LANMOR Consulting

Civil Engineers & Transport Planners

91 Station Road

Drainage Strategy and Flood Risk Assessment

January 2021

211378/DS/MK/RS/01

LANMOR Consulting

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1 INTRODUCTION

1.1 Scope

1.1.1 Lanmor Consulting has been appointed to prepare a drainage strategy for the redevelopment of the site at 91 Station Road, Yiewsley, West Drayton, Middlesex, UB7 7LT for student accommodation, with a commercial unit at ground level. This report has been commissioned to advise on the technical feasibility of providing drainage for the proposed development. Figure 1.1 below shows the location of the site.

Figure 1.1 – Location Plan

1.1.2 This report will consider the proposed drainage regime for the site, it will assess the site's current Greenfield and Brownfield runoff rates, suitable methods of discharging the runoff from the development and set the drainage strategy for the proposed development, including discharge rates and any requirements for attenuation.

1.1.3 The information and details within this report will be refined, modified and updated as the detailed design is progressed, post planning. The scope of works for this drainage strategy report is outlined below:

- Review available data relating to existing on-site drainage and other drainage networks in the vicinity of the site.
- Review of the site's ground conditions for suitability of SuDS.
- Consider the use of Sustainable Drainage Systems as an option for disposal of surface water runoff from the proposed development.
- Undertake drainage assessments of proposed buildings to establish discharge rates and attenuation requirements to deal with any increased surface water runoff.

2 SITE LOCATION AND DESCRIPTION

2.1 Location

2.1.1 The site is located in the London Borough of Hillingdon. The nearest watercourses are the Fray's River and the Grand Union Canal which are located approximately 350m to the west and 270m to the north of the site respectively. The site covers an area of 0.031 hectares and is currently occupied by a hot food takeaway at the front and a private hire and courier service office at the rear.

2.1.2 The site is located within an area of mixed use consisting of residential and commercial uses. Yiewsley Town Centre is located approximately 950m to the north with Uxbridge located a further 4.4km to the north. The site is generally flat with levels varying from 50.09mAOD to 50.97mAOD. The topographical survey is included within Appendix A as Drawing PA-101.

2.2 Proposed Development

2.2.1 The proposed redevelopment will involve the construction of a mixed use, student accommodation-led development comprising of a 3 storey building to provide 15 student rooms and 1 commercial unit (Class E(a-c)) at ground floor following the demolition of the existing buildings. Drawing PA-110 shows the proposed site plan and this is enclosed within Appendix A.

2.3 Regional Geology

2.3.1 The British Geological Survey indicates that the site has an underlying bedrock of London Clay Formation, which consists primarily of clay, silt and sand. Sedimentary Bedrock formed approximately 48 to 56 million years ago in the Palaeogene Period. Local environment previously dominated by deep seas.

2.3.2 Superficial deposits of Langley Silt Member, which consists of lay and silt and was formed up to 2 million years ago in the Quaternary Period.

3 LOCAL AND NATIONAL GOVERNMENT POLICY

3.1 London Plan (March 2016)

3.1.1 Within the London Plan it states;

POLICY 5.13 SUSTAINABLE DRAINAGE

Planning decisions

A Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1. *store rainwater for later use*
2. *use infiltration techniques, such as porous surfaces in non-clay areas*
3. *attenuate rainwater in ponds or open water features for gradual release*
4. *attenuate rainwater by storing in tanks or sealed water features for gradual release*
5. *discharge rainwater direct to a watercourse*
6. *discharge rainwater to a surface water sewer/drain*
7. *discharge rainwater to the combined sewer.*

Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

3.1.2 The London Plan acknowledges that the sustainable drainage hierarchy has an important role to play in facilitating sustainable development. Implementation of the hierarchy will lead to a steady reduction in the overall amount of rainfall being discharged to the drainage system. The proposed development site has been assessed against the hierarchy in Section 5.2 of this report.

3.1.3 The Policy SI13 (Sustainable Drainage) in the Draft New London Plan maintains this and adds within the hierarchy the use of green roofs and rainwater attenuation above ground i.e. blue roofs. It also states: “The benefit of attenuation above compared to below ground or in a basement is that pumping is normally not required to empty the attenuation tank.”

3.2 London Borough of Hillingdon Policies

3.2.1 Within the development management policies adopted in January 2020, it states within section 6.46 under 'Water Management' the following:

"Sustainable drainage systems (SuDS) are vital in addressing Hillingdon's surface water flood risk, which is predicted to rise as climate change increases the frequency of heavy rainfall and as further new development and intensification within the Borough increases the volume of waste and surface water going into the existing drainage infrastructure. SuDS manage runoff from developments, reducing the quantity of water entering drains, especially at peak periods, improving the quantity of runoff and promoting amenity and biodiversity benefits from using water in the environment."

3.2.2 Policy DMEI 10: Water Management, Efficiency, and Quality below describes the proposed measures taken by the London Borough of Hillingdon.

A. *Applications for all new build developments (not conversions, change of use, or refurbishment) are required to include a drainage assessment demonstrating that appropriate sustainable drainage systems (SuDS) have been incorporated in accordance with the London Plan Hierarchy (Policy 5.13: Sustainable drainage).*

B. *All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100 year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification.*

C. *Rain Gardens and non householder development should be designed to reduce surface water run-off rates to Greenfield run-off rates.*

D. *Schemes for the use of SuDS must be accompanied by adequate arrangements for the management and maintenance of the measures used, with appropriate contributions made to the Council where necessary.*

E. *Proposals that would fail to make adequate provision for the control and reduction of surface water run-off rates will be refused.*

F. *Developments should be drained by a SuDs system and must include appropriate methods to avoid pollution of the water environment. Preference should be given to utilising the drainage options in the SuDS hierarchy which remove the key pollutants that hinder improving water quality in Hillingdon. Major development should adopt a 'treatment train' approach where water flows through different SuDS to ensure resilience in the system.*

Water Efficiency

G. *All new development proposals (including refurbishments and conversions) will be required to include water efficiency measures, including the collection and reuse of rain water and grey water.*

H. *All new residential development should demonstrate water usage rates of no more than 105 litres/person/day.*

I. *It is expected that major development proposals will provide an integrated approach to surface water run-off attenuation, water collection, recycling and reuse.*

Water and Wastewater Infrastructure

J. *All new development proposals will be required to demonstrate that there is sufficient capacity in the water and wastewater infrastructure network to support the proposed development. Where there is a capacity constraint the local planning authority will require the developer to provide a detailed water and/or drainage strategy to inform what infrastructure is required, where, when and how it will be delivered.*

4 EXISTING DRAINAGE

4.1 Existing Foul Drainage

4.1.1 As part of the investigation into the existing drainage regime, Thames Water sewer records were obtained. According to the mapping there is a foul water sewer located to the south of the site beneath Station Road.

4.1.2 The foul sewer consists of a 225mm diameter pipe travelling west along Station Road. The nearest listed foul manhole is 1803 located directly outside the site's access, with a recorded cover level of 29.13m and an invert level of 25.12m.

4.2 Existing Surface Water Drainage

4.2.1 The Thames Water records also show there is an existing surface water sewer running parallel to the foul sewer south of the site along Station Road. The sewer consists of a 225mm diameter pipe travelling east.

4.2.2 The nearest surface water manhole is 1802, with a recorded cover level of 29.10m and an invert level of 27.04m. The Thames Water asset records are included in Appendix B of this report.

4.2.3 The topographical survey of the site also shows there are various manholes located in the site access therefore it is assumed that there are sewers serving the application site which discharge out into Station Road to the Thames Water sewers.

5 PROPOSED DRAINAGE REGIME

5.1 Proposed Foul Water Drainage

5.1.1 A new network of foul drainage will be provided to serve the building. Foul water will be collected through a series of pipes from the units and discharged into the existing private sewer on site, beneath the existing vehicular access via a pump located in the plant room. This sewer is assumed to be a foul sewer which discharges to the Thames Water sewer under Station Road however this is subject to a CCTV survey.

5.1.2 The proposals will allow for foul water drainage to discharge to the local drainage network via the existing network. A S106 application will be submitted to Thames Water.

5.2 Proposed Surface Water Drainage

5.2.1 Sustainable Drainage Systems (SuDS) were considered as part of this assessment for disposal of surface water run from the development. The use of both green roofs and blue roofs will be implemented within the design of the roof. Therefore, the roof construction for the green and blue roofs will contain a reservoir 150mm below the green roof to attenuate the runoff.

5.2.2 Rainwater harvesting was also considered to reuse surface water runoff within the units. These systems require a separate network of pipework in the building, tanks and pumps to store the rainwater and distribute it throughout the building. If there were consecutive storms the harvesting tank would be full at the start of the storm and all the runoff would discharge via the overflow, so no attenuation runoff from the site would be provided. Given the rainwater harvesting cannot be relied upon to reduce the rate of runoff from the site and the additional costs for the necessary infrastructure to implement it, rainwater harvesting has therefore been discounted.

5.2.3 Next on the sustainable drainage hierarchy is the use of ground infiltration techniques such as soakaways and infiltration basins. Local geology records indicated that the underlying bedrock consists of London Clay. Therefore, it has been determined that infiltration techniques will not be suitable for the discharge of surface water for the proposed development.

5.2.4 Discharge to watercourse is the next option on the drainage hierarchy. There are no watercourses located within the immediate vicinity of the site. Thus, discharge to watercourse has been discounted.

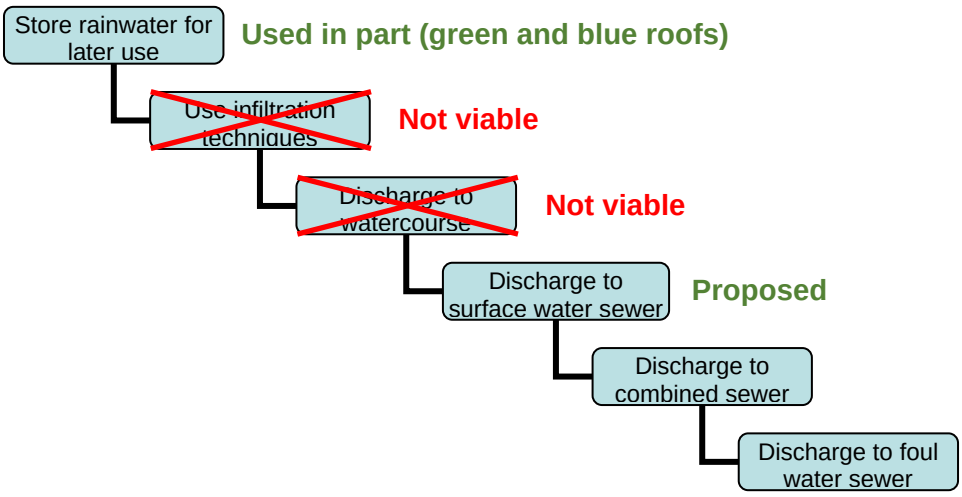


Figure 5.1 – Sustainable Drainage Hierarchy

5.2.5 Next on the Sustainable Drainage Hierarchy is discharge to surface water sewer. As there is Thames Water surface water sewer located outside the site beneath Station Road, the proposed drainage strategy will provide a new connection to the public sewer via attenuation in green and blue roofs, restricted by a pump.

5.2.6 Calculations have been undertaken to determine the Greenfield and Brownfield runoff rates for the existing site. The rates are tabulated below in Table 5.1. The full calculations are included in Appendix C.

	Discharge (l/s)			
Return Period	Greenfield Rate	Brownfield Rate	Proposed Rate	Percentage Reduction
Q_{bar}	0.1 l/s	-	-	-
1 in 1	0.0 l/s	2.6 l/s	2.6 l/s	0%
1 in 30	0.1 l/s	6.2 l/s	2.6 l/s	58%
1 in 100	0.2 l/s	8.2 l/s	2.6 l/s	68%
1 in 100 +40% CC	-	-	2.6 l/s	-

Table 5.1 – Existing & Proposed Run-off Rates

5.2.7 As shown in the table above, the greenfield rate for the 1 in 1 year return period is too low therefore it is not possible to limit the proposed discharge rate to greenfield Rate. Therefore, to ensure that the risk of blockages and flooding within the pump is kept to a minimum, the discharge will be set to the current brownfield rate for the 1 in 1 year return period of 2.6 l/s.

5.2.8 The roof area from the proposed building and the patio area will drain via rainwater pipes and gully's to a series of manholes and pipes, before flowing to the proposed pump which has been located in the plant room and then discharged to the Thames Water surface water sewer located on Station Road, subject to a S106 application.

