Project Title

Flood Risk Assessment
& Outline Drainage Strategy

At

The Nook,
York Lane,
Langho,
Lancs,
BB6 8DR

For

Redwaters (Langho) Ltd

PG Consulting
108 Ack Lane West
Cheadle Hulme
Cheshire
SK8 7ES

Tel: 07710 758971
Mail: Paul@pgcl.co.uk
Paul Graveney Consulting Ltd Trading as PG Consulting
Company Registration 11238546

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Paul Graveney Consulting Ltd

CONTENTS

Executive Summary

Item	Brief Description
Development Proposed	Planning permission for construction of a residential development including associated car parking provision, utilities & other infrastructure, landscaping and highway works on land at The Nook, York Lane, Langho, Blackburn, Lancs, BB6 8DR.
Flood Risk Review	**Tidal:** Low Risk Flood Zone 1 **Fluvial:** Low Risk Flood Zone 1 **Surface Water:** Very Low Risk. **Sewer & Drainage**: Low Risk **Groundwater**: Low Risk **Reservoir:** Low Risk
Geology	A review of the BGS online mapping has indicated the Superficial Deposits to encompass Till, Devensian – Silts and Clays, overlain with bedrock comprising the Pendle Grit Member – Sandstone.
Infiltration Rate	Based on the assessment of the BGS data set and the presence of cohesive ground over sandstone, infiltration as a means of draining the site has been discounted. However, this will be confirmed as part of the future Phase 2 site investigations.
Local Hydrology	There is an unnamed watercourse passing down the southern boundary of The Nook before then flows beneath the access road and flowing north within the western side of the site. This then merges with another watercourse passing down Snodworth Road beyond the northern boundary. To the eastern side of the site, two number 225mm diameter culverts were identified passing into a small open watercourse that flowed north into the adjacent gardens.
Nearest Adopted Sewers and onsite private drainage	A review of the United Utilities (UU) sewer records has indicated there to only be a 150mm diameter foul water sewer flowing north within York Lane. No surface water sewer has been identified in close proximity. It is believed that the retained property outfalls foul water to the UU sewer and surface water runoff to the open watercourse. This will remain post development.
Existing Discharge Rate	For the purpose of this assessment, the site will be classed as fully Greenfield. The greenfield discharge rates for the proposed 0.62ha impermeable areas only are defined below: 1yr – 4.7 l/s Qbar – 5.4 l/s 30yr – 9.2 l/s 100yr – 11.2 l/s
Proposed Discharge Rate	In line with Lancashire County Council (LCC) & Ribble Valley Borough Council (RVBC), Sustainable Drainage Systems (SuDS) Policy, the predevelopment respective Greenfield runoff rates will be applied, but also to take account of the minimum rates to Prevent blockage. This will be a peak 3l/s for each new network.

Item	Brief Description
Surface Water Drainage Outfall and SuDS Hierarchal Approach	Based on current site information and the identified cohesive ground over sandstone, infiltration is discounted. As such the proposed surface water drainage strategy is to discharge to the two open watercourses to the east and west of the site via a new outfalls, at a peak discharge rate for each not exceeding 3.0l/s.
Allowance for Climate Change	50% - based on a residential > 100-year design life to 'the 2100's' Upper End Allowance.
SuDS features	Water butts, rainwater planters, permeable surfacing, small attenuation pond, geocellular tanks & flow controls.
Maintenance Responsibility	Maintenance company and property owners.
Foul Drainage Strategy	New foul water drainage network with outfall to the 150mm diameter foul sewer to the east of the site within York Lane.

1.0 Introduction

1.1 Paul Graveney Consulting (PGC) has been appointed by Redwaters (Langho) Ltd to prepare this Flood Risk Assessment & Outline Drainage Strategy to support a planning application for the construction of a residential development including associated car parking provision, utilities and other infrastructure, green infrastructure, landscaping and highway works on land at The Nook, York Lane, Langho, Blackburn, Lancs, BB6 8DR.

1.2 The proposed layout for this application can be found in Appendix A.

1.3 The assessment has been undertaken in line with Section 14 of the National Planning Policy Framework (NPPF) plus the accompanying Planning Policy Guidance (PPG) on Flood Risk.

1.4 This Flood Risk Assessment (FRA) has been commissioned by Redwaters (Langho) Ltd and is specific to their interests in the development proposals as described by the Architectural plan in Appendix A. This report may not be assigned.

1.5 The report has been commissioned to identify any flood-related issues associated with the proposed developments and any likely constraints that could be imposed plus consider the outline drainage strategy for it. The following issues have been suggested by the Environment Agency (EA), United Utilities (UU), Lancashire County Council (LCC) & Ribble Valley Borough Council (RVBC), and subsequently addressed within this report.

- Identify available data relating to flood risk at the site.
- Determine whether the site is at risk from flooding from all sources, including but not exhaustive, from breach or overtopping of any existing flood defences, watercourse flooding, surface water flooding and/or ground water flooding.
- If at risk from any source, devise appropriate measures to prevent flood risk whilst not compromising the flood risk elsewhere.
- Determine the current surface water drainage regime and assess impacts as a result of the proposed development.
- Discuss if required Sustainable Drainage Systems (SuDS) as an option for reducing surface water flood risk. Determine any potential increase in surface water runoff as a result of the proposed development.
- Devise an appropriate outline foul and surface water drainage strategy to deal with any increase in surface water runoff and include for climate change.
- Consider the recommendations of the Ribble Valley Borough Council (RVBC), Strategic Flood Risk Assessment (SFRA).
- Prepare the Flood Risk Assessment and Surface Water Drainage Strategy report.
- Assess mitigation measures & off-site impacts and define any residual risks.

2.0 Development Description and Location

2.1 Site Location

The site is referenced in Table 1, and a site location map is provided in Appendix A.

Item	Brief Description
Site name	The Nook, York Lane.
Site address and location	The Nook, York Lane, Langho, Blackburn, Lancs, BB6 8DR.
Council Area	Lancashire County Council (LCC) & Ribble Valley Borough Council (RVBC),
Approximate Grid Reference	OS: 370646, 433644
General Locality	The development is located approximately 5km northeast of Blackburn Town Centre.

Table 1: Site Referencing Information

2.2 Existing site Description

2.2.1 The application site is irregular in plan shape and is currently the garden of The Nook residential property. There are two detached dwellings directly to the north and west and two further detached dwellings to the south of the development boundary, with an access road running between them.

2.2.2 Trees and other dense vegetation are located to the majority of boundaries, particularly to the north, with access currently from both Snodworth Road to the west and York Lane to the east.

2.2.3 The general area is predominantly agricultural & rural. However, there are dwellings located beyond Snodworth Road to the west with dwellings, beyond that. There is a further and larger housing estate 260m to the northwest.

2.2.4 Refer to Figure 1 for further location details.

Figure 1: Location Plan

2.3 Topographical Survey

2.3.1 A full topographical survey has been undertaken at this site. This has identified the site to encompasses a reasonable fall in a northerly directly from 169.00m AOD to the southeast down to 160.00m AOD to the northeast corners. The retained Nook property holds a level of 167.50m AOD.

3.0 Planning Policy and Consultation

3.1 National Planning Policy Framework

3.1.1 The indicative flood maps provided by the Environment Agency locate the main development area within low-risk Flood Zone 1 classification, i.e., land assessed as having less than a 1 in 1000 annual probability of fluvial flooding (<0.1%) in any year.

3.1.2 As a requirement of the new NPPF (2025), Section 14, the proposed development must satisfy the requirements of the Sequential Test and where applicable the Exception Test.

3.1.3 Sequential Test:

Under the NPPF (2025) and accompanying Planning Policy Guidance (PPG), Flood Zone 1 is defined as low probability flood risk. The proposal is for a residential development, which in line with Table 1 is classified as 'More Vulnerable'.

Placing both these criteria into Table 2 (Flood Risk Vulnerability and Flood Zone ‘Compatibility’), More Vulnerable development in Flood Zone 1 determines that the 'Development is Appropriate' and that the Exception Test is not applicable to this development proposal.

3.2 Strategic Flood Risk Assessment (SFRA)

3.2.1 SFRA’s assess the risk associated with all types of flooding and provide the information required to identify the amount of development permitted in an area, how drainage systems in the area should function and also how risks in vulnerable areas can be reduced and/or mitigated. The NPPF states that regional planning bodies (RPB’s) or Local Planning Authorities should prepare SFRA’s in consultation with the EA.

3.2.2 The building sits within the coverage of the Ribble Valley Borough Council (RVBC), Level 1 SFRA Final Report dated April 2017. The published SFRA identifies current and future broad scale flood related issues in the Ribble Valley area. The purpose of the SFRA is to assess and map all known sources of flood risk including fluvial, surface water, sewer, groundwater and all impounded water bodies, taking into account future climate change predictions. The purpose of the SFRA is to assess and map all known sources of flood risk including fluvial, surface water, sewer, groundwater and all impounded water bodies, taking into account future climate change predictions.

3.2.3 A summary of the main objectives and elements from the SFRA associated with the district is detailed below. The full report can be obtained from the Ribble Valley Borough Council (RVBC), website.

- Determine the variations in risk from all sources of flooding across the Council area.
- Prepare broad policies for the management of flood risk.
- Steer development towards areas of lowest flood risk, through application of the Sequential Test and, where necessary, the Exception Test.
- Consider opportunities to reduce flood risk to existing communities through better management of surface water, provision for conveyance and storage for flood water; and
- Identify the level of detail required for site-specific Flood Risk Assessments

- SFRA maps indicate the site to be at low risk of fluvial flooding (FZ1).
- The site is not located within a Critical Drainage Area (CDA).
- Low risk of groundwater flooding.
- Full sequential and exception tests to be carried out (where applicable).

3.3 Lancashire County Council (LCC) Sustainable Drainage Guidance

3.3.1 Lancashire Council acting as the LLFA for the area have provided information on their website 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.

3.3.2 The main principles of the report for the integration of how SuDS for Major developments should be included in the Flood Risk Assessment and designs are summarised below.

