Pell Frischmann

# Land West of Ratby

## Sustainable Drainage Report

| **Report Ref.** | **109003-PEF-ZZ-XX-RP-CD-000001** |
|---|---|
| **File Path** | 109003-PEF-ZZ-XX-RP-CD-000001-S2-P04_SDR.docx |

| Suit | Rev | Description | Date | Originator | Checker | Approver |
|---|---|---|---|---|---|---|
| S2 | P01 | Preliminary Issue | 29/05/2024 | H. McColl | D. Allum-Rooney | D. Allum-Rooney |
| S2 | P02 | Updated to Client Comment | 04/07/2024 | H. McColl | D. Allum-Rooney | D. Allum-Rooney |
| S2 | P03 | Updated to new masterplan | 05/09/2024 | H. McColl | D. Allum-Rooney | D. Allum-Rooney |
| S2 | P04 | Updated to LLFA comments | 17/01/2025 | H. McColl | D. Allum-Rooney | D. Allum-Rooney |
| Ref. reference. Rev revision. Suit suitability. | | | | | | |

**Prepared for**

**Lagan Homes Ltd**

Finance House
Beaumont Road
Banbury, Oxfordshire
OX16 1RH

**Prepared by**

**Pell Frischmann**

Suite 4.2 – 1 The Poynt
Wollaton Street
Nottingham
NG1 5FW

# Contents



**Figures**



**Tables**

## Appendices

# 1 Introduction

## 1.1 Report Context

1.1.1 Pell Frischmann has been commissioned by Lagan Homes Ltd. to develop a drainage strategy for a site known as Land West of Ratby to support an Outline planning application for a residential and educational use.

1.1.2 This Sustainable Drainage Report (SDR) will set out the principles of the proposed drainage strategy and demonstrate how the local and national guidance has been considered. This will include justification of; specific surface water discharge rates, the volume of attenuation required and sustainable drainage systems to be included.

## 1.2 Sources of Information

1.2.1 A review of relevant information and guidance from a range of sources has been undertaken and includes the following key documents;

- National Planning Policy Framework (NPPF), December 2023;
- Non-Statutory Technical Standards for Sustainable Drainage Systems, March 2015;
- Water UK, Sewerage Sector Guidance, October 2019;
- CIRIA, C753 The SuDS Manual Version 6, 2015;
- HM Government, The Buildings Regulations 2010, Drainage and Water Disposal (Part H), 2015;
- Leicestershire County Council, Local Flood Risk Management Strategy for Leicestershire, February 2024.

1.2.2 The NPPF specifies that surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development. Opportunities to reduce the flood risk to the site itself and elsewhere, taking climate change into account, should be investigated. The drainage proposals within this strategy have been prepared to meet planning policy requirements.

1.2.3 In their role as Lead Local Flood Authority (LLFA), Leicestershire County Council (LCC) have prepared a supplementary planning guidance document titled 'Lead Local Flood Authority Statutory Consultation Checklist. This SDR has aligned with these requirements to prepare the necessary information.

## 1.3 Site Location

1.3.1 The site is located to the west of Ratby, Leicestershire.

1.3.2 A site location plan is included for reference as **Figure** 1.1**.** The application area covers approximately 33ha.

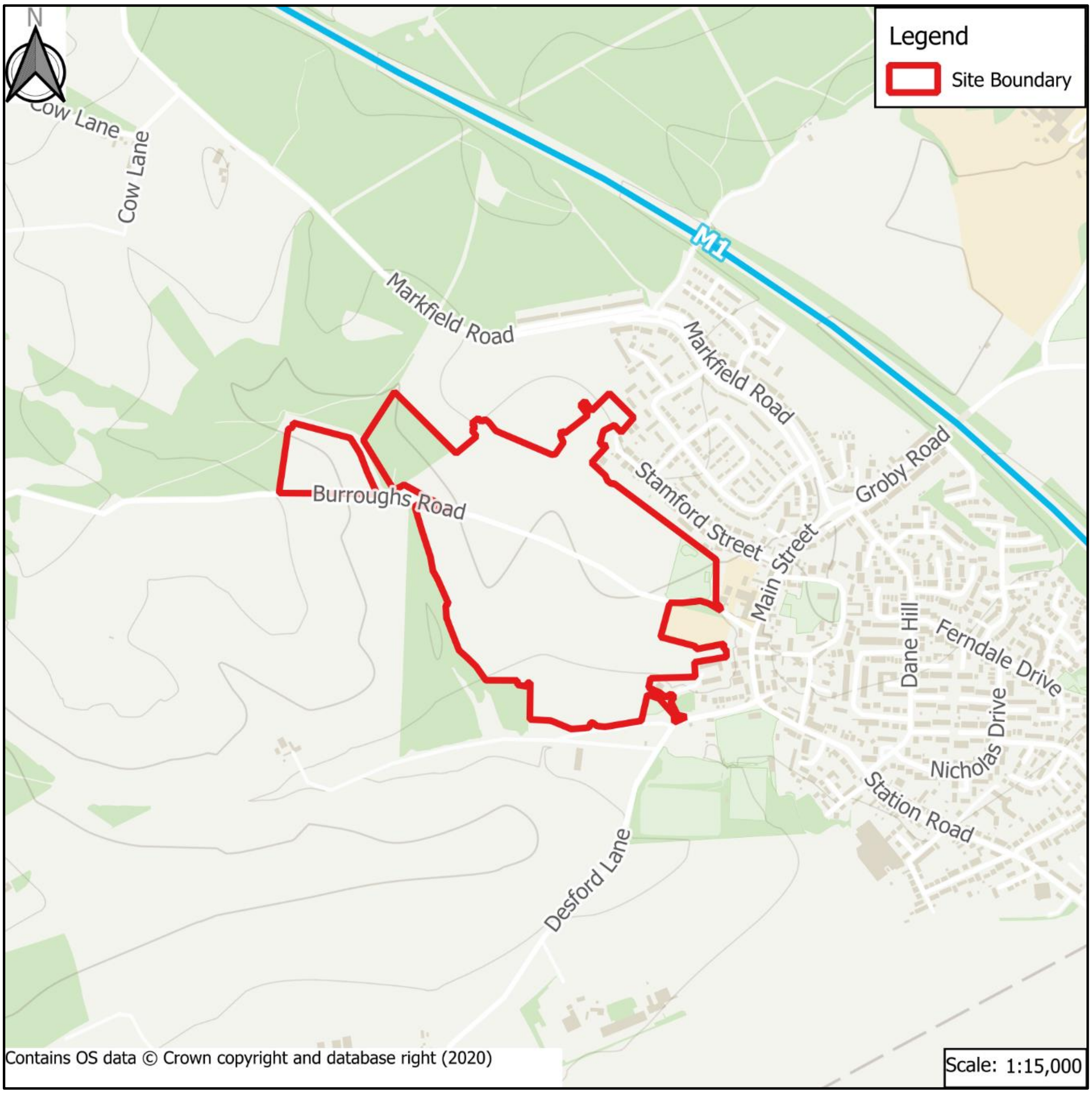



**Figure 1.1 - Site Location Plan**

1.3.3 The site is bound; to the north by land in use for Phases 1 and 2 of the wider development, to the west by open countryside, to the east by Ratby itself and to the south by an unnamed watercourse.

1.3.4 Aerial mapping shows that the site is currently in use as agricultural land and forests.

1.3.5 The absence of any buildings or significant areas of hardstanding indicate that the site is considered subject to a natural regime of runoff and infiltration, where ground conditions permit.

## 1.4 Topography

1.4.1 The site falls generally from north to south. Elevations range from a high point of approximately 109mAOD adjacent to Phase 2 to the north and falls to levels of approximately 83mAOD adjacent to the brook at the south of the site.

1.4.2 Greenhatch topographical survey *43724_T Rev 1* has been included for reference as **Appendix A** to this report.

1.4.3 LiDAR data provided by DEFRA, covering the wider area, shown in **Figure** 1.2, shows the elevations in the wider area follow a similar pattern to that on site.

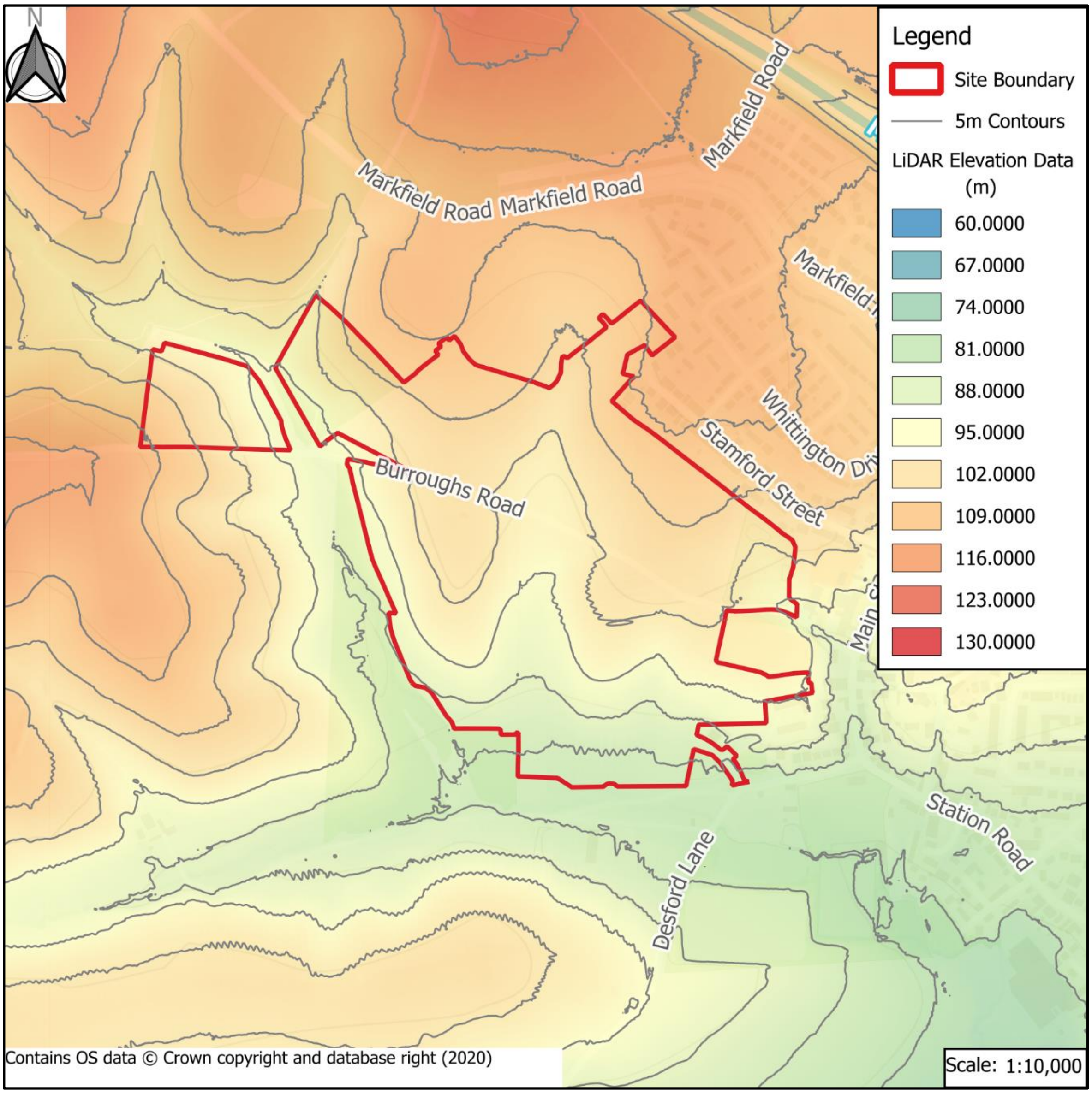



**Figure 1.2 - LiDAR Elevation Data**

## 1.5 Proposed Development

1.5.1 Development proposals comprise an Outline planning application (with all matters reserved apart from access) for a phased, mixed-use development comprising about 470 dwellings (Use Class C3) or, in the alternative, about 450 dwellings and care home (Use Class C2). Provision of land for community hub (Use Class F2); provision of land for 1FE primary school (Use Class F1); and associated operations and infrastructure including but not limited to site re-profiling works, sustainable urban drainage system, public open space, landscaping, habitat creation, internal roads/routes, and upgrades to the public highway.

1.5.2 The masterplan for the site on which this drainage strategy has been based can be seen in **Appendix B**.

# 2 Existing Conditions

## 2.1 Existing Site

2.1.1 The existing site comprises entirely greenfield areas and therefore is considered to drain entirely via natural means; runoff falling toward watercourses at the low points of the site and infiltrating into the ground where possible.

2.1.2 Sewer records, provided in **Appendix C**, show an extensive surface and foul water sewer network within Ratby itself, conveying water to the south. There are no existing sewers identified within the site however there may be limited assets of land drainage located within the site.

2.1.3 There are several watercourses in the immediate vicinity of the site; an unnamed watercourse running alongside the western boundary of the site, originating from the northwest, an unnamed ditch running south from Burroughs Road conveying runoff generated by the northern half of the site and an unnamed brook flowing west to east along the southern end of the site.