5.2.9 Attenuation will be provided in the green and blue roof, it has been designed with a surface area of 190m^2, with a 0.15m deep reservoir beneath to achieve a storage volume of 6.4m^3. The attenuation of the surface water runoff has been designed to cater for all events up to and including a 1 in 100 year storm, including a 40% allowance for climate change. Drawings 211378/DS/01-03 in Appendix C illustrates the proposed drainage strategy for the development. MicroDrainage calculations have also been completed to assess the design of the surface water drainage system, these are enclosed within Appendix C.

6 SUDS MANAGEMENT & MAINTENANCE

6.1.1 Regularly inspection of the surface water drainage network for blockages and clearing unwanted debris/silt from the system should improve the performance of the surface water network and decrease the need for future repairs. In the event of blockages, high pressure water jets can be used to clear the gullies and pipes to ensure they are functioning correctly, this should be undertaken by certified trained professionals.

6.1.2 The level and frequency of maintenance required on site is dependent on the type of facility. The type of maintenance will fall into one of three categories “regular maintenance”, “occasional maintenance” and “remedial maintenance”.

6.1.3 Regular maintenance of the drainage and SuDS features will include, inspections, removal of litter / debris and sweeping of the surfaces. Occasional maintenance will include removal of sediment etc. and remedial maintenance may include structural repairs and infiltration reconditioning if required.

6.1.4 The drainage and SuDS elements after an initial inspection following construction should be inspected on a monthly basis for the first 12 months and after large storms, thereafter the following maintenance regime should be applied and adjusted if the 12-month monitoring process has identified any issues.

6.1.5 Following completion of the development a Management Company will be set up to maintain all the communal areas, including the drainage. It will be their responsibility to maintain the drainage network, including the SuDS elements.

6.2 Green Roofs

6.2.1 For the green roof, the following maintenance will be required as per the CIRIA SuDS Manual 2015.

TABLE 12.5 Operation and maintenance requirements for green roofs

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where > 5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

Table 6.1 – Green Roof Maintenance

6.3 Blue Roofs

6.3.1 The following blue roof maintenance recommendations have been obtained from a blue roof manufacturer known as Bauder and is set out below:

"Maintenance of a blue roof is critical to the viability to its function. It is recommended that:

1. *Following any significant storm event, the outlets should be visually inspected to ensure no blockage has occurred.*

2. *Following any significant traffic or remedial works that take place on or around the roof, each of the outlets should be visually inspected to ensure all drainage holes are clear and free draining.*

3. *Quarterly each outlet, should be inspected and cleared of any build up or debris. All leaf litter mainly autumnal visit, should be removed from the roof surface. Debris must be removed from the roof and not simply flushed down rainwater pipes.*

4. *Cut back tree limbs that overhang the roof to give at least a 1 metre clearance, this will significantly reduce any risk of any blockage to outlets.*

It is also recommend during maintenance visits to visually inspect the waterproofing system at all upstands, to ensure it is firmly adhered to the detail that it is waterproofing."

7 FLOOD RISK TO SITE

7.1.1 The proposed site is within Flood Zone 1, this is defined as land assessed as having a less than 0.1% probability of river or sea flooding in any year. The Figure 7.1 below shows the EA flood map.

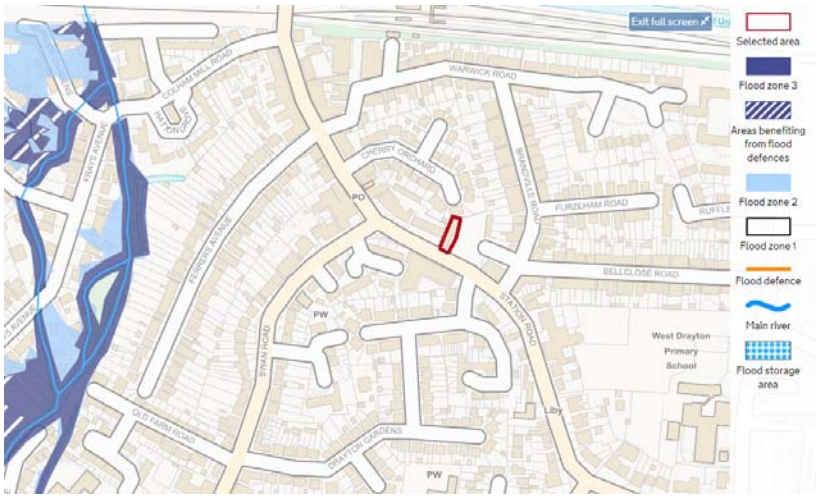


Figure 7.1 – EA Flood Map

7.1.2 The flood information on the Environment Agency's website indicates that the site is not in an area at risk of surface water flooding with a probability of 1.0%. Due to this, it is possible to provide a safe, dry access to and from the site during an extreme flooding event. The Figure 7.2 below outlines the EA surface water flood map and that the site is at very low risk as well as Station Road with no surface water flooding allowing a safe and dry route for access and egress.

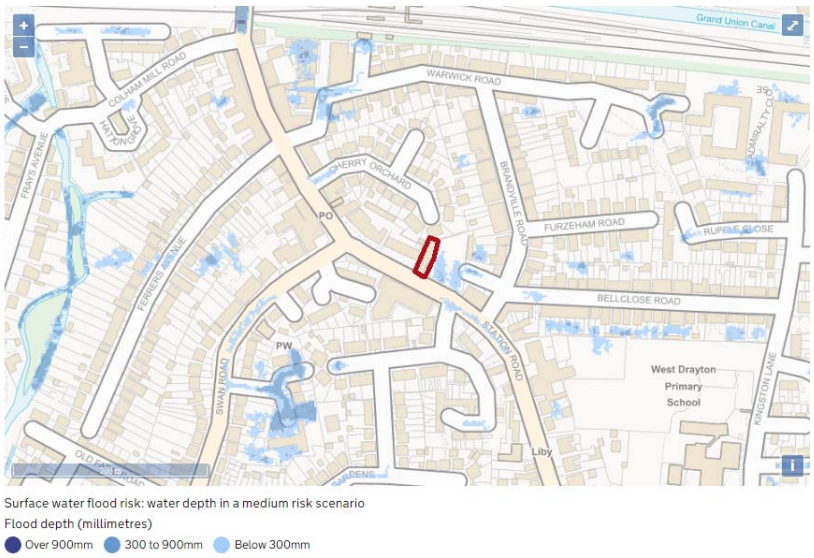


Figure 7.2 – EA Surface Water Flood Map

7.2 Flood Probability and Climate Change

7.2.1 Past, present and future emissions of greenhouse gases are expected to cause significant global climate change during this century – the nature of climate change at regional level will vary. The NPPF recommends that FRA's should consider the future flood levels and the impact climate change may have on rising sea levels, increased rainfall etc.

7.2.2 This FRA has considered changes in flood water levels due to climate change. The flood modelling undertaken by the EA includes an increase for climate change allowances. When the climate change allowances are factored in the site is still in Flood Zone 1 and some distance from Zones 2 & 3. The increase in flood levels resulting from climate change will have no impact of the proposed development.

7.3 Impacts of Flooding

7.3.1 The site is situated in a Flood Zone 1 area, which is a significant distant from Flood Zones 2 and 3. The site has a probability of flooding of less than 0.1% (1 in 1000 years) and there is no history of the site being subject to fluvial flooding or from any other source.

7.3.2 The proposed development is located above the flood level for an event with a probability of 1.0% plus CC or greater. Given the site is above the flood level it will not affect the flow of flood waters or displace any flood volumes associated with an event of 1.0% AEP +CC or greater.

7.3.3 According to EA Flood Maps and the SFRA, the site is assessed as having a less than 0.1% probability of flooding. The site is a significant distance from the nearest fluvial flooding sources and hasn't been affected by flooding in the past. Therefore, a flood event will have no impact on the proposed development and will not cause and damage to the buildings or present a risk to residents in the development.

7.3.4 Since the site is not in Flood Zones 2 and 3, the proposed development is not prone to flooding with a probability of 1.0% or greater a safe access can be provided to and from the site at all times. Overall, the residual risk is considered minimal as the site is located within Flood Zone 1 and safe access can be provided.

7.4 Sequential Test

7.4.1 The principal of the sequential test is to assess locations and prioritise developments to areas at less risk of flooding. National Planning Policy Framework 2019 suggests that Regional Planning Bodies and Local Planning Authorities should ensure their regional spatial strategies include a broad consideration of flood risk.

7.4.2 Within the Technical Guidance to the National Planning Policy Framework, Table 2 categorises each type of development into a flood risk vulnerability. The proposed development is considered 'More Vulnerable' when it comes to flood risk. Any site that is 'More Vulnerable' and located in Flood Zone 1 is considered appropriate for development and does not require the application of the exception test.

8 SUMMARY AND CONCLUSION

8.1.1 The proposed application site is located within the London Borough of Hillingdon. The proposed development will involve the construction of a new student accommodation building providing 15 student rooms and a shop at ground floor.

8.1.2 As part of the assessment, a SuDS assessment has been completed for the discharge of surface water runoff from the proposed building and amenity areas. The proposed building will have flat roofs and a combination of green and blue roofs will be implemented. Ground conditions were not favourable for the use of infiltration techniques and therefore it was proposed that attenuation will be provided within the blue roof before discharging via a pump to the existing Thames Water sewer beneath Station Road.

8.1.3 The blue roof has been sized with an area of 190m^2, with a 0.15m reservoirs beneath to achieve a storage volume of 6.4m^3. The provided storage will be sufficient storage for all events up to and including the 1 in 100 year storm plus 40% climate change. A pump will be used to restrict the flow from the roof with a discharge rate of 2.6 l/s. A Section 106 application will be made to Thames Water for the new connection onto their sewer. A green roof is also incorporated into the proposed design to reduce the flow and pressure on the surface water sewer.

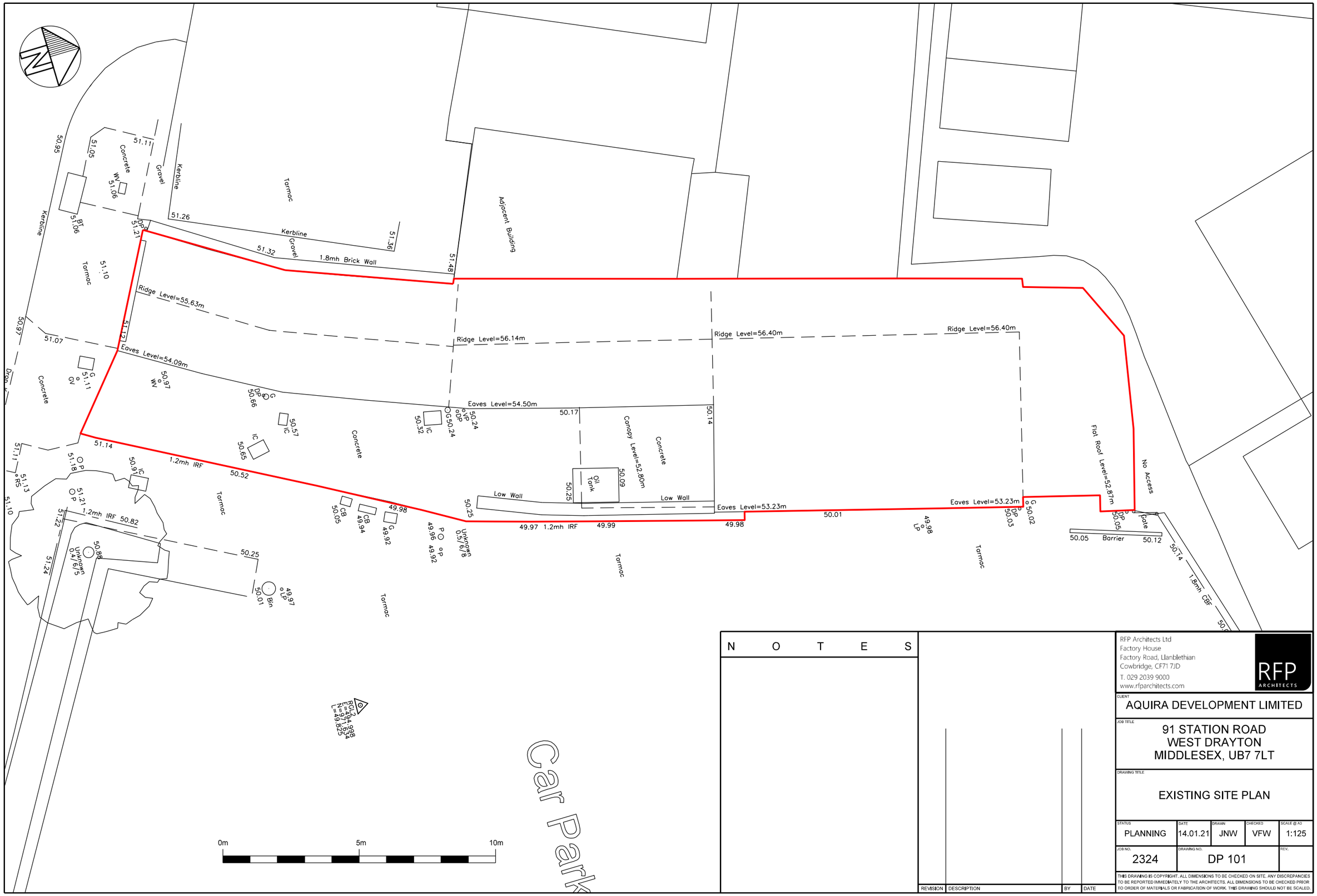
8.1.4 The foul water will discharge to the existing assumed private foul sewer on site which possibly connects onto the Thames Water sewer located to the south beneath Station Road, this is subject to a CCTV survey. A Section 106 application will also be made to utilise this connection.

