



Project Title

## **Drainage Strategy Report**

At

**Lakeside School**

**Naylors Road**

**Liverpool**

**L27 2YA**

For



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## Executive Summary

**Figure 1: Flood Risk and Drainage Strategy Summary**

| Item                                                                                | Brief Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Development Proposed                                                                | Single level classroom block constructed within a grassed play area at Lakeside School, Naylors Road, Liverpool, L27 2YA.                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Flood Zone Classification                                                           | Flood Zone 1 – Low Risk                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Geology                                                                             | A Phase 2 site-specific ground intrusive was carried out at the site in 2021 to support the design of the main school. This identified the ground conditions to consist of a brown clayey silt over a sandy clay.                                                                                                                                                                                                                                                                                                                                                             |
| Infiltration Rate                                                                   | Falling head tests were completed as part of the 2021 investigations with very little drop in water levels recorded. Based on these findings, infiltration has been discounted as a means of draining the site.                                                                                                                                                                                                                                                                                                                                                               |
| Nearest Watercourses                                                                | Netherley Brook is located some 500m to the east of the site, flowing in a southerly direction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Nearest Adopted Sewers and onsite private drainage                                  | The United Utilities (UU) sewer records have been reviewed. These have indicated the head of a 300mm diameter foul water sewer beyond the south western corner of the site. No surface water sewers have been identified, though a 225mm diameter culvert is located in the centre of Naylors Road flowing in a south westerly direction where it outfalls to Netherly Brook some 2km downstream.<br>The drainage plans for the current school have been reviewed with the foul drainage outfalls to the foul sewer and the surface water to the culvert at restricted rates. |
| Existing Discharge Rate                                                             | For the purpose of this assessment the site will be classed as fully Greenfield with greenfield discharge rates defined below based on a site area of 0.014 (Pro-rata'd):<br>1yr – 0.07l/s<br>Qbar – 0.08l/s<br>30yr – 0.14l/s<br>100yr – 0.18l/s                                                                                                                                                                                                                                                                                                                             |
| Surface Water Drainage Outfall and SuDS Hierarchical Approach & Peak Discharge Rate | Infiltration has been discounted as a means of draining the site and there are no watercourses or surface water sewers in close proximity. The surface water strategy will be to outfall to existing onsite surface water network serving the school at a peak rate of 2l/s. This network is already controlled to a peak rate of 27l/s to the local culvert and therefore no increase in the flow rate passing offsite is proposed.                                                                                                                                          |
| Allowance for Climate Change                                                        | 45% - based on a school > 100-year design life to 'the 2100's Upper End Allowance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| SuDS features                                                                       | Flow control.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Maintenance Responsibility                                                          | School.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Foul Drainage Strategy                                                              | Foul drainage to connect to the existing foul network serving the school that outfalls to the UU foul water sewer.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## **1. Introduction**

- 1.1 Paul Graveney Consulting Ltd (PGC) has been appointed by the Witherslack Group to prepare this Drainage & Sustainable Drainage Systems (SuDS) Strategy to support a full planning submission for the construction of a single level classroom block over an existing grassed play area at Lakeside School, Naylors Road, Liverpool, L27 2YA. The Site Masterplan as indicated in Appendix A provides details of the proposed development intent.
- 1.2 The assessment has been undertaken in line with Section 14 of the 2024 'National Planning Policy Framework', plus the accompanying Technical Guidance on Flood Risk and any local policies.
- 1.3 This report has been commissioned by the Witherslack Group and is specific to their interests in the development proposals as described by the Architectural plan in Appendix A.
- 1.4 The report has been commissioned to identify any drainage-related issues associated with the proposed development and any likely constraints that could be imposed. The following issues have been addressed within this report.
  - Determine the current surface water drainage regime and assess any potential increase in surface water runoff as a result of the proposed development.
  - Assess local and national policy in relation to the inclusion of SuDS.
  - Discuss Sustainable Drainage Systems (SUDS) as an option for reducing surface water flood risk and devise an outline Drainage layout.
  - Devise an appropriate outline surface water drainage strategy (including calculation where appropriate) to deal with any potential increase in surface water runoff and include for climate change.
  - Devise an appropriate outline foul water drainage strategy.

## 2. Development Description and Location

### 2.1 Site Location

The site is referenced in Figure 2, and a site location map is provided in Appendix A.

| Item                       | Brief Description                                                    |
|----------------------------|----------------------------------------------------------------------|
| Project name               | Lakeside School, Liverpool.                                          |
| Site address and location  | Lakeside School, Naylor's Road, Liverpool, L27 2YA.                  |
| Council Area               | Knowsley Metropolitan Borough Council.                               |
| Approximate Grid Reference | OS: 343766, 399372                                                   |
| General Locality           | The site is located approximately 9km east of Liverpool City centre. |

**Figure 2: Site Referencing Information**

### 2.2 Existing Site Description

- 2.2.1 The development site (Red Line Boundary) is irregular in plan shape and currently encompasses a school made up of a variety of buildings and areas for parking and play areas.
- 2.2.2 There are hardstanding areas to the southern periphery serving as parking and an access road between the parking area and the main school buildings. There is a small area of grassed land sitting centrally within the site, with a large pond just beyond the boundary to the west.
- 2.2.3 There is limited shrubbery to the north west and southern boundaries. Access will continue to be from Naylor's Road to the south of the site. The M62 motorway is located 200m north beyond an agricultural field.
- 2.2.4 The area is predominantly rural with two golf clubs in close proximity.
- 2.2.5 Figure 3 identifies the overall site location details. Further details of the existing layout can be seen on the Red Line Plans in Appendix A.



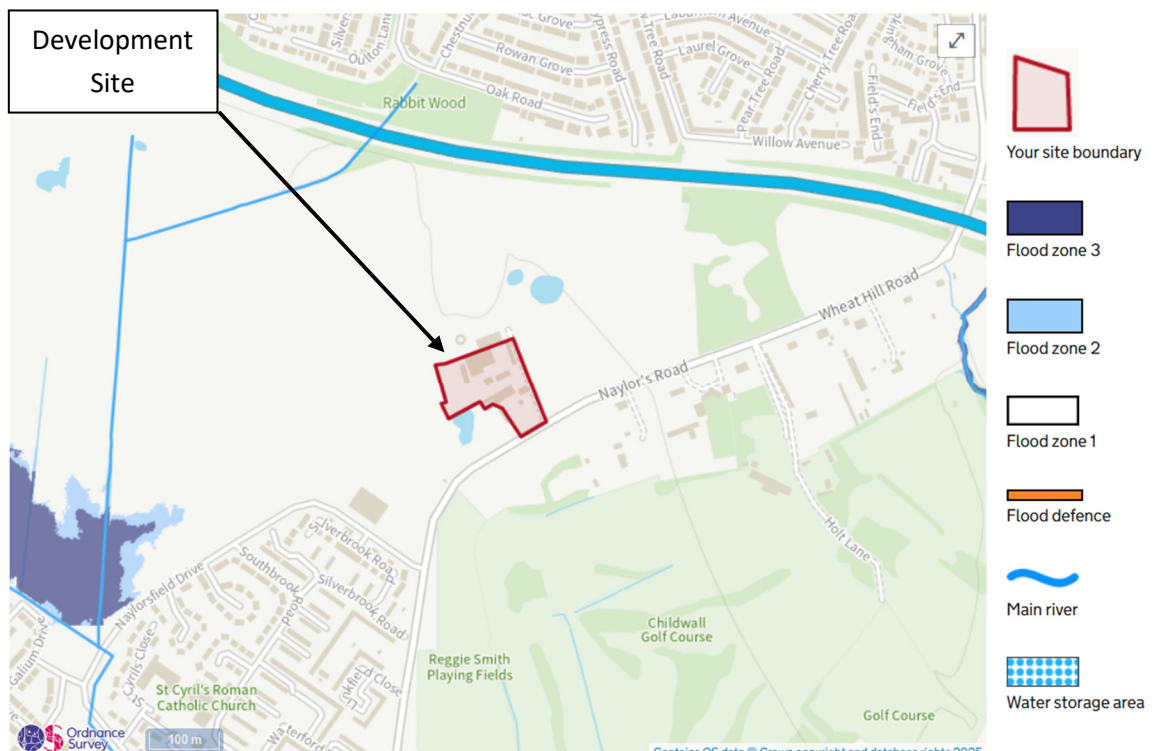
*Figure 3: Location Plan as taken from Google Maps (2025)*

## 2.3 Topography

- 2.3.1 No formal topographical survey has been completed. The area is very flat with existing school holding a finished floor level at approximately 19.70m AOD. The grassed play area holds a level of approximately 19.60m AOD.

