



Project Title

Drainage Strategy Report

At

Former Wicken Hall Mill

Ogden Lane

Newhey

Littleborough

OL16

For

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Executive Summary

Figure 1: Flood Risk and Drainage Strategy Summary

Item	Brief Description
Development Proposed	Development of two detached dwellings with associated landscaping and car parking situated at the former Wicken Hall Mill, Ogden lane, Newhey, Littleborough, OL16 3TG.
Flood Zone Classification	Flood Zone 1 – Low Risk.
Flood Risk Mitigation Measures	To reduce the potential risk of surface water flows passing overland towards the site boundary and adjoining highways a land drainage network will be placed to the south and east of the site and a new drainage network in the existing highway to the west.
Geology	No formal site investigation has been undertaken at this time. A review of the BGS boreholes has shown that the site is underlain by Topsoil / Made Ground of varying depths over Glacial Till & Rough Rock to depth.
Infiltration Rate	Due to the presence of the cohesive Glacial Till, infiltration is not considered a viable means of draining the new development area.
Nearest Watercourses	A review of local maps confirmed that the closest identified watercourse is the Wicken Hall Clough, a culverted section of which flows through the centre of the site.
Nearest Adopted Sewers	There are no United Utilities Water adopted sewers in close proximity.
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 0.17ha: 1yr – 0.1l/s Qbar – 0.1l/s 30yr – 0.2l/s 100yr – 0.3l/s
Surface Water Drainage Outfall and SuDS Hierarchical Approach	Due to the cohesive glacial till, infiltration is not deemed suitable. Outflow to existing culverted watercourse on site at a minimum rates of 5l/s to suit Rochdale Metropolitan Borough Council (RMBC) SuDS Policy rates to mimic the predevelopment Greenfield runoff rates.
Proposed Discharge Rate	Qbar discharge rate to satisfy local and national guidance, minimum discharge of 5l/s.
Allowance for Climate Change	45% - based on a residential > 50-year design life to 'the 2080's'.
SuDS features	Water butts, permeable paving, geocellular storage.
Maintenance Responsibility	Property owners / Management company.
Foul Drainage Strategy	Package Sewage Treatment Plant on site, to outfall into the culverted watercourse.

1. Introduction

- 1.1 Paul Graveney Consulting Ltd (PGC) has been appointed by Leigh Kelly to prepare this Drainage & Sustainable Drainage Systems (SuDS) Strategy to support a planning application for 2 no. self-build dwellings with associated landscaping and car parking, situated at the former Wicken Hall Mill, Ogden Lane, Newhey, Littleborough. 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 10 of the 2021 'National Planning Policy Framework', plus the accompanying Technical Guidance on Flood Risk and any local policies.
- 1.3 This report has been commissioned by Leigh Kelly 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	Wicken Hall Mill
Site address and location	Wicken Hall Mill, Ogden Lane, Newhey, Littleborough, OL16 3TG
Council Area	Rochdale Metropolitan Borough Council
Approximate Grid Reference	OS: 395720, 411818
General Locality	The site is located approximately 1.5km east of Newhey Village Centre in a predominantly rural led area.

Figure 2: Site Referencing Information

2.2 Existing Site Description and Walk Over

- 2.2.1 The development site (Red Line Boundaries) is predominantly rectangular in plan shape and currently encompasses an area of hardcore with trees and shrubs on the periphery to the northwest around to the northeast. There is an access road leading down from Ogden Lane and Huddersfield Road to the south west, adjoining at the entrance to the development site. To the northwest there is a row of terrace housing consisting of approximately 7 dwellings. This is largely a rural area.
- 2.2.2 As mentioned previously the site is located off Ogden Lane and Huddersfield Road to the northwest joining at the entrance to the site, set in a largely rural and farm led area. There is an existing development to the southern boundary consisting of 4 detached dwellings.
- 2.2.3 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.

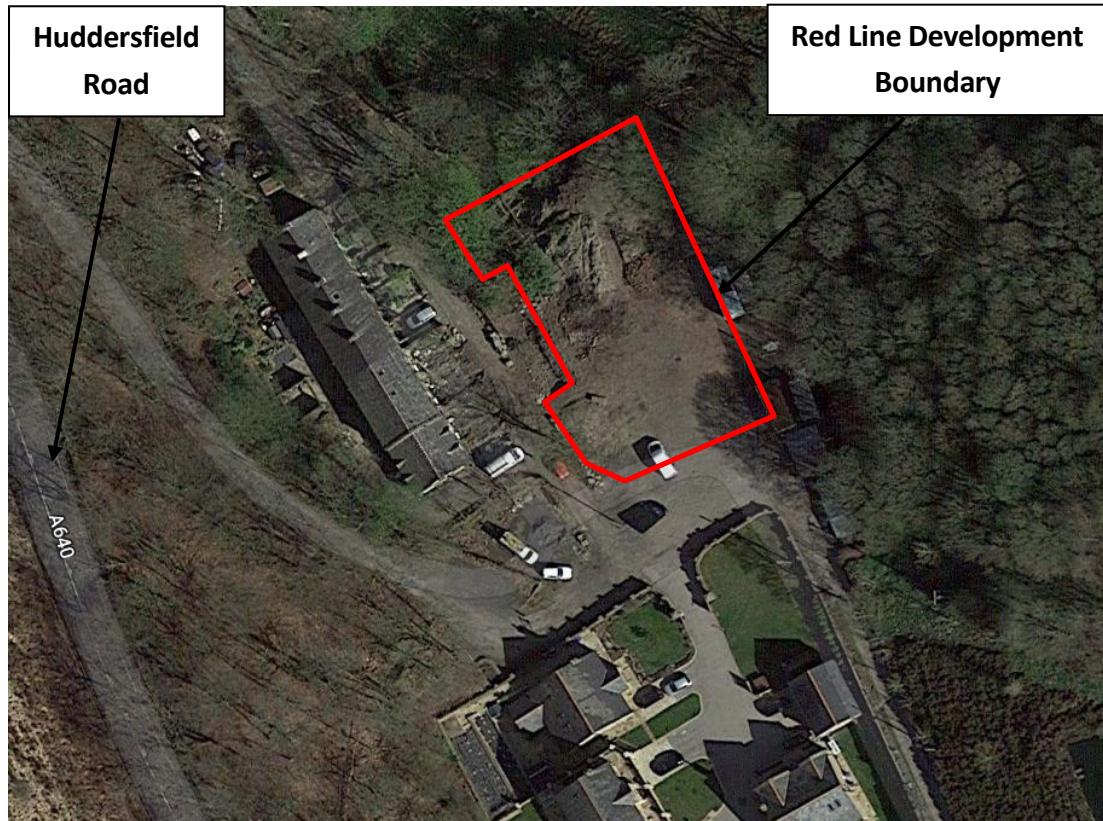


Figure 3: Location Plan as taken from Google Maps (2021)

2.3 Topography

- 2.3.1 A formal topographical survey has been completed. The site and surrounding area generally slopes to the northwest, with the highest point at circa 232.37mAOD located in the southeast of the site and the lowest at circa 229.44mAOD in the northwest adjacent to the culverted watercourse. The area of the houses is relatively flat.

2.4 Hydrology

- 2.4.1 A review of local maps has identified the closest watercourse is a culverted section of Wicken Hall Clough passing north through the centre of the site.

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 2021 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.