- 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).
- Details of how runoff is collected from roofs, roads and other hard surfaces to keep water at or near the surface.
- Site control features shown with approximate volumes, flow control locations and details.
- Flow routes including low flow, overflow and exceeding routes.
- Confirm the destination of the "controlled flow of clean water" from the site – the ground by infiltration, a watercourse or the surface water sewer.
- Existing brownfield sites to discharge at Greenfield rates.
- On greenfield sites, surface water run off must be managed to achieve the respective greenfield run off rates.
- Detailed SuDS management train approach to be incorporated throughout the scheme with appropriate measures from prevention, source control through to site control.
- 50% climate change allowance where the design life does exceeding 100 years.
- Exceedance flows beyond the 30-year event can be incorporated as long as the water is managed and does not flow off site or cause flood risk to the development building.
- Detailed plans and hydraulic calculations to be provided at planning stage.

4.0 Definition of Flood Hazard

4.0.1 Flood risk to the proposed development building is considered from all sources of flooding, as defined by the NPPF.

4.1 Sources of information

4.1.1 The following section defines the flood risk receptors and anticipated flood risk. Section 4.8 then summarises the probability of flooding and the likely impacts. Table 2 defines the main sources of information used in the identification of flood risk.

Source of Information	Details
Environment Agency	Various Flood Maps from EA website
United Utilities (UU)	Sewer Records
Ribble Valley Borough Council (RVBC).	SFRA Report & Various Maps

Table 2: Sources of information used in the identification of flood risk

4.2 Flooding from Sea (Tidal)

4.2.1 The site is situated at a minimum level of circa 160.00m AOD and thus is suitably placed above sea level. Therefore, the risk from tidal flooding is removed.

4.3 Flooding from River (Fluvial)

4.3.1 As mentioned in earlier sections, the closest identified hydrological feature are two small unnamed features passing through the site in a northerly direction. There is no main river in close proximity.

4.3.2 The National Planning Policy Framework (NPPF) categorises fluvial and tidal flood risk as follows:

- Zone 1 (low probability) – Land assessed as having less than a 1 in 1,000 annual probability of river or sea flooding (<0.1%).
- Zone 2 (medium probability) – Land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year; and
- Zone 3a (high probability) - Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- Zone 3b The Functional Floodplain - This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the EA. (Not separately distinguished from Zone 3a on the Flood Map).

4.3.3 Figure 2 below locates the site on the Environment Agency's indicative floodplain map. The development site holds a low-risk Flood Zone 1 classification, i.e., land assessed as having less than a 1 in 1000 annual probability of fluvial flooding (<0.1%) in any year. The risk from fluvial flood water is therefore reduced to acceptable levels and no further assessment is required.

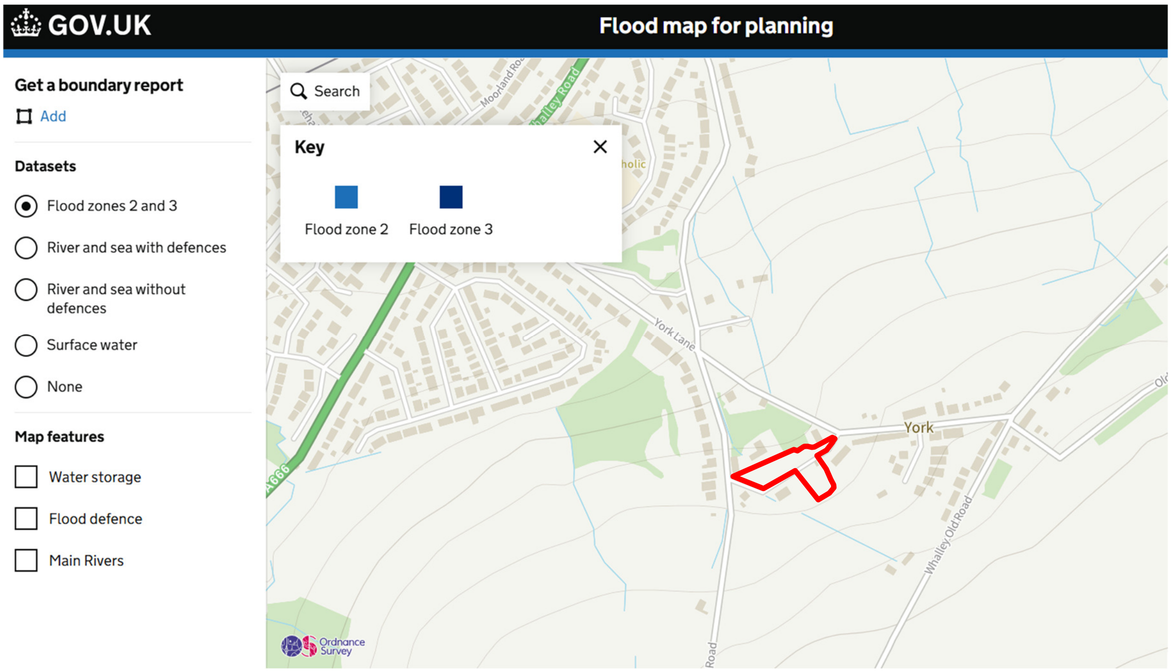


Figure 2 – The EA's Fluvial Flood Map for Planning

4.4 Flooding from Land and Surface Waters (Overland Flow)

4.4.1 The EA descriptions for the High, Medium and Low risk scenarios for surface water flooding are as follows:

- High risk means that each year this area has a chance of flooding of greater than 3.3%.
- Medium risk means that each year this area has a chance of flooding of between 1% and 3.3%.
- Low risk means that each year this area has a chance of flooding of between 0.1% and 1%.
- Very Low risk means that each year this area has a chance of flooding of less than 0.1%.

4.4.2 The general area within and surrounding the proposed development falls in a northerly direction. The higher ground to the south encompasses a number of open fields.

4.4.3 The Environment Agency's (EA's) 1 in 30 year and 1 in 100-year surface water flood maps (refer to Figures 3 & 4) indicate that the full site is at very low risk of surface water flooding.

4.4.4 There are no identified existing surface water flow routes through the site that would need to be maintained. However, due to the raised land to the south, a new cut off drain will be proposed along the southern boundary and directed to the open watercourse.

4.4.5 As part of the proposed development the ground levels will be modified to ensure that all low points are located away from the elevated buildings. The new surface water drainage will also be designed and installed in accordance with the latest guidance and climate change allowances to ensure no surface water ponding will occur.

4.4.6 With these measures incorporated into the layout, the risk from surface water is considered to be very low.

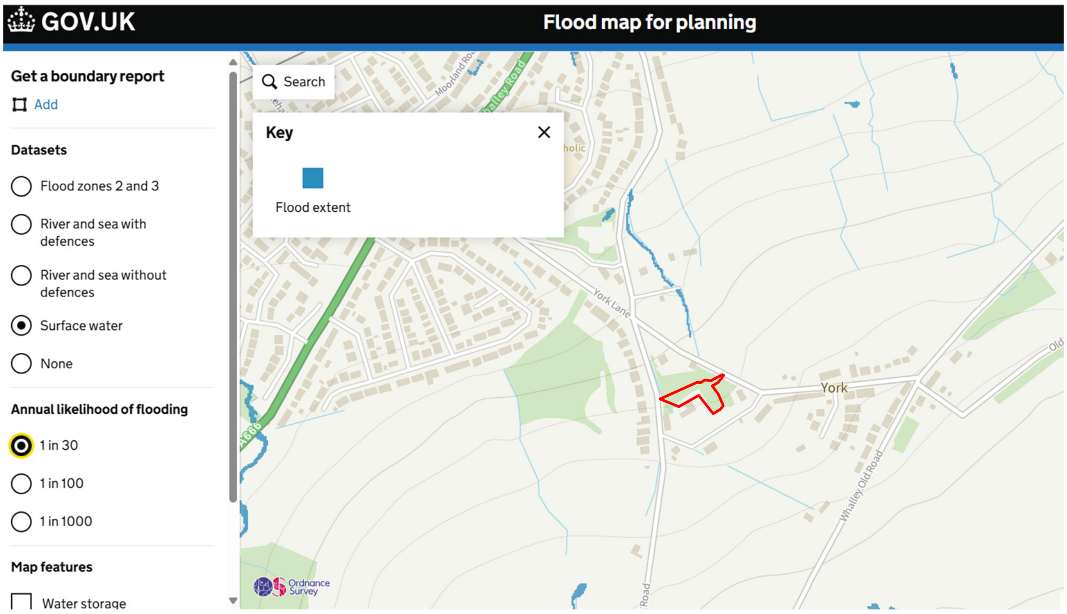


Figure 3 – Extract EA Flood Risk Mapping - Flood Risk from Surface Water (1 in 30)

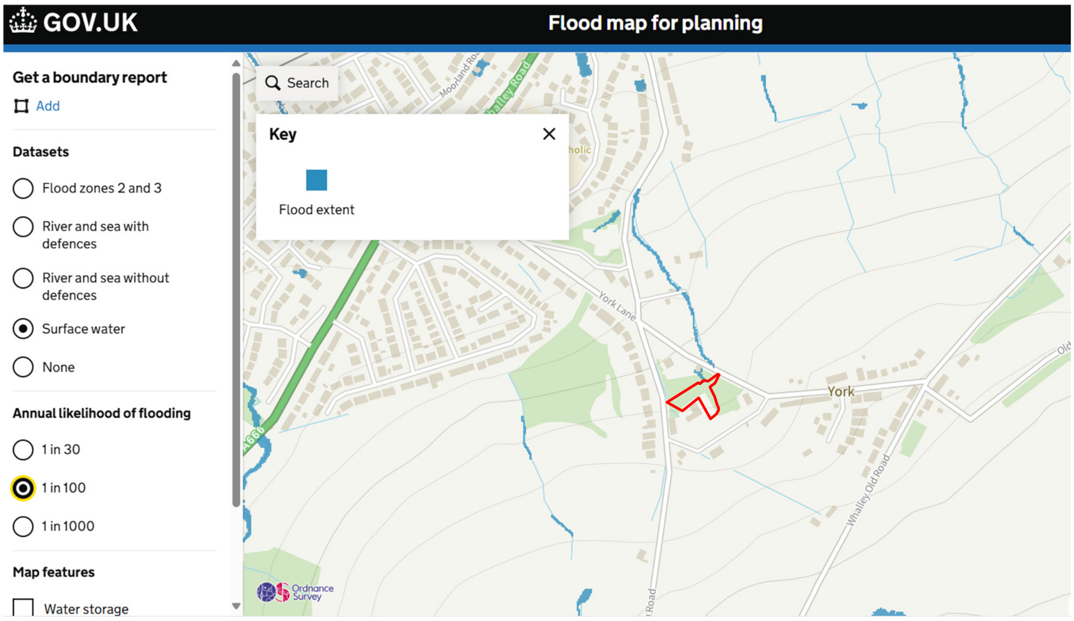


Figure 4 – Extract EA Flood Risk Mapping - Flood Risk from Surface Water (1 in 100)

4.5 Flooding from Sewers and Private Drainage

4.5.1 A review of the United Utilities (UU) sewer records has indicated there to only be a 150mm diameter foul water sewer flowing north within York Lane.