8.1.5 The proposed development site is located in Flood Zone 1 and is at very Low risk of surface water flooding.

8.1.6 This report has shown that the drainage strategy proposed is in accordance with the Sustainable Drainage Hierarchy. Therefore, suitable foul and surface water drainage can be provided for the proposed development. For the reasons outlined within this drainage strategy, we see no reason to refuse planning permission on the grounds of there being insufficient capacity to discharge runoff from the development.

APPENDIX A

Drawing PA-101 – Topographical Survey



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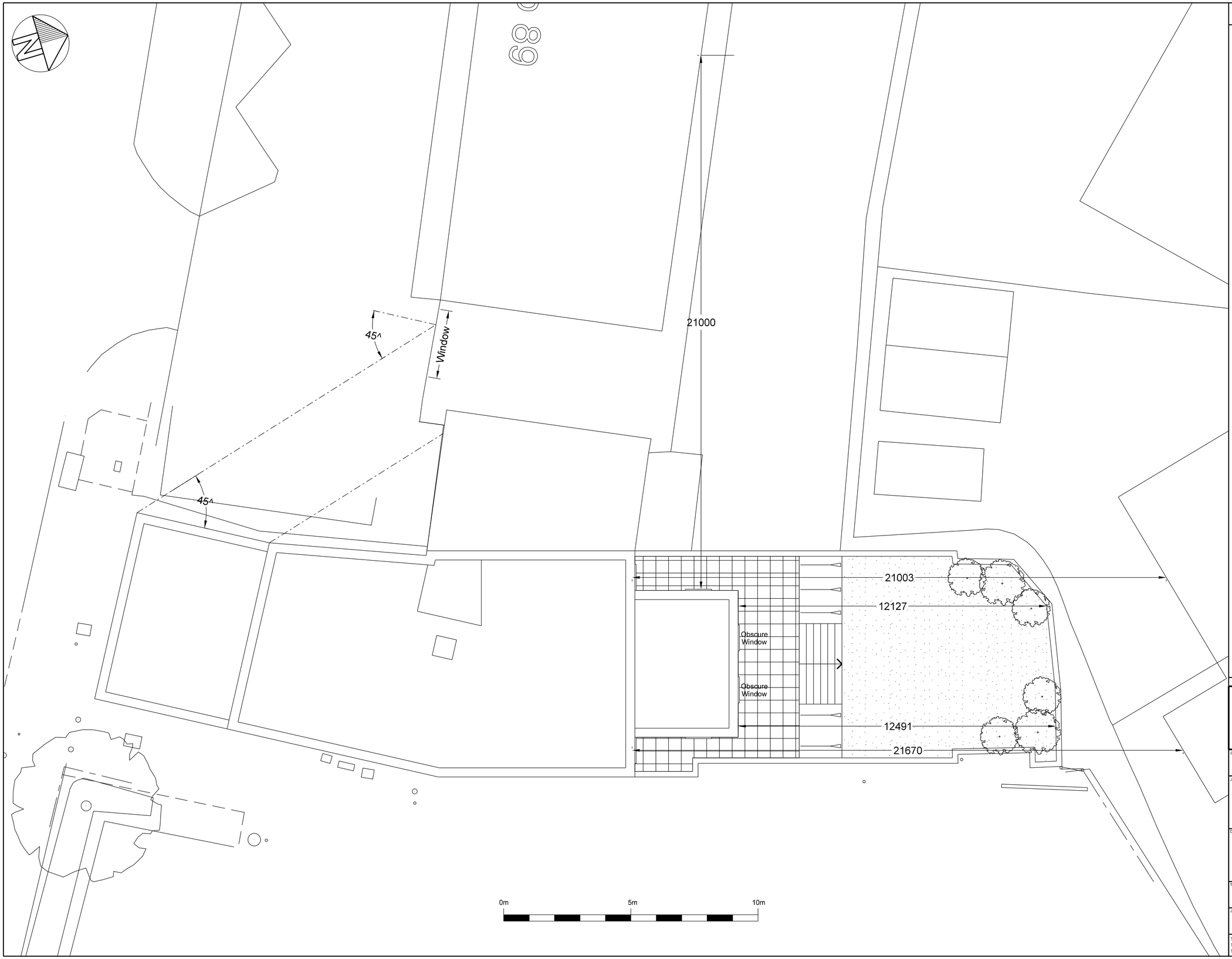
DRAWING TITLE
EXISTING SITE PLAN

STATUS	DATE	DRAWN	CHECKED	SCALE @ A3
PLANNING	14.01.21	JNW	VFW	1:125

JOB NO.	DRAWING NO.	REV.
2324	DP 101	

Drawing PA-110 – Proposed Site Plan



N O T E S

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DRAWING TITLE
PROPOSED SITE PLAN

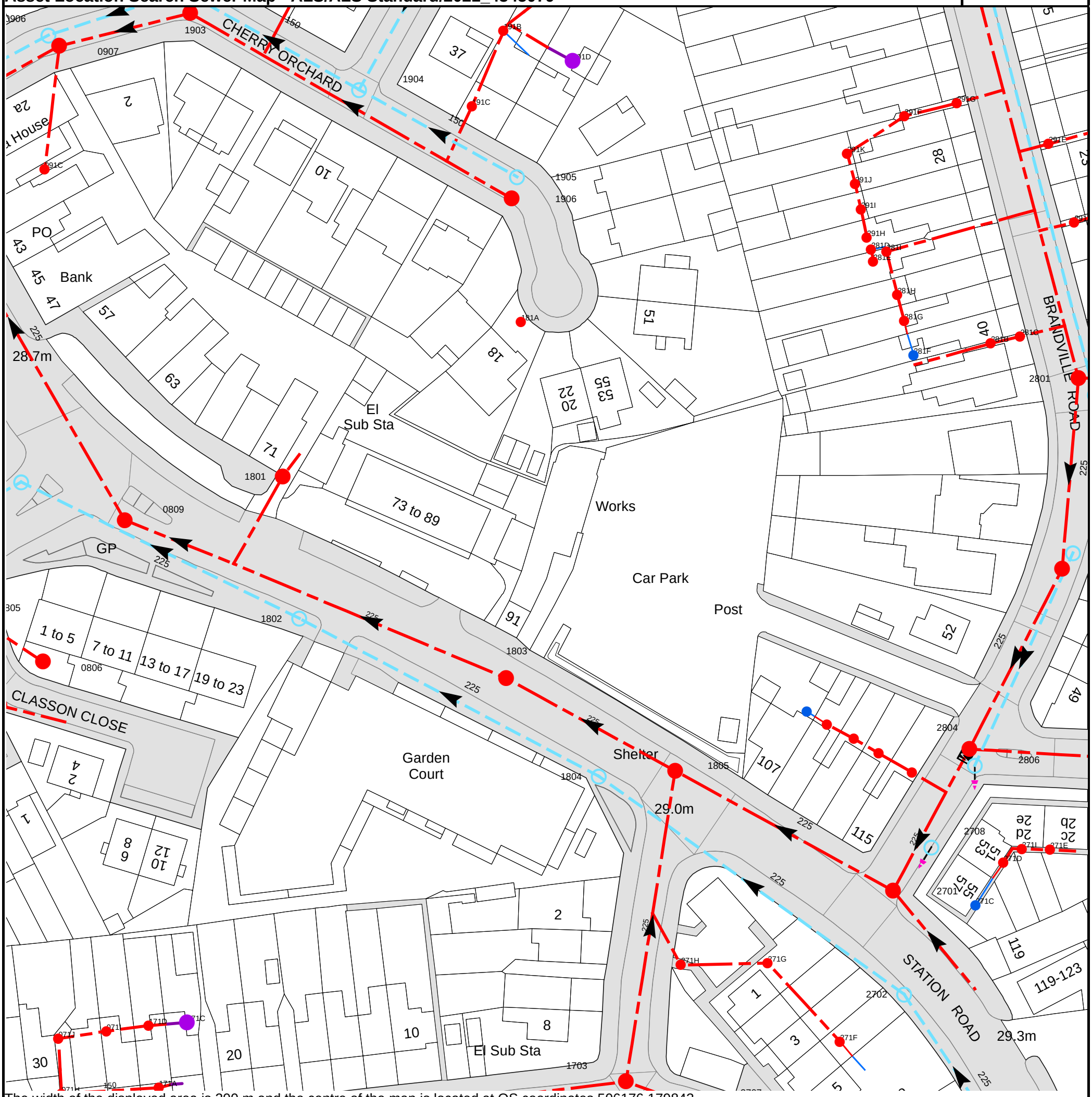
STATUS	DATE	DRAWN	CHECKED	SCALE @ A2
PLANNING	14.01.21	JNW	VFW	1:100

JOB NO.	DRAWING NO.	REV.
2324	DP 110	

APPENDIX B

Thames Water Sewer Records

Asset Location Search Sewer Map - ALS/ALS Standard/2021_4345079



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 506176,179843

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
191D	n/a	n/a
291K	n/a	n/a
291J	n/a	n/a
291I	n/a	n/a
291H	n/a	n/a
281D	n/a	n/a
281E	n/a	n/a
281I	n/a	n/a
281H	n/a	n/a
281G	n/a	n/a
291F	n/a	n/a
281F	n/a	n/a
291G	n/a	n/a
281B	n/a	n/a
281C	n/a	n/a
291E	n/a	n/a
291A	n/a	n/a
181A	n/a	n/a
1906	29.58	27.05
1905	29.57	28.23
091C	n/a	n/a
191C	n/a	n/a
1904	29.21	28.04
0907	28.69	26.49
0906	28.56	27.63
191B	n/a	n/a
1903	n/a	n/a
2811	n/a	n/a
2701	29.33	25.47
2812	n/a	n/a
2708	29.16	27.93
2804	n/a	n/a
2806	29.76	26.79
271C	n/a	n/a
271D	n/a	n/a
271I	n/a	n/a
271E	n/a	n/a
2803	28.89	26.79
2805	n/a	n/a
2801	29.03	27.71
2802	29.01	27.51
0808	28.27	25.97
0806	n/a	n/a
071J	n/a	n/a
071I	n/a	n/a
0809	28.61	24.75
171D	n/a	n/a
171C	n/a	n/a
1801	29.18	26.53
1802	29.1	27.04
1803	29.13	25.12
1804	29.14	27.5
1703	30.46	25.62
1805	29.18	25.26
271H	n/a	n/a
271G	n/a	n/a
2808	n/a	n/a
2809	n/a	n/a
271F	n/a	n/a
2810	n/a	n/a
171A	n/a	n/a
2702	29.28	27.73