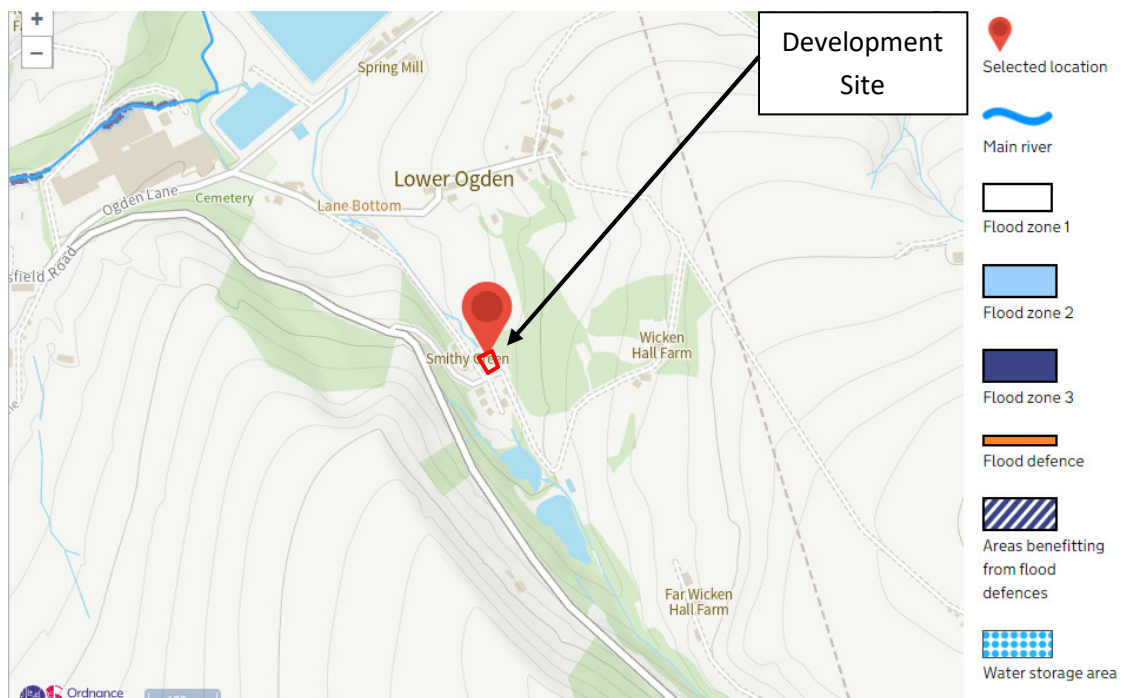


Figure 4: EA Indicative Flood Maps

- 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 Strategic Flood Risk Assessment (SFRA)

- 4.1.1 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.
- 4.1.2 The building sits within the coverage of the Rochdale Metropolitan Borough Council Level 2 SFRA Final Report dated April 2018. The published SFRA identifies current and future broad scale flood related issues within the area that includes the development boundary. 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.
- 4.1.3 A summary of the main elements from the SFRA associated with the district is detailed below. The full report can be obtained from the Rochdale Metropolitan Borough Council website.
- SFRA provides a detailed understanding of flood risks across the borough from all sources.
 - Surface water flooding is deemed a high flood risk, following the natural topography and watercourse routes.
 - Development should aim to deliver greenfield runoff rates on greenfield sites up to a 1 in 100-year storm event, considering climate change.
 - Development should be designed so that there is no flooding to the development in a 1 in 30-year event and so that there is no property flooding in a 1 in 100 year plus climate change event.
 - For all sites, development proposals should look at opportunities to incorporate SuDS to reduce the risk of surface water flooding.
 - All proposed developments must ensure that foul and surface water are kept separate.
 - Full sequential and exception tests to be carried out (where applicable).
 - Follow all local and national policy
 - Flood Resilient construction to be used where applicable.
 - Safe dry access and egress to be assured.

4.2 Local SuDS Strategy

- 4.2.1 In consultation with many other local councils in the region, Rochdale Metropolitan Borough Council prepared the United Utilities Combined Authority Sustainable Drainage Systems Guidance document with the aim to guide developers in the design of surface water drainage systems and 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.

4.2.2 The main principles of the report that affect this development are:

- Detailed SuDS management train approach to be incorporated throughout the scheme with appropriate measures from prevention, source control through to site control.
- Post development runoff rates for Greenfield sites to be as per the calculated greenfield runoff rates.
- Detailed design via hydraulic modelling to be undertaken of the existing drainage network to define the predevelopment peak discharge rates. Post development to encompass a 50% reduction on Brownfield sites.
- Post development runoff rates as close to Q_{bar} where the volume of runoff cannot equal the greenfield volumes.
- Detailed SuDS management train approach to be incorporated throughout the scheme with appropriate measures from prevention, source control through to site control.
- 40% climate change allowance where the design life exceeds 50 years. Though this is likely to now be superseded by recent EA site specific guidance.
- 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.
- Outline plans and hydraulic calculations to be provided at planning stage.

5. Outline Drainage Strategy

5.1 Existing Drainage

- 5.1.1 Based on the sites rural location, the United Utilities Water (UU) sewer records have been reviewed and confirm there are no sewers in close proximity.
- 5.1.2 The site area is fully unmade except for the existing containers along the eastern boundary.

5.2 Existing Runoff

- 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, Qbar, 1 in 30 and 1 in 100-year rainfall events. A copy of the calculations is contained in Appendix D. Figure 5 below provides a summary of the existing greenfield runoff rates based on an area of 0.17ha.

Area (Ha)	Greenfield Runoff Rates (l/s)			
	1 yr	Qbar	30yr	100yr
0.17	0.1	0.1	0.2	0.3

Figure 5: Existing Greenfield Runoff Rates

5.3 Hydrological Assessment

- 5.3.1 As discussed in previous sections, a review of the topographical survey, OS Maps and Environment Agency maps would indicate the closest surface water feature to be the culverted watercourse passing north through the site which appears to be a section of Wicken Hall Clough.

5.4 Geology

- 5.4.1 No site-specific intrusive Phase 2 Site Investigation has been carried out at the site. A review of the geology on the BGS website would indicate that the superficial geology of the site is Glacial Till comprised of clays. The bedrock geology is Rough Rock comprised of sandstone. The cohesive nature of the underlying geology precludes the use of soakaways on 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 the 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 type of development allows the range of prevention, source control and site control SuDS devices to be considered.
- *Site Characteristics:* No Phase 2 intrusive site investigation has been carried out at the site. However, based on the cohesive underlying geology, it is not considered at this time that infiltration-based options would 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	Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater. Promotes evaporation and local biodiversity.	<u>Not suitable:</u> Architectural proposals for the development and maintenance issues deem this unsuitable.
Water Butts	Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas for reuse by the property owners.	<u>Suitable:</u> Suited for residential developments such as this and subject to client approval at the rear of the dwellings.
Rainwater Harvesting	Rainwater harvesting reduces the total runoff volume from the developed site by reusing as 'Grey' water. Also reduces treated water consumption.	<u>Not suitable:</u> Additional costs of installation, running and maintenance would have severe effect on viability of development.
Infiltration Options	Reduces total run off volume from the development by allowing water to infiltrate to suitable sub strata.	<u>Not Suitable:</u> Presence of cohesive underlying geology mean infiltration options are not viable for use on the site.
Permeable Surfacing (Infiltration)	- Reduces total run off volume from the development by allowing water to infiltrate to suitable sub strata. - Can be used to enhance water quality.	<u>Not Suitable:</u> Presence of cohesive underlying geology mean infiltration options are not viable for use on the site.
Permeable Surfacing (Standard)	- Can be used to enhance quality of runoff water. - Sub-base provides 'source' storage and reduces the volume of storage downstream with selection of stone fill or use of plastic box stems. - Impermeable membrane at base of construction to prevent impact on pavement stability.	<u>Suitable:</u> Private access road and driveways have the potential to attenuate and filter surface water flows through the use of permeable surfacing (subject to confirmation from architect on surface finishes).
Bio-Retention	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.	<u>Suitable:</u> The type of the development would enable the use of above ground surface runoff storage to small, planted areas.
Swales, basins and ponds	- Provide areas for above ground surface runoff storage. - Swales also improve water quality through filtration.	<u>Not Suitable:</u> Not sufficient space or suitable development type to include for swales and ponds.