4.5.2 No surface water sewers have been located in close proximity.

4.5.3 It is believed that the retained property outfalls foul water to the UU sewer and surface water runoff to the open watercourse. This will remain post development.

4.5.4 The drainage networks serving the adjacent highways ensure that the development footprint is protected from the impact of both upstream and downstream runoff. It is speculated that complete protection may well exist beyond a storm event equivalent to the 30-year statistical event. Beyond this projection, there may be a small degree of peripheral 'Exceedance' flooding within the areas above the drains and gullies. However, this is expected to be localised and restricted to the location of specific manhole covers located outside the development footprint. Thus, flood risk to the site from drainage is diminished to acceptable levels.

4.6 Flooding from Groundwater

4.6.1 Groundwater flooding occurs when the water table, the level of water below the ground, rises above the ground surface or into cellars and basements. Groundwater flooding is most likely to occur in low lying areas underlain by permeable rocks (aquifers). These may be extensive, regional aquifers, such as chalk or sandstone, or maybe localised sands or river gravels in valley bottoms underlain by less permeable rocks.

4.6.2 No site investigation has been carried out at the site. British Geological Survey mapping confirmed that the bedrock strata for the site to encompass a Principal Aquifer.

4.6.3 Based on there being no proposed basements, the building levels set above existing ground levels, and the lower lying watercourse along the northern boundary, the risk of groundwater flooding is considered to be Low. A full Phase 2 intrusive site investigation will confirm this at detailed design stage.

4.7 Flooding from Other Water Features

4.7.1 Reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925. The Environment Agency is the enforcement authority and ensures that reservoirs are inspected regularly, and essential safety work is carried out.

4.7.2 The Long-Term Flood Risk Assessment (Flood Risk from Reservoirs) map shows that the site is at a very low risk of reservoir flooding.

4.8 Summary

Below is a table summary of the flood risks associated with the development site.

Source	Probability of Flood Risk	Impacts	Remarks
Tidal	Low	Low	The development building is not influenced by Tidal flood risk.
Fluvial (Watercourse)	Low	Low	The development is located in low flood risk zone 1.
Surface (Overland Flood Flow)	Low	Low (with raised FFL's)	The development buildings are located within a very Low Risk Zone. Proposed buildings to be raised above existing ground levels. New cut off drain constructed along the southern boundary.
Sewers & New Drainage	Low	Low	New drainage is to be designed in line with local and national guidance.
Groundwater	Low	Low	SFRA records would indicate the groundwater levels to be deep, supported by the low-lying watercourse to the north of the site.
Artificial Sources	Low	Low	No artificial sources in close proximity.

Table 3 – Flood Risk Summary

5.0 Outline Drainage Strategy

5.1 Existing Drainage

5.1.1 As discussed in Section 4.5, A review of the United Utilities (UU) sewer records has indicated there to only be a 150mm diameter foul water sewer flowing north within York Lane.

5.1.2 No surface water sewers have been located in close proximity.

5.1.3 It is believed that the retained property outfalls foul water to the UU sewer and surface water runoff to the open watercourse. This will remain post development.

5.2 Existing Runoff Rates

5.2.1 For the purpose of this assessment the site will be classed as fully greenfield with greenfield discharge rates defined below.

5.2.2 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. Table 4 below provides a summary of the existing greenfield runoff rates based on the existing site area.

Development Area	Greenfield Runoff Rates (l/s)			
	1 yr	Qbar	30yr	100yr
0.62	4.7 l/s	5.4 l/s	9.2 l/s	11.2 l/s

Table 4: Existing Greenfield Runoff Rates

5.3 Geology

5.3.1 No site-specific intrusive Phase 2 Site Investigation has been carried out at the site at this time. A review of the BGS online mapping has indicated the Superficial Deposits to encompass Till, Devensian – Silts and Clays, overlain with bedrock comprising the Pendle Grit Member – Sandstone.

5.3.2 Due to the presence of the cohesive ground over sandstone to depth, infiltration is not considered a viable means of draining the new development area. However, infiltration testing in line with BRE 365 guidance will be undertaken as part of the future Phase 2 site investigations.

5.4 Hydrological Assessment

5.4.1 There is an unnamed watercourse passing down the southern boundary of The Nook before flowing beneath the access road and flowing north within the western side of the site. This then merges with another watercourse passing down Snodworth Road. To the eastern side of the site, two number 225mm diameter culverts were identified passing into a small open watercourse that flowed north into the adjacent gardens.

5.5 Sustainable Drainage Systems (SuDS) Assessment

5.5.1 SuDS Objectives

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

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

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 enable the potential range of prevention, source control and site control SuDS devices to be considered above and below ground.
- *Site Characteristics:* No site investigation has been carried out at the site. Findings from a review of the BGS maps indicate that the ground encompasses cohesive ground over sandstone to depth, such that infiltration techniques are unlikely to be suitable.

- *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 landscaping zone, if possible. Safety for all future users is paramount, and so best practice guidance will be incorporated so that there is no requirement for significant safety precautions. Maintenance plans will be prepared for all SuDS devices that are included.

5.5.4 SuDS Methods

Table 5 & 6 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 and 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 of time constraints, viability and lifetime maintenance of the residential development.

Method	Comment	Suitability for Development
Green Roofs	• Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater Promotes evaporation. and local biodiversity.	Not suitable: • Additional costs of installation would have a severe effect on the viability of the development. • Pitched roof profile is not suitable for Green roofs.
Water Butts	• Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas.	Suitable: • To be located at the base of the rainwater pipes where possible.
Rainwater Harvesting	• Rainwater harvesting reduces the total runoff volume from the developed site and reduces treated water consumption.	Not Suitable: • Additional costs of installation would have a severe effect on viability of development. • Limited end use with small office area. • The ability to restrict peak flow rates and short-term peak volumes is non-existent where a critical storm event occurs.
Permeable Surfacing (Infiltration)	• Reduces total run off volume from the development. • Can be used to enhance water quality.	Not Suitable: • Initial investigations indicate that the underlying ground is unsuitable for infiltration due to sandstone geology.

Permeable Surfacing (Standard)	• Can be used to enhance the quality of runoff water. • Sub-base provides 'source' storage and reduces the volume of storage downstream. • The storage can be created with selection of the stone fill or use of plastic box stems. • Impermeable membrane at base of construction to prevent impact on pavement stability.	*Suitable:* • Could be utilised for parking areas and driveways within a tanked subbase, subject to client approval.
Swales, basins and ponds	• Provide areas for above ground surface runoff storage. • Swales also improve water quality through filtration.	*Not suitable:* • No available area for attenuation pond to be allocated. Plus very steep ground profiles.

Table 5: Surface SuDS Methods

Method	**Comment**	**Suitability for Development**
Geocellular Storage	• Suitable for sites with insufficient space for basins etc. • Suitable for sites where topography prevents the use of open basins etc.	*Suitable:* • Potential to be incorporated as part of the attenuation measures beneath the yard areas.
Large Diameter Pipes, Culverts or Tanks	• Suitable for sites with insufficient space for basins etc. • Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning. • Generally, be suitable for adoption by the statutory water company (e.g., United Utilities (UU).	*Not suitable:* • More Suited to an adoptable drainage network.

Table 6: Sub-Surface SuDS Methods

5.5.5 SuDS Hierarchal Approach

Based on the SuDS assessment in Tables 5 & 6, 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	Initial assessment has determined that the underlying sandstone ground conditions would not be suitable for infiltration-based options. Further investigation and testing required to confirm.
Connection to Watercourse	Yes	Should insitu testing prove that infiltration is not possible then a new connection to be made to the two small open watercourses passing through the site in a northerly direction at respective Greenfield rates.
Connection to Surface Water Sewer	No	No surface water sewers in close proximity.
Connection to a Combined Sewer	No	Higher options take precedent.

Table 7: SuDS Hierarchal Approach

5.5.6 SuDS Design Philosophy

SuDS assessment and hierarchal approach discussed in Table 5, 6 and 7 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 watercourses.

The following design philosophy is proposed:

- 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.
- Prevention measures by the inclusion of water butts.
- Source Control by the use of permeable paving to the parking areas and driveways subject to client approval.
- Site Control features in the form of a new small shallow attenuation pond and below ground geocellular attenuation tanks to accommodate the additional surface water runoff generated by the development site.
- Surface water discharges to the surface water at a controlled rate.
- Aim to limit where possible the impermeable fraction of development.

5.6 The Non-Statutory Technical Standards for SuDS

5.6.1 It is best practice to develop drainage strategies to the DEFRA document 'The Non-Statutory Technical Standards for SuDS'. The Lancashire County Council (LCC) SuDS document also follows the principles of this document.

5.6.2 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.*

5.6.3 As noted above, and in line with policy, it is intended that surface water discharge rates will be restricted to the minimum Greenfield runoff rates of 6.0l/s (3l/s for each outfall), which is in line with LCC policy for greenfield sites in accordance with standard **S2** and to comply with the peak volume requirements as per **S4** and **S6**.

5.7 Climate Change

5.7.1 In May 2022, the Environment Agency released updated climate change allowances for peak rainfall intensities which should be applied to new developments. Rather than nationwide allowances, each area will have its own peak rainfall allowances. In the case of the Langho area, this is the Ribble Management Catchment peak rainfall allowances.

5.6.2 Based on the residential nature of the development, a lifespan in excess of 100 years is anticipated. Therefore, the potential climate change allowance for the 2070's ranges between 35% for the central allowance and 50% for the upper end allowance. As such, an allowance of 50% for climate change on peak rainfall intensity will be included in calculations.