2.1.4 Local watercourses are shown for reference in **Figure** 2.1.

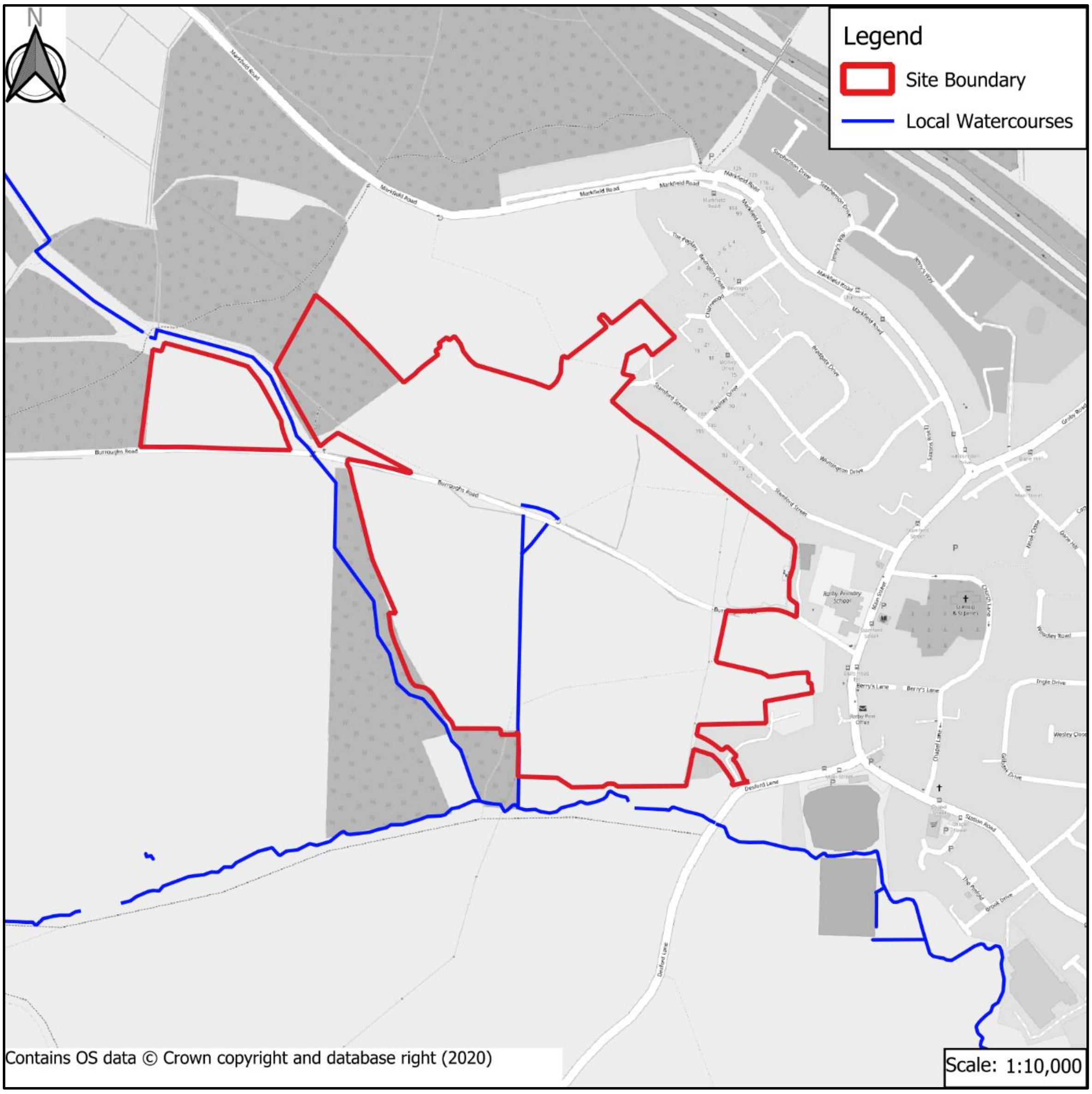



**Figure 2.1 - Local Watercourses**

## 2.2 Site Geology

2.2.1 British Geological Survey (BGS) mapping suggests the site is underlain by a mixed superficial geology comprising areas of Thrussington Member in the north and east, with areas of Alluvium found to the south and east following the approximate routes of the unnamed watercourses. The remainder of the site is shown to have no recorded superficial geology.

2.2.2 Mapping shows the site to be underlain by a mixed bedrock geology comprising Gunthorpe Member, Cotgrave Sandstone Member and Edwalton Member.

2.2.3 It is considered that due to the largely clay nature of the bedrock strata, infiltration may not be a feasible means of surface water disposal for the site as a whole. There may however be areas closer to the watercourse in the south where infiltration may be able to be utilised due to the nature of material.

2.2.4 It is considered at this stage that infiltration as a means of surface water disposal is unlikely. Full soakaway testing to BRE365 is required to support further, more detailed drainage designs to satisfy the drainage hierarchy requirements set out in Building Regulations Approved Document H.

2.2.5 It is currently considered that the requirement for infiltration testing should be attached as a condition to any outline planning permission granted, in accordance with the precedent set for Phase 2 of the development (to the north) under outline planning permission reference 22/00648/OUT.

2.2.6 Given the negligible infiltration rates encountered, it is unlikely that infiltration will be a feasible method of outfall for runoff generated by the proposed development.

## 2.3 Existing Runoff Rate

2.3.1 The overall application site boundary comprises approximately 33ha and is divided into 12 parcels which total an approximate developable area of 14.2ha. This has been taken from the most recent development proposals, available as part of the submission documents accompanying this application with the remainder being used for public open space, landscaping etc.

2.3.2 Within the following outline calculations, the following parameters have been used to assess strategic attenuation.

2.3.3 For residential areas, a 65% impermeability has been assumed and a 10% urban creep factor has been applied.

2.3.4 For areas in use for education, an impermeability of 60% has been assumed.

2.3.5 An assessment of the equivalent greenfield surface water runoff rate from the proposed development areas has been undertaken using HR Wallingford's online greenfield runoff rate estimation tool. This has been carried out using site specific FEH data.

2.3.6 Calculations for the above can be seen in **Appendix D**.

**Table 2-1 Greenfield Runoff Rates**

| Assessed Area (ha) | Runoff Rate | | | |
|---|---|---|---|---|
| | 1-year (l/s) | QBAR (l/s) | 30-year (l/s) | 100-year (l/s) |
| 1 | 3.56 | 4.29 | 8.85 | 11.02 |
| 14.2 | 50.5 | 60.9 | 125.7 | 156.5 |

## 2.4 Existing Runoff Volume

2.4.1 An assessment of the existing surface water runoff volume from the entire area (14.2ha) proposed for development has been made for a 1 in 100-year, 6-hour storm.

2.4.2 As the existing site is undeveloped, the runoff volume has been calculated using the Source Control module within MicroDrainage to be 3980m$^3$ and the results are included within **Appendix E**.

# 3 Surface Water Strategy

## 3.1 Drainage Hierarchy

3.1.1 Prevailing local and national guidance suggests that surface water runoff from a development should be disposed of as high up the following hierarchy as reasonably practicable:

- Water reuse, where a need is identified
- Into the ground (infiltration), where ground conditions permit
- To a surface water body
- To a surface water sewer, highway drain, or another drainage system
- To a combined sewer

3.1.2 The aim of this approach is to manage surface water runoff close to where it falls and mimic natural drainage as closely as possible.

3.1.3 As discussed within **Section 2.2** of this report, it is considered at this stage that, subject to further testing, it is unlikely that infiltration will be a feasible means of wholesale disposal of surface water runoff falling on the site.

3.1.4 Given that discharging surface water generated by areas of hardstanding of the proposed development via infiltration is considered, at this stage, to be unlikely, it is proposed to discharge surface water into the various watercourses adjacent to the site.

3.1.5 It is considered that the drainage hierarchy assessment is satisfied by the above.

3.1.6 The locations and routes of outfall are shown on the drainage strategy drawing presented in **Appendix F**.

## 3.2 Surface Water Attenuation

3.2.1 The overall site application area is approximately 33ha. This includes development space, public open space and associated road infrastructure. The development plots, including associated internal highways and green spaces comprise approximately 14.2ha. Of this area, the site has been divided into 6 functional catchments. A strategic attenuation wetland has been provided for each catchment with consideration of the SuDS treatment train. It should be noted that these catchments will be highly subject to phasing and order of delivery of parcels within the overall development.

3.2.2 Residential plots have been given an assumed impermeability of 65% which accounts for dwelling footprint, driveways, access etc. and excludes areas given over to garden and communal green spaces. These figures may change during detailed design but represent a conservative approach for the current strategy.

3.2.3 Educational areas within the site have been assigned a 60% impermeability.

3.2.4 The total impermeable area contributing to the drainage system is estimated as 10.64ha. Corresponding catchment variables are included for reference on the drainage strategy drawing included as **Appendix F**.

3.2.5 As a runoff rate restriction is required, it is necessary to provide surface water attenuation to balance the excess volume in a safe manner. Sufficient storage is provided for events up to the 1 in 100-year storm with a 40% allowance for climate change. This allowance accords with the peak runoff factors for the Soar Management Catchment Plan produced by DEFRA.

3.2.6 In order to balance the excess surface water runoff generated by the proposed development in a sustainable way, storage will be provided through vegetated attenuation basins. The breakdown of impermeable areas for the catchments, along with the corresponding discharge rates and approximate attenuation volumes is provided in **Table** 3-1.

**Table 3-1 Plot Areas, Runoff Rates, and Volumes of Attenuation**

| Catchment | Total Area (ha) | Impermeable Area (ha) | Discharge Rate (l/s) | Peak Volume of Attenuation ($m^3$) under Critical 100-year Event |
|---|---|---|---|---|
| A | 2.04 | 1.46 | 8.8 | 1318 |
| B | 2.90 | 2.07 | 12.4 | 1840 |
| C | 2.67 | 1.91 | 11.5 | 1693 |
| D | 4.36 | 2.83 | 18.7 | 2492 |
| E | 1.93 | 1.38 | 8.3 | 1249 |
| F | 1.38 | 0.99 | 5.9 | 837 |
| Total | 15.28 | 10.64 | 65.6 | 9429 |

3.2.7 The storage volume required for the catchments have been shown to be provided by numerous strategic attenuation areas across the site. Calculations outlining the above are shown in **Appendix G**.

3.2.8 Although ultimately subject to detailed design, the basins will are proposed to have areas of permanent water under normal conditions and will full up under significant storm events prior to discharge into the receiving watercourse at the catchment greenfield rate.

3.2.9 The wetlands provide sufficient storage capacity for all rainfall events up to the 1 in 100-year event, including a 40% increase in rainfall intensity to account for climate change in line with the Environment Agency's latest guidance on such allowances for the Soar Management Catchment. The storage volumes are calculated based on the restrictions outlined in **Table** 3-1.

3.2.10 In addition to this primary purpose, the attenuation basins will treat the water by naturally filtering out contaminants, provide a pleasant green landscape when not attenuating runoff and enhance biodiversity through wildflower planting and the associated habitats that offers. This achieves all 4 pillars of good SuDS design. Despite this, it is considered that a second level of treatment is required, especially for areas in which the spine road is included. This could take the form of conveyance features e.g. swales and filter drains or dedicated areas dedicated as surface level filter strips adjacent to areas of hardstanding.

3.2.11 An assessment in line with CIRIA SuDS Manual C753's simple index approach shows that the two suggested stages of treatment (wetland and filter drain) are sufficient to treat the critical pollution hazard proposed within the site (the central spine road). This is summarised in **Appendix H**.

3.2.12 The conceptual surface water layout for the development shows the indicative locations of the attenuation basins and SuDS features. This has been included for reference as **Appendix F**.

## 3.3 Runoff Volume Control

3.3.1 The Non-Statutory Technical Standards for Sustainable Drainage Systems S4-S6 states that where reasonably practicable the runoff volume from a development for the 1 in 100-year 6-hour rainfall event should not exceed the runoff volume prior to development or redevelopment. Additionally, if practicable on previously developed sites, the runoff volume should not exceed the equivalent greenfield runoff volume.

3.3.2 As the site intends to restrict runoff to the equivalent greenfield QBAR rate for all storm events up to and including the 100-year 6-hour plus climate change event, the volumetric criteria for the Non-Technical Standards for Sustainable Drainage Systems are met, and provision of long-term storage is not required.

## 3.4 SuDS Features

3.4.1 The proposed strategy is based on sustainable drainage principles, employing SuDS features to manage the surface water runoff across the site. Principally, all surface water will ultimately drain through strategic attenuation features and enter local watercourses in the immediate vicinity of the site.

3.4.2 Whilst the attenuation wetlands are principally designed to address the quantity of water that is to be attenuated, they also have water quality benefits, especially if planted with appropriate vegetation. They can also provide additional habitats for wildlife, increasing biodiversity and can increase the amenity of the immediate area.

3.4.3 A wide variety of other SuDS features should also be implemented across the development as the design progresses and this could include, but is not limited to;

- Water butts
- Swales
- Rainwater harvesting systems
- Rainwater gardens
- Permeable Paving
- Filter drains
- Silt traps
- Sump gullies

3.4.4 It is recommended that the final layout uses the proposed road infrastructure to provide drainage exceedance (overland flood flow) routes through the development and towards the attenuation basins for events in excess of the capacity of the drainage system.

## 3.5 Water Quality

3.5.1 The Simple Index Approach for assessing pollution prevention outlined in the SuDS Manual has been used to quantify the water quality impacts of the proposed SuDS solution to determine their effectiveness.