Table 6: 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.	<u>Suitable:</u> • Subject to detailed design and drainage layout to be used to attenuate the peak flows. Though above ground green SuDS would take precedent.
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).	<u>Not Suitable:</u> • The use of oversized pipes is more suited to large residential schemes.

Table 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	A review of the BGS website and local boreholes have indicated that the underlying cohesive Glacial Till and Rough Rock bedrock would not be suitable for infiltration-based options.
Connection to Watercourse	Yes	New connection to be made to the existing culverted watercourse on site at restricted rates.
Connection to Surface Water Sewer	No	No surface water sewers identified within close proximity.
Connection to a Combined Sewer	No	No combined water sewers identified within close proximity.

Table 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 watercourse at a restricted rate.

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 in the form of water butts to the rear RWP's.
- Source Control via the inclusion of permeable paving to private driveways and parking areas and water butts to each unit.
- Site control in the form of geocellular storage.
- 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 Rochdale Metropolitan Borough Council 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 would be restricted to Qbar 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**. However as these rates are extremely small, a minimum of 5l/s will be applied to mitigate the risk of potential blockage and failure of flow control devices.
- 5.6.4 It should be noted that these rates are indicative only and based on the anticipated measured impermeable areas from the development masterplan. The final discharge rate will be confirmed at detailed design stage and agreed with the LLFA through a reserved matters or condition discharge application.

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 nation wide allowances, each area will have its own peak rainfall allowances. In the case of the Newhey area, this is the Irwell Management Catchment peak rainfall allowances.
- 5.7.2 Based on the 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 30% for the central allowance and 45% for the upper end allowance. As such, an allowance of 45% for climate change on peak rainfall intensity will be included in 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 and direct it to geocellular storage within the rear garden area. This will then outfall into the culverted watercourse on site at a controlled rate of 5l/s. The access road and parking areas will filter through the permeable paving, before connecting into the main piped system and outfall into the culverted watercourse via the same flow control and outlet.
- 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 40% increase to account for climate change to confirm that there is no flood risk to the properties.
- 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 In the case of this development, exceedance flows will be all those over and above the 30-year design criterion set by guidance. Using storage within the external areas would be achievable and would direct flood water away from the proposed properties, with flows directed back into the surface water drainage network as water levels in the drainage network receded. The exceedance flows and volumes can be calculated for the new development drainage layout. In the case of this development and due to the fall across the site, consideration will be given to make sure all water is controlled so that it does not impact on the new properties.
- 5.8.5 Although it is envisaged that Prevention and Source Controls measures could be included in the final scheme, this strategy will assume for outline calculations purposes that only Site Control methods are incorporated. A source control attenuation assessment has been simulated in the Microdrainage Design Software. This takes into account the 5l/s discharge rate for all events, and assumes no source control measures are incorporated and no infiltration to ground is possible. 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.

- 5.8.6 Figure 9 below defines the outline attenuation volumes based on the attenuation ponds and swale.

Plot Area	SuDS Component	Impermeable Area (ha)	Peak Runoff Rate	Outline Attenuation Volumes for the 30 Year Event	Outline Attenuation Volumes for the 100 Year + 45% climate Change Event
Houses & External Parking	Geocellular storage	0.35	5.0l/s	3.1m ³	7.3m ³

Figure 9: Outline Attenuation Volumes

- 5.8.7 Drawing PGC642-C-001 in Appendix C indicates the Drainage Strategy based on the Architects masterplan intent, with the outline hydraulic calculations in Appendix D.
- 5.8.8 Due to ground levels rising up to the south and east of the site boundary a new land drainage network will be installed around the boundary. This will collect any surplus overland flows and direct into the culverted watercourse. In addition there are also some surface water flows passing down the access road leading down from Huddersfield Road. These will be collected by a number of new road gullies and again directed into the culverted watercourse.

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 reduced rate, 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 and driveways are considered as a low hazard in terms of contamination. Figure 10 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 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 10: Pollution Hazard indices for land use classification (Table 26.2 the CIRIA SuDS manual 2015)

- 5.10.2 Figure 11 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 11) exceeds the pollution hazard index (Figure 10).

Type of SuDS component	Mitigation indices ¹		
	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 11: Indicative SuDS mitigation indices (Table 26.3 the CIRIA SuDS manual 2015)

5.10.4 Currently, permeable paving is proposed for the external areas. This will provide the necessary treatment for the new parking areas to reduce contamination risk to the downstream catchments. Residential roofs are classed as very low risk.

5.11 Maintenance

5.11.1 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.

5.11.2 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.'*

5.11.3 Specific maintenance needs should be monitored and maintenance schedules adjusted to suit the location and condition of the drainage feature in question.

Operation and Maintenance Activity	SuDS Component		
	Piped Network / Inspection Chambers	Geocellular Storage	Permeable Paving
Regular Maintenance			
Inspection	■	■	■
Litter and debris removal	■	□	■
Grass cutting			
Weed and invasive plant control			■
Shrub management (including pruning)			
Shoreline vegetation management			
Aquatic vegetation management			
Occasional Maintenance			
Sediment management ¹	■	■	■
Vegetation replacement			
Remedial Maintenance			
Structure rehabilitation / repair	□	□	□
Infiltration surface reconditioning			□
■ Will be required □ May be required ¹ Sediment should be collected and managed in pre-treatment systems, upstream of the main device.			

Figure 12: Extract from The SuDS Manual Table 32.1: Typical key SuDS components operation and maintenance activities.

5.11.4 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
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

Figure 13: Operation and Maintenance Requirements of Piped Networks and Inspection Chambers

5.11.5 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
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.

Figure 14: Operation and Maintenance Requirements for Flow Controls

5.11.6 Porous Paved Area

Permeable surfacing enables any water landing on the surface to infiltrate directly to ground at source, thus acting close to a permeable surface.

Regular inspection and maintenance are important for the effective operation of the permeable surfacing to allow it to work efficiently through its design life.