### 3. Fluvial Flood Risk Review

- 3.1 Figure 4 below locates the site on the Environment Agency's indicative floodplain map. It is clear from this that the red line boundary sits outside of a fluvial generator of flood water from any identified water body or river. It is considered therefore that the site lays outside of the active 100-year and extreme event floodplains, thus lying within 'Flood Zone 1 Classification' in accordance with the 2024 National Planning Policy Framework (NPPF) Flood Risk Guidance Notes, i.e., probability of annual fluvial flooding significantly less than 1 in 1000 in any one year (<0.1%). The risk from fluvial flood water is diminished to acceptable levels, removing the requirement for further investigation and assessment of the fluvial flood regime.



**Figure 4: EA Indicative Flood Maps**

- 3.2 In addition, the development application boundary is less than 1ha in plan area. In line with criteria set within the NPPF a Flood Risk Assessment is not required to support a planning application if the development is less than 1ha and in Flood Zone 1.

## **4. Planning Policy**

### **4.1 Knowsley Sustainable Drainage**

4.1.1 Knowsley Metropolitan Borough Council Provide details on their website and within their Sustainable Drainage & surface Water Management – Technical Guidance for Developers, defining how SuDS can be integrated into the fabric of development starting at the planning stage and leading through the concept, outline and detailed design stages.

4.1.2 The main principles of the integration of SuDS for Major developments are summarised below and as taken from the CIRIA SuDS Manual:

- Sustainable surface water management is a material consideration for all planning applications. This means all development proposals must include a site-specific surface water drainage strategy following sustainable urban drainage guidelines (SuDS).
- On greenfield sites, surface water run off must be managed to achieve at least no increase in run off rates. Where possible, there should be a reduction in rates.
- On previously developed sites, run off proposals should demonstrate a reduction in rates in line with the non-Statutory Technical Standards for Sustainable Drainage Systems (2015) (or any later replacement standards).
- In line with Part H of the building regulations, surface water drainage options must be considered in the following order. An option higher in the hierarchy can only be agreed if it can be demonstrated that earlier options are not feasible.
  - i. Into the ground (infiltration)
  - ii. To a surface water body
  - iii. To a surface water sewer
  - iv. To a combined sewer
- Development in a critical drainage area should not result in the loss of open watercourses. Culverts should be opened where possible. We will only permit the culverting of existing watercourses if there is an overriding need. proposals must show how watercourses and riverside habitats will be conserved and enhanced.
- The Council as Lead Local Flood Authority are a statutory consultee for surface water drainage on all major planning applications. To approve an application, we need to be satisfied that:
  - i. The proposals are appropriate in relation to flood risk and pollution control.
  - ii. There are clear arrangements in place for ongoing maintenance

## 5. Outline Drainage Strategy

### 5.1 Existing Drainage

5.1.1 The United Utilities (UU) sewer records have been reviewed. These have indicated the head of a 300mm diameter foul water sewer beyond the south western corner of the site. No surface water sewers have been identified, though a 225mm diameter culvert is located in the centre of Naylor's Road flowing in a south westerly direction where it outfalls to Netherly Brook some 2km downstream.

5.1.2 The drainage plans for the current school have been reviewed with the foul draining to the foul sewer and the surface water to the culvert at restricted rates.

### 5.2 Existing Runoff

5.2.1 For the purpose of this assessment the area of the new classroom block will be classed as fully greenfield with greenfield discharge rates defined below.

5.3.2 Greenfield discharge calculations have been undertaken for the site in accordance with Rainfall Runoff Management for Developments (Report SC030219, October 2013, Defra/EA). In accordance with the Non-statutory Technical Standards for Sustainable Drainage Systems (March 2015, Defra) greenfield rates have been calculated for the 1 in 1 year,  $Q_{bar}$ , 1 in 30 and 1 in 100-year rainfall events. Figure 5 below provides a summary of the existing greenfield runoff rates based on an area of 0.014ha.

| Area  | Pro-Rata'd Greenfield Runoff Rates (l/s) |           |      |       |
|-------|------------------------------------------|-----------|------|-------|
|       | 1 yr                                     | $Q_{bar}$ | 30yr | 100yr |
| 0.014 | 0.07                                     | 0.08      | 0.14 | 0.18  |

*Figure 5: Existing Greenfield Runoff Rates*

### 5.3 Hydrological Assessment

5.3.1 Netherley Brook is located some 500m to the east of the site, flowing in a southerly direction.

### 5.4 Geology

5.4.1 A Phase 2 site-specific ground intrusive was carried out at the site in 2021 to support the design of the main school. This identified the ground conditions to consist of a brown clayey silt over a sandy clay.

5.4.1 Falling head tests were completed as part of the 2021 investigations with very little drop in water levels recorded. Based on these findings, infiltration has been discounted as a means of draining the site.

## 5.5 Sustainable Drainage Systems (SuDS) Assessment

### 5.5.1 SuDS Objectives

5.5.1.1 Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed both to manage the environmental risks resulting from urban runoff and to contribute wherever possible to environmental enhancement. SuDS objectives are therefore to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).

### 5.5.2 SuDS Design Themes

5.5.2.1 The 'Management Train Approach' should be central to the surface water drainage strategy of the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

- i. **Prevention** – The use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse / harvesting.
- ii. **Source Controls** – Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).
- iii. **Site Control** – Management of water in a local area and can include below ground storage / attenuation, detention basins, large infiltration devices.
- iv. **Regional Control** – Management of water from a site or various sites and can include wetlands and balancing ponds.

### 5.5.3 SuDS Site Constraints

5.5.3.1 SuDS techniques are suitable for all sites; therefore an assessment of the existing site is required so that SuDS limitations can be determined.

- *Land Use Characteristics:* The size and type of development has the potential for a range of source control and site control SuDS devices to be considered.
- *Site Characteristics:* Investigations have determined that infiltration-based options would not be possible.
- *Catchment Characteristics:* The site is currently classed for drainage purposes as 'Greenfield'.
- *Environmental and Amenity Performance:* The inclusion of SuDS within the overall development is a key driver in providing both amenity and habitat creation. All types of SuDS will be considered and blended into the project where feasible. Maintenance plans will be prepared for all SuDS devices that are included.

#### 5.5.4 SuDS Methods

5.5.4.1 Figure 6 and 7 on the following pages provide an assessment of various above and below ground SuDS methods that can provide water quality treatment and management of flows to reduce runoff rates & volumes, and whether they can be suitably incorporated at this development site. The purpose of this assessment is to set out options to be considered at the planning stage with consideration to time constraints, viability and lifetime maintenance of the residential development.

| Method                             | Comment                                                                                                                                                                                                                                                                                                                                             | Suitability for Development                                                                                                                                                                   |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Green Roofs                        | <ul style="list-style-type: none"> <li>Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater. Promotes evaporation and local biodiversity.</li> </ul>                                                                                                                                             | <p><u>Not suitable:</u></p> <ul style="list-style-type: none"> <li>Architectural proposals for the development and maintenance issues deem this unsuitable.</li> </ul>                        |
| Water Butts                        | <ul style="list-style-type: none"> <li>Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas for reuse by the property owners.</li> </ul>                                                                                                                                                        | <p><u>Not suitable:</u></p> <ul style="list-style-type: none"> <li>Small roof area and limited end use within school.</li> </ul>                                                              |
| Rainwater Harvesting               | <ul style="list-style-type: none"> <li>Rainwater harvesting reduces the total runoff volume from the developed site by reusing as 'Grey' water. Also reduces treated water consumption.</li> </ul>                                                                                                                                                  | <p><u>Not suitable:</u></p> <ul style="list-style-type: none"> <li>Additional costs of installation, running and maintenance would have severe effect on viability of development.</li> </ul> |
| Infiltration Options               | <ul style="list-style-type: none"> <li>Reduces total run off volume from the development by allowing water to infiltrate to suitable sub strata.</li> </ul>                                                                                                                                                                                         | <p><u>Not Suitable:</u></p> <ul style="list-style-type: none"> <li>Presence of cohesive ground would preclude infiltration options.</li> </ul>                                                |
| Permeable Surfacing (Infiltration) | <ul style="list-style-type: none"> <li>Reduces total run off volume from the development by allowing water to infiltrate to suitable sub strata.</li> <li>Can be used to enhance water quality.</li> </ul>                                                                                                                                          | <p><u>Not Suitable:</u></p> <ul style="list-style-type: none"> <li>Presence of cohesive ground would preclude infiltration options.</li> </ul>                                                |
| Permeable Surfacing (Standard)     | <ul style="list-style-type: none"> <li>Can be used to enhance quality of runoff water.</li> <li>Sub-base provides 'source' storage and reduces the volume of storage downstream with selection of stone fill or use of plastic box stems.</li> <li>Impermeable membrane at base of construction to prevent impact on pavement stability.</li> </ul> | <p><u>Not Suitable:</u></p> <ul style="list-style-type: none"> <li>No new parking areas proposed.</li> </ul>                                                                                  |
| Bio-Retention                      | <ul style="list-style-type: none"> <li>Collect and retain run-off within tree pits or above ground planers to help improve water quality, prior to discharge in piped system or infiltration.</li> </ul>                                                                                                                                            | <p><u>Not Suitable:</u></p> <ul style="list-style-type: none"> <li>The size and type of the development restricts the use of above ground surface runoff storage.</li> </ul>                  |
| Swales, basins and ponds           | <ul style="list-style-type: none"> <li>Provide areas for above ground surface runoff storage.</li> <li>Swales also improve water quality through filtration.</li> </ul>                                                                                                                                                                             | <p><u>Not Suitable:</u></p> <ul style="list-style-type: none"> <li>No space for any ponds or swales.</li> </ul>                                                                               |

