



SURFACE WATER DRAINAGE STRATEGY REPORT

**PROPOSED RESIDENTIAL DEVELOPMENT
LAND OFF BEECH DRIVE, THORNTON**

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CONTENTS

1.0 INTRODUCTION	4
2.0 SOURCES OF INFORMATION	4
3.0 SITE DESCRIPTION	5
4.0 PROPOSED DEVELOPMENT.....	8
5.0 PLANNING CONTEXT.....	9
6.0 SURFACE WATER DRAINAGE STATEMENT	10
7.0 SUSTAINABLE DRAINAGE ASSESSMENT.....	13
8.0 MAINTENANCE AND ADOPTION	19
9.0 CONCLUSIONS AND RECOMMENDATIONS	22

DRAWINGS

PJS Consulting Engineers – Drainage Design Layouts	
PJS22-058-DR-506	Drainage General Arrangement
PJS22-058-DR-508	Pond General Arrangement
PJS22-058-DR-700	Long Sections
PJS22-058-DR-912	Control Chamber Details

APPENDICES

Appendix A	Site topographical survey
Appendix B	Severn Trent sewer asset record plans
Appendix C	Onsite infiltration testing results
Appendix D	Surface water runoff calculations
Appendix E	PJS Consulting Engineers – Micro Drainage SW Network Outputs

1.0 INTRODUCTION

- 1.1 Cora Homes have commissioned ADC Infrastructure Limited to produce a Surface Water Drainage Strategy report in support the discharge of planning conditions relating to surface water drainage attached to the appeal decision (ref APP/K2420/W/21/328060) for a residential development of 49 dwellings on land off Beech Drive in Thornton, Leicestershire.
- 1.2 This drainage strategy report confirms the key drainage principles for the consented site, and how surface water runoff will be managed over the lifetime of the proposed development. This report will specifically provide information for the discharge of conditions 5 to 7 on the decision notice, to satisfy the requirements of Leicestershire County Council (LCC) as the Lead Local Flood Authority (LLFA). The conditions relate to the management of surface water runoff during construction and occupation phases of the development, as well as the long-term maintenance of the proposed surface water drainage network.

2.0 SOURCES OF INFORMATION

- 2.1 The report has been based upon a variety of information sources as listed below:
 - CIRIA SuDS Manual C753 (2015)
 - LCC Planning response (ref 2020/0511/04/F/R1) (2021)
 - PRP Consulting Civil & Structural Engineers (2014) – Infiltration Test Results
 - PJS Consulting Engineers (2022) – Proposed drainage layout
 - PJS Consulting Engineers (2022) – Micro Drainage outputs
 - Severn Trent sewer asset record plans

3.0 SITE DESCRIPTION

- 3.1 The development site is located to the west of the village centre of Thornton, approximately 13km from the centre of Coalville. It covers an area of approximately 3ha and is currently undeveloped, greenfield land. The site is bound by existing residential development to the north and east, and agricultural land which slopes down to a minor watercourse to the south-west.
- 3.2 The location of the site is included Figure 1 below and is centred on grid reference 446414, 307737.



Figure 1: The site location with the red line boundary shown.

- 3.3 Site walkover photos are shown in the Flood Risk Assessment report (ref ADC1092-RP-E).

Topography

- 3.4 A topographical survey of the site was undertaken by NJC Surveys Ltd in May 2014, as part of a previous planning application for the site. A copy of the survey is provided within **Appendix B**.
- 3.5 The survey shows that the site has a relatively steep gradient and falls from the eastern site boundary adjacent to the existing residential properties on Main Street down towards the north-west site corner. There is a total level difference between the highest and lowest plan of the site of approximately 19m. The highest levels are located adjacent to the eastern boundary at 147.02m AOD, whilst the lowest portion of the site is in the north-west site corner near to the access track off Beech Drive at 127.73m AOD.
- 3.6 The publicly available LiDAR datasets for the site and the surrounding area were obtained and reviewed to gain a better appreciation of the general topography of the area. Contour lines were then extracted at 1m intervals from the LiDAR data.

- 3.7 An extracted digital elevation model taken from the available GOV LiDAR datasets can be found in Figure 2 below. The colour bands represent the variations in elevations in m AOD, with the lowest levels represented in green whilst the highest levels are represented in dark orange.

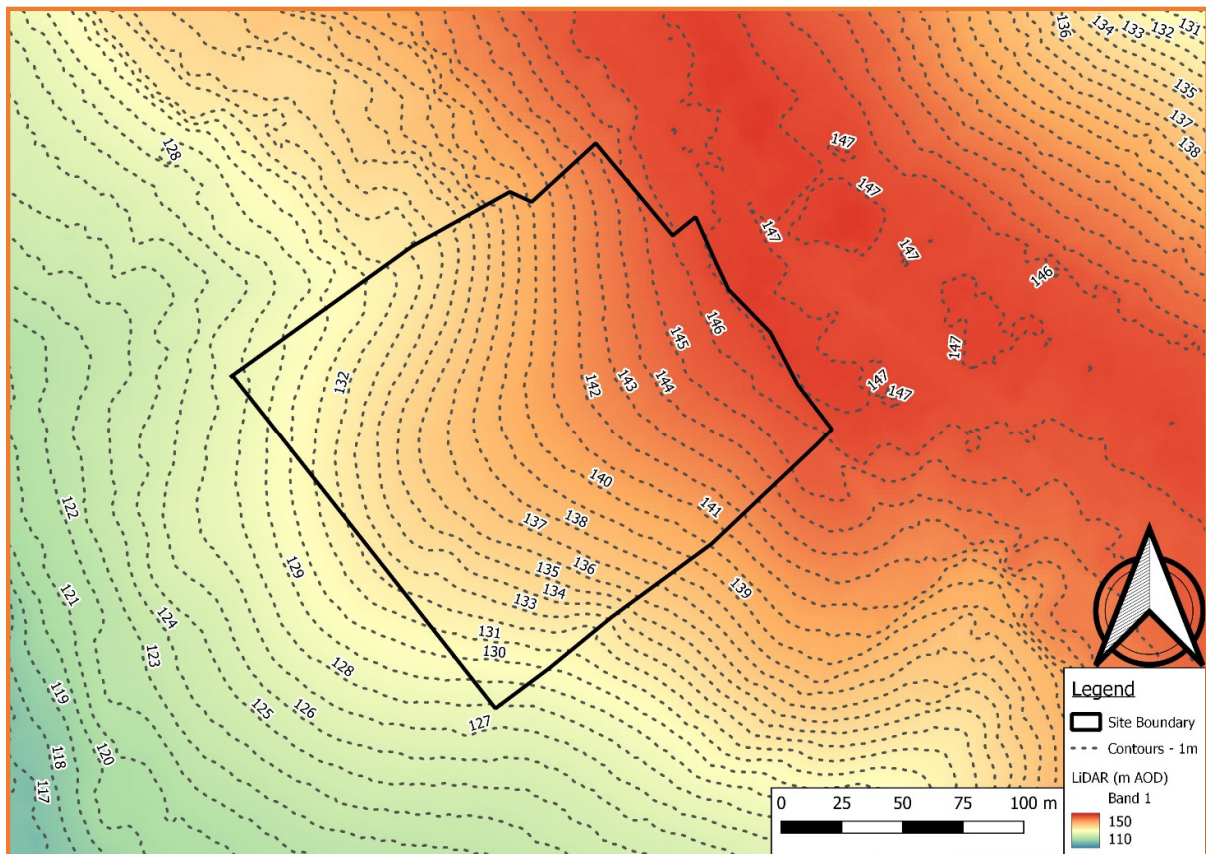


Figure 2: LiDAR map showing the elevation (m AOD) for the site and the surrounding area.

Existing drainage

- 3.8 The site is greenfield and is not currently served by a formal drainage network for surface water runoff. It is believed that runoff generated onsite drains via a combination of slow infiltration into the underlying soils and overland flow towards the minor watercourse to the south-west of the site.
- 3.9 The adopted sewer network for Thornton is currently maintained by Severn Trent Water. The sewer asset record plans have been obtained for the site and the surrounding area, a copy of the plans can be found in **Appendix C**.
- 3.10 The plans show that there are separate foul and surface water drainage networks within Beech Drive and Hawthorne Drive to the north-west of the site. The foul sewer outfalls into a 300mm gravity combined sewer to the south-west. The sewers in Beech Drive are shown as a private network on the sewer plan, but it was confirmed in the PRP Drainage Strategy report that these sewers were transferred into the ownership of Severn Trent following the change in legislation in 2011. It is assumed that the sewer asset plans have not been updated to show the adoptions transfer.

Geology

3.11 The British Geological Survey (BGS) online mapping was reviewed to give an indication of the underlying ground conditions on site. The online mapping showed that the bedrock geology and superficial deposits were as follows:

- **Bedrock Geology:**
 - *Gunthorpe Member – Mudstone. Sedimentary Bedrock formed approximately 237 to 247 million years ago in the Triassic Period. Local environment previously dominated by hot deserts.*
 - *Cotgrave Sandstone Member – Sandstone. Sedimentary Bedrock formed approximately 228 to 237 million years ago in the Triassic Period. Local environment previously dominated by rivers.*
- **Superficial Deposits:** *None recorded*

3.12 Initial infiltration testing was undertaken onsite in October 2014 by PRP, in which a single trial pit was excavated to a depth of 0.6m below existing ground level (bgl).

3.13 The test results calculated an overall infiltration rate of $1.73\text{m} \times 10^{-6}\text{m/s}$ for the underlying soils. This rate was deemed to be poor and was attributed to the underlying mudstone geology, which is usually characterised as not being conducive for infiltration drainage features. A copy of the infiltration testing results from the previous drainage strategy is included within **Appendix D**.

Soils

3.14 The Cranfield Soil and Agrifood Institute Soils mapping for the site was also reviewed. The mapping defined the underlying soil classification as:

- **Soilscape 8:** *Slightly acid, loamy, clayey soils with impeded drainage.*

Onsite drainage implications

3.15 Based on the available information, the underlying ground conditions appear to be impermeable in nature, and not viable for the use of infiltration drainage features. Therefore, an alternative option for the disposal of surface water, in line with the discharge hierarchy in the Building Regulations guidance, should be considered.

Flood warnings/flood alert

3.16 Publicly available mapping shows that the site does not fall within a Flood Warning Area, and so does not receive the Flood Warning Service from the Environment Agency.

4.0 PROPOSED DEVELOPMENT

- 4.1 The development proposals are for a residential development comprised of 49 dwellings. The main vehicular and pedestrian access will be off Beech Drive directly, with provision for accompanying car parking facilities that will serve each dwelling.
- 4.2 There are also areas of soft landscaping, with an area of shelter belt planting and an area near the north-west corner of the site that has been set aside for the provision of a surface water detention basin.
- 4.3 The masterplan for the site has been prepared by BHB Architects, a copy of which is included within Figure 3 below.



Figure 3: The proposed site masterplan.

5.0 PLANNING CONTEXT

Planning Decision Note (20/0511/FUL) – Conditions

- 5.1 Leicestershire County Council (LCC), as the LLFA provide guidance into the planning requirements in respect of the drainage strategy for the site. As part of the appeal decision notice for the planning submission (ref 20/00511/FUL), the following drainage related conditions are provided dated 12th May 2022.

Draft Condition 5 - Surface water drainage scheme

No part of the development hereby permitted shall be occupied until such time as a surface water drainage scheme has been submitted to and approved in writing by the Local Planning Authority. The scheme shall include measures to ensure surface water shall not drain into the Public Highway. Development shall be carried out in accordance with the approved details.

Draft Condition 6 – SUDs during construction

No development shall take place until such time as details in relation to the management of surface water on site during construction of the development has been submitted to and approved in writing by the Local Planning Authority. Development shall be carried out in accordance with the approved details.

Draft Condition 7 – Long term maintenance of SUDs

No occupation of the development hereby permitted shall be occupied until details in relation to the long-term maintenance of the surface water drainage system within the development have been submitted to and approved in writing by the Local Planning Authority. Maintenance shall thereafter be carried out as approved.

- 5.2 Details of the surface water drainage strategy for the site during the construction and operation phases of the development, as well as the maintenance regime for the surface water drainage network is provided in Sections 6 to 8 of this report.

6.0 SURFACE WATER DRAINAGE STATEMENT

Existing discharge rate

- 6.1 The existing site is greenfield and is considered to be entirely permeable in nature, for the purposes of this report it has been assumed that the site drains naturally via soakage into the underlying soil or overland flow in a south westerly direction.
- 6.2 The rate of greenfield runoff for the developable area of the site (2.15ha) was calculated using the ICP SuDS implementation of the IH124 method. A full print out of the results is included within **Appendix E**, and the results have been summarised in the table below. The figures give a realistic estimate of the likely discharge associated with the development.

Return Period	Site Area (ha)	Runoff Rate (l/s)
QBar	2.15	9.5
1 in 1 Year	2.15	7.9
1 in 30 Year	2.15	18.5
1 in 100 Year	2.15	24.3

Discharge options

- 6.3 In accordance with the Building Regulations Part H, the newly published Non-Statutory Technical Standards for SuDS and prevailing best practice, surface water should look to be discharged according to the following preferential hierarchy:
- Infiltration drainage techniques, such as swales and soakaways
 - An open watercourse, river, or ditch
 - A surface water sewer
 - A combined sewer
- 6.4 The British Geological Survey (BGS) mapping, Soilsclapes mapping and the initial onsite infiltration testing were all reviewed to give an indication of the underlying ground conditions. These suggest that the site is underlain by impermeable soils and mudstone bedrock, which may limit the viability of the use of infiltration onsite. A recorded infiltration test result of $1.73\text{m} \times 10^{-6}\text{m/s}$ is not deemed sufficient for infiltration drainage.
- 6.5 As infiltration drainage techniques appear unfeasible; the drainage strategy proposed that an outfall for surface water runoff should be into the nearest watercourse or ditch at the existing greenfield (QBar) rate of 9.5l/s.
- 6.6 Observations made on the site walkovers verified the presence of an ordinary watercourse along the north-west site boundary that can accommodate the surface water outfall from the development. Initial consultation with the LLFA also confirmed that the drainage ditch offers the most suitable outfall for runoff, as well as confirming the need to limit flows to existing greenfield rates.