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

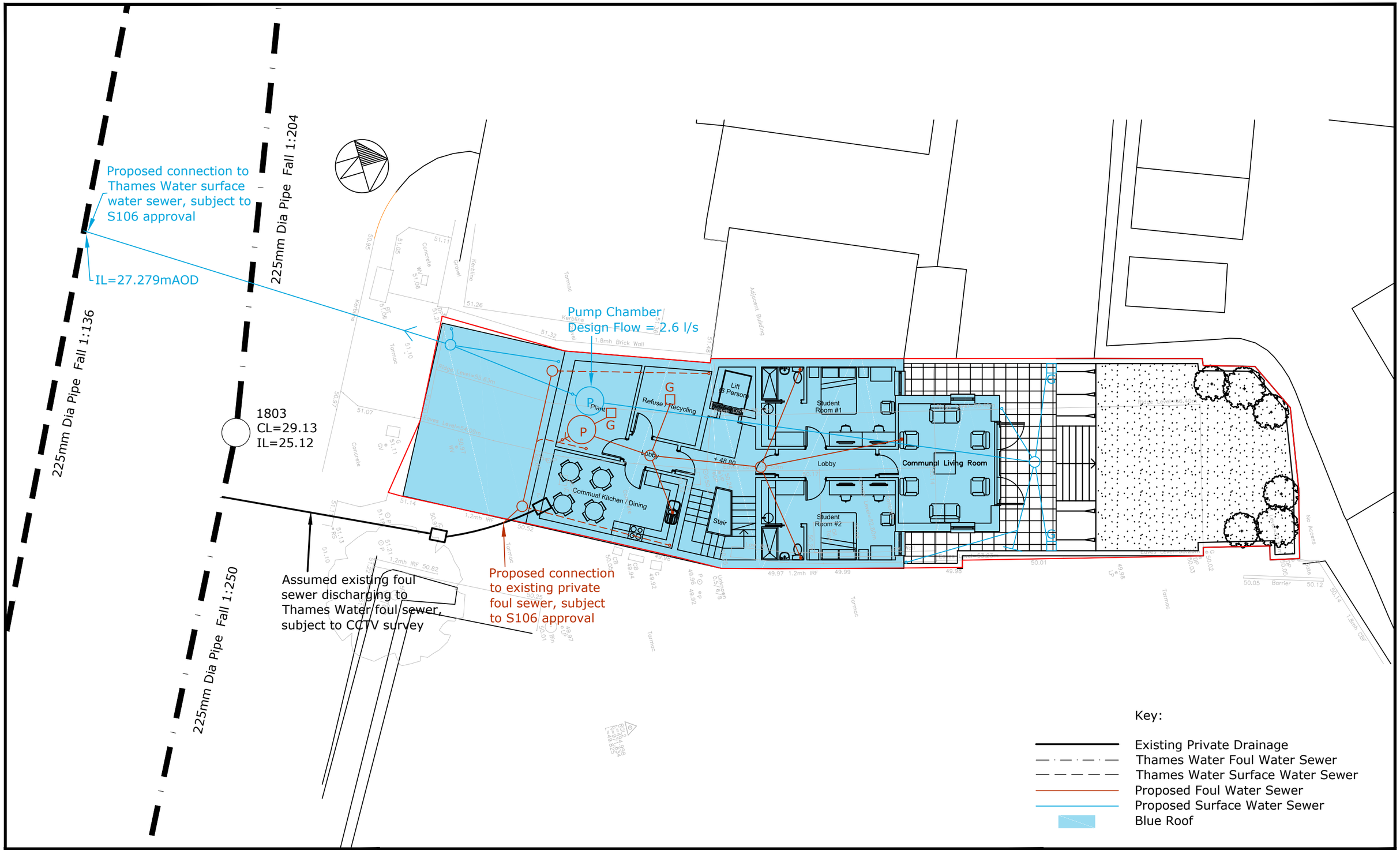
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0800 009 4540.

APPENDIX C

Drawing 211378/DS/01, 02 and 03 – Proposed Drainage Strategy



Aquira Development Ltd

91 Station Road
West Drayton

Proposed Drainage Strategy
Lower Ground Floor Plan

SCALE	DRAWN BY	PRJ No.	DWG No.
1:150	MK	211378	211378/DS/01

LANMOR Consulting
Civil Engineers & Transport Planning
Thorogood House, 34 Tolworth Close, Surbiton, Surrey, KT6 7EW
Telephone: 0208 339 7899 Fax: 0208 339 7898
E-mail: info@lanmor.co.uk
www.lanmor.co.uk

Aquira Development Ltd

91 Station Road
West Drayton

Proposed Drainage Strategy
Ground Floor Plan

SCALE	DRAWN BY	PRJ No.	DWG No.
1:150	MK	211378	211378/DS/02

LANMOR Consulting
Civil Engineers & Transport Planning
Thorogood House, 34 Tolworth Close, Surbiton, Surrey, KT6 7EW
Telephone: 0208 339 7899 Fax: 0208 339 7898
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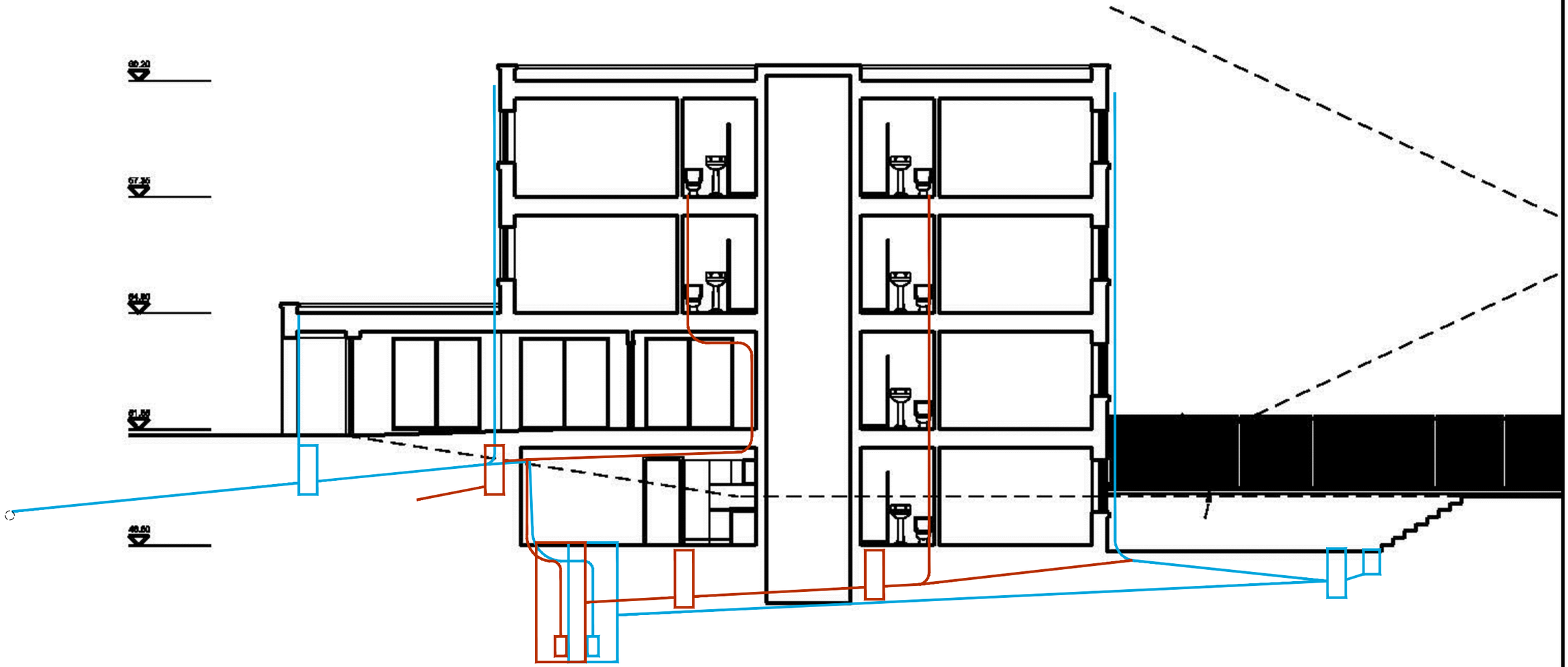
www.lanmor.co.uk



Aquira Development Ltd

91 Station Road
West Drayton

Proposed Drainage Strategy
Sewer Longsections

SCALE	DRAWN BY	PRJ No.	DWG No.
1:100	MK	211378	211378/DS/03

LANMOR Consulting
Civil Engineers & Transport Planning

Thorogood House, 34 Tolworth Close, Surbiton, Surrey, KT6 7EW
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MicroDrainage Calculations – Greenfield Runoff

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 665 Urban 0.000
Area (ha) 0.031 Soil 0.300 Region Number Region 6

Results l/s

QBAR Rural 0.1
QBAR Urban 0.1

Q100 years 0.2

Q1 year 0.0
Q30 years 0.1
Q100 years 0.2

MicroDrainage Calculations – Green/Blue Roof

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.000	0.000	0.0	0.1	Flood Risk
30 min Summer	0.002	0.002	0.0	0.3	Flood Risk
60 min Summer	0.003	0.003	0.1	0.6	Flood Risk
120 min Summer	0.004	0.004	0.1	0.9	Flood Risk
180 min Summer	0.005	0.005	0.1	0.9	Flood Risk
240 min Summer	0.005	0.005	0.1	1.0	Flood Risk
360 min Summer	0.006	0.006	0.1	1.0	Flood Risk
480 min Summer	0.006	0.006	0.1	1.1	Flood Risk
600 min Summer	0.006	0.006	0.1	1.1	Flood Risk
720 min Summer	0.006	0.006	0.1	1.0	Flood Risk
960 min Summer	0.005	0.005	0.1	1.0	Flood Risk
1440 min Summer	0.005	0.005	0.1	0.9	Flood Risk
2160 min Summer	0.004	0.004	0.1	0.8	Flood Risk
2880 min Summer	0.004	0.004	0.1	0.7	Flood Risk
4320 min Summer	0.003	0.003	0.1	0.5	Flood Risk
5760 min Summer	0.002	0.002	0.1	0.5	Flood Risk
7200 min Summer	0.002	0.002	0.1	0.4	Flood Risk
8640 min Summer	0.002	0.002	0.0	0.3	Flood Risk
10080 min Summer	0.002	0.002	0.0	0.3	Flood Risk
15 min Winter	0.001	0.001	0.0	0.2	Flood Risk
30 min Winter	0.002	0.002	0.1	0.4	Flood Risk
60 min Winter	0.004	0.004	0.1	0.7	Flood Risk
120 min Winter	0.005	0.005	0.1	1.0	Flood Risk
180 min Winter	0.006	0.006	0.1	1.1	Flood Risk
240 min Winter	0.006	0.006	0.2	1.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	30.991	0.0	0.1	93
30 min Summer	20.215	0.0	0.4	79
60 min Summer	12.800	0.0	0.8	90
120 min Summer	7.942	0.0	1.1	130
180 min Summer	5.979	0.0	1.4	168
240 min Summer	4.882	0.0	1.6	194
360 min Summer	3.646	0.0	1.9	254
480 min Summer	2.956	0.0	2.1	320
600 min Summer	2.511	0.0	2.3	384
720 min Summer	2.199	0.0	2.4	446
960 min Summer	1.782	0.0	2.6	576
1440 min Summer	1.326	0.0	2.9	822
2160 min Summer	0.988	0.0	3.2	1176
2880 min Summer	0.800	0.0	3.3	1532
4320 min Summer	0.595	0.0	3.4	2288
5760 min Summer	0.483	0.0	3.4	3016
7200 min Summer	0.410	0.0	3.3	3672
8640 min Summer	0.359	0.0	3.3	4432
10080 min Summer	0.322	0.0	3.2	5120
15 min Winter	30.991	0.0	0.2	81
30 min Winter	20.215	0.0	0.6	77
60 min Winter	12.800	0.0	0.9	90
120 min Winter	7.942	0.0	1.4	128
180 min Winter	5.979	0.0	1.7	170
240 min Winter	4.882	0.0	2.0	198

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	0.006	0.006	0.2	1.2	Flood Risk
480 min Winter	0.006	0.006	0.2	1.2	Flood Risk
600 min Winter	0.006	0.006	0.2	1.1	Flood Risk
720 min Winter	0.006	0.006	0.1	1.1	Flood Risk
960 min Winter	0.005	0.005	0.1	1.0	Flood Risk
1440 min Winter	0.005	0.005	0.1	0.9	Flood Risk
2160 min Winter	0.004	0.004	0.1	0.7	Flood Risk
2880 min Winter	0.003	0.003	0.1	0.6	Flood Risk
4320 min Winter	0.002	0.002	0.1	0.4	Flood Risk
5760 min Winter	0.002	0.002	0.0	0.3	Flood Risk
7200 min Winter	0.002	0.002	0.0	0.3	Flood Risk
8640 min Winter	0.001	0.001	0.0	0.2	Flood Risk
10080 min Winter	0.001	0.001	0.0	0.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	3.646	0.0	2.3	268
480 min Winter	2.956	0.0	2.5	334
600 min Winter	2.511	0.0	2.7	398
720 min Winter	2.199	0.0	2.9	468
960 min Winter	1.782	0.0	3.1	598
1440 min Winter	1.326	0.0	3.5	848
2160 min Winter	0.988	0.0	3.8	1176
2880 min Winter	0.800	0.0	4.1	1548
4320 min Winter	0.595	0.0	4.2	2264
5760 min Winter	0.483	0.0	4.3	3056
7200 min Winter	0.410	0.0	4.2	3592
8640 min Winter	0.359	0.0	4.1	4536
10080 min Winter	0.322	0.0	4.0	5016