**Figure 6: Surface SuDS Methods**

| Method                                  | Comment                                                                                                                                                                                                                                                                                                                                                                      | Suitability for Development                                                                                                                                                   |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Geocellular Storage                     | <ul style="list-style-type: none"> <li>• Suitable for sites with insufficient space for basins etc.</li> <li>• Suitable for sites where topography prevents the use of open basins etc.</li> </ul>                                                                                                                                                                           | <u>Suitable:</u> <ul style="list-style-type: none"> <li>• Subject to detailed design and drainage layout has the potential to be used to attenuate the peak flows.</li> </ul> |
| Large Diameter Pipes, Culverts or Tanks | <ul style="list-style-type: none"> <li>• Suitable for sites with insufficient space for basins etc.</li> <li>• Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning.</li> <li>• Generally, be suitable for adoption by the statutory water company (e.g., United Utilities).</li> </ul> | <u>Not Suitable:</u> <ul style="list-style-type: none"> <li>• The use of oversized pipes is more suited to large residential schemes.</li> </ul>                              |

**Figure 7: Sub-Surface SuDS Methods**

#### 5.5.5 SuDS Hierarchal Approach

Based on the SuDS assessment in Tables 6 & 7, plus an assessment of the local site conditions, the SuDS hierarchal approach for discharge of surface water at the development site is considered in greater detail below:

| Method                            | Suitability | Suitability for Development                                                                                                                                                                     |
|-----------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Infiltration to Ground            | No          | Previous investigations have indicated that the underlying clay ground would not be suitable for infiltration-based options.                                                                    |
| Connection to Watercourse         | Yes         | Although no watercourse in close proximity, connection will be made to the existing school network that outfalls to a culvert in Naylor's Road and that ultimately outfalls to Netherley Brook. |
| Connection to Surface Water Sewer | No          | No surface water sewer in close proximity                                                                                                                                                       |
| Connection to a Combined Sewer    | No          | Higher options available.                                                                                                                                                                       |

**Figure 8: SuDS Hierarchal Approach**

#### 5.5.6 SuDS Design Philosophy

5.5.6.1 SuDS assessment and hierarchal approach discussed in Figure 6, 7 and 8 above has defined the overall SuDS strategy. Thus, the SuDS philosophy for the development site is the promotion of prevention, source control and site control techniques with discharge to the adjacent surface water sewer at a restricted rate.

The following design philosophy is proposed:

- Aim to reduce the impermeable fraction of development.
- Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance to the existing drainage infrastructure.
- Site control in the form of a new flow control at restricted rates and which outfalls to the existing school network that flows off site at the retained flows.

## 5.6 The Non-Statutory Technical Standards for SuDS

5.7.1 It is best practice to develop drainage strategies to the DEFRA document 'The Non-Statutory Technical Standards for SuDS'. The Knowsley Metropolitan Borough Council SuDS document also follows the principles of this document.

5.7.2 The DEFRA document advises the following with respect to 'Peak Flow Control' (S2) and 'Volume Control' (S4) for Greenfield sites such as this:

- **S2** *For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield runoff rate for the same event.*
- **S4** *Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event should never exceed the greenfield runoff volume for the same event.*
- **S6** *Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.*

5.7.3 As noted above, and in line with policy, it is intended that surface water discharge rates will be restricted close to the respective greenfield runoff rates for all rainfall events in accordance with standard **S2** and to comply with the peak volume requirements as per **S4** and **S6**. A Maximum rate of 2.0l/s will therefore be applied to the flow control. Though the peak flow actually discharging from the school will be retained at the existing rates.

## 5.7 Climate Change

5.8.1 In May 2022, the Environment Agency released updated climate change allowances for peak rainfall intensities which should be applied to new developments. Rather than nation wide allowances, each area will have its own peak rainfall allowances. In the case of the Liverpool area, this is the Lower Mersey Management Catchment peak rainfall allowances.

5.8.2 Based on the nature of the educational development, a lifespan of circa 100 years is anticipated. Therefore, the potential climate change allowance for the 2070's Upper end Allowance for educational developments is 45%, which will be included in the hydraulic calculations.

## **5.8 Outline Surface Water Drainage Strategy**

- 5.8.1 The general principal of the surface water drainage strategy is to collect the runoff from the roof areas of the new classroom block and direct it into an underground drainage network that will outfall at a restricted rate of 2l/s to the existing school network. This flows in a south easterly direction across the school before outfalling to the culvert in Naylor's Road at a peak restricted rate of 27l/s. Thus, the flow rates passing off site will not be changed.
- 5.8.2 The proposed drainage layout for the new development site will be designed in accordance with BS EN 752: 2008 and Building Regulations Part H guidance, i.e. up to the 30-year storm return period criterion and tested for the 1 in 100-year return period including a 45% increase to account for climate change to confirm that there is no flood risk to the classroom block.
- 5.8.3 A fully detailed hydraulic surface water network has been simulated in the Causeway 'Flow' Design Software. Taking account of the flow control of 2l/s no flooding will occur up to the extreme 100 year + 45% CC storm event. It is noted that these rates and volumes are preliminary for this outline assessment and are likely to alter at detailed design stage when more site-specific information is made available.
- 5.9.4 Drawing PGC1249-DR-C-001 in Appendix C indicates the Drainage Strategy based on the Architects masterplan intent, with the outline hydraulic calculations in Appendix D.

## **5.10 Volume Control**

- 5.10.1 The impermeable area of the application site will be increased as a result of the development and therefore the volume of run-off in the 100-year 6-hour storm event will be increased above the pre-development greenfield level. The management of the additional volume through infiltration or re-use is not considered reasonably practicable for the development and therefore the rate of runoff will be restricted to a maximum of 2l/s, for all storm events, in order to prevent an adverse effect on flood risk.

## **5.11 Pollution Control**

- 5.11.1 Runoff from roofs is generally considered to be clean and will be discharged directly into the new drainage network. Figure 9 illustrates the pollution hazard indices for different land use classifications from The CIRIA SuDS Manual C753 (2015).

| Land use                                                                                                                                                                                                                                                                                                               | Pollution hazard level | Total suspended solids (TSS) | Metals                                                                     | Hydrocarbons     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------------|----------------------------------------------------------------------------|------------------|
| Residential roofs                                                                                                                                                                                                                                                                                                      | Very low               | 0.2                          | 0.2                                                                        | 0.05             |
| Other roofs (typically commercial/ industrial roofs)                                                                                                                                                                                                                                                                   | Low                    | 0.3                          | 0.2 (up to 0.8 where there is potential for metals to leach from the roof) | 0.05             |
| Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day                                                                               | Low                    | 0.5                          | 0.4                                                                        | 0.4              |
| Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways <sup>1</sup>                                                                                                                                 | Medium                 | 0.7                          | 0.6                                                                        | 0.7              |
| Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways <sup>1</sup> | High                   | 0.8 <sup>2</sup>             | 0.8 <sup>2</sup>                                                           | 0.9 <sup>2</sup> |

**Figure 9: Pollution Hazard indices for land use classification (Table 26.2 the CIRIA SuDS manual 2015)**

- 5.11.2 Figure 10 then illustrates the SuDS Component mitigation indices from the CIRIA SuDS Manual C753 (2015)
- 5.11.3 The selection of treatment should ensure that the SuDS mitigation component index (Figure 10) exceeds the pollution hazard index (Figure 9).