5.8 Outline Surface Water Drainage Strategy

5.8.1 The general principle of the surface water drainage strategy is to collect the runoff from the new residential properties and external areas and direct it to two separate below ground surface water drainage networks that will flow beneath the two access roads. Each network will then outfall to the small open watercourses via a new outfall, at a peak greenfield discharge rate not exceeding 3.0l/s each. This is below the 1 in 30 year and 1 in 100-year greenfield rates.

5.8.2 The proposed drainage layout for the new development site will be designed in accordance with Design & Construction Guidance (DCG), 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 25% increase to account for climate change to confirm that there is no flood risk to the buildings.

5.8.3 Flooding can occur on a local scale beyond the 30yr criterion due to runoff exceeding the capacity of the minor system during extreme events and it can only be addressed on a site-specific basis. Guidance states that development should be protected against flooding from extreme events (1 in 30 year) and that flood pathways are identified when the drainage system is exceeded.

5.8.4 Although it is envisaged that Prevention and source control measures could be included in the final scheme, this strategy will assume for outline calculations purposes that site control only methods are incorporated. Two detailed hydraulic surface water networks have been simulated in the Causeway Flow Hydraulic Design Software for all the roof and hard paved areas. This takes into account the overall peak discharge rate of 3l/s each. 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.

5.8.5 Drawing PGC1342-DR-C-001 in Appendix C indicates the Drainage Strategy based on the Architects masterplan intent, with the supporting hydraulic calculations in Appendix D.

5.9 Volume Control

5.9.1 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 6.0l/s, for all storm events, in order to prevent an adverse effect on flood risk.

5.10 Pollution Control

5.10.1 Runoff from roofs is generally considered to be clean and will be discharged directly into the new drainage network. Surface water run-off from hard paved areas at risk of contamination should receive water quality treatment. Access roads are considered as a medium hazard in terms of contamination. Figure 5 illustrates the pollution hazard indices for different land use classifications from The CIRIA SuDS Manual C753 (2015).

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	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[1]	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[1]	High	0.8[2]	0.8[2]	0.9[2]

Figure 5: Pollution Hazard indices for land use classification (Table 26.2 the CIRIA SuDS manual 2015)

5.10.2 Figure 6 then illustrates the SuDS Component mitigation indices from the CIRIA SuDS Manual C753 (2015).

5.10.3 The selection of treatment should ensure that the SuDS mitigation component index (Figure 6) exceeds the pollution hazard index (Figure 5).

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	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[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	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 6: Indicative SuDS mitigation indices (Table 26.3 the CIRIA SuDS manual 2015)

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

5.10.5 The new driveways and adopted highways are also classed as low risk and will pass through the permeable surfacing and new highway gullies, thus providing the necessary treatment to reduce contamination risk to the downstream catchments.

5.11 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 <u>Piped Networks, Inspection, Manhole and Catchpit Chambers</u>

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
Regular Maintenance	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
Remedial Maintenance	Repair / rehabilitation of gratings, inlets and outlets	As required
Monitoring	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
Structure Rehabilitation / Repair	Regular Maintenance and Monitoring to identify if repair and / or replacement of features or pipework is required.	As required

Table 8: Operation and Maintenance Requirements of Piped Networks and Inspection Chambers

5.12.4 Geocellular tanks

Geocellular tanks are modular storage systems made with plastic units. These units can be assembled to achieve the required volume and usually on multiple layers. Generally, the units have 95% of voids content and are used to create an efficient below ground structure to store surface water.

The geocellular units and geotextile are proprietary products and therefore manufacturer's recommendations should also be taken into consideration.

Access for maintenance should be provided by an access shaft located on the tank and from the manhole chambers downstream of the tank.

Regular inspection and maintenance are important for the effective operation of attenuation tanks as designed. As the feature is buried, a regular inspection regime is very important to ensure the correction functionality of the surface water drainage network.

Maintenance schedule	Required action	Typical frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually.
	Remove debris form the catchment surface (where it may cause risks to performance).	Monthly.
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockages by sediment, algae or other matter; remove and replace surface infiltration medium as required.	Annually.
	Remove sediments from pre-treatment structures and/or internal forebays.	Annually, or as required.
Remedial Actions	Repair/rehabilitate inlets, outlets, overflows and vents.	As required.
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of tank for sediment build-up and remove if necessary.	Every 5 years or as required.

Table 9: Operation & maintenance requirements for attenuation storage tanks - Based on CIRIA SuDS Manual 2015

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, the 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
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets for blockages, and clear if required. If faults persist jetting and CCTV survey may be required.	Monthly and after large storms.
Regular maintenance	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)
Remedial Actions	Repair/rehabilitation of inlets.	As required.

Table 10: Operation and Maintenance Requirements for Flow Controls

5.11.6 Permeable Paving

Permeable paving provides a surface suitable for vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying structural layers. The surface itself is impervious to water, but the blocks are laid to provide void space through the surface to the sub-base. The water is temporarily stored within this sub-base before controlled discharge downstream.

Permeable surfaces, together with their associated substructures, are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. Treatment processes that occur within the surface structure, sub-base and geotextile layers include filtration, absorption, biodegradation and sedimentation.

Permeable paving should be inspected regularly, preferably during and after heavy rainfall to check effective operation and identify areas of ponding. Permeable paving needs to be regularly cleaned of silt and other sediments to preserve their infiltration capacity. Evidence suggests that sweeping once per year should be sufficient to maintain an acceptable infiltration rate on most developments.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, or when required during autumn leaf fall
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48hours	Every 3 months, 48 hours after large storms.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Manage other weeds and vegetation and remove nuisance plants	Once a year, or when required
Remedial Actions	Repair erosion of any adjacent soft landscaping adjacent to the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks.	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Table 11: Operation and Maintenance Requirements for Permeable Paving

5.12 Foul Water Drainage

5.12.1 The outline foul water drainage strategy is to construct a new private gravity foul water drainage network to serve the residential properties that will outfall to the 150mm diameter foul sewer to the east of the site within York Lane.

5.12.2 The proposed private drainage layout for the new development site will be designed in accordance with BS EN 752: 2017, Building Regulations Part H guidance and UU adoption guidance.

5.12.3 An indicative foul water drainage layout can be found on the drainage strategy drawing in Appendix C.

6.0 Management Measures, Off Site Impacts and Residual Risk

6.1 Flood Risk Management Measures

6.1.1 The assessment has confirmed that there is no flood risk to the proposed residential units from all sources.

6.1.2 The surface water drainage strategy for the new development site will be to direct the surface water runoff to the adjacent watercourse at restricted greenfield discharge rates. The new surface water network will be designed in line with current British Standard and adoption guidance up to the 100-year storm return period including an allowance for climate change. Beyond the 30yr criterion out of chamber flooding may occur with flood water directed away from the units to the external highways where it will then be directed back into the drainage network as the pipe water levels recede.

6.1.3 The use of SuDS in the form of Prevention, Source Control and Site Control measures will help to reduce the flood risk impact to the surrounding watercourse network.

6.1.4 There will be a site management health and safety document prepared in respect of the final development. This will include the required maintenance regime for the on-site drains and drainage facilities such as the channels, gullies, pipes, manholes and all SuDS facilities.

6.1.5 A new management company and property owners will be responsible for site cleanliness and drain cleansing to ensure that the surface water drainage system will always operate at its maximum efficiency.

6.2 Off Site Impacts

6.2.1 The development of the site does not impair the hydraulic continuity of any watercourse and the current 'local hydraulics' of distributing watercourses / outfalls.

6.2.2 Surface water runoff will look to mimic the predevelopment Greenfield regime and utilises SuDS solutions to satisfy the site constraints. This will reduce surface water flooding impact onto the downstream catchment.

6.2.3 As there is no flood displacement or increased rate of runoff as part of this proposal into the adjacent watercourse, the proposed development will therefore not increase flood risk onto its locality.

6.3 Residual Risk

6.3.1 With careful design of the drainage elements as described above there will be no residual flood-related risks that will remain after the development has been completed.

6.3.2 Flood risk to people and property can be managed but it can never be completely removed; a residual risk remains after flood management or mitigation measures have been put in place. The only known flood related residual risk that will remain after flood management or mitigation measures have been put in place will be the risk of flooding from the new drainage network beyond the extreme event. With the proposed units raised above the external levels, the risk is mitigated.

Appendix A – Architects Drawings

KEY

Redline Boundary

Watercourse

Hard Works

Vehicular HRA Surfacing
Black colour.
To engineer specification & recommendation

Coloured Chip HRA Surfacing
Black colour, with Buff chippings.
To engineer specification & recommendation

Indian Sandstone Paving
To private paths and patios

Permeable Precast Concrete Block Paving
To parking bays and private drives
Buff colour.

Cobble Setts
To driveway edges and rumble strips
Buff colour.

Permeable Resin Bound Gravel Surfacing
To feature junctions
Buff colour.

Bark Mulch
To PRoW

Garden Cobbles
To watercourse edges

Existing Fence
To be retained

Timber Closeboard Fence
1800mm high. With matching gates.

Timber Closeboard Fence
1500mm high. With matching kissing gates.

Estate Railing
1200mm high.

Brick Pillar
With stone cap. Buff colour to match the buildings.

Existing wall
Stone courses to match/ tie in with the new layout.

Timber Bridge
Details TBC

Soft Works

Existing Vegetation
To be retained

Proposed Tree Planting

Proposed Native Hedge Planting
Native species mix.

Proposed Ornamental Hedge Planting
Native single species.

Proposed Groundcover Planting
Ornamental species mix.

Proposed Ornamental Shrub Planting
Ornamental shrub mix.

Proposed Native Shrub Planting
Native shrub mix.

Proposed Mixed Scrub Planting
Native scrub mix.

Proposed Turf Grass
To front gardens.

Proposed Seeded Amenity Grass
To back gardens.

Proposed Wet Planting
Seed mix. To swales and attenuation area.

Proposed Marginal Planting
Marginal plant mix. To open watercourse.