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Green Roof

Area (m^3)	190	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003453	32	36	0.000697	64	68	0.000141	96	100	0.000028
4	8	0.002827	36	40	0.000571	68	72	0.000115	100	104	0.000023
8	12	0.002314	40	44	0.000467	72	76	0.000094	104	108	0.000019
12	16	0.001895	44	48	0.000383	76	80	0.000077	108	112	0.000016
16	20	0.001551	48	52	0.000313	80	84	0.000063	112	116	0.000013
20	24	0.001270	52	56	0.000256	84	88	0.000052	116	120	0.000010
24	28	0.001040	56	60	0.000210	88	92	0.000042			
28	32	0.000851	60	64	0.000172	92	96	0.000035			

Model Details

Storage is Online Cover Level (m) 0.200

Tank or Pond Structure

Invert Level (m) 0.000

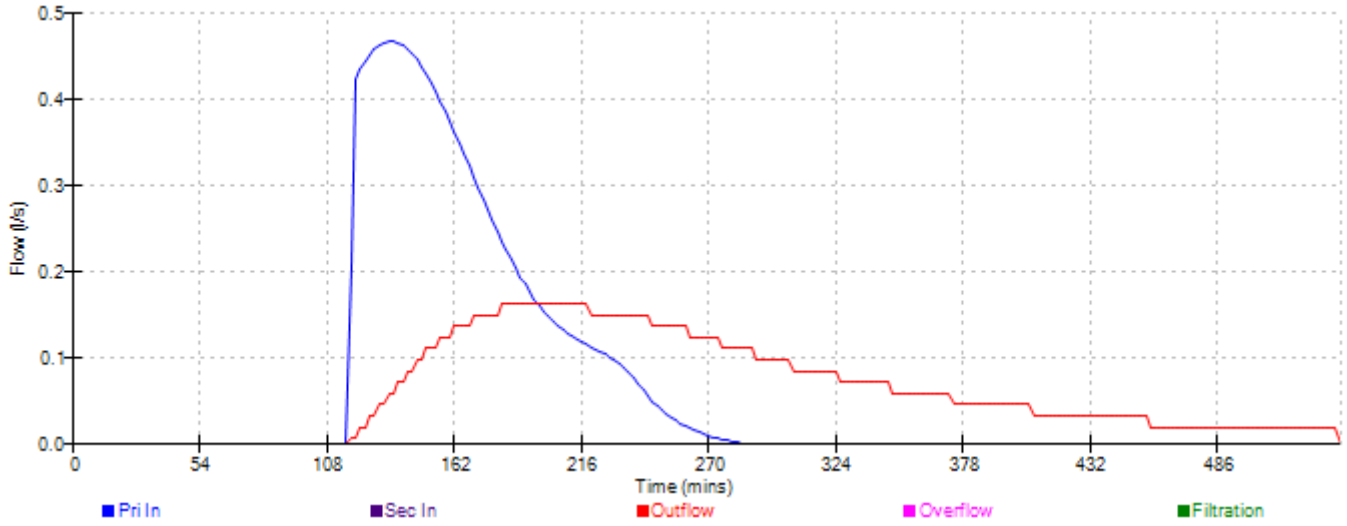
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	190.0	0.150	190.0	0.151	0.0

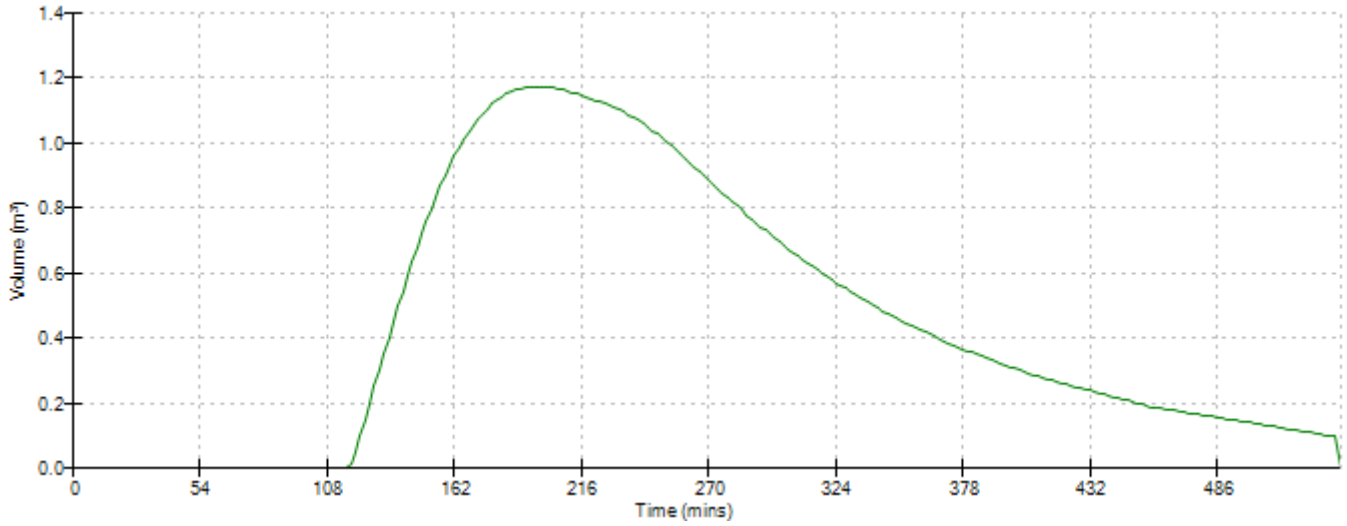
Pump Outflow Control

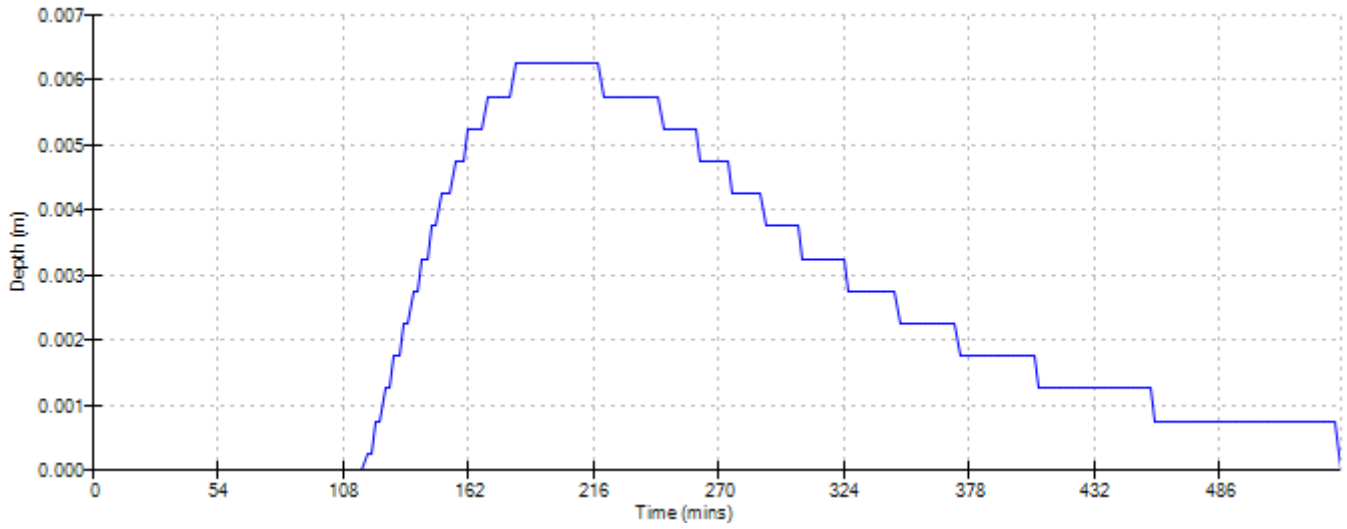
Invert Level (m) 0.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6000	0.700	2.6000	1.300	2.6000	1.900	2.6000	2.500	2.6000
0.200	2.6000	0.800	2.6000	1.400	2.6000	2.000	2.6000	2.600	2.6000
0.300	2.6000	0.900	2.6000	1.500	2.6000	2.100	2.6000	2.700	2.6000
0.400	2.6000	1.000	2.6000	1.600	2.6000	2.200	2.6000	2.800	2.6000
0.500	2.6000	1.100	2.6000	1.700	2.6000	2.300	2.6000	2.900	2.6000
0.600	2.6000	1.200	2.6000	1.800	2.6000	2.400	2.6000	3.000	2.6000

Event: 240 min Winter







Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.006	0.006	0.2	1.2	Flood Risk
30 min Summer	0.009	0.009	0.2	1.8	Flood Risk
60 min Summer	0.012	0.012	0.3	2.4	Flood Risk
120 min Summer	0.015	0.015	0.4	2.8	Flood Risk
180 min Summer	0.015	0.015	0.4	2.9	Flood Risk
240 min Summer	0.015	0.015	0.4	2.9	Flood Risk
360 min Summer	0.015	0.015	0.4	2.9	Flood Risk
480 min Summer	0.015	0.015	0.4	2.8	Flood Risk
600 min Summer	0.014	0.014	0.4	2.7	Flood Risk
720 min Summer	0.014	0.014	0.4	2.6	Flood Risk
960 min Summer	0.013	0.013	0.3	2.4	Flood Risk
1440 min Summer	0.011	0.011	0.3	2.1	Flood Risk
2160 min Summer	0.009	0.009	0.2	1.7	Flood Risk
2880 min Summer	0.008	0.008	0.2	1.4	Flood Risk
4320 min Summer	0.006	0.006	0.1	1.1	Flood Risk
5760 min Summer	0.005	0.005	0.1	0.9	Flood Risk
7200 min Summer	0.004	0.004	0.1	0.8	Flood Risk
8640 min Summer	0.004	0.004	0.1	0.7	Flood Risk
10080 min Summer	0.003	0.003	0.1	0.6	Flood Risk
15 min Winter	0.008	0.008	0.2	1.4	Flood Risk
30 min Winter	0.011	0.011	0.3	2.1	Flood Risk
60 min Winter	0.014	0.014	0.4	2.7	Flood Risk
120 min Winter	0.017	0.017	0.4	3.2	Flood Risk
180 min Winter	0.017	0.017	0.4	3.3	Flood Risk
240 min Winter	0.017	0.017	0.4	3.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.035	0.0	1.6	60
30 min Summer	49.499	0.0	2.4	65
60 min Summer	30.811	0.0	3.4	82
120 min Summer	18.615	0.0	4.3	122
180 min Summer	13.715	0.0	4.8	154
240 min Summer	10.995	0.0	5.1	184
360 min Summer	8.034	0.0	5.7	248
480 min Summer	6.428	0.0	6.1	312
600 min Summer	5.404	0.0	6.4	376
720 min Summer	4.687	0.0	6.7	438
960 min Summer	3.743	0.0	7.1	564
1440 min Summer	2.723	0.0	7.7	810
2160 min Summer	1.979	0.0	8.2	1176
2880 min Summer	1.577	0.0	8.6	1528
4320 min Summer	1.143	0.0	9.0	2260
5760 min Summer	0.910	0.0	9.1	2984
7200 min Summer	0.762	0.0	9.1	3672
8640 min Summer	0.659	0.0	9.1	4416
10080 min Summer	0.583	0.0	9.0	5152
15 min Winter	76.035	0.0	1.9	58
30 min Winter	49.499	0.0	2.9	64
60 min Winter	30.811	0.0	3.9	82
120 min Winter	18.615	0.0	4.8	122
180 min Winter	13.715	0.0	5.4	156
240 min Winter	10.995	0.0	5.8	190

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	0.017	0.017	0.4	3.2	Flood Risk
480 min Winter	0.016	0.016	0.4	3.0	Flood Risk
600 min Winter	0.015	0.015	0.4	2.8	Flood Risk
720 min Winter	0.014	0.014	0.4	2.6	Flood Risk
960 min Winter	0.012	0.012	0.3	2.3	Flood Risk
1440 min Winter	0.010	0.010	0.3	1.9	Flood Risk
2160 min Winter	0.008	0.008	0.2	1.4	Flood Risk
2880 min Winter	0.006	0.006	0.2	1.2	Flood Risk
4320 min Winter	0.005	0.005	0.1	0.9	Flood Risk
5760 min Winter	0.004	0.004	0.1	0.7	Flood Risk
7200 min Winter	0.003	0.003	0.1	0.6	Flood Risk
8640 min Winter	0.003	0.003	0.1	0.5	Flood Risk
10080 min Winter	0.002	0.002	0.1	0.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	8.034	0.0	6.5	258
480 min Winter	6.428	0.0	6.9	326
600 min Winter	5.404	0.0	7.3	392
720 min Winter	4.687	0.0	7.6	456
960 min Winter	3.743	0.0	8.1	582
1440 min Winter	2.723	0.0	8.8	834
2160 min Winter	1.979	0.0	9.5	1180
2880 min Winter	1.577	0.0	9.9	1544
4320 min Winter	1.143	0.0	10.4	2240
5760 min Winter	0.910	0.0	10.8	2968
7200 min Winter	0.762	0.0	10.9	3936
8640 min Winter	0.659	0.0	10.9	4288
10080 min Winter	0.583	0.0	10.8	5240