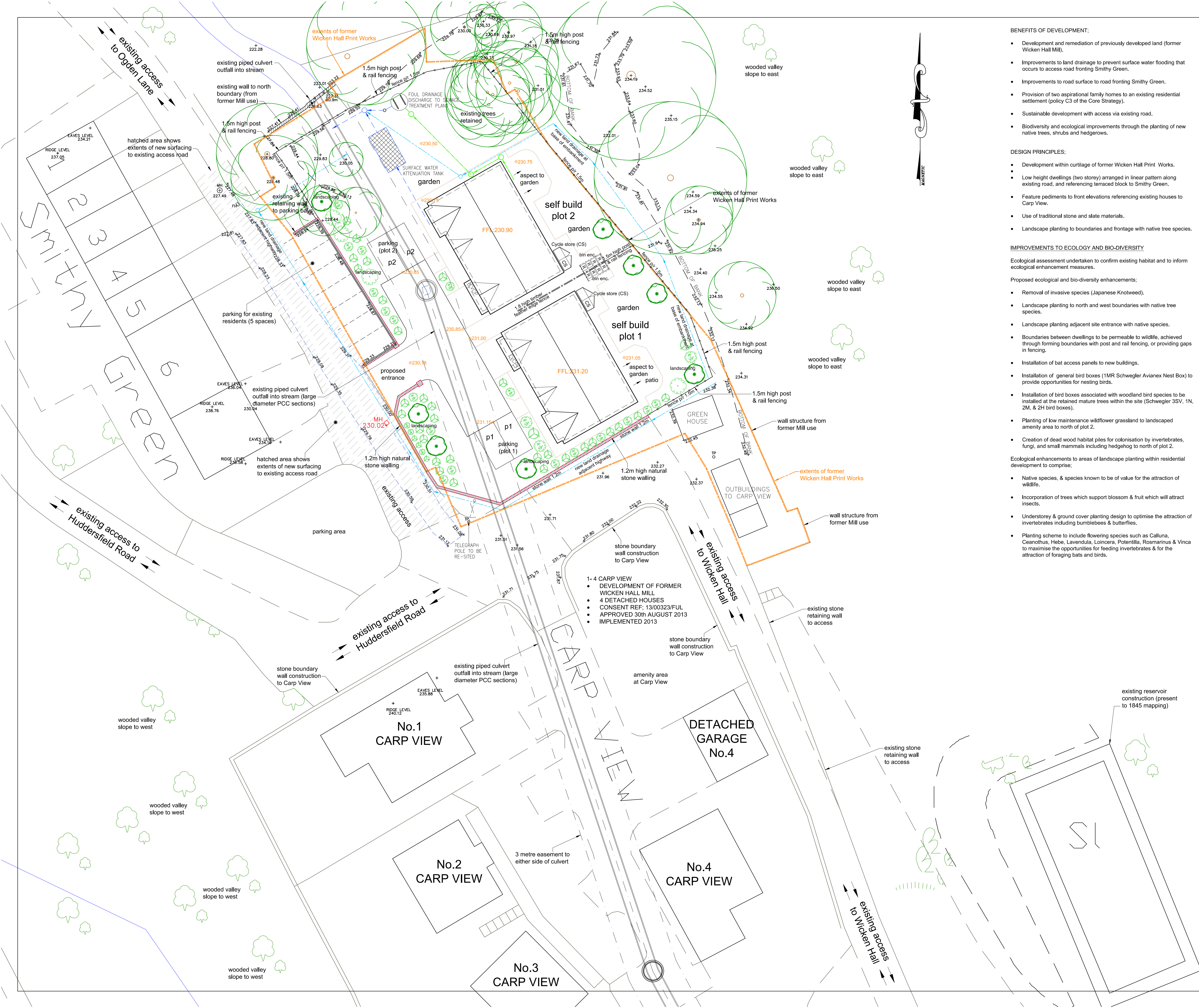
Maintenance schedule	Required action	Typical frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surfaces from adjacent impermeable areas as this are most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements.
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the surface.	As required
	Remedial works to any depressions, rutting and cracked considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Inspect for evidence of poor operation and/or weed growth -if required, take remedial action	Three-monthly, 48 hours after large storms in the first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually
	Monitor inspection chambers	Annually

Figure 5 Operation and Maintenance Requirements of Permeable Surfacing

5.12 Foul Water Drainage

- 5.12.1 As discussed in earlier sections, no foul water sewers are located in close proximity to the development site.
- 5.12.2 The outline foul drainage strategy will be to construct a new private drainage network that will serve each unit and outflow into a new package treatment plant, prior to outfalling into the culverted watercourse on site.
- 5.12.3 As the total flows will be less than 5m³ / day to the watercourse, an environmental permit will not be required.
- 5.12.4 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



BENEFITS OF DEVELOPMENT;

- Development and remediation of previously developed land (former Wicken Hall Mill).
- Improvements to land drainage to prevent surface water flooding that occurs to access road fronting Smithy Green.
- Improvements to road surface to road fronting Smithy Green.
- Provision of two aspirational family homes to an existing residential settlement (policy C3 of the Core Strategy).
- Sustainable development with access via existing road.
- Biodiversity and ecological improvements through the planting of new native trees, shrubs and hedgerows.

DESIGN PRINCIPLES;

- Development within curtilage of former Wicken Hall Print Works.
- Low height dwellings (two storey) arranged in linear pattern along existing road, and referencing terraced block to Smithy Green.
- Feature pediments to front elevations referencing existing houses to Carp View.
- Use of traditional stone and slate materials.
- Landscape planting to boundaries and frontage with native tree species.

IMPROVEMENTS TO ECOLOGY AND BIO-DIVERSITY

Ecological assessment undertaken to confirm existing habitat and to inform ecological enhancement measures.

Proposed ecological and bio-diversity enhancements;

- Removal of invasive species (Japanese Knotweed).
- Landscape planting to north and west boundaries with native tree species.
- Landscape planting adjacent site entrance with native species.
- Boundaries between dwellings to be permeable to wildlife, achieved through forming boundaries with post and rail fencing, or providing gaps in fencing.
- Installation of bat access panels to new buildings.
- Installation of general bird boxes (1MR Schwegler Avianex Nest Box) to provide opportunities for nesting birds.
- Installation of bird boxes associated with woodland bird species to be installed at the retained mature trees within the site (Schwegler 3SV, 1N, 2M, & 2H bird boxes).
- Planting of low maintenance wildflower grassland to landscaped amenity area to north of plot 2.
- Creation of dead wood habitat piles for colonisation by invertebrates, fungi, and small mammals including hedgehog to north of plot 2.

Ecological enhancements to areas of landscape planting within residential development to comprise;

- Native species, & species known to be of value for the attraction of wildlife.
- Incorporation of trees which support blossom & fruit which will attract insects.
- Understorey & ground cover planting design to optimise the attraction of invertebrates including bumblebees & butterflies.
- Planting scheme to include flowering species such as Calluna, Ceanothus, Hebe, Lavendula, Loincera, Potentilla, Rosmarinus & Vinca to maximise the opportunities for feeding invertebrates & for the attraction of foraging bats and birds.

KEY TO EXISTING & PROPOSED LEVELS;

- +230.59 Existing levels from topographical survey.
- @231.40 Proposed design level.
- MH 230.02 Levels relate to manhole located adjacent to site entrance MH = 230.02m.

KEY TO EXTERNAL BOUNDARIES & EQUIPMENT

Each dwelling to have a rear garden with an area with amenity grass, and a rear patio. Perimeter paths & patios to individual dwellings to be Heritage paving by Marshalls (buff finish).

Each dwelling to have a minimum of two external parking spaces (third space available to integral garages). Drives and parking areas to be surfaced with permeable resin bound gravel.

Bin storage area enclosed within close boarded timber screen fence - 1.6metres high (separate containers for general waste, plastic bottles, glass & paper, & garden waste).

Each dwelling to be provided with a single Mode 3 compliant Electric Vehicle Charging Point (EVCP) to be installed to the external wall within the alcove to the garages. The specification for the EVCP's are to be Rolek Wallpod:EV Type 2 Mode 3 charging socket.

EVCP Electric Vehicle Charging Point (EVCP)

Each dwelling to be provided with a cycle store (capable of accommodating two cycles). To be metal storage unit for 2 bikes (colour - grey) by Asgard or similar & approved, galvanised steel, 3-point locking system, unit is securely bolted to the ground. Width: 90cm, depth: 190cm, height: 120cm.

CS Cycle store (CS)

EXTERNAL LIGHTING SPECIFICATION

To minimise indirect impacts from lighting it is proposed that artificial lighting is only directed where necessary for safe use of amenity areas. None of the external lighting installed will be greater than 1,800 lumens (15 Watts) and only LED lights will be installed (they do not emit on the UV spectrum, are more easily controllable in terms of direction/spill and can be turned on and off instantly). Lighting to be fitted as low as practical to external walls, and fixed in a steep downward angle with the lighting housing further helping to direct light below the horizontal plane.