Notes:-

REV.	DATE	DESCRIPTION	DRAWN	CHK'D
P01	06/05/26	FIRST ISSUE	MA	SW

URBAN GREEN

A: Ground Floor, The Tower,
Deva City Office Park, Trinity Way,
Manchester M3 7BF

T: +44 (0) 161 312 3131

weareurbangreen.co.uk

Client: **REDWATERS (LANGHO)**

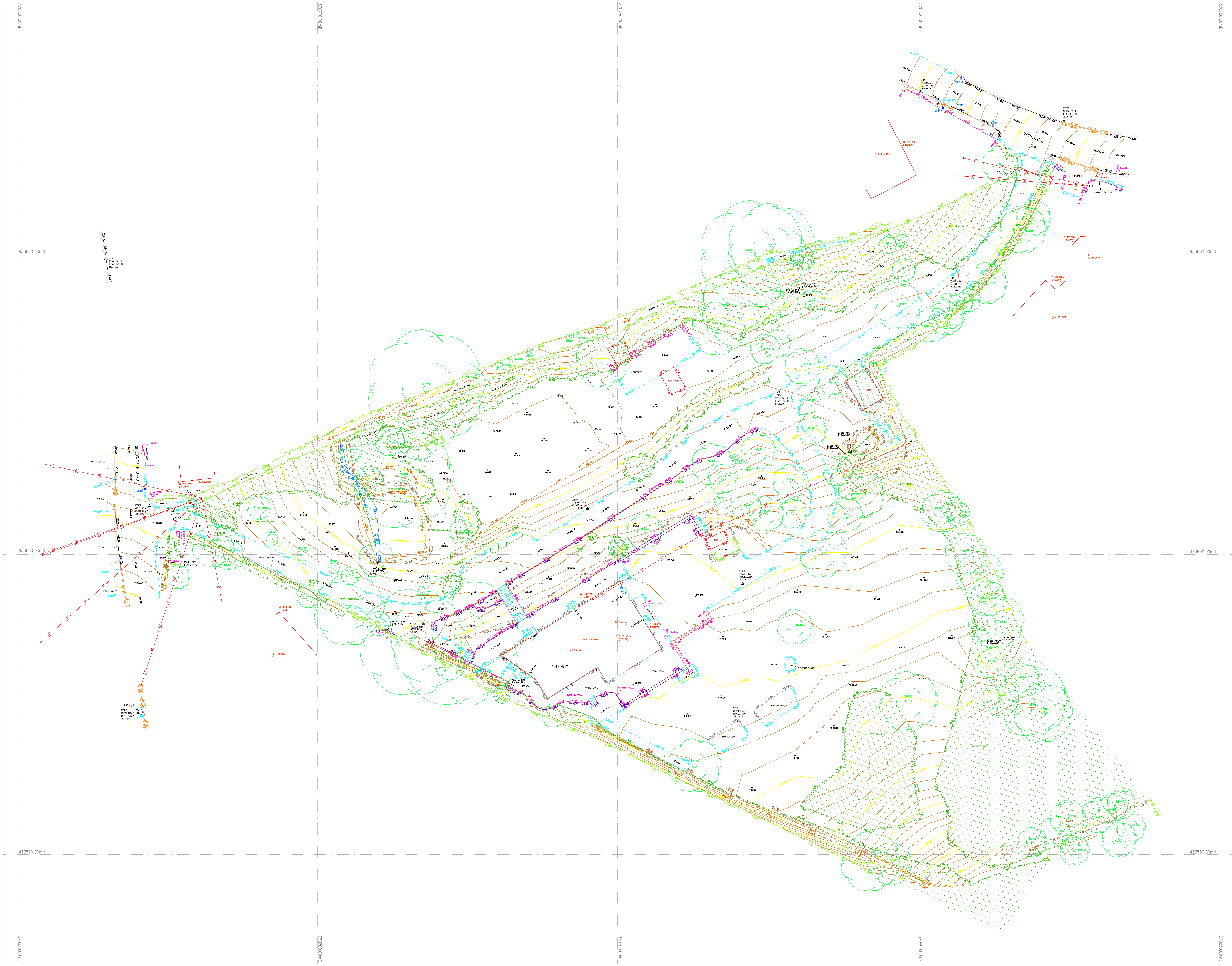
Project: **THE NOOK, LANGHO**

Title: **GENERAL ARRANGEMENT PLAN**

Issue: **PLANNING**

Drawn: MA	Checked: SW	Approved: MK
Project: UG3174	Scale @ A0: 1:200	Date: 06/05/26
Dwg No: UG_3174_LAN_GA_DRW_01		Revision: P01

Appendix B – Topographical Survey



SITE GRID NORTH:

N
W E
S

Symbols/Abbreviations (Where Applicable):

AV:	AIR VALVE
BB:	BELISHA BEACON
BH:	BOREHOLE
BM:	BENCHMARK
BOL:	BOLLARD
B/S:	BUS STOP
CAM:	CAMERA
CS:	CABLE STAY
CATV:	C.A.T.V INSPECTION CHAMBER
CBOX:	ELECTRICITY BOX, CABLE BOX, ETC.
CCTV:	C.C.T.V CAMERA
C.PIT:	CATCH PIT
EC:	ELECTRICITY COVER
EP:	ELECTRICITY POLE
ER:	EARTH ROD
FH:	FIRE HYDRANT
FP:	FLAG POLE
G:	GULLY
G:	GULLY (ROUND)
GV:	GAS VALVE
IC:	INSPECTION COVER (SQUARE)
IC:	INSPECTION COVER (ROUND)
IL:	INVERT LEVEL
KO:	KERB OUTLET
LB:	LETTER BOX
LC:	LIGHTING COLUMN
LP:	LAMP POST
LP/BS:	LAMP POST/BUS STOP
MH:	MANHOLE (SQUARE)
MH:	MANHOLE (ROUND)
MKR:	MARKER
P:	POST
RE:	RODDING EYE
R/S:	ROAD SIGN
S/P:	SIGN POST
SNP:	STREET NAME PLATE
ST:	STOP TAP
SV:	STOP VALVE
TCB:	TELEPHONE CALL BOX
TL:	TRAFFIC LIGHT
TP:	TELEGRAPH POLE
TP/EP:	TELEGRAPH POLE/ELECTRIC POLE
T/IC:	TELECOM INSPECTION COVER
WO:	WATER OUTLET
WM:	WATER METER
	GATE
	DEFINED POINT
	CONTROL POINT
	TREE (CONIFEROUS)
	TREE (DECIDUOUS)
	FOLIAGE
	HEDGE
DPC 99.99m	DAMP PROOF COURSE LEVEL
EL 99.99m	EAVES LEVEL
FL 99.99m	FLOOR LEVEL
RL 99.99m	RIDGE LEVEL
SL 99.99m	SOFFIT LEVEL
TL 99.99m	THRESHOLD LEVEL

FENCE DESCRIPTIONS:

B/W:	BARBED WIRE FENCE
C/B:	CLOSE BOARDED FENCE
C/L:	CHAIN LINK FENCE
C/P:	CHESTNUT PALING FENCE
CONC/P:	CONCRETE PANEL FENCE
I/R:	IRON RAILING FENCE
P/R:	POST AND RAIL FENCE
P/W:	POST AND WIRE FENCE
P/C:	POST AND CHAIN FENCE
S/PAL:	STEEL PALISADE FENCE
S/B:	SAFETY BARRIER
T/PAL:	TIMBER PALISADE FENCE

Revision Information

Rev	Date	Description

INFORMATION

1) Ordnance Survey co-ordinates and level are derived from OSTN15 and OSGM15, transformed from WGS84.
2) Only services located during the site survey are shown on this plan. Further investigation may be required to ascertain the full extent of the site services.
3) Copyright of this drawing remains the property of A-TECK Surveys Ltd. Do not copy or share this drawing with any third parties unless prior authorisation is obtained from A-TECK Surveys Ltd.
4) Do not scale from this drawing. In the event of any discrepancy, refer query to A-TECK Surveys Ltd.

NOTES

1) Survey supplied at Scale 1 and best fit to OS grid.

8 Eastway
Sale
Cheshire, M33 4DX
Tel: 07860 619642 / 07725 815779
Email: info@atecksurveysltd.co.uk

CLIENT INFORMATION:

Urban Green
Ground Floor, The Tower
Deva City Office Park, Trinity Way
Manchester, M3 7BF
EMAIL: weareurbangreen.co.uk

PROJECT: Topographic Survey
The Nook
Snodworth Road
Langho, Blackburn

PROJECT REF: ATS25-0011	SIZE: A0	SURVEYED BY:	ATS
	SCALE: 1:200	DRAWN BY:	ATS
		APPROVED BY:	ATS
DRAWING REFERENCE: ATS25-0011-01		DATE ISSUED: 08/07/2025	

Appendix C – PGC Drawings

SURFACE WATER DRAINAGE STRATEGY

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

- DISCHARGE INTO GROUND - EXISTING COHESIVE GROUND WOULD NEGATE INFILTRATION AS A VIABLE OPTION
- DISCHARGE TO SURFACE WATER BODY - TWO NEW CONNECTIONS TO WATERCOURSES PASSING THROUGH THE SITE AT RESTRICTED RATES.
- DISCHARGE TO SURFACE WATER SEWER, HIGHWAY DRAIN OR OTHER DRAINAGE SYSTEM - NO SURFACE WATER SEWER IN CLOSE PROXIMITY. HIGHER OPTIONS AVAILABLE.
- DISCHARGE TO COMBINED WATER SEWER - HIGHER OPTIONS AVAILABLE.