3.5.2 The proposed use of the development would be considered a medium pollution hazard level due to the anticipated traffic using the proposed spine road so pollution values have been obtained from the SuDS Manual and compared to the mitigation index values as per **Table** 3-2. A summary of the Simple Index Approach is included for reference **Appendix H**.

**Table 3-2 SuDS Mitigation Indices (from CIRIA SuDS Manual)**

| SuDS Component | Mitigation Indices | | |
|---|---|---|---|
| | *Total Suspended Solids* | *Metals* | *Hydrocarbons* |
| Land Use Pollution Index | 0.7 | 0.6 | 0.7 |
| Wetland | 0.7 | 0.7 | 0.5 |
| Filter Drain | 0.4 | 0.4 | 0.4 |
| **SuDS Mitigation Index** | **0.9** | **0.9** | **0.7** |
| **Mitigation Requirement Met?** | **Yes** | **Yes** | **Yes** |

3.5.3 It is therefore considered that when catchments contain areas of the spine road through the site, a strategic wetland provides adequate treatment to runoff when paired with a secondary SuDS feature. Consideration surrounding how this will be delivered will required take place at detailed design stage for the spine road and associated development parcels.

## 3.6 Maintenance and Adoption

3.6.1 For the proposed surface water drainage system to function correctly, it will need to be appropriately maintained. There are several possibilities for these maintenance responsibilities, they are;

- Severn Trent Water, as the local sewerage undertaker.
- The LLFA or SuDS Approval Body (SAB) (if section 3 of the FWM Act 2010 is enacted)
- A private management company.

3.6.2 Furthermore, there are 3 discrete components to the system – the pipe network, the principal SuDS (strategic attenuation features) and ancillary SuDS (any conveyance or localised attenuation features).

3.6.3 A situation may arise whereby one of the bodies adopts a specific part of the network (the pipe network for example) but not one of the other components. In this case, a combination of adopting bodies may be required and agreements should be put in place to reflect this.

3.6.4 The maintenance schedule for the network must be comprehensive and detail the specific maintenance requirements for each element of the drainage system. The CIRIA SuDS Manual has extensive information relating to the maintenance of SuDS which should be consulted when specifying the requirements.

3.6.5 For pipes, manholes and gullies, both general best practice and specific manufacturer maintenance protocols should be followed. Example maintenance activities and frequencies for the proposed SuDS features are included below.

**Table 3-3 Recommended Maintenance Activities for Filter Drains**

| Maintenance Schedule | Required Action | Typical Frequency |
|---|---|---|
| Regular Maintenance | Remove litter (including leaf litter) and debris from filter drain surfaces, access chambers and pre-treatment devices | Monthly (or as required) |
| | Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standard water and structural damage | Monthly |
| | Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt remove frequencies | Six monthly |
| | Remove sediment from pre-treatment devices | Six monthly, or as required |
| Occasional Maintenance | Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010) | As required |
| | At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium | Five yearly, or as required |
| | Clear perforated pipework of blockages | As required |

**Table 3-4 Recommended Maintenance Activities for Strategic Attenuation Wetlands**

| Maintenance Schedule | Required Action | Typical Frequency |
|---|---|---|
| Regular Maintenance | Remove Litter and Debris | Monthly |
| | Cut grass – for spillways and access routes | Monthly (during growing season), or as required |
| | Cut grass – meadow grass in and around basin | Half yearly (spring – before nesting season, and autumn) |
| | Manage other vegetation and remove nuisance plants | Monthly (at start, then as required) |
| | Inspect inlets, outlets and overflows for blockages, and clear if required | Monthly |
| | Inspect banksides, structures, pipework etc for evidence of physical damage | Monthly |
| | Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies | Monthly (for first year), then annually or required |
| | Check any penstocks and other mechanical devices | Annually |
| | Tidy all dead growth before start of growing season | Annually |
| | Remove sediment from inlets, outlet and forebay | Annually (or as required) |
| | Manage wetland plants in outlets pool – where provided | Annually (as set out in Chapter 23) |
| Occasional Maintenance | Reseed areas of poor vegetation growth | As required |
| | Prune and trim any trees and remove cuttings | Every 2 years, or as required |
| | Remove sediment from inlets, outlets, forebay and main basin when required | Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided |
| Remedial actions | Repair erosion or other damage by reseeding or re-turfing | As required |
| | Realignment of rip-rap | As required |
| | Repair/rehabilitation of inlets, outlets and overflows | As required |
| | Relevel uneven surfaces and reinstate design levels | As required |

## 3.7 SuDS Integration Strategy

3.7.1 A robust SuDS strategy has been designed for the site that can be followed by future applicants for reserved matters application as the development of parcels within the overall development come forward. SuDS features are to be an integral part of any future development, and so need to form an important part of any detailed drainage design. The SuDS features need to achieve the four pillars of good SuDS design, by managing both water quantity and quality, whilst providing amenity and biodiversity benefits.

3.7.2 Alongside the strategic drainage features set out as part of the presented drainage strategy, additional SuDS measures could be included, which are currently not shown given the level of detail within the submitted proposals. Subject to the evolution of the detailed design of the proposed development, various measures can be incorporated into individual plots (houses), into the wider street scene and alongside primary road infrastructure. A list of potential measures deemed appropriate at this stage are presented in **Table 3-5**, and it is recommended that, where possible and appropriate, a variety of these measures are incorporated into the scheme at detailed design. Where it is not possible, full justification must be given as to their exclusion.

**Table 3-5 Relevant SuDS Features for Exploration and Potential Inclusion at Detailed Design**

| SuDS Techniques | Applicable On-Plot | Applicable on Street Level | Applicable for Primary Roads | Comments |
|---|---|---|---|---|
| Rainwater Harvesting | ✓ | x | x | Individual properties to have rainwater butts/planters. |
| Permeable Pavements | ✓ | ✓ | ✓ | Driveways and hard landscaping within plots should be porous paving. Sections of streets could be designed with permeable surfacing and storage subbase. |
| Bioretention systems | ✓ | ✓ | ✓ | Can be applied throughout the scheme, as part of tree pits or raingardens in driveways, within streets or on primary road network. |
| Filter Strips | ✓ | ✓ | x | Placed on driveways, adjacent to parking areas of alongside smaller streets |
| Filter Drains | x | ✓ | ✓ | Can be used as storage, treatment and conveyance for road runoff. |
| Trees | x | ✓ | ✓ | Can be used within streets to promote natural surface water management. |
| Swales | x | ✓ | ✓ | Where space allows, swales are to be used as a means of storage, treatment and conveyance. |
| Attenuation Basins | x | x | ✓ | Additional basins beyond the current strategy could provide intermediate control and treatment of runoff from primary road network. |

3.7.3 Given the provisions of the strategic storage within the development to attenuate large volumes of surface water runoff generated by longer events, it is proposed that any additional SuDS measures that are to be included within the proposal should focus on providing short term storage, more intense events to ease capacity issues within the surface water network serving the wider scheme.

## 3.8 Northern Catchment Connectivity

3.8.1 Subsequent to examination by Leicestershire County Council, as Lead Local Flood Authority, investigation has taken place to assess connectivity of flows between the north and south of Burroughs Road in the vicinity of the outfalls from Catchments A and B.

3.8.2 No positive drainage can be observed crossing under Burroughs Road, and it can be seen that the surface water discharged from development to the North outfalls into the ditch (seen below in **Figure 3.1**) north of Burroughs Road.

**Figure 3.1 View eastward of the Ditch on the northern side of Burroughs Road**

3.8.3 It is proposed that positive connectivity is ensured for catchments north of Burroughs Road by providing a culvert, or similar feature to allow conveyance of this surface water to the south.

3.8.4 The above can be seen in **Appendix F**.

# 4 Foul Water Drainage

4.1.1 As the site is currently undeveloped, there is no existing foul network serving the site and there are no identified public sewers within the site boundary. However, there is an extensive network serving Ratby to the east of the site, which may provide points of connection for foul water from the proposed development as per the Severn Trent Water records included as **Appendix C**.

4.1.2 For the foul strategy, it is proposed to use foul gravity sewers to convey generated foul water to a low point at the southern end of the site, at which point a pumping station will be used to pump flows to Severn Trent Water's preferred connection point.

4.1.3 Consultation with Severn Trent is ongoing with regards to this connection and will likely require upgrade works to the existing network. This is anticipated to take place subsequent to granting of planning permission, obliging STW to provide capacity.

4.1.4 All foul connections to the existing public sewerage system will need to be approved by Severn Trent Water in accordance with Section 106 of the Water Industry Act. An application for the connections will need to be submitted to Severn Trent Water in due course to obtain approvals prior to the commencement of works.

# 5 Conclusions & Recommendations

5.1.1 This report and supporting appendices demonstrate that an appropriate surface water drainage strategy has been developed for the site based on sustainable drainage principles in line with the relevant local and national policy and standards.

5.1.2 This Sustainable Drainage Report is intended to support an Outline Planning Application and as such the level of detail included is commensurate with the nature of the proposals. **Table** 5-1 provides a summary of key information.

**Table 5-1 Summary of Key Information**

| Topic | Existing Site | | Proposed Development |
|---|---|---|---|
| Site Area (ha) | 33 | | 14.2 |
| Impermeable Area (ha) | 0 | | 10.6 |
| Number of Sub-Catchments | - | | 6 |
| Outfall Location(s) | Local Watercourses | | Local Watercourses |
| Peak Runoff Rate (l/s) | QBAR | 60.9 | 60.9 |
| | 1 in 30-year | 125.7 | |
| | 1 in 100-year | 156.5 | |
| Proposed Storage Volume (m³) | - | | |
| SuDS Features | - | | Wetlands<br>Filter Drains<br>Swales<br>Other conveyance features |
| Maintenance Responsibilities | Landowner | | Landowner<br>Operators |

# Appendix A Topographic Survey


N

## Station Information:

| Station | Easting (m) | Northing (m) | Level (m) |
|---|---|---|---|
| GH1 | 450145.894 | 306183.647 | 109.988 |
| GH2 | 450389.417 | 306175.214 | 92.367 |
| GH3 | 450569.974 | 306128.973 | 102.478 |
| GH4 | 450749.754 | 306063.458 | 97.939 |
| GH5 | 450869.505 | 305997.721 | 102.565 |
| S1 | 450556.370 | 306518.833 | 111.184 |
| S2 | 450660.543 | 306525.152 | 111.329 |
| S4 | 450464.896 | 306563.497 | 109.093 |
| BG1 | 450966.145 | 305744.334 | 85.765 |
| BG2 | 450993.643 | 305701.365 | 82.352 |
| BG3 | 451042.862 | 305701.957 | 82.645 |
| BG4 | 451099.594 | 305718.658 | 84.153 |
| BG5 | 451167.077 | 305726.403 | 83.515 |
| BG6 | 451147.566 | 305812.017 | 85.672 |
| BG7 | 451148.801 | 305882.960 | 88.270 |
| BG8 | 451096.834 | 305926.444 | 89.691 |
| BG9 | 451039.791 | 305955.536 | 95.287 |
| WC8 | 450418.168 | 306167.586 | 93.091 |
| WC9 | 450356.097 | 306175.781 | 92.706 |

*OS Note:*

*Some services may have been omitted due to parked vehicles. The Ordnance Survey tile is to be used as a guide only.*

*OS Buildings* — *Surveyed Buildings*

*This survey has been orientated to the Ordnance Survey (O.S) National Grid OSGB36(15) via Global Navigation Satellite Systems (GNSS) and the O.S. Active Network (OS Net).*

*A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN15GB & OSGM15GB transformation models.*

*The survey has been correlated to this point and a further one or more OSGB36 (15) points established to create a true O.S. bearing for angle orientation.*

*No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.*

*Please refer to Survey Station Table to enable establishment of the on-site grid and datum.*

## Legend:

Buildings, Wall, Kerb line, Line marking, Drop kerb, Centre line, Top of bank, Station and Name, Overhead Cable, Concrete edge, Tarmac edge, Grass verge, Canopy/Overhang, Verge, Bottom of bank

IC Inspection chamber; PInv Pipe invert; Gy Gully; Bg Back gully; Dp Down pipe; Pipe Pipe above ground; MH Manhole; WL Water level

Bo Bollard; IB Illuminated bollard; Bin Rubbish bin; Vp Vent pipe; Grl Ground light; Lbox Letter box; Stmp Tree Stump; Sty Stile

Interwoven; I\R Iron Railings; W\M Wire Mesh; P\R Post & Rail; P\W Post & Wire; C\L Chain Link; W\P Wooden Panels; C\B Close Boarded; S\P Steel Palisade

Av Air valve; ICU Unidentified inspection; Wo Wash out; Re Rodding eye; BB Belisha beacon; CTV Cable tv; Mkr Marker post; Gmkr Gas marker post; So Soffit; Fh Fire hydrant

CVR Cover; R/wall Retaining wall; TWL Top of Wall Level; TCL Tree canopy level; G: Girth; MG Multi girth; IC Inspection chamber; CL: Cover level; IL: Invert level; UTR Unable to raise

| Rev | Date | Description | Drawn | Q. Ref. |
|---|---|---|---|---|
| 4 | 19.04.24 | Survey Extension/ Update | SA | GH20668 |
| 3 | 09.04.24 | Markfield Road Extension | MH | GH20526 |
| 2 | 22.01.24 | Boundary Update | LB | GH19698 |
| 1 | 13.11.23 | Road & Watercourse added | LB | GH19125 |

greenhatch group

Topographical Surveys
Site Engineering
Utility / CCTV Surveys
Measured Building Surveys
3D Laser Scanning
Revit & BIM Models

Rowan House
Duffield Road
Little Eaton
Derby
DE21 5DR
Tel (01332) 830044 Fax (01332) 830055
admin@greenhatch-group.co.uk
www.greenhatch-group.co.uk

St Albans
Unit B, The Courtyard
Alban Park
St Albans
Hertfordshire
AL4 0LA
t. (01727) 854481

Newcastle
24 Riverside Studios
Amethyst Road
Newcastle Bus. Park
Newcastle-U-Tyne
NE4 7YL
t. (01912) 736391

London
27, Cornwall Terrace Mews
Regents Park
London
NW1 5LL
t. (02072) 241806

CLIENT

**Lagan Homes Ltd**

PROJECT

**Land west of Ratby, Hinckley & Bosworth, LE6 0XZ**

TITLE

**Topographical Survey**

| SCALE | DATE |
|---|---|
| A0@ 1: 1250 | 25.04.2022 |
| DRAWN | QUALITY REF |
| LP | GH13607 |

| | |
|---|---|
| Level datum | See note |
| Grid orientation | See note |
| Job number | 43724 |

| Drawing No. | Rev. |
|---|---|
| 43724_T | 4 |

Comments

*This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.*

*All dimensions should be checked on site prior to design and construction.*

*Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.*

Notes:

# Appendix B Development Masterplan


NOTES

This drawing is the property of FPCR Environment and Design Ltd and is issued on the condition it is not reproduced, retained or disclosed to any unauthorised person, either wholly or in part without written consent of FPCR Environment and Design Ltd.