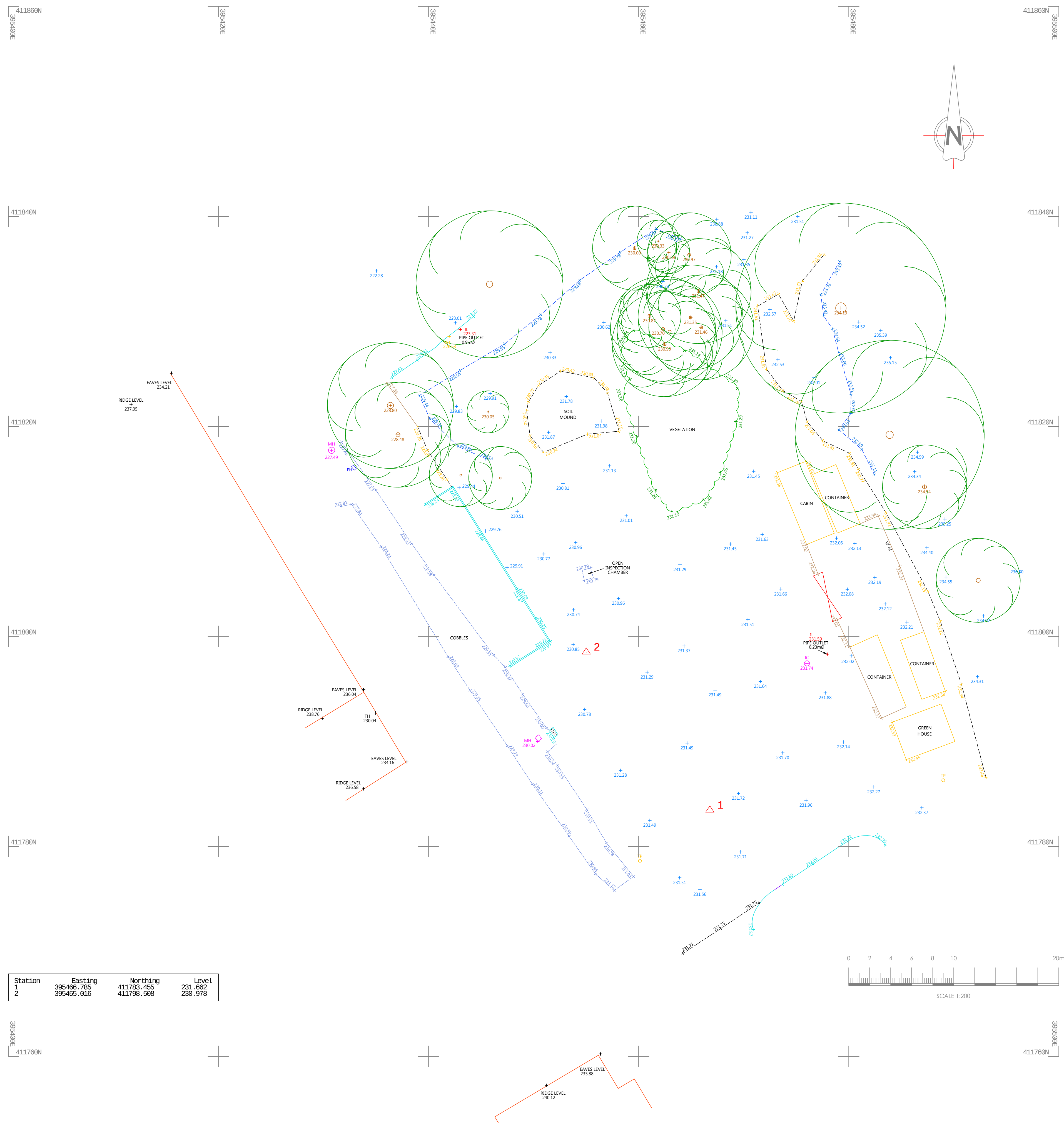
- WMDL W.M.D.L. - Wall Mounted Down Light
Use Saxby Odyssey 7W - wall down lights or similar (630 lumens).
- WMBL W.M.B.L. - Wall Mounted Bulkhead Light
Use Portchester Hood 15W - LED Bulkhead or similar (1,782 lumens).
- ELB E.L.B. - External Lighting Bollard
Use Westminster 10W - LED bollard or similar (1,320 lumens).

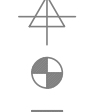
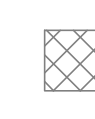
KEY TO BOUNDARY STRUCTURES & LANDSCAPING

- fence p/r 1.5m New 1.5metre high timber post & rail fence to site boundaries.
- fence f/e 1.8m Plot divisions to rear gardens formed with new 1.8metre high feather edged timber fence. Gaps to be left at base of fencing to be permeable to wildlife.
- stone wall 1.2m New 1.2metre high natural stone walling.
- landscaping Indicative new landscape planting & compensatory tree planting with native species. Landscaping design to be provided for hard & soft landscaping details.

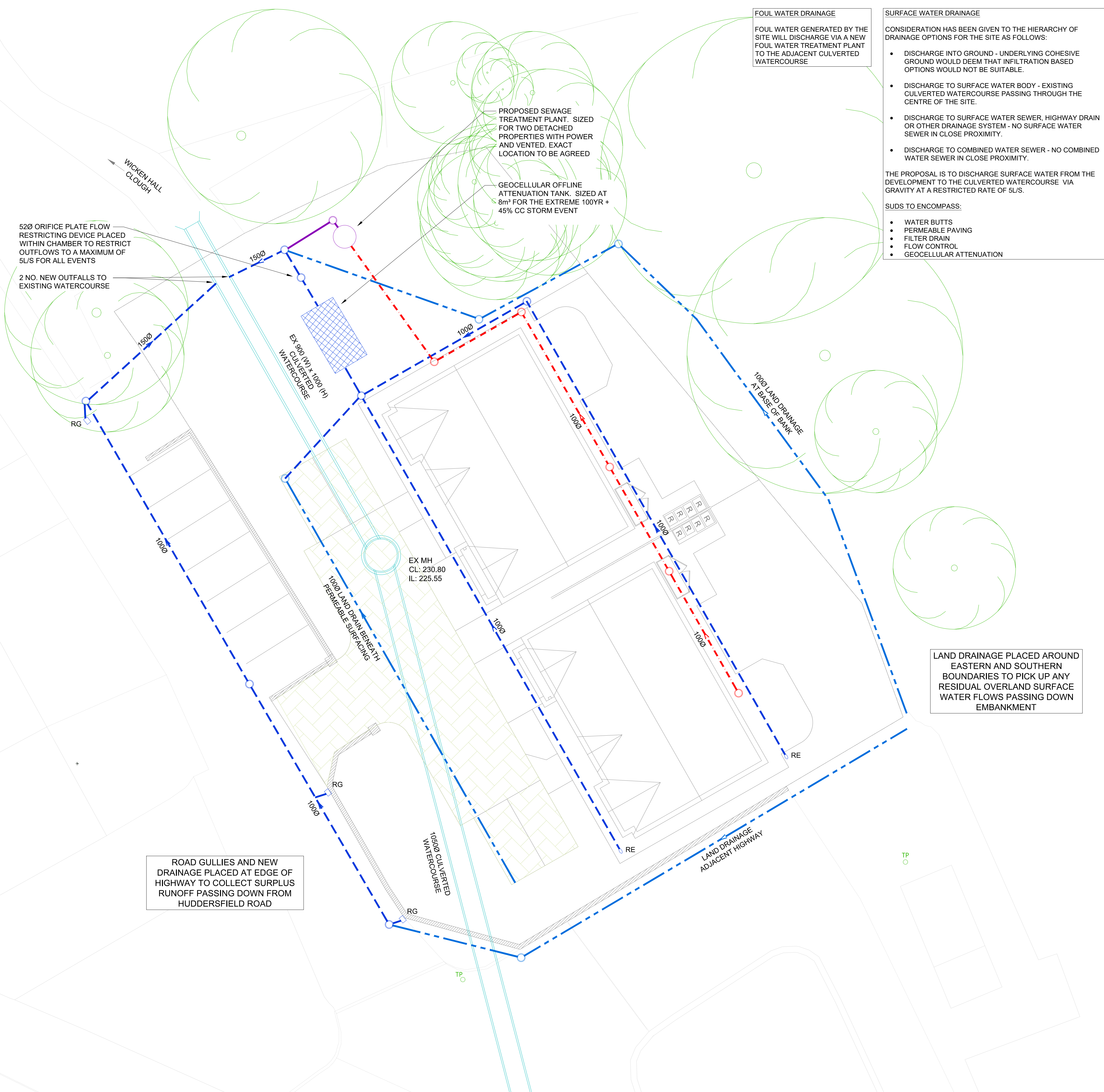
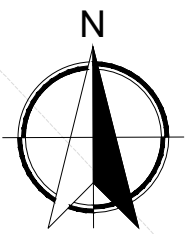
Amendments			
Title			
DEVELOPMENT OF TWO DETACHED DWELLINGS TO PREVIOUSLY DEVELOPED SITE AT FORMER WICKEN HALL MILL, SMITHY GREEN, NEWHEY~			
Client			
LEIGH KELLY			
Dwg. No.			
22/1281/201 - PROPOSED SITE LAYOUT			
Date	Plot Scale	Drawn by	Status
14.12.2022	AT@1:200	JPE	PLANNING
JPE CONSULTANCY LIMITED			
ARCHITECTURAL DESIGN & PLANNING			
9 Woodend Drive, Stalybridge, Cheshire, SK15 2SF			
Telephone 07875 627 988 jim@jpeconsultancy.co.uk			

