 4.3.

The development is drained via a single surface water network operating under gravity and discharging to the receiving watercourse.

Residual runoff is attenuated via an online attenuation basin and shallow SuDS treatment features, accommodating all storm events up to and including the 1 in 100 yr plus 50% climate change return period, with discharge restricted to 18.5 l/s via a Hydro-Brake® flow control device (see Sections 5.2 and 5.3).

Water quality is addressed through the SuDS treatment train, which has been assessed in accordance with the CIRIA C753 SIA and shown to meet the required mitigation indices for all pollutant categories (see Section 5.7). The SuDS features also provide amenity and biodiversity benefits in line with current policy.

Construction phase surface water management will be addressed through a Construction Environmental Management Plan (see Section 7).

A long-term maintenance strategy aligned with CIRIA C753 has been prepared covering all drainage assets (see Section 8).

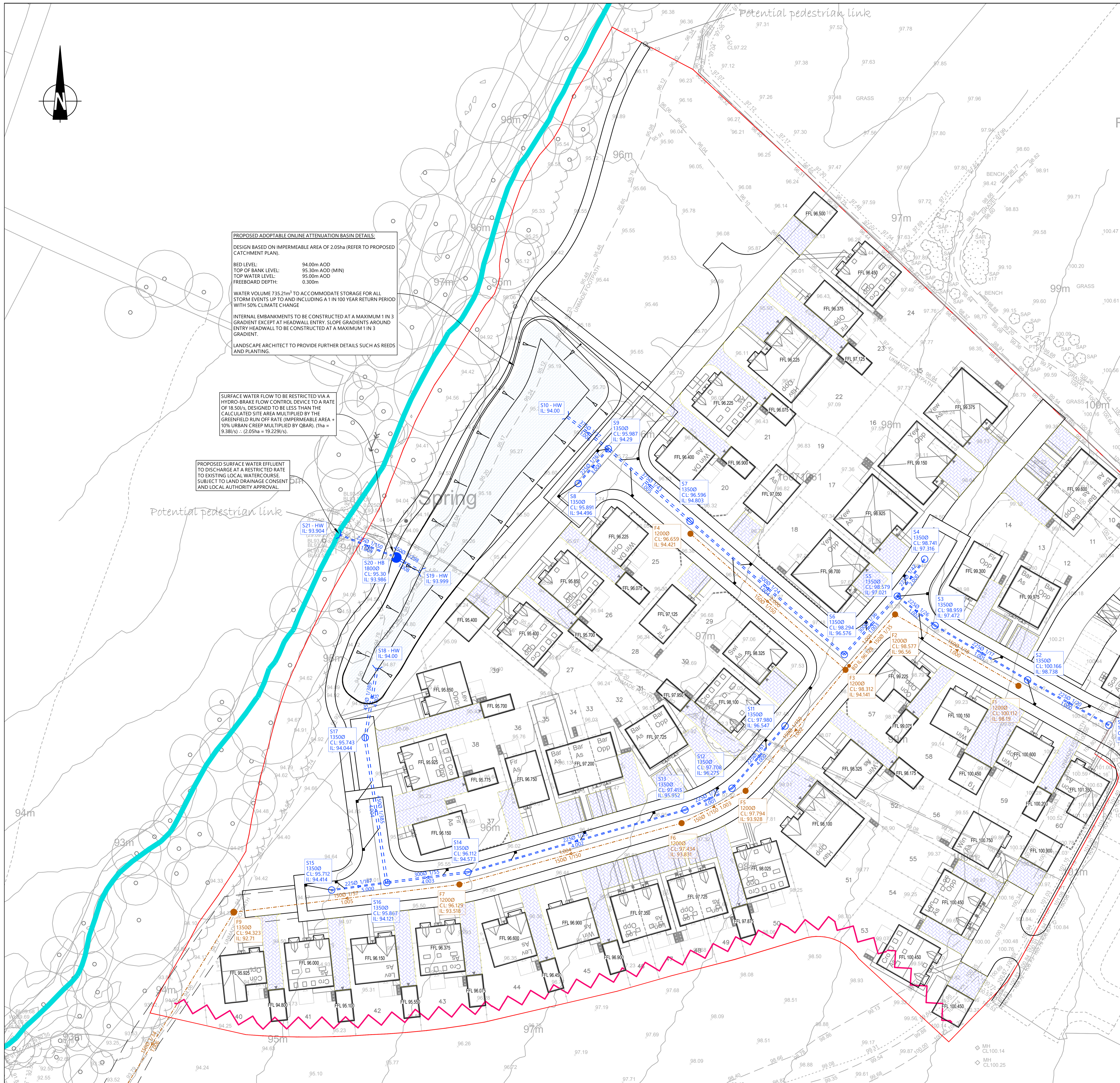
The proposed drainage strategy demonstrates compliance with:

- NPPF
- PPG
- Building Regulations Part H

- CIRIA SuDS Manual C753
- Design and Construction Guidance
- National Standards for Sustainable Drainage Systems (2025)
- LLFA drainage requirements
- Plot level first 5 mm interception principles
- 1 in 100 yr plus climate change design criteria
- SIA water quality requirements
- Long term operation and maintenance principles

Overall, the proposed development can be drained in a sustainable, maintainable and policy compliant manner without increasing flood risk on site or elsewhere and is therefore considered suitable for support by the Local Planning Authority and LLFA.

Appendix A) P26127-DGC-Z1-GF-DR-C-0001-P04 - Drainage Strategy



FIRST 5 MM INTERCEPTION NOTE

THE INTERCEPTION OF THE FIRST 5 MM OF RAINFALL HAS BEEN CONSIDERED ON A SUB CATCHMENT BASIS IN ACCORDANCE WITH CURRENT SUDS GUIDANCE.

PRIVATE DRIVEWAYS AND PARKING AREAS ARE PROPOSED AS PERMEABLE PAVING WITH UNLINED SUB BASES, PROVIDING SOURCE CONTROL AND INTERCEPTION STORAGE AT PLOT LEVEL. THESE FEATURES CAPTURE RUNOFF FROM FREQUENT RAINFALL EVENTS, WITH A VERY LOW DEGREE OF PERMEABILITY ALLOWING FOR GRADUAL DISSIPATION.

ROOF DRAINAGE IS NOT ROUTED THROUGH PERMEABLE PAVING AND WILL DISCHARGE DIRECTLY TO THE FORMAL SURFACE WATER DRAINAGE NETWORK.

ADOPTABLE HIGHWAY AND SHARED SURFACES ARE NOT ROUTED VIA INTERCEPTION FEATURES DUE TO SITE CONSTRAINTS, INCLUDING LIMITED CORRIDOR SPACE AND NO OPPORTUNITY TO DISCHARGE TO PRIVATE LAND.

THE OVERALL STRATEGY MAXIMISES SOURCE CONTROL WHERE PRACTICABLE AND PROVIDES A PROPORTIONATE APPROACH TO INTERCEPTION.

SUDS HIERARCHY NOTE:

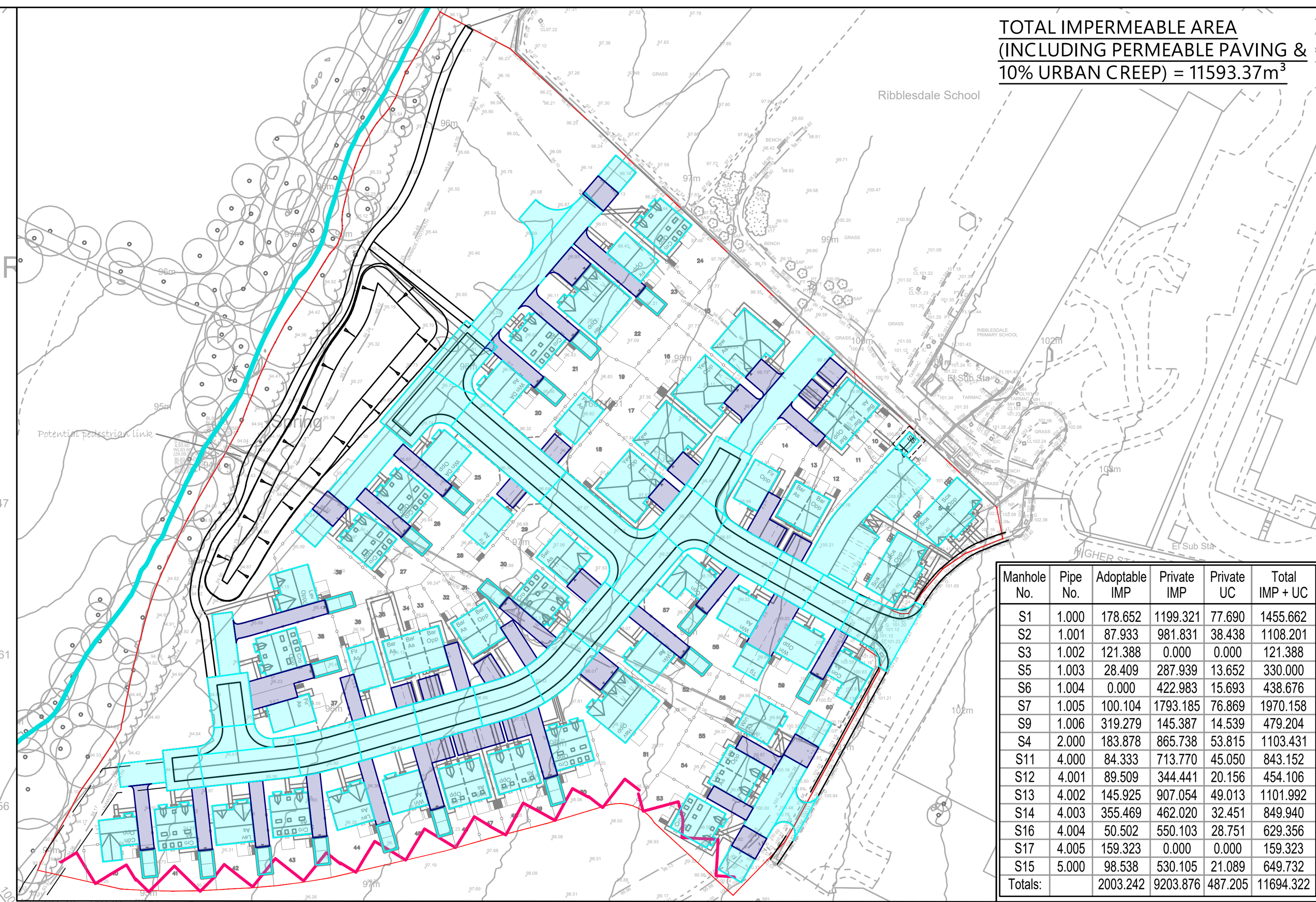
1. RAINWATER HARVESTING AND NON POTABLE REUSE: CONSIDERED AS FIRST PRIORITY, HOWEVER NOT PROPORTIONATE FOR THE PROPOSED RESIDENTIAL LAYOUT AND THEREFORE NOT TAKEN FORWARD.
2. INFILTRATION TO GROUND: EXCLUDED DUE TO CONFIRMED COHESIVE CLAY STRATA AND NON VIABLE INFILTRATION CONDITIONS.
3. RAINFALL INTERCEPTION AND SOURCE CONTROL: TO BE PROVIDED AS THE PRIMARY SUDS MEASURE THROUGH PLOT LEVEL FEATURES, INCLUDING PERMEABLE PAVING AND OTHER SOURCE CONTROL FEATURES WHERE APPLICABLE.
4. DISCHARGE TO WATERCOURSE: PREFERRED FINAL DISCHARGE ROUTE VIA THE ORDINARY WATERCOURSE LOCATED TO THE WEST OF THE SITE BOUNDARY.
5. DISCHARGE TO SEWER: NOT REQUIRED FOR THE PROPOSED SURFACE WATER DRAINAGE STRATEGY AND THEREFORE EXCLUDED.

DEVELOPABLE AREA SURFACE WATER NETWORK CATCHMENT -SCALE- 1:1000

SURFACE WATER FLOW TO BE RESTRICTED VIA A HYDRO BRAKE FLOW CONTROL DEVICE TO 18.5 l/s, CALCULATED AGAINST THE GREENFIELD RUNOFF RATE BASED ON THE TOTAL DEVELOPMENT AREA (19965m^2), USING QBAR OF 9.38 l/s/Ha, PROVIDING A DERIVED DISCHARGE RATE OF 19.229 l/s.