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Green Roof

Area (m^3)	190	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003453	32	36	0.000697	64	68	0.000141	96	100	0.000028
4	8	0.002827	36	40	0.000571	68	72	0.000115	100	104	0.000023
8	12	0.002314	40	44	0.000467	72	76	0.000094	104	108	0.000019
12	16	0.001895	44	48	0.000383	76	80	0.000077	108	112	0.000016
16	20	0.001551	48	52	0.000313	80	84	0.000063	112	116	0.000013
20	24	0.001270	52	56	0.000256	84	88	0.000052	116	120	0.000010
24	28	0.001040	56	60	0.000210	88	92	0.000042			
28	32	0.000851	60	64	0.000172	92	96	0.000035			

Model Details

Storage is Online Cover Level (m) 0.200

Tank or Pond Structure

Invert Level (m) 0.000

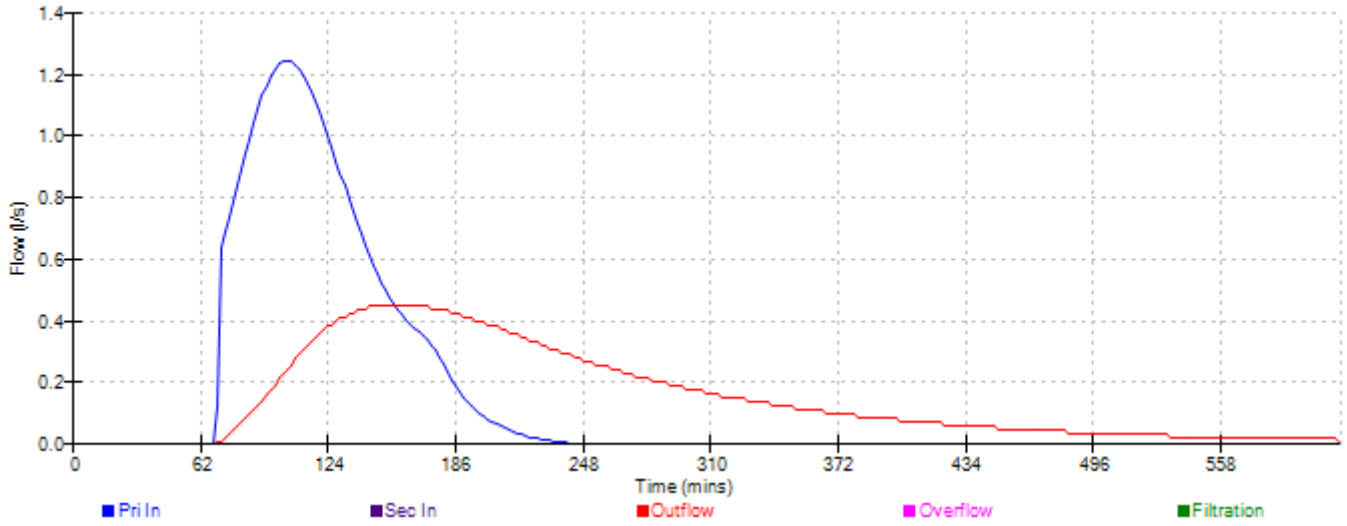
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	190.0	0.150	190.0	0.151	0.0

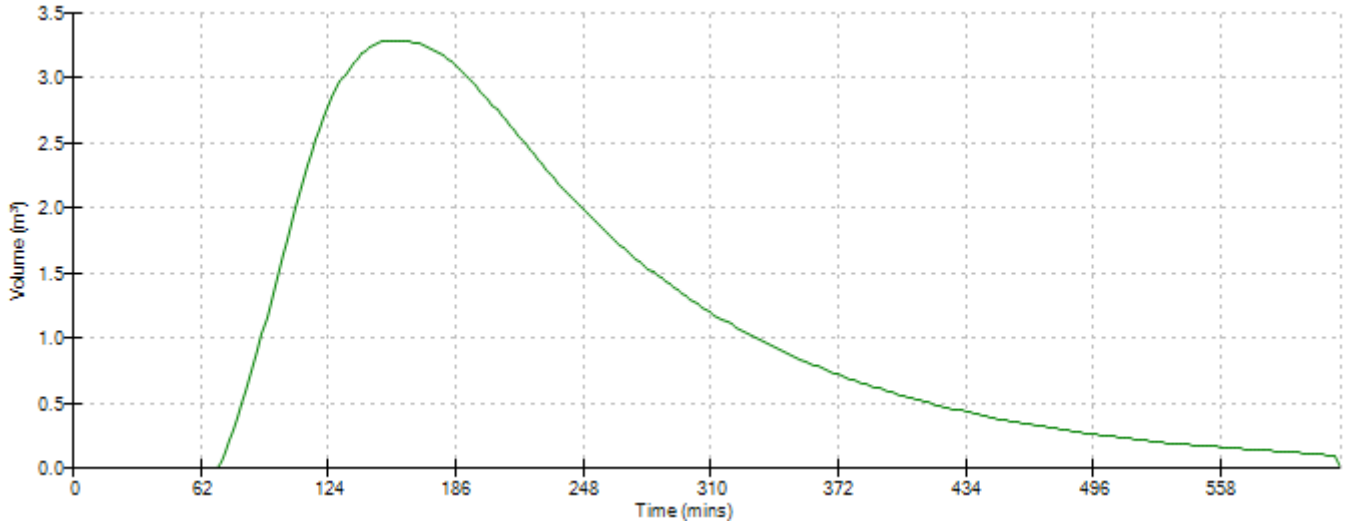
Pump Outflow Control

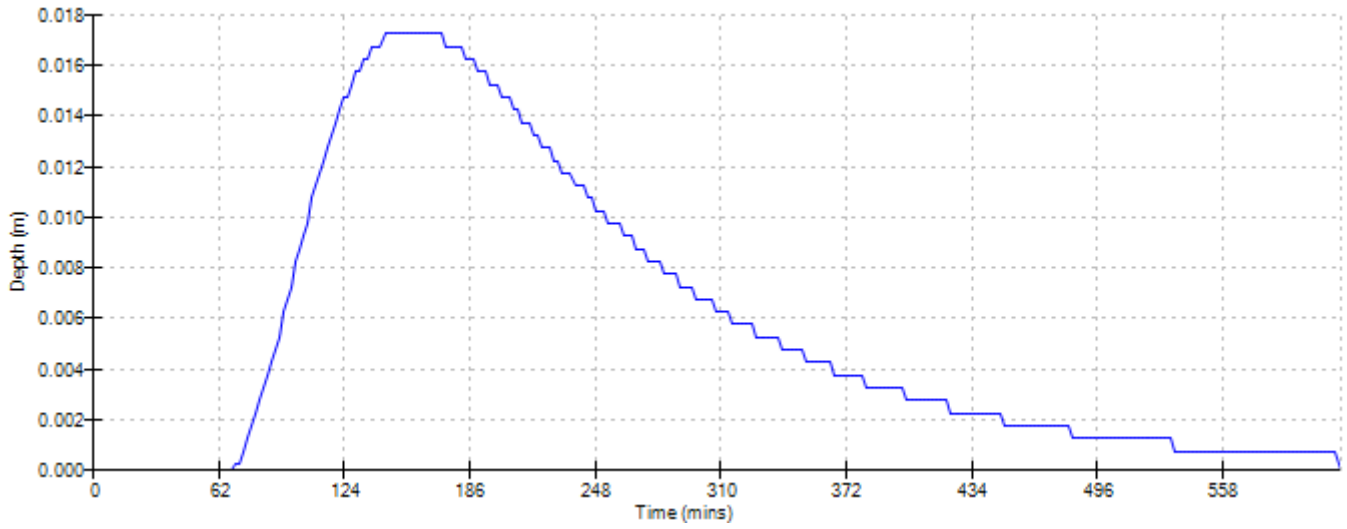
Invert Level (m) 0.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6000	0.700	2.6000	1.300	2.6000	1.900	2.6000	2.500	2.6000
0.200	2.6000	0.800	2.6000	1.400	2.6000	2.000	2.6000	2.600	2.6000
0.300	2.6000	0.900	2.6000	1.500	2.6000	2.100	2.6000	2.700	2.6000
0.400	2.6000	1.000	2.6000	1.600	2.6000	2.200	2.6000	2.800	2.6000
0.500	2.6000	1.100	2.6000	1.700	2.6000	2.300	2.6000	2.900	2.6000
0.600	2.6000	1.200	2.6000	1.800	2.6000	2.400	2.6000	3.000	2.6000

Event: 180 min Winter







Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.009	0.009	0.2	1.8	Flood Risk
30 min Summer	0.013	0.013	0.3	2.6	Flood Risk
60 min Summer	0.017	0.017	0.4	3.3	Flood Risk
120 min Summer	0.020	0.020	0.5	3.9	Flood Risk
180 min Summer	0.021	0.021	0.5	4.0	Flood Risk
240 min Summer	0.021	0.021	0.5	4.0	Flood Risk
360 min Summer	0.021	0.021	0.5	3.9	Flood Risk
480 min Summer	0.020	0.020	0.5	3.8	Flood Risk
600 min Summer	0.019	0.019	0.5	3.6	Flood Risk
720 min Summer	0.018	0.018	0.5	3.4	Flood Risk
960 min Summer	0.016	0.016	0.4	3.1	Flood Risk
1440 min Summer	0.014	0.014	0.4	2.6	Flood Risk
2160 min Summer	0.011	0.011	0.3	2.1	Flood Risk
2880 min Summer	0.010	0.010	0.3	1.8	Flood Risk
4320 min Summer	0.007	0.007	0.2	1.4	Flood Risk
5760 min Summer	0.006	0.006	0.1	1.1	Flood Risk
7200 min Summer	0.005	0.005	0.1	1.0	Flood Risk
8640 min Summer	0.004	0.004	0.1	0.8	Flood Risk
10080 min Summer	0.004	0.004	0.1	0.7	Flood Risk
15 min Winter	0.011	0.011	0.3	2.1	Flood Risk
30 min Winter	0.016	0.016	0.4	2.9	Flood Risk
60 min Winter	0.020	0.020	0.5	3.8	Flood Risk
120 min Winter	0.023	0.023	0.6	4.4	Flood Risk
180 min Winter	0.024	0.024	0.6	4.5	Flood Risk
240 min Winter	0.023	0.023	0.6	4.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	98.681	0.0	2.4	57
30 min Summer	64.789	0.0	3.5	64
60 min Summer	40.510	0.0	4.8	80
120 min Summer	24.461	0.0	5.9	122
180 min Summer	17.964	0.0	6.5	152
240 min Summer	14.342	0.0	7.0	182
360 min Summer	10.418	0.0	7.7	246
480 min Summer	8.302	0.0	8.2	310
600 min Summer	6.956	0.0	8.6	374
720 min Summer	6.017	0.0	8.9	436
960 min Summer	4.784	0.0	9.5	564
1440 min Summer	3.456	0.0	10.2	810
2160 min Summer	2.493	0.0	10.9	1172
2880 min Summer	1.975	0.0	11.3	1536
4320 min Summer	1.421	0.0	11.8	2260
5760 min Summer	1.124	0.0	12.0	3000
7200 min Summer	0.936	0.0	12.1	3728
8640 min Summer	0.806	0.0	12.1	4432
10080 min Summer	0.710	0.0	12.0	5160
15 min Winter	98.681	0.0	2.8	57
30 min Winter	64.789	0.0	4.1	63
60 min Winter	40.510	0.0	5.5	80
120 min Winter	24.461	0.0	6.8	120
180 min Winter	17.964	0.0	7.5	154
240 min Winter	14.342	0.0	8.0	188