| Type of SuDS component                       | Mitigation indices <sup>1</sup>                                                                                                                                                                                                                    |        |              |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------|
|                                              | TSS                                                                                                                                                                                                                                                | Metals | Hydrocarbons |
| Filter strip                                 | 0.4                                                                                                                                                                                                                                                | 0.4    | 0.5          |
| Filter drain                                 | 0.4 <sup>2</sup>                                                                                                                                                                                                                                   | 0.4    | 0.4          |
| Swale                                        | 0.5                                                                                                                                                                                                                                                | 0.6    | 0.6          |
| Bioretention system                          | 0.8                                                                                                                                                                                                                                                | 0.8    | 0.8          |
| Permeable pavement                           | 0.7                                                                                                                                                                                                                                                | 0.6    | 0.7          |
| Detention basin                              | 0.5                                                                                                                                                                                                                                                | 0.5    | 0.6          |
| Pond <sup>4</sup>                            | 0.7 <sup>3</sup>                                                                                                                                                                                                                                   | 0.7    | 0.5          |
| Wetland                                      | 0.8 <sup>3</sup>                                                                                                                                                                                                                                   | 0.8    | 0.8          |
| Proprietary treatment systems <sup>5,6</sup> | These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area. |        |              |

**Notes**

- 1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.
- 2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.
- 3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.
- 4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.
- 5 See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: <http://tinyurl.com/qf7yuj7>
- 6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

**Figure 10: Indicative SuDS mitigation indices (Table 26.3 the CIRIA SuDS manual 2015)**

5.11.4 The roof areas have a have low pollution hazard level and thus no further treatment is required.

## 5.12 Maintenance

5.12.1 This section is intended to give an overview of the operation and maintenance for the drainage features included with the drainage strategy and in relation to typical details. Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints. The recommended operations and frequencies are typical only and should be more frequent initially to ensure that there are no unforeseen issues with the operation and then adjusted to suit the site requirements.

5.12.2 There are three types of maintenance activities associated with surface water drainage systems. The SuDS Manual, CIRIA C753, defines these as:

- Regular Maintenance – *'basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections.'*
- Occasional Maintenance – *'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example).'*
- Remedial Maintenance – *'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.'*

### 5.12.3 Piped Networks, Inspection, Manhole and Catchpit Chambers

The appropriate health and safety equipment must be used when accessing manholes. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained where required.

Pipes are proprietary products, and the materials can vary across the site and as such where used the manufacture's recommendations should be followed.

Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except for during rainfall events. These have been designed to be self-cleaning where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

Access for maintenance is provided through access chambers and manholes.

Regular inspection and maintenance are important to identify areas which may have been obstructed / clogged and may not be drainage correctly thus exposing the development to a greater level of flood risk.

| Maintenance Schedule                     | Required Action                                                                                                                         | Typical Frequency                          |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| <b>Regular Maintenance</b>               | Inspect and identify any features that are not operating correctly. If required, take remedial action                                   | Monthly for three months, then six monthly |
|                                          | Debris removal from catchment surface / gratings (where may cause risks to performance)                                                 | Monthly (and after large storms)           |
|                                          | Remove sediment from trapped sumps, manholes and catchpits.                                                                             | Annually or as required                    |
| <b>Remedial Maintenance</b>              | Repair / rehabilitation of gratings, inlets and outlets                                                                                 | As required                                |
| <b>Monitoring</b>                        | Inspect / check all gratings, trapped sumps, manholes and catchpits to ensure that they are in good condition and operating as designed | Annually and after large storm events      |
| <b>Structure Rehabilitation / Repair</b> | Regular Maintenance and Monitoring to identify if repair and / or replacement of features or pipework is required.                      | As required                                |

**Figure 11: Operation and Maintenance Requirements of Piped Networks and Inspection Chambers**

#### 5.12.5 Flow Control Units

The flow control units are intended for flood control and flow restriction.

The flow control is specified as Hydro-brake and is a proprietary product; therefore, manufacturer's recommendations should also be taken into consideration.

Access for maintenance has been provided by locating within manhole chambers.

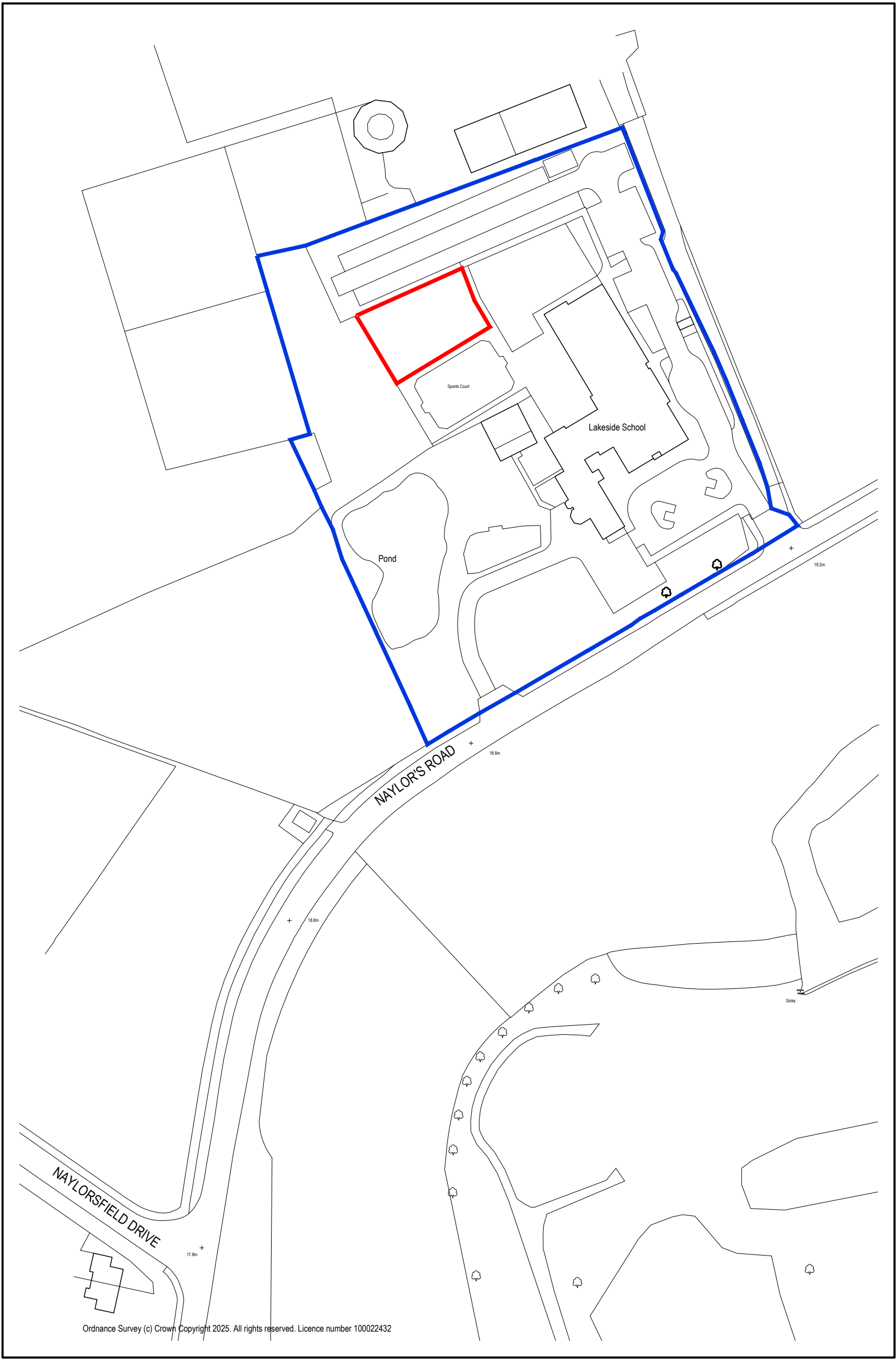
| Maintenance Schedule                                                                                             | Required Action                                                                                                 | Frequency                                             |
|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| <b>Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).</b> | Inspect inlets for blockages, and clear if required. If faults persist jetting and CCTV survey may be required. | Monthly and after large storms.                       |
| <b>Regular maintenance</b>                                                                                       | Inspect and identify any areas that are not operating correctly. If required, take remedial action.             | Monthly for 3 months, then six monthly.               |
|                                                                                                                  | Debris removal from catchment surface (where may cause risks to performance).                                   | Monthly                                               |
|                                                                                                                  | Remove sediment from pre- treatment structures and flow control chambers.                                       | Annually (or as required after heavy rainfall events) |
| <b>Remedial Actions</b>                                                                                          | Repair/rehabilitation of inlets.                                                                                | As required.                                          |

**Figure 13: Operation and Maintenance Requirements for Flow Controls**

### 5.13 Foul Water Drainage

- 5.13.1 Foul flows generated by the new classroom block will discharge via a new below ground foul drainage network to the existing foul network serving the main school and which outfalls to the UU foul water sewer.
- 5.13.2 The proposed foul drainage for the new development site will be designed in accordance with BS EN 752: 2008 and Building Regulations Part H guidance.