Onsite surface water strategy

- 6.7 The proposed strategy involves the use of a below ground surface water drainage network that will collect runoff from impermeable surfaces (roofs and highways) and drain towards a detention basin feature located in the north-west site corner to suit the existing topography.
- 6.8 The basin was initially sized using the Micro Drainage Source Control module to a design standard of a 1 in 100 year (1% AEP) plus 40% climate change storm event, in line with LLFA guidance. To provide the necessary attenuation volume, a basin with a depth of 1.2m and an approximate surface area of 890m² was required. This also included the necessary allowances for urban creep and freeboard.
- 6.9 Detailed drainage and highways design for the site was undertaken by PJS Consulting Engineers in December 2022. This built upon the initial design outlined in the FRA and Drainage Strategy, and provide further detail on the network layout, levels, the basin size as well as proposed outfall into the ordinary watercourse.
- 6.10 The Drainage General Arrangement Plan (drawing ref DR-506-B) shows that the development is to be served by branched drainage network within the internal access road that will collect and convey runoff towards the basin in the north-west corner. Long section details of the proposed surface water drainage network are provided separately in the Long Section Plan (drawing ref DR-700-B).
- 6.11 The basin size and levels have been refined and has resulted in a smaller storage volume required for the development in comparison with the initial design in Micro Drainage Source Control. A bypass with a penstock is also proposed to help manage runoff through the drainage system in the event of a blockage to the hydrobrake. Further detail of the basin, which includes cross-sectional areas of the basin is included separately in the Pond General Arrangement Plan (drawing DR-508-A).
- 6.12 A flow control device with a design head of 1.2m, and an orifice size of 139mm, will be located at the downstream end of the basin, and will limit runoff to a rate of 9.5l/s. The technical specification of the flow control chamber has designed to the Hydro-Brake Optimum product. Details of the flow control chamber construction details are provided on the Construction Details Plan (drawing ref DR-912B).
- 6.13 Copies of all the detailed drainage layouts and technical drawings prepared by PJS Consulting Engineers are appended to this report.
- 6.14 PJS Consulting Engineers also prepared a detailed Micro Drainage network for the development to assess the performance of the proposed network, and to inform the drainage design. In accordance with the guidance from LCC, the model was simulated for the 1 in 1 year, 1 in 30 year, 1 in 100 year and 1 in 100 year with a 40% allowance for climate changes. The outputs for the surface water network can be found in **Appendix G**.

Earthworks and Construction Phase Drainage Strategy

- 6.15 During the site earthworks and construction phases, it is proposed that drainage strategy adopts the same discharge strategy and location as the permanent works which have been approved in principle by the LLFA.

- 6.16 The earthworks operations will comprise the stripping and storage of topsoil, cut and fill earthworks to achieve the proposed development levels, and the construction of drainage works to serve the earthworks operations.
- 6.17 The areas that have received topsoil strip will exhibit an increased runoff rate over the existing agricultural land use scenario. Therefore, the attenuation of runoff, the restriction of discharge rates into the drainage ditch on the north-west site boundary, and control of runoff quality will be required to ensure that surface water discharges replicate the existing site conditions.
- 6.18 The drainage works will include the following activities and will be undertaken at the start of the onsite works:
- Construction of detention basin to provide attenuation of runoff,
 - Construction of restricted outfall from detention basin to existing drainage ditch,
 - Construction of drainage cut-off ditches on the downslope edge of any topsoil stripped areas to intercept runoff from stored material and bare earthworks surfaces.
- 6.19 The estimated runoff rate from the earthworks phase has been calculated based on the area $\times$ a runoff coefficient of 0.5 used for earthworks surfaces. The Micro Drainage Source Control Module was used to calculate the required attenuation volume for up to the 1 in 100-year storm. It is anticipated that the earthworks construction activities will have an approximate return period of 1-2 years, therefore the use of the 1 in 100-year event is a conservative estimate of the required attenuation volume during the construction phase.

Earthworks Phase	Earthworks Area (ha)	Effective Area (Earthworks area $\times$ runoff coefficient) (ha)	Restricted Discharge Rate (l/s)	Attenuation Volume (m ³)
1	2.15	1.08	9.5	720

- 6.20 It is proposed that the detention basin for the permanent development and will be constructed during the initial earthworks phase. Drainage cut-off ditches will be constructed at the down slope edge of earthworks surfaces and will direct runoff to the detention basin.
- 6.21 A comparison between the required storage volume for the earthworks runoff and the proposed detention basin volume shows that there is sufficient capacity to store runoff during the earthworks phase and discharge at the existing greenfield runoff rate.
- 6.22 The following measures should also be implemented to ensure that surface water runoff replicates existing site conditions:
- Soil should not be stripped up to the edge of any watercourse, stream, or drainage ditch to prevent loose soil and silt being washed into the watercourse. This will prevent silt-up and pollution of downstream watercourses.
 - Vegetation and topsoil should be stripped in sequence, only clearing the areas that are to be worked in the short term. This will minimise the amount of exposed ground and stockpiles of soil on the site. This in turn will reduce the quantity of silty water to deal with.

7.0 SUSTAINABLE DRAINAGE ASSESSMENT

- 7.1 Sustainable Drainage Systems (SuDS) remove, store, re-use, and intercept surface water by mimicking the natural water cycle. In turn this not only alleviates flood risk but also promotes benefits for water quality, amenity, recreation, health, and the local ecology¹.
- 7.2 A variety of SuDS options are available to reduce or temporarily hold back the discharge of surface water runoff. The proposed development will see an increase in flows and therefore will require a drainage strategy which incorporates SuDS to ensure that flows are balanced, and that flood risk is not increased elsewhere.
- 7.3 The table below outlines the applicability of the use of a range of SuDS devices in relation to the proposals detailed in this report, this is in accordance with the hierarchical approach outlined in The SuDS Manual (CIRIA C753).

¹ CIRIA (2015). The SuDS Manual C753. Part B. Chapter 1.

SuDS type	Device	Description	Reason for use	Applicability (x / ✓)
Source control	Living roofs	Provide soft landscaping at roof level, intercepting and reducing surface water runoff.	The structural design of the proposed buildings is not conducive for the use of living roofs.	x
	Infiltration devices	Store runoff and allow water to percolate into the ground via natural infiltration.	A desktop review of ground conditions, and previous onsite infiltration testing demonstrate that the site is not suitable for the use of infiltration features.	x
	Pervious surfaces	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers.	The development proposals include designated parking spaces for individual dwellings. On this scale, the attenuation volume provided would be minimal.	x
	Rainwater harvesting	Reduces the annual average rate of runoff from the site by reusing water for non-potable uses e.g., toilet flushing.	There is some potential for small rainwater harvesting features such as water butts for individual dwellings.	✓
	Street trees	Storm water is conveyed to trees located adjacent to the internal roads, the tree pits attenuate and treat runoff	The layout and gradient do not allow for the provision of street trees.	x

SuDS type	Device	Description	Reason for use	Applicability (x / ✓)
Permeable conveyance	Swales	Broad shallow channels that convey /store runoff and allow infiltration when ground conditions are permitting.	Due to the relatively steep topography of the site, swales are deemed not to be suitable for use within the site's drainage design.	x
	Bioretention area/ rain garden	Shallow landscaped depression which are under drained and rely on engineered soils and enhanced vegetation and filtration to remove pollution and reduce runoff downstream.	The layout and gradient do not allow for the provision of bioretention areas.	x
	Filter strips	Wide gently sloping areas of grass or dense vegetation that remove pollutants from run-off from adjacent areas.	The underlying ground conditions and steep onsite gradient mean that filter strips are not deemed to be suitable.	x

SuDS type	Device	Description	Reason for use	Applicability (x / ✓)
	Filter drains and perforated pipes	Trenches filled with granular materials (which are designed to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	A desktop review of the underlying ground conditions demonstrates that the site is not conducive for the use of filter drains and perforated pipes. This is subject to further testing.	x
End of pipe treatment	Infiltration basins	Depressions in the surface designed to store runoff and allow infiltration.	A desktop review of the underlying ground conditions demonstrates that the site is not suitable for the use of infiltration basins.	x
	Wet ponds/ Detention basin	Provide water quality treatment & temporary storage above the permanent water level.	The site layout and volume of surface water storage required means that the use of a detention basin would be a suitable option to provide the required surface water attenuation volume.	✓
	Attenuation tanks	Oversized pipes or geo-cellular tanks designed to store water below ground level.	An attenuation tank would be compatible and could provide the necessary surface water storage required onsite. However, following the hierarchical approach, preference should be given towards utilising SuDS within the surface water drainage strategy.	x

7.4 Given the table above the proposed drainage combination will incorporate the following components:

- Rainwater harvesting (e.g., small water butts)
- A detention basin

7.5 The site's proposed drainage combination has been selected due to spatial and topographical aspects of the site and its proposed layout, and the need to attenuate and convey onsite surface water runoff.

7.6 Any such development can give rise to pollution during both the construction and occupation phases in relation to hydrocarbons, suspended solids, and general waste. Careful consideration of the treatment of surface water runoff should provide confidence that the proposed development will not result in any detriment to the receiving waters.

7.7 The proposed impermeable areas on the site are currently divided into private driveways, roads, shared car parks and buildings. In accordance with the CIRIA SuDS Manual C753 (2015), the attributed pollution 'hazard' levels associated with these classifications of hardstanding surface are all classed as 'low risk'.

Land Use	Pollution Hazard Level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Private driveways, residential car parks and low traffic roads.	Low	0.5	0.4	0.4
source: CIRIA SuDS Manual (C753) (2015) Part E. Chapter 26, Table 26.3, pg. 568				

7.8 As the pollution hazard risk from the development is deemed to be low, then the simple index approach (SIA) is applicable. SIA uses a source to receptor pathway approach which considers three pollutants: total suspended solids (TSS), heavy metals and hydrocarbons. For the selected SuDS components, total pollution indices based on the reduction in pollution, are assigned.

7.9 The selected SuDS components and the associated total pollution mitigation indexes are outlined in the table below (CIRIA SuDS Manual Table 26.3 extract). The proposed SuDS treatment train has been designed to exceed the pollution values/risk occurring from proposed land uses highlighted in the table above.

Type of SuDS component	TSS	Metals	Hydrocarbons
Detention basin	0.5	0.5	0.6
source: CIRIA SuDS Manual (C753) (2015) Part E. Chapter 26, Table 26.3, pg. 569			

7.10 Based on the pollution mitigation indices highlighted in the table above, it is anticipated that the proposed SuDS treatment train will provide more than enough mitigation for the anticipated pollutants that will be generated by the development.

Biodiversity

- 7.11 Detention basins can both provide habitats for a range of species, this can heavily assist in boosting the ecological value of a site and offer much more support for the ecosystem in comparison to alternative grey solutions.
- 7.12 The following extract regards the biodiversity and alternative benefits that can be gained from detention basins and has been obtained from the CIRIA SuDS Manual (C753);

“They can support emergent and submerged aquatic vegetation along their shoreline and in shallow, marshy zones, which helps enhance treatment processes and has amenity and biodiversity benefits. Dense stands of vegetation facilitate the adhesion of contaminant to vegetation, aerobic decomposition of pollutants and can also help stabilise settled sediment and prevent resuspension”

Alternative benefits

- 7.13 In addition to water quality and biodiversity benefits mentioned above the proposed SuDS combination can offer a range of benefits, these include aesthetic enhancements,
- 7.14 The design of the SuDS incorporated within the drainage design will develop as the planning proposals progress, to boost the multifunctionality of the proposed components it is advised that the proposed SuDS are constructed in accordance with the CIRIA SuDS Manual (C753).

8.0 MAINTENANCE AND ADOPTION

- 8.1 The proposed drainage network will require consistent maintenance to ensure that the efficiency of the systems is sustained over the lifetime of the development.
- 8.2 The proposed surface water drainage network will be entirely contained within the site and will be constructed to adoptable standards. Following the submission of a Section 104 agreement, the maintenance of the proposed drainage network will be the responsibility of Severn Trent.
- 8.3 Prior to adoption, the basin and associated pipework will be the responsibility of the developer to maintain.
- 8.4 The onsite drainage system including the detention basin and associated inlets/outlets, headwalls and pipework will be subject to routine monitoring and maintenance, a record of this should be upheld.
- 8.5 The sections below express the minimum standards for the onsite maintenance regime and have been prepared from recommendations contained within the CIRIA SuDS Manual (C753).

Storage and attenuation

- 8.6 Surface water runoff from the site is to be primarily attenuated by a detention basin located in the north-west corner to suit the onsite topography and development proposals. The proposed maintenance regime for the detention basin is detailed in the table below.

Operation and maintenance requirements for detention basins		
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 as 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 outlet pool –where provided	Annually (as set out in CIRIA SuDs guidance)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim ant 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 action	Repair erosion or other damage by reseedling or re-turfing	As required
	Realignment of riprap	As required
	Repair/ rehabilitation of inlets, outlets, and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required
source: CIRIA SuDs Manual (C753) (2015) Part D. Chapter 22, pg. 483		

Conveyance, pipework, and flow control

- 8.7 Surface water runoff generated by the from impermeable surfaces onsite is to be collected and conveyed via a below ground gravity surface water network.

- 8.8 A flow control device located downstream of the proposed detention basin is to be designed to restrict flows to the existing greenfield runoff rate prior to being discharged offsite.
- 8.9 The associated maintenance regime required to sustain the aforementioned drainage features are expressed within the table below.

Drainage Component	Maintenance Task	Frequency
Drainage Network	Inspect for blockages to ensure network is free running	Every 3 months and after any significant storm event
Surface water gullies/ Linear drainage features	Inspect for blockages and ensure that the drainage feature is free running Jet or vacuum as appropriate	Every 3 months and after any significant storm event
Catchpits	Inspect for and remove silt	Every 6 months and after any significant storm event
Discharge Control	Inspect for blockage and correct operation	Every 3 months and after any significant storm event
source: CIRIA SuDs Manual (C753) (2015) Part D. Chapter 28		

Connections

- 8.10 Surface water is to discharge into an existing drainage ditch on the north-west site boundary via an outfall pipe. The proposed maintenance regime for these components is expressed in the table below.