THE ATTENUATION NETWORK HAS BEEN DESIGNED BASED ON THE IDENTIFIED IMPERMEABLE AREA CATCHMENT ONLY, WITH CV VALUES CONSERVATIVELY SET TO 1.0 IN BOTH SUMMER AND WINTER SCENARIOS TO ALLOW FOR ALL OTHER POTENTIAL CONTRIBUTING AREAS WITHIN THE WIDER DEVELOPMENT EXTENT. ADDITIONAL DETAILED DESIGN MEASURES, INCLUDING OVERLAND FLOW ROUTES AND LAND DRAINAGE INTERCEPTION WHERE APPLICABLE, SHALL BE DEVELOPED AT POST PLANNING DETAILED DESIGN STAGE TO CONFIRM THE FINAL SURFACE WATER MANAGEMENT STRATEGY.

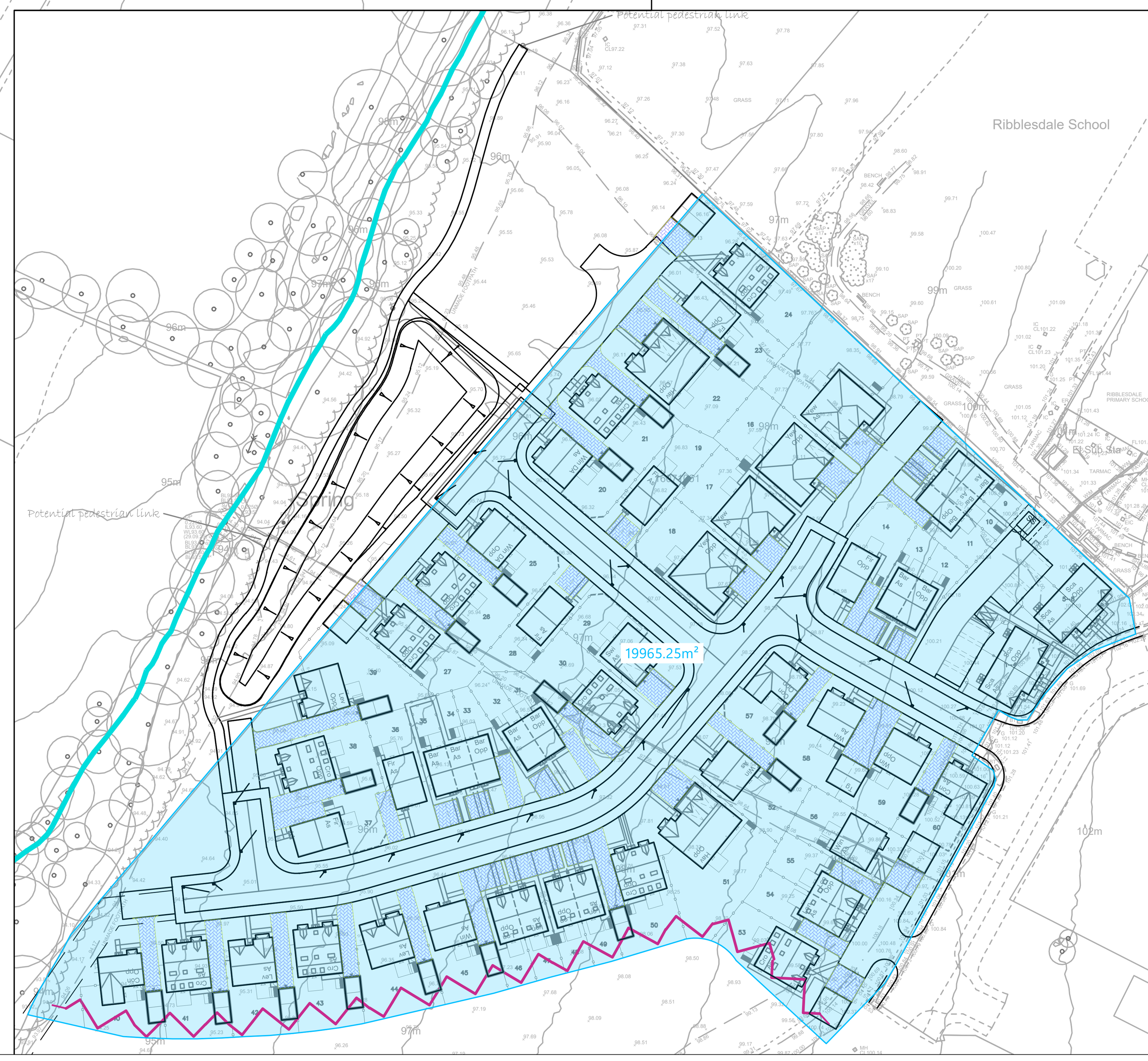
TOTAL IMPERMEABLE AREA (INCLUDING PERMEABLE PAVING & 10% URBAN CREEP) = 11593.37m^3



Manhole No.	Pipe No.	Adoptable IMP	Private IMP	Private UC	Total IMP + UC
S1	1.000	178.652	1199.321	77.690	1455.662
S2	1.001	87.933	981.831	38.438	1108.201
S3	1.002	121.388	0.000	0.000	121.388
S5	1.003	28.409	287.939	13.652	330.000
S6	1.004	0.000	422.983	15.693	438.676
S7	1.005	100.104	1793.185	76.869	1970.158
S9	1.006	319.279	145.387	14.539	479.204
S4	2.000	183.878	865.738	53.815	1103.431
S11	4.000	84.333	713.770	45.050	843.152
S12	4.001	89.509	344.441	20.156	454.106
S13	4.002	145.925	907.054	49.013	1101.992
S14	4.003	355.469	462.020	32.451	849.940
S16	4.004	50.502	550.103	28.751	629.356
S17	4.005	159.323	0.000	0.000	159.323
S15	5.000	98.538	530.105	21.089	649.732
Totals:		2003.242	9203.876	487.205	11694.322

KEY:

S1 1200Ø CL: 00.00 IL: 00.00	ADOPTABLE SURFACE WATER SEWER (SECTION 104 WATER INDUSTRY ACT)
F3 1200Ø CL: 00.00 IL: 00.00	ADOPTABLE FOUL WATER SEWER (SECTION 104 WATER INDUSTRY ACT)
	ADOPTABLE HYDRO-BRAKE FLOW CONTROL CHAMBER
	ADOPTABLE SW HEADWALL
	ADOPTABLE ROAD GULLY & 150mmØ CONNECTION
FW	EXISTING FOUL WATER SEWER
SW	EXISTING SURFACE WATER CULVERT
	WATERCOURSE (TRIBUTARY OF THE RIVER RIBBLE)
	PERMEABLE PAVING



NOTES:

1. DO NOT SCALE THIS DRAWING.
2. THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY AND SHOULD NOT BE USED FOR CONSTRUCTION.
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS, ARCHITECTS AND SPECIALIST DESIGN DRAWINGS AND DETAILS.
4. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE. ALL LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.
5. ALL DRAINAGE WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH DESIGN AND CONSTRUCTION GUIDANCE FOR FOUL AND SURFACE WATER SEWERS OFFERED FOR ADOPTION UNDER THE CODE FOR ADOPTION AGREEMENTS FOR WATER AND SEWERAGE COMPANIES OPERATING WHOLLY OR MAINLY IN ENGLAND ("THE CODE")

DRAINAGE DESIGN NOTES:

1.1. SURFACE WATER DISCHARGE RATES SET AT A PRACTICAL MINIMUM LIMIT BASED ON GREENFIELD RUN-OFF CALCULATIONS: TOTAL IMPERMEABLE AREAS MULTIPLIED BY QBAR GIVING A TOTAL SITE DISCHARGE RATE.

1.2. DISCHARGE RATES TO BE CONFIRMED BY LEAD LOCAL FLOOD AUTHORITY (LLFA).

1.3. SURFACE WATER HYDRAULIC SIMULATIONS ARE IN ACCORDANCE WITH LANCASHIRE LLFA STANDARDS. APPLYING A RUN-OFF COEFFICIENT OF 1 AND MADD FACTOR OF 0.

1.4. APPROPRIATE SUDS REQUIRED IN ORDER TO ENSURE ADEQUATE TREATMENT OF SURFACE WATER FLOWS PRIOR TO DISCHARGE IN ACCORDANCE WITH THE SIMPLE INDEX METHOD AS SET OUT IN THE SUDS MANUAL (CIRIA C753).

1.5. ALL MANHOLE COVERS TO BE SET 1m AND MANHOLES TO BE A MINIMUM OF 0.5m FROM THE KERBLINE.

1.6. INCOMING LATERAL CONNECTIONS TO BE CONFIRMED AT DETAILED DESIGN.

1.7. FOR SOFT LANDSCAPING; INCLUDING GARDENS AND EXISTING GREENFIELD LAND WITHIN THE SITE BOUNDARY, LOCAL LAND DRAINAGE MAY BE INTRODUCED WHERE LOW SPOTS OCCUR NEAR BUILDING THRESHOLDS. ANY REQUIRED COLLECTION FEATURES WILL BE DESIGNED TO DIRECT FLOWS AWAY FROM BUILDINGS, WITH FINAL ARRANGEMENTS CONFIRMED AT DETAILED DESIGN.

REV:	AMENDMENTS:	DRN:	CHK:	DATE:
P04	Updated to suit latest masterplan	BW	EC	07.07.26
P03	Miscellaneous dotted line removed	BW	EC	14.05.26
P02	Drainage Areas Table added	BW	EC	06.05.26
P01	First Issue	BW	EC	01.05.26

PROJECT:
Higher Standen Drive
Clitheroe

DRAWING TITLE:
Drainage Strategy
(Basin Volume & Outfalls)

CLIENT:
Applethwaite Ltd

DRAWING NUMBER:
P26127-DGC-Z1-GF-DR-C-0001

REVISION:	SHEET SIZE:	SCALE:
P04	A1	1:500
DRAWN BY:	CHECKED BY:	DATE:
BW	EC	01.05.2026

STATUS:
PRELIMINARY

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Printed:07.07.2026 File Location: C:\Users\Ben Wheeler\OneDrive - DGC Consulting Engineers\DGC - Documents\Projects\2026\26127 - Higher Standen Drive, Clitheroe\Eng\Civil\CAD\DWG's\P26127-DGC-Z1-GF-DR-C-0001-P04 - Drainage Strategy.dwg

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Appendix B) 26127-Water Quality Design for SuDS - SIA CIRIA C753 Calcs

Water Quality Design for SuDS - Simple Index Approach - SuDS Manual 2015 - CIRIA C753

Project:	Higher Standen Drive, Clitheroe	**Project No:**	26127
Section:		**Date:**	05/05/2026
		Sheet No:	1 **of** 1
Produced by:	BW	**Checked by: EC**	

Key:

- DROP DOWN LIST
- USER ENTRY
- AUTOMATICALLY CALCULATED

PLEASE NOTE!
This tool must be read in conjunction with Chapter 4 and Chapter 26 of the SuDS Manual as other key criteria, parameters and design conditions apply.

STEP 1: **Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme**

- If the land use varies across the 'runoff area', either:
  - use the land use type with the highest Pollution Hazard Index
  - apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.
- If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

	Runoff Area Land Use Description	Pollution Hazard Indices: Level	Total Suspended Solids	Metals	Hydrocarbons
Select land use type from the drop down list (or 'Other' if none applicable):	Residential parking	Low	0.5	0.4	0.4
User Defined Indicies					
	Landuse Pollution Hazard Index	**Low**	**0.5**	**0.4**	**0.4**

STEP 2A: **Determine the Pollution Mitigation Index for the proposed SuDS components**

- This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component
- If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B
- This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components. This will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design.

	SuDS Component Description	Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Select SuDS Component 1 (i.e. the u/s component)	Detention basin	0.5	0.5	0.6
Select SuDS Component 2	Pervious pavement (where the pavement is not designed as an infiltration component)	0.7	0.6	0.7
Select SuDS Component 3	None			
If the proposed SuDS components are bespoke/proprietary select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:				
	Aggregated Surface Water Pollution Mitigation Index	**0.85**	**0.8**	**0.95**

STEP 2B: **Determine the Pollution Mitigation Index for the proposed Groundwater Protection**

- This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater
- This step should be applied where a SuDS component is allows any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design.
- Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

	SuDS Component Description	Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Select type of groundwater protection from the drop down list:	None			
If the proposed groundwater protection is bespoke/proprietary select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:				
	Groundwater Protection Pollution Mitigation Index	**0**	**0**	**0**

STEP 2C: **Determine the Combined Pollution Mitigation Indices for the Runoff Area**

- This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

	Combined Pollution Mitigation Indices **Total Suspended Solids**	**Metals**	**Hydrocarbons**
Combined Pollution Mitigation Indices for the Runoff Area	**0.85**	**0.8**	**0.95**

STEP 2D: **Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components**

- This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type
- When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.
- In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1.