## **Appendix A – Architects Drawings**



SITE LOCATION PLAN @ 1:1250

0 5 10 20 30 40 50 100



PLANNING APPLICATION

space  
architecture and design limited

Park Bottom  
Littton  
Skipton  
BD23 5QJ

t: 01756 530104  
m: 07785 146905  
e: md@spacearchitecture.net  
w: www.spacearchitecture.net

Client  
The Witherslack Group Ltd

Project  
Proposed New Classroom Building  
Lakeside School, Naylor's Road  
Liverpool  
L27 2YA

Drawing Title  
Proposed Site Layout Plan

| Scale | Alt | Scale | Alt | Date         | Drawn | Checked | Drawing Number | Revision |
|-------|-----|-------|-----|--------------|-------|---------|----------------|----------|
| 1:300 |     | 1:600 |     | 19.02.25 MJD | mjd   |         | 25.002(9-1002  |          |



| Copyright All rights reserved. This drawing must not be reproduced without permission.<br>Revisions are to be indicated unless otherwise specified. |                             |          |     |       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------|-----|-------|
| no.                                                                                                                                                 | description                 | date     | by  | check |
| A                                                                                                                                                   | proposed building relocated | 11.03.25 | mjd | mjd   |



# PLANNING APPLICATION

**space**  
architecture and design limited

Park Bottom  
Littton  
Skipton  
BD23 5QJ

t: 01756 530104  
m: 07785 146905  
e: mjd@spacearchitecture.net  
w: www.spacearchitecture.net

Client  
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Proposed New Classroom Building  
Lakeside School, Naylor's Road  
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Drawing Title  
Proposed Site Layout Plan

| Scale | Alt | Scale | Alt | Date         | Drawn | Checked | Drawing Number | Revision |
|-------|-----|-------|-----|--------------|-------|---------|----------------|----------|
| 1:300 |     | 1:600 |     | 19.02.25 MJD | mjd   | mjd     | 25.002(9)-J002 |          |

## **Appendix B – PGC Drawings**



EX SW MH  
CL: 19.72  
IL: 18.25

#### FOUL WATER DRAINAGE

FOUL WATER GENERATED BY THE NEW CLASSROOM BLOCK WILL CONNECT TO THE EXISTING SCHOOL NETWORKS THAT OUTFALLS TO THE UU FOUL SEWER.

#### SURFACE WATER DRAINAGE

CONSIDERATION HAS BEEN GIVEN TO THE HIERARCHY OF DRAINAGE OPTIONS FOR THE SITE AS FOLLOWS:

- DISCHARGE INTO GROUND - UNDERLYING CLAYS AND SILTS WOULD PRECLUDE INFILTRATION AS A MEANS OF DRAINING THE SITE.
- DISCHARGE TO SURFACE WATER BODY - REUSE EXISTING CONNECTION TO THE CULVERT IN NAYLORS ROAD AT A PEAK RATE OF 2L/S.
- DISCHARGE TO SURFACE WATER SEWER, HIGHWAY DRAIN OR OTHER DRAINAGE SYSTEM - NO SURFACE WATER SEWER IN CLOSE PROXIMITY.
- DISCHARGE TO COMBINED WATER SEWER - HIGHER OPTIONS AVAILABLE.

#### SUMMARY

NEW CONNECTION TO EXISTING SCHOOL NETWORK AT A PEAK RATE OF 2L/S.

#### SUDS TO ENCOMPASS:

- FLOW CONTROLS.

#### SUMMARY

IMPERMEABLE AREA: 140m<sup>2</sup> (NEW)  
OUTFALL LOCATION: CULVERT  
PEAK DISCHARGE RATE: 2.0 L/S (100YR + 45%). THOUGH CONTROL RATE FLOWING OFF THE SCHOOL SITE WILL REMAIN AS EXISTING.

## GENERAL NOTES

- DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, ENGINEERS, ARCHITECTS & SERVICES DRAWINGS, INCLUDING APPROVED BUILDERS WORK DRAWINGS. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES BETWEEN STRUCTURAL DRAWINGS AND SPECIFICATIONS OR OTHER DRAWINGS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
- DETAILS OF EXISTING SEWERS SHALL BE CONFIRMED BY THE CONTRACTOR ON SITE PRIOR TO THE COMMENCEMENT OF WORKS. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY. THE CONTRACTOR SHOULD CHECK THE LEVELS OF ALL NEW OUT FALLS IN RELATION TO EXISTING SEWERS PRIOR TO ANY CONSTRUCTION TO ENSURE THE PROPOSED DESIGN CAN BE ACHIEVED.
- DO NOT SCALE FROM THIS DRAWN, WORK TO DIMENSIONS OR COORDINATES PROVIDED. ALL LEVELS ARE IN MILLIMETRES, UNLESS OTHERWISE NOTED. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER IMMEDIATELY.

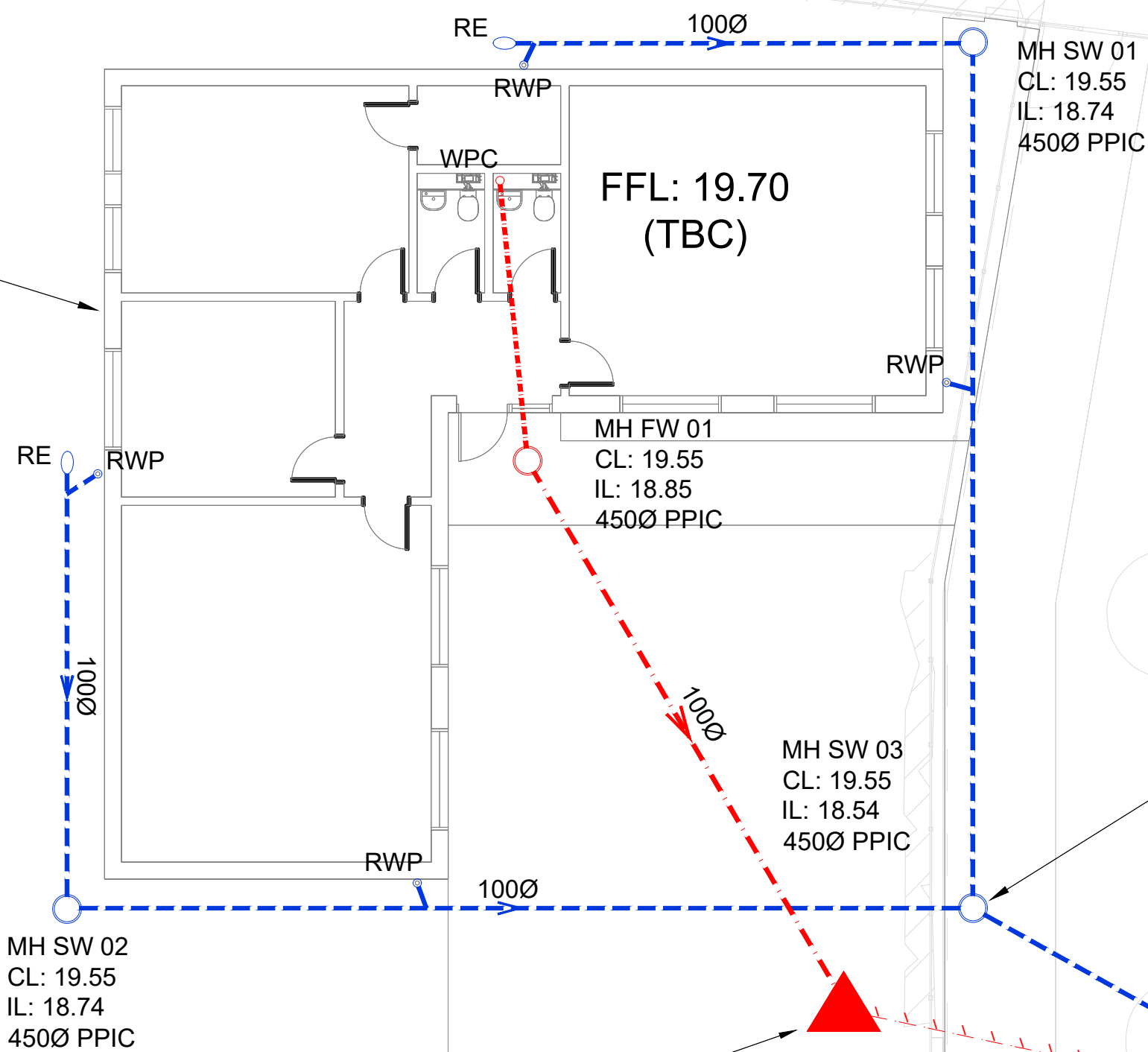
## KEY

- PROPOSED SURFACE WATER DRAINAGE
- EXISTING SURFACE WATER DRAINAGE
- EXISTING FOUL WATER DRAINAGE
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED FOUL WATER DRAINAGE

NOTE ALL RWP AND SVP LOCATIONS AND PROPOSED LEVELS TO BE CONFIRMED BY OTHERS

ALL PIPEWORK TO BE 100Ø UNLESS NOTED OTHERWISE

PROPOSED CLASSROOM BLOCK



FOUL WATER PUMPING STATION WITH KIOSK, BEACON, HIGH LEVEL ALARM, VENT ETC. RISING MAIN SIZED BY SPECIALIST TO SUIT FLOW RATES AND DESIGN HEAD.