Drainage Component	Maintenance Task	Frequency
Outfall pipe	Regular maintenance and monitoring to ensure sufficient operation.	Annually or as required
Drainage ditch	Monitoring of watercourse levels	Frequently post development then as required/after any storm event
source: CIRIA SuDs Manual (C753) (2015) Part D. Chapter 28		

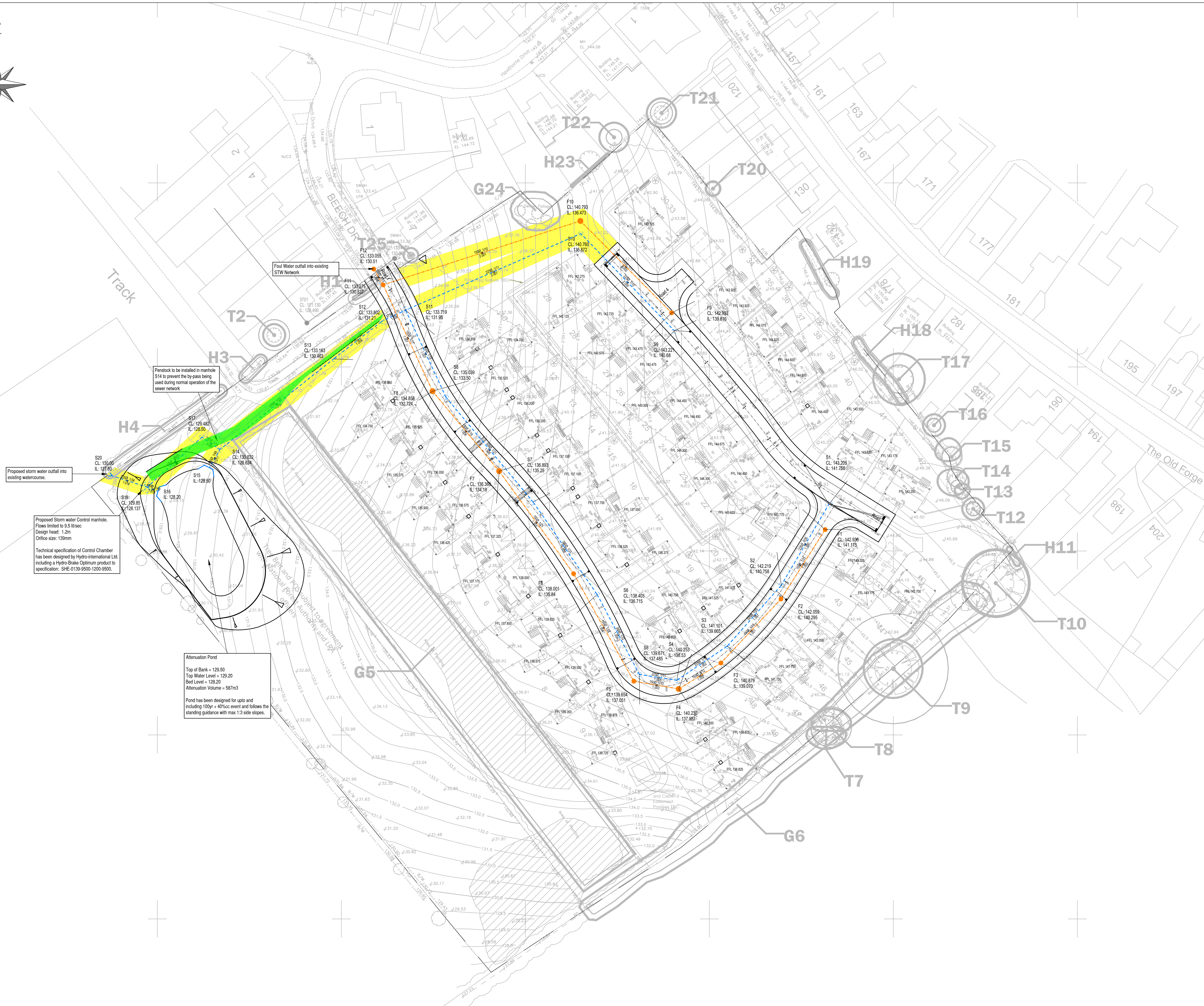
Design life

- 8.11 The design life of the development may exceed the design life of certain components of the surface water network, this however is based upon numerous unpredictable variables.
- 8.12 During the maintenance regime it should be assessed whether any repairs are required and whether drainage components have reached the end of their functional lifetime. The proposed drainage network is to be built to adoptable standards and it is anticipated that the network will be adopted by Severn Trent Water, thus the responsibility to replace or repair any unfunctional components of the drainage network will lie with them. Should any components fail prior to adoption the responsibility would lie with the developer.

9.0 CONCLUSIONS AND RECOMMENDATIONS

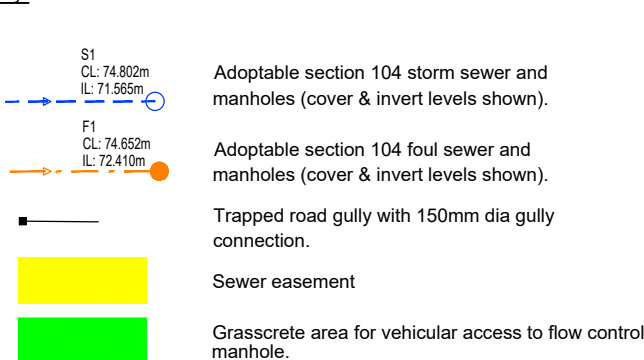
- 9.1 Cora Homes have commissioned ADC Infrastructure to produce a Surface Water Drainage Strategy report to support the discharge of planning conditions relating to surface water drainage attached to the original planning submission (reference 20/00511/FUL) for residential development on land off Beech Drive, Thornton, Leicestershire.
- 9.2 The surface water drainage strategy has been refined and further information provided as part of the detailed drainage design undertaken by PJS Consulting Engineers. The strategy looks to adhere to principles proposed in the original FRA and Drainage Strategy report, whilst ensuring it is compliant to the relevant guidance and manages surface water runoff during the construction and operation phases of the development.
- 9.3 A series of drawings have been prepared by PJS Consulting Engineers to provide additional detail for the discharge of planning condition 5. A more detailed examination of the potential SuDS features that could be incorporated within the development design is provided in Section 7. This seeks to identify further features that could be implemented to provide surface water treatment, biodiversity enhancement and amenity benefits for the site.
- 9.4 Planning condition 6 relates to the management of surface water runoff during the construction phases, details of temporary drainage strategy are discussed in further detail in Section 6.
- 9.5 Planning condition 7 regards the long-term maintenance of the surface water drainage network for the lifetime of the development. A discussion of the required maintenance and adoption of the various elements of the proposed surface water drainage network is provided in Section 8.

DRAWINGS
PJS CONSULTING ENGINEERS
DRAINAGE DRAWINGS



1. Do not scale this drawing. If in doubt, ask.
2. This drawing is to be read in conjunction with all other relevant Engineers, Architects and specialist design drawings and details.
3. All dimensions are in metres unless noted otherwise. All levels are in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the Engineer immediately.
5. The Contractor shall establish exact levels of the existing foul and surface water sewers, and/or proposed level at discharge point, prior to the commencement of any drainage works.
6. The Contractor must ensure that the gradients indicated on the longitudinal sections are checked between the levels shown, prior to laying. On no times must the contractor proceed with pipe laying by dialling the gradient shown into a laser without checking.
7. Any discrepancy in this respect must be reported to the engineer prior to pipe laying.
8. The Contractor shall check his pipe gradients by means of profiles and accept to verify the laser gradients.
9. In the event of the above procedures not being followed, the client will accept no responsibility whatsoever for any consequential loss or damage.
10. The Contractor is responsible for ensuring that all works are to the satisfaction of the Engineer and shall be deemed to have included within his rates for any necessary testing.
11. Pipes of different diameters entering manholes should be installed with soffits at the same level.
12. Sewers shall be constructed to the satisfaction of Severn Trent Water and in accordance with the Design and Construction Guidance (DCG)
13. A protective plastic membrane is to be applied to all foul sewers that are laid above surface water sewers.
14. Where pipe crossing, plastic membrane to be used for protection to eliminate any chances of cross contamination.
15. No backdrops to be used. Steeper gradients are preferred to the use of backdrops.
16. Precast concrete manhole rings must not be cut under any circumstances. Other options, manhole built up with concrete or brickwork to the top of pipe.
17. Protective concrete cover slabs to be used on pipes in non traffic areas which doesn't achieve 0.9m cover level and 1.2m cover in trafficked areas.
18. All cover and frames to be kitemarked.
19. The outside of the sewer should be in vehicle carriageway and not footpath, and be at least 1m from the kerb line. The outside of manholes should be at least 0.5m from the kerb line.
20. All proposed trees will be as per BS 51 of DCG.
21. All proposed manhole covers and frames at a minimum of 675mm x 675mm to maintain clear opening and to comply with Severn Trent Water current Health and Safety standards. Refer to Manhole Construction and Installation Section and Drainage Construction Details for specific opening dimensions for each manhole.
22. Only suitable materials to be used.
23. All lateral pipe sizes and gradients to be constructed as specified on the external works drawings. If the external works drawings are unavailable please consult the Engineer prior to construction.
24. Infill covers and frames in back paved areas are not to be used.
25. The materials to be used are suitable for the ground conditions.
26. In situations where traffic loadings is anticipated to be heavier than would typically occur on a residential estate distributor road (ie braked or emptying a tractor near a junction) a higher specification cover (E800) should be used.
27. Temporary screen/girls to be installed during construction to ensure debris doesn't enter the existing network
28. Relevant S106 applications will be applied for and approved before any construction is made to the existing network

ey:



ANY WORKS CARRIED OUT ON SITE PRIOR TO RECEIVING TECHNICAL APPROVALS WILL BE UNDERTAKEN AT THE DEVELOPERS RISK

B	16.12.22	Updated to suit client comments.	LD	TN
A	06.12.22	Updated to suit client comments.	LD	TN
Rev	Date	Amendments	By	Chk



PJS Consulting Engineers Limited, Geneva II, Lakeview,
Sherwood Business Park, Nottingham, NG15 0ED.
Registered number: 10815993 Tel: 0115 704 3989 Email: Enquiries@pjs-ce.co.uk