SUDS TO ENCOMPASS:

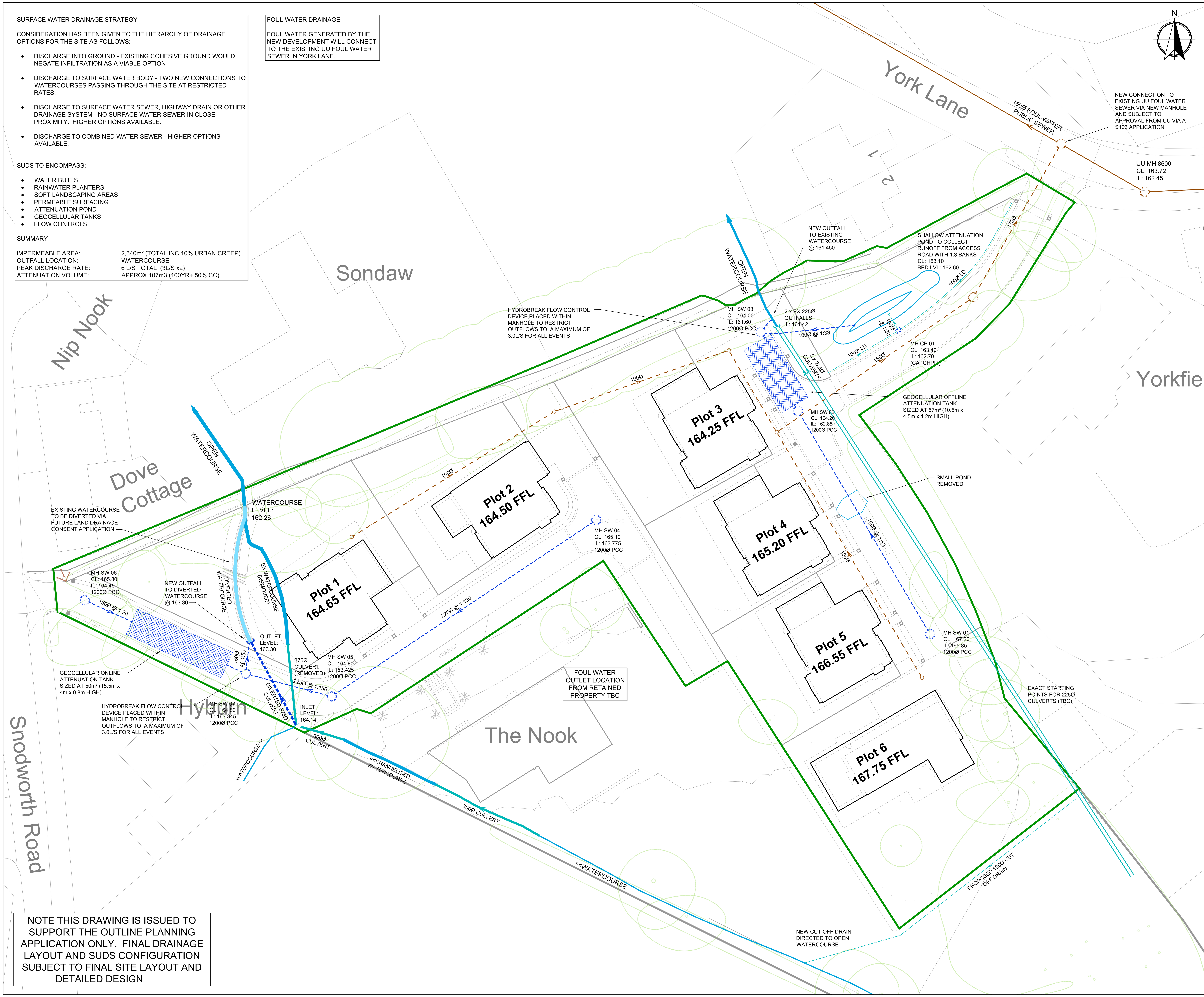
- WATER BUTTS
- RAINWATER PLANTERS
- SOFT LANDSCAPING AREAS
- PERMEABLE SURFACING
- ATTENUATION POND
- GEOCELLULAR TANKS
- FLOW CONTROLS

SUMMARY

IMPERMEABLE AREA:	2,340m² (TOTAL INC 10% URBAN CREEP)
OUTFALL LOCATION:	WATERCOURSE
PEAK DISCHARGE RATE:	6 L/S TOTAL (3L/S x2)
ATTENUATION VOLUME:	APPROX 107m3 (100YR+ 50% CC)

FOUL WATER DRAINAGE

FOUL WATER GENERATED BY THE NEW DEVELOPMENT WILL CONNECT TO THE EXISTING UU FOUL WATER SEWER IN YORK LANE.



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

GENERAL NOTES

1. 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.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. 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

- EXISTING FOUL WATER PUBLIC SEWER
- EXISTING CULVERT
- EXISTING WATERCOURSE
- PROPOSED FOUL WATER DRAINAGE
- PROPOSED SURFACE WATER DRAINAGE
- DIVERTED WATERCOURSE
- SITE BOUNDARY

REV	DATE	DRAWN	REV'D ENG.	NOTES
P2	11.05.26	PG	PG	GENERAL UPDATES
P1	06.05.26	PG	PG	PRELIMINARY ISSUE

CLIENT
REDWATERS (LANGHO) LTD

PROJECT
THE NOOK,
LANGHO

DRAWING TITLE
DRAINAGE STRATEGY PLAN

DRAWING STATUS
PRELIMINARY

SCALE	DRAWN BY	ENGINEER	SHEET
1:250	PG	PG	A1

DRAWING No	REVISION
PGC1342-DR-C-001	P2

PG Consulting
Civil & Infrastructure Engineers

108 Ack Lane West,
Cheadle Hulme,
Cheshire,
SK8 7ES
Tel: 07710 758971
Email: paul@pgcl.co.uk

Appendix D – Outline Hydraulic Calculations

Design Settings

Rainfall Methodology	FSR
Return Period (years)	20
Additional Flow (%)	0
FSR Region	England and Wales
M5-60 (mm)	20.000
Ratio-R	0.400
CV	1.000
Time of Entry (mins)	5.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	150.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	✓
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

Template	Freeform Carrier
Shape	Circular
Barrels	1
Auto Increment (mm)	75
Follow Ground	✓

Available Diameters (mm)

100 | 150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)	Invert Level (m)
CP01	0.016	10.00	163.400	600	0.700	162.700
POND			163.100	100	0.500	162.600
SW01	0.071	5.00	167.200	1200	1.350	165.850
SW02	0.035	5.00	164.200	1200	1.350	162.850
TANK			164.100	1200	2.300	161.800
SW03			164.000	1200	2.400	161.600
OUTFALL			162.000	100	0.550	161.450

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)
2.000	CP01	POND	3.000	0.600	162.700	162.600	0.100	30.0	100	10.04	87.0
2.001	POND	SW03	13.000	0.600	162.600	162.200	0.400	32.5	100	10.19	86.3
1.000	SW01	SW02	39.000	0.600	165.850	162.850	3.000	13.0	150	5.23	117.3
1.001	SW02	TANK	1.000	0.600	162.850	162.750	0.100	10.0	150	5.24	117.2
1.002	TANK	SW03	1.000	0.600	161.800	161.700	0.100	10.0	150	5.24	117.2
1.003	SW03	OUTFALL	3.000	0.600	161.600	161.450	0.150	20.0	150	10.22	86.2

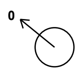
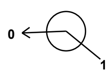
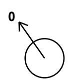
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	1.414	11.1	5.0	0.600	0.400	0.016	0.0	47	1.380
2.001	1.358	10.7	5.0	0.400	1.700	0.016	0.0	48	1.335
1.000	2.809	49.6	30.1	1.200	1.200	0.071	0.0	84	2.937
1.001	3.204	56.6	44.9	1.200	1.200	0.106	0.0	101	3.546
1.002	3.204	56.6	44.9	2.150	2.150	0.106	0.0	101	3.546
1.003	2.262	40.0	38.0	2.250	0.400	0.122	0.0	117	2.565

Pipeline Schedule

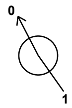
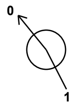
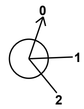
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2.000	3.000	30.0	100	Circular	163.400	162.700	0.600	163.100	162.600	0.400
2.001	13.000	32.5	100	Circular	163.100	162.600	0.400	164.000	162.200	1.700
1.000	39.000	13.0	150	Circular	167.200	165.850	1.200	164.200	162.850	1.200
1.001	1.000	10.0	150	Circular	164.200	162.850	1.200	164.100	162.750	1.200
1.002	1.000	10.0	150	Circular	164.100	161.800	2.150	164.000	161.700	2.150
1.003	3.000	20.0	150	Circular	164.000	161.600	2.250	162.000	161.450	0.400

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
2.000	CP01	600	Manhole	Adoptable	POND	100	Manhole	Adoptable
2.001	POND	100	Manhole	Adoptable	SW03	1200	Manhole	Adoptable
1.000	SW01	1200	Manhole	Adoptable	SW02	1200	Manhole	Adoptable
1.001	SW02	1200	Manhole	Adoptable	TANK	1200	Manhole	Adoptable
1.002	TANK	1200	Manhole	Adoptable	SW03	1200	Manhole	Adoptable
1.003	SW03	1200	Manhole	Adoptable	OUTFALL	100	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
CP01	111.176	67.163	163.400	0.700	600		0	2.000	162.700	100
POND	100.658	75.664	163.100	0.500	100		1	2.000	162.600	100
							0	2.001	162.600	100
SW01	72.069	21.621	167.200	1.350	1200		0	1.000	165.850	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SW02	49.114	53.985	164.200	1.350	1200		1	1.000	162.850	150
							0	1.001	162.850	150
TANK	43.588	64.612	164.100	2.300	1200		1	1.001	162.750	150
							0	1.002	161.800	150
SW03	36.575	73.114	164.000	2.400	1200		1	2.001	162.200	100
							2	1.002	161.700	150
							0	1.003	161.600	150
OUTFALL	41.784	88.204	162.000	0.550	100		1	1.003	161.450	150

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	1.000	Check Discharge Rate(s)	x
Winter CV	1.000	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	45	0	0
100	50	0	0

Node SW03 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	161.600	Product Number	CTL-SHE-0075-3000-1500-3000
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.0	Min Node Diameter (mm)	1200

Node POND Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	162.600
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	84

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	9.0	9.0	0.500	58.0	58.9

Node TANK Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	161.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	47.3	47.3	1.200	47.3	76.6	1.201	0.0	76.6

Approval Settings

Node Size	✓	Maximum Full Bore Velocity (m/s)	3.000
Node Losses	✓	Proportional Velocity	✓
Link Size	✓	Return Period (years)	
Minimum Diameter (mm)	150	Minimum Proportional Velocity (m/s)	0.750
Link Length	✓	Maximum Proportional Velocity (m/s)	3.000
Maximum Length (m)	100.000	Surcharged Depth	✓
Coordinates	✓	Return Period (years)	
Accuracy (m)	1.000	Maximum Surcharged Depth (m)	0.100
Crossings	✓	Flooding	✓
Cover Depth	✓	Return Period (years)	30
Minimum Cover Depth (m)		Time to Half Empty	x
Maximum Cover Depth (m)	3.000	Discharge Rates	✓
Backdrops	✓	Discharge Volume	✓
Minimum Backdrop Height (m)		100 year 360 minute (m³)	
Maximum Backdrop Height (m)	1.500	First Flush	✓
Full Bore Velocity	✓	Return Period (years)	30
Minimum Full Bore Velocity (m/s)		First Flush Depth (mm)	5