32Ø ORIFICE PLATE FLOW CONTROL PLACED WITHIN MANHOLE TO RESTRICT OUTFLOWS TO A MAXIMUM OF 2.0L/S FOR ALL EVENTS

FOUL WATER RISING MAIN

EX FW MH  
CL: 19.65  
IL: 19.14

EX FW MH  
CL: 19.68  
IL: 19.10

EX SW MH  
CL: 19.60  
IL: 18.24

EX SW MH  
CL: 19.60  
IL: 18.39

EX SW MH  
CL: 19.70  
IL: 18.30

NEW CONNECTIONS TO EXISTING CHAMBERS

NOTE THIS DRAWING IS ISSUED TO SUPPORT THE PLANNING APPLICATION ONLY. FINAL DRAINAGE LAYOUT AND SUDS CONFIGURATION SUBJECT TO FINAL SITE LAYOUT AND DETAILED DESIGN

|                                                                                                             |          |          |       |                           |
|-------------------------------------------------------------------------------------------------------------|----------|----------|-------|---------------------------|
| P2                                                                                                          | 12.03.25 | PG       | PG    | BUILDING POSITION REVISED |
| P1                                                                                                          | 10.03.25 | PG       | PG    | PRELIMINARY ISSUE         |
| REV                                                                                                         | DATE     | DRAWN    | REV'D | NOTES                     |
| CLIENT                                                                                                      |          |          |       |                           |
| WITHERSLACK GROUP LTD                                                                                       |          |          |       |                           |
| PROJECT                                                                                                     |          |          |       |                           |
| LAKESIDE SCHOOL,<br>NAYLORS ROAD, LIVERPOOL                                                                 |          |          |       |                           |
| DRAWING TITLE                                                                                               |          |          |       |                           |
| DRAINAGE STRATEGY PLAN                                                                                      |          |          |       |                           |
| DRAWING STATUS                                                                                              |          |          |       |                           |
| INFORMATION                                                                                                 |          |          |       |                           |
| SCALE                                                                                                       | 1:125    | DRAWN BY | PG    | ENGINEER                  |
|                                                                                                             |          |          |       | PG                        |
|                                                                                                             |          |          |       | SHEET                     |
|                                                                                                             |          |          |       | A1                        |
| DRAWING No                                                                                                  |          |          |       | REVISION                  |
| PGC1249-DR-C-001                                                                                            |          |          |       | P2                        |
| <b>PG Consulting</b><br>Civil & Infrastructure Engineers                                                    |          |          |       |                           |
| 106 Ack Lane West,<br>Cheadle Hulme,<br>Cheshire,<br>SK8 7ES<br>Tel: 07710 758971<br>Email: paul@pgcd.co.uk |          |          |       |                           |

## **Appendix C – Outline Hydraulic Calculations**

### Design Settings

|                       |                   |                                      |               |
|-----------------------|-------------------|--------------------------------------|---------------|
| Rainfall Methodology  | FSR               | Maximum Time of Concentration (mins) | 30.00         |
| Return Period (years) | 10                | Maximum Rainfall (mm/hr)             | 50.0          |
| Additional Flow (%)   | 0                 | Minimum Velocity (m/s)               | 1.00          |
| FSR Region            | England and Wales | Connection Type                      | Level Soffits |
| M5-60 (mm)            | 20.000            | Minimum Backdrop Height (m)          | 0.200         |
| Ratio-R               | 0.400             | Preferred Cover Depth (m)            | 1.200         |
| CV                    | 0.750             | Include Intermediate Ground          | ✓             |
| Time of Entry (mins)  | 4.00              | Enforce best practice design rules   | ✓             |

### Adoptable Manhole Type

| Max Width (mm) | Diameter (mm) | Max Width (mm) | Diameter (mm) |
|----------------|---------------|----------------|---------------|
| 374            | 1200          | 749            | 1500          |
| 499            | 1350          | 900            | 1800          |

>900 Link+900 mm

| Max Depth (m) | Diameter (mm) | Max Depth (m) | Diameter (mm) |
|---------------|---------------|---------------|---------------|
| 1.500         | 1050          | 99.999        | 1200          |

### Circular Link Type

|         |          |                     |    |
|---------|----------|---------------------|----|
| Shape   | Circular | Auto Increment (mm) | 75 |
| Barrels | 1        | Follow Ground       | x  |

### Available Diameters (mm)

100 | 150

### Nodes

| Name  | Area<br>(ha) | T of E<br>(mins) | Cover<br>Level<br>(m) | Diameter<br>(mm) | Depth<br>(m) |
|-------|--------------|------------------|-----------------------|------------------|--------------|
| RE01  | 0.003        | 4.00             | 19.550                | 100              | 0.700        |
| SW01  | 0.003        | 4.00             | 19.550                | 450              | 0.810        |
| RE02  | 0.004        | 4.00             | 19.550                | 100              | 0.700        |
| SW02  | 0.004        | 4.00             | 19.550                | 450              | 0.810        |
| SW03  |              |                  | 19.550                | 450              | 1.010        |
| EX MH |              |                  | 19.600                | 450              | 1.360        |

### Links

| Name  | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|-------|---------|---------|------------|-------------|-----------|-----------|----------|-------------|----------|---------------|--------------|
| 1.000 | RE01    | SW01    | 8.500      | 0.600       | 18.850    | 18.740    | 0.110    | 77.3        | 100      | 4.16          | 50.0         |
| 1.001 | SW01    | SW03    | 15.500     | 0.600       | 18.740    | 18.540    | 0.200    | 77.5        | 100      | 4.46          | 50.0         |
| 2.000 | RE02    | SW02    | 8.000      | 0.600       | 18.850    | 18.740    | 0.110    | 72.7        | 100      | 4.15          | 50.0         |
| 2.001 | SW02    | SW03    | 16.000     | 0.600       | 18.740    | 18.540    | 0.200    | 80.0        | 100      | 4.46          | 50.0         |
| 1.002 | SW03    | EX MH   | 27.000     | 0.600       | 18.540    | 18.240    | 0.300    | 90.0        | 100      | 5.01          | 50.0         |

| Name  | Vel (m/s) | Cap (l/s) | Flow (l/s) | US Depth (m) | DS Depth (m) | Σ Area (ha) | Σ Add Inflow (l/s) | Pro Depth (mm) | Pro Velocity (m/s) |
|-------|-----------|-----------|------------|--------------|--------------|-------------|--------------------|----------------|--------------------|
| 1.000 | 0.876     | 6.9       | 0.4        | 0.600        | 0.710        | 0.003       | 0.0                | 17             | 0.479              |
| 1.001 | 0.875     | 6.9       | 0.8        | 0.710        | 0.910        | 0.006       | 0.0                | 23             | 0.582              |
| 2.000 | 0.903     | 7.1       | 0.5        | 0.600        | 0.710        | 0.004       | 0.0                | 19             | 0.537              |
| 2.001 | 0.861     | 6.8       | 1.1        | 0.710        | 0.910        | 0.008       | 0.0                | 27             | 0.628              |
| 1.002 | 0.811     | 6.4       | 1.9        | 0.910        | 1.260        | 0.014       | 0.0                | 37             | 0.704              |