0 50 100 150 200m

N

KEY

| | |
|---|---|
| Site Boundary | 32.7ha |
| Residential Development (Residential (13.5ha) c. 470 Units @ 35 dph) | |
| EC (Residential (12.9ha) c. 450 Units @ 35 dph + 0.6ha Extra Care | |
| Green Infrastructure (Includes retained vegetation, new planting, habitat creation, accessible green space and drainage basins) | 17ha |
| Access Points (See application plans for access drawings) | |
| Primary Street - Access Road (Indicative alignment) | |
| Recreational Routes (Indicative) | |
| Primary School (1FE) | 1.0ha |
| Community Hub | 0.2ha |
| Drainage Basins | |
| Additional Pond | |
| Existing Vegetation | |
| National Forest Planting Area (As part of Lagan Homes - 20/00462/FUL) | |
| Structural Planting (Indicative) | |
| Existing Public Rights of Way | |
| Children's Equipped Play | |
| Section of Burroughs Road to be pedestrian-cycle only | |

NOTES

Capacity masterplan based of topographical data, see drawing; *'43724_T_REV4'*

| rev | date | description | drn | chk |
|---|---|---|---|---|
| P13 | 10/07/2024 | Addition of Pond and Hedgerows | SJL | BC |
| P12 | 19/06/2024 | Amended PRoW Alignment & additional access point | SJL | BC |


masterplanning
environmental assessment
landscape design
urban design
ecology
architecture
arboriculture

FPCR Environment and Design Ltd
Lockington Hall
Lockington
Derby
DE74 2RH

t: 01509 672772
e: mail@fpcr.co.uk
w: www.fpcr.co.uk


client
Lagan Homes Ltd

project
(Burrough Field) Land West of Ratby, Leicestershire

drawing title
Framework Plan

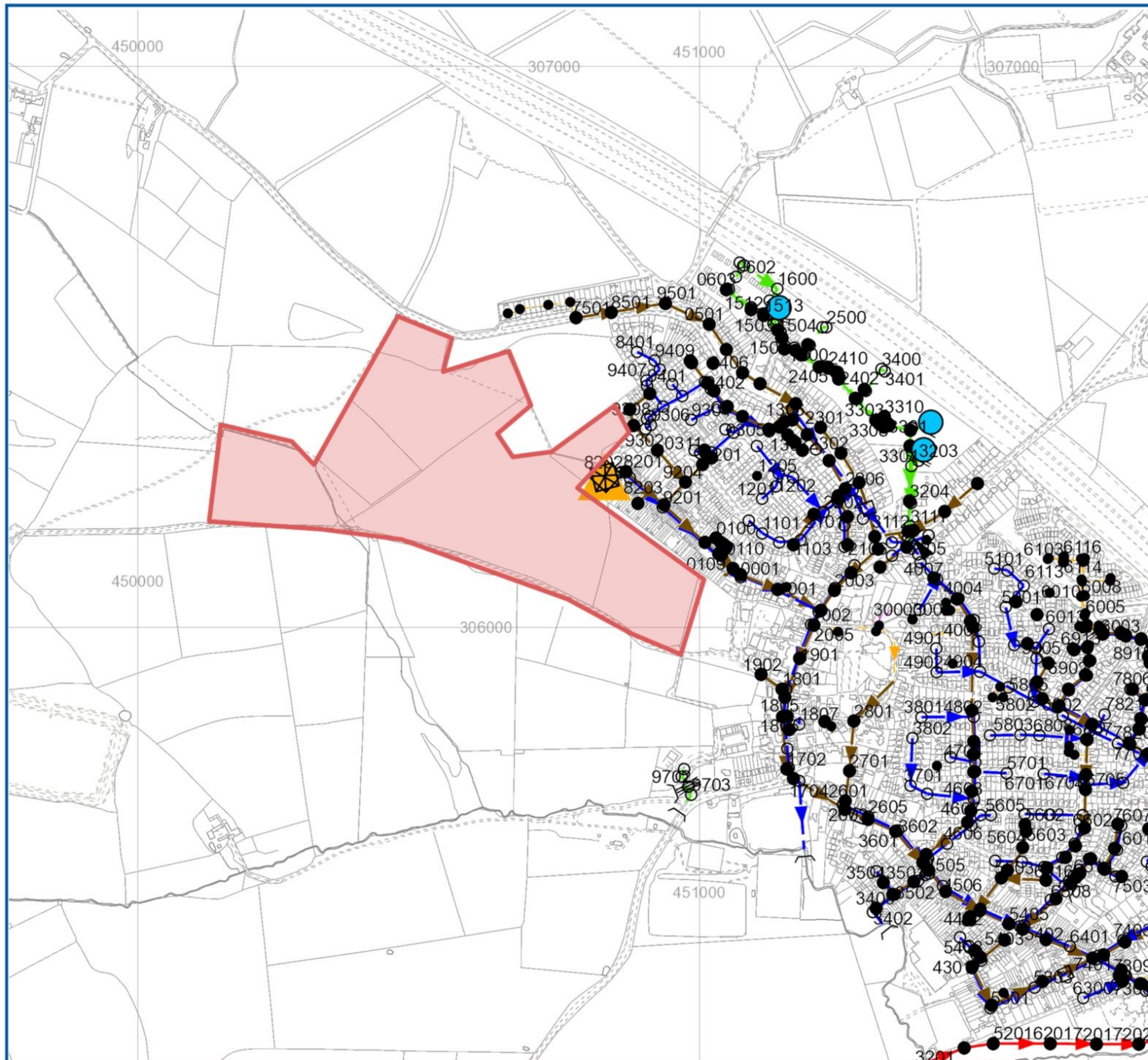
| scale | drn | chk | date created |
|---|---|---|---|
| 1:2000 @ A1 | SJL | BC | 10 July 2024 |

| project number | status | issue |
|---|---|---|
| 10783 | S3 | P13 |

document number
10783-FPCR-XX-XX-DR-L-0007
Project Code - Originator - Zone - Level - Type - Role - Drawing Number

File: \\FPCR-FS-01\Projects2\10700\10783\LANDS\Drawings\10783-FPCR-XX-XX-DR-L-0007-P13-Framework Plan.vwx

# Appendix C Sewer Records




| Reference | Cover Level | Invert Level Upstream | Invert Level Downstream | Purpose | Material | Pipe Shape | Max Size | Min Size | Gradient | Year Laid |
|---|---|---|---|---|---|---|---|---|---|---|
| SK51057810 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057906 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51056905 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057905 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057809 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51056908 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51056813 | 0 | 88.193 | 84.114 | F | VC | C | 300 | <UNK> | 16.84 | 31/12/1899 00:00:00 |
| SK51057812 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057907 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51056907 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057901 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057819 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057808 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057903 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51056904 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057818 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51056810 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51056812 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057704 | 0 | <UNK> | <UNK> | F | U | C | 150 | 0 | 0 | 06/07/2010 00:00:00 |
| SK51057908 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51056909 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057816 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51056911 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057815 | 0 | 0 | 0 | F | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057904 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057902 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057821 | 0 | 0 | 0 | S | VC | C | 150 | 0 | 0 | 10/08/2010 00:00:00 |
| SK51056811 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |
| SK51057822 | 0 | 0 | 0 | S | <UNK> | <UNK> | 0 | 0 | 0 | 31/12/1899 00:00:00 |

## LEGEND

**MATERIALS**

- - NONE
- AC - ASBESTOS CEME
- BR - BRICK
- CC - CONCRETE BOX CULVERT
- CI - CAST IRON
- CO - CONCRETE
- CSB - CONCRETE SEGMENTS (BOLTED)
- CSU - CONCRETE SEGMENTS (UNBOLTED)
- DI - DUCTILE IRON
- GRP - GLASS REINFORCED PLASTIC
- MAC - MASONRY IN REGULAR COURSES
- MAR - MASONRY RANDOMLY COURSED
- PE - POLYETHLENE
- PF - PITCH
- PP - POLYPROPYLENE
- PSC - PLASTIC STEEL COMPOSITE
- PVC - POLYVINYL CHLORIDE
- RPM - REINFORCED PLASTIC MATRIX
- SI - SPUN (GREY) IRON
- ST - STEEL
- U - UNKNOWN
- VC - VITRIFIED CLAY
- XXX - OTHER

**CATEGORIES**

- W - WEIR
- C - CASCADE
- DB - DAMBOARD
- SE - SIDE ENTRY
- FV - FLAP VALVE
- BD - BACK DROP
- S - SIPHON
- D - HIGHWAY DRAIN
- S104 - SECTION 104

**SHAPE**

- C - CIRCULAR
- E - EGG SHAPED
- O - OTHER
- R - RECTANGLE
- S - SQUARE
- T - TRAPEZOIDAL
- U - UNKNOWN

**PURPOSE**

- C - COMBINED
- E - FINAL EFFLUENT
- F - FOUL
- L - SLUDGE
- S - SURFACE WATER


SEVERN TRENT

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0345 601 6616


# SEWER RECORD (Tabular)

**O/S Map Scale:** 1:10,000 **This map is centred upon:**

**Date of Issue:** 27-04-22 **X:** 450788.20 **Y:** 306158.28

**Disclaimer Statement:**

1 Do not scale off this Map.

2 This plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this plan and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of SEVERN TRENT WATER assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems.

3 On 1 October 2011 most private sewers and private lateral drains in Severn Trent Water's sewerage area, which were connected to a public sewer as at 1 July 2011, transferred to the ownership of Severn Trent Water and became public sewers and public lateral drains. A further transfer takes place on 1 October 2012. Private pumping stations, which form part of these sewers or lateral drains, will transfer to ownership of Severn Trent Water on or before 1 October 2016. Severn Trent Water does not possess complete records of these assets. These assets may not be displayed on the map.

# Appendix D Greenfield Runoff Rate Calculations

# Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

| | |
|---|---|
| **Calculated by:** | Henry McColl |
| **Site name:** | Ratby Phases 3 & 4 |
| **Site location:** | Leicestershire |

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

## Site Details

| | |
|---|---|
| **Latitude:** | 52.65162° N |
| **Longitude:** | 1.25372° W |
| **Reference:** | 203887378 |
| **Date:** | May 28 2024 09:23 |

## Runoff estimation approach

FEH Statistical

## Site characteristics

| | |
|---|---|
| **Total site area (ha):** | 1 |

## Methodology

| | |
|---|---|
| **$Q_{MED}$ estimation method:** | Calculate from BFI and SAAR |
| **BFI and SPR method:** | Specify BFI manually |
| **HOST class:** | N/A |
| **BFI / BFIHOST:** | 0.345 |
| **$Q_{MED}$ (l/s):** | |
| **$Q_{BAR}$ / $Q_{MED}$ factor:** | 1.12 |

## Hydrological characteristics

| | Default | Edited |
|---|---|---|
| **SAAR (mm):** | 665 | 665 |
| **Hydrological region:** | 4 | 4 |
| **Growth curve factor 1 year:** | 0.83 | 0.83 |
| **Growth curve factor 30 years:** | 2 | 2 |
| **Growth curve factor 100 years:** | 2.57 | 2.57 |
| **Growth curve factor 200 years:** | 3.04 | 3.04 |

## Notes

### (1) Is $Q_{BAR}$ < 2.0 l/s/ha?

When $Q_{BAR}$ is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

### (2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

### (3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Greenfield runoff rates

Default Edited

| | | |
|---|---|---|
| $Q_{BAR}$ (l/s): | | 4.29 |
| 1 in 1 year (l/s): | | 3.56 |
| 1 in 30 years (l/s): | | 8.58 |
| 1 in 100 year (l/s): | | 11.02 |
| 1 in 200 years (l/s): | | 13.04 |