Client

Cora

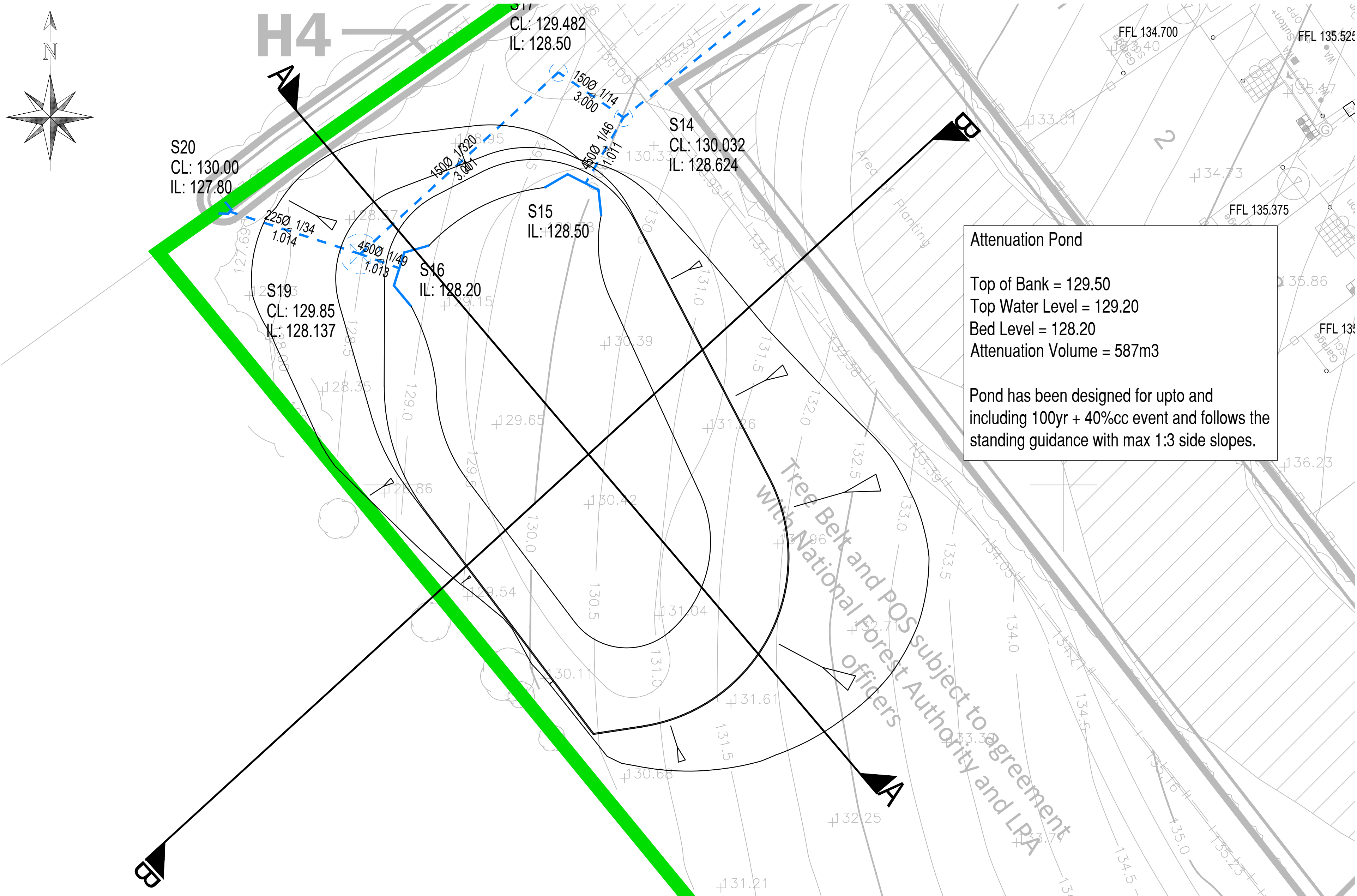
Project _____

Thornton

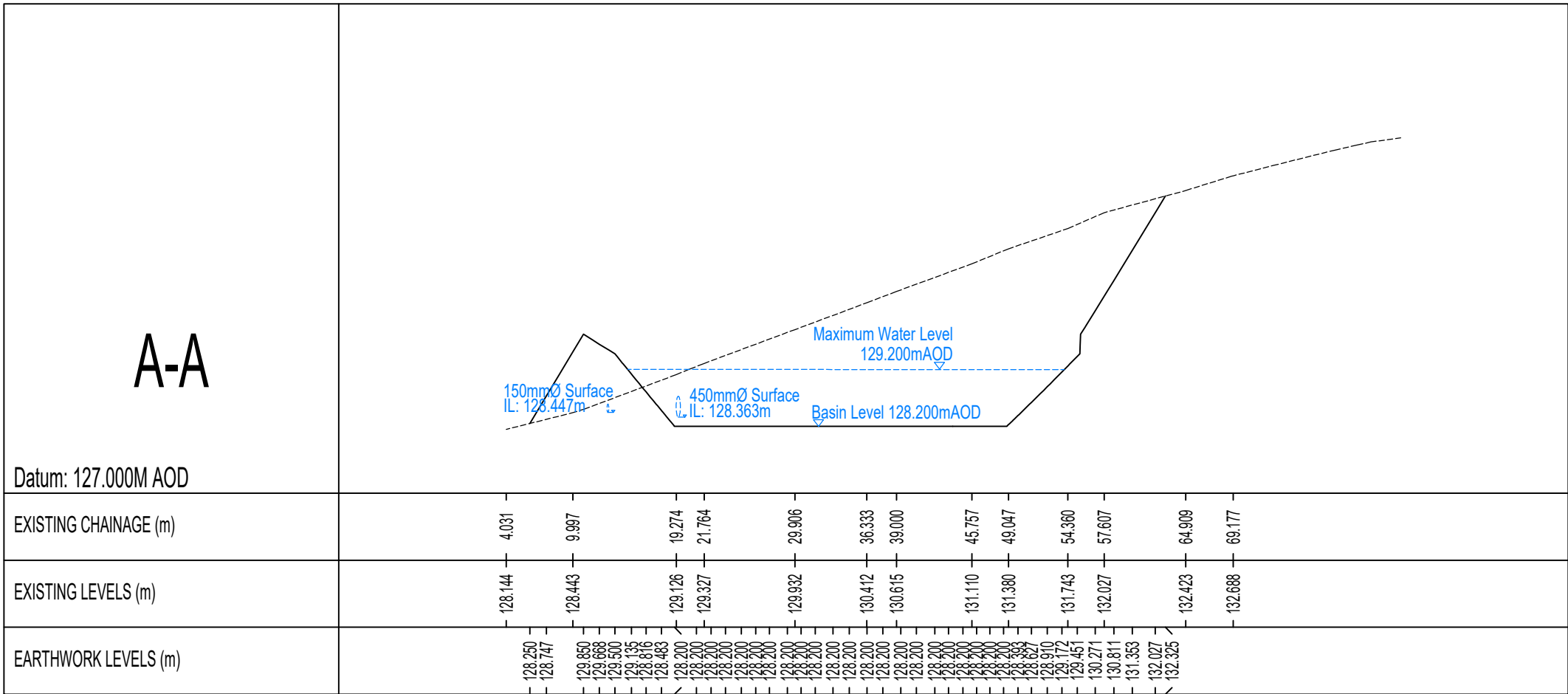
Drawing Title

Drainage General Arrangement

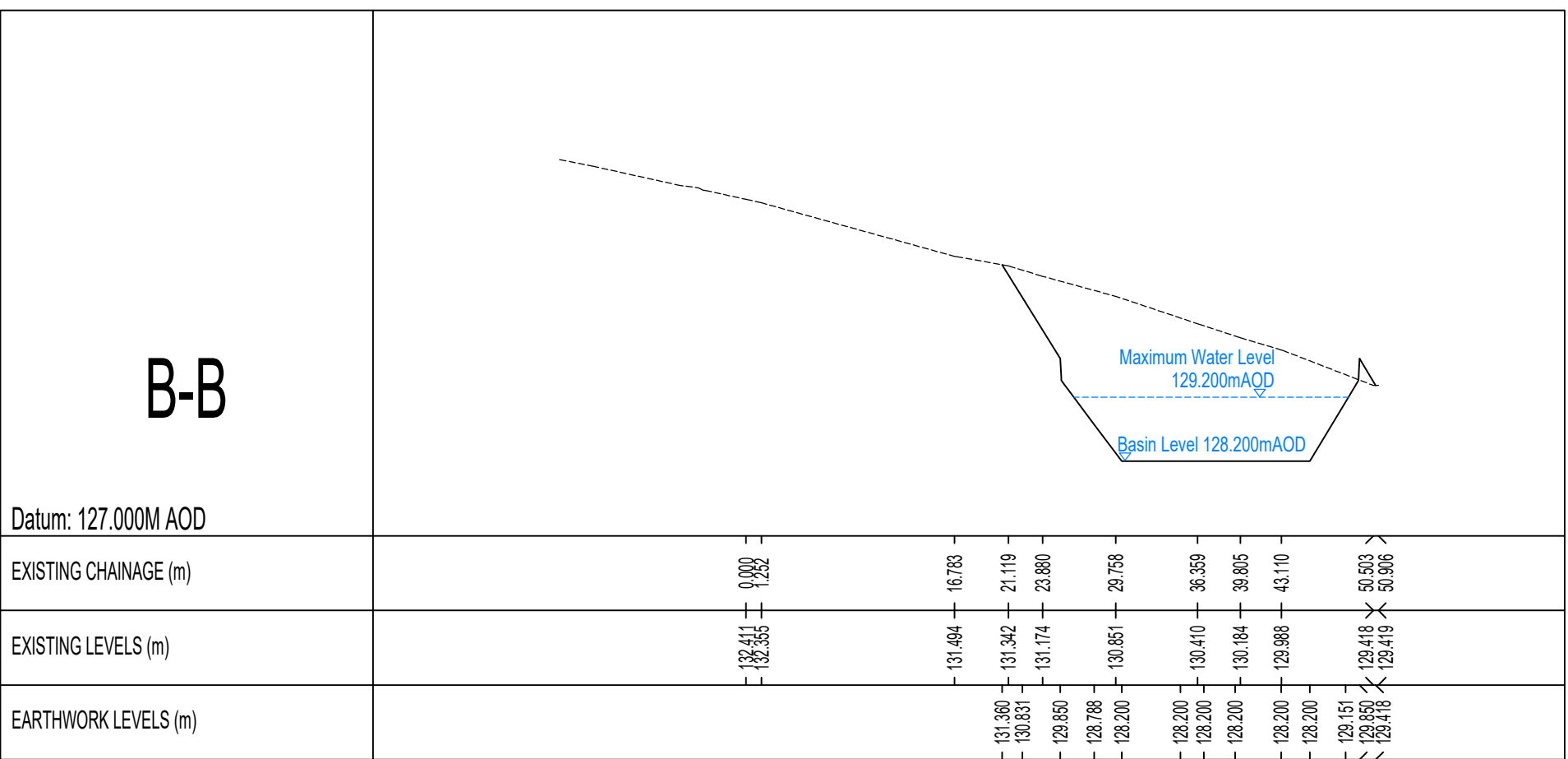
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Initial	DC	TN		
Date	21/10/22	21/10/22		
			Tender	1:500
Project Number			Drawing Number	Revision
PJS22-058			DR-506	B



Plan
1:200



Long Sections
1:500 Horizontal
1:250 Vertical



General Notes

- Do not scale this drawing. If in doubt, ask.
- This drawing is to be read in conjunction with all other relevant Engineers, Architects and specialist design drawings and details.
- All dimensions are in metres unless noted otherwise. All levels are in metres unless noted otherwise.
- Any discrepancies noted on site are to be reported to the Engineer immediately.
- The Contractor shall establish exact levels of the existing foul and surface water sewers, and/or proposed level at discharge point, prior to the commencement of any drainage works.
- The Contractor must ensure that the gradients indicated on the longitudinal sections are checked between the levels shown, prior to laying pipes. At no times must the contractor proceed with pipe laying by dialling the gradient shown into a laser without checking. Any discrepancy in this respect must be reported to the engineer prior to pipe laying.
- The Contractor shall check his pipe gradients by means of profiles and traveller to verify the laser gradients.
- In the event of the above procedures not being followed, the client will accept no responsibility whatsoever for any consequential loss or damage.
- The Contractor is responsible for ensuring that all works are to the satisfaction of the Engineer and shall be deemed to have included within his rates for any necessary testing.
- Pipes of different diameters entering manholes should be installed with soffits at the same level.
- Sewers shall be constructed to the satisfaction of Anglian Water and in accordance with the Design and Construction Guidance (DCG).
- A protective plastic membrane is to be applied to all foul sewers that are laid above surface water sewers.
- Catch pits shall not be adopted.
- Easements at any change in width, these should be 2.5m to each side the centreline of pipe for pipe sizes upto 300mm dia. And 5m each side of the centre of pipe for 300mm dia or greater.
- Where pipe crossing, plastic membrane to be used for protection to eliminate any chances of cross contamination.
- No backdrops to be used. Steeper gradients are preferred to the use of backdrops.
- Precast concrete manhole rings will not be cut under any circumstances. Other options, manhole built up with concrete or brickwork to the top of pipe.
- Protective concrete cover slabs to be used on pipes in non traffic area which doesn't achieve 0.9m cover level and 1.2m cover in trafficked areas.
- All cover and frames to be kitemarked.
- Type E manhole, the opening cover and frame should be located centrally over the pipe - please refer to DCG figures B23-B25.
- The outside of the sewer should be in vehicle carriageway and not footpath, and be at least 1m from the kerb line. The outside of manholes should be at least 0.5m from the kerb line.
- All proposed trees will be as per B5.1 of DCG.
- All proposed manhole covers and frames at a minimum of 675mm x 675mm to maintain clear opening and to comply with Anglian Water Ltd current Health and Safety standards.
- Only suitable materials to be used.
- All lateral pipe sizes and gradients to be constructed as specified on the external works drawings. If the external works drawings are unavailable please consult the Engineer prior to construction.
- Infill covers and frames in block paved areas are not to be used.
- The materials to be used are suitable for the ground conditions.
- In situations where traffic loadings is anticipated to be heavier than would typically occur on a residential estate distributor road (ie braking or turning near a junction) a higher specification cover (E600) should be used.

Key:

- S1 CL: 14.825m L: 71.56m Adoptable section 104 storm sewer and manholes (cover & invert levels shown).
- F1 CL: 14.625m L: 74.02m Adoptable section 104 foul sewer and manholes (cover & invert levels shown).
- Trapped road gully with 150mm dia gully connection.
- Sewer easement 3m either side centreline of pipe

ANY WORKS CARRIED OUT ON SITE PRIOR TO RECEIVING TECHNICAL APPROVALS WILL BE UNDERTAKEN AT THE DEVELOPERS RISK

A	06.12.22	Updated to suit client comments.			LD TN
Rev	Date	Amendments			By Chk



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Client

Cora

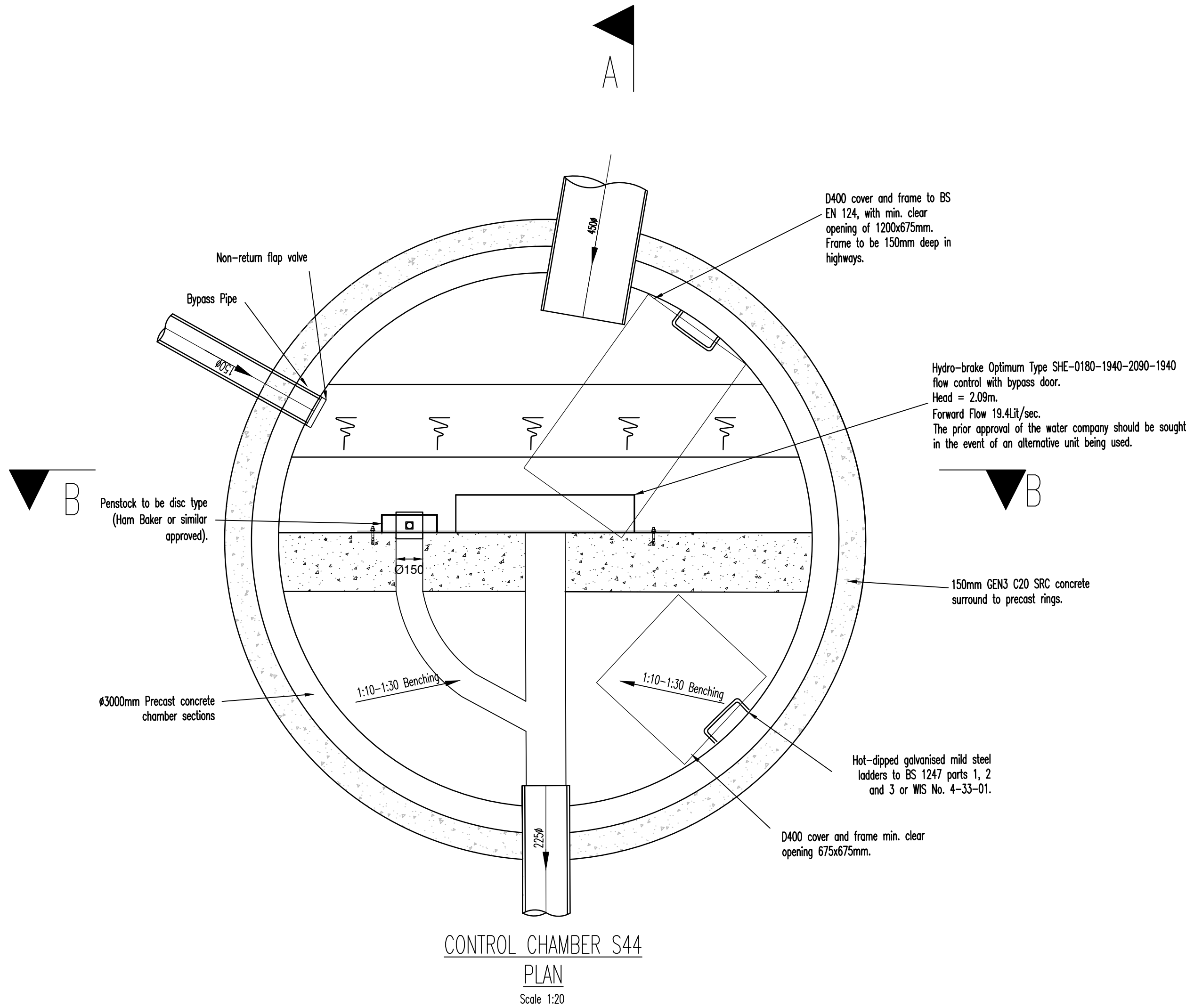
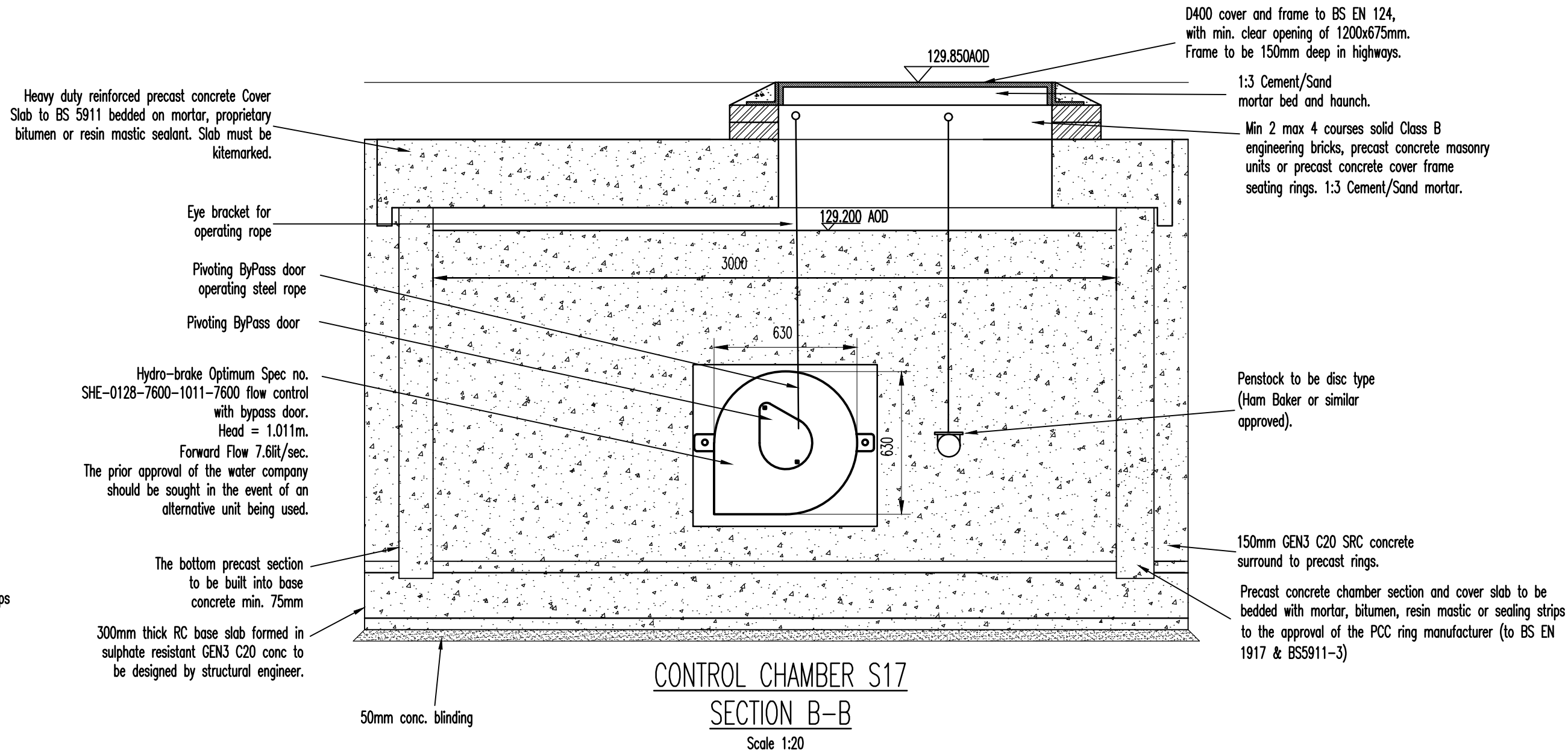
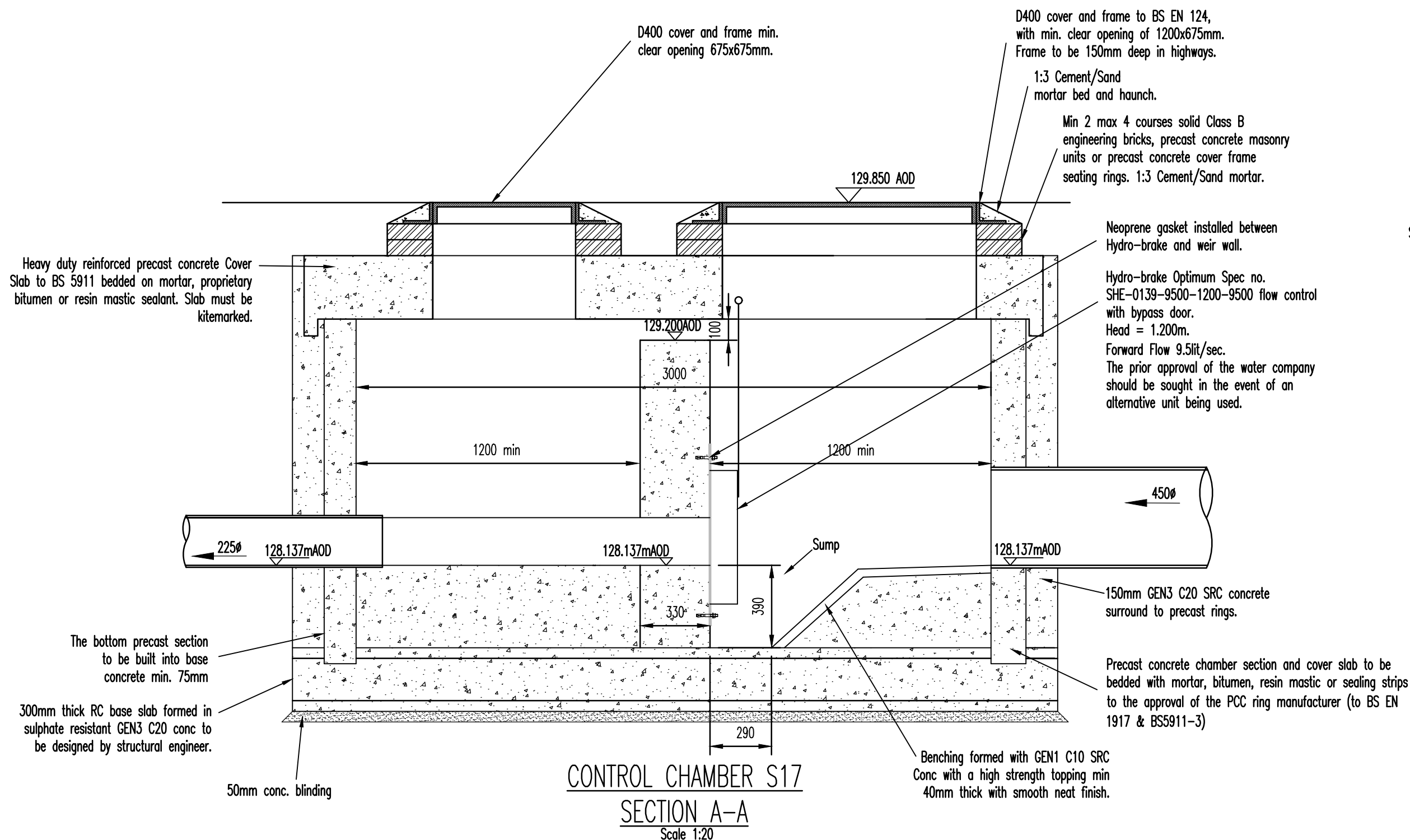
Project