Appendix B – Topographical Survey



Abbreviations/Symbols (Measured Building Surveys): C: Window Cill Height H: Window Head Height BH: Beam Height DH: Door Height COL: Column SVP: Soil Vent Pipe FL: Floor Level TH: Threshold Level F to C: Floor to Ceiling Height  Vaulted Ceiling Line types  Hedge Lines  Drainage Runs  Overhead Electricity Cables  Overhead Telephone Cables Symbols  Tree/Bush  Control Station  Borehole  Trial Hole  Glass House  Osm																				
Abbreviations (Topographic Survey): AH: Arch Height AV: Air Valve BB: Balisla Beacon BOX: Electricity Box, Cables Box, Etc. BOL: Bollard BT/CJ: British Telecom Inspection Chamber BS: Bus Stop BS/LP: Bus Stop / Lamp Post CATV: CATV inspection Chamber CCCTV: Closed Circuit Television CJ: Celler Joint C.Pit: Catch Pit ER: Earth Road EJC: Electricity Inspection Chamber EP: Electricity Pole FH: Fire Hydrant FP: Flag Pole GV: Gas Valve G: Gully IC: Inspection Chamber KO: Kerb Outlet LP: Lamp Post LR: Letter Box LC: Lighting Column MR: Marker MH: Manhole MP: Mooring Point MS: Mile Stone NINEX: Nines Inspection Chamber O/H: Over Hang P: Post PO/CJ: Post Office Inspection Chamber R/S: Road Sign RE: Roding Eye RTW: Retaining Wall S/P: Sign Post SNP: Street Name Plate ST: Stop Tap SV: Stop Valve T: Telecom Inspection Chamber TCB: Telephone Call Box TH: Threshold Level TL: Traffic Light TP: Telegraph Pole TROUGH: Trough WO: Water Outlet WM: Water Meter Fence Descriptions: B/W: Barbed Wire C/B: Close Boarded C/BARRIER: Chain Barrier C/L: Chain Link C/P: Chestnut Paving C/L: Corrugated Iron I/R: Iron Rolling MISC: Miscellaneous P/R: Post & Rail P/W: Post & Wire P/C: Post & Chain S/PAL: Steel Palisade W/M: Wire Mesh																				
Survey Notes: Coordinates and Levels related to Ordnance Survey Datum - GFS OSGB36																				
<table border="1"> <thead> <tr> <th>Revision</th> <th>Date</th> <th>Description</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>			Revision	Date	Description															
Revision	Date	Description																		
 Chris Parlington Land Surveyors 44a Green Lane Sole Cheshire M33 9PP T: 0161 976 1194 www.cpls.co.uk esurvey@cpls.co.uk 																				
Client JPE Consultancy Ltd																				
Project Carp View, Newhey, Rochdale Site Survey																				
Scale	1:200	Surveyed By J.C Date 09.09.22																		
Drawing No.	090922JC-01	Checked by C.PLS Date 09.09.22																		
	Drawn By J.C	Date 09.09.22																		

Appendix C – PGC Drawings



FOUL WATER DRAINAGE

FOUL WATER GENERATED BY THE SITE WILL DISCHARGE VIA A NEW FOUL WATER TREATMENT PLANT TO THE ADJACENT CULVERTED WATERCOURSE

SURFACE WATER DRAINAGE

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

- DISCHARGE INTO GROUND - UNDERLYING COHESIVE GROUND WOULD DEEM THAT INFILTRATION BASED OPTIONS WOULD NOT BE SUITABLE.
- DISCHARGE TO SURFACE WATER BODY - EXISTING CULVERTED WATERCOURSE PASSING THROUGH THE CENTRE OF THE SITE.
- DISCHARGE TO SURFACE WATER SEWER, HIGHWAY DRAIN OR OTHER DRAINAGE SYSTEM - NO SURFACE WATER SEWER IN CLOSE PROXIMITY.
- DISCHARGE TO COMBINED WATER SEWER - NO COMBINED WATER SEWER IN CLOSE PROXIMITY.

THE PROPOSAL IS TO DISCHARGE SURFACE WATER FROM THE DEVELOPMENT TO THE CULVERTED WATERCOURSE VIA GRAVITY AT A RESTRICTED RATE OF 5L/S.

SUDS TO ENCOMPASS:

- WATER BUTTS
- PERMEABLE PAVING
- FILTER DRAIN
- FLOW CONTROL
- GEOCELLULAR ATTENUATION

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.
- 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.
- DRAWING ISSUED FOR PLANNING PURPOSES ONLY AND SUBJECT TO FURTHER ASSESSMENT AND DETAILED DESIGN.

KEY

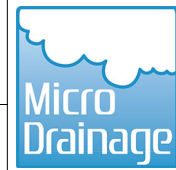
- EXISTING CULVERT
- PROPOSED FOUL WATER DRAINAGE
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED FILTER DRAIN
- PROPOSED TREATED FOUL WATER DRAINAGE
- PROPOSED PERMEABLE SURFACING

P3	21.12.22	PG	PG	SITE PLAN UPDATED
P2	30.11.22	PG	PG	DRAINAGE LAYOUT UPDATED
P1	25.11.22	PG	PG	PRELIMINARY ISSUE
REV	DATE	DRAWN	REV'D ENCL	NOTES
CLIENT LEIGH KELLY				
PROJECT FORMER WICKEN HALL MILL OGDEN LANE, NEWHEY				
DRAWING TITLE DRAINAGE STRATEGY PLAN				
DRAWING STATUS INFORMATION				
SCALE	1:125	DRAWN BY PG	ENGINEER PG	SHEET A1
DRAWING No PGC642-C-001				REVISION P3
PGConsulting Civil & Infrastructure Engineers		108 Ack Lane West, Cheshire Hulme, Cheshire, SK9 7ES Tel: 07710 758971 Email: paul@pgcl.co.uk		