Sufficiency of Pollution Mitigation Indices **Total Suspended Solids**	**Metals**	**Hydrocarbons**
Sufficient	**Sufficient**	**Sufficient**

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Appendix C) Extracts of E3P Phase II Geoenvironmental Site Assessment

Phase II Geoenvironmental Site Assessment

Site: Higher Standen Drive, Clitheroe
Reference: 17-912-R2-1
Date: November 24

E3P

Taylor Road
Trafford Park
Urmston
Manchester
M41 7JQ

+ 44 (0) 161 707 9612
https://e3p.co.uk

Registered in England
CRN: 08725262

QUALITY ASSURANCE

Report reference	17-912-R1 – Interim Report

REV REF:	DESCRIPTION	AUTHOR	CHECKED	AUTHORISED	DATE
R1-1	First issue	GC	KK	AS	30/11/24

This report has been prepared for the sole benefit, use, and information of the client. The liability of Environmental Engineering Partnership Limited T/A E3P with respect to the information contained in the report will not extend to any third party. This report has been prepared by the qualified persons as listed below.

WRITTEN BY	QUALIFICATIONS	POSITION
Georgia Calvert	BSc (Hons), FGS	Geoenvironmental Consultant

REVIEWED BY	QUALIFICATIONS	POSITION
Kay Kierans	BEng (Hons), FGS, MIEnvSc	Project Manager

AUTHORISED BY	QUALIFICATIONS	POSITION
Alex Smith	BSc (Hons), FGS, MIEnvSc, CEnv	Associate Director

EXECUTIVE SUMMARY

Site Address	Higher Standen Drive, Standen, Clitheroe BB7 1FT.
Grid Reference	N 374676 E 440681
Site Area	2.57 Ha
Proposed Development	The Trustees of the Standen Estate intend to construct a low-rise residential development comprising 68 dwellings with associated gardens, estate roads and infrastructure.
Current Site Use	The site is an irregularly shaped parcel of land located to the south east of Clitheroe, with access available from Higher Standen Drive, on the eastern boundary of the site. Currently the site comprises an open field, with trees present at the western boundary, alongside a tributary of the Pendleton brook. There is also a single tree located close to the centre of the field. There are no structures or stone wall located within the site. The site is located on a slight slope, with a fall of approximately 8 meters from the north east corner towards the western boundary of the site.
Site History	An examination of the relevant Ordnance Survey maps shows that the site has remain undeveloped agricultural fields since the earliest available mapping. The only minor changes relating to field boundaries. There is no evidence of structures on the site being present at any point in the recorded site history.

ENVIRONMENTAL SETTING

Geology	Drift Geology	Till (Devensian)
	Bedrock Geology	Clitheroe Limestone Formation and Hodder Mudstone Formation.
	Faults	The nearest geological fault is located 174m to the north west of the site, trending north west to south east, with a downthrow to the south west.
Geomorphology	A review of relevant records indicates that the site has not been subject to significant anthropogenic changes with the current site topography broadly representing natural landform.	
Hydrogeology	A Secondary (undifferentiated) Aquifer has been recorded on site in the drift geology with a Secondary A Aquifer in the bedrock geology.	
	The Groundsure report indicates that the site is not located within a groundwater source protection zone. Furthermore, there are no groundwater/potable abstractions within 1 km of the site.	
Hydrology	The nearest surface water feature is a tributary of the Pendleton Brook, located on the Western boundary of the site. Due to the local topography, it is likely that any shallow groundwater, if present, will flow in a south westerly direction towards the Pendleton Brook tributary.	
	The site is located within Flood Zone 1 - no risk of flooding	

Utility Locations	An 11 kV cable is present along the northwestern boundary of the site. There are no other below ground utilities at the site.
Landfill Sites and Waste Sites	There are no active or historic landfills within 250 m of the site.
Radon	Radon Class 1 - less than 1% of homes are estimated to be at or above the Action Level. No radon protection measures required.
Unexploded Ordnance	Low risk UXO area – no further assessment required.
PFAS	No potential current or historical sources of PFAS have been identified on site. No further risk assessment required.
Hazardous Installations	No hazardous installations that could potentially prejudice the proposed construction of the development have been identified within influencing distance of the subject site.
Previous Reports	The following previous report has been completed for the site: • Phase I Geoenvironmental Site Assessment, Higher Standen Drive (ref: 17912-R1-1), September 2024. The key findings are summarised in Section 1.5 and where necessary, data has been used to support the geoenvironmental assessment.

E3P GROUND INVESTIGATION

Ground Investigation Works	E3P has completed an intrusive ground investigation comprising: • 6 x window sample probeholes; • 8 x mechanically excavated trial pits; and • Construction of 4 No. environmental monitoring installations.
Ground Conditions	**Made Ground** No Made Ground was encountered during the investigation.
	Topsoil – 0.00 m bgl to 0.35 m bgl Topsoil was encountered within all exploratory hole locations to depths ranging from 0.15 m to 0.35 m bgl. The topsoil comprised brown sandy CLAY, without significant anthropogenic inclusions.
	Superficial – 0.15 m bgl to >5.45 m bgl Superficial deposits were encountered within all exploratory locations to a proven depth of 5.45 m bgl. The base of the superficial deposits was not encountered in any of the exploratory locations. Superficial deposits generally comprise brown slightly gravelly slightly sandy CLAY with fine to medium, angular to subrounded gravel of sandstone and mudstone. These deposits gradually become more gravelly with depth. Underlying these deposits at approximately 1.20 m bgl, the deposits are recorded as grey slightly sandy gravelly CLAY which increases in stiffness with depth.
	Solid Geology Solid geology was not encountered during the ground investigation.

	Groundwater Limited groundwater was encountered during the intrusive investigation. Groundwater strikes were encountered in WS101 and WS102 at 1.00 m and 4.00 m bgl and 1.00 m bgl, respectively. Seepages were encountered at 1.00 m and 1.50 m bgl in TP104 and TP108, respectively.

CONTAMINATED LAND ASSESSMENT

Initial Conceptual Site Model	There has been very little historical activity on site and therefore the likelihood of potentially contaminated soils is considered to be low.
Human Health	No elevated concentrations of potential contaminants of concern have been identified when compared with Tier 2 GACs for a residential end use (with plant uptake). Asbestos was not identified in any of the eleven samples submitted for analysis. Based on the above there is no unacceptable level of risk to human health for future end users and construction workers. Preliminary chemical analysis has confirmed the topsoil, and subsoil is likely to be suitable for re-use within any landscaped areas; however further chemical analysis in accordance with an agreed testing frequency will be required to confirm this prior to placement in any landscaped areas.
Controlled Waters	The site is considered to pose a low risk to controlled waters.
Ground Gas	Ground gas monitoring indicates the site falls into a classification Characteristic Situation 1; as such gas protection measures are not required. It should be noted that at this stage gas monitoring at the site remains ongoing.
Potable Water Infrastructure	A UKWIR Risk Assessment will be required to confirm the most suitable potable water supply pipework. Chemical analysis suggests that PE pipe is likely to be suitable.

GEOTECHNICAL ASSESSMENT

Underground Obstructions & Subterranean Hazards	Obstructions have not been identified to date and significant obstructions are not anticipated.
Allowable Bearing Capacity	Generally, the underlying cohesive deposits are to be firm, medium strength, with a net Allowable Bearing Capacity (ABC) of in excess of 80kN/m² at an approximate depth of 1 meter below ground level (bgl). The ABC typically increases with depth.

Foundation Options	The suitable target founding stratum has been identified as the underlying stiff to very stiff CLAY. Following this assessment, it is recommended that shallow strip foundations, bearing upon the stiff to very stiff CLAY, is the most cost-effective solution. A deeper foundation solution will be required in any areas were soft to firm clays are recorded (such as WS105). The final foundation solution will be dependent on the structural loadings, elevation and should be designed by a suitably qualified structural engineer.
Foundations Near Trees	Foundation depths within the conjectured influence of former, existing or proposed trees will need to be deepened to ensure that structural loading bears within the underlying target founding stratum, which cannot be subject to volumetric instability associated with fluctuation in moisture content.
Heave Precautions Near Trees	Given that the underlying clay is of low volume change potential, heave precautions will not be required to the internal face of a foundation less than 1.5 m in depth. Heave precautions will be required to the underside of floor slabs (where there is no 200 mm void) and pile ground beams are required within the modelled influencing distance of trees.
Building Floor Slabs	A ground bearing slab will be viable for the residential buildings, but it will need to be constructed on a granular sub-base with the thickness designed by a structural engineer to ensure that settlement tolerances are taken into consideration.
Soakaway Drainage	Soakaway drainage is unlikely to be suitable due to the presence of low permeability cohesive deposits across the site.
Sulphate Assessment	Concrete classification of DS-1, AC-1s applicable across the site.
Highway & Infrastructure Construction	Where a proposed highway or infrastructure is to be constructed, remediation works will be required to ensure the site is engineered to a suitable geotechnical design specification.
CBR Design %	Natural clay soils will provide a CBR in the order of 2–4% during drier climatic periods. However, if water is allowed to shed onto the formation, the CBR will reduce to < 2%, which will require specialist engineering of the subgrade.
Enabling Earthworks	Development levels are unlikely to change significantly; however, an element of cut-and-fill works will likely be required to prepare the development platform. As part of the earthworks design, materials should be assessed and characterised prior to re-use in the construction of upfill to a geotechnical design. All future earthworks should be completed in accordance with a Geotechnical Design Report (GDR) that will consider the ground model within the context of the potential for settlement induced by surcharge from earthworks, dynamic and permanent loading of the development and all known hazards.
Waste Characterisation	Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: *Waste Classification – Guidance on the classification and assessment of waste*. This can be done upon request and in line with the Environment Agency sampling frequencies.

2.5. STORAGE, PRESERVATION AND TRANSPORT OF SAMPLES

Measures taken to ensure the quality and integrity of the collected samples, from collection to receipt of the samples by the laboratory, are summarised in Table 5.

Table 5 Sample Integrity Information

SUBJECT	CHEMICAL SAMPLING	
	Soil	**Groundwater**
Storage	Glass jars supplied by the laboratory were used for the collection of soil samples to be analysed for VOCs. Plastic tubs were used to collect soil samples for metals analysis, and asbestos screening.	Glass vials supplied by the laboratory were used for the collection of samples to be analysed for VOCs. Samples to be analysed for lower volatility compounds were stored in laboratory-prepared glass jars.
Preservation	Soil and groundwater sample containers were filled to minimise headspace prior to sealing and stored at a low temperature within cool boxes with cooling aids to minimise the loss of volatile contaminants and reduce microbial activity during the collection of samples.	
	Soil	**Groundwater**
Sample Integrity	Dedicated disposable nitrile gloves were worn and changed between sample collections to prevent cross-contamination.	Groundwater samples were collected using dedicated plastic tubing, which was changed between monitoring well locations to prevent cross-contamination.
Transport	Samples were stored and shipped in dedicated sample boxes provided by the laboratory. Sample details were recorded on the laboratory chain of custody form enclosed with the samples prior to dispatch. Scheduling information for the samples was confirmed with the laboratory via email.	

Chemical analysis has been undertaken by an accredited laboratory with the testing results summarised and discussed in Section 4 and the testing certificates included in APPENDIX VII.

Geotechnical samples were collected as required per location immediately after excavation, labelled and sealed to minimise moisture loss. The geotechnical samples were collected and couriered by a dedicated courier to an accredited geotechnical testing laboratory.

The testing results are summarised and discussed in Section 5 and the testing certificates included in Appendix VIII.

3. GROUND AND GROUNDWATER CONDITIONS

3.1. SUMMARY OF GROUND CONDITIONS

The ground investigation generally confirms the published geology and identifies the strata set out in Table 6.