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	109.521	30.991	1 year 1440 minute winter	3.326	1.326
1 year 15 minute winter	76.857	30.991	30 year +45% CC 15 minute summer	389.624	110.250
1 year 30 minute summer	71.439	20.215	30 year +45% CC 15 minute winter	273.421	110.250
1 year 30 minute winter	50.133	20.215	30 year +45% CC 30 minute summer	253.647	71.773
1 year 60 minute summer	48.435	12.800	30 year +45% CC 30 minute winter	177.998	71.773
1 year 60 minute winter	32.179	12.800	30 year +45% CC 60 minute summer	169.054	44.676
1 year 120 minute summer	30.053	7.942	30 year +45% CC 60 minute winter	112.316	44.676
1 year 120 minute winter	19.966	7.942	30 year +45% CC 120 minute summer	102.135	26.991
1 year 180 minute summer	23.233	5.979	30 year +45% CC 120 minute winter	67.856	26.991
1 year 180 minute winter	15.102	5.979	30 year +45% CC 180 minute summer	77.282	19.887
1 year 240 minute summer	18.475	4.882	30 year +45% CC 180 minute winter	50.235	19.887
1 year 240 minute winter	12.274	4.882	30 year +45% CC 240 minute summer	60.326	15.942
1 year 360 minute summer	14.169	3.646	30 year +45% CC 240 minute winter	40.079	15.942
1 year 360 minute winter	9.210	3.646	30 year +45% CC 360 minute summer	45.271	11.650
1 year 480 minute summer	11.185	2.956	30 year +45% CC 360 minute winter	29.427	11.650
1 year 480 minute winter	7.431	2.956	30 year +45% CC 480 minute summer	35.270	9.321
1 year 600 minute summer	9.182	2.511	30 year +45% CC 480 minute winter	23.432	9.321
1 year 600 minute winter	6.274	2.511	30 year +45% CC 600 minute summer	28.646	7.835
1 year 720 minute summer	8.203	2.199	30 year +45% CC 600 minute winter	19.572	7.835
1 year 720 minute winter	5.513	2.199	30 year +45% CC 720 minute summer	25.360	6.797
1 year 960 minute summer	6.768	1.782	30 year +45% CC 720 minute winter	17.043	6.797
1 year 960 minute winter	4.483	1.782	30 year +45% CC 960 minute summer	20.612	5.428
1 year 1440 minute summer	4.949	1.326	30 year +45% CC 960 minute winter	13.654	5.428

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +45% CC 1440 minute summer	14.733	3.949	100 year +50% CC 240 minute winter	54.083	21.513
30 year +45% CC 1440 minute winter	9.901	3.949	100 year +50% CC 360 minute summer	60.725	15.627
100 year +50% CC 15 minute summer	523.107	148.021	100 year +50% CC 360 minute winter	39.473	15.627
100 year +50% CC 15 minute winter	367.093	148.021	100 year +50% CC 480 minute summer	47.121	12.453
100 year +50% CC 30 minute summer	343.448	97.184	100 year +50% CC 480 minute winter	31.306	12.453
100 year +50% CC 30 minute winter	241.016	97.184	100 year +50% CC 600 minute summer	38.147	10.434
100 year +50% CC 60 minute summer	229.932	60.764	100 year +50% CC 600 minute winter	26.064	10.434
100 year +50% CC 60 minute winter	152.761	60.764	100 year +50% CC 720 minute summer	33.678	9.026
100 year +50% CC 120 minute summer	138.843	36.692	100 year +50% CC 720 minute winter	22.634	9.026
100 year +50% CC 120 minute winter	92.244	36.692	100 year +50% CC 960 minute summer	27.249	7.175
100 year +50% CC 180 minute summer	104.709	26.945	100 year +50% CC 960 minute winter	18.050	7.175
100 year +50% CC 180 minute winter	68.064	26.945	100 year +50% CC 1440 minute summer	19.345	5.185
100 year +50% CC 240 minute summer	81.404	21.513	100 year +50% CC 1440 minute winter	13.001	5.185

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	CP01	20	162.730	0.030	1.9	0.0224	0.0000	OK
30 minute summer	POND	22	162.628	0.028	1.9	0.2933	0.0000	OK
15 minute summer	SW01	10	165.902	0.052	12.7	0.1126	0.0000	OK
15 minute summer	SW02	10	162.939	0.089	18.9	0.1475	0.0000	OK
60 minute summer	TANK	48	161.984	0.184	15.2	8.4931	0.0000	SURCHARGED
60 minute summer	SW03	48	161.984	0.384	9.3	0.4342	0.0000	SURCHARGED
30 minute summer	OUTFALL	22	161.476	0.026	2.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	CP01	2.000	POND	1.9	1.054	0.170	0.0056	
30 minute summer	POND	2.001	SW03	1.8	0.993	0.166	0.0232	
15 minute summer	SW01	1.000	SW02	12.6	1.555	0.254	0.3180	
15 minute summer	SW02	1.001	TANK	18.6	2.139	0.329	0.0087	
60 minute summer	TANK	1.002	SW03	9.3	1.333	0.164	0.0176	
60 minute summer	SW03	1.003	OUTFALL	2.6	1.208	0.065	0.0064	15.5

Results for 30 year +45% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	CP01	120	162.771	0.071	2.9	0.0523	0.0000	OK
120 minute winter	POND	120	162.771	0.171	2.9	2.9631	0.0000	SURCHARGED
15 minute summer	SW01	10	165.965	0.115	45.2	0.2507	0.0000	OK
15 minute summer	SW02	11	163.412	0.562	66.8	0.9274	0.0000	SURCHARGED
120 minute winter	TANK	118	162.771	0.971	20.1	44.7147	0.0000	SURCHARGED
120 minute winter	SW03	118	162.770	1.170	9.6	1.3233	0.0000	SURCHARGED
120 minute winter	OUTFALL	118	161.476	0.026	2.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute winter	CP01	2.000	POND	2.9	1.103	0.261	0.0206	
120 minute winter	POND	2.001	SW03	2.9	1.107	0.272	0.1017	
15 minute summer	SW01	1.000	SW02	44.5	2.602	0.896	0.6254	
15 minute summer	SW02	1.001	TANK	65.4	3.715	1.155	0.0176	
120 minute winter	TANK	1.002	SW03	9.0	1.328	0.159	0.0176	
120 minute winter	SW03	1.003	OUTFALL	2.6	1.215	0.066	0.0065	50.5

Results for 100 year +50% CC Critical Storm Duration. Lowest mass balance: 99.87%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	CP01	176	163.045	0.345	3.0	0.2552	0.0000	SURCHARGED
180 minute winter	POND	176	163.045	0.445	5.2	13.6952	0.0000	FLOOD RISK
15 minute summer	SW01	12	166.993	1.142	60.7	2.4940	0.0000	FLOOD RISK
15 minute summer	SW02	11	163.597	0.747	76.7	1.2324	0.0000	SURCHARGED
180 minute winter	TANK	176	163.045	1.245	19.7	55.3521	0.0000	SURCHARGED
180 minute winter	SW03	176	163.044	1.444	7.1	1.6330	0.0000	SURCHARGED
180 minute winter	OUTFALL	176	161.478	0.028	2.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute winter	CP01	2.000	POND	3.0	1.108	0.270	0.0235	
180 minute winter	POND	2.001	SW03	-3.2	1.054	-0.298	0.1017	
15 minute summer	SW01	1.000	SW02	49.3	2.798	0.992	0.6866	
15 minute summer	SW02	1.001	TANK	76.1	4.324	1.344	0.0176	
180 minute winter	TANK	1.002	SW03	6.5	1.264	0.114	0.0176	
180 minute winter	SW03	1.003	OUTFALL	2.9	1.248	0.073	0.0070	64.7

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	20	Maximum Rainfall (mm/hr)	150.0
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	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

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

Template	Freeform Carrier	Auto Increment (mm)	75
Shape	Circular	Follow Ground	✓
Barrels	1		

Available Diameters (mm)

100	150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)	Invert Level (m)
SW04	0.057	5.00	165.100	1200	1.325	163.775
SW05	0.026	5.00	164.800	1200	1.375	163.425
SW06	0.019	5.00	165.800	1200	1.350	164.450
TANK			165.000	100	1.500	163.500
SW07			164.800	1200	1.455	163.345
OUTFALL			164.500	100	1.200	163.300

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	SW04	SW05	45.000	0.600	163.775	163.425	0.350	128.6	225	5.65	113.6
1.001	SW05	SW07	12.000	0.600	163.425	163.345	0.080	150.0	225	5.84	112.1
2.000	SW06	TANK	12.000	0.600	164.450	163.850	0.600	20.0	150	5.09	118.6
2.001	TANK	SW07	4.000	0.600	163.500	163.400	0.100	40.0	150	5.13	118.2
1.002	SW07	OUTFALL	4.000	0.600	163.345	163.300	0.045	88.9	150	5.90	120.6

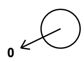
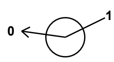
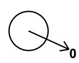
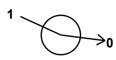
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.151	45.8	23.4	1.100	1.150	0.057	0.0	114	1.157
1.001	1.065	42.3	33.6	1.150	1.230	0.083	0.0	152	1.178
2.000	2.262	40.0	8.1	1.200	1.000	0.019	0.0	46	1.785
2.001	1.596	28.2	8.1	1.350	1.250	0.019	0.0	55	1.379
1.002	1.066	18.8	44.5	1.305	1.050	0.102	0.0	150	1.086