Thornton

Drawing Title

Pond General Arrangement

Drawn / Checked / Status			Scale	
Initial	DC	TN	Tender	As Shown
Date	28/10/22	28/10/22		
Project Number	Drawing Number		Revision	
PJS22-058	DR-508		A	



General Notes

- Do not scale this drawing. If in doubt, ask.
- This drawing is to be read in conjunction with all other relevant Engineers, Architects and specialist design drawings and details.
- All dimensions are in metres unless noted otherwise. All levels are in metres unless noted otherwise.
- Any discrepancies noted on site are to be reported to the Engineer immediately.
- All materials for use in the contract must be as kitemarked.
- The contractor must allow within his rates for compliance at all times with the 1974 health and safety at work act and the 2007 CDM Regulations.
- Flows in existing sewers shall be maintained at all times.
- Manholes with outgoing pipes greater than 600mm diameter shall be fitted with safety chains, guard bars or similar.
- All lifting eyes in P.C.C. products shall be pointed smooth after fixing.
- Corbelling of brickwork shall not exceed 30mm per course.
- Cut pipes to be machined cut and ground smooth.
- All cement and concrete products to use sulphate resisting cement.
- All pipework to have spigot and socket flexible joints unless otherwise specified. All clay pipes and fittings shall be to spec cl. 4.2.19 (BS 65). All concrete pipes and fittings shall be to spec cl. 4.2.20 (BS5911).
- Wherever appropriate, geotextiles shall be used to contain bedding material e.g. in areas of running sand.
- Manhole rings are not to be cut.
- The base of the chamber, up to pipe soffit levels, may have to be of brickwork or concrete to ensure that concrete rings are not cut around any pipes to the chamber.
- A sign must be fitted in the flow control chamber manhole to read "Caution- Hydrobrake located here".
- A sign must be fitted in the upstream manhole to read "Caution- Hydrobrake located downstream".
- A sign must be fitted in the downstream manhole to read "Caution- Hydrobrake located upstream".

B	16.12.22	Updated to suit client comments.	LD	TN
A	05.12.22	Drawing updated to suit client comments	LD	TN
Rev	Date	Amendments	By	Chk



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Client

Cora

Project

Thornton

Drawing Title

Control Chamber Construction Details

Drawn	Checked	Status	Scale
Initial	DC	TN	Approval
Date	28/10/22	28/10/22	1:20
Project Number	Drawing Number	Revision	
PJS22-058	DR-912	B	

APPENDIX A

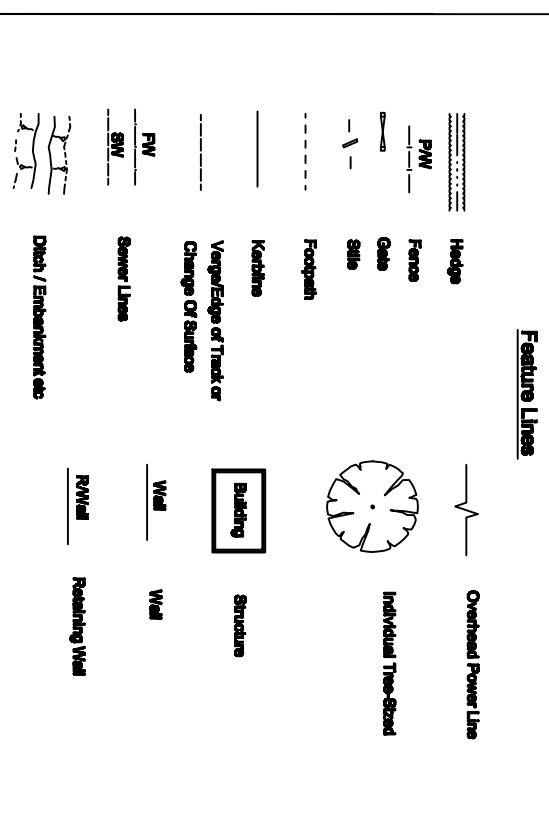
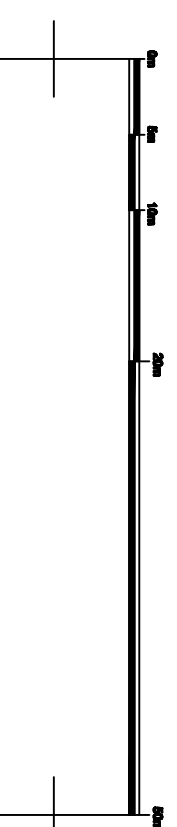
SITE TOPOGRAPHICAL SURVEY

1. This Survey is related OS Grid Name (OS6362)
2. All letters are related to OS Datum (OS6362)
3. The Information Shown on this drawing is surveyed to the accuracy of the base scale as shown.
4. Use entry to measure has not been undertaken.
5. Depths and ground areas are measured / determined from the plan. This should be checked against Local Authority records or on site prior to the commencement of any works.
6. Boundaries shown are physical features and may not represent legally conveyed ownership.
7. Where adjacent buildings have been surveyed, the boundary is shown as a line, but is not intended as a warranty as it will only be shown as data to construction along these of agreement.
7. This plan should not be used for its original purpose. JCB Surveyors LTD accepts no responsibility for the plan it is supplied to as other than the original client.

- 1: This Survey is related OS Grid Name (OS960)
- 2: All letters are related to OS Datum (OS960)
- 3: The Information Shown on this drawing is surveyed to the accuracy of the base scale as shown.
- 4: No entry to measure has not been undertaken from the ground.
- 5: Details and spot elevations are measured / determined by the project team.
- 6: This should be checked against the Local Authority records or on site prior to the commencement of any works.
- 7: Boundaries shown are physical features and may not represent legally conveyed ownership.
- 8: Where adjacent buildings have been surveyed, boundaries will be shown as close as reasonably as walls may not be known due to obstructions along those of adjacent.
- 9: This plan should not be used for its original purpose, NCE Surveys LTD accepts no responsibility for the plans it is supplied to so other than the original client.

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REV	DATE	DESCRIPTION	BY	APP.



**The Old Police Station,
South Street,
Ashby de la Zouch,
Leicestershire**

Telephone • 07876 78

Mail ● nclarke@nlsurveys.co.uk

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Client

**Beech Drive,
Thornton**

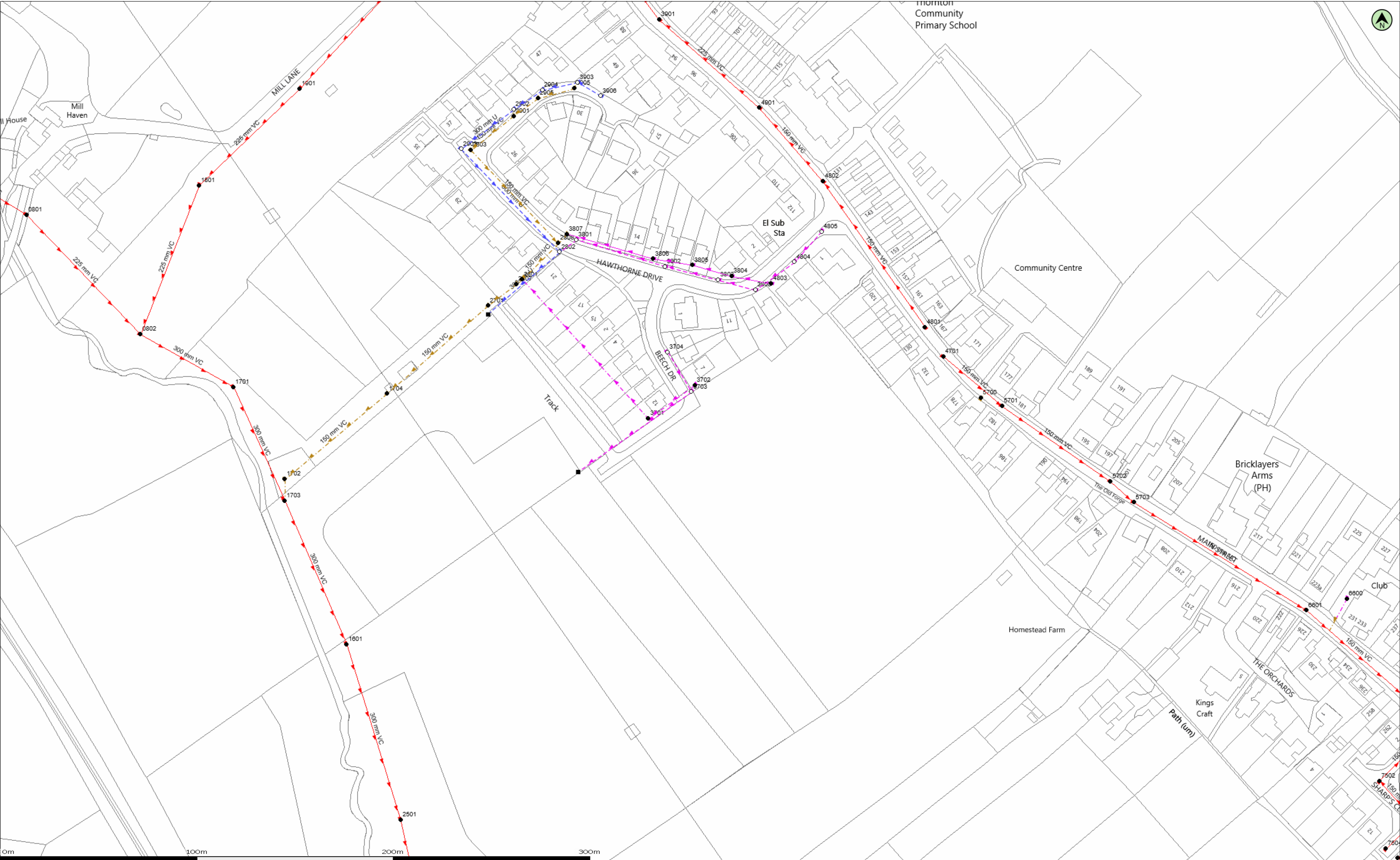
Topographical Survey

Drawn	Checked	Authorized
\$1B	LD	NJC
Date 27/05/2014	Score 1/500	Sheet Size A0

C H I S C C H	
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APPENDIX B

SEWER RECORD PLANS



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Do not scale off this Map. 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. 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 assess complete records of these assets. These assets may not be displayed on the map. Reproduction by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and database right 2004. All rights reserved. Ordnance Survey licence number: 100031673. Document users other than SEVERN TRENT WATER business users are advised that this document is provided for reference purpose only and is subject to copyright, therefore, no further copies should be made from it.