Table 6 **Summary of Strata**

HOLE	DEPTH TO STRATUM (M BGL)			
	TOPSOIL	SANDY CLAY	GRAVELLY CLAY	GRAVELLY SANDY CLAY
TP101	0.00 – 0.20	-	-	0.20 – 2.20
TP102	0.00 – 0.30	-	1.20 – 2.30	0.30 – 1.20
TP103	0.00 – 0.25	-	-	0.25 – 2.20
TP104	0.00 – 0.20	-	-	0.20 – 2.30
TP105	0.00 – 0.35	-	-	0.35 – 2.00
TP106	0.00 – 0.25	-	-	0.25 – 2.00
TP107	0.00 – 0.15	-	-	0.15 – 2.15
TP108	0.00 – 0.20	0.20 – 1.20	-	1.20- 2.30
WS101	0.00 – 0.25	3.00 – 5.45	-	0.25 – 3.00
WS102	0.00 – 0.25	0.25 – 4.43	-	-
WS103	0.00 – 0.20	0.20 – 1.40	-	1.40 – 4.40
WS104	0.00 – 0.30	0.30 – 2.10	-	2.10 – 2.40
WS105	0.00 – 0.30	0.30 – 1.00	-	1.00 – 2.00
WS106	0.00 – 0.25	0.25 – 2.00	-	2.00 – 4.00

3.2. MADE GROUND

Made Ground was not encountered in any of the exploratory hole locations

3.3. TOPSOIL

Topsoil was encountered within all exploratory hole locations to depths ranging from 0.15 m to 0.35 m bgl. The topsoil comprised brown sandy CLAY, without significant anthropogenic inclusions.

A Depth of Topsoil Plan is presented as Drawing 17-752-008 in APPENDIX IV.

5.4. SOIL PLASTICITY

The Atterberg limits determinations, summarised in Table 23, show the clay to be of low plasticity.

Table 23 Summary of Plasticity Index Test results

LOCATION	DEPTH (m)	NATURAL MOISTURE CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING 425 MM SIEVE (%)	MODIFIED PLASTICITY INDEX	NHBC VOLUME CHANGE POTENTIAL
WS101	1.00 – 1.45	15.2	13	34	21	86	18.06	Low
WS102	2.00 – 2.45	26	18	32	14	99	13.86	Low
WS106	1.00 – 1.45	14	13	30	17	90	15.3	Low

The results of the Atterberg limits testing confirmed that the soils would be deemed to be "Low Volume Change Potential" in accordance with the classification system utilised by the LABC/NHBC industry guidance.

5.5. PH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in APPENDIX VII (summarised in Table 24), shows that the soils at the site meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1 in accordance with BRE *Special Digest 1* (2005).

Table 24 Summary of pH and Sulphate Data

LOCATION	DEPTH (m)	SO_4 IN 2:1 WATER/SOIL (g/l)	PH VALUE	CLASSIFICATION
TP101	0.1	< 0.010	7.6	DS-1, AC-1s
TP101	1.2	0.060	8.5	DS-1, AC-1s
TP102	0.5	< 0.010	7.4	DS-1, AC-1s
TP105	0.1	< 0.010	7.2	DS-1, AC-1s
TP105	0.6	0.031	7.1	DS-1, AC-1s
TP106	1.5	< 0.010	8.2	DS-1, AC-1s
WS102	0.1	< 0.010	6.5	DS-1, AC-1s
WS105	0.1	0.044	6.4	DS-1, AC-1s
WS105	0.5	< 0.010	7.0	DS-1, AC-1s

5.5.1. HIGHWAYS AND CONCRETE

MCHW Series 600 provides a criteria of 1500mg/l for water-soluble sulphate within 500mm of any concrete structure.

A second criteria of 300 mg/l is given with respect to soils within 500mm of steel structures.

5.8. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the safe allowable bearing capacity (ABC) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The results of this assessment are summarised in Table 26.

Table 26 Summary of ABC

COHESIVE SOILS			
Description	**Depth (range m bgl)**	**Undrained Shear Strength (Cu) (kN/m^2)**	**Allowable Bearing Capacity (kN/m^2)**
Firm CLAY	1.00–2.00	30.24	62.18
Stiff CLAY	1.00–2.00	40.33–82.22	82.91–169.04
Stiff gravelly CLAY.	2.00–4.00	59.38–211.21	122.09–434.25
Very stiff sandy CLAY.	2.00–5.00	77.65–228.38	159.65–469.56

Firm sandy CLAY was encountered between 1.00 – 2.00 m bgl in WS105 with an ABC of 62.18 kN/m^2, which would not be a suitable founding stratum and foundations in this location should be taken to the underlying stiff CLAY.

Elsewhere, the site is underlain by stiff to very stiff CLAY from depths of 1.00 m to 5.00 m bgl with an ABC of 82.91 – 469.56 kN/m^2. This is considered to be an appropriate founding stratum, and as such, it is anticipated that for the majority of the site the foundations will be taken to ~1.00 m bgl.

5.9. FOUNDATIONS OPTIONS APPRAISAL

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe allowable bearing capacity, the following recommendations have been developed for the site of the potential foundation solutions that may be adopted for the future residential development. The suitable target founding stratum has been identified as the underlying stiff to very stiff CLAY.

Following this assessment, it is recommended that strip foundations, bearing upon the stiff to very stiff CLAY at depth of >1.00m bgl is the most cost-effective solution.

The final foundation solution will be dependent on the structural loadings, elevation and should be designed by a suitably qualified structural.

5.10. GROUND FLOOR SLABS

Current building control regulations require that where infilled ground is present to depths in excess of 600 mm, or where the substratum is variable in terms of the structure and settlement potential, or where clay soils are present within the influence of existing or proposed trees, a suspended floor slab is required.

In this instance, it is considered that for the substructures in the areas of site investigated, the underlying stratum would have less than 600 mm of infill and, as such, a suspended floor slab may not be required.

5.18. FURTHER WORKS

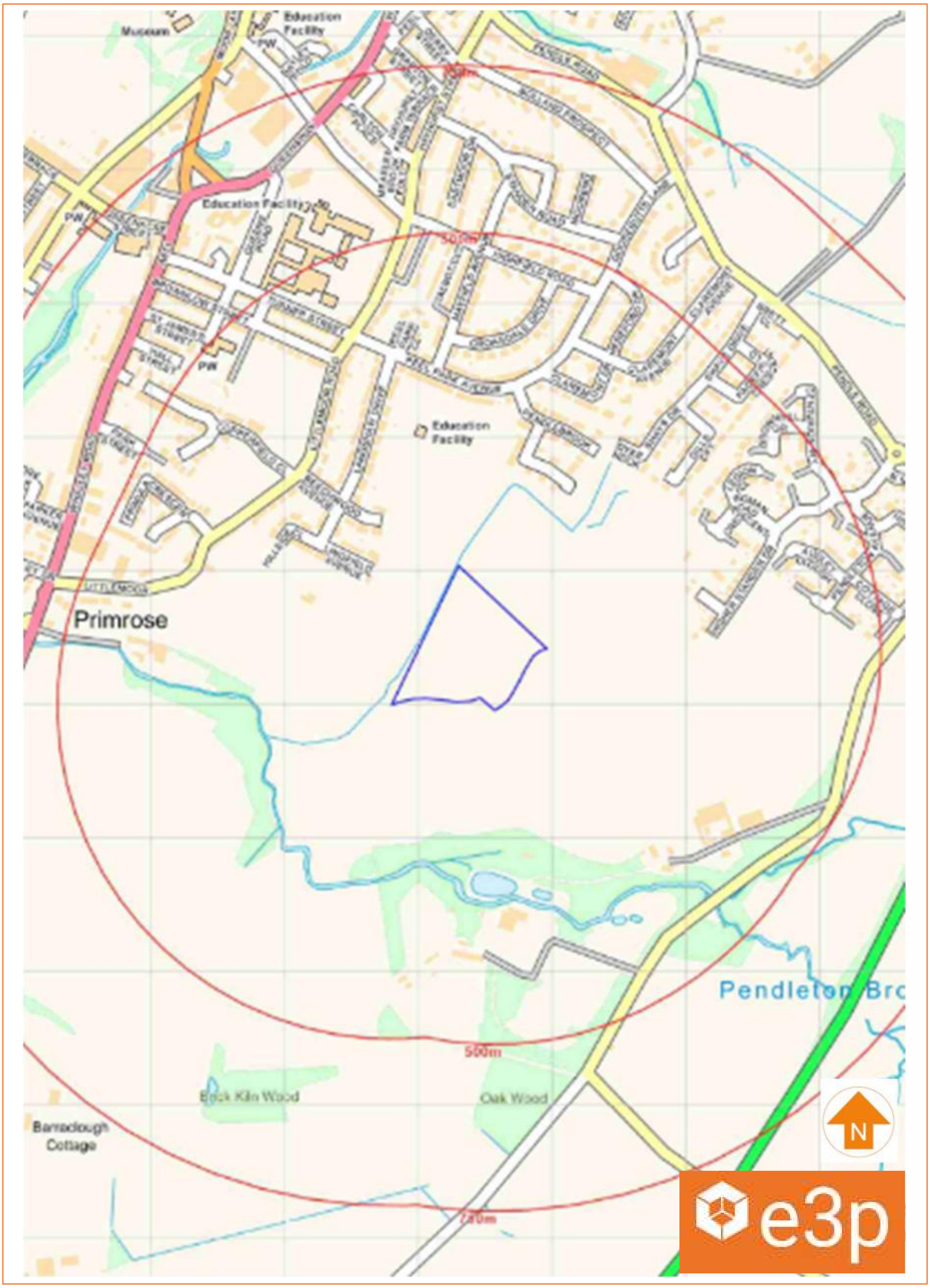
Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course:

- Foundations to be designed by suitably qualified Structural Engineer.
- Geotechnical Earthworks Specification
- Enabling Works Strategy.

END OF REPORT

APPENDIX IV
DRAWINGS

DRAWING 17-912-001 – Site Location Plan



Appendix D) Higher Standen Drive - Hydraulic Calcs - 07.07.2026

Network Details

Manhole Schedule

Manhole	Catchment Area (ha)	Size (mm)	Type	CL (m)	IL (m)	Depth To Soffit (m)	Easting (m)	Northing (m)
S1	0.146	1350	Type C	101.115	99.690	1.200	374758.456	440662.750
S2	0.111	1350	Type C	100.166	98.738	1.203	374741.900	440671.939
S3	0.012	1350	Type C	98.959	97.472	1.262	374723.068	440682.999
S4	0.110	1350	Type C	98.741	97.316	1.200	374720.956	440696.513
S5	0.033	1350	Type C	98.579	97.021	1.259	374715.391	440688.981
S6	0.044	1350	Type C	98.294	96.576	1.418	374704.594	440677.097
S7	0.197	1350	Type C	96.596	94.803	1.418	374673.209	440704.246
S8	0.000	1350	Type C	95.891	94.496	1.170	374650.433	440711.890
S9	0.048	1350	Type C	95.987	94.290	1.322	374656.557	440718.961
S10	0.000	1350	Type C	95.300	94.000	0.925	374648.175	440725.502
S11	0.084	1350	Type C	97.980	96.547	1.208	374692.523	440662.587
S12	0.045	1350	Type C	97.708	96.275	1.208	374681.721	440649.896
S13	0.110	1350	Type C	97.415	95.952	1.238	374672.152	440645.501
S14	0.085	1350	Type C	96.112	94.573	1.238	374627.985	440632.843
S15	0.065	1350	Type C	95.712	94.414	1.073	374600.230	440629.208
S16	0.063	1350	Type C	95.867	94.121	1.295	374611.477	440630.720
S17	0.016	1350	Type C	95.739	94.044	1.245	374607.078	440660.190
S18	0.000	1350	Type C	95.300	94.000	0.850	374609.905	440676.754
S19	0.000	1350	Type C	95.300	93.999	0.851	374616.791	440694.850
S20	0.000	1800	Type C	95.300	93.986	1.089	374613.407	440696.859
S21	0.000	1350	Type C	95.300	93.904	1.171	374601.983	440701.451

Pipe Schedule

Pipe Number	US Manhole	US IL (m)	DS Manhole	DS IL (m)	Shape	Dimension (mm)	Length (m)	Gradient (1:x)	Roughness (mm)	US Depth To Soffit (m)	DS Depth To Soffit (m)
1.000	S1	99.690	S2	98.738	Circ	225	18.935	20	0.600	1.200	1.203
1.001	S2	98.738	S3	97.472	Circ	225	21.840	17	0.600	1.203	1.262
1.002	S3	97.472	S5	97.096	Circ	225	9.732	26	0.600	1.262	1.259
2.000	S4	97.316	S5	97.096	Circ	225	9.365	42	0.600	1.200	1.259
1.003	S5	97.021	S6	96.576	Circ	300	16.056	36	0.600	1.259	1.418
1.004	S6	96.576	S7	94.878	Circ	300	41.499	24	0.600	1.418	1.418
1.005	S7	94.803	S9	94.290	Circ	375	22.222	43	0.600	1.418	1.322
3.000	S8	94.496	S9	94.440	Circ	225	9.354	167	0.600	1.170	1.322
1.006	S9	94.290	S10	94.000	Circ	375	10.632	37	0.600	1.322	0.925
1.007	S10	94.000	S19	93.999	Circ	450	43.869	Flat	0.600	0.850	0.851
4.000	S11	96.547	S12	96.275	Circ	225	16.665	61	0.600	1.208	1.208
4.001	S12	96.275	S13	95.952	Circ	225	10.531	33	0.600	1.208	1.238
4.002	S13	95.952	S14	94.648	Circ	225	45.945	35	0.600	1.238	1.238
4.003	S14	94.573	S16	94.271	Circ	300	16.644	55	0.600	1.238	1.295
5.000	S15	94.414	S16	94.346	Circ	225	11.348	167	0.600	1.073	1.295
4.004	S16	94.121	S17	94.044	Circ	450	29.796	385	0.600	1.295	1.245
4.005	S17	94.044	S18	94.000	Circ	450	16.803	385	0.600	1.245	0.850
4.006	S18	94.000	S19	93.999	Circ	450	19.362	Flat	0.600	0.850	0.851
1.008	S19	93.999	S20	93.986	Circ	450	3.935	298	0.600	0.851	0.864
1.009	S20	93.986	S21	93.904	Circ	225	12.312	150	0.600	1.089	1.171