# Appendix E Greenfield Runoff Volume Calculations

## Greenfield Runoff Volume

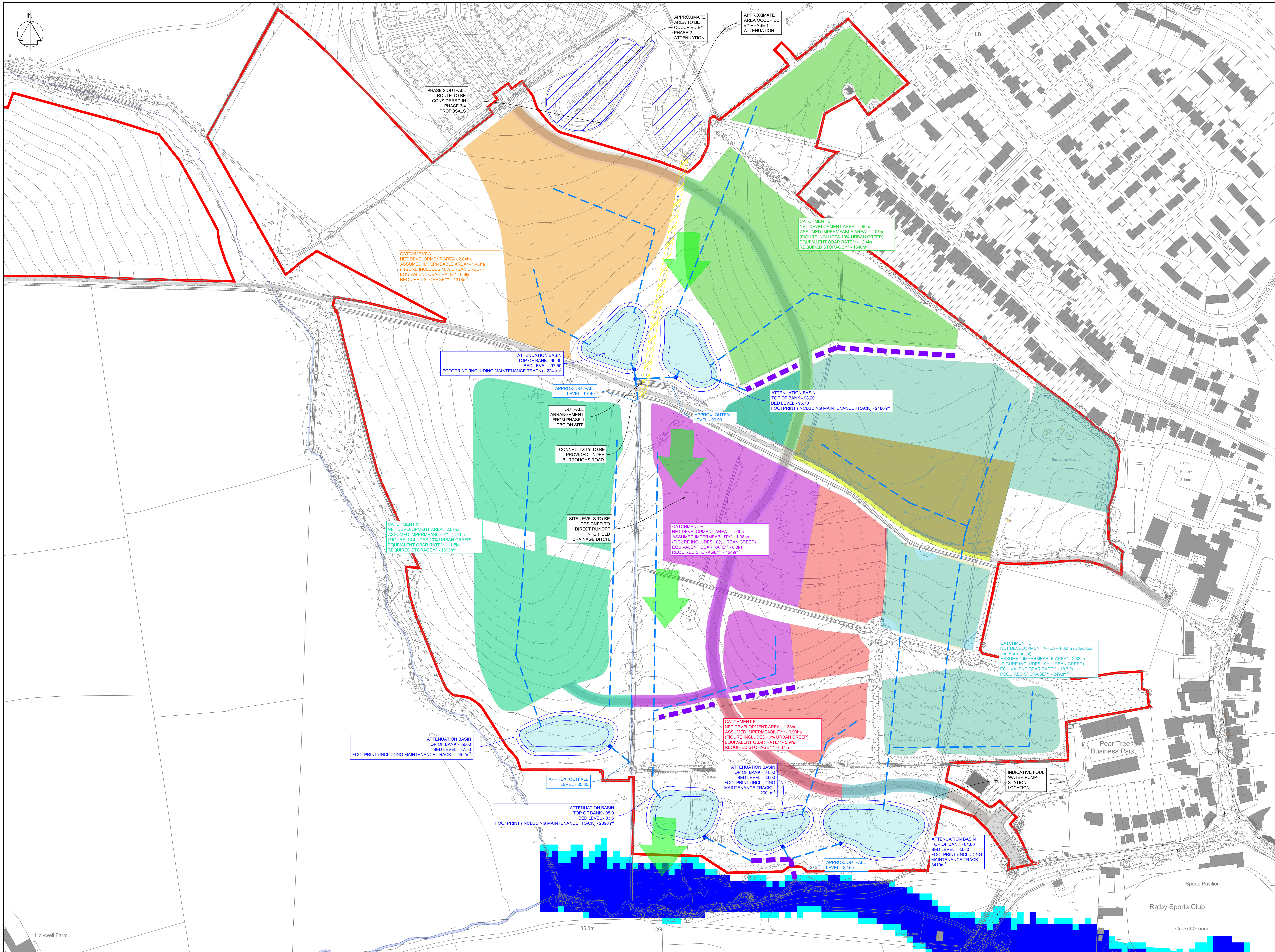
FSR Data

| | |
|---|---|
| Return Period (years) | 100 |
| Storm Duration (mins) | 360 |
| Region | England and Wales |
| M5-60 (mm) | 20.000 |
| Ratio R | 0.400 |
| Areal Reduction Factor | 1.00 |
| Area (ha) | 14.200 |
| SAAR (mm) | 700 |
| CWI | 100.320 |
| Urban | 0.000 |
| SPR | 47.000 |

Results

| | |
|---|---|
| Percentage Runoff (%) | 44.81 |
| Greenfield Runoff Volume (m³) | 3977.272 |

# Appendix F Conceptual Drainage Strategy




GENERAL NOTES

G1. DO NOT SCALE THIS DRAWING.

G2. ANY DIMENSIONAL DISCREPANCIES SHOULD BE NOTIFIED TO THE ENGINEER IMMEDIATELY.

G3. ALL DIMENSIONS ARE IN MILLIMETRES - (mm) ALL LEVELS ARE IN METRES - (m) AND ARE ABOVE ORDNANCE DATUM AT NEWLYN, CORNWALL UNLESS NOTED OTHERWISE.

G4. NORTH SHOWN INDICATIVE ONLY

G5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT; SPECIFICATIONS; DRAWINGS; DETAILS AND OTHER DESIGN INFORMATION.

G6. ALL DRAWINGS AND WRITTEN MATERIAL CONTAINED WITHIN, CONSTITUTE ORIGINAL AND UNPUBLISHED WORK OF THE ENGINEER AND MAY NOT BE DUPLICATED, USED, REPRODUCED OR DISCLOSED WITHOUT WRITTEN CONSENT OR EXPRESS PERMISSION FROM THE ENGINEER.

G7. ALL INFORMATION CONTAINED IN THIS DOCUMENT IS COPYRIGHT ©

G8. WHERE THE CONTRACTOR UNDERTAKES OR ENGAGES A THIRD PARTY TO UNDERTAKE TEMPORARY WORKS DESIGN, OR VARIES THE PELL FRISCHMANN DESIGN IN ANY WAY, THEN THE CONTRACTOR WILL TAKE FULL RESPONSIBILITY AND LIABILITY FOR ALL DESIGN ASPECTS, INCLUDING A DESIGN RISK ASSESSMENT. THE CONTRACTOR SHALL INFORM PELL FRISCHMANN OF ANY PROPOSED VARIANCES TO THE DESIGN.

STRATEGY NOTES

*RESIDENTIAL DEVELOPMENT HAS BEEN ASSUMED AT 65%

*EDUCATION DEVELOPMENT HAS BEEN ASSUMED AT 60%

**QBAR HAS BEEN CALCULATED AS 4.29l/s/ha

***REQUIRED STORAGE ASSESSED FOR THE 100 YEAR + 40% CLIMATE CHANGE EVENT

KEY

RED LINE BOUNDARY

CATCHMENTS

INDICATIVE ATTENUATION BASIN

INDICATIVE UNDERGROUND SURFACE WATER ROUTING

ATTENUATION SERVING ADJACENT PHASES

FLOOD ZONE 2

FLOOD ZONE 3

OVERLAND FLOOD ROUTING

INDICATIVE ABOVE GROUND SURFACE WATER ROUTING

| REV | DESCRIPTION | DRN | CHK | APP | DATE |
|---|---|---|---|---|---|
| P05 | UPDATED TO LLFA COMMENTS | HM | DAR | DAR | 13.12.24 |
| P04 | UPDATED TO NEW SURVEY DATA | HM | DAR | DAR | 04.07.24 |
| P03 | UPDATED TO NEW MASTERPLAN | HM | DAR | DAR | 28.05.24 |
| P02 | UPDATED TO COMMENTS | HM | DAR | DAR | 27.11.23 |
| P01 | INITIAL ISSUE | HM | DAR | DAR | 17.11.23 |

Pell Frischmann
4th FLOOR, THE POYNT, WOLLATON STREET, NOTTINGHAM NG1 5FW
Telephone +44 (0)115 784 8960
Email: pfnottingham@pellfrischmann.com
www.pellfrischmann.com

ARCHITECT/CLIENT/CONTRACTOR: LAGAN HOMES

Project: MARKFIELD ROAD, RATBY PHASE 3 & 4

Drawing Title: CONCEPTUAL SURFACE WATER DRAINAGE STRATEGY

Drawing Status: PRELIMINARY

| | Name | Date |
|---|---|---|
| Drawn | H. McCOLL | 13.11.23 |
| Designed | H. McCOLL | 13.11.23 |
| Eng Chk | D. ALLUM-ROONEY | 17.11.23 |
| Approved | D. ALLUM-ROONEY | 17.11.23 |

Status Code: S2
Scale: 1:1000
Revision: P05

Drawing No.: 109003 - PEF - ZZ - XX - DR - CD - 0500

# Appendix G Attenuation Calculations

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Winter | 0.528 | 0.528 | 12.4 | 0.0 | 12.4 | 703.6 | O K |
| 30 min Winter | 0.676 | 0.676 | 12.4 | 0.0 | 12.4 | 922.6 | O K |
| 60 min Winter | 0.818 | 0.818 | 12.4 | 0.0 | 12.4 | 1143.0 | O K |
| 120 min Winter | 0.973 | 0.973 | 12.4 | 0.0 | 12.4 | 1396.1 | O K |
| 180 min Winter | 1.065 | 1.065 | 12.4 | 0.0 | 12.4 | 1550.2 | O K |
| 240 min Winter | 1.124 | 1.124 | 12.4 | 0.0 | 12.4 | 1652.3 | O K |
| 360 min Winter | 1.190 | 1.190 | 12.4 | 0.0 | 12.4 | 1767.8 | O K |
| 480 min Winter | 1.219 | 1.219 | 12.5 | 0.0 | 12.5 | 1819.0 | Flood Risk |
| 600 min Winter | 1.229 | 1.229 | 12.5 | 0.0 | 12.5 | 1836.8 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 15 min Winter | 138.460 | 0.0 | 672.2 | 0.0 | 26 |
| 30 min Winter | 91.070 | 0.0 | 870.7 | 0.0 | 41 |
| 60 min Winter | 56.875 | 0.0 | 1154.4 | 0.0 | 70 |
| 120 min Winter | 35.332 | 0.0 | 1430.4 | 0.0 | 128 |
| 180 min Winter | 26.592 | 0.0 | 1607.9 | 0.0 | 186 |
| 240 min Winter | 21.604 | 0.0 | 1731.7 | 0.0 | 244 |
| 360 min Winter | 15.907 | 0.0 | 1880.0 | 0.0 | 360 |
| 480 min Winter | 12.670 | 0.0 | 1939.8 | 0.0 | 476 |
| 600 min Winter | 10.563 | 0.0 | 1941.5 | 0.0 | 590 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Σ Max Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 720 min Winter | 1.228 | 1.228 | 12.5 | 0.0 | 12.5 | 1835.2 | Flood Risk |
| 960 min Winter | 1.207 | 1.207 | 12.4 | 0.0 | 12.4 | 1798.7 | Flood Risk |
| 1440 min Winter | 1.135 | 1.135 | 12.4 | 0.0 | 12.4 | 1671.1 | O K |
| 2160 min Winter | 1.033 | 1.033 | 12.4 | 0.0 | 12.4 | 1495.7 | O K |
| 2880 min Winter | 0.940 | 0.940 | 12.4 | 0.0 | 12.4 | 1340.8 | O K |
| 4320 min Winter | 0.758 | 0.758 | 12.4 | 0.0 | 12.4 | 1048.7 | O K |
| 5760 min Winter | 0.591 | 0.591 | 12.4 | 0.0 | 12.4 | 795.7 | O K |
| 7200 min Winter | 0.466 | 0.466 | 12.4 | 0.0 | 12.4 | 614.3 | O K |
| 8640 min Winter | 0.370 | 0.370 | 12.4 | 0.0 | 12.4 | 480.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 720 min Winter | 9.077 | 0.0 | 1927.5 | 0.0 | 704 |
| 960 min Winter | 7.106 | 0.0 | 1890.9 | 0.0 | 926 |
| 1440 min Winter | 4.989 | 0.0 | 1807.5 | 0.0 | 1332 |
| 2160 min Winter | 3.489 | 0.0 | 2582.2 | 0.0 | 1652 |
| 2880 min Winter | 2.715 | 0.0 | 2676.0 | 0.0 | 2112 |
| 4320 min Winter | 1.930 | 0.0 | 2841.3 | 0.0 | 2992 |
| 5760 min Winter | 1.531 | 0.0 | 3037.3 | 0.0 | 3752 |
| 7200 min Winter | 1.296 | 0.0 | 3211.8 | 0.0 | 4472 |
| 8640 min Winter | 1.141 | 0.0 | 3389.8 | 0.0 | 5112 |

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Σ Max Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Winter | 0.301 | 0.301 | 12.3 | 0.0 | 12.3 | 385.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 10080 min Winter | 1.032 | 0.0 | 3570.5 | 0.0 | 5760 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FEH | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 1.000 |
| FEH Rainfall Version | 2013 | Cv (Winter) | 1.000 |
| Site Location | GB 450501 306499 SK 50501 06499 | Shortest Storm (mins) | 15 |
| Data Type | Point | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 2.070

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.690 | 4 | 8 | 0.690 | 8 | 12 | 0.690 |

## Model Details

Storage is Online Cover Level (m) 1.500

## Tank or Pond Structure

Invert Level (m) 0.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 1217.0 | 1.500 | 1933.0 |