### Pipeline Schedule

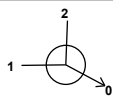
| Link  | Length (m) | Slope (1:X) | Dia (mm) | Link Type | US CL (m) | US IL (m) | US Depth (m) | DS CL (m) | DS IL (m) | DS Depth (m) |
|-------|------------|-------------|----------|-----------|-----------|-----------|--------------|-----------|-----------|--------------|
| 1.000 | 8.500      | 77.3        | 100      | Circular  | 19.550    | 18.850    | 0.600        | 19.550    | 18.740    | 0.710        |
| 1.001 | 15.500     | 77.5        | 100      | Circular  | 19.550    | 18.740    | 0.710        | 19.550    | 18.540    | 0.910        |
| 2.000 | 8.000      | 72.7        | 100      | Circular  | 19.550    | 18.850    | 0.600        | 19.550    | 18.740    | 0.710        |
| 2.001 | 16.000     | 80.0        | 100      | Circular  | 19.550    | 18.740    | 0.710        | 19.550    | 18.540    | 0.910        |
| 1.002 | 27.000     | 90.0        | 100      | Circular  | 19.550    | 18.540    | 0.910        | 19.600    | 18.240    | 1.260        |

| Link  | US Node | Dia (mm) | Node Type | MH Type   | DS Node | Dia (mm) | Node Type | MH Type   |
|-------|---------|----------|-----------|-----------|---------|----------|-----------|-----------|
| 1.000 | RE01    | 100      | Manhole   | Adoptable | SW01    | 450      | Manhole   | Adoptable |
| 1.001 | SW01    | 450      | Manhole   | Adoptable | SW03    | 450      | Manhole   | Adoptable |
| 2.000 | RE02    | 100      | Manhole   | Adoptable | SW02    | 450      | Manhole   | Adoptable |
| 2.001 | SW02    | 450      | Manhole   | Adoptable | SW03    | 450      | Manhole   | Adoptable |
| 1.002 | SW03    | 450      | Manhole   | Adoptable | EX MH   | 450      | Manhole   | Adoptable |

### Manhole Schedule

| Node | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections                                                                         | Link  | IL (m) | Dia (mm) |
|------|-------------|--------------|--------|-----------|----------|-------------------------------------------------------------------------------------|-------|--------|----------|
| RE01 | 18.486      | 90.508       | 19.550 | 0.700     | 100      |  |       |        |          |
|      |             |              |        |           |          | 0                                                                                   | 1.000 | 18.850 | 100      |
| SW01 | 48.825      | 90.339       | 19.550 | 0.810     | 450      |  | 1     | 1.000  | 18.740   |
|      |             |              |        |           |          | 0                                                                                   | 1.001 | 18.740 | 100      |
| RE02 | 18.994      | 78.644       | 19.550 | 0.700     | 100      |  |       |        |          |
|      |             |              |        |           |          | 0                                                                                   | 2.000 | 18.850 | 100      |
| SW02 | 18.994      | 67.288       | 19.550 | 0.810     | 450      |  | 1     | 2.000  | 18.740   |
|      |             |              |        |           |          | 0                                                                                   | 2.001 | 18.740 | 100      |

### Manhole Schedule

| Node  | Easting<br>(m) | Northing<br>(m) | CL<br>(m) | Depth<br>(m) | Dia<br>(mm) | Connections                                                                       | Link | IL<br>(m) | Dia<br>(mm) |
|-------|----------------|-----------------|-----------|--------------|-------------|-----------------------------------------------------------------------------------|------|-----------|-------------|
| SW03  | 47.977         | 67.627          | 19.550    | 1.010        | 450         |  | 1    | 2.001     | 18.540      |
|       |                |                 |           |              |             |                                                                                   | 2    | 1.001     | 18.540      |
|       |                |                 |           |              |             |                                                                                   | 0    | 1.002     | 18.540      |
| EX MH | 101.537        | 38.983          | 19.600    | 1.360        | 450         |  | 1    | 1.002     | 18.240      |
|       |                |                 |           |              |             |                                                                                   |      |           | 100         |

### Simulation Settings

|                      |                   |                            |        |
|----------------------|-------------------|----------------------------|--------|
| Rainfall Methodology | FSR               | Analysis Speed             | Normal |
| Rainfall Events      | Singular          | Skip Steady State          | x      |
| FSR Region           | England and Wales | Drain Down Time (mins)     | 240    |
| M5-60 (mm)           | 20.000            | Additional Storage (m³/ha) | 20.0   |
| Ratio-R              | 0.400             | Starting Level (m)         |        |
| Summer CV            | 0.750             | Check Discharge Rate(s)    | x      |
| Winter CV            | 0.840             | Check Discharge Volume     | x      |

### Storm Durations

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

| Return Period<br>(years) | Climate Change<br>(CC %) | Additional Area<br>(A %) | Additional Flow<br>(Q %) |
|--------------------------|--------------------------|--------------------------|--------------------------|
| 1                        | 0                        | 0                        | 0                        |
| 30                       | 0                        | 0                        | 0                        |
| 100                      | 45                       | 0                        | 0                        |

### Node SW03 Online Orifice Control

|                          |        |                   |       |                       |       |
|--------------------------|--------|-------------------|-------|-----------------------|-------|
| Flap Valve               | x      | Design Depth (m)  | 0.800 | Discharge Coefficient | 0.600 |
| Replaces Downstream Link | x      | Design Flow (l/s) | 2.0   |                       |       |
| Invert Level (m)         | 18.540 | Diameter (m)      | 0.032 |                       |       |

### Approval Settings

|                             |         |                                     |       |
|-----------------------------|---------|-------------------------------------|-------|
| Node Size                   | ✓       | Minimum Full Bore Velocity (m/s)    |       |
| Node Losses                 | ✓       | Maximum Full Bore Velocity (m/s)    | 3.000 |
| Link Size                   | ✓       | Proportional Velocity               | ✓     |
| Minimum Diameter (mm)       | 150     | Return Period (years)               |       |
| Link Length                 | ✓       | Minimum Proportional Velocity (m/s) | 0.750 |
| Maximum Length (m)          | 100.000 | Maximum Proportional Velocity (m/s) | 3.000 |
| Coordinates                 | ✓       | Surcharged Depth                    | ✓     |
| Accuracy (m)                | 1.000   | Return Period (years)               |       |
| Crossings                   | ✓       | Maximum Surcharged Depth (m)        | 0.100 |
| Cover Depth                 | ✓       | Flooding                            | ✓     |
| Minimum Cover Depth (m)     |         | Return Period (years)               | 30    |
| Maximum Cover Depth (m)     | 3.000   | Time to Half Empty                  | x     |
| Backdrops                   | ✓       | Discharge Rates                     | ✓     |
| Minimum Backdrop Height (m) |         | Discharge Volume                    | ✓     |
| Maximum Backdrop Height (m) | 1.500   | 100 year 360 minute (m³)            |       |
| Full Bore Velocity          | ✓       |                                     |       |