Permeable Paving Schedule

Permeable Paving	Assigned Manhole	Effective Storage Volume (m3)	CL (m)	IL (m)	Storage Infil Rate (m/hr)	Safety Factor	Easting (m)	Northing (m)
Permeable Paving 2	S1	3.460	101.115	100.735	0.00000100	2.00	374729.643	440610.770
Permeable Paving 3	S1	3.470	101.115	100.735	0.00000100	2.00	374725.166	440619.881
Permeable Paving 4	S1	3.509	101.115	100.735	0.00000100	2.00	374731.312	440631.792
Permeable Paving 5	S1	3.460	101.115	100.735	0.00000100	2.00	374741.776	440632.069
Permeable Paving 6	S1	3.967	101.115	100.735	0.00000100	2.00	374748.389	440654.758
Permeable Paving 1	S2	8.793	100.166	99.786	0.00000100	2.00	374735.140	440661.459
Permeable Paving 7	S3	3.922	98.959	98.579	0.00000100	2.00	374722.153	440669.693
Permeable Paving 43	S3	5.817	98.959	98.579	0.00000100	2.00	374733.041	440684.059
Permeable Paving 44	S3	2.400	98.959	98.579	0.00000100	2.00	374740.926	440679.615
Permeable Paving 37	S4	2.984	98.741	98.361	0.00000100	2.00	374714.364	440698.141

Permeable Paving Schedule

Permeable Paving	Assigned Manhole	Effective Storage Volume (m3)	CL (m)	IL (m)	Storage Infil Rate (m/hr)	Safety Factor	Easting (m)	Northing (m)
Permeable Paving 38	S4	3.477	98.741	98.361	0.00000100	2.00	374727.779	440713.689
Permeable Paving 39	S4	3.464	98.741	98.361	0.00000100	2.00	374732.806	440719.509
Permeable Paving 40	S4	2.394	98.741	98.361	0.00000100	2.00	374748.908	440720.538
Permeable Paving 41	S4	2.384	98.741	98.361	0.00000100	2.00	374744.612	440715.516
Permeable Paving 42	S4	3.685	98.741	98.361	0.00000100	2.00	374744.424	440706.132
Permeable Paving 36	S5	2.841	98.579	98.199	0.00000100	2.00	374709.693	440691.711
Permeable Paving 21	S7	2.500	96.596	96.216	0.00000100	2.00	374674.157	440692.371
Permeable Paving 34	S7	5.013	96.596	96.216	0.00000100	2.00	374670.505	440726.750
Permeable Paving 35	S7	2.497	96.596	96.216	0.00000100	2.00	374684.456	440702.647
Permeable Paving 18	S9	3.459	95.987	95.607	0.00000100	2.00	374631.714	440688.681
Permeable Paving 19	S9	4.580	95.987	95.607	0.00000100	2.00	374644.136	440687.710
Permeable Paving 20	S9	4.961	95.987	95.607	0.00000100	2.00	374653.347	440697.617
Permeable Paving 30	S9	3.460	95.987	95.607	0.00000100	2.00	374694.909	440762.312
Permeable Paving 31	S9	6.432	95.987	95.607	0.00000100	2.00	374692.985	440749.062
Permeable Paving 32	S9	4.200	95.987	95.607	0.00000100	2.00	374688.202	440745.426
Permeable Paving 33	S9	4.837	95.987	95.607	0.00000100	2.00	374683.616	440733.392
Permeable Paving 8	S11	5.152	97.980	97.600	0.00000100	2.00	374705.519	440662.405
Permeable Paving 22	S11	3.281	97.980	97.600	0.00000100	2.00	374691.087	440670.660
Permeable Paving 9	S12	4.102	97.708	97.328	0.00000100	2.00	374694.597	440650.802
Permeable Paving 27	S12	4.849	97.708	97.328	0.00000100	2.00	374677.913	440661.988
Permeable Paving 10	S13	8.246	97.415	97.035	0.00000100	2.00	374678.456	440638.559
Permeable Paving 23	S13	2.780	97.415	97.035	0.00000100	2.00	374668.626	440651.339
Permeable Paving 45	S13	3.566	97.415	97.035	0.00000100	2.00	374674.330	440659.540
Permeable Paving 11	S14	5.101	96.112	95.732	0.00000100	2.00	374641.984	440622.472
Permeable Paving 12	S14	4.872	96.112	95.732	0.00000100	2.00	374628.015	440623.453
Permeable Paving 24	S14	2.397	96.112	95.732	0.00000100	2.00	374655.237	440646.856
Permeable Paving 25	S14	2.400	96.112	95.732	0.00000100	2.00	374648.892	440645.041
Permeable Paving 26	S14	3.453	96.112	95.732	0.00000100	2.00	374637.028	440644.486
Permeable Paving 28	S14	5.700	96.112	95.732	0.00000100	2.00	374666.402	440634.979
Permeable Paving 29	S14	7.983	96.112	95.732	0.00000100	2.00	374654.044	440631.323
Permeable Paving 46	S14	3.640	96.112	95.732	0.00000100	2.00	374661.402	440651.748
Permeable Paving 14	S15	4.830	95.712	95.332	0.00000100	2.00	374601.269	440620.412
Permeable Paving 15	S15	5.024	95.712	95.332	0.00000100	2.00	374587.483	440622.247
Permeable Paving 13	S16	5.050	95.867	95.487	0.00000100	2.00	374614.623	440621.669
Permeable Paving 16	S17	8.584	95.739	95.359	0.00000100	2.00	374618.520	440646.513
Permeable Paving 17	S17	7.348	95.739	95.359	0.00000100	2.00	374612.645	440660.599

Outfall Details

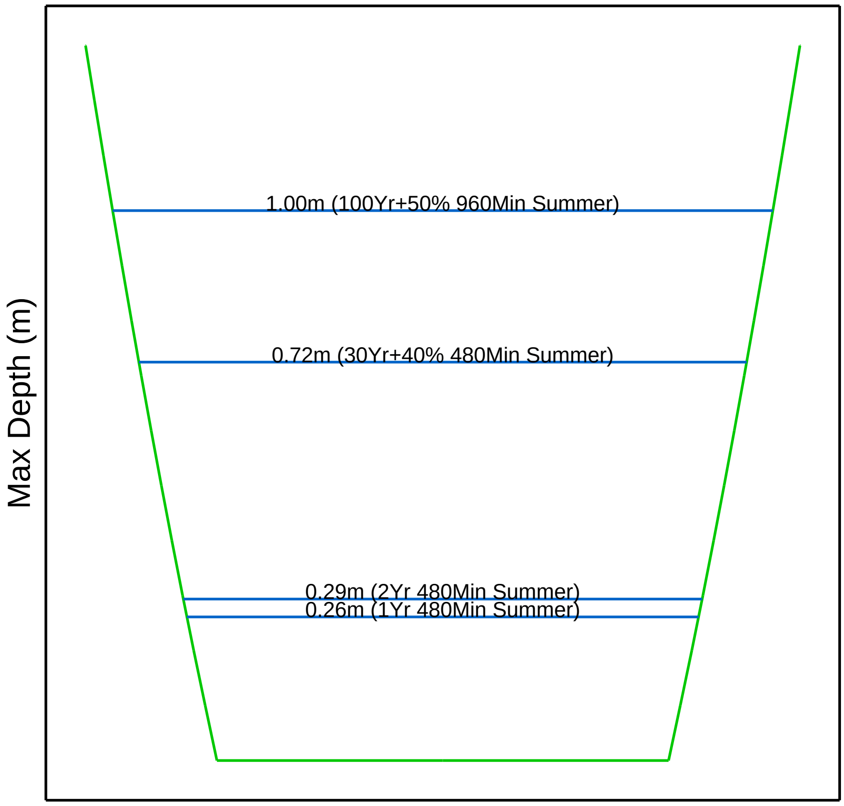
Outfall Manhole S21 : Free Discharge

Flow Control Details

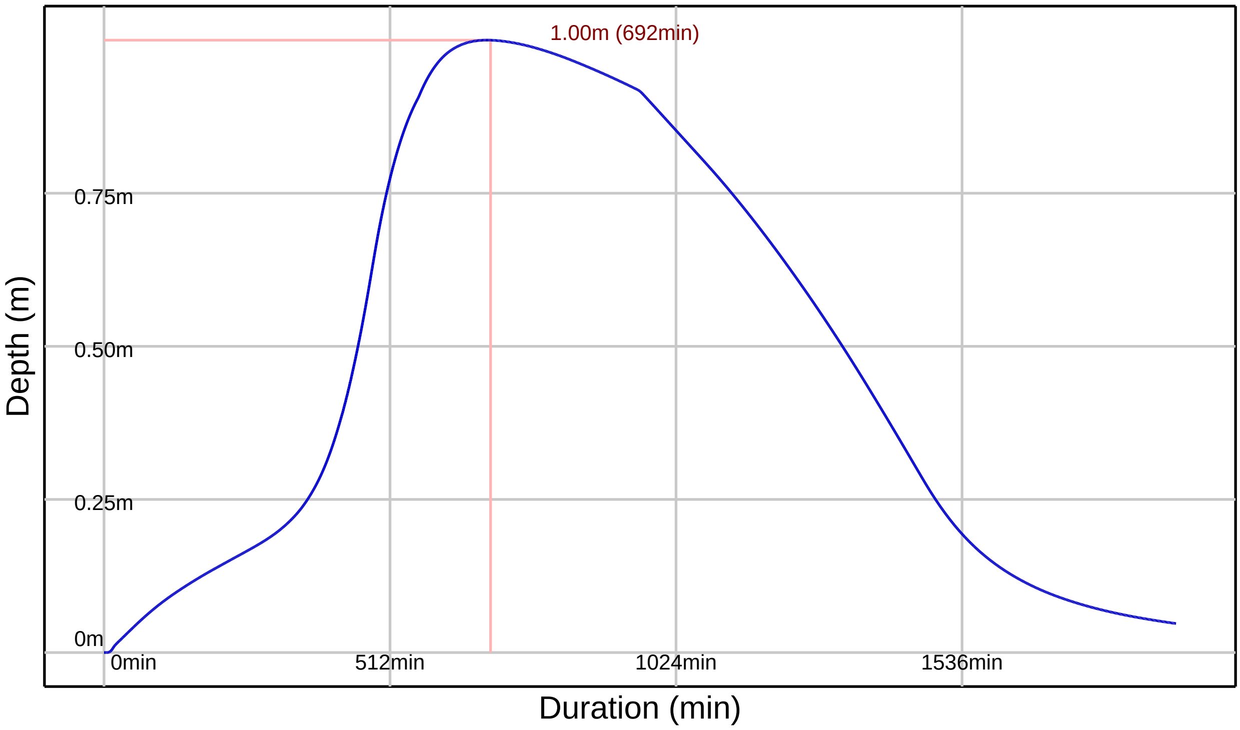
Pond Structure at Manhole S19

Pond Invert (m)	Max Depth (m)	Volume To Water Level (m3)	Water Level (m)	Freeboard (m)	Infil Base (m/hr)	Infil Side (m/hr)	Safety Factor
94.000	1.300	735.205	95.000	0.300	0.00000000	0.00000000	2.00

Pond Depth/Area Diagram at S19



Pond 1 at S19 (100Yr+50% 960Min Summer)