Appendix D – Outline Hydraulic Calculations

		Page 1																								
	Former Wicken Hall Mill Greenfield Runoff Rates																									
Date 25/11/2022 File WICKEN HALL MILL.SRCX	Designed by paulg Checked by																									
Innovyze	Source Control 2017.1.2																									
<u>ICP SUDS Mean Annual Flood</u> Input <table><tr><td>Return Period (years)</td><td>1</td><td>Soil</td><td>0.150</td></tr><tr><td>Area (ha)</td><td>0.170</td><td>Urban</td><td>0.000</td></tr><tr><td>SAAR (mm)</td><td>1191</td><td>Region Number</td><td>Region 10</td></tr></table> Results 1/s <table><tr><td>QBAR Rural</td><td>0.1</td></tr><tr><td>QBAR Urban</td><td>0.1</td></tr><tr><td>Q1 year</td><td>0.1</td></tr><tr><td>Q1 year</td><td>0.1</td></tr><tr><td>Q30 years</td><td>0.2</td></tr><tr><td>Q100 years</td><td>0.3</td></tr></table>			Return Period (years)	1	Soil	0.150	Area (ha)	0.170	Urban	0.000	SAAR (mm)	1191	Region Number	Region 10	QBAR Rural	0.1	QBAR Urban	0.1	Q1 year	0.1	Q1 year	0.1	Q30 years	0.2	Q100 years	0.3
Return Period (years)	1	Soil	0.150																							
Area (ha)	0.170	Urban	0.000																							
SAAR (mm)	1191	Region Number	Region 10																							
QBAR Rural	0.1																									
QBAR Urban	0.1																									
Q1 year	0.1																									
Q1 year	0.1																									
Q30 years	0.2																									
Q100 years	0.3																									
©1982-2017 XP Solutions																										

Former Wicken Hall Mill
30yr Attenuation



Date 25/11/2022
File Wicken Hall Mill - 30yr...

Designed by paulg
Checked by

Innovyze

Source Control 2017.1.2

Summary of Results for 30 year Return Period

Half Drain Time : 10 minutes.

	Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
	15 min Summer	229.826	0.226	0.0	2.5	2.5	2.1	O K
	30 min Summer	229.890	0.290	0.0	2.9	2.9	2.8	O K
	60 min Summer	229.909	0.309	0.0	3.0	3.0	2.9	O K
	120 min Summer	229.882	0.282	0.0	2.9	2.9	2.7	O K
	180 min Summer	229.844	0.244	0.0	2.6	2.6	2.3	O K
	240 min Summer	229.811	0.211	0.0	2.4	2.4	2.0	O K
	360 min Summer	229.764	0.164	0.0	2.1	2.1	1.6	O K
	480 min Summer	229.733	0.133	0.0	1.8	1.8	1.3	O K
	600 min Summer	229.712	0.112	0.0	1.7	1.7	1.1	O K
	720 min Summer	229.697	0.097	0.0	1.5	1.5	0.9	O K
	960 min Summer	229.678	0.078	0.0	1.3	1.3	0.7	O K
	1440 min Summer	229.664	0.064	0.0	1.0	1.0	0.6	O K
	2160 min Summer	229.653	0.053	0.0	0.7	0.7	0.5	O K
	2880 min Summer	229.647	0.047	0.0	0.6	0.6	0.4	O K
	4320 min Summer	229.639	0.039	0.0	0.5	0.5	0.4	O K
	5760 min Summer	229.634	0.034	0.0	0.4	0.4	0.3	O K
	7200 min Summer	229.631	0.031	0.0	0.3	0.3	0.3	O K
	8640 min Summer	229.629	0.029	0.0	0.3	0.3	0.3	O K
	10080 min Summer	229.628	0.028	0.0	0.3	0.3	0.3	O K
	15 min Winter	229.858	0.258	0.0	2.7	2.7	2.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	63.167	0.0	4.1	21
30 min Summer	43.952	0.0	5.8	30
60 min Summer	29.395	0.0	7.7	46
120 min Summer	19.054	0.0	10.0	76
180 min Summer	14.569	0.0	11.5	108
240 min Summer	11.994	0.0	12.6	138
360 min Summer	9.111	0.0	14.3	198
480 min Summer	7.484	0.0	15.7	258
600 min Summer	6.419	0.0	16.8	318
720 min Summer	5.660	0.0	17.8	376
960 min Summer	4.635	0.0	19.5	494
1440 min Summer	3.491	0.0	22.0	736
2160 min Summer	2.624	0.0	24.8	1100
2880 min Summer	2.140	0.0	27.0	1464
4320 min Summer	1.609	0.0	30.4	2156
5760 min Summer	1.314	0.0	33.1	2936
7200 min Summer	1.124	0.0	35.4	3584
8640 min Summer	0.990	0.0	37.4	4264
10080 min Summer	0.889	0.0	39.2	5104
15 min Winter	63.167	0.0	4.6	22

Former Wicken Hall Mill
30yr Attenuation



Date	25/11/2022
------	------------

Designed by paulg

File Wicken Hall Mill - 30yr...

Checked by

Innovyze

Source Control 2017.1.2

Summary of Results for 30 year Return Period

	Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
	30 min Winter	229.926	0.326	0.0	3.1	3.1	3.1	O K
	60 min Winter	229.931	0.331	0.0	3.1	3.1	3.1	O K
	120 min Winter	229.872	0.272	0.0	2.8	2.8	2.6	O K
	180 min Winter	229.816	0.216	0.0	2.5	2.5	2.1	O K
	240 min Winter	229.775	0.175	0.0	2.2	2.2	1.7	O K
	360 min Winter	229.724	0.124	0.0	1.8	1.8	1.2	O K
	480 min Winter	229.696	0.096	0.0	1.5	1.5	0.9	O K
	600 min Winter	229.679	0.079	0.0	1.3	1.3	0.8	O K
	720 min Winter	229.671	0.071	0.0	1.2	1.2	0.7	O K
	960 min Winter	229.662	0.062	0.0	1.0	1.0	0.6	O K
	1440 min Winter	229.652	0.052	0.0	0.7	0.7	0.5	O K
	2160 min Winter	229.644	0.044	0.0	0.5	0.5	0.4	O K
	2880 min Winter	229.638	0.038	0.0	0.4	0.4	0.4	O K
	4320 min Winter	229.631	0.031	0.0	0.3	0.3	0.3	O K
	5760 min Winter	229.628	0.028	0.0	0.3	0.3	0.3	O K
	7200 min Winter	229.626	0.026	0.0	0.2	0.2	0.3	O K
	8640 min Winter	229.625	0.025	0.0	0.2	0.2	0.2	O K
	10080 min Winter	229.624	0.024	0.0	0.2	0.2	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	43.952	0.0	6.5	30
60 min Winter	29.395	0.0	8.6	46
120 min Winter	19.054	0.0	11.2	80
180 min Winter	14.569	0.0	12.8	110
240 min Winter	11.994	0.0	14.1	140
360 min Winter	9.111	0.0	16.1	200
480 min Winter	7.484	0.0	17.6	258
600 min Winter	6.419	0.0	18.9	318
720 min Winter	5.660	0.0	20.0	374
960 min Winter	4.635	0.0	21.8	494
1440 min Winter	3.491	0.0	24.6	734
2160 min Winter	2.624	0.0	27.8	1096
2880 min Winter	2.140	0.0	30.2	1460
4320 min Winter	1.609	0.0	34.1	2148
5760 min Winter	1.314	0.0	37.1	2864
7200 min Winter	1.124	0.0	39.7	3552
8640 min Winter	0.990	0.0	41.9	4376
10080 min Winter	0.889	0.0	43.9	5008

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	Former Wicken Hall Mill 30yr Attenuation	
Date 25/11/2022 File Wicken Hall Mill - 30yr...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.100	Shortest Storm (mins)	15
Ratio R	0.267	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.035

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.010	4 8	0.010	8 12	0.010	12 16	0.005

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	Former Wicken Hall Mill 30yr Attenuation	
Date 25/11/2022 File Wicken Hall Mill - 30yr...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Model Details

Storage is Online Cover Level (m) 231.000

Cellular Storage Structure

Invert Level (m) 229.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	10.0	10.0	0.801	0.0	20.1
0.800	10.0	20.1			

Orifice Outflow Control

Diameter (m) 0.052 Discharge Coefficient 0.600 Invert Level (m) 229.600

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Former Wicken Hall Mill
100yr + 45% CC Attenuation



Date 25/11/2022
File Wicken Hall Mill - 100y...