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	0.022	0.022	0.6	4.2	Flood Risk
480 min Winter	0.021	0.021	0.5	3.9	Flood Risk
600 min Winter	0.019	0.019	0.5	3.6	Flood Risk
720 min Winter	0.018	0.018	0.5	3.4	Flood Risk
960 min Winter	0.016	0.016	0.4	3.0	Flood Risk
1440 min Winter	0.013	0.013	0.3	2.4	Flood Risk
2160 min Winter	0.010	0.010	0.3	1.8	Flood Risk
2880 min Winter	0.008	0.008	0.2	1.5	Flood Risk
4320 min Winter	0.006	0.006	0.1	1.1	Flood Risk
5760 min Winter	0.005	0.005	0.1	0.9	Flood Risk
7200 min Winter	0.004	0.004	0.1	0.7	Flood Risk
8640 min Winter	0.003	0.003	0.1	0.6	Flood Risk
10080 min Winter	0.003	0.003	0.1	0.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	10.418	0.0	8.8	256
480 min Winter	8.302	0.0	9.3	324
600 min Winter	6.956	0.0	9.8	390
720 min Winter	6.017	0.0	10.2	456
960 min Winter	4.784	0.0	10.8	582
1440 min Winter	3.456	0.0	11.6	824
2160 min Winter	2.493	0.0	12.4	1188
2880 min Winter	1.975	0.0	13.0	1564
4320 min Winter	1.421	0.0	13.6	2256
5760 min Winter	1.124	0.0	13.9	2944
7200 min Winter	0.936	0.0	14.1	3688
8640 min Winter	0.806	0.0	14.2	4392
10080 min Winter	0.710	0.0	14.2	5248

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Green Roof

Area (m^3)	190	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003453	32	36	0.000697	64	68	0.000141	96	100	0.000028
4	8	0.002827	36	40	0.000571	68	72	0.000115	100	104	0.000023
8	12	0.002314	40	44	0.000467	72	76	0.000094	104	108	0.000019
12	16	0.001895	44	48	0.000383	76	80	0.000077	108	112	0.000016
16	20	0.001551	48	52	0.000313	80	84	0.000063	112	116	0.000013
20	24	0.001270	52	56	0.000256	84	88	0.000052	116	120	0.000010
24	28	0.001040	56	60	0.000210	88	92	0.000042			
28	32	0.000851	60	64	0.000172	92	96	0.000035			

Model Details

Storage is Online Cover Level (m) 0.200

Tank or Pond Structure

Invert Level (m) 0.000

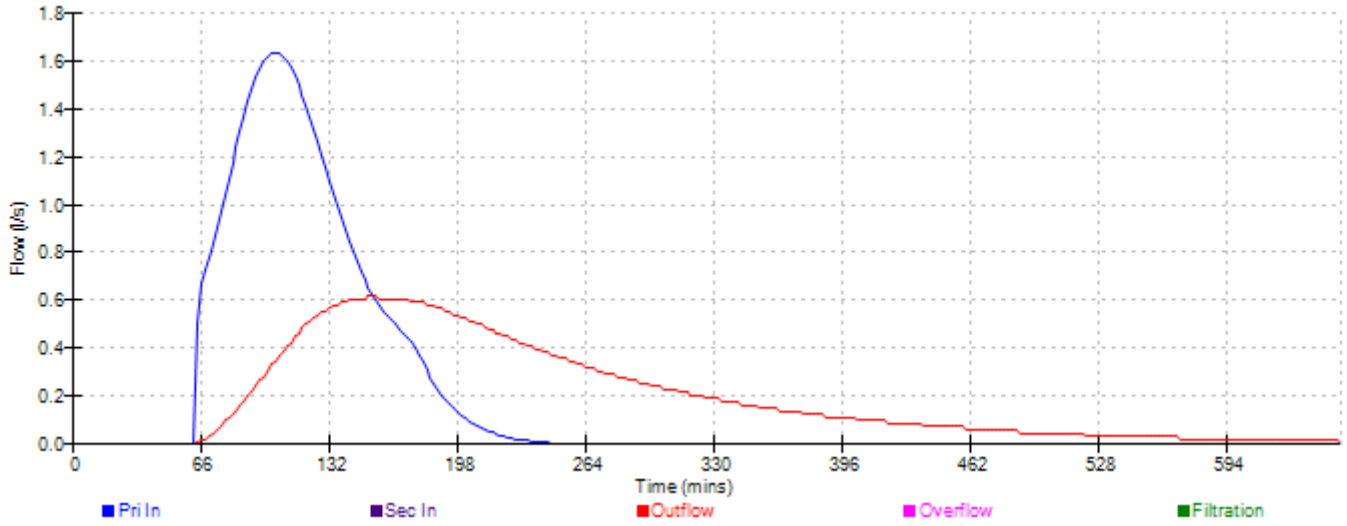
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	190.0	0.150	190.0	0.151	0.0

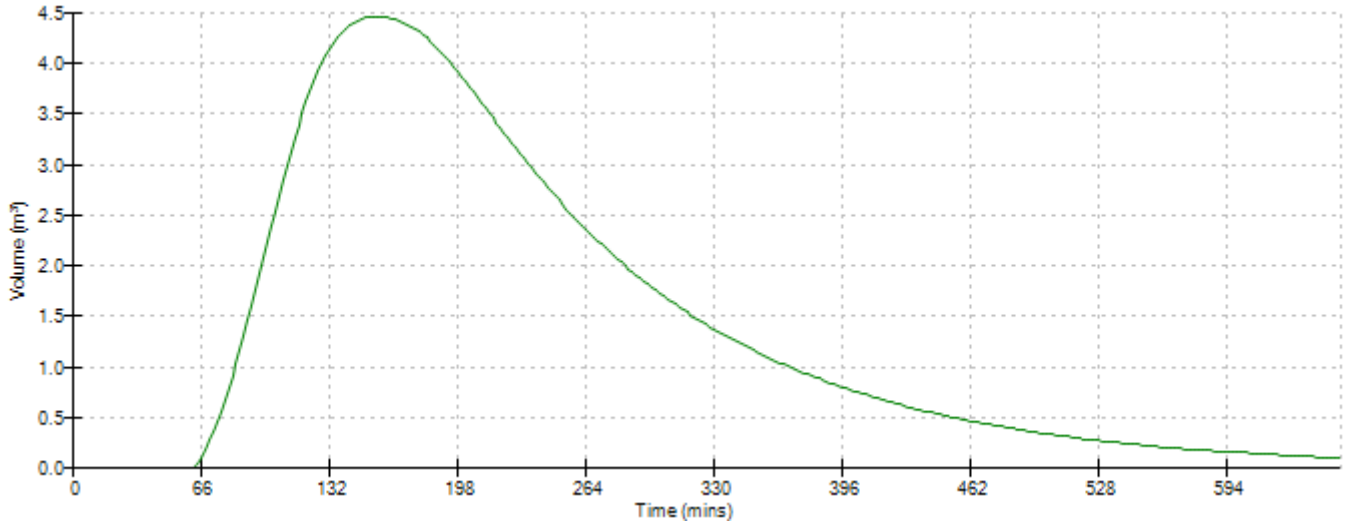
Pump Outflow Control

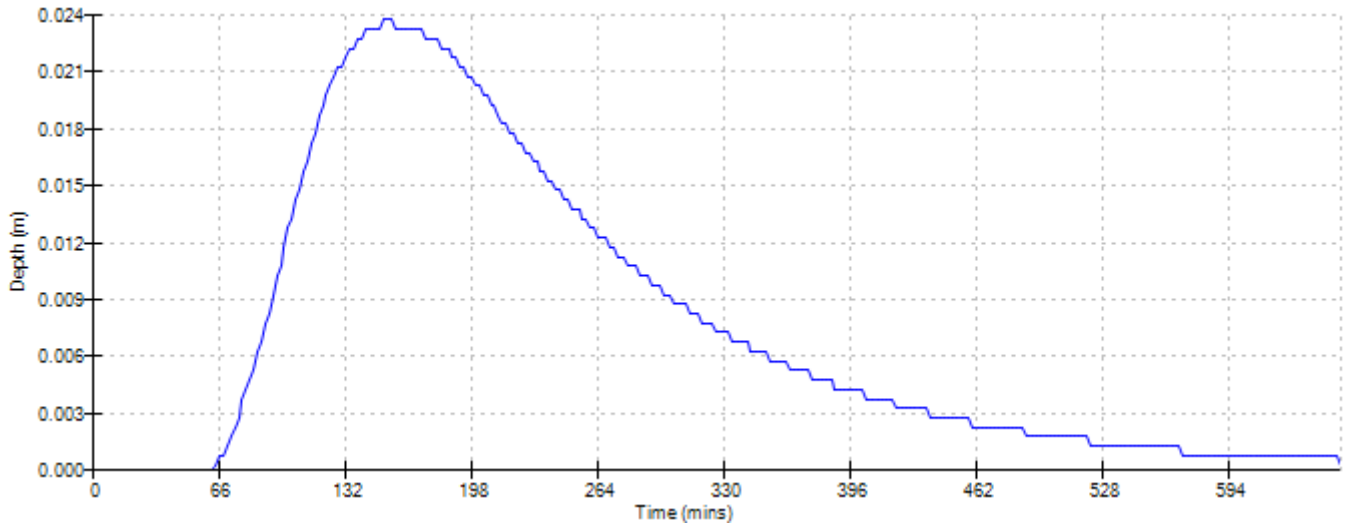
Invert Level (m) 0.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6000	0.700	2.6000	1.300	2.6000	1.900	2.6000	2.500	2.6000
0.200	2.6000	0.800	2.6000	1.400	2.6000	2.000	2.6000	2.600	2.6000
0.300	2.6000	0.900	2.6000	1.500	2.6000	2.100	2.6000	2.700	2.6000
0.400	2.6000	1.000	2.6000	1.600	2.6000	2.200	2.6000	2.800	2.6000
0.500	2.6000	1.100	2.6000	1.700	2.6000	2.300	2.6000	2.900	2.6000
0.600	2.6000	1.200	2.6000	1.800	2.6000	2.400	2.6000	3.000	2.6000

Event: 180 min Winter







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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.015	0.015	0.4	2.8	Flood Risk
30 min Summer	0.020	0.020	0.5	3.8	Flood Risk
60 min Summer	0.026	0.026	0.7	4.9	Flood Risk
120 min Summer	0.030	0.030	0.8	5.7	Flood Risk
180 min Summer	0.030	0.030	0.8	5.8	Flood Risk
240 min Summer	0.030	0.030	0.8	5.7	Flood Risk
360 min Summer	0.029	0.029	0.8	5.6	Flood Risk
480 min Summer	0.028	0.028	0.7	5.4	Flood Risk
600 min Summer	0.027	0.027	0.7	5.1	Flood Risk
720 min Summer	0.026	0.026	0.7	4.9	Flood Risk
960 min Summer	0.023	0.023	0.6	4.4	Flood Risk
1440 min Summer	0.020	0.020	0.5	3.7	Flood Risk
2160 min Summer	0.016	0.016	0.4	3.0	Flood Risk
2880 min Summer	0.013	0.013	0.3	2.5	Flood Risk
4320 min Summer	0.010	0.010	0.3	1.9	Flood Risk
5760 min Summer	0.008	0.008	0.2	1.6	Flood Risk
7200 min Summer	0.007	0.007	0.2	1.3	Flood Risk
8640 min Summer	0.006	0.006	0.2	1.2	Flood Risk
10080 min Summer	0.006	0.006	0.1	1.0	Flood Risk
15 min Winter	0.017	0.017	0.4	3.2	Flood Risk
30 min Winter	0.023	0.023	0.6	4.4	Flood Risk
60 min Winter	0.029	0.029	0.8	5.6	Flood Risk
120 min Winter	0.034	0.034	0.9	6.4	Flood Risk
180 min Winter	0.034	0.034	0.9	6.4	Flood Risk
240 min Winter	0.033	0.033	0.9	6.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	3.9	55
30 min Summer	90.705	0.0	5.5	62
60 min Summer	56.713	0.0	7.1	80
120 min Summer	34.246	0.0	8.7	120
180 min Summer	25.149	0.0	9.6	150
240 min Summer	20.078	0.0	10.3	180
360 min Summer	14.585	0.0	11.3	246
480 min Summer	11.622	0.0	12.0	310
600 min Summer	9.738	0.0	12.6	372
720 min Summer	8.424	0.0	13.0	436
960 min Summer	6.697	0.0	13.8	562
1440 min Summer	4.839	0.0	14.9	808
2160 min Summer	3.490	0.0	16.0	1176
2880 min Summer	2.766	0.0	16.7	1536
4320 min Summer	1.989	0.0	17.6	2260
5760 min Summer	1.573	0.0	18.2	3000
7200 min Summer	1.311	0.0	18.5	3688
8640 min Summer	1.129	0.0	18.7	4416
10080 min Summer	0.994	0.0	18.8	5160
15 min Winter	138.153	0.0	4.5	55
30 min Winter	90.705	0.0	6.2	62
60 min Winter	56.713	0.0	8.0	80
120 min Winter	34.246	0.0	9.8	120
180 min Winter	25.149	0.0	10.9	154
240 min Winter	20.078	0.0	11.6	188