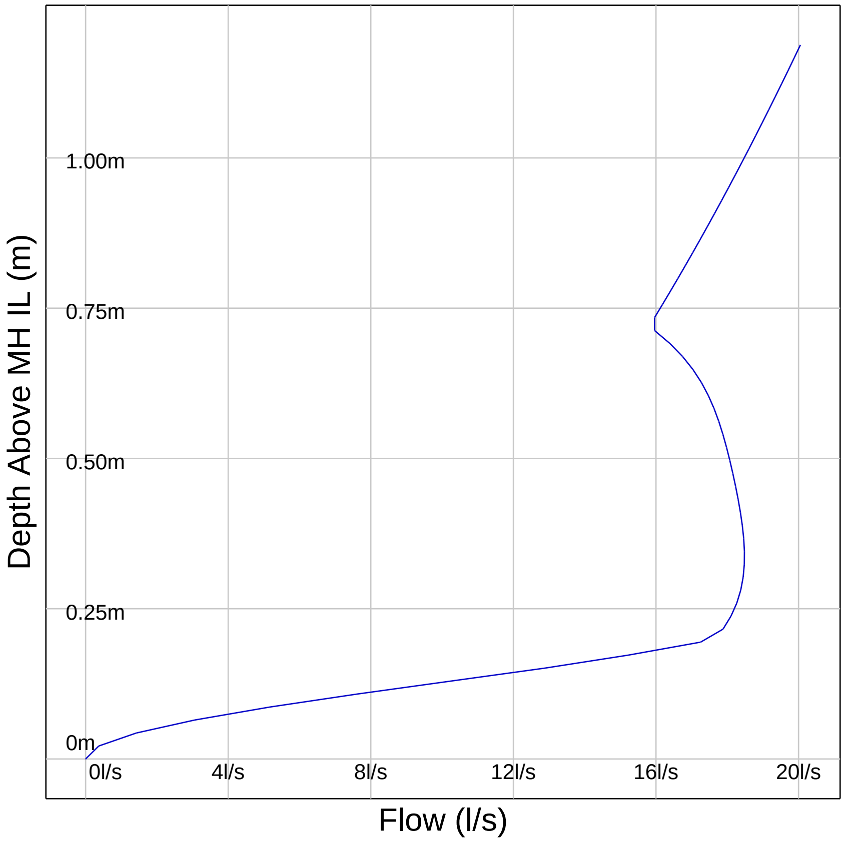


Controls within Manhole S20

Hydro-Brake® Optimum Control

Model Ref	Design Depth (m)	Design Flow (l/s)	Invert Offset (m)	FF Head (m)	FF Flow (l/s)	KF Head (m)	KF Flow (l/s)
SHE-0192-1850-1000-1850	1.000	18.500	0.000	0.337	18.483	0.719	15.799

Hydro-Brake® Optimum Control from S20 to S21



Simulation Settings

FSR: M5-60=19.10, R=0.26, Locale=England and Wales
Summer (Cv: 1.00), Winter (Cv: 1.00)

Global Time of Entry: 5.0 mins

Durations (mins): 15, 30, 60, 120, 240, 360, 480, 960, 1440

Return Periods (yrs) + Climate Change: (1, +0%), (2, +0%), (30, +40%), (100, +50%)

Manhole Flood Risk Freeboard: 0.300m

Simulated Rainfall Events

Storm	Average Intensity (mm/hr)	Runoff Continuity %	Flow Continuity %	Storm	Average Intensity (mm/hr)	Runoff Continuity %	Flow Continuity %
1Yr 15Min Winter	30.567	0.00	-0.06	30Yr+40% 15Min Summer	87.643	0.00	0.08
1Yr 15Min Summer	30.567	0.00	-0.06	30Yr+40% 15Min Winter	87.643	0.00	0.07
1Yr 30Min Winter	20.667	0.00	-0.06	30Yr+40% 30Min Summer	61.248	0.00	0.07
1Yr 30Min Summer	20.667	0.00	-0.06	30Yr+40% 30Min Winter	61.248	0.00	0.03
1Yr 60Min Winter	13.593	0.00	-0.04	30Yr+40% 60Min Summer	41.154	0.00	0.10
1Yr 60Min Summer	13.593	0.00	-0.04	30Yr+40% 60Min Winter	41.154	0.00	0.03
1Yr 120Min Summer	8.863	0.00	-0.03	30Yr+40% 120Min Summer	26.794	0.00	0.06
1Yr 120Min Winter	8.863	0.00	-0.03	30Yr+40% 120Min Winter	26.794	0.00	0.04
1Yr 240Min Winter	5.811	0.00	-0.01	30Yr+40% 240Min Summer	16.936	0.00	-0.01
1Yr 240Min Summer	5.811	0.00	-0.01	30Yr+40% 240Min Winter	16.936	0.00	-0.01
1Yr 360Min Winter	4.533	0.00	0.00	30Yr+40% 360Min Summer	12.896	0.00	-0.01
1Yr 360Min Summer	4.533	0.00	0.00	30Yr+40% 360Min Winter	12.896	0.00	-0.01
1Yr 480Min Winter	3.801	0.00	0.00	30Yr+40% 480Min Summer	10.611	0.00	-0.01
1Yr 480Min Summer	3.801	0.00	0.00	30Yr+40% 480Min Winter	10.611	0.00	-0.01
1Yr 960Min Summer	2.489	0.00	0.00	30Yr+40% 960Min Summer	6.597	0.00	0.00
1Yr 960Min Winter	2.489	0.00	0.00	30Yr+40% 960Min Winter	6.597	0.00	0.00
1Yr 1440Min Winter	1.946	0.00	0.00	30Yr+40% 1440Min Summer	4.980	0.00	0.00
1Yr 1440Min Summer	1.946	0.00	0.00	30Yr+40% 1440Min Winter	4.980	0.00	0.00
2Yr 15Min Summer	35.376	0.00	-0.05	100Yr+50% 15Min Summer	121.028	0.00	0.08
2Yr 15Min Winter	35.376	0.00	-0.05	100Yr+50% 15Min Winter	121.028	0.00	0.25
2Yr 30Min Summer	24.080	0.00	-0.05	100Yr+50% 30Min Summer	85.574	0.00	0.19
2Yr 30Min Winter	24.080	0.00	-0.05	100Yr+50% 30Min Winter	85.574	0.00	0.23
2Yr 60Min Winter	15.906	0.00	-0.04	100Yr+50% 60Min Summer	57.936	0.00	0.65
2Yr 60Min Summer	15.906	0.00	-0.04	100Yr+50% 60Min Winter	57.936	0.00	0.54
2Yr 120Min Winter	10.369	0.00	-0.03	100Yr+50% 120Min Summer	37.700	0.00	0.59
2Yr 120Min Summer	10.369	0.00	-0.03	100Yr+50% 120Min Winter	37.700	0.00	0.57
2Yr 240Min Summer	6.747	0.00	-0.01	100Yr+50% 240Min Summer	23.523	0.00	0.38
2Yr 240Min Winter	6.747	0.00	-0.01	100Yr+50% 240Min Winter	23.523	0.00	0.37
2Yr 360Min Summer	5.238	0.00	0.00	100Yr+50% 360Min Summer	17.760	0.00	0.14
2Yr 360Min Winter	5.238	0.00	0.00	100Yr+50% 360Min Winter	17.760	0.00	0.13
2Yr 480Min Summer	4.375	0.00	0.00	100Yr+50% 480Min Summer	14.515	0.00	-0.02
2Yr 480Min Winter	4.375	0.00	0.00	100Yr+50% 480Min Winter	14.515	0.00	-0.02
2Yr 960Min Winter	2.835	0.00	0.00	100Yr+50% 960Min Summer	8.860	0.00	-0.01
2Yr 960Min Summer	2.835	0.00	0.00	100Yr+50% 960Min Winter	8.860	0.00	-0.01
2Yr 1440Min Summer	2.201	0.00	0.00	100Yr+50% 1440Min Winter	6.605	0.00	0.00
2Yr 1440Min Winter	2.201	0.00	0.00	100Yr+50% 1440Min Summer	6.605	0.00	-0.01

Simulation Results

Return Period (yrs) + Climate Change (%):

1yr+0%

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Summer	8	99.756	0.066	23.081		OK
S2	15 min Summer	8	98.825	0.087	41.445		OK
S3	15 min Summer	8	97.574	0.102	41.246		OK
S4	15 min Summer	8	97.386	0.070	16.620		OK
S5	15 min Summer	8	97.144	0.123	62.978		OK
S6	15 min Summer	8	96.692	0.115	70.713		OK
S7	15 min Summer	9	94.956	0.152	102.569		OK
S8	15 min Winter	7	94.590	0.093	9.311		OK
S9	15 min Winter	7	94.607	0.317	88.057		OK
S10	15 min Summer	7	94.578	0.578	75.186		Surcharged
S11	15 min Summer	8	96.616	0.069	13.715		OK
S12	15 min Summer	8	96.345	0.069	20.224		OK
S13	15 min Summer	8	96.053	0.102	37.388		OK
S14	15 min Summer	8	94.689	0.115	45.754		OK
S15	15 min Summer	8	94.490	0.076	9.962		OK
S16	15 min Summer	8	94.333	0.212	65.766		OK
S17	15 min Winter	7	94.297	0.254	48.172		OK
S18	15 min Winter	7	94.266	0.266	49.634		OK
S19	480 min Summer	291	94.261	0.261	15.904		OK
S20	480 min Summer	291	94.261	0.275	15.875		Surcharged
S21	480 min Summer	291	93.995	0.091	15.874		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	15 min Summer	8	S1	S2	0.076	1.933	23.004	0.196	OK
1.001	15 min Summer	8	S2	S3	0.094	2.605	41.246	0.328	OK
1.002	15 min Summer	8	S3	S5	0.098	2.465	40.991	0.399	OK
2.000	15 min Summer	8	S4	S5	0.068	1.632	16.535	0.207	OK
1.003	15 min Summer	8	S5	S6	0.119	2.393	62.784	0.339	OK
1.004	15 min Summer	9	S6	S7	0.114	2.854	70.147	0.311	OK
1.005	15 min Winter	9	S7	S9	0.224	2.262	95.168	0.312	OK
3.000	15 min Winter	8	S8	S9	0.130	0.300	1.475	0.037	OK
1.006	15 min Winter	8	S9	S10	0.346	1.399	118.120	0.357	OK
1.007	480 min Summer	290	S10	S19	0.262	0.345	24.318	1.743	OK
4.000	15 min Summer	8	S11	S12	0.069	1.314	13.634	0.205	OK
4.001	15 min Summer	8	S12	S13	0.086	1.446	20.108	0.220	OK
4.002	15 min Summer	8	S13	S14	0.101	2.135	36.818	0.419	OK
4.003	15 min Summer	9	S14	S16	0.112	1.887	45.607	0.304	OK
5.000	15 min Summer	8	S15	S16	0.074	0.862	9.858	0.246	OK
4.004	15 min Winter	8	S16	S17	0.228	0.903	62.621	0.383	OK
4.005	15 min Winter	8	S17	S18	0.260	0.916	67.397	0.412	OK
4.006	480 min Summer	291	S18	S19	0.261	0.549	14.279	0.661	OK
1.008	480 min Summer	291	S19	S20	0.268	0.204	15.875	0.085	OK
1.009	480 min Summer	291	S20	S21	0.093	1.022	15.874	0.375	OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 2	1440 min Summer	2878	100.841	0.105	0.000			OK
Permeable Paving 3	1440 min Summer	2879	100.841	0.105	0.000			OK
Permeable Paving 4	1440 min Summer	2878	100.841	0.105	0.000			OK
Permeable Paving 5	1440 min Summer	2878	100.841	0.105	0.000			OK
Permeable Paving 6	1440 min Summer	2878	100.841	0.105	0.000			OK
Permeable Paving 1	1440 min Summer	2879	99.892	0.105	0.000			OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 7	1440 min Summer	2879	98.684	0.105	0.000			OK
Permeable Paving 43	1440 min Summer	2878	98.684	0.105	0.000			OK
Permeable Paving 44	1440 min Summer	2878	98.684	0.105	0.000			OK
Permeable Paving 37	1440 min Summer	2878	98.467	0.105	0.000			OK
Permeable Paving 38	1440 min Summer	2878	98.467	0.105	0.000			OK
Permeable Paving 39	1440 min Summer	2879	98.467	0.105	0.000			OK
Permeable Paving 40	1440 min Summer	2878	98.467	0.105	0.000			OK
Permeable Paving 41	1440 min Summer	2879	98.467	0.106	0.000			OK
Permeable Paving 42	1440 min Summer	2878	98.467	0.105	0.000			OK
Permeable Paving 36	1440 min Summer	2878	98.305	0.105	0.000			OK
Permeable Paving 21	1440 min Summer	2879	96.322	0.106	0.000			OK
Permeable Paving 34	1440 min Summer	2878	96.321	0.105	0.000			OK
Permeable Paving 35	1440 min Summer	2879	96.322	0.105	0.000			OK
Permeable Paving 18	1440 min Summer	2878	95.712	0.105	0.000			OK
Permeable Paving 19	1440 min Summer	2878	95.712	0.105	0.000			OK
Permeable Paving 20	1440 min Summer	2879	95.712	0.105	0.000			OK
Permeable Paving 30	1440 min Summer	2879	95.712	0.105	0.000			OK
Permeable Paving 31	1440 min Summer	2878	95.712	0.105	0.000			OK
Permeable Paving 32	1440 min Summer	2879	95.712	0.105	0.000			OK
Permeable Paving 33	1440 min Summer	2878	95.712	0.105	0.000			OK
Permeable Paving 8	1440 min Summer	2878	97.705	0.105	0.000			OK
Permeable Paving 22	1440 min Summer	2879	97.705	0.106	0.000			OK
Permeable Paving 9	1440 min Summer	2878	97.433	0.105	0.000			OK
Permeable Paving 27	1440 min Summer	2878	97.433	0.105	0.000			OK
Permeable Paving 10	1440 min Summer	2878	97.140	0.105	0.000			OK
Permeable Paving 23	1440 min Summer	2879	97.140	0.105	0.000			OK
Permeable Paving 45	1440 min Summer	2879	97.140	0.105	0.000			OK
Permeable Paving 11	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 12	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 24	1440 min Summer	2879	95.837	0.105	0.000			OK
Permeable Paving 25	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 26	1440 min Summer	2879	95.837	0.105	0.000			OK
Permeable Paving 28	1440 min Summer	2879	95.837	0.105	0.000			OK
Permeable Paving 29	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 46	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 14	1440 min Summer	2879	95.437	0.105	0.000			OK
Permeable Paving 15	1440 min Summer	2878	95.437	0.105	0.000			OK
Permeable Paving 13	1440 min Summer	2879	95.592	0.105	0.000			OK
Permeable Paving 16	1440 min Summer	2879	95.464	0.105	0.000			OK
Permeable Paving 17	1440 min Summer	2878	95.464	0.105	0.000			OK