## Hydro-Brake® Optimum Outflow Control

| | | | |
|---|---|---|---|
| Unit Reference | MD-SHE-0158-1240-1200-1240 | Sump Available | Yes |
| Design Head (m) | 1.200 | Diameter (mm) | 158 |
| Design Flow (l/s) | 12.4 | Invert Level (m) | 0.000 |
| Flush-Flo™ | Calculated | Minimum Outlet Pipe Diameter (mm) | 225 |
| Objective | Minimise upstream storage | Suggested Manhole Diameter (mm) | 1200 |
| Application | Surface | | |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.200 | 12.4 | Kick-Flo® | 0.792 | 10.2 |
| Flush-Flo™ | 0.360 | 12.4 | Mean Flow over Head Range | - | 10.7 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

## Hydro-Brake® Optimum Outflow Control

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 5.7 | 0.600 | 11.9 | 1.600 | 14.2 | 2.600 | 17.9 | 5.000 | 24.5 | 7.500 | 29.7 |
| 0.200 | 11.7 | 0.800 | 10.2 | 1.800 | 15.0 | 3.000 | 19.2 | 5.500 | 25.6 | 8.000 | 30.7 |
| 0.300 | 12.3 | 1.000 | 11.4 | 2.000 | 15.8 | 3.500 | 20.6 | 6.000 | 26.7 | 8.500 | 31.6 |
| 0.400 | 12.4 | 1.200 | 12.4 | 2.200 | 16.5 | 4.000 | 22.0 | 6.500 | 27.8 | 9.000 | 32.5 |
| 0.500 | 12.2 | 1.400 | 13.3 | 2.400 | 17.2 | 4.500 | 23.3 | 7.000 | 28.8 | 9.500 | 33.3 |

## Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Winter | 0.516 | 0.516 | 11.5 | 0.0 | 11.5 | 648.4 | O K |
| 30 min Winter | 0.659 | 0.659 | 11.5 | 0.0 | 11.5 | 850.2 | O K |
| 60 min Winter | 0.797 | 0.797 | 11.5 | 0.0 | 11.5 | 1053.3 | O K |
| 120 min Winter | 0.947 | 0.947 | 11.5 | 0.0 | 11.5 | 1286.6 | O K |
| 180 min Winter | 1.035 | 1.035 | 11.5 | 0.0 | 11.5 | 1428.7 | O K |
| 240 min Winter | 1.092 | 1.092 | 11.5 | 0.0 | 11.5 | 1522.8 | O K |
| 360 min Winter | 1.155 | 1.155 | 11.5 | 0.0 | 11.5 | 1629.3 | O K |
| 480 min Winter | 1.183 | 1.183 | 11.5 | 0.0 | 11.5 | 1676.4 | O K |
| 600 min Winter | 1.192 | 1.192 | 11.5 | 0.0 | 11.5 | 1692.8 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 15 min Winter | 138.460 | 0.0 | 620.8 | 0.0 | 26 |
| 30 min Winter | 91.070 | 0.0 | 804.7 | 0.0 | 41 |
| 60 min Winter | 56.875 | 0.0 | 1064.8 | 0.0 | 70 |
| 120 min Winter | 35.332 | 0.0 | 1319.5 | 0.0 | 128 |
| 180 min Winter | 26.592 | 0.0 | 1483.4 | 0.0 | 186 |
| 240 min Winter | 21.604 | 0.0 | 1597.9 | 0.0 | 244 |
| 360 min Winter | 15.907 | 0.0 | 1735.5 | 0.0 | 360 |
| 480 min Winter | 12.670 | 0.0 | 1791.7 | 0.0 | 476 |
| 600 min Winter | 10.563 | 0.0 | 1793.8 | 0.0 | 590 |

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Σ Max Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 720 min Winter | 1.191 | 1.191 | 11.5 | 0.0 | 11.5 | 1691.4 | O K |
| 960 min Winter | 1.172 | 1.172 | 11.5 | 0.0 | 11.5 | 1657.7 | O K |
| 1440 min Winter | 1.102 | 1.102 | 11.5 | 0.0 | 11.5 | 1539.6 | O K |
| 2160 min Winter | 1.002 | 1.002 | 11.5 | 0.0 | 11.5 | 1375.8 | O K |
| 2880 min Winter | 0.912 | 0.912 | 11.5 | 0.0 | 11.5 | 1231.1 | O K |
| 4320 min Winter | 0.730 | 0.730 | 11.5 | 0.0 | 11.5 | 953.3 | O K |
| 5760 min Winter | 0.570 | 0.570 | 11.5 | 0.0 | 11.5 | 723.4 | O K |
| 7200 min Winter | 0.449 | 0.449 | 11.5 | 0.0 | 11.5 | 557.3 | O K |
| 8640 min Winter | 0.357 | 0.357 | 11.5 | 0.0 | 11.5 | 435.4 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 720 min Winter | 9.077 | 0.0 | 1780.6 | 0.0 | 704 |
| 960 min Winter | 7.106 | 0.0 | 1746.4 | 0.0 | 926 |
| 1440 min Winter | 4.989 | 0.0 | 1669.0 | 0.0 | 1334 |
| 2160 min Winter | 3.489 | 0.0 | 2380.7 | 0.0 | 1652 |
| 2880 min Winter | 2.715 | 0.0 | 2467.3 | 0.0 | 2116 |
| 4320 min Winter | 1.930 | 0.0 | 2621.1 | 0.0 | 2988 |
| 5760 min Winter | 1.531 | 0.0 | 2799.8 | 0.0 | 3744 |
| 7200 min Winter | 1.296 | 0.0 | 2960.6 | 0.0 | 4464 |
| 8640 min Winter | 1.141 | 0.0 | 3124.8 | 0.0 | 5112 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Winter | 0.290 | 0.290 | 11.4 | 0.0 | 11.4 | 349.4 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 10080 min Winter | 1.032 | 0.0 | 3291.5 | 0.0 | 5760 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FEH | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 1.000 |
| FEH Rainfall Version | 2013 | Cv (Winter) | 1.000 |
| Site Location | GB 450501 306499 SK 50501 06499 | Shortest Storm (mins) | 15 |
| Data Type | Point | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 1.908

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.636 | 4 | 8 | 0.636 | 8 | 12 | 0.636 |

## Model Details

Storage is Online Cover Level (m) 1.500

## Tank or Pond Structure

Invert Level (m) 0.000

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 1139.0 | 1.500 | 1890.0 |

## Hydro-Brake® Optimum Outflow Control

| | | | |
|---|---|---|---|
| Unit Reference | MD-SHE-0152-1150-1200-1150 | Sump Available | Yes |
| Design Head (m) | 1.200 | Diameter (mm) | 152 |
| Design Flow (l/s) | 11.5 | Invert Level (m) | 0.000 |
| Flush-Flo™ | Calculated | Minimum Outlet Pipe Diameter (mm) | 225 |
| Objective | Minimise upstream storage | Suggested Manhole Diameter (mm) | 1200 |
| Application | Surface | | |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.200 | 11.5 | Kick-Flo® | 0.787 | 9.4 |
| Flush-Flo™ | 0.358 | 11.5 | Mean Flow over Head Range | - | 9.9 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

## Hydro-Brake® Optimum Outflow Control

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 5.5 | 0.600 | 11.0 | 1.600 | 13.2 | 2.600 | 16.6 | 5.000 | 22.7 | 7.500 | 27.6 |
| 0.200 | 10.9 | 0.800 | 9.5 | 1.800 | 13.9 | 3.000 | 17.8 | 5.500 | 23.7 | 8.000 | 28.4 |
| 0.300 | 11.4 | 1.000 | 10.6 | 2.000 | 14.6 | 3.500 | 19.1 | 6.000 | 24.8 | 8.500 | 29.3 |
| 0.400 | 11.5 | 1.200 | 11.5 | 2.200 | 15.3 | 4.000 | 20.4 | 6.500 | 25.7 | 9.000 | 30.1 |
| 0.500 | 11.3 | 1.400 | 12.4 | 2.400 | 16.0 | 4.500 | 21.6 | 7.000 | 26.7 | 9.500 | 30.9 |

## Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Σ Max Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Winter | 0.475 | 0.475 | 18.6 | 0.0 | 18.6 | 960.7 | O K |
| 30 min Winter | 0.611 | 0.611 | 18.6 | 0.0 | 18.6 | 1258.9 | O K |
| 60 min Winter | 0.743 | 0.743 | 18.6 | 0.0 | 18.6 | 1557.7 | O K |
| 120 min Winter | 0.890 | 0.890 | 18.6 | 0.0 | 18.6 | 1903.8 | O K |
| 180 min Winter | 0.977 | 0.977 | 18.6 | 0.0 | 18.6 | 2113.2 | O K |
| 240 min Winter | 1.033 | 1.033 | 18.6 | 0.0 | 18.6 | 2251.1 | O K |
| 360 min Winter | 1.095 | 1.095 | 18.6 | 0.0 | 18.6 | 2405.3 | O K |
| 480 min Winter | 1.121 | 1.121 | 18.6 | 0.0 | 18.6 | 2471.4 | O K |
| 600 min Winter | 1.129 | 1.129 | 18.6 | 0.0 | 18.6 | 2492.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 15 min Winter | 138.460 | 0.0 | 898.9 | 0.0 | 26 |
| 30 min Winter | 91.070 | 0.0 | 1176.1 | 0.0 | 41 |
| 60 min Winter | 56.875 | 0.0 | 1566.0 | 0.0 | 70 |
| 120 min Winter | 35.332 | 0.0 | 1943.1 | 0.0 | 128 |
| 180 min Winter | 26.592 | 0.0 | 2187.5 | 0.0 | 186 |
| 240 min Winter | 21.604 | 0.0 | 2361.4 | 0.0 | 244 |
| 360 min Winter | 15.907 | 0.0 | 2586.2 | 0.0 | 360 |
| 480 min Winter | 12.670 | 0.0 | 2717.8 | 0.0 | 476 |
| 600 min Winter | 10.563 | 0.0 | 2794.8 | 0.0 | 590 |

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 720 min Winter | 1.127 | 1.127 | 18.6 | 0.0 | 18.6 | 2486.3 | O K |
| 960 min Winter | 1.104 | 1.104 | 18.6 | 0.0 | 18.6 | 2429.8 | O K |
| 1440 min Winter | 1.030 | 1.030 | 18.6 | 0.0 | 18.6 | 2244.6 | O K |
| 2160 min Winter | 0.929 | 0.929 | 18.6 | 0.0 | 18.6 | 1998.0 | O K |
| 2880 min Winter | 0.829 | 0.829 | 18.6 | 0.0 | 18.6 | 1758.5 | O K |
| 4320 min Winter | 0.636 | 0.636 | 18.6 | 0.0 | 18.6 | 1315.3 | O K |
| 5760 min Winter | 0.488 | 0.488 | 18.6 | 0.0 | 18.6 | 989.4 | O K |
| 7200 min Winter | 0.379 | 0.379 | 18.6 | 0.0 | 18.6 | 756.4 | O K |
| 8640 min Winter | 0.301 | 0.301 | 18.5 | 0.0 | 18.5 | 594.8 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 720 min Winter | 9.077 | 0.0 | 2832.7 | 0.0 | 702 |
| 960 min Winter | 7.106 | 0.0 | 2818.9 | 0.0 | 922 |
| 1440 min Winter | 4.989 | 0.0 | 2684.9 | 0.0 | 1296 |
| 2160 min Winter | 3.489 | 0.0 | 3520.2 | 0.0 | 1640 |
| 2880 min Winter | 2.715 | 0.0 | 3648.7 | 0.0 | 2108 |
| 4320 min Winter | 1.930 | 0.0 | 3877.4 | 0.0 | 2896 |
| 5760 min Winter | 1.531 | 0.0 | 4146.6 | 0.0 | 3632 |
| 7200 min Winter | 1.296 | 0.0 | 4383.8 | 0.0 | 4328 |
| 8640 min Winter | 1.141 | 0.0 | 4625.1 | 0.0 | 5008 |

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Σ Max Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Winter | 0.248 | 0.248 | 18.1 | 0.0 | 18.1 | 487.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 10080 min Winter | 1.032 | 0.0 | 4867.9 | 0.0 | 5640 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FEH | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 1.000 |
| FEH Rainfall Version | 2013 | Cv (Winter) | 1.000 |
| Site Location | GB 450501 306499 SK 50501 06499 | Shortest Storm (mins) | 15 |
| Data Type | Point | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 2.829

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.943 | 4 | 8 | 0.943 | 8 | 12 | 0.943 |

## Model Details

Storage is Online Cover Level (m) 1.500

## Tank or Pond Structure

Invert Level (m) 0.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 1897.0 | 1.500 | 2762.0 |

## Hydro-Brake® Optimum Outflow Control

| | | | |
|---|---|---|---|
| Unit Reference | MD-SHE-0190-1870-1200-1870 | Sump Available | Yes |
| Design Head (m) | 1.200 | Diameter (mm) | 190 |
| Design Flow (l/s) | 18.7 | Invert Level (m) | 0.000 |
| Flush-Flo™ | Calculated | Minimum Outlet Pipe Diameter (mm) | 225 |
| Objective | Minimise upstream storage | Suggested Manhole Diameter (mm) | 1500 |
| Application | Surface | | |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.200 | 18.7 | Kick-Flo® | 0.823 | 15.6 |
| Flush-Flo™ | 0.376 | 18.6 | Mean Flow over Head Range | - | 16.0 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