Public Foul Gravity/Lateral Drain	Public Combined Gravity/Lateral Drain	Public Surface Water Gravity/Lateral Drain	Pressure Foul	Pressure Combined	Pressure Surface Water
Highway Drain	Overflow Pipe	Disposal Pipe	Culverted Water Course	Pumping Station	Filling
Manhole Foul	Manhole Surface	Abandoned Pipe	Section 104 sewers are shown in green	Private sewers are shown in magenta	

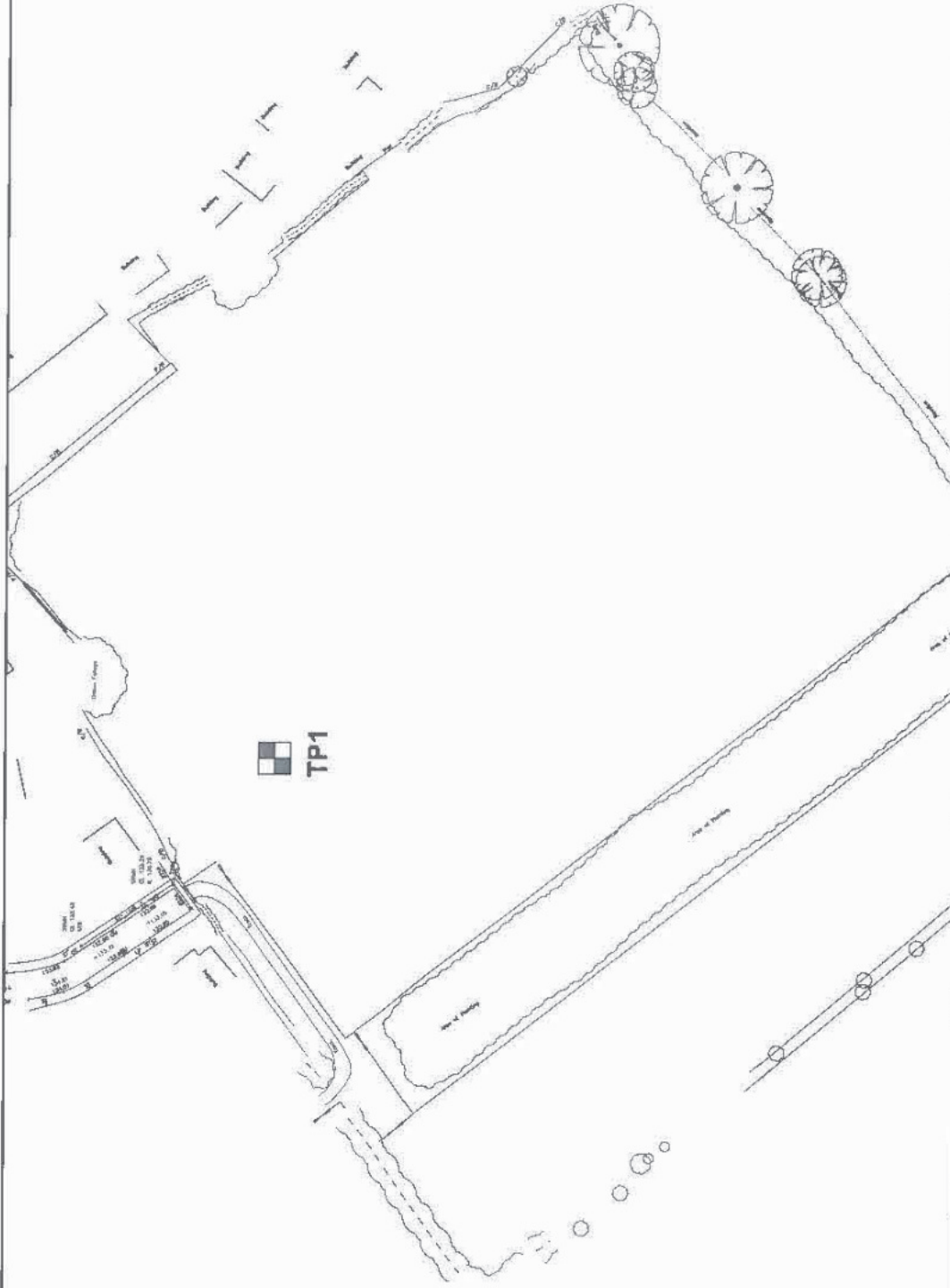
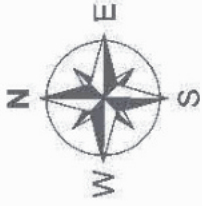
matthew.genn@adcinfrastucture.com

Beech Dr, Thornton



APPENDIX C

ONSITE INFILTRATION TESTING RESULTS



PRP:

consulting civil & structural engineers

Project:

Land off Beech Drive, Thornton

Title:

Test Pit Location Plan

Status:

For Information

Engineer:

RG

Drawn:

GF

Checked:

BMS

Date:

Oct 2014

Scales @ A4:

NTS

Drawing No:

60977 - SK10

Rev:

-

**PRP**

consulting civil & structural engineers

Leicester
0116
275 1710Northampton
01604
889870Huntingdon
01832
710959**SOIL INFILTRATION REPORT**

Project No:

60977

Project:

Land off Beech Drive 60977

Prepared by:

R Gray

10/10/2014

Checked by:

Sheet:

Test Pit 1

Soil type	mudstone	Size	Length (m)	Width (m)	Depth (m)
Ground Water Level (m below GL)	-0.47		0.30	0.30	0.60

No	Site Readings			
	Time (hh:mm)	Water Level from Base of Pit (mm)	Time (mins)	Depth of Water Below Ground Level (m)
1	10:20	220	0	-0.47
2	10:25	220	5	-0.47
3	10:30	210	10	-0.48
4	10:35	205	15	-0.48
5	10:40	200	20	-0.49
6	10:45	197	25	-0.49
7	10:55	195	35	-0.49
8	11:25	191	65	-0.49
9	11:40	190	80	-0.49
10	11:55	188	95	-0.49
11	12:10	187	110	-0.49
12	12:25	187	125	-0.49
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

	25%	75%
Effective depth (m)	-0.49	-0.48
Time (min)	90	5

taken from Graph

Volume outflowing between 75% & 25% effective depth

$$V_{p75-25} = 0.3 \times 0.3 \times (0.49 - 0.48) = 0.0009 \quad \text{m}^3$$

$$Q_{p50} = (0.3 \times 0.01 \times 2) +$$

$$+ (0.3 \times 0.01 \times 2) +$$

$$+ (0.3 \times 0.3)$$

$$= 0.102 \quad \text{m}^2$$

$$t_{p75-25} = 90 - 5$$

$$= 85 \quad \text{min}$$

Soil infiltration rate

$$f = \frac{0.0009}{0.102 \times 85 \times 60} = 1.73\text{E-}06 \quad \text{m/sec}$$



PRP

consulting civil & structural engineers

Leicester
0116
275 1710

Northampton
01604
889870

Huntingdon
01832
710959

SOIL INFILTRATION REPORT

Project No:

60977

Project:

Land off Beech Drive 60977

Prepared by:

R Gray

10/10/2014

Checked by:

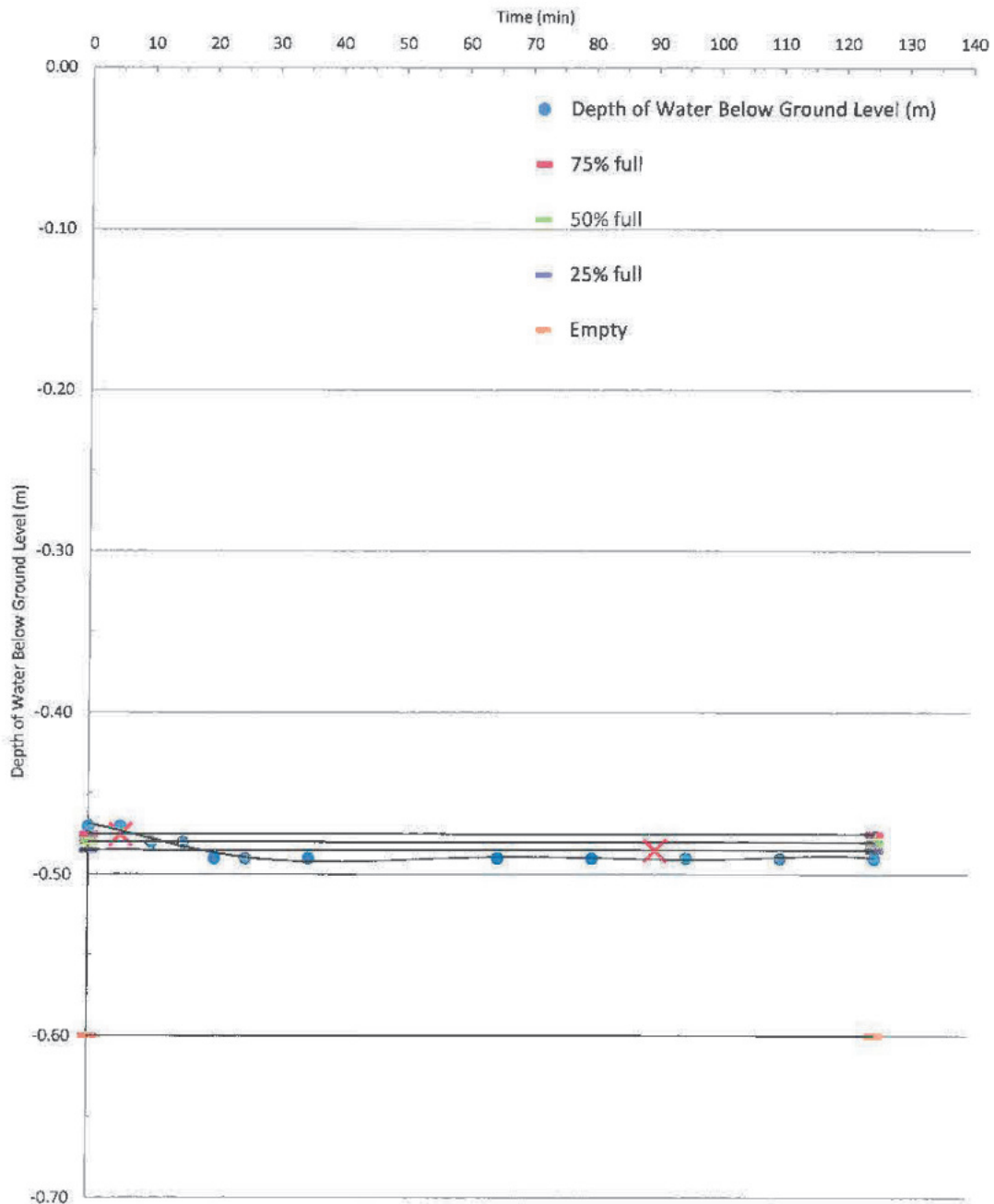
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Sheet:

01

Test Pit 1

Relationship Between Time and Depth of Water



APPENDIX D

SURFACE WATER RUNOFF CALCULATIONS

ADC Infrastructure Limited		Page 1
22 Esher Grove Nottingham NG3 5DR	Beech Drive Thornton	
Date 04/03/2020 File	Designed by Matthew Genn Checked by Richard Winn	
Innovyze Source Control 2018.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 700 Urban 0.000
Area (ha) 2.153 Soil 0.450 Region Number Region 4

Results 1/s

QBAR Rural 9.5
QBAR Urban 9.5

Q100 years 24.3

Q1 year 7.9
Q30 years 18.5
Q100 years 24.3

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APPENDIX E

PJS CONSULTING ENGINEERS
MICRO DRAINAGE SW DRAINAGE NETWORK OUTPUTS

Surface Water Drainage Network Outputs
1 in 1 year storm event

PJS Consulting Engineers Limited		Page 2
Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP		
Date 05/12/2022 11:46	Designed by leighton.dawson	
File PJS Storm model Dec 2.mdx	Checked by	
Innovyze	Network 2019.1	

Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

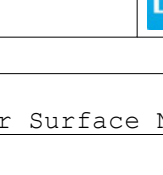
Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.900	Storm Duration (mins)	30
Ratio R	0.400		

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PJS Consulting Engineers Limited		Page 3																																																																																										
Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP																																																																																												
Date 05/12/2022 11:46	Designed by leighton.dawson																																																																																											
File PJS Storm model Dec 2.mdx	Checked by																																																																																											
Innovyze	Network 2019.1																																																																																											
Online Controls for Surface Network 1 Hydro-Brake® Optimum Manhole: S15, DS/PN: 1.013, Volume (m³): 5.1 Unit Reference MD-SHE-0139-9500-1200-9500 Design Head (m)1.200 Design Flow (l/s)9.5 Flush-Flo™Calculated ObjectiveMinimise upstream storage ApplicationSurface Sump AvailableYes Diameter (mm)139 Invert Level (m)128.200 Minimum Outlet Pipe Diameter (mm)225 Suggested Manhole Diameter (mm)1200 <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.200</td><td>9.5</td><td>Kick-Flo®</td><td>0.773</td><td>7.7</td></tr><tr><td>Flush-Flo™</td><td>0.356</td><td>9.5</td><td>Mean Flow over Head Range</td><td>-</td><td>8.2</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>5.0</td><td>1.200</td><td>9.5</td><td>3.000</td><td>14.7</td><td>7.000</td><td>22.0</td></tr><tr><td>0.200</td><td>9.0</td><td>1.400</td><td>10.2</td><td>3.500</td><td>15.8</td><td>7.500</td><td>22.7</td></tr><tr><td>0.300</td><td>9.4</td><td>1.600</td><td>10.9</td><td>4.000</td><td>16.8</td><td>8.000</td><td>23.4</td></tr><tr><td>0.400</td><td>9.5</td><td>1.800</td><td>11.5</td><td>4.500</td><td>17.8</td><td>8.500</td><td>24.1</td></tr><tr><td>0.500</td><td>9.3</td><td>2.000</td><td>12.1</td><td>5.000</td><td>18.7</td><td>9.000</td><td>24.8</td></tr><tr><td>0.600</td><td>9.0</td><td>2.200</td><td>12.6</td><td>5.500</td><td>19.6</td><td>9.500</td><td>25.5</td></tr><tr><td>0.800</td><td>7.9</td><td>2.400</td><td>13.2</td><td>6.000</td><td>20.4</td><td></td><td></td></tr><tr><td>1.000</td><td>8.7</td><td>2.600</td><td>13.7</td><td>6.500</td><td>21.2</td><td></td><td></td></tr></table>			Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.200	9.5	Kick-Flo®	0.773	7.7	Flush-Flo™	0.356	9.5	Mean Flow over Head Range	-	8.2	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	5.0	1.200	9.5	3.000	14.7	7.000	22.0	0.200	9.0	1.400	10.2	3.500	15.8	7.500	22.7	0.300	9.4	1.600	10.9	4.000	16.8	8.000	23.4	0.400	9.5	1.800	11.5	4.500	17.8	8.500	24.1	0.500	9.3	2.000	12.1	5.000	18.7	9.000	24.8	0.600	9.0	2.200	12.6	5.500	19.6	9.500	25.5	0.800	7.9	2.400	13.2	6.000	20.4			1.000	8.7	2.600	13.7	6.500	21.2		
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)																																																																																							
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Flush-Flo™	0.356	9.5	Mean Flow over Head Range	-	8.2																																																																																							
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																																					
0.100	5.0	1.200	9.5	3.000	14.7	7.000	22.0																																																																																					
0.200	9.0	1.400	10.2	3.500	15.8	7.500	22.7																																																																																					
0.300	9.4	1.600	10.9	4.000	16.8	8.000	23.4																																																																																					
0.400	9.5	1.800	11.5	4.500	17.8	8.500	24.1																																																																																					
0.500	9.3	2.000	12.1	5.000	18.7	9.000	24.8																																																																																					
0.600	9.0	2.200	12.6	5.500	19.6	9.500	25.5																																																																																					
0.800	7.9	2.400	13.2	6.000	20.4																																																																																							
1.000	8.7	2.600	13.7	6.500	21.2																																																																																							
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Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP																																																			
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000	Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0	MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0	Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500	Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000	