Return Period (yrs) + Climate Change (%):

2yr+0%

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Summer	8	99.761	0.071	26.711		OK
S2	15 min Summer	8	98.832	0.094	47.968		OK
S3	15 min Summer	8	97.583	0.111	47.746		OK
S4	15 min Summer	8	97.392	0.076	19.235		OK
S5	15 min Summer	8	97.155	0.135	72.907		OK
S6	15 min Summer	8	96.701	0.125	81.864		OK
S7	15 min Summer	8	94.969	0.165	120.242		OK
S8	15 min Winter	7	94.651	0.155	0.000		OK
S9	15 min Winter	7	94.638	0.348	110.297		OK
S10	15 min Winter	7	94.590	0.590	108.854		Surcharged
S11	15 min Summer	8	96.622	0.075	15.873		OK
S12	15 min Summer	8	96.351	0.076	23.410		OK
S13	15 min Summer	8	96.063	0.111	43.277		OK
S14	15 min Summer	8	94.699	0.126	52.994		OK
S15	15 min Summer	8	94.496	0.082	11.530		OK
S16	15 min Summer	8	94.350	0.229	76.186		OK
S17	15 min Winter	7	94.302	0.258	59.280		OK
S18	480 min Summer	292	94.294	0.294	6.800		OK
S19	480 min Summer	293	94.294	0.294	17.460		OK
S20	480 min Summer	293	94.293	0.307	17.600		Surcharged
S21	480 min Summer	293	94.000	0.096	17.601		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	15 min Summer	8	S1	S2	0.083	2.008	26.627	0.227	OK
1.001	15 min Summer	8	S2	S3	0.103	2.695	47.746	0.379	OK
1.002	15 min Summer	8	S3	S5	0.107	2.552	47.458	0.462	OK
2.000	15 min Summer	8	S4	S5	0.073	1.696	19.141	0.239	OK
1.003	15 min Summer	8	S5	S6	0.130	2.479	72.687	0.392	OK
1.004	15 min Summer	9	S6	S7	0.123	2.964	81.126	0.360	OK
1.005	15 min Winter	8	S7	S9	0.245	2.286	110.209	0.362	OK
3.000	15 min Winter	7	S8	S9	0.177	0.315	8.579	0.214	OK
1.006	15 min Winter	8	S9	S10	0.362	1.476	132.449	0.400	OK
1.007	480 min Summer	292	S10	S19	0.294	0.608	27.981	2.005	OK
4.000	15 min Summer	8	S11	S12	0.075	1.360	15.784	0.237	OK
4.001	15 min Summer	8	S12	S13	0.093	1.493	23.279	0.255	OK
4.002	15 min Summer	8	S13	S14	0.110	2.215	42.651	0.486	OK
4.003	15 min Summer	9	S14	S16	0.122	1.958	52.761	0.352	OK
5.000	15 min Summer	8	S15	S16	0.080	0.896	11.413	0.285	OK
4.004	15 min Winter	9	S16	S17	0.242	0.946	70.958	0.434	OK
4.005	480 min Summer	292	S17	S18	0.272	0.337	16.816	0.103	OK
4.006	480 min Summer	293	S18	S19	0.294	0.570	16.374	0.758	OK
1.008	480 min Summer	293	S19	S20	0.301	0.213	17.603	0.095	OK
1.009	480 min Summer	293	S20	S21	0.099	1.050	17.601	0.416	OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 2	1440 min Summer	2879	100.856	0.121	0.000			OK
Permeable Paving 3	1440 min Summer	2879	100.856	0.121	0.000			OK
Permeable Paving 4	1440 min Summer	2879	100.856	0.121	0.000			OK
Permeable Paving 5	1440 min Summer	2878	100.856	0.121	0.000			OK
Permeable Paving 6	1440 min Summer	2878	100.856	0.121	0.000			OK
Permeable Paving 1	1440 min Summer	2878	99.907	0.121	0.000			OK
Permeable Paving 7	1440 min Summer	2878	98.699	0.121	0.000			OK
Permeable Paving 43	1440 min Summer	2879	98.699	0.121	0.000			OK
Permeable Paving 44	1440 min Summer	2878	98.699	0.121	0.000			OK
Permeable Paving 37	1440 min Summer	2878	98.482	0.121	0.000			OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 38	1440 min Summer	2878	98.482	0.121	0.000			OK
Permeable Paving 39	1440 min Summer	2879	98.482	0.121	0.000			OK
Permeable Paving 40	1440 min Summer	2878	98.482	0.121	0.000			OK
Permeable Paving 41	1440 min Summer	2878	98.482	0.121	0.000			OK
Permeable Paving 42	1440 min Summer	2879	98.482	0.121	0.000			OK
Permeable Paving 36	1440 min Summer	2878	98.320	0.121	0.000			OK
Permeable Paving 21	1440 min Summer	2878	96.337	0.121	0.000			OK
Permeable Paving 34	1440 min Summer	2878	96.337	0.121	0.000			OK
Permeable Paving 35	1440 min Summer	2879	96.337	0.120	0.000			OK
Permeable Paving 18	1440 min Summer	2879	95.727	0.121	0.000			OK
Permeable Paving 19	1440 min Summer	2878	95.727	0.121	0.000			OK
Permeable Paving 20	1440 min Summer	2878	95.727	0.121	0.000			OK
Permeable Paving 30	1440 min Summer	2879	95.727	0.121	0.000			OK
Permeable Paving 31	1440 min Summer	2878	95.727	0.121	0.000			OK
Permeable Paving 32	1440 min Summer	2878	95.727	0.121	0.000			OK
Permeable Paving 33	1440 min Summer	2879	95.727	0.121	0.000			OK
Permeable Paving 8	1440 min Summer	2879	97.720	0.121	0.000			OK
Permeable Paving 22	1440 min Summer	2878	97.720	0.121	0.000			OK
Permeable Paving 9	1440 min Summer	2878	97.448	0.121	0.000			OK
Permeable Paving 27	1440 min Summer	2878	97.448	0.121	0.000			OK
Permeable Paving 10	1440 min Summer	2878	97.156	0.121	0.000			OK
Permeable Paving 23	1440 min Summer	2879	97.156	0.121	0.000			OK
Permeable Paving 45	1440 min Summer	2878	97.156	0.121	0.000			OK
Permeable Paving 11	1440 min Summer	2878	95.852	0.121	0.000			OK
Permeable Paving 12	1440 min Summer	2879	95.852	0.121	0.000			OK
Permeable Paving 24	1440 min Summer	2878	95.852	0.121	0.000			OK
Permeable Paving 25	1440 min Summer	2878	95.852	0.121	0.000			OK
Permeable Paving 26	1440 min Summer	2879	95.852	0.121	0.000			OK
Permeable Paving 28	1440 min Summer	2878	95.852	0.121	0.000			OK
Permeable Paving 29	1440 min Summer	2878	95.852	0.121	0.000			OK
Permeable Paving 46	1440 min Summer	2879	95.852	0.121	0.000			OK
Permeable Paving 14	1440 min Summer	2879	95.452	0.121	0.000			OK
Permeable Paving 15	1440 min Summer	2879	95.452	0.121	0.000			OK
Permeable Paving 13	1440 min Summer	2879	95.607	0.121	0.000			OK
Permeable Paving 16	1440 min Summer	2878	95.480	0.121	0.000			OK
Permeable Paving 17	1440 min Summer	2878	95.480	0.121	0.000			OK

Return Period (yrs) + Climate Change (%):

30yr+40%

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Summer	8	99.808	0.117	66.192		OK
S2	15 min Summer	8	98.921	0.184	118.915		OK
S3	15 min Summer	9	97.852	0.380	115.190		Surcharged
S4	15 min Summer	8	97.451	0.135	47.664		OK
S5	15 min Summer	9	97.277	0.256	176.755		OK
S6	15 min Summer	9	96.824	0.248	198.869		OK
S7	15 min Summer	9	95.566	0.762	291.267		Surcharged
S8	15 min Summer	9	95.060	0.564	1.069		Surcharged
S9	15 min Summer	9	95.060	0.770	294.670		Surcharged
S10	15 min Winter	5	94.779	0.779	110.189		Surcharged
S11	15 min Summer	8	96.674	0.127	39.333		OK
S12	15 min Summer	10	96.492	0.216	47.037		OK
S13	15 min Summer	10	96.387	0.435	90.666		Surcharged
S14	15 min Summer	9	94.791	0.218	118.986		OK
S15	480 min Summer	345	94.725	0.311	0.979		Surcharged
S16	480 min Summer	345	94.725	0.604	6.602		Surcharged
S17	480 min Summer	345	94.725	0.681	6.602		Surcharged
S18	480 min Summer	346	94.725	0.725	6.534		Surcharged
S19	480 min Summer	346	94.724	0.724	17.141		Surcharged
S20	480 min Summer	346	94.724	0.738	17.137		Surcharged
S21	360 min Winter	547	94.003	0.099	18.481		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	15 min Summer	8	S1	S2	0.150	2.420	66.030	0.564	OK
1.001	15 min Summer	8	S2	S3	0.204	3.096	117.386	0.933	OK
1.002	15 min Summer	9	S3	S5	0.225	2.915	115.913	1.129	OK
2.000	15 min Summer	9	S4	S5	0.156	1.742	47.451	0.593	OK
1.003	15 min Summer	9	S5	S6	0.252	2.963	177.072	0.955	OK
1.004	15 min Summer	9	S6	S7	0.274	3.037	198.346	0.879	OK
1.005	15 min Winter	9	S7	S9	0.375	2.437	269.108	0.883	Surcharged
3.000	30 min Summer	19	S8	S9	0.225	0.317	10.276	0.257	OK
1.006	15 min Winter	9	S9	S10	0.375	2.498	275.869	0.833	Surcharged
1.007	60 min Winter	39	S10	S19	0.450	1.352	163.540	11.721	OK
4.000	15 min Summer	9	S11	S12	0.166	1.586	39.069	0.587	OK
4.001	15 min Summer	10	S12	S13	0.221	1.694	55.060	0.602	OK
4.002	30 min Summer	17	S13	S14	0.225	2.550	94.038	1.071	OK
4.003	15 min Summer	9	S14	S16	0.231	2.195	118.920	0.793	OK
5.000	360 min Summer	207	S15	S16	0.225	0.770	7.699	0.192	OK
4.004	120 min Winter	79	S16	S17	0.450	0.757	66.731	0.408	OK
4.005	60 min Winter	42	S17	S18	0.450	0.832	99.535	0.608	OK
4.006	60 min Winter	39	S18	S19	0.450	1.215	97.723	4.522	OK
1.008	240 min Winter	334	S19	S20	0.450	0.340	19.917	0.107	OK
1.009	360 min Winter	547	S20	S21	0.101	1.063	18.481	0.437	OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 2	1440 min Winter	1041	100.990	0.254	0.039			Surcharged
Permeable Paving 3	1440 min Winter	1041	100.990	0.254	0.039			Surcharged
Permeable Paving 4	1440 min Winter	1041	100.990	0.254	0.039			Surcharged
Permeable Paving 5	1440 min Winter	1041	100.990	0.254	0.039			Surcharged
Permeable Paving 6	1440 min Winter	1041	100.990	0.255	0.044			Surcharged
Permeable Paving 1	1440 min Winter	1040	100.044	0.258	0.104			Surcharged
Permeable Paving 7	1440 min Winter	1041	98.833	0.255	0.044			Surcharged
Permeable Paving 43	1440 min Winter	1041	98.835	0.256	0.065			Surcharged
Permeable Paving 44	1440 min Winter	1041	98.832	0.253	0.027			Surcharged
Permeable Paving 37	1440 min Winter	1041	98.615	0.254	0.034			Surcharged