## Hydro-Brake® Optimum Outflow Control

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 6.6 | 0.600 | 18.0 | 1.600 | 21.4 | 2.600 | 27.0 | 5.000 | 37.0 | 7.500 | 45.1 |
| 0.200 | 17.5 | 0.800 | 16.1 | 1.800 | 22.7 | 3.000 | 29.0 | 5.500 | 38.8 | 8.000 | 46.5 |
| 0.300 | 18.5 | 1.000 | 17.1 | 2.000 | 23.8 | 3.500 | 31.2 | 6.000 | 40.5 | 8.500 | 47.9 |
| 0.400 | 18.6 | 1.200 | 18.7 | 2.200 | 25.0 | 4.000 | 33.3 | 6.500 | 42.1 | 9.000 | 49.2 |
| 0.500 | 18.4 | 1.400 | 20.1 | 2.400 | 26.0 | 4.500 | 35.2 | 7.000 | 43.6 | 9.500 | 50.6 |

## Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Winter | 0.363 | 0.363 | 8.3 | 0.0 | 8.3 | 469.5 | O K |
| 30 min Winter | 0.468 | 0.468 | 8.3 | 0.0 | 8.3 | 615.3 | O K |
| 60 min Winter | 0.570 | 0.570 | 8.3 | 0.0 | 8.3 | 761.6 | O K |
| 120 min Winter | 0.685 | 0.685 | 8.3 | 0.0 | 8.3 | 931.3 | O K |
| 180 min Winter | 0.755 | 0.755 | 8.3 | 0.0 | 8.3 | 1036.9 | O K |
| 240 min Winter | 0.801 | 0.801 | 8.3 | 0.0 | 8.3 | 1108.4 | O K |
| 360 min Winter | 0.854 | 0.854 | 8.3 | 0.0 | 8.3 | 1190.8 | O K |
| 480 min Winter | 0.878 | 0.878 | 8.3 | 0.0 | 8.3 | 1229.7 | O K |
| 600 min Winter | 0.889 | 0.889 | 8.3 | 0.0 | 8.3 | 1246.0 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 15 min Winter | 138.460 | 0.0 | 433.7 | 0.0 | 26 |
| 30 min Winter | 91.070 | 0.0 | 563.3 | 0.0 | 41 |
| 60 min Winter | 56.875 | 0.0 | 761.6 | 0.0 | 70 |
| 120 min Winter | 35.332 | 0.0 | 944.0 | 0.0 | 128 |
| 180 min Winter | 26.592 | 0.0 | 1060.0 | 0.0 | 186 |
| 240 min Winter | 21.604 | 0.0 | 1139.3 | 0.0 | 244 |
| 360 min Winter | 15.907 | 0.0 | 1231.1 | 0.0 | 362 |
| 480 min Winter | 12.670 | 0.0 | 1265.4 | 0.0 | 478 |
| 600 min Winter | 10.563 | 0.0 | 1264.9 | 0.0 | 594 |

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Σ Max Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 720 min Winter | 0.890 | 0.890 | 8.3 | 0.0 | 8.3 | 1249.0 | O K |
| 960 min Winter | 0.880 | 0.880 | 8.3 | 0.0 | 8.3 | 1231.9 | O K |
| 1440 min Winter | 0.832 | 0.832 | 8.3 | 0.0 | 8.3 | 1156.3 | O K |
| 2160 min Winter | 0.745 | 0.745 | 8.3 | 0.0 | 8.3 | 1021.7 | O K |
| 2880 min Winter | 0.667 | 0.667 | 8.3 | 0.0 | 8.3 | 903.4 | O K |
| 4320 min Winter | 0.536 | 0.536 | 8.3 | 0.0 | 8.3 | 711.3 | O K |
| 5760 min Winter | 0.430 | 0.430 | 8.3 | 0.0 | 8.3 | 561.9 | O K |
| 7200 min Winter | 0.350 | 0.350 | 8.3 | 0.0 | 8.3 | 451.2 | O K |
| 8640 min Winter | 0.289 | 0.289 | 8.2 | 0.0 | 8.2 | 369.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 720 min Winter | 9.077 | 0.0 | 1253.1 | 0.0 | 708 |
| 960 min Winter | 7.106 | 0.0 | 1225.6 | 0.0 | 934 |
| 1440 min Winter | 4.989 | 0.0 | 1168.5 | 0.0 | 1364 |
| 2160 min Winter | 3.489 | 0.0 | 1714.1 | 0.0 | 1692 |
| 2880 min Winter | 2.715 | 0.0 | 1776.6 | 0.0 | 2108 |
| 4320 min Winter | 1.930 | 0.0 | 1883.7 | 0.0 | 2940 |
| 5760 min Winter | 1.531 | 0.0 | 2022.4 | 0.0 | 3696 |
| 7200 min Winter | 1.296 | 0.0 | 2138.2 | 0.0 | 4464 |
| 8640 min Winter | 1.141 | 0.0 | 2255.8 | 0.0 | 5112 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Winter | 0.244 | 0.244 | 8.1 | 0.0 | 8.1 | 309.8 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 10080 min Winter | 1.032 | 0.0 | 2374.0 | 0.0 | 5848 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FEH | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 1.000 |
| FEH Rainfall Version | 2013 | Cv (Winter) | 1.000 |
| Site Location | GB 450501 306499 SK 50501 06499 | Shortest Storm (mins) | 15 |
| Data Type | Point | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 1.380

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.460 | 4 | 8 | 0.460 | 8 | 12 | 0.460 |

## Model Details

Storage is Online Cover Level (m) 1.500

## Tank or Pond Structure

Invert Level (m) 0.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 1220.0 | 1.500 | 1878.0 |

## Hydro-Brake® Optimum Outflow Control

| | | | |
|---|---|---|---|
| Unit Reference | MD-SHE-0131-8300-1200-8300 | Sump Available | Yes |
| Design Head (m) | 1.200 | Diameter (mm) | 131 |
| Design Flow (l/s) | 8.3 | Invert Level (m) | 0.000 |
| Flush-Flo™ | Calculated | Minimum Outlet Pipe Diameter (mm) | 150 |
| Objective | Minimise upstream storage | Suggested Manhole Diameter (mm) | 1200 |
| Application | Surface | | |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.200 | 8.3 | Kick-Flo® | 0.764 | 6.7 |
| Flush-Flo™ | 0.353 | 8.3 | Mean Flow over Head Range | - | 7.2 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

## Hydro-Brake® Optimum Outflow Control

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 4.7 | 0.600 | 7.9 | 1.600 | 9.5 | 2.600 | 12.0 | 5.000 | 16.3 | 7.500 | 19.8 |
| 0.200 | 7.9 | 0.800 | 6.9 | 1.800 | 10.0 | 3.000 | 12.8 | 5.500 | 17.1 | 8.000 | 20.4 |
| 0.300 | 8.3 | 1.000 | 7.6 | 2.000 | 10.6 | 3.500 | 13.8 | 6.000 | 17.8 | 8.500 | 21.0 |
| 0.400 | 8.3 | 1.200 | 8.3 | 2.200 | 11.0 | 4.000 | 14.7 | 6.500 | 18.5 | 9.000 | 21.6 |
| 0.500 | 8.1 | 1.400 | 8.9 | 2.400 | 11.5 | 4.500 | 15.5 | 7.000 | 19.2 | 9.500 | 22.2 |

## Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Winter | 0.359 | 0.359 | 8.3 | 0.0 | 8.3 | 334.5 | O K |
| 30 min Winter | 0.460 | 0.460 | 8.3 | 0.0 | 8.3 | 437.8 | O K |
| 60 min Winter | 0.556 | 0.556 | 8.3 | 0.0 | 8.3 | 539.8 | O K |
| 120 min Winter | 0.662 | 0.662 | 8.3 | 0.0 | 8.3 | 655.7 | O K |
| 180 min Winter | 0.723 | 0.723 | 8.3 | 0.0 | 8.3 | 725.4 | O K |
| 240 min Winter | 0.762 | 0.762 | 8.3 | 0.0 | 8.3 | 771.0 | O K |
| 360 min Winter | 0.804 | 0.804 | 8.3 | 0.0 | 8.3 | 819.4 | O K |
| 480 min Winter | 0.818 | 0.818 | 8.3 | 0.0 | 8.3 | 836.4 | O K |
| 600 min Winter | 0.819 | 0.819 | 8.3 | 0.0 | 8.3 | 837.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 15 min Winter | 138.460 | 0.0 | 323.5 | 0.0 | 26 |
| 30 min Winter | 91.070 | 0.0 | 426.4 | 0.0 | 40 |
| 60 min Winter | 56.875 | 0.0 | 553.3 | 0.0 | 70 |
| 120 min Winter | 35.332 | 0.0 | 688.1 | 0.0 | 126 |
| 180 min Winter | 26.592 | 0.0 | 776.5 | 0.0 | 184 |
| 240 min Winter | 21.604 | 0.0 | 840.6 | 0.0 | 244 |
| 360 min Winter | 15.907 | 0.0 | 926.7 | 0.0 | 360 |
| 480 min Winter | 12.670 | 0.0 | 982.1 | 0.0 | 474 |
| 600 min Winter | 10.563 | 0.0 | 1021.3 | 0.0 | 588 |

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 720 min Winter | 0.812 | 0.812 | 8.3 | 0.0 | 8.3 | 829.0 | O K |
| 960 min Winter | 0.784 | 0.784 | 8.3 | 0.0 | 8.3 | 796.4 | O K |
| 1440 min Winter | 0.706 | 0.706 | 8.3 | 0.0 | 8.3 | 705.8 | O K |
| 2160 min Winter | 0.601 | 0.601 | 8.3 | 0.0 | 8.3 | 588.9 | O K |
| 2880 min Winter | 0.508 | 0.508 | 8.3 | 0.0 | 8.3 | 488.0 | O K |
| 4320 min Winter | 0.359 | 0.359 | 8.3 | 0.0 | 8.3 | 334.2 | O K |
| 5760 min Winter | 0.256 | 0.256 | 8.1 | 0.0 | 8.1 | 233.9 | O K |
| 7200 min Winter | 0.193 | 0.193 | 7.8 | 0.0 | 7.8 | 173.9 | O K |
| 8640 min Winter | 0.156 | 0.156 | 7.4 | 0.0 | 7.4 | 139.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 720 min Winter | 9.077 | 0.0 | 1050.6 | 0.0 | 700 |
| 960 min Winter | 7.106 | 0.0 | 1090.9 | 0.0 | 916 |
| 1440 min Winter | 4.989 | 0.0 | 1134.7 | 0.0 | 1124 |
| 2160 min Winter | 3.489 | 0.0 | 1237.1 | 0.0 | 1544 |
| 2880 min Winter | 2.715 | 0.0 | 1283.1 | 0.0 | 1964 |
| 4320 min Winter | 1.930 | 0.0 | 1364.7 | 0.0 | 2724 |
| 5760 min Winter | 1.531 | 0.0 | 1452.3 | 0.0 | 3400 |
| 7200 min Winter | 1.296 | 0.0 | 1535.6 | 0.0 | 4040 |
| 8640 min Winter | 1.141 | 0.0 | 1620.5 | 0.0 | 4664 |

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Winter | 0.140 | 0.140 | 6.9 | 0.0 | 6.9 | 124.8 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 10080 min Winter | 1.032 | 0.0 | 1706.6 | 0.0 | 5256 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FEH | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 1.000 |
| FEH Rainfall Version | 2013 | Cv (Winter) | 1.000 |
| Site Location | GB 450501 306499 SK 50501 06499 | Shortest Storm (mins) | 15 |
| Data Type | Point | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 0.990

| **Time (mins) From:** | **To:** | **Area (ha)** | **Time (mins) From:** | **To:** | **Area (ha)** | **Time (mins) From:** | **To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.330 | 4 | 8 | 0.330 | 8 | 12 | 0.330 |

## Model Details

Storage is Online Cover Level (m) 1.500

## Tank or Pond Structure

Invert Level (m) 0.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 865.0 | 1.500 | 1497.0 |

## Hydro-Brake® Optimum Outflow Control

| | | | |
|---|---|---|---|
| Unit Reference | MD-SHE-0131-8300-1200-8300 | Sump Available | Yes |
| Design Head (m) | 1.200 | Diameter (mm) | 131 |
| Design Flow (l/s) | 8.3 | Invert Level (m) | 0.000 |
| Flush-Flo™ | Calculated | Minimum Outlet Pipe Diameter (mm) | 150 |
| Objective | Minimise upstream storage | Suggested Manhole Diameter (mm) | 1200 |
| Application | Surface | | |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.200 | 8.3 | Kick-Flo® | 0.764 | 6.7 |
| Flush-Flo™ | 0.353 | 8.3 | Mean Flow over Head Range | - | 7.2 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

## Hydro-Brake® Optimum Outflow Control

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 4.7 | 0.600 | 7.9 | 1.600 | 9.5 | 2.600 | 12.0 | 5.000 | 16.3 | 7.500 | 19.8 |
| 0.200 | 7.9 | 0.800 | 6.9 | 1.800 | 10.0 | 3.000 | 12.8 | 5.500 | 17.1 | 8.000 | 20.4 |
| 0.300 | 8.3 | 1.000 | 7.6 | 2.000 | 10.6 | 3.500 | 13.8 | 6.000 | 17.8 | 8.500 | 21.0 |
| 0.400 | 8.3 | 1.200 | 8.3 | 2.200 | 11.0 | 4.000 | 14.7 | 6.500 | 18.5 | 9.000 | 21.6 |
| 0.500 | 8.1 | 1.400 | 8.9 | 2.400 | 11.5 | 4.500 | 15.5 | 7.000 | 19.2 | 9.500 | 22.2 |

## Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Winter | 0.436 | 0.436 | 8.8 | 0.0 | 8.8 | 499.8 | O K |
| 30 min Winter | 0.559 | 0.559 | 8.8 | 0.0 | 8.8 | 655.1 | O K |
| 60 min Winter | 0.678 | 0.678 | 8.8 | 0.0 | 8.8 | 811.1 | O K |
| 120 min Winter | 0.811 | 0.811 | 8.8 | 0.0 | 8.8 | 992.8 | O K |
| 180 min Winter | 0.889 | 0.889 | 8.8 | 0.0 | 8.8 | 1103.9 | O K |
| 240 min Winter | 0.941 | 0.941 | 8.8 | 0.0 | 8.8 | 1177.8 | O K |
| 360 min Winter | 0.998 | 0.998 | 8.8 | 0.0 | 8.8 | 1262.6 | O K |
| 480 min Winter | 1.024 | 1.024 | 8.8 | 0.0 | 8.8 | 1301.5 | O K |
| 600 min Winter | 1.034 | 1.034 | 8.8 | 0.0 | 8.8 | 1316.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 15 min Winter | 138.460 | 0.0 | 473.2 | 0.0 | 26 |
| 30 min Winter | 91.070 | 0.0 | 613.3 | 0.0 | 41 |
| 60 min Winter | 56.875 | 0.0 | 817.8 | 0.0 | 70 |
| 120 min Winter | 35.332 | 0.0 | 1013.0 | 0.0 | 128 |
| 180 min Winter | 26.592 | 0.0 | 1137.5 | 0.0 | 186 |
| 240 min Winter | 21.604 | 0.0 | 1223.4 | 0.0 | 244 |
| 360 min Winter | 15.907 | 0.0 | 1321.7 | 0.0 | 360 |
| 480 min Winter | 12.670 | 0.0 | 1353.3 | 0.0 | 476 |
| 600 min Winter | 10.563 | 0.0 | 1348.1 | 0.0 | 592 |

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 720 min Winter | 1.035 | 1.035 | 8.8 | 0.0 | 8.8 | 1317.8 | O K |
| 960 min Winter | 1.021 | 1.021 | 8.8 | 0.0 | 8.8 | 1296.1 | O K |
| 1440 min Winter | 0.963 | 0.963 | 8.8 | 0.0 | 8.8 | 1211.1 | O K |
| 2160 min Winter | 0.873 | 0.873 | 8.8 | 0.0 | 8.8 | 1080.5 | O K |
| 2880 min Winter | 0.791 | 0.791 | 8.8 | 0.0 | 8.8 | 964.3 | O K |
| 4320 min Winter | 0.626 | 0.626 | 8.8 | 0.0 | 8.8 | 742.4 | O K |
| 5760 min Winter | 0.498 | 0.498 | 8.8 | 0.0 | 8.8 | 576.2 | O K |
| 7200 min Winter | 0.399 | 0.399 | 8.8 | 0.0 | 8.8 | 453.4 | O K |
| 8640 min Winter | 0.323 | 0.323 | 8.8 | 0.0 | 8.8 | 362.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 720 min Winter | 9.077 | 0.0 | 1336.1 | 0.0 | 706 |
| 960 min Winter | 7.106 | 0.0 | 1308.0 | 0.0 | 930 |
| 1440 min Winter | 4.989 | 0.0 | 1248.0 | 0.0 | 1354 |
| 2160 min Winter | 3.489 | 0.0 | 1831.4 | 0.0 | 1684 |
| 2880 min Winter | 2.715 | 0.0 | 1897.7 | 0.0 | 2144 |
| 4320 min Winter | 1.930 | 0.0 | 2015.7 | 0.0 | 2948 |
| 5760 min Winter | 1.531 | 0.0 | 2156.3 | 0.0 | 3744 |
| 7200 min Winter | 1.296 | 0.0 | 2280.1 | 0.0 | 4464 |
| 8640 min Winter | 1.141 | 0.0 | 2406.2 | 0.0 | 5112 |

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Overflow (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Winter | 0.268 | 0.268 | 8.7 | 0.0 | 8.7 | 297.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Overflow Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|---|
| 10080 min Winter | 1.032 | 0.0 | 2533.9 | 0.0 | 5848 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FEH | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 1.000 |
| FEH Rainfall Version | 2013 | Cv (Winter) | 1.000 |
| Site Location | GB 450501 306499 SK 50501 06499 | Shortest Storm (mins) | 15 |
| Data Type | Point | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 1.470

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.490 | 4 | 8 | 0.490 | 8 | 12 | 0.490 |

## Model Details

Storage is Online Cover Level (m) 1.500

## Tank or Pond Structure

Invert Level (m) 0.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 1058.0 | 1.500 | 1725.0 |

## Hydro-Brake® Optimum Outflow Control

| | | | |
|---|---|---|---|
| Unit Reference | MD-SHE-0134-8800-1200-8800 | Sump Available | Yes |
| Design Head (m) | 1.200 | Diameter (mm) | 134 |
| Design Flow (l/s) | 8.8 | Invert Level (m) | 0.000 |
| Flush-Flo™ | Calculated | Minimum Outlet Pipe Diameter (mm) | 150 |
| Objective | Minimise upstream storage | Suggested Manhole Diameter (mm) | 1200 |
| Application | Surface | | |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.200 | 8.8 | Kick-Flo® | 0.769 | 7.1 |
| Flush-Flo™ | 0.355 | 8.8 | Mean Flow over Head Range | - | 7.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

## Hydro-Brake® Optimum Outflow Control

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 4.8 | 0.600 | 8.4 | 1.600 | 10.1 | 2.600 | 12.7 | 5.000 | 17.3 | 7.500 | 21.0 |
| 0.200 | 8.3 | 0.800 | 7.3 | 1.800 | 10.6 | 3.000 | 13.6 | 5.500 | 18.1 | 8.000 | 21.7 |
| 0.300 | 8.7 | 1.000 | 8.1 | 2.000 | 11.2 | 3.500 | 14.6 | 6.000 | 18.9 | 8.500 | 22.3 |
| 0.400 | 8.8 | 1.200 | 8.8 | 2.200 | 11.7 | 4.000 | 15.6 | 6.500 | 19.6 | 9.000 | 22.9 |
| 0.500 | 8.6 | 1.400 | 9.5 | 2.400 | 12.2 | 4.500 | 16.5 | 7.000 | 20.3 | 9.500 | 23.6 |

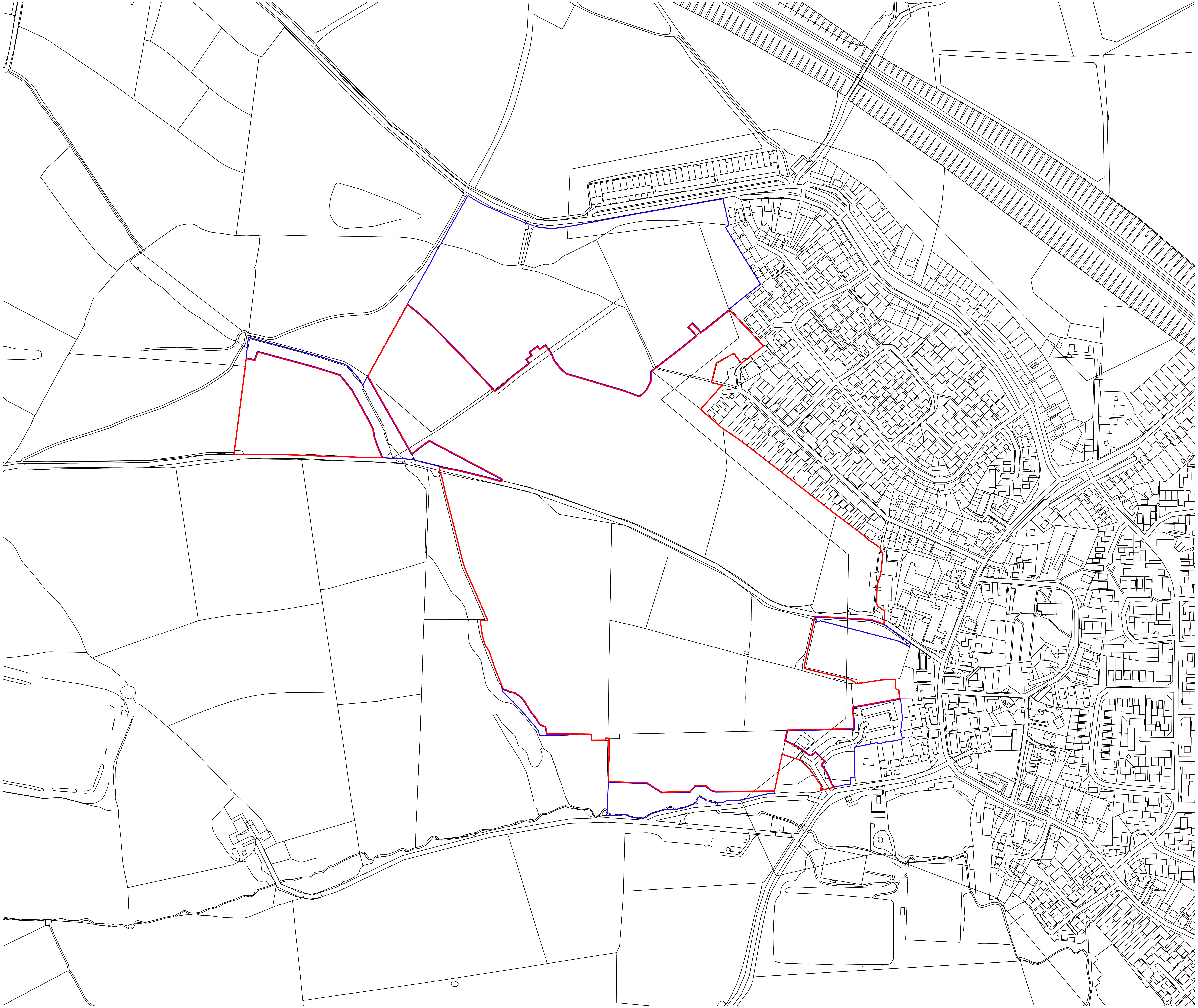
## Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

# Appendix H Simple Index Approach Summary

| SUMMARY TABLE | | DESIGN CONDITIONS | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| **Land Use Type** | Roads (excluding low traffic roads, highly frequented lorry approaches to industrial estates, trunk roads/motorways) | | | | |
| **Pollution Hazard Level** | Medium | | | | |
| **Pollution Hazard Indices** | | | | | |
| **TSS** | 0.7 | | | | |
| **Metals** | 0.6 | | | | |
| **Hydrocarbons** | 0.7 | | | | |
| **SuDS components proposed** | | | | | |
| **Component 1** | Pond or wetland | SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B | Ponds/wetlands should be preceded by an upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events | | |
| **Component 2** | Filter drain (where the trench is not designed as an infiltration component) | SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B | Filter drains should be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events | | |
| **Component 3** | None | | | | |
| **SuDS Pollution Mitigation Indices** | | | | | |
| **TSS** | 0.9 | | | | |
| **Metals** | 0.9 | | | | |
| **Hydrocarbons** | 0.7 | | | | |
| **Groundwater protection type** | None | | | | |
| **Groundwater protection Pollution Mitigation Indices** | | | | | |
| **TSS** | 0 | | | | |
| **Metals** | 0 | | | | |
| **Hydrocarbons** | 0 | | | | |
| **Combined Pollution Mitigation Indices** | | | | | |
| **TSS** | 0.9 | Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England | | | |
| **Metals** | 0.9 | | | | |
| **Hydrocarbons** | 0.7 | | | | |
| **Acceptability of Pollution Mitigation** | | | | | |
| **TSS** | Sufficient | | | | |
| **Metals** | Sufficient | | | | |
| **Hydrocarbons** | Sufficient | | | | |

# Appendix I Land Ownership Plan



NOTES

This drawing is the property of FPCR Environment and Design Ltd and is issued on the condition it is not reproduced, retained or disclosed to any unauthorised person, either wholly or in part without written consent of FPCR Environment and Design Ltd.

Ordnance Survey base mapping - supplied by client.

0 50 100 150 200m

N

## KEY

| | | |
|---|---|---|
| Site Boundary | | 32.7 ha |
| Land under applicants control | | |

**NOTES:**

- This drawing is based on OS mapping supplied by the client, land ownership boundaries downloaded from: https://use-land-property-data.service.gov.uk/datasets/inspire/download#download and the latest topographical data supplied by the client - 43724_T_REV4

- Blue line will vary as Phase 1 & 2 are constructed

| rev | date | description | drn | chk |
|---|---|---|---|---|
| P02 | 02/08/2024 | Amendments to boundaries | SJL | BC |


masterplanning
environmental assessment
landscape design
urban design
ecology
architecture
arboriculture

FPCR Environment and Design Ltd
Lockington Hall
Lockington
Derby
DE74 2RH

t: 01509 672772
e: mail@fpcr.co.uk
w: www.fpcr.co.uk


client
Lagan Homes Ltd

project
Land West of Ratby, Leicestershire

drawing title
Site Location Plan
(with wider land ownership boundary)

scale
1:2500 @ A1

drn SJL chk BC

date created
02 August 2024

project number
10783

status
S3

issue
P02

document number
10783-FPCR-XX-XX-DR-L-0015

File: L:\10700\10783\LANDS\Drawings\10783-FPCR-XX-XX-DR-L-0005-P11-Site Location Plan.vwx