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 1	Number of Storage Structures 1	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R 0.400
Region England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.900 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep 2.5 Second Increment (Extended)	
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440	
Return Period(s) (years)	1
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S1	15 Winter	1	+0%					141.801	-0.174
1.001	S2	15 Winter	1	+0%					140.826	-0.158
1.002	S3	15 Winter	1	+0%					139.744	-0.147
1.003	S4	15 Winter	1	+0%					138.610	-0.146
1.004	S5	15 Winter	1	+0%					137.593	-0.193
1.005	S6	15 Winter	1	+0%					136.817	-0.199
1.006	S7	15 Winter	1	+0%					135.362	-0.189
1.007	S8	15 Winter	1	+0%					133.611	-0.190
2.000	S9	15 Winter	1	+0%					140.749	-0.156
2.001	S10	15 Winter	1	+0%					136.942	-0.155
1.008	S11	15 Winter	1	+0%					132.098	-0.227
1.009	S12	15 Winter	1	+0%					131.357	-0.228
1.010	S19	15 Winter	1	+0%					130.608	-0.230
1.011	S13	15 Winter	1	+0%					128.879	-0.195
1.012	S14	15 Winter	1	+0%					128.697	-0.253

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Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP		
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Flooded		Pipe		Status	Level Exceeded
		Volume (m ³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)		
1.000	S1	0.000	0.12		11.2	OK	
1.001	S2	0.000	0.19		20.2	OK	
1.002	S3	0.000	0.26		31.2	OK	
1.003	S4	0.000	0.27		35.7	OK	
1.004	S5	0.000	0.27		47.8	OK	
1.005	S6	0.000	0.25		55.1	OK	
1.006	S7	0.000	0.30		66.1	OK	
1.007	S8	0.000	0.29		69.0	OK	
2.000	S9	0.000	0.20		32.3	OK	
2.001	S10	0.000	0.21		32.0	OK	
1.008	S11	0.000	0.33		110.3	OK	
1.009	S12	0.000	0.33		110.4	OK	
1.010	S19	0.000	0.32		122.2	OK	
1.011	S13	0.000	0.61		121.6	OK	
1.012	S14	0.000	0.39		121.2	OK	

Surface Water Drainage Network Outputs
1 in 30-year storm event

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Date 05/12/2022 11:44
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Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.001	51.977	4.772	10.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.008	7.094	0.740	9.6	0.080	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	16.722	0.747	22.4	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.010	39.447	1.764	22.4	0.099	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.011	5.700	0.124	46.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.012	15.347	0.300	51.2	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.013	3.121	0.063	49.5	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.014	11.502	0.337	34.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.001	50.00	5.36	136.872	0.221	0.0	0.0	0.0	3.99	158.5	29.9
1.008	50.00	6.02	131.950	0.847	0.0	0.0	0.0	5.88	649.5	114.7
1.009	50.00	6.10	131.210	0.847	0.0	0.0	0.0	3.84	424.6	114.7
1.010	50.00	6.27	130.463	0.946	0.0	0.0	0.0	3.85	424.8	128.1
1.011	50.00	6.30	128.624	0.946	0.0	0.0	0.0	3.00	477.9	128.1
1.012	50.00	6.39	128.500	0.946	0.0	0.0	0.0	2.85	452.9	128.1
1.013	50.00	6.41	128.200	0.946	0.0	0.0	0.0	2.89	460.3	128.1
1.014	50.00	6.46	128.137	0.946	0.0	0.0	0.0	3.49	554.9	128.1

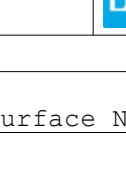
Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.014	S18	130.000	127.800	0.000	0	0

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Online Controls for Surface Network 1 Hydro-Brake® Optimum Manhole: S15, DS/PN: 1.013, Volume (m³): 5.1 Unit Reference MD-SHE-0139-9500-1200-9500 Design Head (m) 1.200 Design Flow (l/s) 9.5 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 139 Invert Level (m) 128.200 Minimum Outlet Pipe Diameter (mm) 225 Suggested Manhole Diameter (mm) 1200 <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.200</td><td>9.5</td><td>Kick-Flo®</td><td>0.773</td><td>7.7</td></tr><tr><td>Flush-Flo™</td><td>0.356</td><td>9.5</td><td>Mean Flow over Head Range</td><td>-</td><td>8.2</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>5.0</td><td>1.200</td><td>9.5</td><td>3.000</td><td>14.7</td><td>7.000</td><td>22.0</td></tr><tr><td>0.200</td><td>9.0</td><td>1.400</td><td>10.2</td><td>3.500</td><td>15.8</td><td>7.500</td><td>22.7</td></tr><tr><td>0.300</td><td>9.4</td><td>1.600</td><td>10.9</td><td>4.000</td><td>16.8</td><td>8.000</td><td>23.4</td></tr><tr><td>0.400</td><td>9.5</td><td>1.800</td><td>11.5</td><td>4.500</td><td>17.8</td><td>8.500</td><td>24.1</td></tr><tr><td>0.500</td><td>9.3</td><td>2.000</td><td>12.1</td><td>5.000</td><td>18.7</td><td>9.000</td><td>24.8</td></tr><tr><td>0.600</td><td>9.0</td><td>2.200</td><td>12.6</td><td>5.500</td><td>19.6</td><td>9.500</td><td>25.5</td></tr><tr><td>0.800</td><td>7.9</td><td>2.400</td><td>13.2</td><td>6.000</td><td>20.4</td><td></td><td></td></tr><tr><td>1.000</td><td>8.7</td><td>2.600</td><td>13.7</td><td>6.500</td><td>21.2</td><td></td><td></td></tr></table> ©1982-2019 Innovyze			Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.200	9.5	Kick-Flo®	0.773	7.7	Flush-Flo™	0.356	9.5	Mean Flow over Head Range	-	8.2	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	5.0	1.200	9.5	3.000	14.7	7.000	22.0	0.200	9.0	1.400	10.2	3.500	15.8	7.500	22.7	0.300	9.4	1.600	10.9	4.000	16.8	8.000	23.4	0.400	9.5	1.800	11.5	4.500	17.8	8.500	24.1	0.500	9.3	2.000	12.1	5.000	18.7	9.000	24.8	0.600	9.0	2.200	12.6	5.500	19.6	9.500	25.5	0.800	7.9	2.400	13.2	6.000	20.4			1.000	8.7	2.600	13.7	6.500	21.2		
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0
Number of Online Controls	1	Number of Storage Structures	1
Number of Time/Area Diagrams	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.900	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	30	+0%					141.833
1.001	S2	15 Winter	30	+0%					140.876
1.002	S3	15 Winter	30	+0%					139.812
1.003	S4	15 Winter	30	+0%					138.681
1.004	S5	15 Winter	30	+0%					137.691
1.005	S6	15 Winter	30	+0%					136.908
1.006	S7	15 Winter	30	+0%					135.470
1.007	S8	15 Winter	30	+0%					133.717
2.000	S9	15 Winter	30	+0%					140.793
2.001	S10	15 Winter	30	+0%					136.988
1.008	S11	15 Winter	30	+0%					132.237
1.009	S12	15 Winter	30	+0%					131.496
1.010	S19	15 Winter	30	+0%					130.773
1.011	S13	15 Winter	30	+0%	30/15 Summer				129.375
1.012	S14	15 Winter	30	+0%	30/15 Summer				129.002

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Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP		
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged		Flooded		Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)			
1.000	S1	-0.142	0.000	0.29		27.5	OK	
1.001	S2	-0.108	0.000	0.52		55.6	OK	
1.002	S3	-0.079	0.000	0.74		89.8	OK	
1.003	S4	-0.075	0.000	0.77		103.0	OK	
1.004	S5	-0.095	0.000	0.80		140.1	OK	
1.005	S6	-0.108	0.000	0.73		161.9	OK	
1.006	S7	-0.081	0.000	0.87		195.1	OK	
1.007	S8	-0.084	0.000	0.85		202.0	OK	
2.000	S9	-0.112	0.000	0.50		79.3	OK	
2.001	S10	-0.109	0.000	0.52		78.5	OK	
1.008	S11	-0.088	0.000	0.91		307.6	OK	
1.009	S12	-0.089	0.000	0.92		310.0	OK	
1.010	S19	-0.065	0.000	0.89		344.8	OK	
1.011	S13	0.301	0.000	1.73		342.8	SURCHARGED	
1.012	S14	0.052	0.000	1.10		340.2	SURCHARGED	

Surface Water Drainage Network Outputs
1 in 100-year storm event

PJS Consulting Engineers Limited			Page 0
Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP			
Date 05/12/2022 11:35 File PJS Storm model Dec 2.mdx		Designed by leighton.dawson Checked by	
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.900	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	25.574	0.991	25.8	0.077	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	22.139	1.093	20.3	0.074	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	16.524	1.135	14.6	0.090	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	10.295	0.970	10.6	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	24.592	0.770	31.9	0.098	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	30.566	1.465	20.9	0.059	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	37.002	1.750	21.1	0.090	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	26.109	1.476	17.7	0.023	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	36.634	3.808	9.6	0.221	5.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.16	141.750	0.077	0.0	0.0	0.0	2.59	102.8	10.4
1.001	50.00	5.29	140.759	0.151	0.0	0.0	0.0	2.92	116.1	20.4
1.002	50.00	5.37	139.666	0.241	0.0	0.0	0.0	3.45	137.1	32.6
1.003	50.00	5.41	138.531	0.276	0.0	0.0	0.0	4.04	160.6	37.4
1.004	50.00	5.56	137.486	0.374	0.0	0.0	0.0	2.79	197.4	50.6
1.005	50.00	5.71	136.716	0.433	0.0	0.0	0.0	3.46	244.4	58.6
1.006	50.00	5.89	135.251	0.523	0.0	0.0	0.0	3.43	242.8	70.8
1.007	50.00	6.00	133.501	0.546	0.0	0.0	0.0	3.76	265.5	73.9
2.000	50.00	5.14	140.680	0.221	0.0	0.0	0.0	4.24	168.7	29.9

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Date 05/12/2022 11:35	Designed by leighton.dawson	
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Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.001	51.977	4.772	10.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.008	7.094	0.740	9.6	0.080	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	16.722	0.747	22.4	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.010	39.447	1.764	22.4	0.099	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.011	5.700	0.124	46.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.012	15.347	0.300	51.2	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.013	3.121	0.063	49.5	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.014	11.502	0.337	34.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.001	50.00	5.36	136.872	0.221	0.0	0.0	0.0	3.99	158.5	29.9
1.008	50.00	6.02	131.950	0.847	0.0	0.0	0.0	5.88	649.5	114.7
1.009	50.00	6.10	131.210	0.847	0.0	0.0	0.0	3.84	424.6	114.7
1.010	50.00	6.27	130.463	0.946	0.0	0.0	0.0	3.85	424.8	128.1
1.011	50.00	6.30	128.624	0.946	0.0	0.0	0.0	3.00	477.9	128.1
1.012	50.00	6.39	128.500	0.946	0.0	0.0	0.0	2.85	452.9	128.1
1.013	50.00	6.41	128.200	0.946	0.0	0.0	0.0	2.89	460.3	128.1
1.014	50.00	6.46	128.137	0.946	0.0	0.0	0.0	3.49	554.9	128.1

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.014	S18	130.000	127.800	0.000	0	0

PJS Consulting Engineers Limited		Page 2
Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP		
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Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

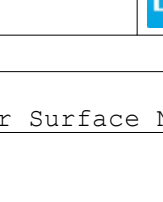
Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.900	Storm Duration (mins)	30
Ratio R	0.400		