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 38	1440 min Winter	1041	98.616	0.254	0.039			Surcharged
Permeable Paving 39	1440 min Winter	1041	98.616	0.254	0.039			Surcharged
Permeable Paving 40	1440 min Winter	1041	98.615	0.253	0.027			Surcharged
Permeable Paving 41	1440 min Winter	1044	98.615	0.253	0.027			Surcharged
Permeable Paving 42	1440 min Winter	1041	98.616	0.254	0.041			Surcharged
Permeable Paving 36	1440 min Winter	1041	98.453	0.254	0.032			Surcharged
Permeable Paving 21	1440 min Winter	1041	96.469	0.253	0.028			Surcharged
Permeable Paving 34	1440 min Winter	1041	96.471	0.255	0.056			Surcharged
Permeable Paving 35	1440 min Winter	1041	96.469	0.253	0.028			Surcharged
Permeable Paving 18	1440 min Winter	1041	95.861	0.254	0.039			Surcharged
Permeable Paving 19	1440 min Winter	1041	95.862	0.255	0.051			Surcharged
Permeable Paving 20	1440 min Winter	1041	95.862	0.255	0.055			Surcharged
Permeable Paving 30	1440 min Winter	1041	95.861	0.254	0.039			Surcharged
Permeable Paving 31	1440 min Winter	1041	95.863	0.256	0.072			Surcharged
Permeable Paving 32	1440 min Winter	1041	95.861	0.255	0.047			Surcharged
Permeable Paving 33	1440 min Winter	1041	95.862	0.255	0.054			Surcharged
Permeable Paving 8	1440 min Winter	1041	97.855	0.255	0.058			Surcharged
Permeable Paving 22	1440 min Winter	1041	97.854	0.254	0.037			Surcharged
Permeable Paving 9	1440 min Winter	1041	97.582	0.255	0.046			Surcharged
Permeable Paving 27	1440 min Winter	1041	97.583	0.255	0.054			Surcharged
Permeable Paving 10	1440 min Winter	1040	97.292	0.257	0.098			Surcharged
Permeable Paving 23	1440 min Winter	1041	97.289	0.254	0.031			Surcharged
Permeable Paving 45	1440 min Winter	1041	97.289	0.254	0.040			Surcharged
Permeable Paving 11	1440 min Winter	1041	95.987	0.255	0.057			Surcharged
Permeable Paving 12	1440 min Winter	1041	95.987	0.255	0.054			Surcharged
Permeable Paving 24	1440 min Winter	1041	95.985	0.253	0.027			Surcharged
Permeable Paving 25	1440 min Winter	1041	95.985	0.253	0.027			Surcharged
Permeable Paving 26	1440 min Winter	1041	95.986	0.254	0.039			Surcharged
Permeable Paving 28	1440 min Winter	1041	95.988	0.256	0.064			Surcharged
Permeable Paving 29	1440 min Winter	1040	95.989	0.257	0.095			Surcharged
Permeable Paving 46	1440 min Winter	1041	95.986	0.254	0.040			Surcharged
Permeable Paving 14	1440 min Winter	1041	95.587	0.255	0.054			Surcharged
Permeable Paving 15	1440 min Winter	1041	95.587	0.255	0.056			Surcharged
Permeable Paving 13	1440 min Winter	1041	95.742	0.255	0.056			Surcharged
Permeable Paving 16	1440 min Winter	1040	95.617	0.258	0.102			Surcharged
Permeable Paving 17	1440 min Winter	1041	95.616	0.257	0.082			Surcharged

Return Period (yrs) + Climate Change (%):

100yr+50%

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Summer	10	100.498	0.807	72.852		Surcharged
S2	15 min Summer	10	100.094	1.356	133.198		Flood Risk
S3	15 min Summer	10	98.667	1.195	131.428		Flood Risk
S4	15 min Summer	10	98.126	0.810	52.459		Surcharged
S5	15 min Summer	10	98.028	1.007	195.370		Surcharged
S6	15 min Summer	10	97.496	0.920	217.161		Surcharged
S7	15 min Summer	9	95.949	1.146	332.300		Surcharged
S8	15 min Summer	10	95.308	0.812	0.000		Surcharged
S9	15 min Summer	10	95.307	1.017	333.710		Surcharged
S10	960 min Summer	685	95.000	1.000	10.685		Flood Risk
S11	15 min Summer	10	97.368	0.821	43.290		Surcharged
S12	15 min Summer	10	97.256	0.980	62.930		Surcharged
S13	15 min Summer	10	97.097	1.145	115.587		Surcharged
S14	960 min Summer	685	95.001	0.427	4.957		Surcharged
S15	960 min Summer	685	95.000	0.586	0.988		Surcharged
S16	960 min Summer	685	95.000	0.879	6.898		Surcharged
S17	960 min Summer	685	95.000	0.957	7.142		Surcharged
S18	960 min Summer	686	95.000	1.000	7.120		Flood Risk
S19	960 min Summer	687	95.000	1.000	17.648		Surcharged
S20	960 min Summer	687	95.000	1.014	17.689		Surcharged
S21	15 min Winter	21	94.003	0.099	18.481		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	30 min Summer	16	S1	S2	0.225	2.407	82.171	0.701	OK
1.001	30 min Summer	16	S2	S3	0.225	3.311	131.629	1.046	OK
1.002	30 min Summer	19	S3	S5	0.225	3.217	127.903	1.246	OK
2.000	30 min Summer	16	S4	S5	0.225	1.777	56.595	0.707	OK
1.003	30 min Summer	18	S5	S6	0.300	2.898	189.616	1.023	Surcharged
1.004	30 min Summer	19	S6	S7	0.300	3.280	214.938	0.953	Surcharged
1.005	30 min Summer	17	S7	S9	0.375	2.886	318.740	1.046	Surcharged
3.000	30 min Summer	22	S8	S9	0.225	0.393	14.633	0.365	OK
1.006	30 min Summer	17	S9	S10	0.375	2.945	325.255	0.982	Surcharged
1.007	30 min Winter	20	S10	S19	0.450	2.046	298.597	21.401	OK
4.000	15 min Winter	8	S11	S12	0.225	1.592	45.836	0.689	OK
4.001	30 min Summer	15	S12	S13	0.225	1.694	60.639	0.663	OK
4.002	30 min Summer	18	S13	S14	0.225	2.773	110.264	1.255	OK
4.003	30 min Summer	18	S14	S16	0.300	2.140	137.343	0.916	Surcharged
5.000	30 min Summer	16	S15	S16	0.225	1.047	36.140	0.902	OK
4.004	30 min Summer	17	S16	S17	0.450	1.282	203.964	1.247	OK
4.005	60 min Summer	31	S17	S18	0.450	1.119	178.047	1.088	OK
4.006	60 min Summer	33	S18	S19	0.450	1.425	175.759	8.133	OK
1.008	60 min Winter	75	S19	S20	0.450	0.519	20.464	0.110	OK
1.009	960 min Winter	1352	S20	S21	0.101	1.063	18.481	0.437	OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 2	1440 min Summer	798	100.996	0.261	0.163			Surcharged
Permeable Paving 3	1440 min Summer	798	100.996	0.261	0.163			Surcharged
Permeable Paving 4	1440 min Summer	798	100.996	0.261	0.165			Surcharged
Permeable Paving 5	1440 min Summer	798	100.996	0.261	0.163			Surcharged
Permeable Paving 6	1440 min Summer	797	100.997	0.262	0.189			Surcharged
Permeable Paving 1	1440 min Summer	795	100.056	0.270	0.416			Surcharged
Permeable Paving 7	1440 min Summer	797	98.840	0.262	0.187			Surcharged
Permeable Paving 43	1440 min Summer	797	98.844	0.265	0.277			Surcharged
Permeable Paving 44	1440 min Summer	798	98.837	0.258	0.113			Surcharged
Permeable Paving 37	1440 min Summer	798	98.621	0.260	0.140			Surcharged

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 38	1440 min Summer	797	98.622	0.261	0.165			Surcharged
Permeable Paving 39	1440 min Summer	798	98.622	0.261	0.163			Surcharged
Permeable Paving 40	1440 min Summer	798	98.620	0.258	0.113			Surcharged
Permeable Paving 41	1440 min Summer	798	98.620	0.258	0.112			Surcharged
Permeable Paving 42	1440 min Summer	798	98.623	0.261	0.173			Surcharged
Permeable Paving 36	1440 min Summer	798	98.459	0.259	0.134			Surcharged
Permeable Paving 21	1440 min Summer	798	96.475	0.259	0.118			Surcharged
Permeable Paving 34	1440 min Summer	798	96.480	0.264	0.235			Surcharged
Permeable Paving 35	1440 min Summer	798	96.475	0.259	0.117			Surcharged
Permeable Paving 18	1440 min Summer	798	95.867	0.261	0.163			Surcharged
Permeable Paving 19	1440 min Summer	797	95.869	0.263	0.219			Surcharged
Permeable Paving 20	1440 min Summer	797	95.870	0.264	0.237			Surcharged
Permeable Paving 30	1440 min Summer	798	95.867	0.261	0.163			Surcharged
Permeable Paving 31	1440 min Summer	797	95.873	0.266	0.306			Surcharged
Permeable Paving 32	1440 min Summer	797	95.869	0.262	0.200			Surcharged
Permeable Paving 33	1440 min Summer	797	95.870	0.263	0.231			Surcharged
Permeable Paving 8	1440 min Summer	797	97.864	0.264	0.246			Surcharged
Permeable Paving 22	1440 min Summer	798	97.860	0.260	0.154			Surcharged
Permeable Paving 9	1440 min Summer	798	97.590	0.262	0.193			Surcharged
Permeable Paving 27	1440 min Summer	797	97.591	0.263	0.231			Surcharged
Permeable Paving 10	1440 min Summer	795	97.304	0.269	0.390			Surcharged
Permeable Paving 23	1440 min Summer	798	97.294	0.259	0.131			Surcharged
Permeable Paving 45	1440 min Summer	798	97.296	0.261	0.168			Surcharged
Permeable Paving 11	1440 min Summer	797	95.996	0.264	0.243			Surcharged
Permeable Paving 12	1440 min Summer	798	95.995	0.263	0.229			Surcharged
Permeable Paving 24	1440 min Summer	798	95.990	0.258	0.113			Surcharged
Permeable Paving 25	1440 min Summer	798	95.990	0.258	0.113			Surcharged
Permeable Paving 26	1440 min Summer	798	95.992	0.261	0.162			Surcharged
Permeable Paving 28	1440 min Summer	797	95.997	0.265	0.272			Surcharged
Permeable Paving 29	1440 min Summer	795	96.001	0.269	0.378			Surcharged
Permeable Paving 46	1440 min Summer	798	95.993	0.261	0.171			Surcharged
Permeable Paving 14	1440 min Summer	798	95.595	0.263	0.227			Surcharged
Permeable Paving 15	1440 min Summer	798	95.596	0.264	0.236			Surcharged
Permeable Paving 13	1440 min Summer	798	95.750	0.264	0.237			Surcharged
Permeable Paving 16	1440 min Summer	795	95.629	0.270	0.406			Surcharged
Permeable Paving 17	1440 min Summer	795	95.627	0.268	0.347			Surcharged