Designed by paulg
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Source Control 2017.1.2

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 17 minutes.

	Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
	15 min Summer	230.081	0.481	0.0	3.8	3.8	4.6	O K
	30 min Summer	230.233	0.633	0.0	4.4	4.4	6.0	O K
	60 min Summer	230.297	0.697	0.0	4.6	4.6	6.6	O K
	120 min Summer	230.264	0.664	0.0	4.5	4.5	6.3	O K
	180 min Summer	230.190	0.590	0.0	4.2	4.2	5.6	O K
	240 min Summer	230.120	0.520	0.0	4.0	4.0	4.9	O K
	360 min Summer	230.012	0.412	0.0	3.5	3.5	3.9	O K
	480 min Summer	229.935	0.335	0.0	3.1	3.1	3.2	O K
	600 min Summer	229.880	0.280	0.0	2.8	2.8	2.7	O K
	720 min Summer	229.838	0.238	0.0	2.6	2.6	2.3	O K
	960 min Summer	229.781	0.181	0.0	2.2	2.2	1.7	O K
	1440 min Summer	229.721	0.121	0.0	1.7	1.7	1.1	O K
	2160 min Summer	229.681	0.081	0.0	1.3	1.3	0.8	O K
	2880 min Summer	229.667	0.067	0.0	1.1	1.1	0.6	O K
	4320 min Summer	229.655	0.055	0.0	0.8	0.8	0.5	O K
	5760 min Summer	229.648	0.048	0.0	0.6	0.6	0.5	O K
	7200 min Summer	229.644	0.044	0.0	0.5	0.5	0.4	O K
	8640 min Summer	229.641	0.041	0.0	0.5	0.5	0.4	O K
	10080 min Summer	229.637	0.037	0.0	0.4	0.4	0.4	O K
	15 min Winter	230.149	0.549	0.0	4.1	4.1	5.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	118.088	0.0	7.7	22
30 min Summer	83.120	0.0	10.9	31
60 min Summer	56.005	0.0	14.7	48
120 min Summer	36.287	0.0	19.0	80
180 min Summer	27.568	0.0	21.7	110
240 min Summer	22.558	0.0	23.7	142
360 min Summer	16.993	0.0	26.8	202
480 min Summer	13.868	0.0	29.1	262
600 min Summer	11.831	0.0	31.1	322
720 min Summer	10.383	0.0	32.7	382
960 min Summer	8.437	0.0	35.4	500
1440 min Summer	6.279	0.0	39.6	740
2160 min Summer	4.657	0.0	44.0	1100
2880 min Summer	3.762	0.0	47.4	1460
4320 min Summer	2.791	0.0	52.7	2176
5760 min Summer	2.260	0.0	56.9	2880
7200 min Summer	1.920	0.0	60.5	3672
8640 min Summer	1.682	0.0	63.6	4336
10080 min Summer	1.506	0.0	66.4	4976
15 min Winter	118.088	0.0	8.7	23

Former Wicken Hall Mill
100yr + 45% CC Attenuation



Date 25/11/2022
File Wicken Hall Mill - 100y...

Designed by paulg
Checked by

Innovyze

Source Control 2017.1.2

Summary of Results for 100 year Return Period (+45%)

	Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
	30 min Winter	230.316	0.716	0.0	4.7	4.7	6.8	O K
	60 min Winter	230.366	0.766	0.0	4.9	4.9	7.3	O K
	120 min Winter	230.276	0.676	0.0	4.6	4.6	6.4	O K
	180 min Winter	230.158	0.558	0.0	4.1	4.1	5.3	O K
	240 min Winter	230.061	0.461	0.0	3.7	3.7	4.4	O K
	360 min Winter	229.930	0.330	0.0	3.1	3.1	3.1	O K
	480 min Winter	229.850	0.250	0.0	2.7	2.7	2.4	O K
	600 min Winter	229.798	0.198	0.0	2.3	2.3	1.9	O K
	720 min Winter	229.762	0.162	0.0	2.1	2.1	1.5	O K
	960 min Winter	229.719	0.119	0.0	1.7	1.7	1.1	O K
	1440 min Winter	229.678	0.078	0.0	1.3	1.3	0.7	O K
	2160 min Winter	229.662	0.062	0.0	1.0	1.0	0.6	O K
	2880 min Winter	229.654	0.054	0.0	0.8	0.8	0.5	O K
	4320 min Winter	229.645	0.045	0.0	0.6	0.6	0.4	O K
	5760 min Winter	229.640	0.040	0.0	0.5	0.5	0.4	O K
	7200 min Winter	229.635	0.035	0.0	0.4	0.4	0.3	O K
	8640 min Winter	229.632	0.032	0.0	0.4	0.4	0.3	O K
	10080 min Winter	229.630	0.030	0.0	0.3	0.3	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	83.120	0.0	12.2	32
60 min Winter	56.005	0.0	16.5	48
120 min Winter	36.287	0.0	21.3	82
180 min Winter	27.568	0.0	24.3	116
240 min Winter	22.558	0.0	26.5	146
360 min Winter	16.993	0.0	30.0	206
480 min Winter	13.868	0.0	32.6	266
600 min Winter	11.831	0.0	34.8	324
720 min Winter	10.383	0.0	36.6	384
960 min Winter	8.437	0.0	39.7	502
1440 min Winter	6.279	0.0	44.3	740
2160 min Winter	4.657	0.0	49.3	1096
2880 min Winter	3.762	0.0	53.1	1440
4320 min Winter	2.791	0.0	59.1	2204
5760 min Winter	2.260	0.0	63.8	2880
7200 min Winter	1.920	0.0	67.7	3560
8640 min Winter	1.682	0.0	71.2	4328
10080 min Winter	1.506	0.0	74.4	5040

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	Former Wicken Hall Mill 100yr + 45% CC Attenuation																																																	
Date 25/11/2022 File Wicken Hall Mill - 100y...	Designed by paulg Checked by																																																	
Innovyze Source Control 2017.1.2																																																		
<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>19.100</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Ratio R</td> <td>0.267</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+45</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.035 <table> <thead> <tr> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> </tr> <tr> <th>From: To:</th> <th>(ha)</th> <th>From: To:</th> <th>(ha)</th> <th>From: To:</th> <th>(ha)</th> <th>From: To:</th> <th>(ha)</th> </tr> </thead> <tbody> <tr> <td>0 4</td> <td>0.010</td> <td>4 8</td> <td>0.010</td> <td>8 12</td> <td>0.010</td> <td>12 16</td> <td>0.005</td> </tr> </tbody> </table>			Rainfall Model	FSR	Winter Storms	Yes	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	19.100	Shortest Storm (mins)	15	Ratio R	0.267	Longest Storm (mins)	10080	Summer Storms	Yes	Climate Change %	+45	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	From: To:	(ha)	From: To:	(ha)	From: To:	(ha)	From: To:	(ha)	0 4	0.010	4 8	0.010	8 12	0.010	12 16	0.005
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Date 25/11/2022 File Wicken Hall Mill - 100y...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Model Details

Storage is Online Cover Level (m) 231.000

Cellular Storage Structure

Invert Level (m) 229.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	10.0	10.0	0.801	0.0	20.1
0.800	10.0	20.1			

Orifice Outflow Control

Diameter (m) 0.052 Discharge Coefficient 0.600 Invert Level (m) 229.600

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