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<u>Online Controls for Surface Network 1</u> <u>Hydro-Brake® Optimum Manhole: S15, DS/PN: 1.013, Volume (m³): 5.1</u> <table><tr><td>Unit Reference</td><td>MD-SHE-0139-9500-1200-9500</td></tr><tr><td>Design Head (m)</td><td>1.200</td></tr><tr><td>Design Flow (l/s)</td><td>9.5</td></tr><tr><td>Flush-Flo™</td><td>Calculated</td></tr><tr><td>Objective</td><td>Minimise upstream storage</td></tr><tr><td>Application</td><td>Surface</td></tr><tr><td>Sump Available</td><td>Yes</td></tr><tr><td>Diameter (mm)</td><td>139</td></tr><tr><td>Invert Level (m)</td><td>128.200</td></tr><tr><td>Minimum Outlet Pipe Diameter (mm)</td><td>225</td></tr><tr><td>Suggested Manhole Diameter (mm)</td><td>1200</td></tr></table> <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.200</td><td>9.5</td><td>Kick-Flo®</td><td>0.773</td><td>7.7</td></tr><tr><td>Flush-Flo™</td><td>0.356</td><td>9.5</td><td>Mean Flow over Head Range</td><td>-</td><td>8.2</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>5.0</td><td>1.200</td><td>9.5</td><td>3.000</td><td>14.7</td><td>7.000</td><td>22.0</td></tr><tr><td>0.200</td><td>9.0</td><td>1.400</td><td>10.2</td><td>3.500</td><td>15.8</td><td>7.500</td><td>22.7</td></tr><tr><td>0.300</td><td>9.4</td><td>1.600</td><td>10.9</td><td>4.000</td><td>16.8</td><td>8.000</td><td>23.4</td></tr><tr><td>0.400</td><td>9.5</td><td>1.800</td><td>11.5</td><td>4.500</td><td>17.8</td><td>8.500</td><td>24.1</td></tr><tr><td>0.500</td><td>9.3</td><td>2.000</td><td>12.1</td><td>5.000</td><td>18.7</td><td>9.000</td><td>24.8</td></tr><tr><td>0.600</td><td>9.0</td><td>2.200</td><td>12.6</td><td>5.500</td><td>19.6</td><td>9.500</td><td>25.5</td></tr><tr><td>0.800</td><td>7.9</td><td>2.400</td><td>13.2</td><td>6.000</td><td>20.4</td><td></td><td></td></tr><tr><td>1.000</td><td>8.7</td><td>2.600</td><td>13.7</td><td>6.500</td><td>21.2</td><td></td><td></td></tr></table>			Unit Reference	MD-SHE-0139-9500-1200-9500	Design Head (m)	1.200	Design Flow (l/s)	9.5	Flush-Flo™	Calculated	Objective	Minimise upstream storage	Application	Surface	Sump Available	Yes	Diameter (mm)	139	Invert Level (m)	128.200	Minimum Outlet Pipe Diameter (mm)	225	Suggested Manhole Diameter (mm)	1200	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.200	9.5	Kick-Flo®	0.773	7.7	Flush-Flo™	0.356	9.5	Mean Flow over Head Range	-	8.2	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	5.0	1.200	9.5	3.000	14.7	7.000	22.0	0.200	9.0	1.400	10.2	3.500	15.8	7.500	22.7	0.300	9.4	1.600	10.9	4.000	16.8	8.000	23.4	0.400	9.5	1.800	11.5	4.500	17.8	8.500	24.1	0.500	9.3	2.000	12.1	5.000	18.7	9.000	24.8	0.600	9.0	2.200	12.6	5.500	19.6	9.500	25.5	0.800	7.9	2.400	13.2	6.000	20.4			1.000	8.7	2.600	13.7	6.500	21.2		
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<u>Storage Structures for Surface Network 1</u> <u>Tank or Pond Manhole: S15, DS/PN: 1.013</u> Invert Level (m) 128.200 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr><tr><td>0.000</td><td>457.9</td><td>0.500</td><td>617.5</td><td>1.000</td><td>799.9</td><td>1.500</td><td>944.0</td></tr><tr><td>0.100</td><td>488.0</td><td>0.600</td><td>652.1</td><td>1.100</td><td>839.1</td><td>1.549</td><td>955.3</td></tr><tr><td>0.200</td><td>519.0</td><td>0.700</td><td>687.7</td><td>1.200</td><td>879.2</td><td>1.550</td><td>428.7</td></tr><tr><td>0.300</td><td>550.9</td><td>0.800</td><td>724.2</td><td>1.300</td><td>900.7</td><td></td><td></td></tr><tr><td>0.400</td><td>583.7</td><td>0.900</td><td>761.6</td><td>1.400</td><td>921.8</td><td></td><td></td></tr></table>				Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	457.9	0.500	617.5	1.000	799.9	1.500	944.0	0.100	488.0	0.600	652.1	1.100	839.1	1.549	955.3	0.200	519.0	0.700	687.7	1.200	879.2	1.550	428.7	0.300	550.9	0.800	724.2	1.300	900.7			0.400	583.7	0.900	761.6	1.400	921.8		
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Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP		
Date 05/12/2022 11:35 File PJS Storm model Dec 2.mdx	Designed by leighton.dawson Checked by	
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.900	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	100	+40%					141.867
1.001	S2	15 Winter	100	+40%	100/15 Summer				141.594
1.002	S3	15 Winter	100	+40%	100/15 Summer				140.995
1.003	S4	15 Winter	100	+40%	100/15 Summer				139.905
1.004	S5	15 Winter	100	+40%	100/15 Summer				138.984
1.005	S6	15 Winter	100	+40%	100/15 Summer				138.179
1.006	S7	15 Winter	100	+40%	100/15 Summer	100/15 Summer			136.895
1.007	S8	15 Winter	100	+40%	100/15 Summer	100/15 Summer			135.041
2.000	S9	15 Winter	100	+40%					140.848
2.001	S10	15 Winter	100	+40%	100/15 Summer				137.517
1.008	S11	15 Winter	100	+40%	100/15 Summer	100/15 Summer			133.721
1.009	S12	15 Winter	100	+40%	100/15 Summer				132.837
1.010	S19	15 Winter	100	+40%	100/15 Summer				131.948
1.011	S13	15 Winter	100	+40%	100/15 Summer				129.761
1.012	S14	15 Winter	100	+40%	100/15 Summer				129.191

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Surface Water Drainage Network Outputs
1 in 100-year plus CC storm event

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Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP		
Date 14/12/2022 16:30	Designed by leighton.dawson	
File PJS Storm model Dec 2.mdx	Checked by	
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Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.001	51.977	4.772	10.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.008	7.094	0.740	9.6	0.080	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	16.722	0.747	22.4	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.010	39.447	1.764	22.4	0.099	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.011	5.700	0.124	46.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.012	15.347	0.300	51.2	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.013	3.121	0.063	49.5	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.014	11.502	0.337	34.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.001	50.00	5.36	136.872	0.221	0.0	0.0	0.0	3.99	158.5	29.9
1.008	50.00	6.02	131.950	0.847	0.0	0.0	0.0	5.88	649.5	114.7
1.009	50.00	6.10	131.210	0.847	0.0	0.0	0.0	3.84	424.6	114.7
1.010	50.00	6.27	130.463	0.946	0.0	0.0	0.0	3.85	424.8	128.1
1.011	50.00	6.30	128.624	0.946	0.0	0.0	0.0	3.00	477.9	128.1
1.012	50.00	6.39	128.500	0.946	0.0	0.0	0.0	2.85	452.9	128.1
1.013	50.00	6.41	128.200	0.946	0.0	0.0	0.0	2.89	460.3	128.1
1.014	50.00	6.46	128.137	0.946	0.0	0.0	0.0	3.49	554.9	128.1

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.014	S18	130.000	127.800	0.000	0	0

PJS Consulting Engineers Limited		Page 2
Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP		
Date 14/12/2022 16:30	Designed by leighton.dawson	
File PJS Storm model Dec 2.mdx	Checked by	
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Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0
 Number of Offline Controls 0
 Number of Time/Area Diagrams 0
 Number of Online Controls 1
 Number of Storage Structures 1
 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.900	Storm Duration (mins)	30
Ratio R	0.400		

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Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP																																																																																												
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Online Controls for Surface Network 1 Hydro-Brake® Optimum Manhole: S15, DS/PN: 1.013, Volume (m³): 5.1 Unit Reference MD-SHE-0139-9500-1200-9500 Design Head (m) Design Flow (l/s) Flush-Flo™ Objective Application Sump Available Diameter (mm) Invert Level (m) Minimum Outlet Pipe Diameter (mm) Suggested Manhole Diameter (mm) 1.200 9.5 Calculated Minimise upstream storage Surface Yes 139 128.200 225 1200 <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.200</td><td>9.5</td><td>Kick-Flo®</td><td>0.773</td><td>7.7</td></tr><tr><td>Flush-Flo™</td><td>0.356</td><td>9.5</td><td>Mean Flow over Head Range</td><td>-</td><td>8.2</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>5.0</td><td>1.200</td><td>9.5</td><td>3.000</td><td>14.7</td><td>7.000</td><td>22.0</td></tr><tr><td>0.200</td><td>9.0</td><td>1.400</td><td>10.2</td><td>3.500</td><td>15.8</td><td>7.500</td><td>22.7</td></tr><tr><td>0.300</td><td>9.4</td><td>1.600</td><td>10.9</td><td>4.000</td><td>16.8</td><td>8.000</td><td>23.4</td></tr><tr><td>0.400</td><td>9.5</td><td>1.800</td><td>11.5</td><td>4.500</td><td>17.8</td><td>8.500</td><td>24.1</td></tr><tr><td>0.500</td><td>9.3</td><td>2.000</td><td>12.1</td><td>5.000</td><td>18.7</td><td>9.000</td><td>24.8</td></tr><tr><td>0.600</td><td>9.0</td><td>2.200</td><td>12.6</td><td>5.500</td><td>19.6</td><td>9.500</td><td>25.5</td></tr><tr><td>0.800</td><td>7.9</td><td>2.400</td><td>13.2</td><td>6.000</td><td>20.4</td><td></td><td></td></tr><tr><td>1.000</td><td>8.7</td><td>2.600</td><td>13.7</td><td>6.500</td><td>21.2</td><td></td><td></td></tr></table>			Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.200	9.5	Kick-Flo®	0.773	7.7	Flush-Flo™	0.356	9.5	Mean Flow over Head Range	-	8.2	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	5.0	1.200	9.5	3.000	14.7	7.000	22.0	0.200	9.0	1.400	10.2	3.500	15.8	7.500	22.7	0.300	9.4	1.600	10.9	4.000	16.8	8.000	23.4	0.400	9.5	1.800	11.5	4.500	17.8	8.500	24.1	0.500	9.3	2.000	12.1	5.000	18.7	9.000	24.8	0.600	9.0	2.200	12.6	5.500	19.6	9.500	25.5	0.800	7.9	2.400	13.2	6.000	20.4			1.000	8.7	2.600	13.7	6.500	21.2		
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)																																																																																							
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Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP																																																			
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File PJS Storm model Dec 2.mdx		Checked by																																																	
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<u>Storage Structures for Surface Network 1</u> <u>Tank or Pond Manhole: S15, DS/PN: 1.013</u> Invert Level (m) 128.200 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr><tr><td>0.000</td><td>457.9</td><td>0.500</td><td>617.5</td><td>1.000</td><td>799.9</td><td>1.500</td><td>944.0</td></tr><tr><td>0.100</td><td>488.0</td><td>0.600</td><td>652.1</td><td>1.100</td><td>839.1</td><td>1.549</td><td>955.3</td></tr><tr><td>0.200</td><td>519.0</td><td>0.700</td><td>687.7</td><td>1.200</td><td>879.2</td><td>1.550</td><td>428.7</td></tr><tr><td>0.300</td><td>550.9</td><td>0.800</td><td>724.2</td><td>1.300</td><td>900.7</td><td></td><td></td></tr><tr><td>0.400</td><td>583.7</td><td>0.900</td><td>761.6</td><td>1.400</td><td>921.8</td><td></td><td></td></tr></table>				Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	457.9	0.500	617.5	1.000	799.9	1.500	944.0	0.100	488.0	0.600	652.1	1.100	839.1	1.549	955.3	0.200	519.0	0.700	687.7	1.200	879.2	1.550	428.7	0.300	550.9	0.800	724.2	1.300	900.7			0.400	583.7	0.900	761.6	1.400	921.8		
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PJS Consulting Engineers Limited								Page 5	
Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP									
Date 14/12/2022 16:30				Designed by leighton.dawson					
File PJS Storm model Dec 2.mdx				Checked by					
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<u>Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1</u>									
<u>Simulation Criteria</u>									
Areal Reduction Factor		1.000	Additional Flow - % of Total Flow		0.000				
Hot Start (mins)		0	MADD Factor * 10m³/ha Storage		0.000				
Hot Start Level (mm)		0	Inlet Coefficient		0.800				
Manhole Headloss Coeff (Global)		0.500	Flow per Person per Day (l/per/day)		0.000				
Foul Sewage per hectare (l/s)		0.000							
Number of Input Hydrographs		0	Number of Offline Controls		0	Number of Time/Area Diagrams		0	
Number of Online Controls		1	Number of Storage Structures		1	Number of Real Time Controls		0	
<u>Synthetic Rainfall Details</u>									
Rainfall Model		FSR	Ratio R		0.400				
Region		England and Wales		Cv (Summer)	0.750				
M5-60 (mm)		20.900	Cv (Winter)		0.840				
Margin for Flood Risk Warning (mm)		300.0							
Analysis Timestep		2.5 Second Increment (Extended)							
DTS Status		OFF							
DVD Status		OFF							
Inertia Status		OFF							
Profile(s)		Summer and Winter							
Duration(s) (mins)		15, 30, 60, 120, 240, 360, 480, 960, 1440							
Return Period(s) (years)		100							
Climate Change (%)		40							
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level
									(m)
1.000	S1	15 Winter	100	+40%	100/15 Winter				142.018
1.001	S2	15 Winter	100	+40%	100/15 Summer				141.805
1.002	S3	15 Winter	100	+40%	100/15 Summer	100/15 Summer			141.103
1.003	S4	15 Winter	100	+40%	100/15 Summer				140.174
1.004	S5	15 Winter	100	+40%	100/15 Summer				139.253
1.005	S6	15 Winter	100	+40%	100/15 Summer				138.364
1.006	S7	15 Winter	100	+40%	100/15 Summer	100/15 Summer			136.897
1.007	S8	15 Winter	100	+40%	100/15 Summer	100/15 Summer			135.042
2.000	S9	15 Winter	100	+40%					140.848
2.001	S10	15 Winter	100	+40%	100/15 Summer				137.568
1.008	S11	15 Winter	100	+40%	100/15 Summer	100/15 Summer			133.723
1.009	S12	15 Winter	100	+40%	100/15 Summer				132.835
1.010	S19	15 Winter	100	+40%	100/15 Summer				131.948
1.011	S13	15 Winter	100	+40%	100/15 Summer				129.780
1.012	S14	15 Winter	100	+40%	100/15 Summer				129.204
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PJS Consulting Engineers Limited		Page 6
Unit 4 Winking Hill Farm Kingston-on-Soar, Nottingham Nottinghamshire NG11 0DP		
Date 14/12/2022 16:30 File PJS Storm model Dec 2.mdx	Designed by leighton.dawson Checked by	
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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged		Flooded		Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)			
1.000	S1	0.043	0.000	0.52		49.8	SURCHARGED	
1.001	S2	0.821	0.000	0.79		84.1	SURCHARGED	
1.002	S3	1.212	1.699	1.03		125.4	FLOOD	2
1.003	S4	1.418	0.000	1.05		140.6	FLOOD RISK	
1.004	S5	1.467	0.000	1.06		186.8	SURCHARGED	
1.005	S6	1.348	0.000	0.97		216.5	FLOOD RISK	
1.006	S7	1.346	4.387	1.05		234.7	FLOOD	3
1.007	S8	1.241	3.307	1.16		276.4	FLOOD	3
2.000	S9	-0.057	0.000	0.91		144.3	OK	
2.001	S10	0.471	0.000	0.89		135.5	SURCHARGED	
1.008	S11	1.398	3.709	1.14		384.4	FLOOD	2
1.009	S12	1.250	0.000	1.14		384.9	SURCHARGED	
1.010	S19	1.110	0.000	1.11		428.1	SURCHARGED	
1.011	S13	0.706	0.000	2.14		425.1	FLOOD RISK	
1.012	S14	0.254	0.000	1.38		426.3	FLOOD RISK	