### Rainfall

| Event                     | Peak<br>Intensity<br>(mm/hr) | Average<br>Intensity<br>(mm/hr) | Event                               | Peak<br>Intensity<br>(mm/hr) | Average<br>Intensity<br>(mm/hr) |
|---------------------------|------------------------------|---------------------------------|-------------------------------------|------------------------------|---------------------------------|
| 1 year 15 minute summer   | 109.521                      | 30.991                          | 30 year 360 minute summer           | 31.221                       | 8.034                           |
| 1 year 15 minute winter   | 76.857                       | 30.991                          | 30 year 360 minute winter           | 20.295                       | 8.034                           |
| 1 year 30 minute summer   | 71.439                       | 20.215                          | 30 year 480 minute summer           | 24.324                       | 6.428                           |
| 1 year 30 minute winter   | 50.133                       | 20.215                          | 30 year 480 minute winter           | 16.160                       | 6.428                           |
| 1 year 60 minute summer   | 48.435                       | 12.800                          | 30 year 600 minute summer           | 19.756                       | 5.404                           |
| 1 year 60 minute winter   | 32.179                       | 12.800                          | 30 year 600 minute winter           | 13.498                       | 5.404                           |
| 1 year 120 minute summer  | 30.053                       | 7.942                           | 30 year 720 minute summer           | 17.490                       | 4.687                           |
| 1 year 120 minute winter  | 19.966                       | 7.942                           | 30 year 720 minute winter           | 11.754                       | 4.687                           |
| 1 year 180 minute summer  | 23.233                       | 5.979                           | 30 year 960 minute summer           | 14.215                       | 3.743                           |
| 1 year 180 minute winter  | 15.102                       | 5.979                           | 30 year 960 minute winter           | 9.416                        | 3.743                           |
| 1 year 240 minute summer  | 18.475                       | 4.882                           | 30 year 1440 minute summer          | 10.161                       | 2.723                           |
| 1 year 240 minute winter  | 12.274                       | 4.882                           | 30 year 1440 minute winter          | 6.829                        | 2.723                           |
| 1 year 360 minute summer  | 14.169                       | 3.646                           | 100 year +45% CC 15 minute summer   | 505.670                      | 143.087                         |
| 1 year 360 minute winter  | 9.210                        | 3.646                           | 100 year +45% CC 15 minute winter   | 354.856                      | 143.087                         |
| 1 year 480 minute summer  | 11.185                       | 2.956                           | 100 year +45% CC 30 minute summer   | 332.000                      | 93.944                          |
| 1 year 480 minute winter  | 7.431                        | 2.956                           | 100 year +45% CC 30 minute winter   | 232.982                      | 93.944                          |
| 1 year 600 minute summer  | 9.182                        | 2.511                           | 100 year +45% CC 60 minute summer   | 222.268                      | 58.739                          |
| 1 year 600 minute winter  | 6.274                        | 2.511                           | 100 year +45% CC 60 minute winter   | 147.669                      | 58.739                          |
| 1 year 720 minute summer  | 8.203                        | 2.199                           | 100 year +45% CC 120 minute summer  | 134.215                      | 35.469                          |
| 1 year 720 minute winter  | 5.513                        | 2.199                           | 100 year +45% CC 120 minute winter  | 89.169                       | 35.469                          |
| 1 year 960 minute summer  | 6.768                        | 1.782                           | 100 year +45% CC 180 minute summer  | 101.219                      | 26.047                          |
| 1 year 960 minute winter  | 4.483                        | 1.782                           | 100 year +45% CC 180 minute winter  | 65.795                       | 26.047                          |
| 1 year 1440 minute summer | 4.949                        | 1.326                           | 100 year +45% CC 240 minute summer  | 78.690                       | 20.795                          |
| 1 year 1440 minute winter | 3.326                        | 1.326                           | 100 year +45% CC 240 minute winter  | 52.280                       | 20.795                          |
| 30 year 15 minute summer  | 268.706                      | 76.035                          | 100 year +45% CC 360 minute summer  | 58.701                       | 15.106                          |
| 30 year 15 minute winter  | 188.566                      | 76.035                          | 100 year +45% CC 360 minute winter  | 38.157                       | 15.106                          |
| 30 year 30 minute summer  | 174.929                      | 49.499                          | 100 year +45% CC 480 minute summer  | 45.550                       | 12.038                          |
| 30 year 30 minute winter  | 122.757                      | 49.499                          | 100 year +45% CC 480 minute winter  | 30.262                       | 12.038                          |
| 30 year 60 minute summer  | 116.589                      | 30.811                          | 100 year +45% CC 600 minute summer  | 36.875                       | 10.086                          |
| 30 year 60 minute winter  | 77.459                       | 30.811                          | 100 year +45% CC 600 minute winter  | 25.195                       | 10.086                          |
| 30 year 120 minute summer | 70.438                       | 18.615                          | 100 year +45% CC 720 minute summer  | 32.556                       | 8.725                           |
| 30 year 120 minute winter | 46.797                       | 18.615                          | 100 year +45% CC 720 minute winter  | 21.879                       | 8.725                           |
| 30 year 180 minute summer | 53.298                       | 13.715                          | 100 year +45% CC 960 minute summer  | 26.340                       | 6.936                           |
| 30 year 180 minute winter | 34.645                       | 13.715                          | 100 year +45% CC 960 minute winter  | 17.448                       | 6.936                           |
| 30 year 240 minute summer | 41.604                       | 10.995                          | 100 year +45% CC 1440 minute summer | 18.700                       | 5.012                           |
| 30 year 240 minute winter | 27.641                       | 10.995                          | 100 year +45% CC 1440 minute winter | 12.567                       | 5.012                           |

**Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%**

| Node Event       | US<br>Node | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|------------------|------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 15 minute winter | RE01       | 11             | 18.866       | 0.016        | 0.4             | 0.0015           | 0.0000        | OK         |
| 15 minute winter | SW01       | 11             | 18.763       | 0.023        | 0.8             | 0.0054           | 0.0000        | OK         |
| 15 minute winter | RE02       | 10             | 18.870       | 0.020        | 0.6             | 0.0024           | 0.0000        | OK         |
| 15 minute winter | SW02       | 10             | 18.768       | 0.028        | 1.2             | 0.0073           | 0.0000        | OK         |
| 15 minute winter | SW03       | 14             | 18.756       | 0.216        | 2.0             | 0.0344           | 0.0000        | SURCHARGED |
| 15 minute winter | EX MH      | 14             | 18.266       | 0.026        | 0.9             | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Upstream Depth) | US<br>Node | Link  | DS<br>Node | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|------------|-------|------------|------------------|-------------------|----------|------------------|-----------------------|
| 15 minute winter               | RE01       | 1.000 | SW01       | 0.4              | 0.370             | 0.058    | 0.0093           |                       |
| 15 minute winter               | SW01       | 1.001 | SW03       | 0.8              | 0.387             | 0.116    | 0.0712           |                       |
| 15 minute winter               | RE02       | 2.000 | SW02       | 0.6              | 0.415             | 0.084    | 0.0116           |                       |
| 15 minute winter               | SW02       | 2.001 | SW03       | 1.2              | 0.435             | 0.175    | 0.0772           |                       |
| 15 minute winter               | SW03       | 1.002 | EX MH      | 0.9              | 0.579             | 0.147    | 0.0436           | 0.9                   |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%**

| Node Event       | US<br>Node | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|------------------|------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 30 minute winter | RE01       | 24             | 18.956       | 0.106        | 0.8             | 0.0100           | 0.0000        | SURCHARGED |
| 30 minute winter | SW01       | 24             | 18.956       | 0.216        | 1.6             | 0.0503           | 0.0000        | SURCHARGED |
| 30 minute winter | RE02       | 23             | 18.957       | 0.107        | 1.1             | 0.0131           | 0.0000        | SURCHARGED |
| 30 minute winter | SW02       | 23             | 18.957       | 0.217        | 2.2             | 0.0559           | 0.0000        | SURCHARGED |
| 30 minute winter | SW03       | 23             | 18.954       | 0.414        | 2.6             | 0.0658           | 0.0000        | SURCHARGED |
| 30 minute winter | EX MH      | 24             | 18.271       | 0.031        | 1.3             | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Upstream Depth) | US<br>Node | Link  | DS<br>Node | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|------------|-------|------------|------------------|-------------------|----------|------------------|-----------------------|
| 30 minute winter               | RE01       | 1.000 | SW01       | 0.8              | 0.411             | 0.116    | 0.0665           |                       |
| 30 minute winter               | SW01       | 1.001 | SW03       | 1.1              | 0.289             | 0.156    | 0.1213           |                       |
| 30 minute winter               | RE02       | 2.000 | SW02       | 1.1              | 0.448             | 0.155    | 0.0626           |                       |
| 30 minute winter               | SW02       | 2.001 | SW03       | 1.5              | 0.497             | 0.220    | 0.1252           |                       |
| 30 minute winter               | SW03       | 1.002 | EX MH      | 1.3              | 0.638             | 0.208    | 0.0559           | 2.9                   |

**Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%**

| Node Event       | US<br>Node | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|------------------|------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 30 minute winter | RE01       | 25             | 19.339       | 0.489        | 1.6             | 0.0460           | 0.0000        | FLOOD RISK |
| 30 minute winter | SW01       | 25             | 19.339       | 0.599        | 2.3             | 0.1395           | 0.0000        | FLOOD RISK |
| 30 minute winter | RE02       | 25             | 19.342       | 0.492        | 2.1             | 0.0600           | 0.0000        | FLOOD RISK |
| 30 minute winter | SW02       | 25             | 19.341       | 0.601        | 3.0             | 0.1550           | 0.0000        | FLOOD RISK |
| 30 minute winter | SW03       | 25             | 19.336       | 0.796        | 2.6             | 0.1265           | 0.0000        | FLOOD RISK |
| 30 minute winter | EX MH      | 25             | 18.277       | 0.037        | 1.9             | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Upstream Depth) | US<br>Node | Link  | DS<br>Node | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|------------|-------|------------|------------------|-------------------|----------|------------------|-----------------------|
| 30 minute winter               | RE01       | 1.000 | SW01       | 1.1              | 0.411             | 0.158    | 0.0665           |                       |
| 30 minute winter               | SW01       | 1.001 | SW03       | 1.1              | 0.379             | 0.156    | 0.1213           |                       |
| 30 minute winter               | RE02       | 2.000 | SW02       | 1.3              | 0.449             | 0.177    | 0.0626           |                       |
| 30 minute winter               | SW02       | 2.001 | SW03       | 1.8              | 0.523             | 0.270    | 0.1252           |                       |
| 30 minute winter               | SW03       | 1.002 | EX MH      | 1.9              | 0.701             | 0.292    | 0.0716           | 5.5                   |