Pipeline Schedule

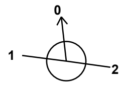
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	45.000	128.6	225	Circular	165.100	163.775	1.100	164.800	163.425	1.150
1.001	12.000	150.0	225	Circular	164.800	163.425	1.150	164.800	163.345	1.230
2.000	12.000	20.0	150	Circular	165.800	164.450	1.200	165.000	163.850	1.000
2.001	4.000	40.0	150	Circular	165.000	163.500	1.350	164.800	163.400	1.250
1.002	4.000	88.9	150	Circular	164.800	163.345	1.305	164.500	163.300	1.050

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW04	1200	Manhole	Adoptable	SW05	1200	Manhole	Adoptable
1.001	SW05	1200	Manhole	Adoptable	SW07	1200	Manhole	Adoptable
2.000	SW06	1200	Manhole	Adoptable	TANK	100	Manhole	Adoptable
2.001	TANK	100	Manhole	Adoptable	SW07	1200	Manhole	Adoptable
1.002	SW07	1200	Manhole	Adoptable	OUTFALL	100	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SW04	65.435	67.288	165.100	1.325	1200		0	1.000	163.775	225
SW05	34.418	52.203	164.800	1.375	1200		1	1.000	163.425	225
							0	1.001	163.425	225
SW06	-22.531	65.763	165.800	1.350	1200		0	2.000	164.450	150
TANK	-3.879	57.267	165.000	1.500	100		1	2.000	163.850	150
							0	2.001	163.500	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SW07	18.486	54.407	164.800	1.455	1200		1	2.001	163.400	150
							2	1.001	163.345	225
							0	1.002	163.345	150
OUTFALL	16.791	69.492	164.500	1.200	100		1	1.002	163.300	150

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 (m^3/ha)	20.0
Ratio-R	0.400	Starting Level (m)	
Summer CV	1.000	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 (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	45	0	0
100	50	0	0

Node SW07 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	163.345	Product Number	CTL-SHE-0077-3000-1400-3000
Design Depth (m)	1.400	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.0	Min Node Diameter (mm)	1200

Node TANK Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	163.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	186

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	62.0	62.0	0.800	62.0	84.3	0.801	0.0	84.3

Approval Settings

Node Size	✓	Coordinates	✓
Node Losses	✓	Accuracy (m)	1.000
Link Size	✓	Crossings	✓
Minimum Diameter (mm)	150	Cover Depth	✓
Link Length	✓	Minimum Cover Depth (m)	
Maximum Length (m)	100.000	Maximum Cover Depth (m)	3.000

Approval Settings

Backdrops	✓
Minimum Backdrop Height (m)	
Maximum Backdrop Height (m)	1.500
Full Bore Velocity	✓
Minimum Full Bore Velocity (m/s)	
Maximum Full Bore Velocity (m/s)	3.000
Proportional Velocity	✓
Return Period (years)	
Minimum Proportional Velocity (m/s)	0.750
Maximum Proportional Velocity (m/s)	3.000
Surcharged Depth	✓
Return Period (years)	
Maximum Surcharged Depth (m)	0.100
Flooding	✓
Return Period (years)	30
Time to Half Empty	x
Discharge Rates	✓
Discharge Volume	✓
100 year 360 minute (m³)	
First Flush	✓
Return Period (years)	30
First Flush Depth (mm)	5

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	109.521	30.991
1 year 15 minute winter	76.857	30.991
1 year 30 minute summer	71.439	20.215
1 year 30 minute winter	50.133	20.215
1 year 60 minute summer	48.435	12.800
1 year 60 minute winter	32.179	12.800
1 year 120 minute summer	30.053	7.942
1 year 120 minute winter	19.966	7.942
1 year 180 minute summer	23.233	5.979
1 year 180 minute winter	15.102	5.979
1 year 240 minute summer	18.475	4.882
1 year 240 minute winter	12.274	4.882
1 year 360 minute summer	14.169	3.646
1 year 360 minute winter	9.210	3.646
1 year 480 minute summer	11.185	2.956
1 year 480 minute winter	7.431	2.956
1 year 600 minute summer	9.182	2.511
1 year 600 minute winter	6.274	2.511
1 year 720 minute summer	8.203	2.199
1 year 720 minute winter	5.513	2.199
1 year 960 minute summer	6.768	1.782
1 year 960 minute winter	4.483	1.782
1 year 1440 minute summer	4.949	1.326
1 year 1440 minute winter	3.326	1.326
30 year +45% CC 15 minute summer	389.624	110.250
30 year +45% CC 15 minute winter	273.421	110.250
30 year +45% CC 30 minute summer	253.647	71.773
30 year +45% CC 30 minute winter	177.998	71.773
30 year +45% CC 60 minute summer	169.054	44.676
30 year +45% CC 60 minute winter	112.316	44.676
30 year +45% CC 120 minute summer	102.135	26.991
30 year +45% CC 120 minute winter	67.856	26.991
30 year +45% CC 180 minute summer	77.282	19.887
30 year +45% CC 180 minute winter	50.235	19.887
30 year +45% CC 240 minute summer	60.326	15.942
30 year +45% CC 240 minute winter	40.079	15.942
30 year +45% CC 360 minute summer	45.271	11.650
30 year +45% CC 360 minute winter	29.427	11.650
30 year +45% CC 480 minute summer	35.270	9.321
30 year +45% CC 480 minute winter	23.432	9.321
30 year +45% CC 600 minute summer	28.646	7.835
30 year +45% CC 600 minute winter	19.572	7.835
30 year +45% CC 720 minute summer	25.360	6.797
30 year +45% CC 720 minute winter	17.043	6.797
30 year +45% CC 960 minute summer	20.612	5.428
30 year +45% CC 960 minute winter	13.654	5.428
30 year +45% CC 1440 minute summer	14.733	3.949
30 year +45% CC 1440 minute winter	9.901	3.949
100 year +50% CC 15 minute summer	523.107	148.021
100 year +50% CC 15 minute winter	367.093	148.021
100 year +50% CC 30 minute summer	343.448	97.184
100 year +50% CC 30 minute winter	241.016	97.184
100 year +50% CC 60 minute summer	229.932	60.764
100 year +50% CC 60 minute winter	152.761	60.764
100 year +50% CC 120 minute summer	138.843	36.692
100 year +50% CC 120 minute winter	92.244	36.692
100 year +50% CC 180 minute summer	104.709	26.945
100 year +50% CC 180 minute winter	68.064	26.945
100 year +50% CC 240 minute summer	81.404	21.513
100 year +50% CC 240 minute winter	54.083	21.513
100 year +50% CC 360 minute summer	60.725	15.627
100 year +50% CC 360 minute winter	39.473	15.627
100 year +50% CC 480 minute summer	47.121	12.453
100 year +50% CC 480 minute winter	31.306	12.453
100 year +50% CC 600 minute summer	38.147	10.434
100 year +50% CC 600 minute winter	26.064	10.434
100 year +50% CC 720 minute summer	33.678	9.026
100 year +50% CC 720 minute winter	22.634	9.026
100 year +50% CC 960 minute summer	27.249	7.175
100 year +50% CC 960 minute winter	18.050	7.175
100 year +50% CC 1440 minute summer	19.345	5.185
100 year +50% CC 1440 minute winter	13.001	5.185

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW04	10	163.846	0.071	10.2	0.1407	0.0000	OK
15 minute summer	SW05	11	163.636	0.211	14.6	0.3188	0.0000	OK
15 minute summer	SW06	10	164.480	0.030	3.4	0.0426	0.0000	OK
60 minute summer	TANK	45	163.588	0.088	8.9	5.1827	0.0000	OK
15 minute summer	SW07	11	163.623	0.278	14.6	0.3148	0.0000	SURCHARGED
15 minute summer	OUTFALL	11	163.338	0.038	2.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW04	1.000	SW05	9.9	0.632	0.217	1.1103	
15 minute summer	SW05	1.001	SW07	14.6	0.454	0.344	0.4710	
15 minute summer	SW06	2.000	TANK	3.4	1.354	0.084	0.0297	
60 minute summer	TANK	2.001	SW07	-6.6	0.562	-0.236	0.0567	
15 minute summer	SW07	1.002	OUTFALL	2.6	0.717	0.139	0.0147	7.7

Results for 30 year +45% CC Critical Storm Duration. Lowest mass balance: 99.51%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW04	12	164.387	0.612	36.3	1.2183	0.0000	SURCHARGED
15 minute summer	SW05	12	164.218	0.793	47.5	1.1971	0.0000	SURCHARGED
15 minute summer	SW06	10	164.510	0.059	12.1	0.0840	0.0000	OK
120 minute summer	TANK	120	164.066	0.565	22.2	33.3104	0.0000	SURCHARGED
15 minute summer	SW07	12	164.101	0.756	45.2	0.8550	0.0000	SURCHARGED
60 minute winter	OUTFALL	31	163.338	0.038	2.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW04	1.000	SW05	31.7	0.796	0.692	1.7897	
15 minute summer	SW05	1.001	SW07	45.2	1.136	1.067	0.4773	
15 minute summer	SW06	2.000	TANK	12.0	1.913	0.300	0.0753	
120 minute summer	TANK	2.001	SW07	-17.1	-0.970	-0.606	0.0704	
15 minute summer	SW07	1.002	OUTFALL	2.7	0.722	0.143	0.0149	27.9

Results for 100 year +50% CC Critical Storm Duration. Lowest mass balance: 99.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW04	12	164.964	1.189	48.6	2.3680	0.0000	FLOOD RISK
120 minute summer	SW05	120	164.768	1.343	29.3	2.0266	0.0000	FLOOD RISK
120 minute summer	SW06	120	164.768	0.318	7.0	0.4487	0.0000	SURCHARGED
120 minute summer	TANK	120	164.768	1.268	32.5	47.1596	0.0000	FLOOD RISK
120 minute summer	SW07	120	164.768	1.423	28.4	1.6089	0.0000	FLOOD RISK
120 minute summer	OUTFALL	120	163.340	0.040	3.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW04	1.000	SW05	41.2	1.036	0.900	1.7897	
120 minute summer	SW05	1.001	SW07	28.4	0.714	0.670	0.4773	
120 minute summer	SW06	2.000	TANK	7.0	1.657	0.175	0.2113	
120 minute summer	TANK	2.001	SW07	-25.5	-1.449	-0.904	0.0704	
120 minute summer	SW07	1.002	OUTFALL	3.0	0.742	0.158	0.0161	52.4