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	0.032	0.032	0.8	6.0	Flood Risk
480 min Winter	0.029	0.029	0.8	5.6	Flood Risk
600 min Winter	0.027	0.027	0.7	5.2	Flood Risk
720 min Winter	0.025	0.025	0.7	4.8	Flood Risk
960 min Winter	0.022	0.022	0.6	4.2	Flood Risk
1440 min Winter	0.018	0.018	0.5	3.3	Flood Risk
2160 min Winter	0.014	0.014	0.4	2.6	Flood Risk
2880 min Winter	0.011	0.011	0.3	2.1	Flood Risk
4320 min Winter	0.008	0.008	0.2	1.5	Flood Risk
5760 min Winter	0.006	0.006	0.2	1.2	Flood Risk
7200 min Winter	0.005	0.005	0.1	1.0	Flood Risk
8640 min Winter	0.005	0.005	0.1	0.9	Flood Risk
10080 min Winter	0.004	0.004	0.1	0.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	14.585	0.0	12.7	256
480 min Winter	11.622	0.0	13.6	324
600 min Winter	9.738	0.0	14.2	390
720 min Winter	8.424	0.0	14.8	454
960 min Winter	6.697	0.0	15.7	580
1440 min Winter	4.839	0.0	16.9	828
2160 min Winter	3.490	0.0	18.1	1188
2880 min Winter	2.766	0.0	19.0	1544
4320 min Winter	1.989	0.0	20.1	2264
5760 min Winter	1.573	0.0	20.8	3064
7200 min Winter	1.311	0.0	21.2	3768
8640 min Winter	1.129	0.0	21.5	4312
10080 min Winter	0.994	0.0	21.7	5216

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Green Roof

Area (m^3)	190	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003453	32	36	0.000697	64	68	0.000141	96	100	0.000028
4	8	0.002827	36	40	0.000571	68	72	0.000115	100	104	0.000023
8	12	0.002314	40	44	0.000467	72	76	0.000094	104	108	0.000019
12	16	0.001895	44	48	0.000383	76	80	0.000077	108	112	0.000016
16	20	0.001551	48	52	0.000313	80	84	0.000063	112	116	0.000013
20	24	0.001270	52	56	0.000256	84	88	0.000052	116	120	0.000010
24	28	0.001040	56	60	0.000210	88	92	0.000042			
28	32	0.000851	60	64	0.000172	92	96	0.000035			

Model Details

Storage is Online Cover Level (m) 0.200

Tank or Pond Structure

Invert Level (m) 0.000

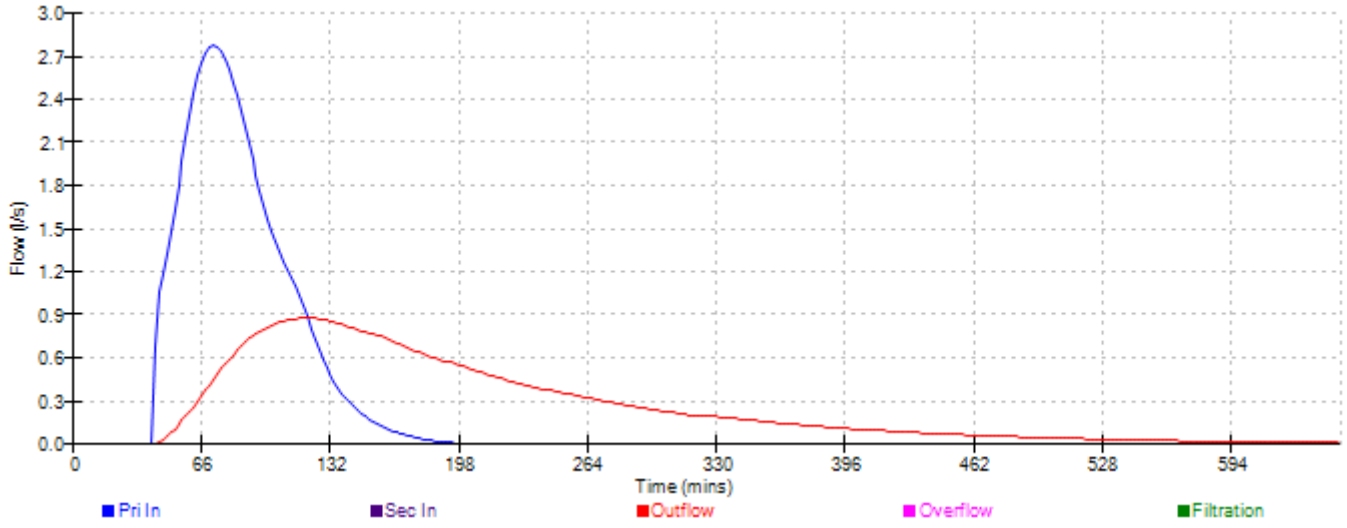
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	190.0	0.150	190.0	0.151	0.0

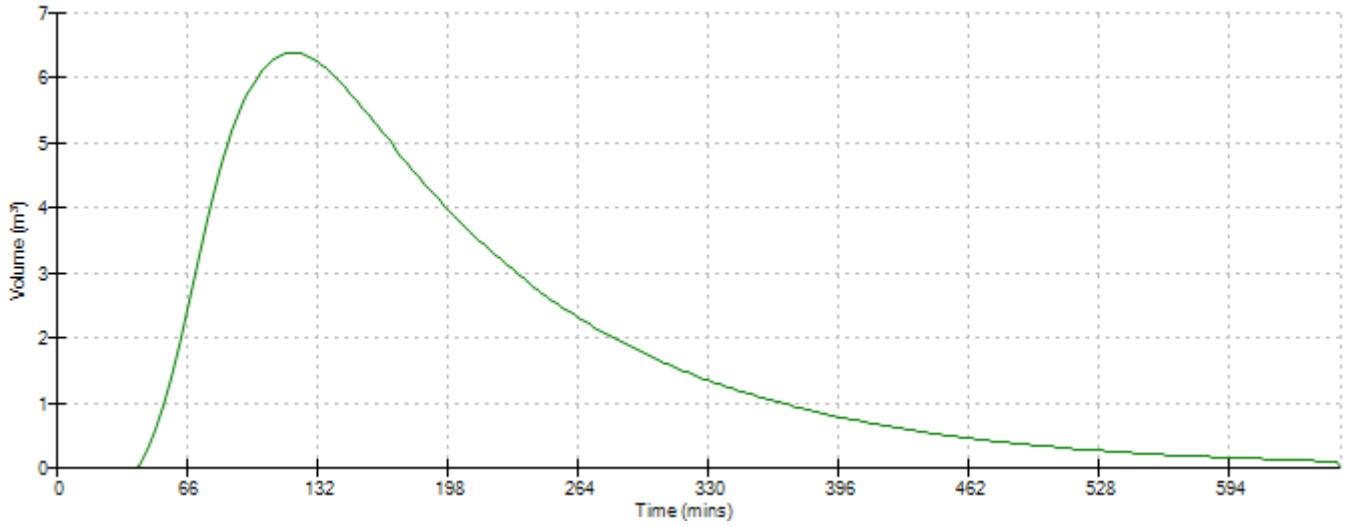
Pump Outflow Control

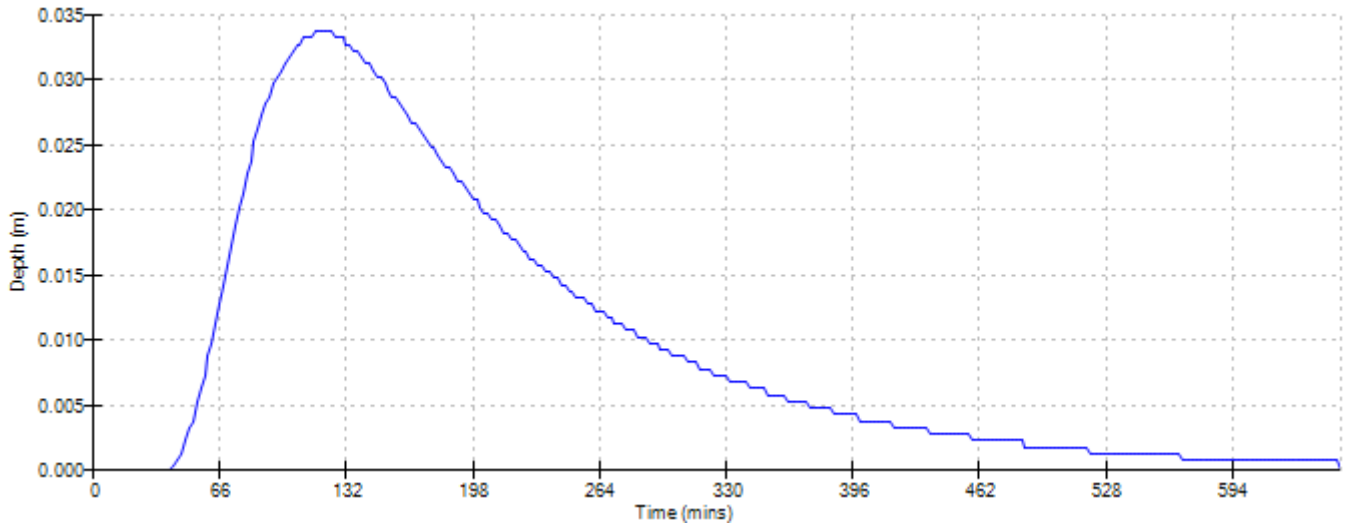
Invert Level (m) 0.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6000	0.700	2.6000	1.300	2.6000	1.900	2.6000	2.500	2.6000
0.200	2.6000	0.800	2.6000	1.400	2.6000	2.000	2.6000	2.600	2.6000
0.300	2.6000	0.900	2.6000	1.500	2.6000	2.100	2.6000	2.700	2.6000
0.400	2.6000	1.000	2.6000	1.600	2.6000	2.200	2.6000	2.800	2.6000
0.500	2.6000	1.100	2.6000	1.700	2.6000	2.300	2.6000	2.900	2.6000
0.600	2.6000	1.200	2.6000	1.800	2.6000	2.400	2.6000	3.000	2.6000

Event: 120 min Winter







SuDS Proforma

HILLINGDON LONDON

GREATER LONDON AUTHORITY

LoDEG

1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	91 Station Road
Address & post code	91 Station Road, Yiewsley, West Drayton, Middlesex, UB7 7LT
OS Grid ref. (Easting, Northing)	E 506176
	N 179843
LPA reference (if applicable)	
Brief description of proposed work	Redevelopment of site to provide 15 student accomodation part commerical use on ground floor.
Total site Area	310 m^2
Total existing impervious area	310 m^2
Total proposed impervious area	220 m^2
Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	No
Existing drainage connection type and location	Sewer, Station Road
Designer Name	Mo Khan
Designer Position	Civil Engineer Consultant
Designer Company	Lanmor Consulting Ltd

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	Langley Silt Member
Bedrock geology classification	London Clay Formation
Site infiltration rate	N/A m/s
Depth to groundwater level	N/A m below ground level
Is infiltration feasible?	No

2b. Drainage Hierarchy

	Feasible (Y/N)	*Proposed (Y/N)*
1 store rainwater for later use	Y	Y
2 use infiltration techniques, such as porous surfaces in non-clay areas	N	N
3 attenuate rainwater in ponds or open water features for gradual release	N	N
4 attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Y
5 discharge rainwater direct to a watercourse	N	N
6 discharge rainwater to a surface water sewer/drain	Y	Y
7 discharge rainwater to the combined sewer.	N	N

2c. Proposed Discharge Details

Proposed discharge location	Sewer, Station Road
Has the owner/regulator of the discharge location been consulted?	No

3. Drainage Strategy

3a. Discharge Rates & Required Storage

	Greenfield (GF) runoff rate (l/s)	*Existing discharge rate (l/s)*	*Required storage for GF rate (m^3)*	*Proposed discharge rate (l/s)*
Qbar	0.1			
1 in 1	0	2.6	N/A	0.2
1 in 30	0.1	6.2	N/A	0.4
1 in 100	0.2	8.2	N/A	0.6
1 in 100 + CC			N/A	0.9
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Pump		

3c. Proposed SuDS Measures

	Catchment area (m^2)	*Plan area (m^3)*	*Storage vol. (m^3)*
Rainwater harvesting	0		0
Infiltration systems	0		0
Green roofs	190	190	6.4
Blue roofs	190	190	6.4
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	0	0	0
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	0		0
Total	**380**	**380**	**12.8**

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Page 8
Drainage hierarchy (2b)	Pages 8 & 9
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Appendix B
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Appendix C
Proposed SuDS measures & specifications (3b)	Pages 11 - 13
4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Appendix A
Detailed drainage design drawings, including exceedance flow routes	Appendix C
Detailed landscaping plans	N/A
Maintenance strategy	Page 11
Demonstration of how the proposed SuDS measures improve:	Yes
a) water quality of the runoff?	Pages 8 - 11
b) biodiversity?	Pages 8 - 11
c) amenity?	Pages 8 - 11